K

APPENDIX K

Road Embankment and Culvert Report

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Ref: 8946

OCEANA GOLD (NEW ZEALAND) LIMITED
DEEPDELL NORTH STAGE III
HORSE FLAT ROAD REALIGNMENT
TECHNICAL REPORT FOR RESOURCE CONSENT

Prepared for: 26 November 2019

Oceana Gold (NZ) Limited

CONTENTS

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1.0 INTRODUCTION

EGL (Engineering Geology Limited) was engaged by Oceana Gold (New Zealand) Limited (OGNZL) to prepare a technical report for resource consent, for the Horse Flat Road realignment which includes two culverts and a new embankment, so that the effects can be assessed.

The location of the site is shown on Figure 1.

The realignment is required to allow space for the proposed Deepdell East Waste Rock Stack as shown on Figure 2.

The existing road is a two-way single lane unsealed road, which provides access to two dwellings and a forestry block. The average daily traffic (ADT) volume is expected to be less than 20 vehicles.

All plans, grid references and geological orientations referred to in this report are to Mine North, which is approximately 45 degrees anti-clockwise from true north.

2.0 DESIGN CRITERIA

The following design criteria are proposed for the road realignment:

- 15m to 40m wide road reserve
- The road shall also be delineated and marked to a public road standard
- Geometric design will be in terms of Rural Road Design manual published by AUSTROADS – Sydney 1989 edition [Ref. 3] and any subsequent revisions [Ref. 4]
- Design and construction details shall be lodged with Waitaki District Council for approval
- Permanent culvert sizing for 1/100 Annual Exceedance Probability (AEP) rainfall event

For the Coronation North Project, part of the Macraes Gold Project, similar roads adopted the following pavement design:

- Minimum 150 mm sub-base, a basecourse of 100mm AP40 with a wearing course of AP20

The pavement for Horse Flat Road will be similar, however, the final thickness is subject to detailed design for the specific ground conditions and ADT.

3.0 GROUND CONDITIONS

Along the alignment the ground profile can be expected to be as in Table 1:

TABLE 1: EXPECTED GROUND PROFILE OVER THE ROAD ALIGNMENT

Soil or Rock Layer	Expected layer thickness	Expected depth to top of layer
Topsoil	0.05 to 0.15m	0m
Loess soils	0 to 5m	0.05 to 0.15m
Weathered schist as residual soil	0 to 1m	0.05 to 5m
Schist rock	Basement rock	0 to 5m

A walk over and test pitting investigation of the Deepdell Stage III project site was undertaken by a senior engineering geologist from EGL. This predominantly covered the proposed Deepdell East WRS area which is adjacent to the realignment road. The walk over extended to the position of the road embankment. Photos of the gully which the road crosses can be found in Plate 1 to Plate 3. More details on the geology of the area and the walkover and test pitting investigation can be found in the Deepdell East WRS Design Report [Ref. 2].

It is evident from the walk over and the aerial photos, that the road embankment western approach is likely underlain by loess soils which mantles the schist rock. As we have not undertaken specific test pitting or logged the bank slope cutting at this specific point the specific depth of the loess layer is unknown. However, test pitting further up the gully found the loess soil layer was typically between 0.5 to 1.3m. At one location on the western side of the gully the loess soils were up to 4.0m. Typically the loess soils are thickest on the western slopes due to the prevailing wind at the time of deposition. The loess soils are erodible by nature and need to be managed carefully during construction.

On the eastern approach, outcrops of schist rock are visible and we expect that any cuts for this eastern approach would be predominantly in schist rock.

4.0 ROAD REALIGNMENT PRELIMINARY DESIGN

The realignment moves Horse Flat Road to the north as shown on Figure 2. The length of the existing road that is to be realigned is approximately 1220m and the new length of road will be 1050m.

The realignment of the road will require a fill embankment to cross a gully, which drains the surface water runoff from the proposed area for the Deepdell East WRS and conveys water to the East via a series of gullies and ephemeral tributaries of Highlay Creek, a tributary of Deepdell Creek. The minor tributary of Highlay Creek being crossed by the embankment is assessed to have intermittent flow in this location. A culvert will be required to convey surface water runoff past the embankment. See Section 5.2.

A new culvert is also proposed at the western end of the road realignment to pass surface water runoff from the northern hills, to the west via a clean water drain to be installed as part of the Deepdell North Stage III works. Details of the erosion and sediment control for the project are set out in the Deepdell North Stage III Erosion and Sediment Control Report

[Ref. 1]. A preliminary assessment indicated an inside diameter of 685mm is required for the culvert, passing a peak flow of 0.86m^3/s.

The overall formation profile proposed is 7.5m wide (lane plus shoulder and verge), with a 5.5m carriage way (lane plus shoulder width) [Ref. 5]. This allows for the following design widths:

- 3.5m lane width
- 1.0m shoulder width, each side
- 1.0m verge width, each side

In addition, a 1.0m width for table drain is to be allowed on each side of the road where at grade or in cut. Where the road crosses the embankment a table drain is not required, however, this 1m width is to be added to the verge.

At the start of the western end of the road realignment, the northern table drain will need to be wider as it acts as a clean water cut off drain for the wider project.

Given the ADT is likely less than 20, it is proposed that the road be designed as would an Austroads Classification 5D - Access Track/Road [Ref. 7 & 8]. For access tracks/roads in flat terrain the target safe maximum operating speeds (car) is 40km/h. We have assumed flat terrain as the realignment is at the transition from flat to rolling terrain, and the target safe speed for flat terrain is higher.

For the target safe operating speed of 40km/h, the recommend minimum corner radius is 80m with 5% super elevation [Ref. 7]. A super elevation development length of 30m is recommend for this design speed and super elevation.

For most of the alignment, 80m minimum radius is achievable, however, for the eastern most corner of the realignment a 70m radius is required to allow distance to transition to the alternate super elevation for the following corner.

The longitudinal grade of the approaches to the road embankment have been limited to a maximum of 8%, to minimise wear on the pavement.

Modelling of the road alignment for the sections approaching and crossing the embankment has been undertaken to assess the effects, as cuts and fills will be required. The rest of the alignment will be close to the existing ground profile and only the centreline is shown.

The alignment elevation is a balance between the embankment height, length of the culvert, and the depth of cut.

The embankment has been modelled at 10.3m height at its centre line, with a 11.5m height when taken from the downstream toe and 10.2m from the upstream toe. The length of the base of the embankment and culvert is approximately 50m.

Cuts up to 5m are proposed on the eastern approach. These have been modelled, for this assessment of effects, at 1H:1V. Geotechnically this slope is likely to be stable in the long term, however this does depend on the orientation of the foliations and joints in the rock and would need to be confirmed on excavation. If foliations or joints are unfavourable for specific cuts, the steepness of the batter may need to be reduced.

Further to maintain safe sight distances around the corner the steepness of the inside batter may need to be reduced, or the road widened to allow for better site lines, so opposing vehicle have time to sight each other and stop or pull on to the shoulder. This can be refined in a detailed design process and at this stage extra allowance for the width of the road reserve at this location is recommended, over what is shown on the figures. If the batters were reduced from 1H:1V to 2H:1V this would add an extra 5m width each side, to the extent of works. At the point of highest cut the width modelled in this assessment is 18m, allowing an additional 10m is 28m. Therefore, it is recommended that a 40m width is allowed at this location for any road reserve width.

The design presented in this report is only preliminary and is to be subject to detailed design. It is recommended, a detailed design report, construction drawings and specification are prepared for the road, embankment and culverts.

5.0 ROAD EMBANKMENT

5.1. Embankment fill slopes

The proposed embankment slopes are 2H:1V. The embankment fill will need to be compacted in regular lifts to an engineered fill standard to ensure the embankment isn't subject to self-weight settlement over time, is stable and provides an effective subgrade for the road pavement. It is proposed that similar material specification and compaction is used as to construct embankment dams at the Macraes Gold Project.

The schist rock from the eastern approach cut are likely suitable for the bulk embankment fill. Imported fill is likely required for the fill around the culvert, which requires specific particle grading control. Loess soils may also be suitable for the bulk embankment fill, however, their placement would need to be only in bulk fill zones that are above the gully flood level (approximately 3m above the culvert inlet invert) and not within the outer 3m of the embankment fill so not subject to saturation and erosion, which may present long term stability issues.

5.2. Road embankment culvert

The culvert passing the embankment has been preliminary sized to pass a 1/20 AEP rainfall event while the Deepdell WRS is being constructed, and for the permanent case, the culvert has been sized for a 1/100 AEP rainfall event. Details of this are included in the Deepdell North Stage III Erosion and Sediment Control Report [Ref. 1].

The runoff coefficient used is 0.32 for the complete rock stack and 0.6 for disturbed ground during construction of the Waste Rock Stack. A 20ha catchment was applied for the permanent case.

A preliminary inside diameter of 900mm for the culvert was assessed in the Deepdell North Stage III Erosion and Sediment Control Report [Ref. 1], passing a peak flow of 1.7m^3/s. This will be a concrete pipe and will either require a reinforced concrete inlet, or rock protection and filter material. The outlet will require rock protection to prevent erosion, during peak flows. See Figure 7 for an indicative cross section.

5.3. Earthworks volumes and areas

For the section of the road modelled, the earthworks volumes were:

Cut 3,200m^3
Fill 8,000m^3

The total disturbed area, for the full length of the realignment, is estimated to be 12,500m^2

6.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control proposed for the wider Deepdell North Stage III Project is outlined in the Deepdell North Stage III Erosion and Sediment Control Report [Ref. 1]. This includes a clean water cut off drain immediately upstream of the Horse Flat Road realignment and utilises the proposed new culvert at the western end of the new section of road to pass surface water to a continuation of the clean water cut off drain to the west.

The clean water cut of drain may be able to be utilised as the table drain for the road on the upstream (northern) side of the road realignment.

Both the table drain/uphill diversion drain will require rock and potentially a geofabric to prevent the drain from erosion, as the ground steepens down the approach towards the road embankment. Rockfill protection with a geofabric, or alternatively an Armco or concrete lined flume will be required to pass surface water into the gully, either down the embankment or gully slope, without erosion. The position and method for passing this water to prevent erosion in the long term, is best determined on site once the ground conditions are confirmed during excavation during construction.

During construction the table drains should be used to control runoff from the road working areas. These table drains should be established upfront and temporary berms and silt fences in the drains can be utilised to trap sediment until grass cover can be established. A silt pond is recommended at the western end of the road realignment and in the gully.

To control surface water runoff during the construction of the road embankment a small cofferdam is proposed upstream, with HDPE pipes to pass water through the construction area. Once the concrete culvert is in place the HDPE pipes can be passed through the culvert. Downstream of the road embankment a silt pond is recommend to treat sediment ladened surface water runoff, from the road embankment and road alignment construction. This would be a standard silt pond or earth bund as outlined in Environment Canterbury’s Erosion and Sediment Control Toolbox and Guidelines [Ref. 9].

Figure 9 shows the draft erosion and sediment control features.

7.0 SUMAMRY AND CONCLUSIONS

The report presents a preliminary design for the Horse Flat Road realignment for the purpose of demonstrating the effects for resources consent. The length of the realigned road is approximately 1050m.

The preliminary design requires an embankment approximately 10 to 11m high and cuts for the eastern approach up to 5m high. A 900mm inside diameter (ID) culvert is required though the road embankment to pass surface water from the intermittent Highlay Creek. The culvert is sized for a 1/100 AEP rainfall event.

A culvert is also required for the at the western end of the road alignment to pass a clean water diversion drain beneath the road.

Overall the area of works is approximately 12,500m^2.

The design presented in this report is only preliminary and is to be subject to detailed design. It is recommended, a detailed design report, construction drawings and specification are prepared for the road, embankment and culverts.

ENGINEERING GEOLOGY LTD

Report Prepared By

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BE (Hons) Civil
MEngNZ

Report Reviewed By

J Yeats
CPEng

References

[Ref. 1] Engineering Geology Ltd (2019) 'Oceana Gold (New Zealand) Ltd, Macraes Gold Project, Deepdell North Stage III, Erosion and Sediment Control Report'

[Ref. 2] Engineering Geology Ltd (2019) 'Oceana Gold (New Zealand) Ltd, Macraes Gold Project, Deepdell North Stage III, Deepdell East WRS Design Report'

[Ref. 3] Austroads (1989) Rural Road Design: A Guide to the Geometric Design of Rural Roads 7th edition

[Ref. 4] Austroads (2003) Rural Road Design: A Guide to the Geometric Design of Rural Roads AP-G1/03, 8th edition

[Ref. 5] Henning, T.F.P., Giummarra, G.J., Roux, D.C. (2008) The development of gravel deterioration models for adoption in a New Zealand gravel road management system. Land Transport New Zealand Research Report 348

[Ref. 6] Austroads (2016) 'Guide to Road Design Part 3: Geometric Design' Austroads Publication No. AGRD03-16. Pg. 359

[Ref. 7] Roberts. J. 'ARRB presentation on unsealed local roads', arrb.com.au

[Ref. 8] Giummarra. G. (2001) 'Road classification, geometric designs and maintenance standards for low volume roads' ARRB Research Report ARR 354, arrb.com.au

[Ref. 9] Environment Canterbury Erosion and Sediment Control Toolbox (2019) https://www.esccanterbury.co.nz/resources/

FIGURE 1: HORSE FLAT ROAD REALIGNMENT - LOCATION PLAN

FIGURE 2: HORSE FLAT ROAD REALIGNMENT - SITE PLAN

FIGURE 3: HORSE FLAT ROAD REALIGNMENT - ROAD EMBANKMENT APPROACHES PLAN

FIGURE 4: HORSE FLAT ROAD REALIGNMENT - ROAD EMBANKMENT APPROACHES LONG SECTION

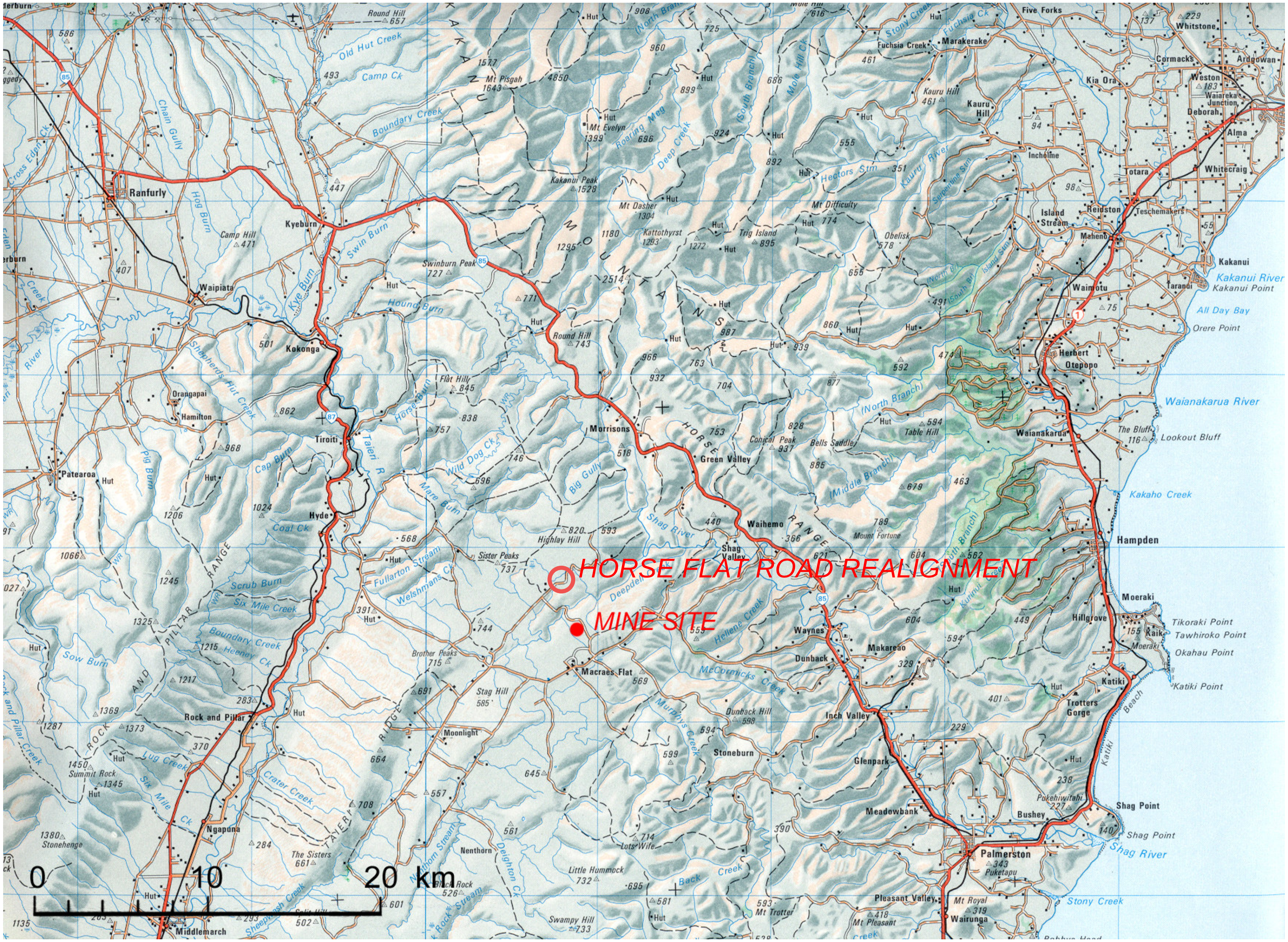
FIGURE 5: HORSE FLAT ROAD REALIGNMENT – ROAD EMBANKMENT APPROACHES CROSS SECTIONS

FIGURE 6: HORSE FLAT ROAD REALIGNMENT - ROAD EMBANKMENT PLAN

FIGURE 7: HORSE FLAT ROAD REALIGNMENT - ROAD EMBANKMENT CROSS SECTIONS

FIGURE 8: HORSE FLAT ROAD REALIGNMENT - CATCHMENT PLAN

FIGURE 9: HORSE FLAT ROAD REALIGNMENT - ROAD EMBANKMENT EROSION AND SEDIMENT CONTROL PLAN



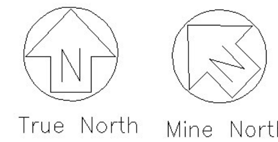


Figure 1

Source: NZMS Sheet 15 Waitaki.

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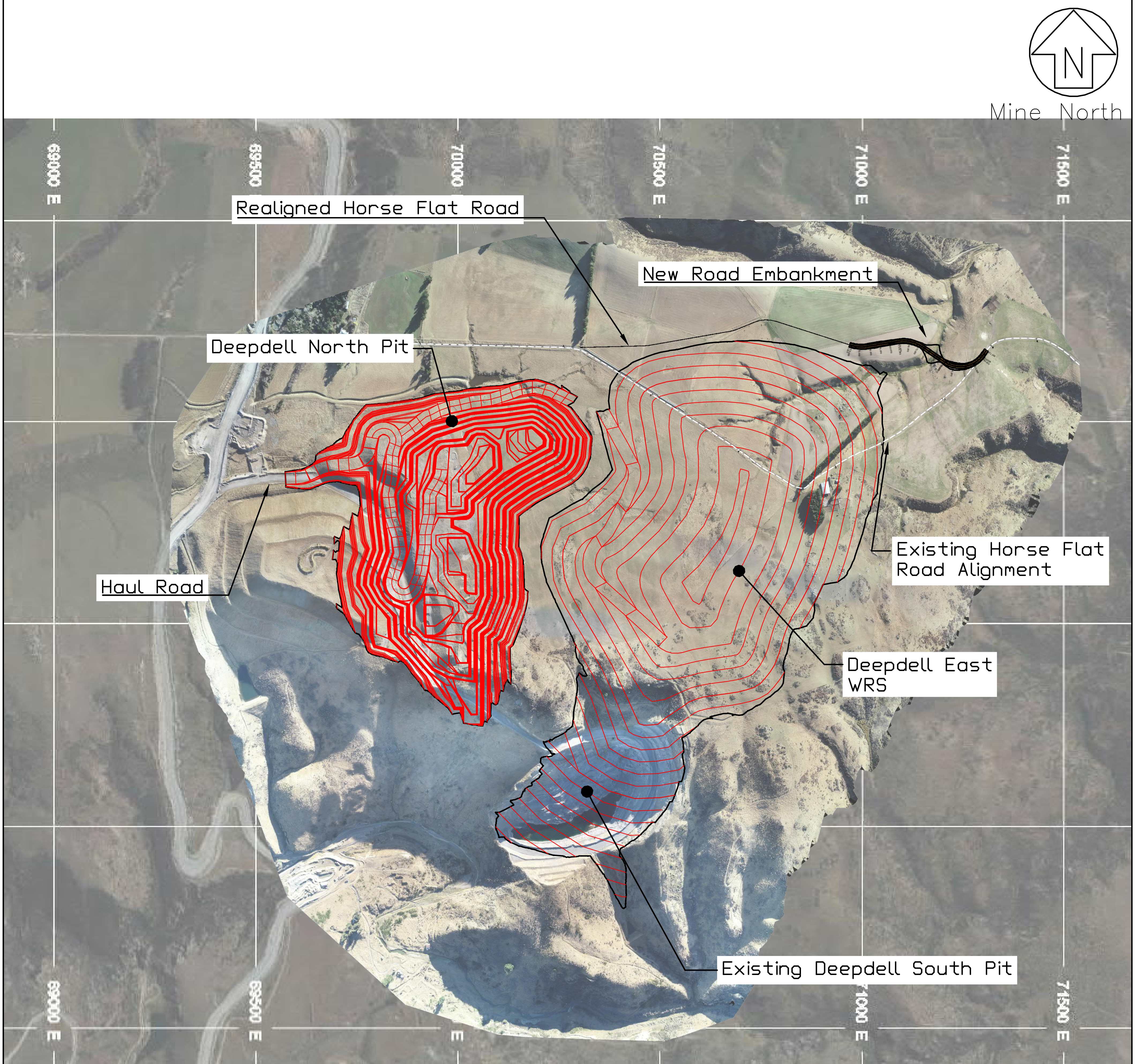
OCEANA GOLD (NEW ZEALAND) LTD
Macraes Gold Project
Locality Plan

Ref. No.: 1410
Date: 26 June 2002
Drawn: SP
File: local.grf



LEGEND:

Deepdell East WRS - Contours 10m Intervals

Deepdell North Stage III Pit - Contours 2.5m Intervals

Figure 2

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OCEANA GOLD NZ LIMITED
MACRAES GOLD PROJECT-
Deepdell North Stage III
Site Plan

Drawing No.	8946-Fig2
Date:	Aug 2019
Drawn:	NT
Scale:	1:10,000 (@A3)
Filename:	8946-Fig2.dwg

Figure 3

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MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Road Embankment Approaches Plan

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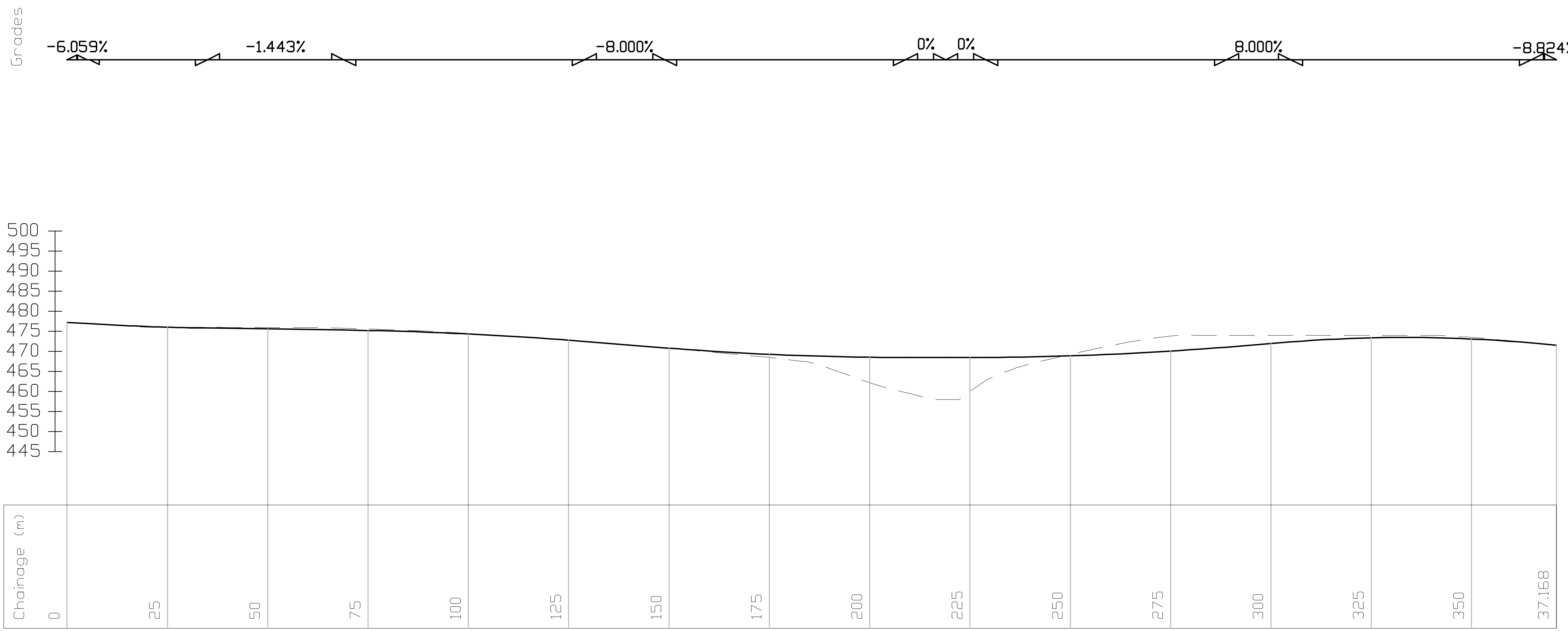

LEGEND:

Preliminary Design Road Level

Existing Ground Level

Figure 4

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OCEANA GOLD NZ LIMITED
MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Road Embankment Approaches Plan - Long Section

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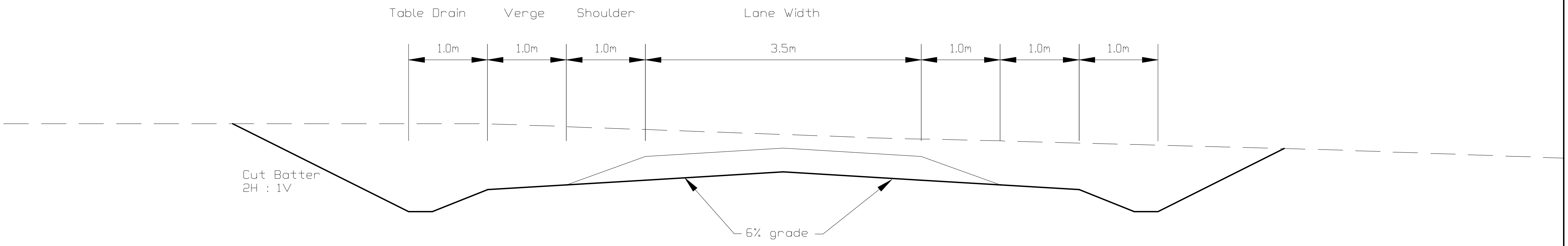
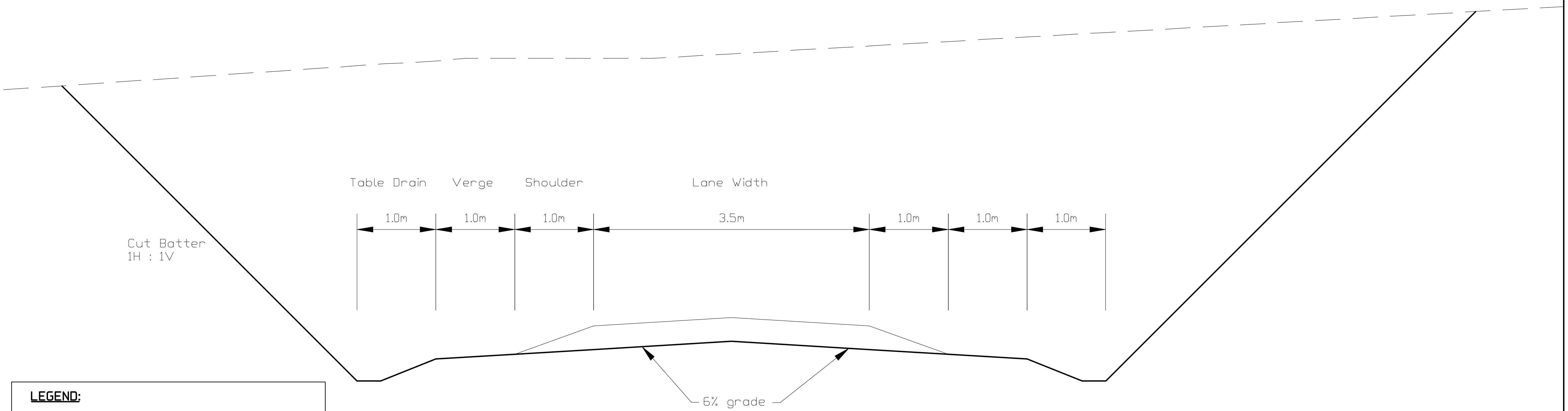


Section A Chainage 65 - Formation Profile West Approach



LEGEND:

Preliminary Design Road Level

Existing Ground Level

Section B Chainage 280 - Formation Profile East Approach

Figure 5

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OCEANA GOLD NZ LIMITED
MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Road Embankment Approaches Plan - Cross Sections

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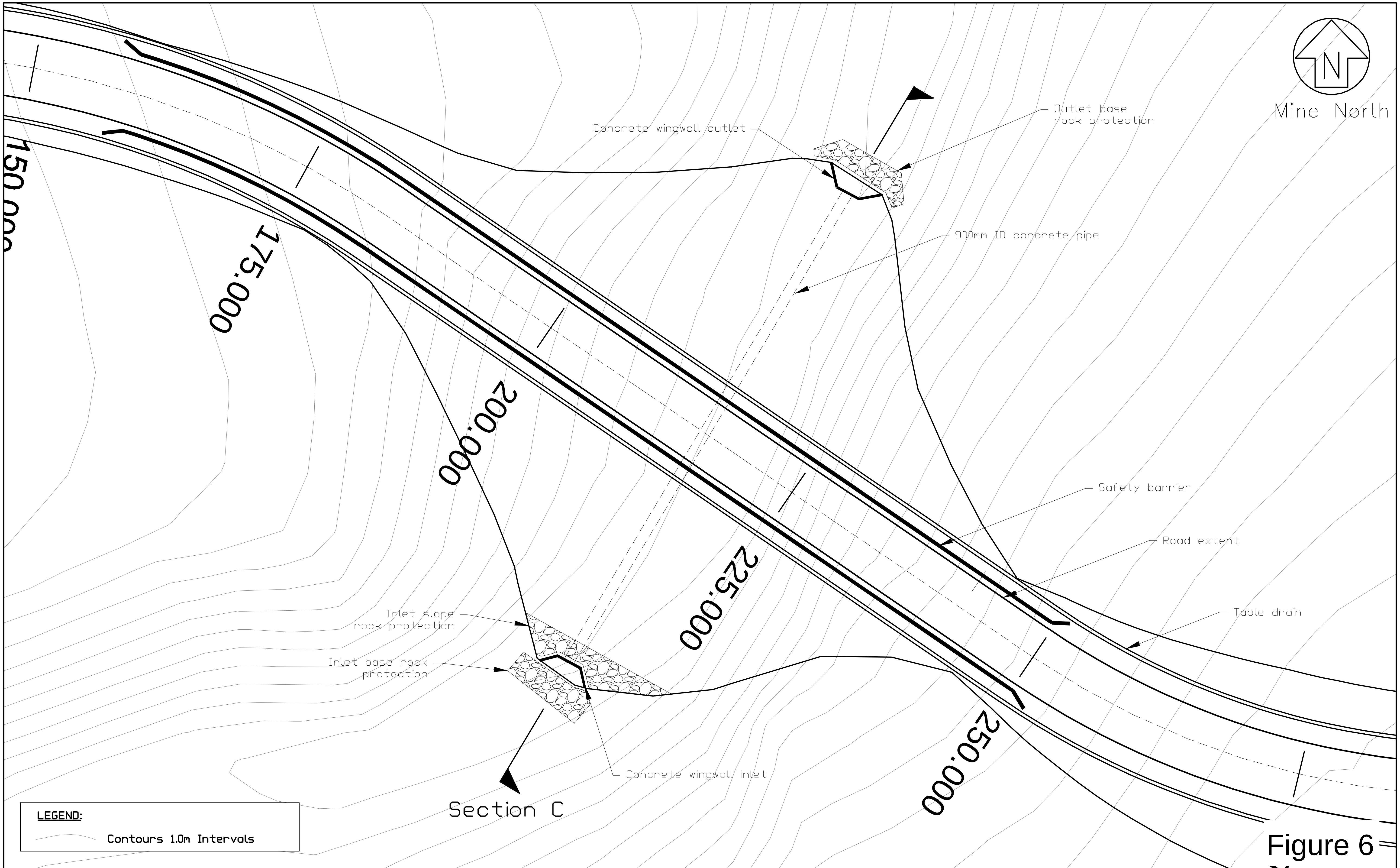

Figure 6

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OCEANA GOLD NZ LIMITED
MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Road Embankment - Plan

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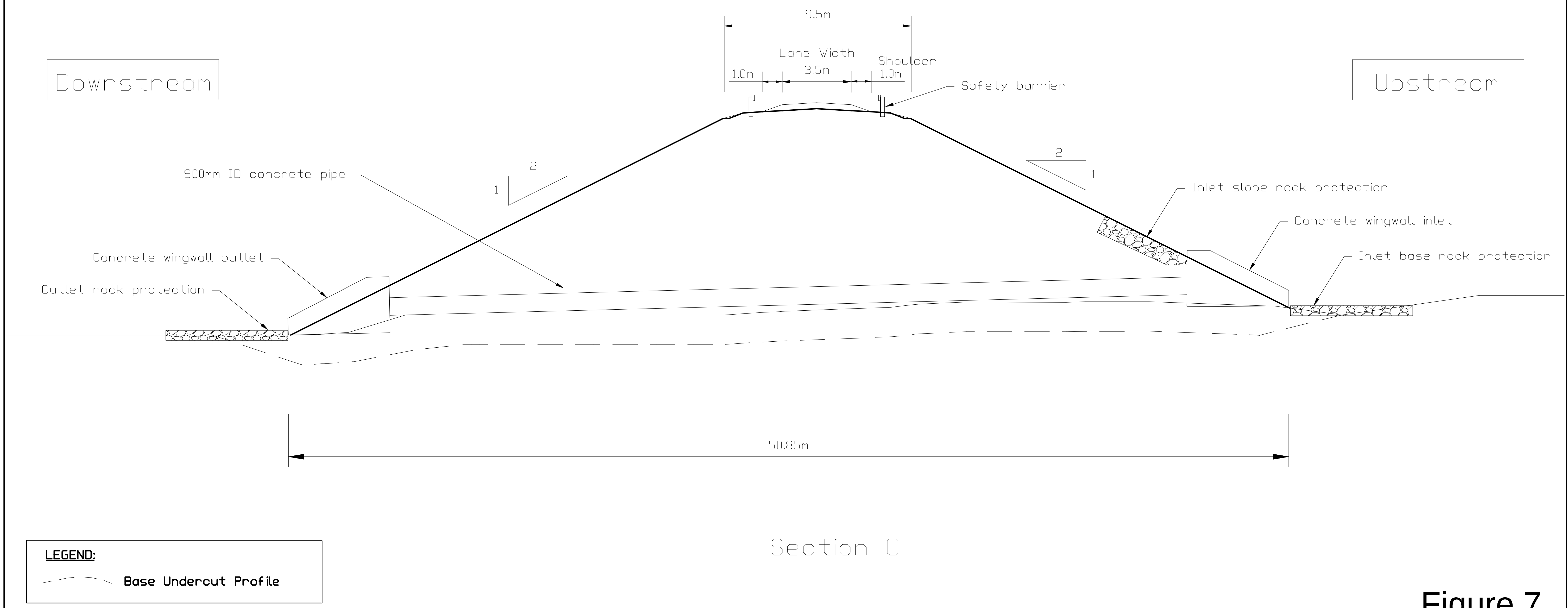

Figure 7

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MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Road Embankment - Cross Section

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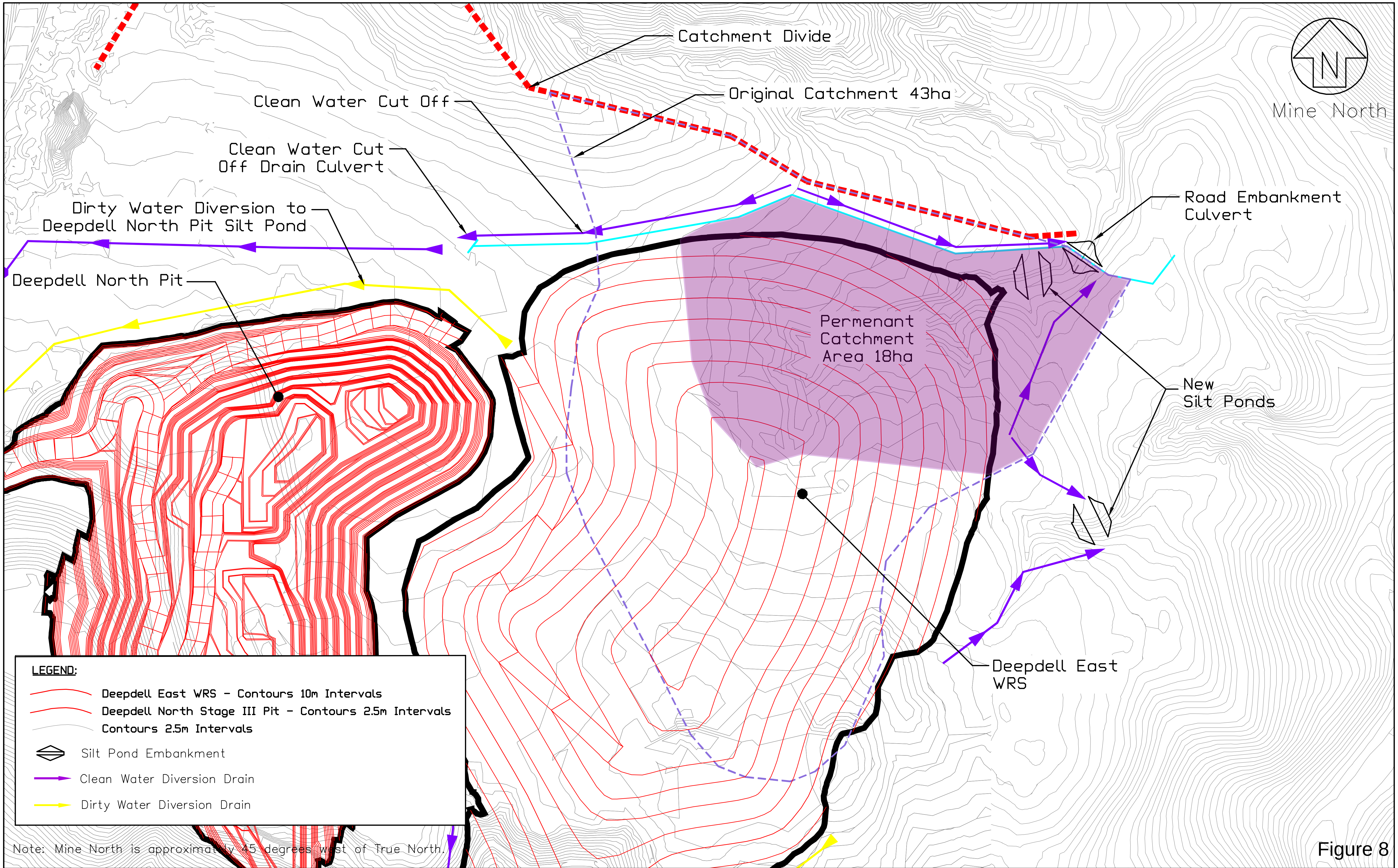

Figure 8

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MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Catchment Plan

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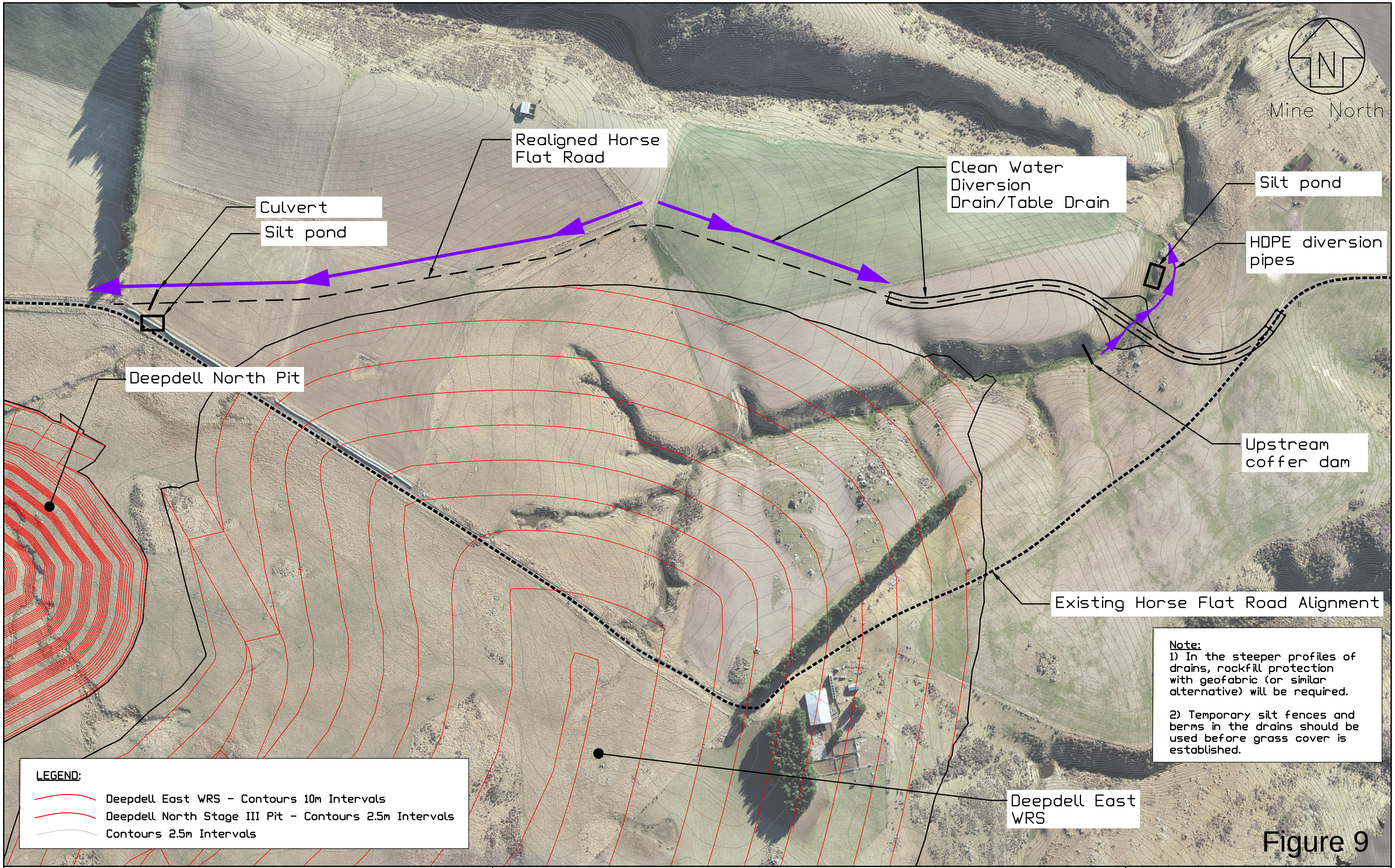

Figure 9

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MACRAES GOLD PROJECT-Deepdell North Stage III
Horse Flat Road Realignment
Erosion and Sediment Control Plan

Drawing No.	8946-Fig9
Date:	Nov 2019
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Filename:	8946-09.dwg

PLATE 1: OBLIQUE PHOTO LOOKING DOWN TO THE HORSE FLAT AREA WHERE THE ROAD IS TO BE REALIGNED

PLATE 2: PHOTO OF THE EPHEMERAL GULLY UPSTREAM OF ROAD EMBANKMENT

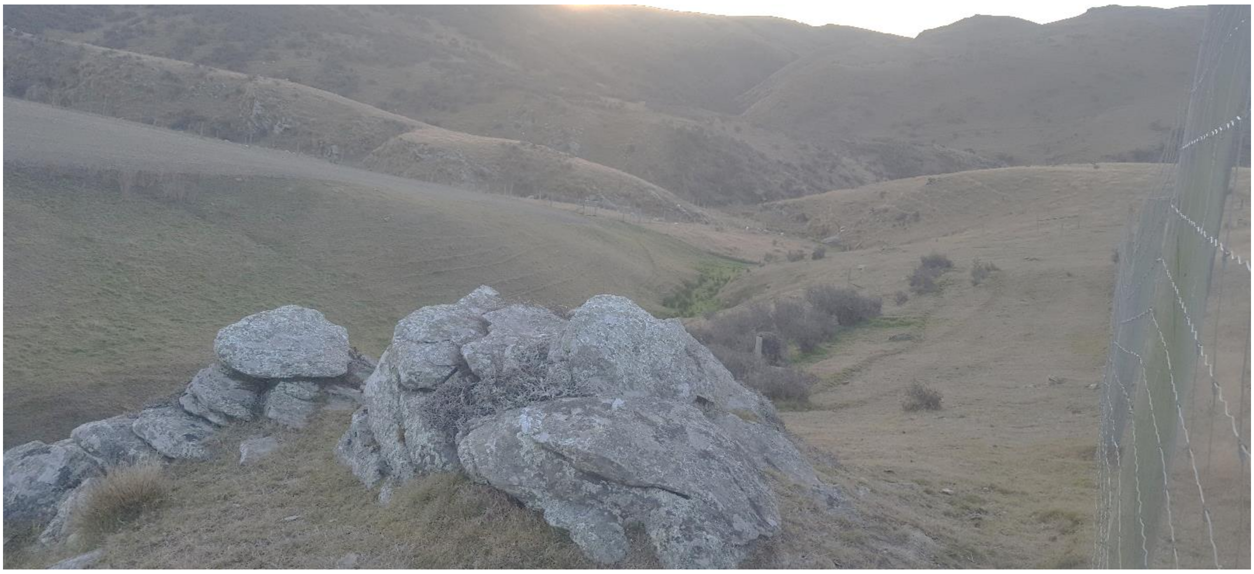

PLATE 3: PHOTOGRAPH FROM ROCK OUTCROP ADJACENT TO ROAD EMBANKMENT. LOOKING DOWNSTREAM AT THE SITE WHICH IS JUST BEYOND THE ROCK OUTCROP

L

APPENDIX L

Air Effects Report

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Report

Oceana Gold (New Zealand) Ltd - Deepdell North Stage III - Assessment of Effects of Discharges to Air

Prepared for Oceana Gold (New Zealand) Ltd

Prepared by Beca Limited

9 July 2019

Revision History

Revision Nº	Prepared By	Description	Date
1	Prue Harwood	Draft for Revised Project	17 June 2019
2	Prue Harwood	Final Draft for Revised Project	2 July 2019
3	Prue Harwood	Final	9 July 2019

Document Acceptance

Action	Name	Signed	Date
Prepared by	Michele Dyer		9 July 2019
Reviewed by	Prue Harwood		9 July 2019
Approved by	Graeme Jenner		9 July 2019
on behalf of	Beca Limited		

Contents

Appendices

List of Figures

List of Tables

1 Introduction

1.1 Proposal

Oceana Gold (New Zealand) Limited (OGNZL) operates an open pit gold mine at Macraes Flat in North Otago.

OGNZL wishes to re-mine and extend the current Deepdell North Pit, backfill the existing Deepdell South Pit and construct a new waste rock stack (WRS). The project elements are to be known as Deepdell North Stage III Pit, Deepdell South Backfill and Deepdell East WRS.

Mining of Deepdell North Stage III Pit is expected to commence in October 2020 and will add an additional two years to the Macraes Gold Project's life.

The proposed Deepdell North Stage III Pit area will be mined using the same equipment and processes as currently used in other areas of the Macraes mining operation. No additional equipment, such as trucks or excavators will be used. Overall, the level of activity at the Macraes Gold project will not increase.

OGNZL currently holds 5 consents for discharges to air issued by the ORC for the Macraes Gold Project. These are:

- Consent 96785_V5 for discharges to air from the main mine area
- Consent RM10.351.52 for discharges to air from the Macraes Phase III Project
- Consent 2006.689 for discharges to air from underground mining at Frasers
- Consent RM12.378.15 for discharges to air from Coronation Pit
- Consent RM16.138.19 for discharges to air from Coronation North Pit

The discharges to air from the proposed new Deepdell North Stage III Pit are not authorised by the existing resource consents and are not activities which are permitted in the Regional Plan: Air for Otago (Air Plan). A new resource consent is therefore required for the discharges to air that will result from the proposed Deepdell North Stage III project mining activities under section 15 of the Resource Management Act, 1991 (RMA)

OGNZL has commissioned Beca Limited (Beca) to prepare an Assessment of Environmental Effects (AEE) of the discharges to air from the proposed Deepdell North Stage III project to accompany an application to the Otago Regional Council (ORC) for a new consent. The AEE has been prepared in accordance with section 88 and the Fourth Schedule of the RMA and the relevant provisions of the Regional Plan: Air for Otago (Air Plan).

1.2 Limitations

This report has been prepared by Beca for OGNZL. Beca has relied upon the information provided by OGNZL in completing this document. Unless otherwise stated, Beca has not sought to independently verify the information provided. This document is, therefore, based upon the accuracy and completeness of the information provided and Beca cannot be held responsible for any misrepresentations, incompleteness, or inaccuracies provided within that information. Should any new or additional information become available, this report will need to be reviewed accordingly.

2 Environmental Setting

2.1 Site and Locality Description

The OGNZL Macraes Gold Project is located in a rural area that is dominated by OGNZL's existing mining activity and low intensity pastoral farming. Macraes Village, located to the southwest of the Macraes Gold Project mining area, is a small village that includes approximately 20 houses and an historic hotel.

The existing Deepdell North Pit is located to the north of the main Macraes Gold Project, approximately 4.3 km from Macraes Village and approximately 600m to the southeast of the Coronation Project. The Deepdell North Stage III Pit is located to the north of Deepdell Creek.

The previous Deepdell North Pit will be re-mined and extended primarily to the north and east. A map showing the locations of the existing and proposed mine features is shown in

Figure 2-1.

The land in the vicinity of the proposed Deepdell North Stage III project mining activity is rural and of a similar character to the land surrounding the existing Macraes Gold Project mine and Coronation Project, which is dominated by steep contours.

The land is owned by OGNZL. The Deepdell North Stage III project area will be located within the Waitaki District.

Figure 2-2shows the areas of land in the vicinity of the proposed Deepdell North Stage III project that are owned or leased by OGNZL, the boundaries of the land owned by neighbours and the locations of the nearest residences to the proposed works. The map also shows the locations of the existing Macraes Gold Project, Coronation Project and the location of the proposed Deepdell North Stage III project and demonstrates the distances from the mining activities to the boundaries with neighbouring properties.

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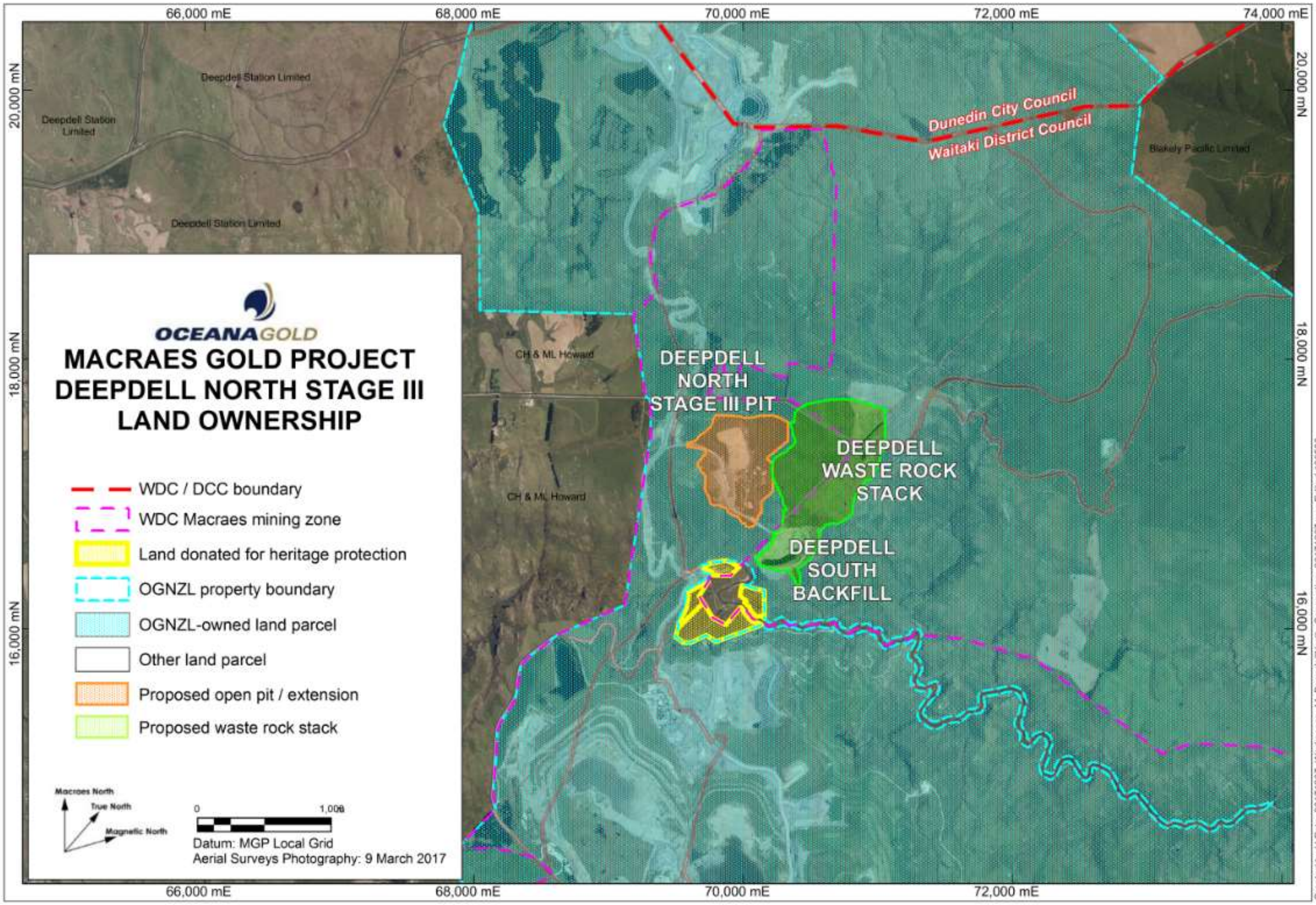

Figure 2-1 Aerial photograph showing the main mine features and land owned and leased by OGNZL and locations of neighbouring landowners (note that the photograph is aligned with "Macraes North" and not true north)(Source OGNZL)

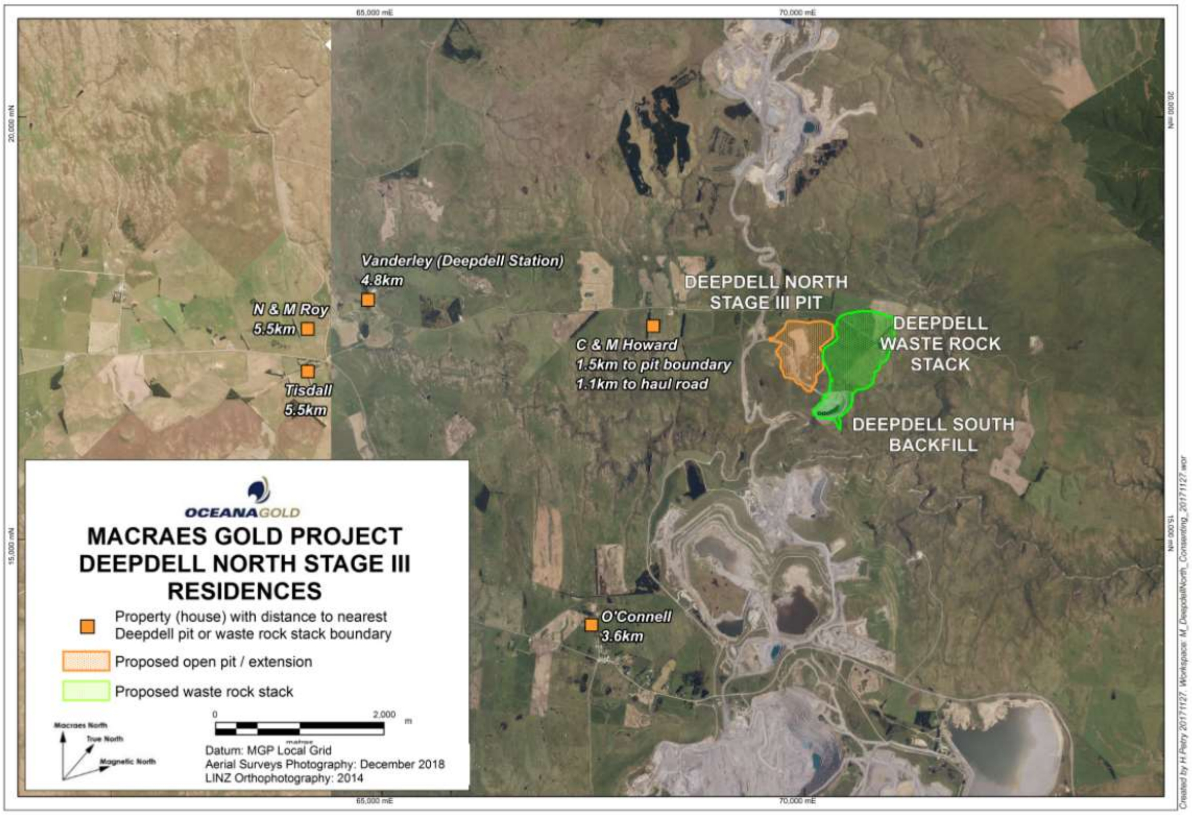

Figure 2-2 Aerial photograph showing the locations of the nearest residences to the proposed works (note that the photograph is aligned with "Macraes North" and not true north) (Source OGNZL)

Figure 2-2 illustrates that there are very few houses in the area. The closest privately owned houses to the Deepdell North Stage III Pit will be the Howard residence, the O'Connell residence and the Vanderley residence at Deepdell station. For reference, all orientations described within this report are aligned with true north (the mine plans are oriented to Macraes North).

The Howard residence is located approximately 1.5 km to the southwest of the proposed Deepdell North Stage III Pit boundary and approximately 1.1 km to the southwest of the existing haul road. The O'Connell residence is located approximately 3.6 km to the south of the Deepdell North Stage III Pit boundary. The Vanderley residence at Deepell Station is located approximately 4.8 km to the southwest of the proposed pit and the Tisdall and Roy residences are located approximately 5.5km to the southwest of the proposed project area.

The legal descriptions of the land to be mined as part of the Deepdell North Stage III project are listed in Table 2-1.

Table 2-1 Legal descriptions of land to be mined

Deepdell North Stage III project element	Parcel Description	CT number	Owner
Deepdell North Stage III Pit	Part Section 12 Block VII Highlay SD	OT16B/855	OGNZL
Deepdell East WRS	Part Section 11 Block VII Highlay SD	OT16B/855	OGNZL
	Section 10 Block VII Highlay SD	OT18C/1099	OGNZL
	Part Section 1 Block VIII Highlay SD	OT16B/854	OGNZL
Deepdell South Backfill	Part Section 1 Block VIII Highlay SD	OT16B/854	OGNZL
	Part Section 11-12 Block VII Highlay SD	OT16B/855	OGNZL
Noise bunds, park up areas and stockpiles	Part Section 11-12 Block VII Highlay SD	OT16B/855	OGNZL

The map reference for the centre of the site is within an 1800m radius of NZTM 2000 1397500E, 4975500N.

The proposed mine is located in Airzone 3 as defined in the Regional Air Plan. Airzone 3 includes all areas of Otago which are not located within Airzones 1 and 2 and comprises the rural areas of the region. The proposed mine is not located within an airshed which is gazetted under the National Environmental Standard for Air Quality (NESAQ) and is not in an area which is defined as “polluted” by Regulation 17 of the NESAQ.

2.2 Meteorology

OGNZL measures meteorological variables at a climate station located on Golden Point Road (Site 3), approximately 5.5 km south of the existing Coronation Project.

Figure 2-3 is a windrose for the years 2012-2018 inclusive, which shows that winds blow predominantly from the south-westerly and north-westerly quarters. The strongest winds also come from these quarters. Winds from the north-easterly quarter tend to be lighter and less frequent and winds from the south-easterly quarter are rare.

The average wind speed measured between 2012 and 2018 (inclusive) was 3.3 m/s and calm conditions occurred for 3.0% of the time. Winds exceeding 5 m/s, which is the critical wind speed for the pick-up of dust from unconsolidated surfaces, occurred for 20.1% of the time.

Figure 2-4 shows the frequency of occurrence of various wind speed classes measured between 2012 and 2018 (inclusive). Figure 2-5 is an aerial photograph overlaid with the site windrose, which also shows the location of the proposed Deepdell North Stage III project and the locations of the closest residences.

The average annual rainfall measured by OGNZL, at the Golden Point climate station between 2012 and 2018 (inclusive), was 550 mm.

The relatively high frequency of winds exceeding 5 m/s and the relatively low rainfall are climatic features that contribute to the generation and transport of dust.

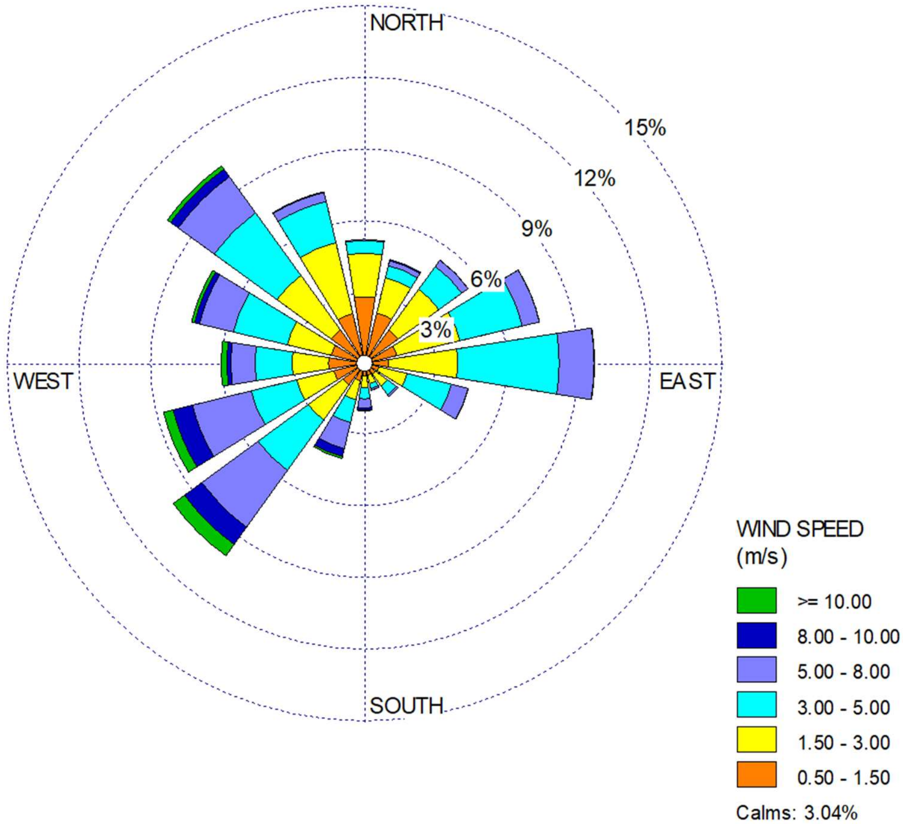

Figure 2-3 Windrose of hourly average wind speed and direction measured at Golden Point Road 2012-2018 (inclusive)[1] (windrose aligned to true north)

[1] Data supplied by OGNZL

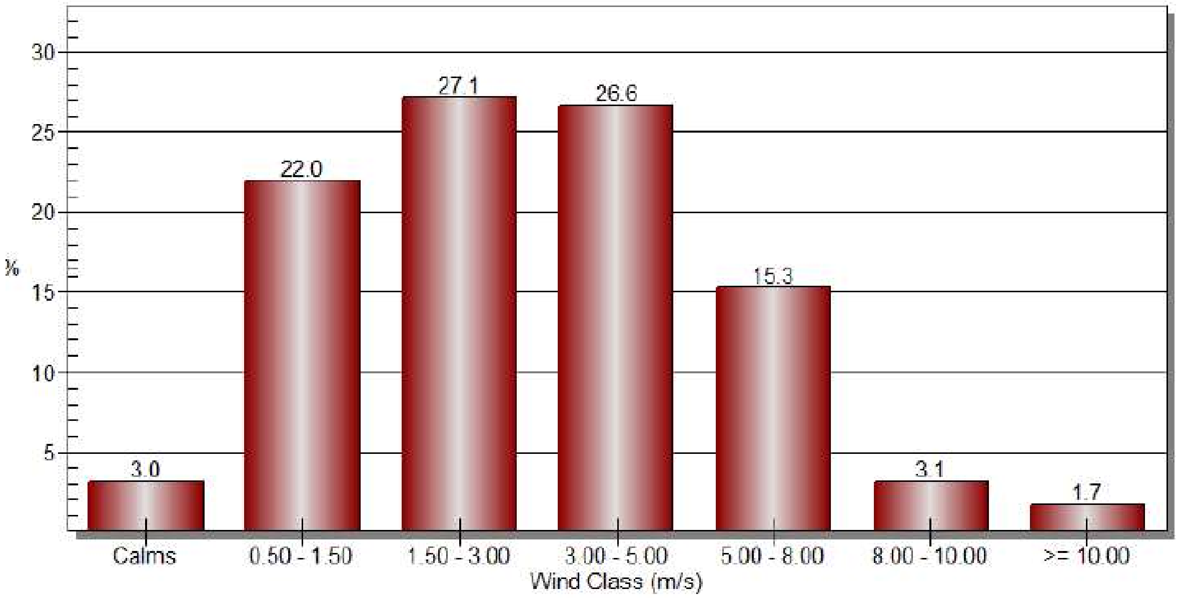

Figure 2-4 Frequency distribution of hourly average wind speeds measured at Golden Point Road 2012-2018 (inclusive)[1]

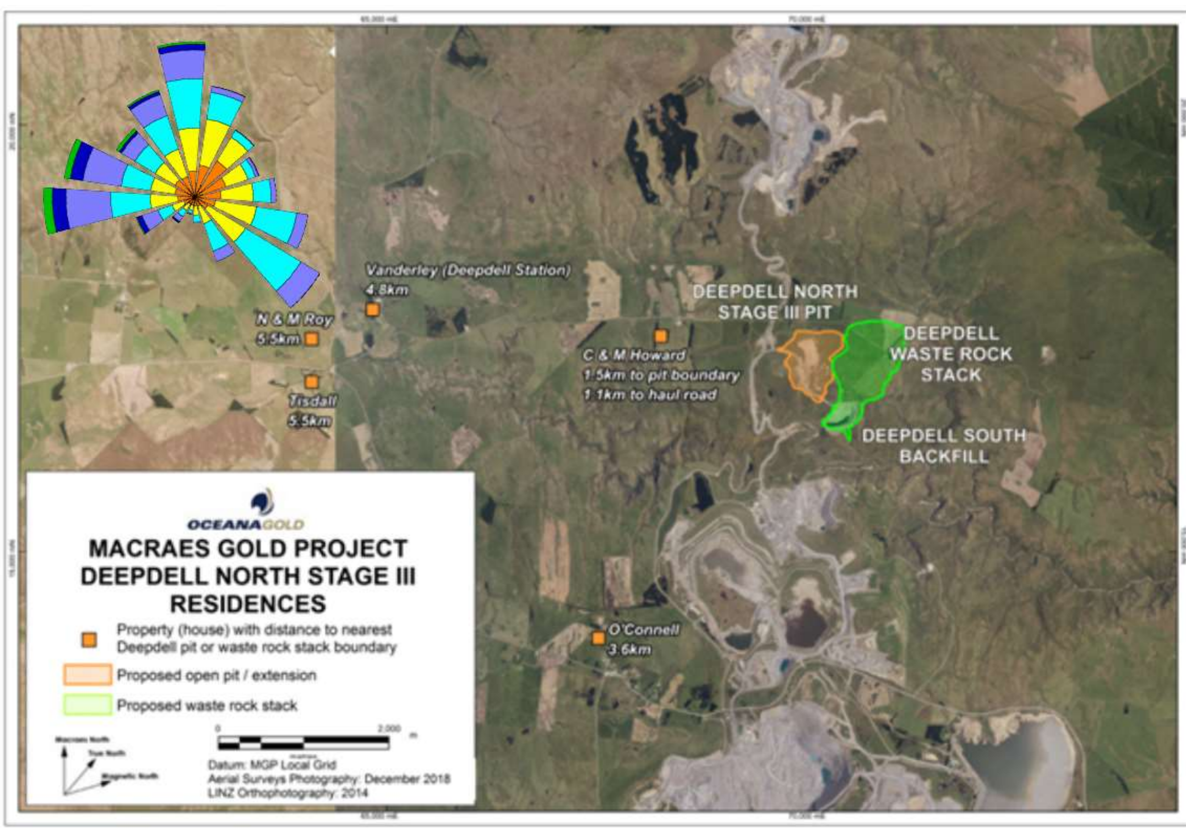

Figure 2-5 Aerial photograph of proposed project area overlain with the site windrose for 2012-2018 oriented to Macraes north. (background image provided by OceanaGold)

2.3 Background Air Quality

OGNZL has been monitoring deposited dust and total suspended particulate (TSP) concentrations in the vicinity of the Macraes Gold Project since 1989, prior to mining beginning in 1990. The concentrations of fine particulate (PM_{10}) and respirable quartz were also measured for a period. Deposited dust is presently measured at three background sites (Sites 9, 10, and 24), which are unaffected by mining activities. Prior to Consent RM12.378.15 being granted, Site 17 was also used as a background site, but as this site is located in relatively close proximity to the Coronation Project, it is no longer included in the background concentration calculations. The dustfall measured at these sites should be indicative of background deposited dust concentrations in the rural area surrounding the mine and in the vicinity of the proposed Deepdell North Stage III project.

TSP concentrations are measured at one site, in the vicinity of Macraes Village (Site 15). The TSP concentrations measured at this site should also be indicative of background TSP concentrations in the general area of the Deepdell North Stage III project. Table 2-2 summarises the average background deposited dust and TSP data for 2016 to 2018 inclusive.

Table 2-2 Summary of background insoluble deposited dust values and TSP concentrations for 2016 to 2018

Parameter	Insoluble Background Dust (g/m³/30 days)			TSP 24 hour average concentrations at Site 15 (µg/m³)		
	2018[2]	2017[3]	2016[4]	2018[2]	2017[3]	2016[4]
Minimum	0.1	0.2	0.2	1.6	0.0	0.0
Average	1.0	0.9	0.4	12.3	10.1	8.3
Maximum	3.6	2.3	0.7	100.1	156.1	191.3

[2] Beca Ltd *"Macraes Mine – Summary of Ambient Air Monitoring Results for 2018"* prepared for OGNZL (New Zealand) Limited, April 2019.

[3] Beca Ltd *"Macraes Mine – Summary of Ambient Air Monitoring Results for 2017"* prepared for OGNZL (New Zealand) Limited, April 2018.

[4] Beca Ltd "*Macraes Mine – Summary of Ambient Air Monitoring Results for 2016*" prepared for OGLNZ (New Zealand) Limited, 2017

3 Air Quality Standards

In October 2004, the Government introduced five National Environmental Standards for Ambient Air Quality (NESAQ). The NESAQ regulations are designed to address the health effects caused by poor air quality. Ambient air quality standards for fine particles (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NO_2), carbon monoxide (CO) and ozone (O_3) came into force on 1 September 2005. The standard of relevance to this application is the NES for PM_{10}. The PM_{10} standard allows a maximum of one exceedance per year of a PM_{10} concentration of 50 µg/m^3 (24 hour average).

Regulation 17 restricts the granting of resource consents for discharges of PM_{10}, where that discharge would be likely to increase off-site 24 hour average PM_{10} concentrations in "polluted" airsheds by more than 2.5 µg/m^3 at any time.

The proposed Deepdell North Stage III project area is located within the airshed comprised of all areas within the Otago region that do not fall within the four gazetted airsheds. There is no meaningful PM_{10} concentration data available for this airshed and it therefore, does not meet the NESAQ definition of "polluted". As such there are no restrictions under Regulation 17 to the granting of this consent.

4 Deepdell North Stage III Project Description

The Deepdell North Stage III project will re-mine and extend the previous Deepdell North Pit and will have the following features:

- The re-mining of the previously backfilled area known as Deepdell North pit to be known as Deepdell North Stage III;
- The extension of the area of the Deepdell North Pit from 18.7 ha to 38 ha;
- The construction of a new 21.6 Mm^3 capacity WRS to be known as Deepdell East WRS, which will be located to the north of the proposed Deepdell North Stage III pit and will cover an area of 70.8 ha of which 57.6ha will be new disturbance; and

The backfilling of Deepdell South pit with 13 Mt of rock. A total backfill footprint of 16.4 ha, where 13.2 ha will be filling in a previously disturbed open pit and 3.2 ha will be new fill.

The Deepdell North Stage III project is estimated to contain approximately 3.5 Mt of ore and will produce 9.4 Mt of backfill waste, 2.4 Mt of in-situ oxide waste and 41.5 Mt of fresh waste. The total movement rate will be approximately 57 Mt and is expected to take up to two years to complete.

Horseflat Road will be permanently moved north due to construction of the Deepdell East WRS and a new short haul road will be constructed between Deepdell North Pit and the WRS.

Overall, the mining rate at the Macraes Gold Project will not change substantially during the course of the mining at Deepdell North Stage III.

The mining methods used will be similar to those already conducted at the Macraes Gold Project and will involve drilling and blasting. The mining will use the existing fleet of diesel-powered mining equipment.

The Deepdell North Stage III pit will be progressively rehabilitated. At closure, a pit lake will be formed and the land restored to pastoral use.

The Deepdell North Stage III project features and layout are shown in Figure 4-1.

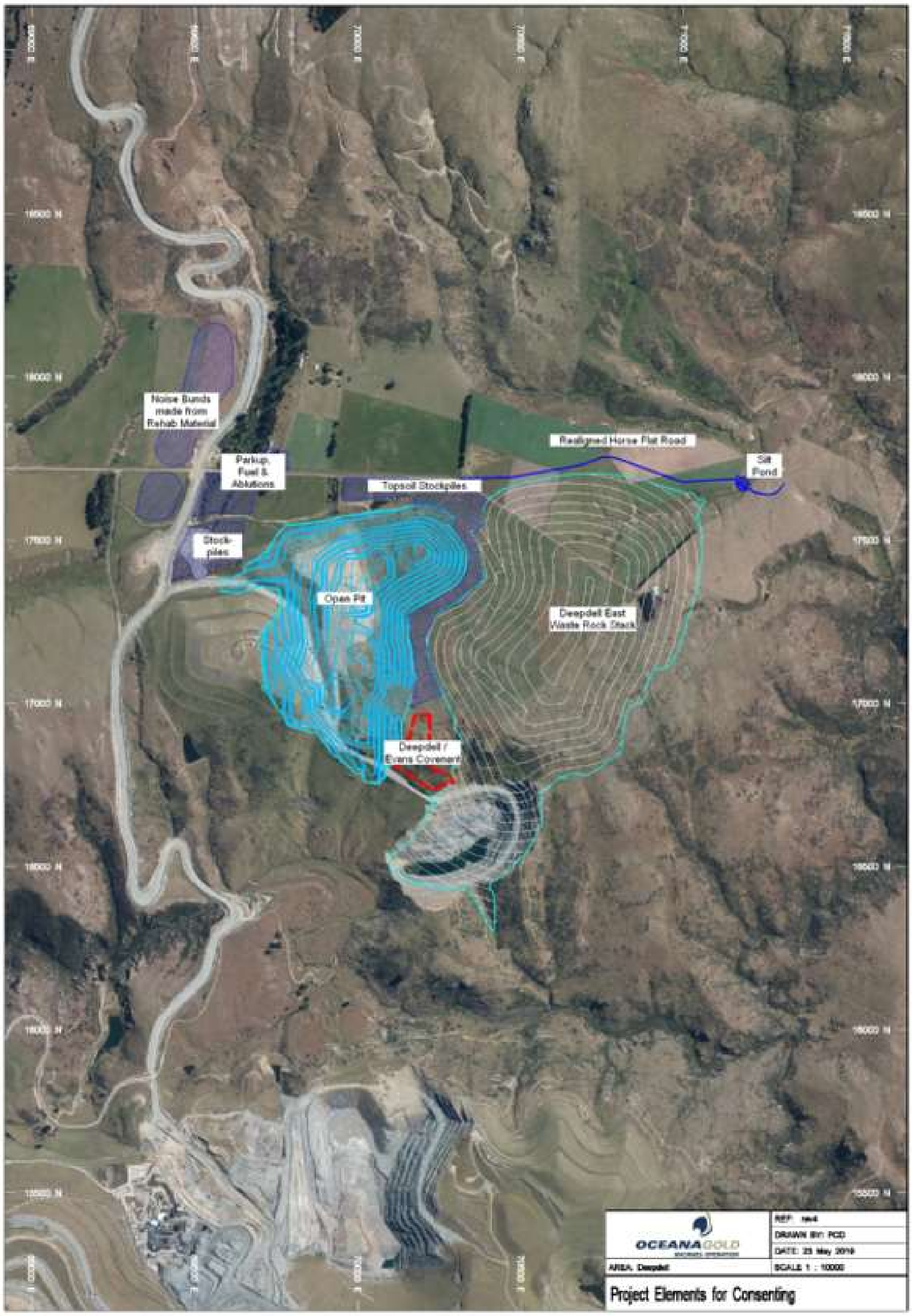

Figure 4-1 aerial photograph showing the major project elements for the Deepdell Stage III project (figure supplied by OGNZL)

5 Discharges and Associated Mitigation Methods

5.1 Emissions from Mining

The nature of the emissions from the mining of Deepdell North Stage III Pit will be the same as the nature of the emissions from other mining activities carried out by OGNZL at the Macraes Gold Project.

Engine exhaust emissions will be generated from the mobile equipment used on the site. The vehicles to be used at the Deepdell North Stage III Pit will be sourced from other parts of the Macraes operation and no additional vehicles will be required. The emissions from the engines are considered to be relatively minor and expected to be well-dispersed prior to reaching sensitive receptors; therefore, these emissions are not assessed further in this report.

5.2 Factors which Influence Dust Generation

The predominant discharge from the proposed project will be particulate matter. The dust that will be discharged from the project activities will be comprised of a wide variety of size fractions. The larger settleable dust material is generally greater than 50 µm in diameter. It has the potential to create a nuisance effect due to soiling of surfaces and by causing irritation to eyes and nose.

The distance a particle will travel that is entrained in the wind is dependent on the height above ground level that it is discharged from, its size and the wind speed. For example, in a 5 m/s wind a 100 µm particle disturbed from ground level would settle back to the ground within approximately 10 m of the source while a 10 µm particle would have the potential to travel about a kilometre[5]. Because deposited particulate is relatively large in size, it usually falls out of the air within a short distance (approximately 100 to 200 m) of the source[6][7].

The finer material is defined as suspended particulate and known as TSP. It is generally less than 20 µm in diameter and can travel large distances downwind. The portions of TSP that pose the greatest potential health effect are particulates less than 10 µm in diameter (known as PM_{10}) and particulates less than 2.5 µm (known as $PM_{2.5}$). PM_{10} is able to penetrate the upper respiratory tract and consequently, has the potential to impact on human health. $PM_{2.5}$ can penetrate even further into the lung and is suspected of being the fraction of PM_{10} that is responsible for health impacts that can lead to an increase in morbidity and mortality in particular circumstances.

The particulate generated from processes, such as those involved in the Deepdell North Stage III project, is likely to be predominantly made up of larger size fractions (ie greater than 10 µm)[8]. The major source of the finer particulates PM_{10} and $PM_{2.5}$ in the atmosphere is combustion processes. The assessment of effects in this report focuses primarily on the effect of the larger settleable particulates, as there are few combustion processes associated with the project and therefore only minor amounts of finer particulates are expected to be generated.

The major factors that influence dust emissions from surfaces are:

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[5] Ministry for the Environment "*Good Practice Guide for Assessing and Managing Dust*" 2016
[6] Ibid at 5
[7] Institute of Air Quality Management "*Guidance on the Assessment of Mineral Dust Impacts for Planning*" May 2016
[8] Ibid at 5

- Wind speed across the surface – the critical wind speed for pickup of dust from surfaces is 5 m/s; above 10 m/s pickup increases rapidly[9];
- The percentage of fine particles in the materials on the surface;
- Moisture content of the material on the surface;
- The area of exposed surface; and
- Disturbances such as traffic, excavation, loading and unloading of materials.

Dust emissions from mining activities can be significant if not controlled. However, if standard dust control techniques are used the emissions can be reduced significantly.

The larger the area of exposed material, the more potential there will be for dust emissions. Vehicles travelling over exposed surfaces tend to pulverise any surface particles. Particles are lifted and dropped from rolling wheels and the road surface is exposed to strong air currents due to turbulence between the wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

The smaller the particle size of the material on the surface of a road or an exposed surface, the more easily the particles are able to be picked up and entrained in the wind. Moisture binds particles together preventing them from being disturbed by wind or vehicle movements. Therefore, one of the primary techniques for controlling dust is the application of water to unconsolidated surfaces.

It is possible to estimate the potential emissions of particulate matter from construction and mining activities using emission factors developed primarily for the US Environmental Protection Agency (USEPA) and published in a number of publications including the USEPA AP42 database[10]. However, for fugitive dust sources such as those at OGNZL, these emission factors have a large degree of uncertainty. For this assessment, no attempt has been made to quantify the emissions from the mine. Instead, the assessment method is based on comparing the effects of the existing Macraes Gold Projects with the potential effects of the new Deepdell North Stage III development, taking into account any changes in the level of operation and the location of the development in relation to sensitive receptors.

5.3 Sources of Particulates and Proposed Mitigation Methods

5.3.1 Proposed activities

The activities that are proposed at the Deepdell North Stage III project (and currently take place at the existing Macraes Gold Project mining sites), with a potential to generate discharges to air include:

- Earthworks, including stripping of overburden and topsoil, mining, construction of roads and dam structures and formation of the WRS and stockpiles;
- Blasting;
- Vehicle movements on unpaved surfaces;
- Loading and unloading of materials; and
- Wind-generated dust from dry exposed surfaces such as roads and stockpiles.

These activities are addressed in the following subsections along with a summary of the proposed mitigation methods. OGNZL has a Dust Management Plan, which provides details of the mitigation methods currently

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[9] Air and Waste Management Association *"Air Pollution Engineering Manual"* 2nd edition edited by Wayne T Davis, 2000.

[10] United States Environmental Protection Agency (USEPA) *AP42 Emission Factor Database*, Chapter 13

used at the Macraes Gold Project and which will also be used on the Deepdell North Stage III project. A copy of the Dust Management Plan is attached as **Appendix A**. The mitigation methods prescribed in the Dust Management Plan have been effective at controlling dust generated at the Macraes Gold Project and should also be an effective management tool for controlling dust emissions at the Deepdell North Stage III project.

5.3.2 Earthworks

The stripping of overburden, soil and rock from surface areas and the spreading of overburden and topsoil on rehabilitated land has the potential to generate significant quantities of dust, if the process is not carefully controlled. Similarly, the construction of infrastructure such as roads, dams, stockpiles and WRSs has the potential to generate significant quantities of dust.

To control dust from these activities, OGNZL proposes to continue to use the methods currently utilised at the Macraes Gold Project. These include the following methods:

- Keep exposed surface areas to a minimum and re-vegetate exposed areas as soon as practical;
- Plan potentially dusty activities such as stripping and spreading of topsoil for days when weather conditions are predicted to be favourable (as defined in the Dust Management Plan); and
- Use water as a dust suppressant to keep un-vegetated surfaces and haul roads damp.

The National Pollution Inventory for Mining published by the Commonwealth of Australia[11] (NPI Manual), estimates that the use of water to control dust on stripping, hauling and loading and unloading activities can reduce the emissions of dust by 50%. The NPI Manual also estimates that re-vegetation of overburden stockpiles reduces their dust generation capacity by 99%.

5.3.3 Roads

Dust generated from heavy vehicle movements on haul roads and around the proposed WRS, and from general traffic around the proposed Deepdell North Stage III works area, all have the potential to be significant sources of dust. Dust from roads is controlled primarily by limiting the amount of fine particles exposed to the wind, keeping surfaces damp and controlling vehicle speeds. To achieve this, OGNZL proposes to use the following dust mitigation methods, which are used successfully at the Macraes Gold Project at present:

- Limit vehicle speeds;
- Minimise haul distances as far as practical;
- Keep roads and construction surfaces damp with water carts and/or fixed sprinklers when required; and
- Regularly maintain haul roads by grading and laying of fresh rock/gravel.

Speed controls on vehicles have an approximately linear relationship with dust emissions[12]. OGNZL imposes speed limits on all haul roads and other access roads in and around the Macraes Gold Project site that are appropriate for their use.

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[11] Commonwealth of Australia *"National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 2.3"* 2001.

[12] Supra note 11

5.3.4 Vehicles

Overall, the number of vehicles to be used on the Deepdell North Stage III project will be small in comparison to the number of vehicles used over the entire Macraes mine site. Up to two dig fleets may be engaged in the excavation operations. When ore is being hauled to the processing plant, the majority of the truck fleet will be used. Providing the management practices currently employed at the Macraes Gold Project continue to be carried out, the dust discharges generated by vehicle movements are expected to be negligible.

5.3.5 Loading and unloading

The loading of material onto trucks (and including the subsequent offloading), has the potential to generate dust. Trucks will be loaded with materials from the base of the pit and from areas where construction activities are occurring using excavators and loaders. The majority of materials will be unloaded onto the WRS, or onto areas that are being rehabilitated. Dust from sources such as these is best controlled by minimising drop heights. OGNZL currently requires machinery operators to minimise drop heights and will continue to do so.

5.3.6 Exposed surfaces

Exposed surfaces on stockpiles, the WRS, and pit walls are all potential sources of dust. The primary means of controlling dust from sources such as these is by keeping surfaces damp and progressive revegetation, wherever practical. Minimising the quantity of fine particles on the surfaces exposed to the wind also reduces the dust potential.

At present, OGNZL revegetates all permanent stockpiles of materials, such as topsoil, as soon as practical and will continue to do so during the Deepdell North Stage III project.

OGNZL progressively revegetates the outer walls of WRSs as each lift is constructed. This will continue to be the practice on the WRS that will be constructed as part of this project.

5.3.7 Blasting

Blasting will occur at intervals and within restricted hours. The explosive to be used is a mix of ammonium nitrate and fuel oil, referred to as ANFO. Blasting generates emissions of particulates, carbon monoxide, nitrogen oxides and small quantities of sulphur dioxide[13]. Blasting also produces dust generated from the shattering of rock. Blasting will take place within the pit and the majority of the discharges produced will be contained within the pit walls. Due to the large distances between the pit and the site boundaries, any contaminants that do disperse beyond the pit will be well-diluted before they reach the boundary of the mine site.

[13] US EPA AP42 Compilation of Emission Factors. Chapter 13.3 Explosives Detonation.

6 Effects of Existing Mining Activities

6.1 Approach to Assessment of Effects

A common method of assessing the effects of a new activity is to measure or estimate the potential emissions from the site and to then calculate the likely down-wind concentrations of contaminants using dispersion modelling. The modelling predictions are then compared with air quality standards and guidelines in order to determine if an adverse effect is likely to occur. It is very difficult to estimate the emissions from fugitive dust sources such as mining and it is also very difficult to model these emissions as the locations and scale of the sources will change frequently, as will the local topography. Consequently, qualitative assessment methods must be used.

For this assessment, the effects of the existing Macraes Gold Project activity have been assessed by analysing the available environmental monitoring data, with particular emphasis on the effects of the existing Coronation Project. The potential effects of the planned Deepdell North Stage III project have been estimated based on the existing effects of the Coronation Project and the likely changes to the scale and location of the emissions and the proposed mitigation methods.

6.2 Nature of Dust and Potential to Cause Adverse Effects

Dust deposition is the settling of dust onto surfaces. The effects of dust deposition can be subjective and are dependent on the sensitivity of the receiving environment. Some people will consider dust a nuisance while others may find it objectionable or offensive. Dust fallout on a road or rural farmland may not be a nuisance even at relatively high deposition rates[14][15].

Typically, the most common areas of concern from dust deposition arise at residential properties (or similar sensitive locations such as retail premises or schools), and include the visual soiling of clean surfaces, such as cars, window ledges, and household washing, as well as dust deposits on vegetation.

The Ministry for the Environment *Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions* (GPG Dust)[16] notes that the potential for a dust discharge to cause an objectionable or offensive effect depends on the following characteristics of the dust fallout:

- The frequency of dust nuisance events;
- The intensity of events, as indicated by dust quantity and the degree of nuisance;
- The duration of each dust nuisance event;
- The offensiveness of the discharge having regard to the nature of the dust; and
- The location of the dust nuisance, having regard to the sensitivity of the receiving environment.

These factors are known as the FIDOL factors and are also used in odour assessment to consider whether a discharge to air has caused an offensive or objectionable effect. Essentially, whether a dust discharge

[14] Supra note 5

[15] Institute of Air Quality Management "*Guidance on the Assessment of Mineral Dust Impacts for Planning",* May 2016.

[16] Supra note 14

leading to dust deposition causes an offensive or objectionable effect depends on how frequent it is, how much dust is deposited and the sensitivity of the receiving environment.

Dust deposition is typically measured over a period of about 30 days using a dust gauge. However, this does not mean that dust deposition occurs gradually and evenly over that 30 day period. Dust concentrations in the ambient air, downwind of a dust discharge, vary with the rate of dust generation and the wind conditions. Therefore, the rate of dust deposition varies as well. It is quite possible that the majority of the dust deposition measured in a 30 day period by a dust gauge actually occurs during a small number of short, relatively high-rate deposition events. Short-term events of relatively high-rate dust fallout are more likely to be noticed by residents as deposits on surfaces, cars and washing.

Total Suspended Particulate (TSP) monitoring measures particles that are suspended in the air. Most monitoring equipment collects particles that vary in diameter between 0.1 μm and about 100 μm. The finer fractions can travel large distances downwind before they reach ground level. While the larger fractions of TSP can have nuisance effects, the perception of potential for TSP to cause health effects is usually the cause of most concern for nearby residents.

6.3 Assessment Criteria for Deposited and Total Suspended Dust

6.3.1 New Zealand guidelines

In New Zealand, there are no environmental standards or guidelines for deposited dust. However, the GPG Dust recommends a ‘trigger’ level for deposited dust of not more than 4 g/m^2/30 days above background levels. The GPG Dust notes that deposition rates of more than 4 g/m^2/30 days above background levels, in some industrial and sparsely populated areas, may not cause nuisance, but conversely in sensitive residential areas, deposition in the order of 2 g/m^2/30 days above background levels may cause nuisance.

Similarly, there are no environmental standards or guidelines for Total Suspended Particulates (TSP). The GPG Dust suggests ‘trigger’ levels for TSP of 60 μg/m^3 (24-hour average) for sensitive areas with significant residential development, 80 μg/m^3 for areas with moderate sensitivity and 100μg/m^3 for areas of low sensitivity, such as sparsely populated rural areas similar to Macraes Flat.[17]

6.3.2 Current consent conditions

The current consent for the Coronation North Project sets limits for deposited dust and TSP. These limits are shown in Table 6-1.

Table 6-1 Current consent limits for deposited dust and TSP

Contaminant	RM16.138.19
Deposited dust	Not to exceed 3 g/m^2/30 days insoluble dust above background more than twice in any calendar year at Sites 7, 20, 21, 22 and 25. Not to exceed 3 g/m^2/30 days insoluble dust above background at Sites 2 and 15.
TSP	Not to exceed 120 μg/m^3 at Site 15.

[17] The GPG Dust was revised in 2016 and included lower TSP trigger levels than those included in the previous version of the guidance document.

6.4 OGNZL Dust Monitoring

6.4.1 Background

OGNZL has been monitoring deposited dust and TSP concentrations, in the vicinity of the Macraes Gold Project, since 1989. The concentrations of fine particulate (PM_{10}) and respirable quartz were also measured for a period. Over the years of monitoring, some new monitoring sites have been added to measure the impacts of new areas of the mine and some sites have become redundant.

Deposited dust is made up of soluble and insoluble dust fractions. Soluble dust is only of interest downwind of sources that produce water-soluble emissions, such as milk powder from a dairy factory. For OGNZL, the only emissions of any significance are crustal dust particles, which are insoluble in rainwater.

6.4.2 Deposited dust

Figure 6-1 shows the locations of the deposited dust monitoring stations as required by the most recent Consent RM16.138.19, which includes the gauges for the MPIII and Coronation Projects.

The majority of the monitoring sites are located on land that is owned by OGNZL and within the existing mine boundary. The monitoring sites that are subject to the 3 g/m^2/30 day limit, described in the conditions of consents RM16.138.19, RM12.378.15, RM10.351.52 and 96785_V5, are Sites 2, 7, 15, 20, 21, and 25. All of the sites subject to the 3 g/m^2/30 day limit were located beyond the boundary of the mine when consent RM16.138.19 was granted.

The consent conditions also state that OGNZL must undertake a review of dust mitigation measures if the dust deposition rate exceeds 3 g/m^2/day above background, during any month at either Site 2 or Site 15. Site 15 is located very close to the boundary of the mine.

Background deposited dust concentrations are currently measured at Sites 9, 10 and 24. Sites 7 and 17 will be the closest sites to the proposed project area.

Figure 6-2 and Figure 6-3 show the annual average insoluble dust deposition corrected for background concentrations for monitoring sites within the mine boundary and beyond the mine boundary, by year and by site respectively for the years 2004 to 2018. Where concentrations measured at the background sites exceed the values at the monitoring sites, the dust concentration above background will be negative. These values are shown as zero.

Appendix B includes a table which summarises the annual average and maximum values for each site plus the number of exceedances above 3 g/m^2/30 days. The consent conditions limit deposited dust accumulation to no more than 3 g/m^2/30 days, above background concentrations measured beyond the mine boundaries, more than twice in any calendar year. The sites which are beyond the site boundary and/or are subject to the consent limits are highlighted in the appended table.

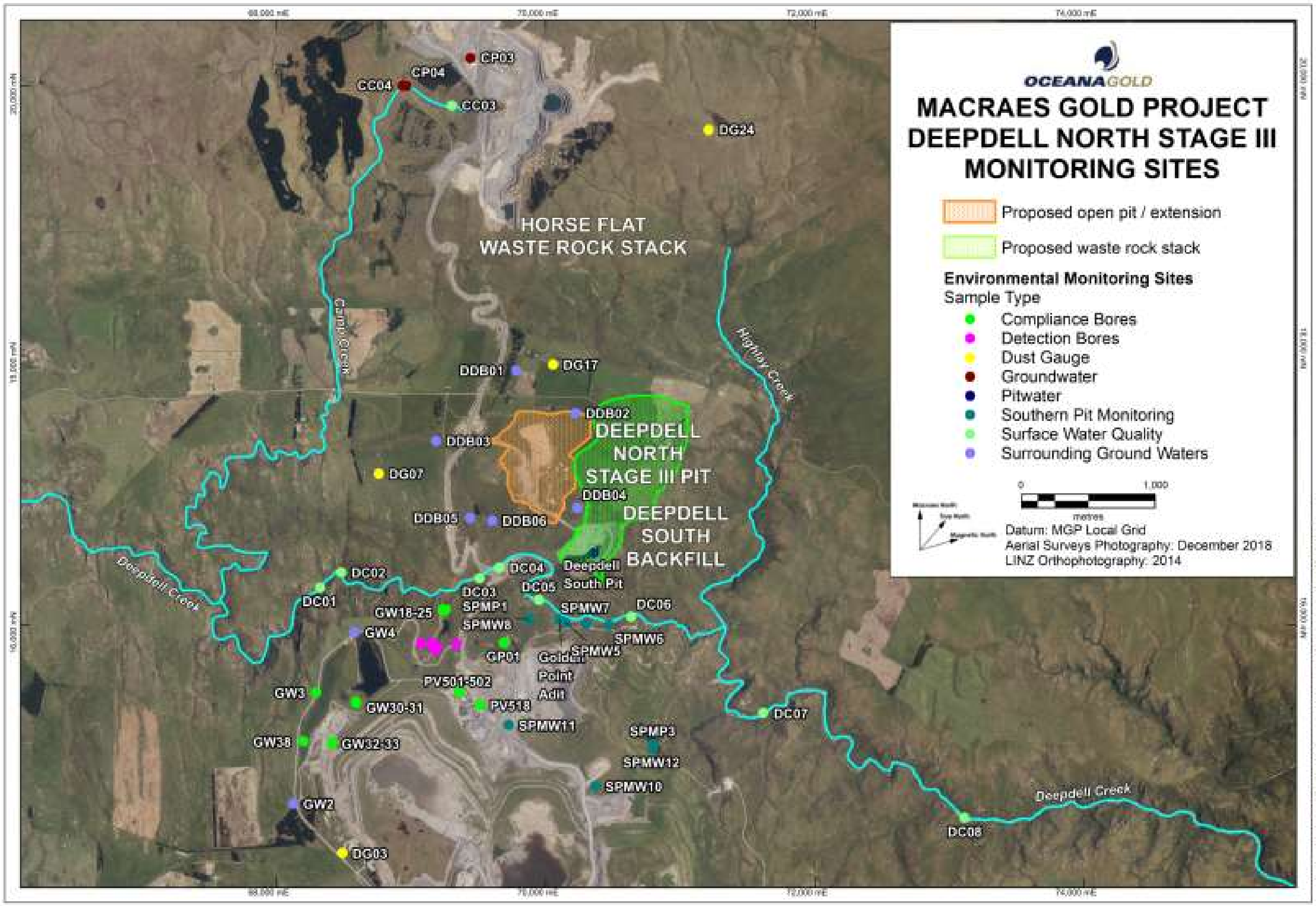

Figure 6-1 Aerial photograph showing locations of current deposited dust and TSP monitoring sites in the vicinity of Deepdell North Stage III Pit

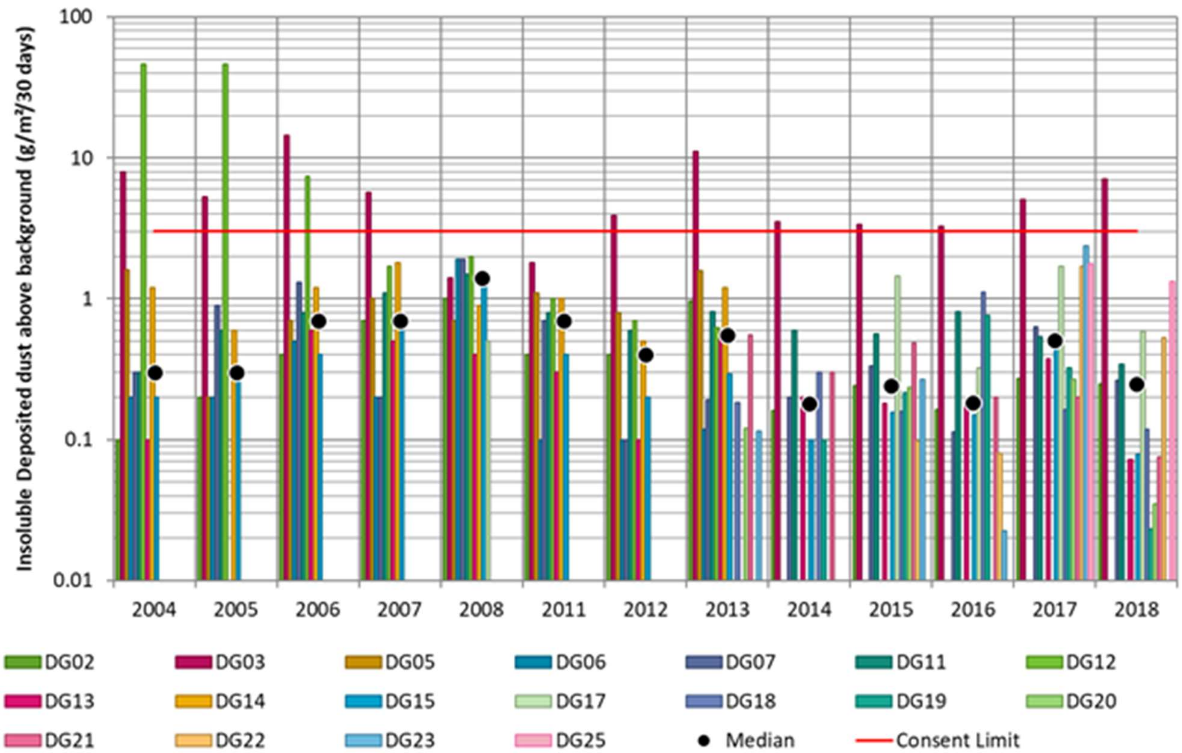

Figure 6-2 Annual summary of insoluble deposited dust above background 2004 – 2018 (by year) (note only Sites 2, 7, 15, 20, 21, and 25 are subject to the consent limit)

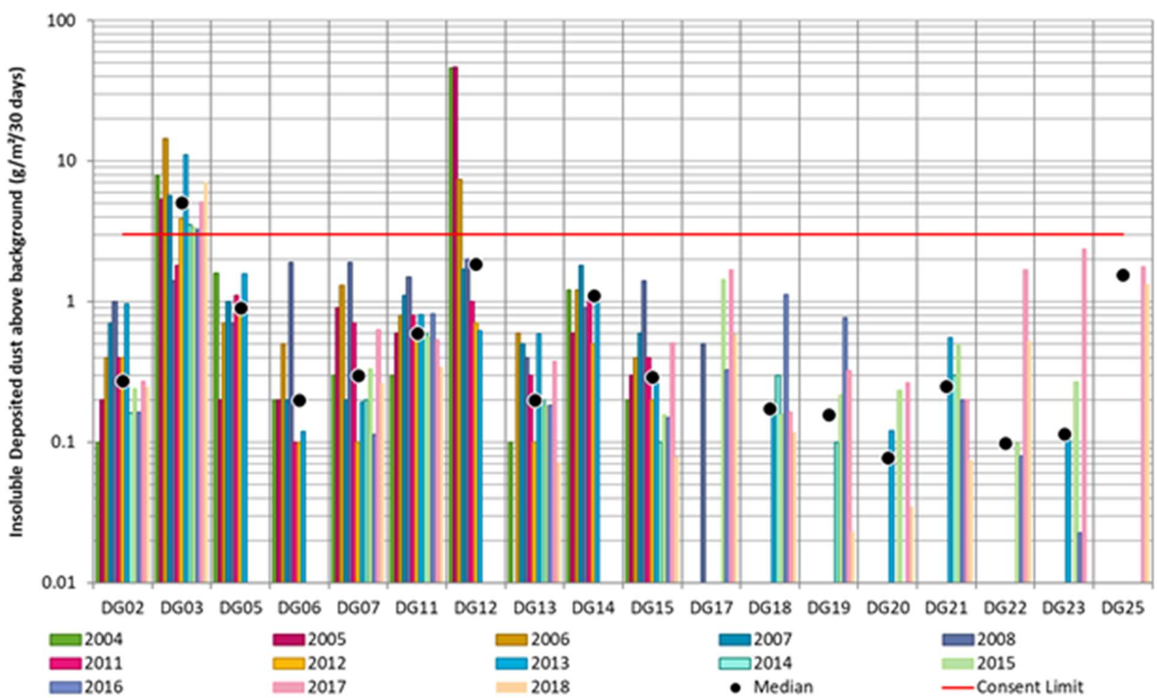

Figure 6-3 Summary of annual average insoluble deposited dust above background 2004 – 2018 (by station) (note only Sites 2, 7, 15, 20, 21, and 25 are subject to the consent limit)

6.4.3 Summary of current effects of deposited dust

For the majority of the time, during the twenty eight years of mining at the Macraes Gold Project, the deposited dust levels measured beyond the mine boundary have been within the consent limits. Dust levels measured within the mine boundary have also remained below 3 g/m^2/30 days for the majority of the time. There have been occasional recordings of high dust deposition levels at some sites, which have been attributed to specific reasons, such as extreme wind events and the proximity of busy, unpaved roads and agricultural activities as discussed in previous annual monitoring reports prepared for OceanaGold. Where problems have been identified, such as the dust events associated with the Mixed Tailing Impoundment (MTI) during 2006 and 2007, OGNZL has implemented additional dust control measures, which have reduced dust levels below the limit. Dust levels measured in proximity to Macraes Village have exceeded 3 g/m^2/30 days only 3 times between 2004 and 2016 (at Sites 2 and 15).

6.4.4 TSP

All five current consents for discharges to air from the mine require OGNZL to monitor TSP concentrations at Site 15 using a nephelometer, or another similar continuous monitoring instrument. The consents all impose an upper limit on concentrations measured at Site 15 of no more than 120 µg/m^3 (24-hour average) and require that dust mitigation methods are reviewed if concentrations exceed the threshold.

Figure 6-4 to Figure 6-6 show the 24-hour average TSP concentrations measured at Site 15 for 2016, 2017 and 2018, respectively.

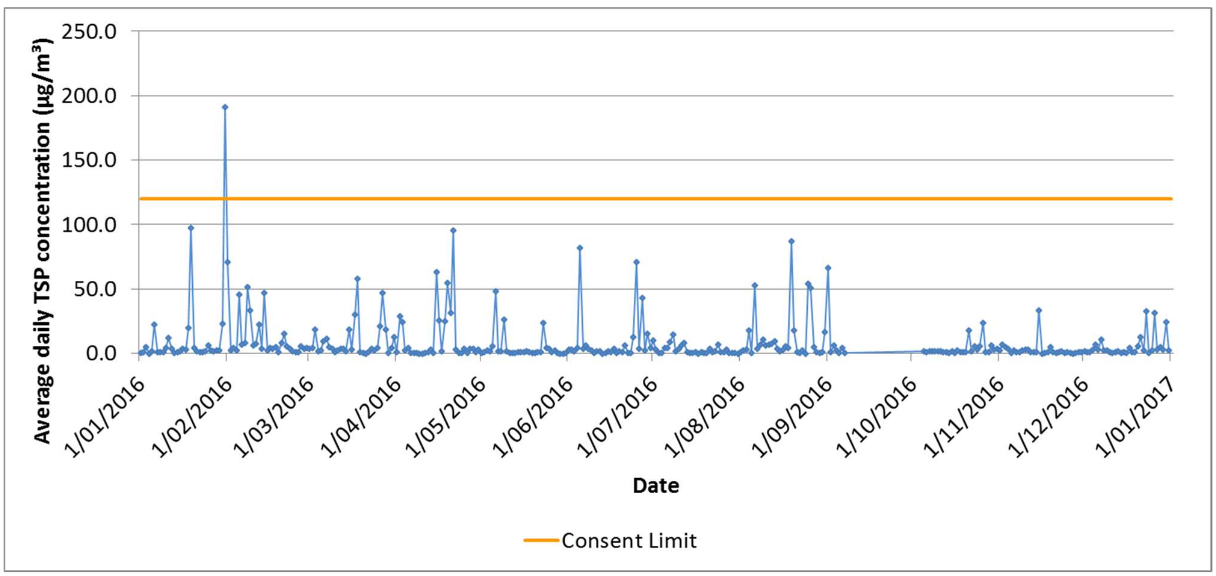

Figure 6-4 Site 15, 24 hour average ambient TSP concentrations for 2016

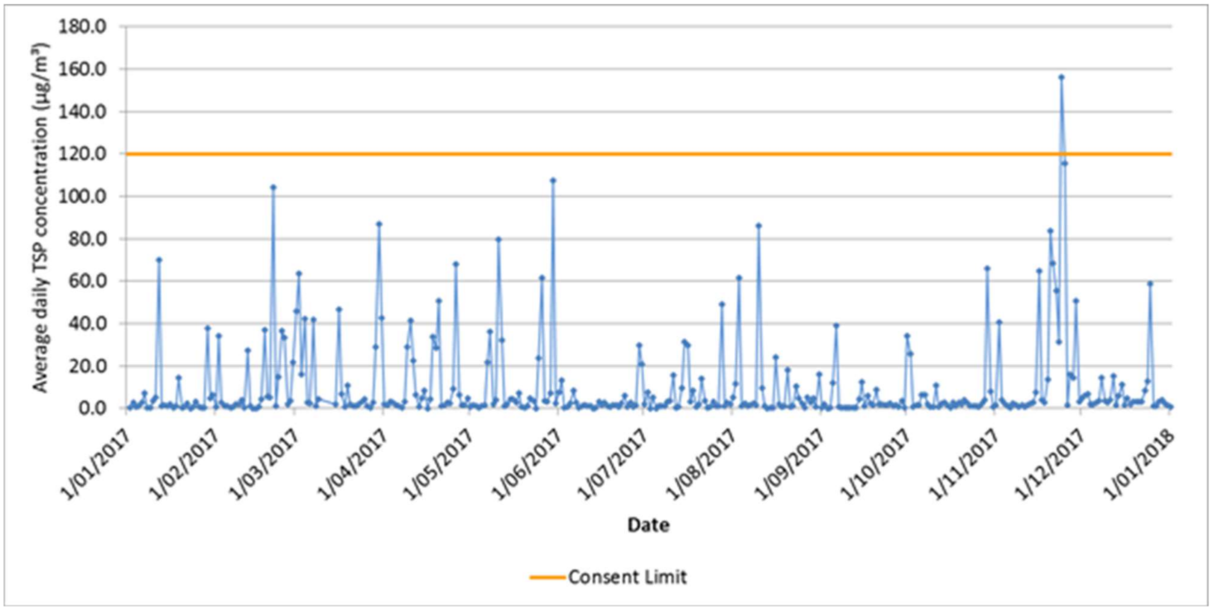

Figure 6-5 Site 15, 24 hour average ambient TSP concentrations for 2017

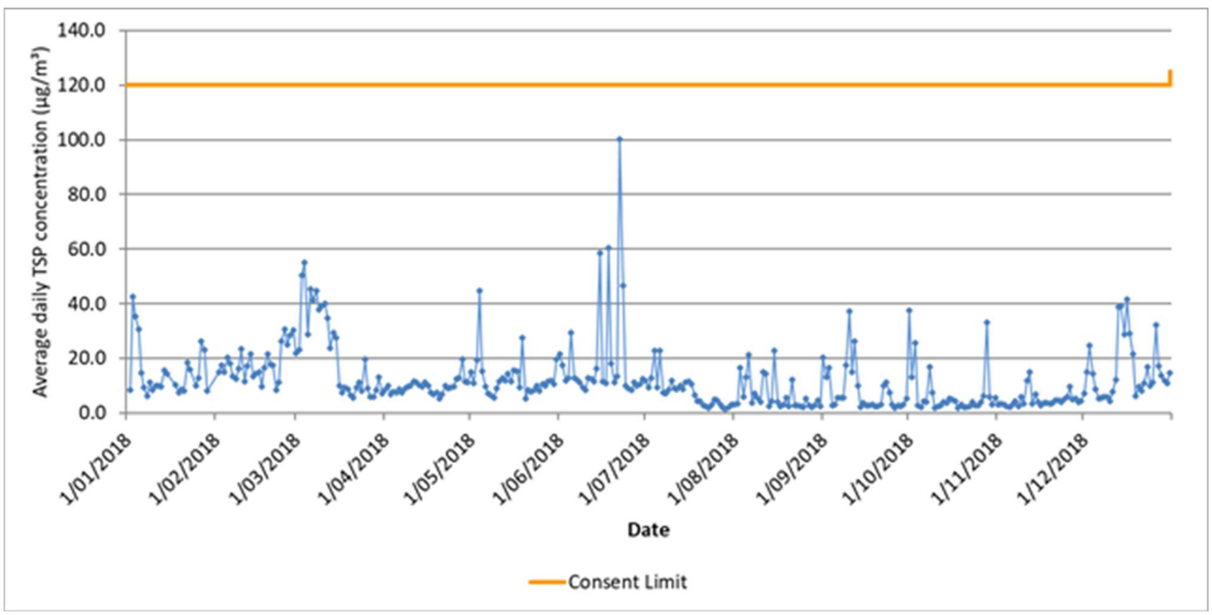

Figure 6-6 Site 15, 24 hour average ambient TSP concentrations for 2018

There was one exceedance of the TSP consent limit in 2016, which was most likely due to the instrument recording moisture as particulate or localised sources of dust and was unlikely to be related to mining activities[18]. In 2017 there were two exceedances of the TSP consent limit recorded on 23 November 2017, which were attributed to fog.[19].There were no exceedances of the TSP consent limit in 2018.

6.4.5 PM_{10}/$PM_{2.5}$ and respirable quartz monitoring

The fine PM_{10}/$PM_{2.5}$ fractions of particulate within the dust emissions from the mine have the potential to impact on human health. Respirable quartz contains silica which can cause the lung disease silicosis when people are exposed to high concentrations over extended periods of time. PM_{10}/$PM_{2.5}$ and respirable quartz concentrations were measured at Macraes Village by OGNZL during the summer months between 1998 and 2000. Monitoring was undertaken at the three TSP monitoring sites, plus an additional site located at Golden Point to the north of the Golden Point Pit. The monitoring was undertaken using two High Volume Samplers at each site, one fitted with a PM_{10} inlet and the other fitted with a $PM_{2.5}$ inlet. The particulate collected on the $PM_{2.5}$ filters was analysed for quartz concentrations. Samples were taken once a month at each site in November through to March. PM_{10}/$PM_{2.5}$ and respirable quartz concentrations were all well below the consent limits and national and regional guideline values. The ORC subsequently authorised that this monitoring could cease.

6.5 Complaint records

ORC and OGNZL both record complaints received from the public regarding dust discharges from the Macraes Gold Project site. The ORC has recorded five complaints since 2009, the majority of which related to dust coming from the Mixed Tailings Facility (MTI). OGNZL has recorded 15 complaints since 2006, the majority of which were also related to the MTI.

Only one dust related complaint has been received by ORC, or OGNZL, relating to the operation at the mine between 2014 and 2019. The complaint was received on 15 September 2018 and involved dust from the vicinity of Coronation coming down Camp Creek and affecting a residence on Horse Flat Road. The incident occurred on a relatively still cool day and it appeared that source of the dust was activities on the stockpiles. OGNZL found that the cause of the dust was a malfunctioning water truck which was repaired as soon as the fault was identified.

The record of complaints clearly demonstrates that the MTI has been the largest source of complaints regarding dust and those complaints often occur during high winds. Complaints tend to occur most frequently in the spring, summer and autumn months, which correspond to the windiest times of the year. The dust incidents were identified by OGNZL to occur primarily when no tailings were being deposited and the edges of the impoundment had dried out. OGNZL has instituted a dust control procedure specifically to control dust from the edges of the tailings impoundment during these conditions.

6.6 Summary of Current Effects from Existing Mining Activities

From the information presented above, the current effects of the existing mining activities can be summarised as follows:

- The operation of the Macraes Gold Project has resulted in deposited dust levels in the area increasing in comparison to background values. However, at the majority of locations, levels have not increased more than those permitted in the current resource consents. At locations close to where the majority of people

[18] Beca *"Macraes Mine – Summary of Ambient Air Monitoring Results for 2016"* prepared for OGNZL May 2017

[19] Beca "*Macraes Mine – Summary of Ambient Air Monitoring Results for 2017*" prepared by OGNZL April 2018

live in the area, such as in Macraes Village (Sites 2 and 15), deposited dust levels are consistently below the consent limit.
- TSP concentrations are generally below the consent limit, but on occasions relatively high concentrations have been recorded. However, the majority of these high concentrations have been found to be due to causes other than the mine and are most likely due to the instrument measuring moisture as particulate.
- PM_{10} and respirable quartz concentrations are low.
- The number of dust related complaints reported to the ORC is low and were related mainly to dust from the MTI. Only one complaint has been received since 2014.

Taking all of these factors into account, it is considered that the discharges to air from the existing Macraes Gold and Coronation Projects result in effects on the environment that are no more than minor.

7 Potential Effects on the Environment from Proposed Development

7.1 Potential Effects of Discharges to Air from Deepdell North Stage III Project

7.1.1 Potential range of dust deposition effects

In addition to consideration of dust sources and factors that may influence dust generation, an assessment of effects of dust should consider the distance that any dust may travel from the sources.

In general, although mining activities can generate dust from a wide range of particle sizes, those dust emissions are comprised mostly of larger particles. In general, the larger the size of a particle, the less distance it is likely to travel.

As a general rule, based on the results of research into dust entrainment, dust deposition is unlikely to occur to any significant degree beyond an approximate distance of 100 - 200 m from a significant dust source in most circumstances. Dust nuisance is more likely to occur where sensitive receptors are located within such proximity of a significant dust source.

Local environmental conditions may influence the potential range of dust deposition. High average wind speeds, a high frequency of strong winds or complex local topography may increase the potential range over which dust deposition may occur.

At Macraes Flat, the average wind speed is relatively high, the terrain is complex and local environmental factors would therefore tend to increase the range of dust deposition due to mining activities.

Operational factors will also influence the likely range of dust deposition. Discharges from elevated sources (such as from the surfaces of elevated WRSs), will be able to travel proportionally further before reaching ground level. A larger scale of dust-generating activities and associated emissions will also increase the potential for dust deposition to occur at greater distances.

Hence, for an area such as Macraes Flat, which is subject to high wind speeds, with large scale open cast mining activities and elevated dust sources, it is expected that areas within approximately 1-2 km of mining activities may be potentially affected by dust under worst-case weather conditions, if appropriate mitigation measures are not implemented.

7.1.2 Potential effects of emissions from construction of the Deepdell North Stage III Pit, Deepdell WRS and Deepdell South Backfill

The proposed Deepdell project will be located to the southeast of the existing Coronation Pit, approximately 1.5 km to the northeast of the Howard residence and 4.8 km northeast of the Vanderley residence. These residences will be downwind from the proposed development during northeast winds. Winds from this direction occur approximately 12% of the time with wind speeds from the northeast that can entrain dust (greater than 5 m/s) occurring for 0.8% of all hours. Due to the large distance from the mine, the nature of the topography between the mine and the houses and the low percent of wind speeds that are able to blow dust towards the Howard and Vanderley residences, it is unlikely that these residences will be adversely affected by dust arising from the construction and operation of the Deepdell North Stage III project.

The proposed project is located approximately 3.6 km to the north of the O'Connell residence. Winds blowing towards the O'Connell residence from the project area occur approximately 12% of the time, with high wind speeds from the north occurring approximately 0.3% of the time. Due to the large distance from the mine and the low percentage of wind speeds that are able to blow dust towards the O'Connell residence, it is considered unlikely that the O'Connell residence will be adversely affected by dust arising from the construction of the Deepdell North Stage III project.

The predominant westerly quarter winds will blow dust generated from the Deepdell North Stage III project towards rural farmland which is leased by OGNZL to B. O'Connell (approximately 150 m to the east of the pit) and R. O'Connell (approximately 750 m to the south east of the pit). If dust is not controlled, there is a potential for this farmland in close proximity to the Deepdell WRS to be affected by dust. The potential effects of dust on vegetation are discussed in Section 7.1.5.

The sides of the Deepdell East WRS will be progressively re-vegetated as it is constructed during the life of the mine. This should minimise the discharge of dust from the WRS.

7.1.3 Potential effects of emissions from the haul road

The existing haul road will be located approximately 1.1 km to the northeast of the Howard residence. As the frequency of winds blowing towards the Howard residence, with a wind speed of over 5 m/s, is approximately 0.8% and the residence is located well beyond the distance that dust would be expected to travel from the haul road, nuisance effects are not expected. OGNZL proposes to continue to use the standard mitigation methods for dust suppression on the haul road such as keeping the road surface damp and limiting vehicle speeds (see Section 5.3.3)

7.1.4 Potential effects of emissions from blasting

Immediately after blasting, there will be discharge of combustion contaminants and dust from the fractured rock. These emissions will dissipate quickly and are unlikely to have any measurable effect on air quality beyond the boundary of the site.

7.1.5 Potential effects on vegetation and farm animals

High levels of dust deposition have the potential to adversely affect vegetation by interfering with plant photosynthesis, promoting weed or disease incidence and impacting on the application of pesticides or fertilisers. In addition to potentially impacting on vegetation, dust may also affect agricultural activity through the promotion of disease or health problems in stock animals.

The proposed Deepdell North Stage III mine area will be bounded by the properties leased by the Peddies, Howards and O'Connells. The activities associated with the project will be the same nature and scale as the activities carried out in the existing Coronation Project area. OGNZL owns and farms all of the land surrounding the existing Macraes Gold Project and has not experienced any adverse effects on vegetation or animal health on this land. OGNZL is also not aware of any problems being experienced by the neighbouring farmers regarding effects on vegetation.

7.1.6 Potential public health effects

Fine fractions of dust emitted from mining activities, such as PM_{10} and $PM_{2.5}$, have the potential to cause adverse respiratory health effects downwind of the mine. As described in Section 6, dust discharges from earthworks and mining activities are typically comprised of a high proportion of coarse particle sizes. Such particles generally have minimal impact on respiratory health, as particles have only limited penetration into the human respiratory tract.

The major sources of fine particulates at the mine are from vehicle exhausts. The monitoring undertaken by OGNZL of PM_{10} and $PM_{2.5}$ concentrations demonstrated that concentrations in the vicinity of the Macraes Gold Project mining operation were low and below national standard and regional guideline values. The emissions from vehicles will occur from locations spread over a large area and will be widely dispersed before they reach the boundary of the site. Beyond the boundary, these emissions will be dispersed further before the contaminants reach sensitive locations, namely residences downwind of the mine. It is expected that the concentrations of fine particulate in the vicinity of the Deepdell North Stage III project will not change significantly and no adverse effects on public health should result.

7.2 Potential Cumulative Dust Effects

There is potential for the discharges of dust from the Deepdell North Stage III project to combine with the discharges to air from the existing Coronation North Project, Coronation Project and Macraes Gold Project mining activity to create cumulative effects. During north-westerly quarter winds, the plumes from the Macraes Gold project and the Deepdell North Stage III project mining areas may combine. However, the two mining areas are approximately 1 km apart and the dust plumes are not expected to combine to any substantial degree. During southeast winds, the plumes from the Coronation North, Coronation project and the Deepdell North Stage III project mining areas may combine. However, the mining areas are approximately 1 km apart and the dust plumes are also not expected to combine to any substantial degree.

During the predominant westerly quarter winds, the dust from the mining areas will not combine at all. Hence, there are not expected to be any significant cumulative effects resulting from the proposed and existing mining activities.

OGNZL proposes to continue to use the dust control methods that have been successfully used to date at the mine. Providing these measures are diligently carried out, any increases in the discharges from the mine should be minimised and adequately mitigated.

7.3 Summary of Potential Effects

The quantity and frequency of dust discharges from mining activities are related to a number of factors, such as the amount of material that is moved and processed, the area of open ground, the dust control measures employed and local weather conditions. The scale of the dust emissions will also have a strong bearing on the potential for dust effects. In comparison to the existing mining activity at the Macraes Gold Project, activity at the Deepdell North Stage III project will be of relatively small scale and will be completed in a period of two years.

The nature of the activities that will take place during the Deepdell North Stage III Project will be the same as the activities currently taking place at the Coronation, Coronation North and Macraes Gold projects. The nature of the effects will also be similar.

The results of site monitoring and audits, as well as the very low number of recent complaints, demonstrate that measured dust levels resulting from existing mining activities are within the limits set by the current resource consents and the existing effects of the mine are no more than minor. OGNZL intends to continue to use the dust mitigation techniques that have been used successfully to date at the Coronation and Macraes Gold projects. Given the scale of the proposed additional mining activities associated with the Deepdell North Stage III project, relative to the scale of existing activities, any increase in the nature and scale of effects of dust emissions from the extension of the current activities is expected to be minimal.

It is considered that, provided particular care continues to be taken with the construction of the new mine components, the discharge of dust from the proposed Deepdell North Stage III project will be adequately mitigated and any adverse effects downwind of the site are expected to be less than minor.

8 Monitoring

The current ambient air monitoring programme for the Coronation, Coronation North and Macraes projects includes three sites that are also in the vicinity of the proposed Deepdell North Stage III project, one of which (Site 24) is a background site. Site 7 is located to the southwest of the proposed project and Site 17 is located to the northwest. No other additional monitoring sites are considered necessary.

9 Statutory Matters

9.1 Resource Management Act 1991

The Resource Management Act 1991 (RMA) provides the framework for all resources used in New Zealand. The overriding purpose of the RMA is *"to promote the sustainable management of natural and physical resources"* (s.5, RMA). The broader principles (s.6 to s.8) are a guide to considerations of any resource consent, development or protection.

An activity can be authorised by a rule, either in the Regional or District Plan, or through a resource consent. Part 3 of the RMA has the following section that is considered relevant to the activities sought in this application:

Section 15 – Discharges

Section 15(1)(c) of the RMA states that:

> *"No person may discharge any –*
>
> *(b) Contaminant from any industrial or trade premises into air;*
>
> ……………………………….
>
> > *Unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan as well as a rule in a proposed regional plan for the same region (if there is one), or a resource consent.*

The proposed project works will involve discharges of contaminants to air (dust); therefore, the discharge of contaminants into air needs to be expressly allowed by a rule in a regional plan and any relevant proposed plan or resource consent.

The relevant regional plan rules are discussed in Section 9.2.3.

9.2 Relevant Planning Instruments

9.2.1 Otago Regional Policy Statement

The Regional Policy Statement for Otago (RPS) provides an overview of resource management issues in the region and directs how the resources of Otago are to be managed. The policy statement is an umbrella document that provides the framework for the Regional Plans.

The primary objectives of the RPS, with regards to air quality, are to promote the protection of high ambient air quality, the enhancement of degraded air quality and the maintenance of good air quality by avoiding, remedying or mitigating the adverse effects of the discharge of contaminants to air.

Otago's air quality is generally very good, with poor air quality usually only experienced in towns with specific topographic and climatic constraints. Whilst the proposed activity will not result in any improvements in ambient air quality, it is expected that the discharges from the proposed activity will not have a significant adverse effect on the local air quality, or the overall air quality within Air Zone 3, in regard to NES and Air Plan requirements.

In summary, the proposed Deepdell North Stage III project is considered to be consistent with the provisions of the RPS.

9.2.2 Proposed Regional Policy Statement (pRPS)

on 1 October 2016 which are subject to a number of appeals which are yet to be resolved. A version of the pRPS with changes as a result of appeals was released on 17 May 2019 and is partially operative. The policies and objectives included in the pRPS need to be taken into consideration for decision making but, at this stage, should be given less weight compared to the operative RPS where they are still subject to appeals. Where provisions are not subject to remaining appeals and the equivalent provisions in the Operative RPS has been revoked, those pRPS provisions should be considered to be operative and given full weight.

The objectives of the pRPS that are relevant to this application include Objective 2.1 which promotes recognising, maintaining and enhancing Otago's natural and physical resources including air quality. Policy 2.1.4 aims to maintain good ambient air quality that supports human health or enhance air quality where it has been degraded, protect Kai Tahu values and maintain other cultural, aesthetic and amenity values. Policy 2.3.5 applies an integrated management approach to activities that affect air quality by co-ordinating the management of land use and air quality in order to maintain or enhance air quality values and reduce the potential for adverse health and nuisance effects.

The effects of the existing Macraes, Coronation and Coronation North mining projects have been demonstrated to have no more than minor effects on ambient air quality. The proposed Deepdell North Stage III project will have no additional significant adverse effects on the environment, human health or amenity values and is therefore considered to be consistent with the policies and objectives of the pRPS.

9.2.3 Regional Plan: Air for Otago

Objectives and Policies

The relevant objectives and policies of the Air Plan (Operative in 2003, and including amendments 2006 & 2009), are discussed in the following section.

The proposal is considered consistent with the following objectives:

Objective 6.1.1 – To maintain ambient air quality in parts of Otago that have high air quality and enhance ambient air quality in places where it has been degraded

Objective 6.1.2 –To avoid adverse localised effects of contaminant discharges into air on:

- Human health;
- Cultural, heritage and amenity values;
- Ecosystems and the plants and animals within them; and
- The life-supporting capacity of air.

Objective 6.1.3 – To allow for sustainable use of Otago's air resource.

Section 7 of this report discusses the effects of the proposed activities on the environment. The conclusions from this assessment are that adverse effects on the local environment including health effects, amenity values and ecosystems, that are more than minor, are not expected. The proposal will not enhance ambient air quality, but neither is it expected to result in any significant degradation of air quality.

Policy 7.1.1 – To recognise and provide for the relationship Kai Tahu have with the air resource through procedures that enable Kai Tahu to participate in management of the air resources.

The Deepdell North Stage III project is not expected to result in any significant adverse effects that will impact on the air resource. The proposal should not result in adverse effects on the relationship that Kai Tahu, as Kaitiaki, has with the air resource or affect the ability of Kai Tahu to participate in the management of the air resource.

Policy 8.1.1 – To have regard to the Otago Goal Levels identified in Schedule 1 and comply with the Resource Management (National Environmental Standard Relating to Certain Air Pollutants, Dioxins and Other Toxics) regulations 2004 in managing the regions ambient air resource.

Monitoring of PM_{10} in the vicinity of the current Macraes Gold Project mining activity has found that concentrations are well below the NES and Otago Goal Levels. The Deepdell North Stage III project is not expected to result in any significant increase in local concentrations of PM_{10}.

Policy 8.2.3 – In the consideration of any application to discharge contaminants into air, Council will have;

a) Particular regard to avoiding adverse effects including cumulative effects on:

i. Values of significance to Kai Tahu

ii. The health and functioning of ecosystems, plants and animals

iii. Cultural, heritage and amenity values

iv. Human health

v. Ambient air quality of any airshed; and

b) Regard to any existing discharge from the site, into air, and its effects

The effects of the current Macraes, Coronation and Coronation North projects, and the potential effects of the proposed Deepdell North Stage III project, have been discussed in Sections 6 and 7. The actual, potential and cumulative effects of the proposal on human health, ecosystems, amenity values and cultural and heritage values are considered to be less than minor.

Policy 8.2.8 – To avoid discharges to air being noxious, dangerous, offensive or objectionable on the surrounding local environment.

The proposed Deepdell North Stage III mining operation will be very similar in scale and nature to the current Coronation North project's operations and will generate the same discharges. OGNZL proposes to continue to use the dust mitigation methods that are being used successfully at present. The effects of the proposed operation are also expected to be very similar to the effects of the current Coronation North project. The current operation has not caused any effects to date that have been considered to be noxious, dangerous, offensive or objectionable. It is therefore expected that the discharges from the proposed Deepdell North Stage III project will not result in discharges that are noxious, dangerous, offensive or objectionable.

Policy 10.1.1 – The Otago Regional Council will encourage:

a) People undertaking land use activities to adopt management practices to avoid, remedy or mitigate any adverse effects of dust beyond the boundary of the property; and

b) *City and District councils to use land use planning mechanisms and other land management techniques to manage land use activities which have the potential to result in dust beyond the boundary of the property.*

OGNZL plans to continue to use the dust mitigation methods that it currently employs and which have been demonstrated to be effective.

Overall, the discharges to air from the proposed expansion of mining activities are considered to be consistent with the policies and objectives of the Air Plan.

Rules

Rule 16.3.5.3 – Discharges from mineral extraction and processing – permitted activity

The discharge of contaminants into air from:

1) *The extraction of minerals from the surface or from an open pit at a rate less than 20,000 cubic metres per month and 100,000 cubic metres per year; or*

2) *The crushing and screening of minerals at a rate less than 200 tonnes an hour; or*

3) *The drying or heating of minerals from single activities or a combination of activities on one site with equipment that has a heat generation capacity of less than 500 kW; or*

4) *The making of refractory, bricks or ceramic products at a rate less than 200 kg/hr of products;*

is a ***permitted activity****, providing:*

a) *The mineral extraction, crushing and screening activities are located in Air Zone 3; and*

b) *In the case of equipment installed after 28 February 1998, any chimney complies with Schedule 6 ("Determination of Chimney Heights"); and*

c) *Any discharge of smoke, odour or particulate matter is not noxious, dangerous, offensive or objectionable at or beyond the boundary of the property.*

The Deepdell North Stage III project will exceed the processing rates included in Rule 16.3.5.3. Hence, Rule 16.3.5.9 applies.

Rule 16.3.5.9 – Other discharges from industrial or trade processes – discretionary activity

Except as provided for by Rules 16.3.5.1 to 16.3.5.8 and 16.3.6.1, 16.3.6.2, 16.3.7.1, 16.3.9.2, 16.3.10.2, 16.3.11.1, 16.3.13.1 and 16.3.13.2, or prohibited by Rule 16.3.3.1, the discharge of contaminants into air from industrial or trade processes is a ***discretionary activity****.*

Rule 16.3.15.5 – Discharges of PM_{10} after 31 August 2013 – discretionary activity.

Except as provided for by the permitted activity rules in this Plan or prohibited by Rules 16.3.1.1, 16.3.3.1, 16.3.12.1 and 16.3.15.1, the discharge of PM_{10} to air in an airshed after 31 August 2013,

is a ***discretionary activity****, providing:*

a) *The concentration of PM_{10} in the airshed does not breach its ambient air quality standard; or*

b) *The granting of the resource consent is not likely, at any time, to cause the concentration of PM_{10} in an airshed to breach its ambient air quality standard.*

The concentration of PM_{10} in Airshed 3 does not breach the ambient air quality standard and the granting of consent to the Deepdell North Stage III project is not expected to result in the airshed exceeding the ambient air quality standard for PM_{10}.

Overall, the discharge to air from the proposed expansion of mining activities is a ***discretionary activity***.

10 Alternatives

Section 105 of the RMA requires that an assessment of environmental effects include a description of any alternative methods of discharge, including discharge into any other receiving environment. There are no alternative locations for the mining operation as it is dependent on the location of the gold resource. There are also no practical alternative methods of discharge as OGNZL is proposing to use all of the relevant best practice techniques to control dust from the proposed Deepdell North Stage III project.

OGNZL investigated three alternative locations for the proposed Deepdell East WRS, which are illustrated in Figure 10-1. Option B is OGNZL's preferred location and is the location which has been assessed in this report.

Option A is located approximately 1200 m from the closest house (the Howard residence), and approximately 300 m closer to a sensitive location than Option B. The location of Option A is, however, still well beyond the distance that dust is expected to travel and cause an adverse effect. Therefore, the potential air quality effects associated with Option A are considered to be no greater than for the preferred option.

Option C is located further from sensitive locations than Option B and therefore any adverse effects resulting from the discharge of dust from a WRS located at this location are expected to be no more or less than the potential effects resulting from Option B.

OGNZL also investigated a fourth option (Option D) immediately adjacent to the north east of the pit (briefly described in the project description issued for the project), however this was dismissed at an early stage due to visual impacts and inability to blend with surrounding landscape features. Any adverse effects resulting from the discharge of dust from this option would be expected to be no more or less than the potential effects resulting from Option B.

Overall it is considered that the four alternative locations for the proposed Deepdell East WRS will have minimal impact on the scale of the potential effects of air discharges from the proposed project.

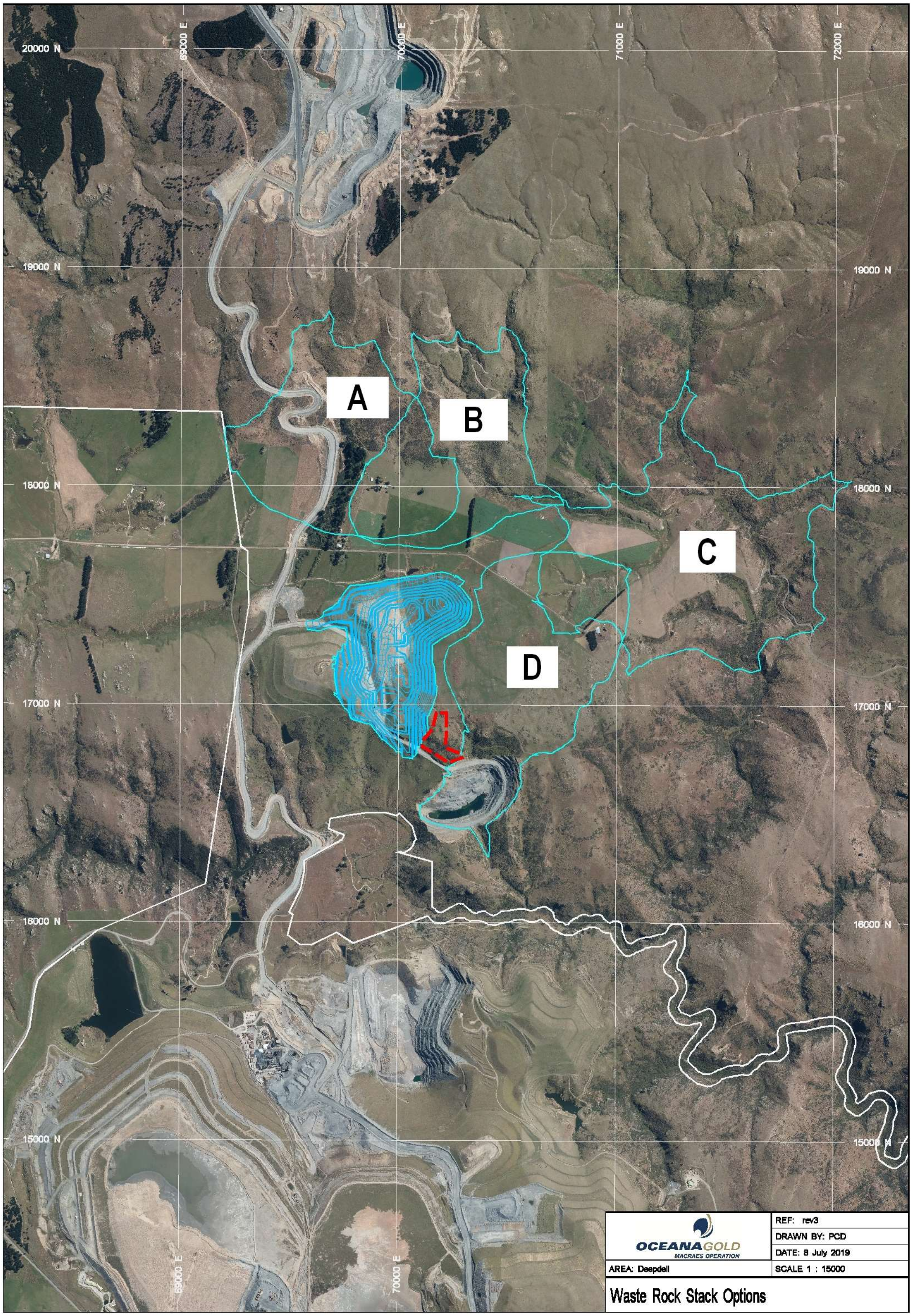

Figure 10-1 Alternative locations for the proposed Deepdell East WRS (source OGNZL)

11 Proposed Conditions of Resource Consent

OGNZL proposes that the conditions of consent for the Deepdell North Stage III project are essentially the same as the conditions included in Consent RM16.138.19 granted for the Coronation North project, with only minor alterations to change specific references to the location.

A copy of Consent RM16.138.19 is attached in **Appendix C**. No changes to the monitoring conditions and performance standards are considered to be necessary.

12 Conclusion

OGNZL proposes to develop a new mine pit, associated WRS and backfill to be known as the Deepdell North Stage III project in the area of the existing Macraes Gold Project mine. The location of the new Deepdell North Stage III project, WRS and backfill will be located between the Macraes Pit and Coronation Pit, approximately 1.5 km from the nearest privately-owned residences and 7 km from Macraes Village.

The nature of the proposed activities will be the same as the activities currently undertaken at other parts of the Macraes Gold and Coronation Projects. The scale of the proposed activities will be similar to the Coronation North Project and small in comparison to the scale of the Macraes Gold Project operation. Consequently, the effects of the operation are expected to be very similar to the effects of the Coronation North Project and proportionally smaller than the effects of the Macraes Gold Project operation, providing standard dust mitigation techniques are carried out, as proposed, by OGNZL.

Overall, it is considered that the emissions to air from the Deepdell North Stage III Project will result in a minimal level of effects in addition to those of the emissions from the currently-consented activities at the mine. OGNZL intends to continue to operate within and comply with the current consent limits.

It is therefore considered that, providing the proposed mitigation methods are diligently carried out, any adverse effects of discharges of dust from the proposed Deepdell North Stage III Project should be adequately avoided, remedied or mitigated. The effects of the discharges of dust on the environment should be no more than minor.

Appendix A

Dust Management Plan

Macraes Operation

Dust Management Plan

May 2019

Table of Contents

Revision History

Date	Revision No.	Issued for	By
04Mar11	A	Initial Draft	Debbie Clarke
18Mar11	B	Amendments to Draft A	Jenny Autridge
01May13	C	Plan Review	Patrick Windsor
09Jul14	D	General Review and Update to include Coronation	Debbie Clarke
04Aug15	E	Plan Review	Debbie Clarke
10Aug16	F	Plan Review	Lauren Arnold
23Jan17	G	Review and update to include Coronation North	Lauren Arnold
14 May 19	H	Review and update to include Frasers West	Gavin Lee

1 BACKGROUND

1.1 Air Discharge Consents

This Dust Management Plan (DMP) covers the area of the original mining operation at Macraes (up until May 2012), the Macraes Phase III mine expansion area, the Coronation Project area and the Coronation North Project area. The plan has been prepared to fulfil the requirement for a DMP which is a resource consent condition in four air discharge consents held by Oceana Gold (New Zealand) Limited (OceanaGold). A fifth air discharge consent is held for the ventilation of the Frasers Underground mine. Details of the consents are summarised in Table 1.1.

Table 1.1: Air Discharge Consents held by OceanaGold

Consent Number	Details
Discharge Permit 96785_V5	To discharge contaminants from mining operations and post mining rehabilitation to air in the vicinity of Macraes Flat. (all the mine site except features associated with Macraes Phase III and Coronation).
Discharge Permit 2006.689	To discharge contaminants to air for the purpose of ventilating Frasers Underground Mine.
Discharge Permit RM10.351.52	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations (Macraes Phase III expansion).
Discharge Permit RM12.378.15	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations (Coronation Waste Rock Stack, Coronation Pit and associated haul roads, utility areas and stockpiles).
Discharge Permit RM16.138.19	To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations.

Discharge Permit 96785_V5, RM10.351.52, RM12.378.15 and RM16.138.19 include conditions requiring a DMP. Relevant conditions are reproduced below.

“Prior to the exercise of this consent, the consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:

(a) A description of potential dust sources and the factors influencing dust generation;

(b) Dust mitigation measures and procedures including, but not limited to:

i) Minimising the areas of disturbed ground;

ii) Watering, with water trucks and fixed sprinklers;

iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;

iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;

v) Ensuring materials being moved are kept in a coarse state;

vi) Covering materials; and

vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.

(c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;

(d) Procedures for managing and addressing air quality or odour related complaints; and

(e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Condition 18 of this consent."

"The consent holder shall review the Dust Management Plan annually taking into account the following:

(a) The outcomes of reviews completed in accordance with Condition 10 and 18 of this consent; and

(b) Whether management practices are resulting in compliance with the conditions of this consent.

Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring."

1.2 Purpose

The purpose of this DMP is:

To facilitate the avoidance, remediation and mitigation of any adverse effects of dust discharges generated from mining activities and to promote proactive solutions to the control of dust discharges from the site.

The DMP includes information on the following:

- The sources of dust at Macraes Gold Project;
- Dust mitigation and prevention measures;
- Monitoring methods;
- Mechanisms for remediation of adverse effects (should this be required);
- Methods for managing complaints regarding dust and keeping records related to compliance; and
- Key responsibilities, consultation and reporting.

The DMP is intended to be a working document and is to be reviewed annually. Any updates made to the DMP must be forwarded to the Otago Regional Council within one month of the update occurring.

1.3 Objectives

The objectives of this management plan are:

- To describe current and proposed dust management methods and procedures;
- To enable OceanaGold to operate in full compliance with resource consent requirements; and
- To describe the dust monitoring regime and reporting of results.

2 SITE OVERVIEW

2.1 Description of Mine Areas

The key features of the Macraes Gold Project up until August 2012 are:

- The Deepdell South, Golden Point, Round Hill, Innes Mills, Frasers, Golden Bar, Coronation, Coronation North and Frasers West Open Pits;
- Pit Backfilling in Deepdell North, Coronation, Coronation North and Frasers Pit;
- The Mixed Tailings, Southern Pit 11 and Top Tipperary tailings storage facilities;

  The Deepdell, Northern Gully, Western, Back Road, Frasers West, Frasers East, Golden Bar, Coronation, Coronation North and TrimbellsWaste Rock Stacks;
- A processing plant;
- Various offices, workshops and ancillary buildings;
- The Lone Pine Fresh Water Reservoir; and
- All Haul road, light vehicle access roads, assorted silt ponds, topsoil stockpiles, oxide stockpiles and low grade stockpiles.
- Works associated with road realignments of Macraes Dunback Road and Golden Bar Road.
- Construction of dams in Camp Creek and Coal Creek.

2.2 Description of Site and Local Environment

Macraes Landscape sits within a rural upland landscape of fluvially dissected rolling hills of moderate relief and with characteristic broad ridge crests; being the coastal extent of Central Otago' s basin and range topography.
Prominent regional landscape features include the Nenthorn Valley, Taieri Ridge, Taieri Valley and the Rock and Pillar Range, which lie to the south1 and west, the Shag Valley and Horse Range to the east and the coastal hills and extinct volcanic cones of Palmerston and Waikouaiti to the south.

Pastoral farming is the broad land use in the area, followed by gold mining; the latter has a history in the area that goes back to the nineteenth century. Macraes is on the eastern edge of the schist country and the broader historic goldfields of Central Otago. The presence of the relatively large scale Macraes Gold Operation is a noticeable and culturally interesting element in the current landscape. The Macraes Gold Operation is the modern 'face' of open pit gold mining and its presence and effect relative to landscape change is now a major feature contributing to the local landscape character.

The long term, focal and cultural landscape feature of Macraes Flat is the Macraes village with its hotel, school, churches, cemeteries and small clusters of houses and various outbuildings and shelterbelts. The village sits in splendid isolation within 'the flat' and various local roads lead to even more isolated farms and homesteads. Scattered and isolated habitation is a feature of the open, rolling, landscape on the edge of basin and range topography that expands through to the upper Taieri and the Maniototo.

[1] As noted at Footnote 1, the orientation of the geographic features in the broader landscape are given relative to 'Macraes North'

2.2.1 Macraes Gold Project

Macraes Gold Project has been operational since 1990.The existing mining area extends to the north and south of Macraes-Dunback Road. Initially the mining operations were all to the north of Macraes-Dunback Road and include the Golden Point and Round Hill Pit, and the now backfilled Southern Pit. The Deepdell complex of pits (north and south) lie to the across Deepdell Creek. Since 2000, mining has been developed to the south of the road into Frasers Pit and Golden Bar Pit. Mining has been completed at Golden Bar, whilst mining further mining development in Frasers is planned at Frasers West, Frasers Slip and the Innes Mills Pit backfill.

Waste rock is stored around the Frasers Pit in the Frasers South, Frasers West and Frasers East Waste Rock Stacks as shown in Figure 2.1. A consented but yet to be used area to the north of Frasers Pit – Fraser North Waste Rock Stack is also indicated in Figure 2.1. Waste rock stacks are also located in Northern Gully Waste Rock Stack and to the south at the Backroad Waste Rock Stack, to the east and north east of the Round Hill/Golden Point Pit.

Deepdell North Pit is currently backfilled with Waste Rock, whilst Deepdell South Pit remains a pit lake. Plans are currently being developed to backfill this lake with a cutback in the Deepdell North Pit backfill.

The Coronation and Coronation North projects commenced in 2015 and 2017 respectively and are located on the Taieri Ridge. Mining consists of the Coronation and Coronation North Pits and associated waste rocks stacks. Coronation and Coronation North are linked to the Process Plant via a haul road and a culvert crossing across Deepdell Creek. They are located on the, in the headwaters of; Camp Creek (Shag River catchment),

The Top Tipperary Tailings Storage Facility is located to the east of the present mining activity and is the current operational facility for deposition of tailings. The Mixed Tailings Impoundment and the Southern Pit 11 tailings storage are currently in the process of being rehabilitated, whilst also providing some water storage.

The processing plant is central located on the south side of Deepdell Creek and below the Southern Pit and Mixed Tailings facilities.

The Deepdell Pits, Round Hill/Golden Point Pit, the associated waste rock stacks, the Southern Pit 11 and Mixed Tailings Storage Facilities and sections of Coronation Pit and Waste Rock Stack lie in the Deepdell Creek Catchment. Whilst the Frasers Pit and associated rock stacks lie predominantly in the North Branch of the Waikouaiti River catchment. The Top Tipperary Waste Rock Stack and a small portion of Frasers East Waste Rock Stack lies in the Tipperary Creek Catchment. Coronation North Pit and Waste Rock Stack and sections of Coronation Pit and Waste Rock Stack lie in the Maori Hen Creek and Trimbells Gully Creek (tributaries of the Mare Burn in the Taieri River catchment).

The mine site occupies an area of approximately 1500 hectares.

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Figure 2-1 Macraes Gold Project Mine Elements

2.2.2 Local Environment

The land in the vicinity of the Macraes Mine is rural and is of a similar character to the land surrounding the existing mine. The topography of the area is dominated by the large waste rock stacks and mine pits. Rehabilitated waste rock stacks have been shaped so that their profile, contours, skylines and transitions blend with the surrounding natural landforms. The land to be mined is all owned by OceanaGold with the exception of the Camp Creek Reservoir site.

Figure 2.2 shows the areas of land in the vicinity of the mine which are owned by OceanaGold, including areas of land leased and the boundaries of land owned by neighbours. The map also shows the locations of the existing and proposed mine activities and demonstrates the distances from the mining activities to the boundaries with neighbouring properties.

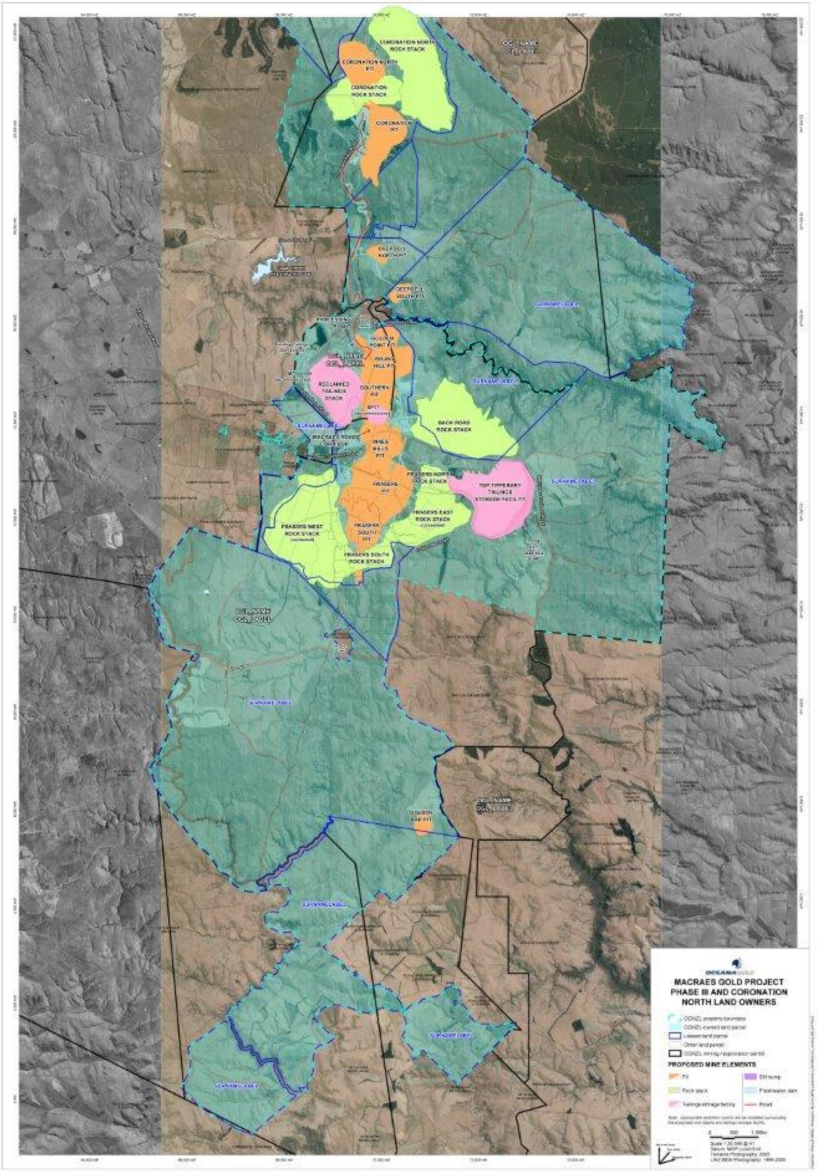


Figure 2-2: Land Owned and Leased by OceanaGold and Locations of Neighbouring Landowners

2.2.3 Site Weather Conditions

The main features of the Macraes Flat climate are the relatively low rainfall (site average annual rainfall is 634mm) and the moderately strong average wind speed of 5.5m/s[2]. Both of these features can contribute to the generation and transport of dust. OceanaGold measures wind speed and wind direction at a climate station located on Golden Point Road and at a second site adjacent to dust monitoring site 15 near the Macraes Village. A typical windrose for the years 2000-2006 is shown in Figure 2.4. Winds tend to blow predominantly from the south and west. The strongest winds also come from these quarters. Winds from the northerly and easterly quarters tend to be lighter and less frequent.

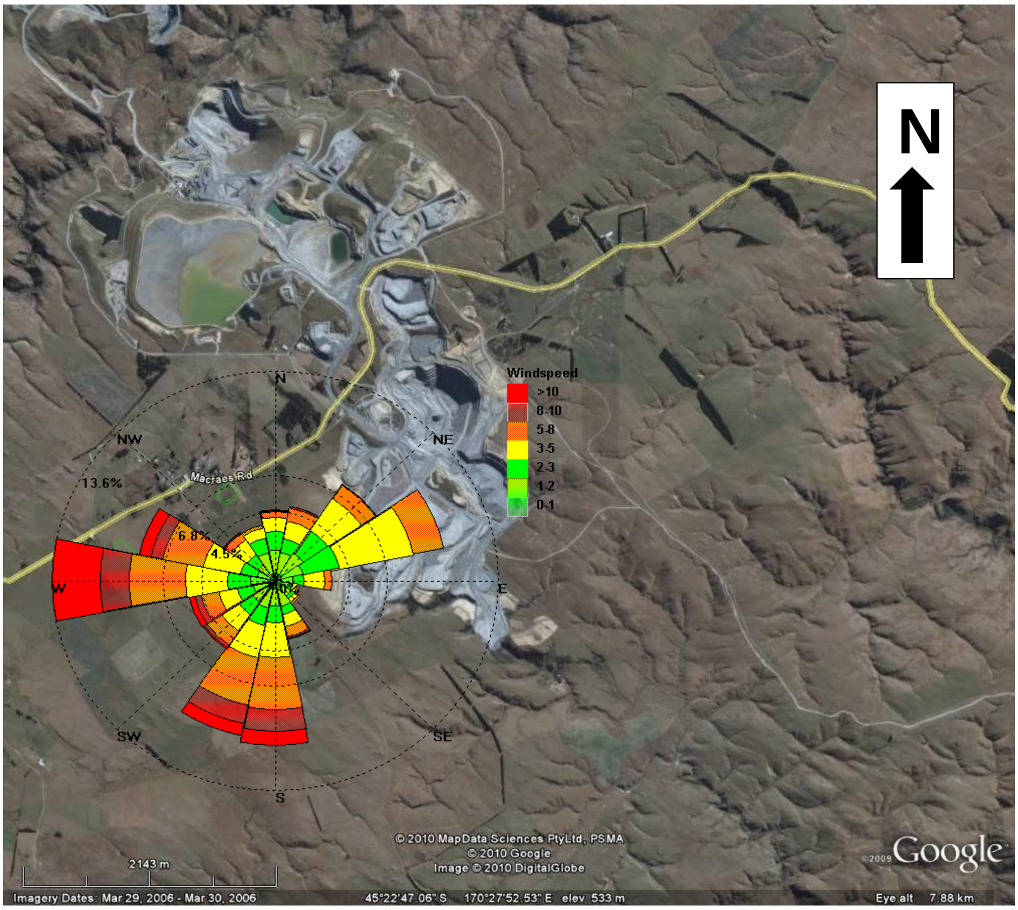


Figure 2-3: Macraes Windrose based on Data from the Golden Point Weather Station 2000 to 2006

[2] Macraes Mining Company Ltd. Macraes Gold Project Discharges to Air Assessment of Environmental Effects December 1996.

3 DUST SOURCES AND GENERATION

3.1 Potential Dust Sources

The following activities have the potential to generate dust:

- Blasting of rock;
- Excavation, including stripping of overburden and topsoil;
- Vehicle movements on unpaved surfaces (i.e. haul roads);
- Loading and unloading of materials;
- Wind generated dust from dry exposed surfaces such as stockpiles, tailings impoundment surfaces and non-rehabilitated surfaces; and
- Crushing of materials.

Dust emissions from exposed surfaces generally increase with increasing wind speed. However, dust pick up by wind is only significant at wind speeds above 5m/s. The smaller the particle size of the material on an exposed surface, the more easily the particles are able to be picked up and entrained in the wind. Moisture binds particles together preventing them from being disturbed by winds or vehicle movements. Similarly vegetated surfaces are less prone to wind erosion than bare surfaces. The larger the areas of exposed surfaces the more potential there will be for dust emissions.

Vehicles travelling over exposed surfaces (i.e. haul roads) tend to pulverise any surface particles. Particles are lifted and dropped from rolling wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

The discharge of dust from haul roads has the potential to have effects on two scales. The first is individually from a source where the effects are localised in the immediate area surrounding the activity. Secondly, cumulative effects may be observed where the dust generated from all of the nearby dust sources (such as machinery operating in the pit and adjacent haul roads) combine to affect the air quality of the area as a whole. Therefore, it is important that all dust sources be minimised as far as practical, including those well separated from sensitive locations, as all dust generated will have an effect on the overall air quality in the area.

3.2 Factors Influencing Dust Generation

There are five major factors which influence the potential for dust to be generated from the site. These are:

- Wind speed across the surface;
- The percentage of fine particles in the material on the surface;
- Moisture content of the material;
- The area of exposed surface;
- Disturbances such as traffic, excavation, loading and unloading of materials and blasting.

Systems for controlling dust emissions need to include methods that modify the condition of the materials so that it has a lesser tendency to lift with the wind or disturbances such as vehicle movements, and methods that reduce the velocity of the wind at the surface.

Watering of exposed surfaces and materials that may be disturbed is a primary method of control. As a general guide, the typical water requirements for most parts of New Zealand are up to 1 litre per square meter per hour.

The dust prevention methods detailed in Section 4 are the methods that have been found to be effective over the last 20 years of operation at the Macraes mine site. They can be used alone or in combination depending on the circumstances.

4 DUST MITIGATION MEASURES AND PROCEDURES

The following measures and procedures are implemented as necessary. Where relevant, the measures and procedures are also incorporated into contractor's responsibilities.

Unpaved Surfaces (haul roads, waste rock stacks, tailings impoundment surfaces, pits)

- Limit the area of exposed surfaces.
- Retain as much vegetation as possible.
- Keep tailings impoundment, pit and haul road maintenance up to date, such as repair of pot holes and the laying of fresh gravel or surfacing material.
- Keep haul road and exposed surfaces damp during dry conditions with water carts or fixed sprinklers.
- Cover exposed fine fill materials with coarse materials where practicable.

Vehicles (light vehicles, dump trucks, earthmoving machinery)

- Minimise traffic movements and control vehicle speeds to a maximum of 60km/h on haul roads.
- Adhere to load sizes to avoid spillages.
- Minimise travel distances through appropriate site layout and design**.**

Stockpiles (topsoil, brown rock, waste rock)

- Limit the height and slope of stockpiles to reduce wind entrainment.
- Orientate stockpiles to maximise wind sheltering.
- Minimise drop heights.
- Vegetate stockpiles of any materials that are to be left undisturbed for more than three months.
- Maximise shelter from winds as practicable.

Miscellaneous

- Revegetate exposed soil with appropriate vegetation as soon as practical.
- Install wind fences or barricades where practicable and appropriate.
- Minimise the area of surfaces covered with fine materials.
- Remove topsoil and loose material covering rock prior to blasting.
- Schedule potentially dusty operations where possible to avoid times of the day and year when conditions are likely to be particularly dry and windy.
- Schedule blasts to take into account wind conditions.

In addition to the above measures, specific dust mitigation methods exist for the tailings impoundment surfaces. These mitigation methods are detailed in the *Southern Pit 11 Tailings Impoundment, Mixed Tailings Impoundment and Top Tipperary Tailings Storage Facility Dust Control Manual presented in Appendix B*. Specifically, the measures outlined in the Tailings Dust Control Manual include:

Tailings Discharge

- Tailings deposition to be sequentially moved around the dam, restricting the likelihood of windborne dust generation created by the tailings beach drying out.

Rock Mattress Cover

- If feasible mitigate dust generation from the tailings beach via construction of a rock mattress. A rock mattress to be laid out over the outer 120m of the tailings beach for the Mixed Tailings and 90m for the Southern Pit 11 Tailings Impoundments.
- Rock mattress construction will commence as soon as practicable after cessation of tailings deposition for impoundments constructed using upstream construction methods.

Tailings Wetting System

- For impoundments constructed using upstream construction methods a tailings wetting system is to be established following rockfill mattress construction to enable distribution of either water or tails onto the inner surface of the impoundment surface not covered by the rock mattress.
- Tailings wetting systems are to have the capacity to be operational at all times when the impoundment is not active or resting.
- Limit traffic on the tailings surface when the impoundment is inactive in order to preserve the crust.
- Ensure tailings wetting system can be mobilised to other areas of the impoundment where necessary to mitigate dust generation.

5 MONITORING

OceanaGold currently holds five air discharge consents: RM10.351.52 (Macraes Phase III), 96785_V5 (covering general mining and processing operations in all areas not covered by Macraes Phase III), RM12.378.15 covering the Coronation area and RM16.138.19 covering the Coronation North area as well as Consent No 2006.689 for the purpose of ventilating the underground mine. Copies of these consents are presented in Appendix A.

Under air discharge consents 96785_V5, RM10.351.52, RM12.378.15 and RM16.138.19 the following monitoring is currently undertaken:

- Dust deposition rates at monthly intervals at 16 sites
- Real time total suspended particulate concentrations at site DG15. The ORC gave permission for the concurrently operated High Volume Sampler to be disestablished in May 2015);
- Continuous meteorological monitoring of conditions at two representative locations (Sites DG03 and DG15); and
- Daily record kept of water used for dust suppression.

In addition to the resource consent monitoring OceanaGold has a process of checking weather forecasts and advising key operational personnel if strong winds are forecast. This process is set out in the *Tailings Storage Facilities Dust Control Manual*, included as Appendix B.

To ensure that controls are implemented and are effective in minimising dust emissions, OceanaGold monitors weather conditions, the condition of potential dust generating areas and undertakes depositional dust and total suspended particulate monitoring.

Table 5.1 below outlines the current dust monitoring programme.

Table 5.1: Existing Dust Monitoring Programme

Monitoring Activities	Frequency
Check weather forecasts for strong winds and send electronic alerts to key personnel.	Daily
Observe weather conditions, wind via observations (Beaufort Scale)[3].	Daily and as conditions change.
Inspect all haul road surfaces for dampness and general condition.	Daily and as conditions change
Inspect all exposed surfaces for dampness and to ensure that surface exposure is minimised.	Daily and as conditions change.
Inspect tailings impoundment surfaces for dampness.	Daily and as conditions change.
Inspect tailings impoundment dust suppression systems.	Twice daily during extended periods of no deposition
Monitor dust deposition rates in 16 gauges surrounding the mine site.	Monthly
Monitor real time Total Suspended Particulate (TSP) at Dust Site 15 using a Nephelometer.	Continuously
Monitor meteorological conditions at Dust Sites 3 and 15.	Continuously

The locations of the depositional and total suspended particulate monitoring sites are shown on Figure 5.1.

[3] A description of the Beaufort Scale can be found in Appendix C

5.1 Monitoring Equipment Specifications

Specifications of the equipment used to undertake these monitoring activities can be found in Tables 5.2 to 5.4 below.

Table 5.2: Monitoring Equipment at Site DG15

Monitor Type	Monitor Specifications
Nephelometer (real time total suspended particulate monitoring)	Met One E-Sampler-9800.
Atmospheric monitoring site	Temperature sensor: Campbell Scientific 107 Anemometer: Vector A101M Wind Vane: Vector W200P Rain Gauge: TB3-0.2/P
Dustfall Gauge	Standard Dust Deposition Gauge. Dust gauges are analysed using the Horizontal Deposit Gauge Method.

Table 5.3: Monitoring Equipment at Site DG03

Monitor Type	Monitor Specifications
Atmospheric Monitoring Site	Temperature Sensor: Campbell Scientific 107 Temperature and RH Sensor: Viasala HMP50Y Anemometer: Vector A101M Wind Vane: Vector W200P Rain Gauge: Ota Keiki Seisakusho 34-T Solar Radiation: Apogee SP110 Pyranometer
Dustfall Gauge	Standard Dust Deposition Gauge. Dust gauges are analysed using the Horizontal Deposit Gauge Method.

Table 5.4: Other Dust Monitoring Locations

Monitoring Type	Specifications
Dustfall Gauge	Standard Dust Deposition Gauge. Sixteen gauges are positioned in various locations around site (see Figure 5.1 for locations). Dust gauges are analysed using the Horizontal Deposit Gauge Method.

5.2 Data Analysis and Reporting

5.2.1 Dustfall Gauge Data

Data from dustfall gauges is collected, analysed and reported on a monthly basis by Environmental Standards Limited. Dustfall gauges are analysed using the Horizontal Deposit Gauge method. This method is detailed in the Draft International Standard ISO/DIS 4222.2 (‘*Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method”* 1980).

Depositional dust results are included in the Quarterly Monitoring Reports supplied to the Otago Regional Council.

5.2.2 Atmospheric and Total Suspended Particulate Data

Watercare Services Limited (WSL) undertakes data analysis and reporting for the nephelometer, and atmospheric monitoring station. A monthly summary report is produced once all the data has been collected and analysed. Details of the methods for data analysis can be found in Section 5 of their latest monthly report, which can also be found in Appendix D of this plan.

Total suspended particulate results are included in the Quarterly Monitoring Reports supplied to the Otago Regional Council.

5.3 Compliance Limits

Under resource consent RM10.352.52 (Macraes Phase III) and 96785_V5, the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07, DG20 and DG21 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year;
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background; and
- 24 hour average total suspended particulate at Site DG15 must not exceed 120ug/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining sites.

Under resource consent RM12.378.15 (Coronation), the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG23 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year;
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background.
- 24 hour average total suspended particulate at Site DG15 must not exceed 120ug/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining two sites.

Development of the Coronation North Project results in DG23 needing to be decommissioned and a new site being established (DG25). An application to vary resource consent RM12.378.15 to reflect this change will be submitted in the first quarter of 2017.

Under resource consent RM16.138.19 (Coronation North), the following compliance limits apply:

- Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG25 must not exceed 3g/m^2/30days of insoluble dust above background more than twice in any calendar year.
- Insoluble dust deposition rates at sites DG02 and DG15 must not exceed 3g/m^2/30days of insoluble dust above background.
- Twenty-four hour average total suspended particulate at site DG15 must not exceed 120μg/m^3.

Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24. In the event that a result for one of these sites is unavailable, the background concentration will be calculated by averaging the remaining two sites.

5.4 Exceedance of a Compliance Limit

If a consent limit for depositional dust or total suspended particulate is exceeded, OceanaGold will undertake an immediate review to determine the likely cause of the exceedance. The Otago Regional Council will be notified within a 24 hour period of the exceedance becoming apparent and depending on the nature of the incident, a report detailing the findings of the investigation will be forwarded to the Otago Regional Council within one month, or follow up comment will be made in the Quarterly Monitoring Report (in the event of clear indication that the exceedance is not a result of OceanaGold operational activities). If it is found that activities of OceanaGold were the cause of the exceedance then dust mitigation measures shall be reviewed by an independent consultant and a report prepared summarising the cause of the exceedance and recommending measures to improve dust mitigation so the exceedance does not occur again. The report will be forwarded to the Otago Regional Council within two months of the exceedance being identified.

5.5 Annual Dust Review

An annual summary of the ambient air monitoring results is to be forwarded to the ORC by 30th April each year. This report reviews and assesses the results for the previous calendar year and is to be undertaken by a suitably qualified independent reviewer. OceanaGold engage Prue Harwood from Beca Infrastructure Ltd for this report. Her qualifications and experience can be found in Appendix B of *"OceanaGold Macraes Mine – Summary of Ambient Air Monitoring Results for 2015".*

The report shall include the following:

(a) The name, qualifications and experience of the reviewer;

(b) The methods used and the investigations undertaken for the review;

(c) Interpretation of the monitoring data reviewed;

(d) An assessment of the quality of the monitoring data;

(e) An assessment of the monitoring regime;

(f) A description and evaluation of each of the dust mitigation measures used;

(g) Recommendations on whether:

   i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended;

   ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended; and

   iii) Any changes that should be made to the conditions of this consent.

(h) Any other matters that the reviewer considers should be drawn to the attention of OceanaGold or the Otago Regional Council.

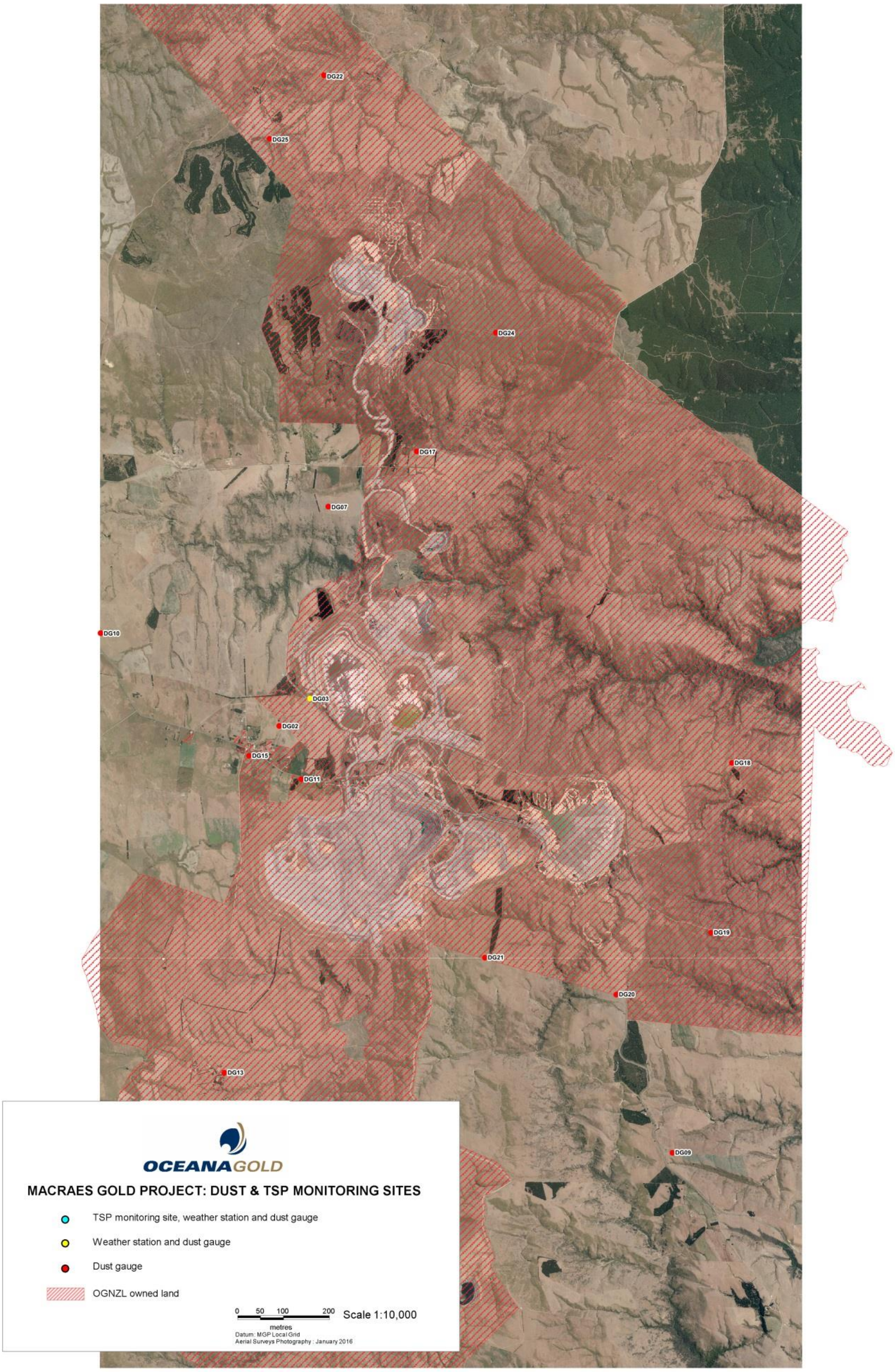


Figure 5-1: Depositional Dust and TSP Monitoring Sites

6 COMPLAINTS

Complaints may be referred by one or more of the regulatory authorities, a member of the public or an OceanaGold employee or contractor. It is the responsibility of the Environment and Community Manager to respond to and follow up all complaints regarding dust. The Environment and Community Manager is responsible for ensuring suitably qualified personnel are available to respond to complaints at all times.

Actions to be taken as soon as possible by the Environment and Community Manager

- All complaints are logged in Inform Stakeholder data base.
- Note the time, date, identity and contact details of complainant. Wind direction, strength and weather conditions are to be recorded. Note if complaint has been referred from a Consent Authority.
- Ask the complainant to describe the dust emission; whether it is constant or intermittent, how long it has been going on for, is it worse at any time of day, does it come from an identifiable source.
- As soon as possible after receipt of a complaint undertake a site inspection. Note all dust producing activities taking place, which staff member or contractor is responsible for the site and the dust mitigation methods that are being used. Order any remedial action necessary. If the complaint was related to an event in the recent past, note any dust producing activities that were underway at that time, if possible.
- As soon as practical (preferably within two hours) visit the area from where the complaint originated to ascertain if dust is still a problem.
- If it becomes apparent that there may be a source of dust other than activities at Macraes Gold Mine causing the dust nuisance it is important to verify this. Photograph and document the source and emissions.
- If complaint is received more than 12 hours after the event, conduct investigation including collecting relevant weather data, identifying operational activities at the time of the incident, collecting camera footage and interviewing operational staff. Investigations should endeavour to identify root cause and contributing factors.
- As soon as possible after the investigations have been completed contact the complainant to explain what has been found and remedial actions taken.
- If necessary update any relevant procedures to prevent any recurrence of problems.
- Complete complaint form and file on complaint register.

Follow Up Actions

- Advise the Otago Regional Council as soon as practical that a complaint has been received and what the findings of the investigation were and any remedial actions taken.

7 RESPONSIBILITIES

OceanaGold as the holder of consents for Macraes Gold Mine site has the ultimate responsibility to ensure that all statutory requirements and conditions of consent are complied with and mining activities are carried out in accordance with the DMP.

Specifically, the following roles share operational responsibility for ensuring mining activities are carried out in accordance with the DMP:

- General Manager Macraes Operation
- Open Pit Mine Operations Superintendent
- Process Manager

These roles will have the following responsibilities:

- Overall responsibility at the site for ensuring that the dust control and mitigation measures and procedures outlined in Section 4 of the DMP are implemented effectively.
- Overall responsibility to ensure that dust emissions are avoided and mitigated as far as is practicable.

The Environment and Community Manager will have the following associated responsibilities:

- Responsibility to ensure that the dust monitoring programme is carried out as required.
- Responsibility to ensure that complaints are received and investigated as outlined in Section 6 of the DMP.
- Responsibility to ensure the DMP is current and reviewed at least annually.

All contractors and staff working on site are to ensure that their activities comply with the requirements of the DMP.

8 CONSULTATION, REPORTING AND REVIEW

8.1 Neighbours

OceanaGold will consult with the Macraes Community Incorporated (MCI) regularly, as part of the bi-monthly meeting process, to inform them of any issues relating to dust control at the Macraes Gold Mine site that may be of interest to the community and to obtain feedback from the community.

OceanaGold will advise the Macraes Community through MCI of the contact phone numbers to be used to advise OceanaGold of a complaint.

The contact phone numbers and email addresses to be used for registering a complaint are included in **Appendix E**.

8.2 OceanaGold to Otago Regional Council

OceanaGold will maintain a regular and formal reporting regime with the Otago Regional Council (ORC) to inform them of any issues regarding dust control at the site that may be of interest to them and to obtain feedback on compliance and performance.

OceanaGold will provide the ORC with contact numbers to be used to advise OceanaGold of a dust complaint. The contact phone numbers and email addresses to be used for registering a complaint are included in **Appendix E**.

OceanaGold will inform the ORC of the following:

- Any complaints received regarding dust as soon as practical after receipt of the complaint.
- Of any non-compliances with monitoring as outlined in Section 5. Any non-compliance will be reported to the ORC through the nominated compliance contact (currently Rachel Brennan) or via the compliance email address (compliance@orc.govt.nz).
- Provide ORC with a copy of the DMP if any significant revisions of the DMP are made during the year.

8.3 Otago Regional Council to OceanaGold

OceanaGold requests that the ORC advise them of any complaints they receive regarding dust from the Macraes Gold Mine site immediately after the complaint has been lodged.

8.4 DMP Review Procedure

The DMP shall be reviewed regularly and at least annually preferably during the winter period and prior to the next dry season. The review shall take into account the following:

- The outcome of any reviews completed as the result of any non-compliant results;
- The outcome of the annual review of all dust monitoring data; and
- Whether management practices are resulting in compliance with the conditions of the relevant air discharge consents.

A copy of any updates to the DMP will be forwarded to the Otago Regional Council within one month of any update occurring. Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan.

9 EXCESSIVE DUST ACTION PLAN

In the event that personnel are unable to control dust adequately on the mine site and additional measures are required in order for OceanaGold to comply with the provisions of the resource consents OceanaGold shall initiate an emergency action plan. OceanaGold will maintain an in-house register of persons and contractors who have suitable equipment and personnel available that can be contacted at short notice in the event of a dust emergency occurring.

The emergency procedures may include, but are not limited to, the following:

- The use of additional water carts and irrigation systems; and
- Stopping work on areas of the site that are sources of excessive dust, where practical.

The Site Personnel Contacts list is included in **Appendix E.**

Appendix A

Resource Consents Held for Air Discharges

Our Reference: A942120

Consent No. RM16.138.19

DISCHARGE PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Oceana Gold (New Zealand) Limited

Address: 22 MacLaggan Street, Dunedin

To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations

For a term expiring 31 August 2032

Location of consent activity: Coronation North Project, approximately 7.5 kilometres to the northwest of the intersection of Macraes Road and Red Bank Road, Macraes Flat.

Legal description of consent location: Pt Section 2 Blk V Highlay SD, Pt Section 2 Blk VII Highlay SD, Lot 1 DP 465577, Pt Section 11 Block VII Highlay SD,

Map Reference: Within a 2.5 kilometre radius of NZTM 2000: E1395000 N4979000

Conditions

Specific

1. This consent shall be exercised in conjunction with Discharge Permit 96785, Discharge Permit 2006.689, Discharge Permit RM10.351.52, Discharge Permit RM12.373.15 and any subsequent variations to these permits.

2. This consent authorises the discharge of contaminants to air from the Coronation North Waste Rock Stack, Coronation Pit extension, Coronation North Pit and associated haul roads and working areas, as shown on Appendix I attached.

3. There shall be no visible dust beyond the boundary of the Macraes Gold Project site that, in the opinion of an enforcement officer, is offensive or objectionable to such an extent that it has an adverse effect on the environment, including the human environment.

Performance Monitoring

4. Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG25, as shown on Appendices' II-IV attached, must not exceed 3 grams per square metre per 30 days (g/m2/30 days) of insoluble dust above background more than twice in any calendar year. Compliance with this condition shall be demonstrated by the monitoring required in Condition 9 of this consent.

5. Insoluble dust deposition rates at sites DG02 and DG15, as shown on Appendices' II-IV attached, must not exceed 3 grams per square metre per 30 days (g/m2/30 days) of insoluble dust above background. Compliance with this condition will be demonstrated by the monitoring required in Condition 9 of this consent.

6. Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24 as shown on Appendices' II-IV attached.

7. Twenty-four hour average total suspended particulate at site DG15, as shown on Appendix II attached, must not exceed 120μg/m3. Compliance with this condition will be demonstrated by the monitoring required in Condition 10 of this consent.

8. In the event of any exceedance of those limits specified in Conditions 4, 5 and 7 of this consent, the Consent Holder must undertake an immediate review of the cause of the exceedance. A report detailing the findings of this review shall be provided to the Consent Authority within 1 month of the non-compliant result(s) being received. If it is shown that activities within the Macraes Gold Project site were the cause of the exceedance, then dust mitigation measures within the Macraes Gold Project shall be reviewed by an independent consultant engaged in consultation with the Consent Authority. The independent consultant shall provide a report summarising the cause of the exceedance and recommending measures to improve dust mitigation at the Macraes Gold Project site so that the exceedance does not occur again. This report shall be provided to the Consent Authority within 2 months of the non-compliant result(s) being received.

9. The consent holder shall monitor dust deposition rates at monthly intervals in accordance with draft ISO Standard ISO/DIS 4222.2 ("Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method" 1980), or another method approved in writing by the Consent Authority. The monitoring shall be undertaken at the sites shown on Appendices' II-IV attached.

10. (a) The consent holder shall monitor real time total suspended particulate concentrations at site DG15 as shown on Appendix I attached. The monitoring shall be undertaken using a nephelometer, or other instrument as agreed in writing by the Consent Authority. The instrument shall be sited in accordance with AS/NZS 3580.1.1:2007 (Methods for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment).
(b) The consent holder shall monitor total suspended particulate at monitoring site DG15 as shown on Appendix II in accordance with Australian Standard AS/NZS3580.9.3:2003 (Determination of suspended particulate matter - Total Suspended Particulates [TSP] - High Volume Sampler Gravimetric Method), or another method approved by the Consent Authority. Twenty-four hour measurements must be taken every six days March to October inclusive, and every three days November to February inclusive, for a minimum period of twelve months or for however long is required to ensure that adequate data is collected to achieve the objectives of Condition 10(d).
(c) Parameters to be recorded shall include, but not be limited to:

i) Hourly average TSP concentrations as measured by the instrument installed in accordance with Condition 10(a) of this consent;
ii) 24-hour average TSP concentrations as measured by the instruments installed in accordance with Conditions 10(a) and 10(b).

(d) The instruments installed in accordance with Conditions 10(a) and 10(b) shall be operated concurrently for a period of no less then twelve months to ensure that twelve months of coincident data is collected. A correlation between the data shall be established by an independent consultant engaged in consultation with the Consent Authority. A report detailing this investigation shall be provided to the Consent Authority within two months of the data being collected.

11. (a) Meteorological conditions shall be continuously monitored and recorded at site DG03 as shown on Appendix II attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall. Sufficient information shall also be measured to allow an estimate of atmospheric stability. These estimates shall be obtained from measurements of solar radiation and temperature at two heights above ground level, or other parameters as approved by the Consent Authority.
(b) Meteorological conditions shall be continuously monitored and recorded at site DG15 as shown on Appendix II attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall.

12. The consent holder shall keep a daily record of water used for dust suppression. These records shall be made available to the Consent Authority on request.

13. Results of all monitoring undertaken in accordance with this consent shall be reported to the Consent Authority on a quarterly basis. The format of the report shall be agreed upon in consultation with the Consent Authority.

14. Prior to the exercise of this consent, the consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:
(a) A description of potential dust sources and the factors influencing dust generation;
(b) Dust mitigation measures and procedures including, but not limited to:
i) Minimising the areas of disturbed ground;
ii) Watering, with water trucks and fixed sprinklers;
iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;
iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;
v) Ensuring materials being moved are kept in a coarse state;
vi) Covering materials; and
vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.
(c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;
(d) Procedures for managing and addressing air quality or odour related complaints; and
(e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Condition 18 of this consent.

15. The consent holder shall review the Dust Management Plan annually taking into account the following:
(a) The outcomes of reviews completed in accordance with Conditions 8 and 16 of this consent; and
(b) Whether management practices are resulting in compliance with the conditions of this consent.
Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring.

16. An independent consultant, engaged by the Consent Holder in consultation with the Consent Authority, shall undertake an annual review and assessment of all dust monitoring data. The reviewer's report shall include:
(a) The name, qualifications, and experience of the reviewer;
(b) The methods used and the investigations undertaken for the review;
(c) Interpretation of the monitoring data reviewed;
(d) An assessment of the quality of the monitoring data;
(e) An assessment of the monitoring regime;
(f) A description and evaluation of each of the dust mitigation measures used by the consent holder;
(g) Recommendations on whether:
i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended;
ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended; and
iii) Any changes should be made to the conditions of this consent; and
(h) Any other matters that the reviewer considers should be drawn to the attention of the consent holder or the Consent Authority.

17. The annual report required by Condition 16 shall be provided to the Consent Authority by 30 April each year.

18. In the event of any non compliance with the conditions of this consent, the consent holder shall notify the Consent Authority within 24 hours of the non compliance being detected. Within five working days the consent holder shall provide written notification to the Consent Authority providing details of the non-compliance. This notification will at a minimum include an explanation of the cause of the non compliance, the steps taken to remedy the situation and steps taken to mitigate any future occurrence of the non compliance.

19. The consent holder shall maintain a record of any complaints received regarding their operation. The register shall include, but not be limited to:
(a) name and location of site where the problem is experienced;
(b) nature of the problem;
(c) date and time problem occurred, and when reported;
(d) action taken by consent holder to remedy the situation and any policies or methods put in place to avoid or mitigate the problem occurring again.

The register of complaints shall be incorporated into the Project Overview and Annual Work and Rehabilitation Plan.

General

20. (a) The consent holder shall provide and maintain in favour of the Consent Authority one or more bonds to secure:

    i) The performance and completion of rehabilitation in accordance with the conditions of this consent; and
    ii) The carrying out of the monitoring required by the conditions of this consent; and
    iii) The remediation of any adverse effect on the environment that may arise from the exercise of this consent.
    iv) Compliance with Conditions 20 (m) to 20(q) of this consent.

(b) Before the first exercise of this consent, the consent holder shall provide to the Consent Authority one or more bonds required by Condition 20(a).

(c) Subject to the other provisions of this consent, any bond shall be in the form and on the terms and conditions approved by the Consent Authority.

(d) Any bond shall be given or guaranteed by a surety acceptable to the Consent Authority.

(e) The surety shall bind itself to pay for the carrying out and completion of the conditions of consent which are the subject of the bond on default by the consent holder or the occurrence of any adverse environment effect requiring remedy; during or after the expiry of this consent.

(f) The amount of each bond shall be fixed annually by the Consent Authority which will take into account any calculations and other matters submitted by the consent holder relevant to the determination of the amount to be bonded in the Project Overview and Annual Work and Rehabilitation Plan required for by condition 6 of RM16.138.05, condition 6 of RM16.138.10, condition 8 of RM16.138.17 and condition 10 of RM16.138.18.

(g) The amount of the bond(s) shall include:

    i) The estimated costs of complete rehabilitation in accordance with the conditions of consent on the completion of the mining operations proposed for the next year and described in the Project Overview and Annual Work and Rehabilitation Plan.
    ii) The estimated costs of:
    - Monitoring in accordance with the monitoring conditions of the consent;
    - Monitoring for and of any adverse effect of the activity authorised by this consent which may become apparent during or after expiry of this consent;
    - Monitoring any rehabilitation required by this consent.
    iii) Any further sum which the Consent Authority considers necessary for monitoring and dealing with any adverse effect on the environment that may arise from the exercise of the consent whether during or after the expiry of this consent.

(h) The amount shall be calculated for the duration of this consent and for a period of 20 years after its expiry.

(i) If, on review, the total amount of bond to be provided by the consent holder is greater or less than the sum secured by the current bond(s), the consent holder, surety and the Consent Authority may, in writing, vary the amount of the bond(s).

(j) While the liability of the surety is limited to the amount of the bond(s), the liability of the consent holder is unlimited.

(k) Any bond may be varied, cancelled, or renewed at any time by written agreement between the consent holder, surety and Consent Authority.

(l) The costs (including the costs of the Consent Authority) of providing, maintaining, varying and reviewing any bond shall be paid by the consent holder.
(m) For a period of 20 years from the expiry or surrender of this consent the consent holder shall provide in favour of the Consent Authority one or more bonds.
(n) The amount of the bond to be provided under Condition 20(m) shall include the amount (if any) considered by the Consent Authority necessary for:

i) Completing rehabilitation in accordance with the conditions of this consent.
ii) Monitoring for and of any adverse effect on the environment that may arise from the exercise of the consent.
iii) Monitoring any measures taken to prevent, remedy or mitigate any adverse effect on the environment that may arise from the exercise of this consent.
iv) Dealing with any adverse effect on the environment which may become apparent after the surrender or expiry of this consent.
v) Contingencies.

(o) Without limitation, the amount secured by the bond given under Condition 20(m) may include provision to deal with structural instability or failure, land and water contamination, and the failure of rehabilitation in terms of the rehabilitation objectives and conditions of this consent. Costs shall include costs of investigating, preventing, remedying or mitigating any adverse effect.
(p) The bond(s) required by Condition 20(m) must be provided on the earlier of:

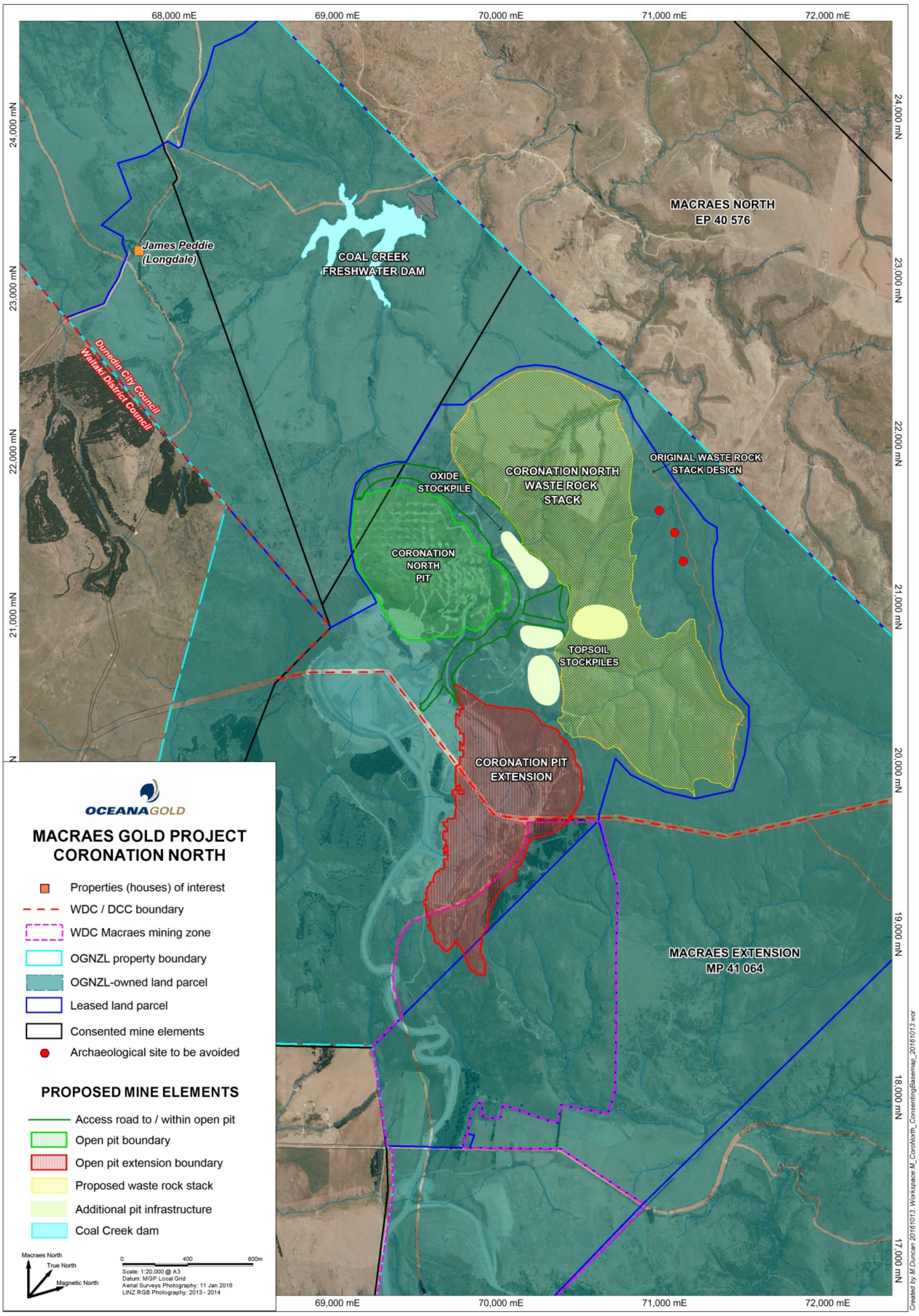
i) 12 months before the expiry of this consent.
ii) Three months before the surrender of this consent.

(q) Conditions 20(c), (d), (e), (h), (i), (j) and (k) apply to the bond(s) required by Condition 20(m).

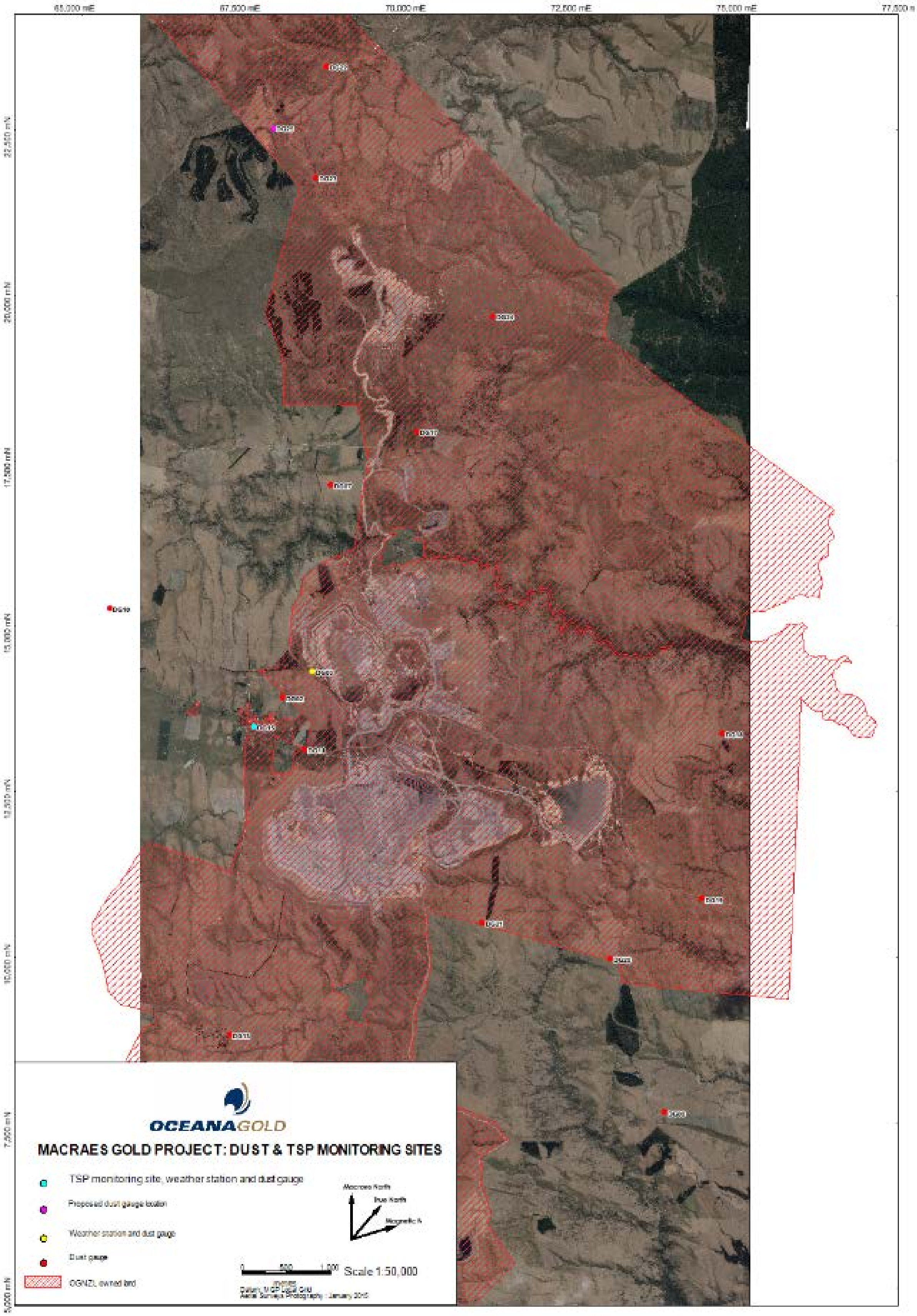
Review

21. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within three months of each anniversary of the commencement of this consent, for the purpose of:
(a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent; or
(b) ensuring the conditions of this consent are consistent with any National Environmental Standards; or
(c) requiring the consent holder to adopt the best practicable option, in order to remove or reduce any adverse effect on the environment arising as a result of the exercise of this consent.

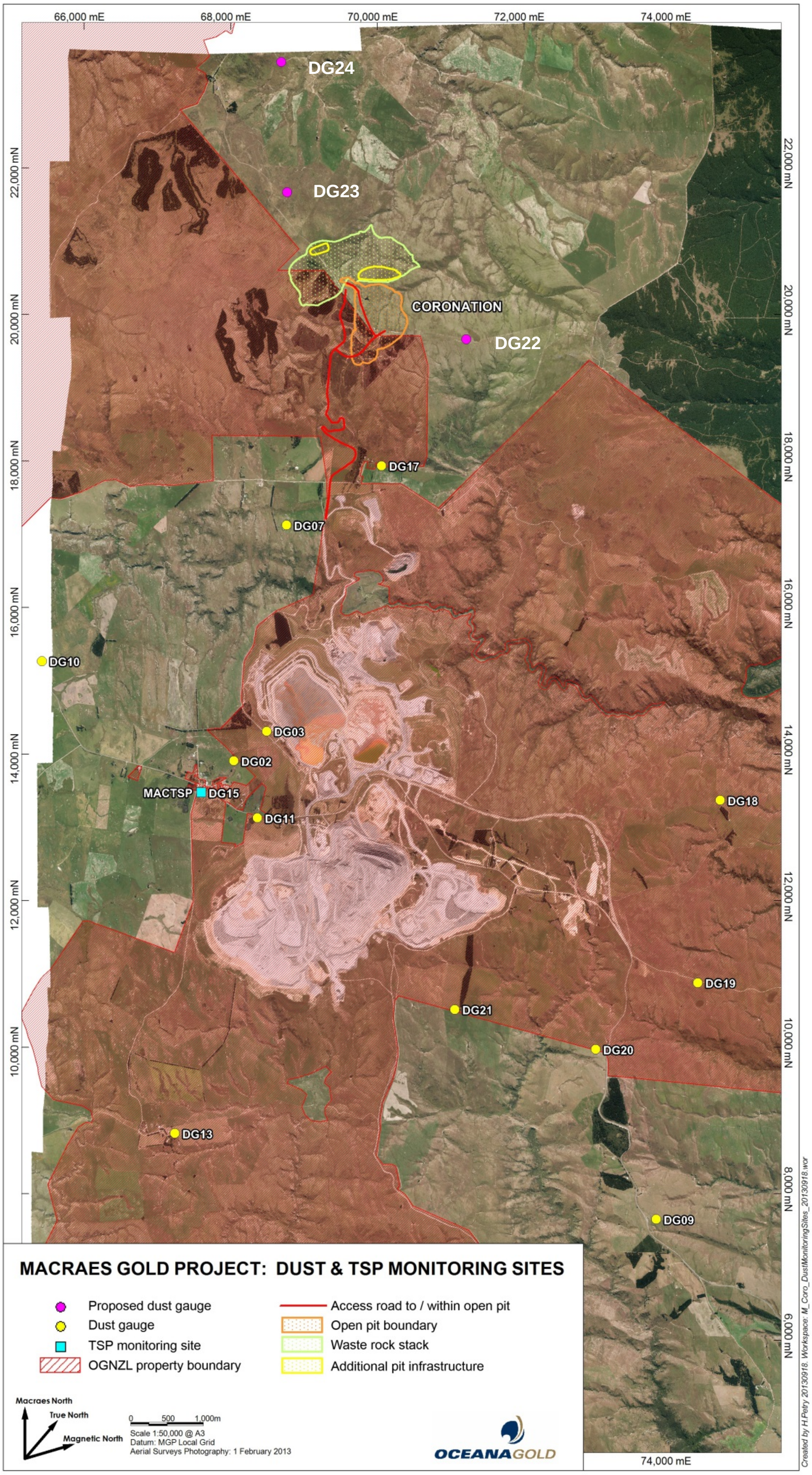
Appendix I
RM16.138.19



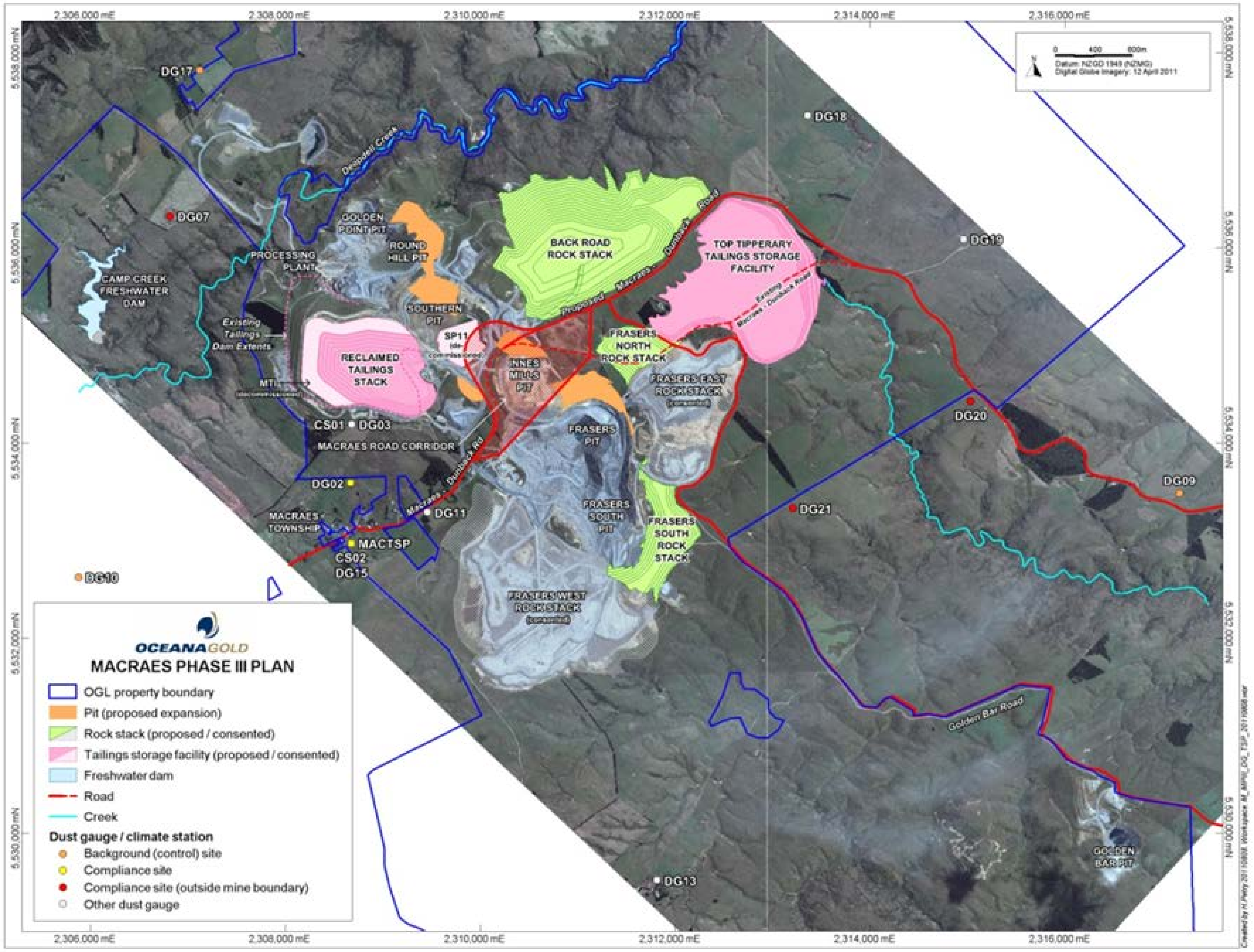
Appendix II
RM16.138.19



Appendix III
RM16.138.19



Appendix IV
RM16.138.19



Otago Regional Council

ORIGINAL

Consent No. 2006.689

DISCHARGE PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Oceana Gold (New Zealand) Limited

Address: Simpson Grierson, Barristers & Solicitors, Level 24, HSBC Tower, 195 Lambton Quay, Wellington

To discharge contaminants to air

for the purpose of ventilating Frasers Underground Mine

for a term expiring on 31 August 2032 or on completion of the rehabilitation of the underground mine, whichever occurs earlier

Location of activity: Frasers Underground Mine, immediately east of Frasers Pit, and approximately 2.6 kilometres northeast of the Macraes Flat township, Macraes Flat, East Otago.

Legal description of land: Sec 27 Blk II Highlay Survey District

Map grid reference: NZMS 260 I42:114-334

Conditions

1. This consent shall be exercised in accordance with the application for resource consent dated 2 October 2006, including the Assessment of Environmental Effects and all supporting documents.

2. There shall be no discharge of contaminants resulting from the consent holder's activities that, in the opinion of an enforcement officer of the Consent Authority, is offensive or objectionable at or beyond the boundary of the consent holder's premises.

3. The Consent Authority may, in accordance with sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within three months of each anniversary of the commencement of this consent for the purpose of:
   (a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent; or

(b) ensuring the conditions of this consent are consistent with any National Environmental Standards; or

(c) requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment arising as a result of the exercise of this consent.

Issued at Dunedin this 14th day of February 2007

Christopher P Shaw
Manager Consents
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ORIGINAL

Otago Regional Council

Our Reference: A525831

Consent No 96785_V5

DISCHARGE PERMIT

Pursuant to Section 105 of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Oceana Gold (New Zealand) Limited

Address: Level 3, Taunton Mews, 22 Maclaggan Street, Dunedin

to discharge contaminants from mining operations and post mining rehabilitation to air in the vicinity of Macraes Flat at the site shown on Appendix I.

Description of consent location: Mine Boundaries as shown on Appendix I

Map reference centre of activity: NZMS 260 I42:105-335

Commencement of Consent: This consent shall commence when:

(i) The provisions of Section 116 Resource Management Act 1991 are satisfied.

(ii) The consent authority has accepted the surrender under S138 of the Resource Management Act 1991 of discharge permit 95787.

Expiry of Consent: This consent shall expire on 31 August 2032 or on the completion of rehabilitation to the satisfaction of the consent authority, whichever occurs earlier.

Conditions

1. This consent shall not be exercised until air discharge permit number 95787 is surrendered in accordance with Section 138 of the Act.

2. This consent shall be exercised in conjunction with in conjunction with Discharge Permit 2006.689, Discharge Permit RM10.351.52 and Discharge Permit RM12.378.15.

3. This consent shall be exercised in accordance with:

   (i) the application for resource consent dated December 1996 including the Assessment of Environmental Effects and all supporting documents (which are deemed to be incorporated in, and form part of this consent);

   (ii) *the application for a change in conditions of consent 96785_V1 dated May 2001 (and supporting documents);*

   (iii) *the application for a change in conditions of consent 96785_V2 dated April 2004 (and supporting documents) that is relevant only to the construction of the decline;*

(iv) *the application for a change in conditions of consent 96785_V3 dated April 2005 (and supporting documents); and,*

(v) *the application for a change in conditions of consent 96785_V4 dated May 2005 (and supporting documents);*

except to the extent that any condition in this consent is inconsistent with such material. If there is an inconsistency the conditions and terms of this consent shall prevail.

4. This discharge shall occur in the area shown on Appendix I attached, other than where the discharge of contaminants to air in that area is authorised by Discharge Permit 2006.689, Discharge Permit 2007.511 and Discharge Permit RM10.351.52.

5. The consent holder shall minimise any adverse effect on the environment resulting from the discharge of dust. The methods shall include the following :

a) Minimising the areas of disturbed ground.

b) Watering, with water trucks and fixed sprinklers.

c) Avoiding as far a possible, ground disturbance when wind may cause dust nuisance.

d) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion.

e) Ensuring materials being moved are kept in a coarse state.

f) Covering materials.

g) Replanting disturbed ground as soon as possible, including temporary planting if necessary.

Dust Limits

6. There shall be no emission of visible dust from the mining activities that, in the opinion of an enforcement officer, is offensive or objectionable to such an extent that it has an adverse effect on the environment.

7. Insoluble dust deposition rates at sites DG07, DG20 and DG21, as shown on Appendix II attached, must not exceed 3 grams per square metre per 30 days of insoluble dust above background more than twice in any calendar year. Compliance with this condition shall be demonstrated by the monitoring required by Condition 11 of this consent.

8. Insoluble dust deposition rates at sites DG02 and DG15, as shown on Appendix II attached, must not exceed 3 grams per square metre per 30 days of insoluble dust above background. Compliance with this condition shall be demonstrated by the monitoring required by Condition 11 of this consent.

8a. Background insoluble dust concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24 as shown on Appendix II attached to this consent.

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9. Twenty-four hour average total suspended particulate at site DG15, as shown on Appendix II attached, shall not exceed 120 micrograms per cubic metre. Compliance with this condition will be demonstrated by the monitoring required by Condition 12 of this consent.

10. In the event of any exceedance of those limits specified in Conditions 7, 8, 8a and 9 of this consent, the consent holder must undertake an immediate review of the cause of the exceedance. A report detailing the findings of this review shall be provided to the Consent Authority within 1 month of the non compliant result(s) being received. If it is shown that the activities within the Macraes Gold Project site were the cause of the exceedance, then dust mitigation measures within the Macraes Gold Project site shall be reviewed by an independent consultant engaged in consultation with the Consent Authority. The independent consultant shall provide a report summarising the cause of the exceedance and recommending measures to improve dust mitigation so that the exceedances do not occur again. This report shall be provided to the Consent Authority within two months of the non-compliant result(s) being received.

Monitoring

11. The consent holder shall monitor dust deposition rates at monthly intervals in accordance with the draft ISO Standard ISO/SIS 4222.2, ("Air Quality Measurement of Atmospheric Dustfall - Horizontal Deposit Gauge Method" 1980), or another method approved in writing by the Consent Authority. The monitoring shall be undertaken at the sites shown in Appendix II attached.

12. a) The consent holder shall monitor real time total suspended particulate concentrations at site DG15 as shown on Appendix II attached. The monitoring shall be undertaken using a nephelometer, or other instrument as agreed in writing by the Consent Authority. The instrument shall be sited in accordance with AS/NZS 3580.1.1:2007.

b) The consent holder shall monitor total suspended particulate at monitoring site DG15 as shown on Appendix II in accordance with Australian Standard AS/NZS3580.9.3:2003 (Determination of suspended particulate matter - Total Suspended Particulates [TSP] - High Volume Sampler Gravimetric Method), or another method approved by the Consent Authority. Twenty-four hour measurements must be taken every six days March to October inclusive, and every three days November to February inclusive, for a minimum period of twelve months or for however long is required to ensure that adequate data is collected to achieve the objectives of Condition 12(d).

c) Parameters to be recorded shall include, but not be limited to:

i) Hourly average TSP concentrations as measured by the instrument installed in accordance with Condition 12(a) of this consent;

ii) 24-hour average TSP concentrations as measured by the instruments installed in accordance with Conditions 12(a) and 12(b).

d) The instruments installed in accordance with Conditions 12(a) and 12(b) shall be operated concurrently for a period of no less then twelve months to ensure that twelve months of coincident data is collected. A correlation between the data shall be established by an independent consultant engaged in consultation with the Consent Authority. A report detailing this investigation shall be provided to the Consent Authority within two months of the data being collected.

13. *Deleted*

14. (a) Meteorological conditions shall be continuously monitored and recorded at site DG03 as shown on Appendix II attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall. Sufficient information shall also be measured to allow an estimate of atmospheric stability. These estimates shall be obtained from measurements of solar radiation and temperature at two heights above ground level, or other parameters as approved by the Consent Authority.
(b) Meteorological conditions shall be continuously monitored and recorded at site DG15 as shown on Appendix II attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall.

15. The consent holder shall keep a daily record of water used for dust suppression. These records shall be made available to the Consent Authority upon request.

Monitoring reports and quality assurance

16. Results of all monitoring undertake in accordance with this consent shall be reported to the Consent Authority on a quarterly basis. The format of the report shall be agreed upon in writing with the Consent Authority.

16a. The consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:
   a) A description of potential dust sources and the factors influencing dust generation;
   b) Dust mitigation measures and procedures including, but not limited to:
      i) Minimising the areas of disturbed ground;
      ii) Watering, with water trucks and fixed sprinklers;
      iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;
      iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;
      v) Ensuring materials being moved are kept in a coarse state;
      vi) Covering materials; and
      vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.
   c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;
   d) Procedures for managing and addressing air quality or odour related complaints; and
   e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Conditions 16b and 17 of this consent.

16b. The consent holder shall review the Dust Management Plan annually taking into account the following:
   a) The outcomes of reviews completed in accordance with Conditions 10 and 17 of this consent; and

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b) Whether management practices are resulting in compliance with the conditions of this consent.

Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring.

17. An independent consultant, engaged by the Consent Holder in consultation with the Consent Authority, shall undertake an annual review and assessment of all dust monitoring data. The reviewers report shall include:

a) The name, qualifications, and experience of the reviewer.

b) The methods used and the investigations undertaken for the review

c) Interpretation of the monitoring data reviewed

d) An assessment of the quality of the monitoring data

e) An assessment of the monitoring regime

f) A description and evaluation of each of the dust mitigation measures used by the consent holder.

g) Recommendations on whether:

i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended.

ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended.

iii) Any changes should be made to the conditions of this consent.

h) Any other matters which the reviewer considers should be drawn to the attention of the consent holder or the Consent Authority

18. Deleted

19. The annual report required by Condition 17 shall be provided to the Consent Authority by 30 April each year.

20. The consent holder shall maintain a record of any complaints received regarding their operation. The register shall include, but not be limited to:

(a) name and location of site where the problem is experienced;
(b) nature of the problem;
(c) date and time problem occurred, and when reported;
(d) action taken by consent holder to remedy the situation and any policies or methods put in place to avoid or mitigate the problem occurring again.

The register of complaints shall be incorporated into the Project Overview and Annual Work and Rehabilitation Plan.

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21a. In the event of any non compliance with the conditions of this consent, the consent holder shall notify the Consent Authority within 24 hours of the non compliance being detected. Within five working days the consent holder shall provide written notification to the Consent Authority providing details of the non-compliance. This notification will at a minimum include an explanation of the cause of the non compliance, the steps taken to remedy the situation and steps taken to mitigate any future occurrence of the non compliance.

21b. The consent holder shall pay to the Consent Authority, the costs for monitoring, enforcing and administering this consent as agreed upon between the consent holder and the Consent Authority pursuant to Section 36 of the Resource Management Act 1991.

21c. (a) The consent holder shall provide and maintain in favour of the Consent Authority one or more bonds to secure:

i) The performance and completion of rehabilitation in accordance with the conditions of this consent; and

ii) The carrying out of the monitoring required by the conditions of this consent; and

iii) The remediation of any adverse effect on the environment that may arise from the exercise of this consent.

iv) Compliance with Conditions 21c(m) to 22 of this consent.

(b) Before the first exercise of this consent, the consent holder shall provide to the Consent Authority one or more bonds required by Condition 21c(a).

(c) Subject to the other provisions of this consent, any bond shall be in the form and on the terms and conditions approved by the Consent Authority.

(d) Any bond shall be given or guaranteed by a surety acceptable to the Consent Authority.

(e) The surety shall bind itself to pay for the carrying out and completion of the conditions of consent which are the subject of the bond on default by the consent holder or the occurrence of any adverse environment effect requiring remedy; during or after the expiry of this consent.

(f) The amount of each bond shall be fixed annually by the Consent Authority which will take into account any calculations and other matters submitted by the consent holder relevant to the determination of the amount to be bonded in the Project Overview and Annual Work and Rehabilitation Plan, or otherwise.

(g) The amount of the bond(s) shall include:

i) The estimated costs of complete rehabilitation in accordance with the conditions of consent on the completion of the mining operations proposed for the next year and described in the Project Overview and Annual Work and Rehabilitation Plan.

ii) The estimated costs of:

- Monitoring in accordance with the monitoring conditions of the consent;
- Monitoring for and of any adverse effect of the activity authorised by this consent which may become apparent during or after expiry of this consent;
- Monitoring any rehabilitation required by this consent.

iii) Any further sum which the Consent Authority considers necessary for monitoring and dealing with any adverse effect on the environment that may arise from the exercise of the consent whether during or after the expiry of this consent.

(h) The amount shall be calculated for the duration of this consent and for a period of 20 years after its expiry.
(i) If, on review, the total amount of bond to be provided by the consent holder is greater or less than the sum secured by the current bond(s), the consent holder, surety and the Consent Authority may, in writing, vary the amount of the bond(s).
(j) While the liability of the surety is limited to the amount of the bond(s), the liability of the consent holder is unlimited.
(k) Any bond may be varied, cancelled, or renewed at any time by written agreement between the consent holder, surety and Consent Authority.
(l) The costs (including the costs of the Consent Authority) of providing, maintaining, varying and reviewing any bond shall be paid by the consent holder.
(m) For a period of 20 years from the expiry or surrender of this consent the consent holder shall provide in favour of the Consent Authority one or more bonds.
(n) The amount of the bond to be provided under Condition 21c(m) shall include the amount (if any) considered by the Consent Authority necessary for:

- i) Completing rehabilitation in accordance with the conditions of this consent.
- ii) Monitoring for and of any adverse effect on the environment that may arise from the exercise of the consent.
- iii) Monitoring any measures taken to prevent, remedy or mitigate any adverse effect on the environment that may arise from the exercise of this consent.
- iv) Dealing with any adverse effect on the environment which may become apparent after the surrender or expiry of this consent.
- v) Contingencies.

(o) Without limitation, the amount secured by the bond given under Condition 21c(m) may include provision to deal with structural instability or failure, land and water contamination, and the failure of rehabilitation in terms of the rehabilitation objectives and conditions of this consent. Costs shall include costs of investigating, preventing, remedying or mitigating any adverse effect.
(p) The bond(s) required by Condition 21c(m) must be provided on the earlier of:

- i) 12 months before the expiry of this consent.
- ii) Three months before the surrender of this consent.

(q) Conditions 21c(c), (d), (e), (h), (i), (j) and (k) apply to the bond(s) required by Condition 21c(m).

22. The conditions of this consent may be reviewed by the Consent Authority giving notice in accordance with Section 129 of the Act within 3 months of:
    - (a) Receiving the Project Overview and Annual Work and Rehabilitation Programme.
    - (b) Receiving any monitoring information relating to the exercise (including the review reports required by Conditions 10, 16b and 17) of this consent.
    - (c) Any material change in circumstances (including, but without limitation, change in expansion, or cessation of the mining operations to which this consent relates)

    for the purposes of:

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Otago Regional Council

(i) Dealing with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage.
(ii) Requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment.
(iii) Ensuring the conditions of this consent are appropriate.

23. *Deleted*

Issued at Dunedin this 4th day of March 1998
Reissued at Dunedin on this 10th day of January 2003 with changes to the standard conditions (Additions underlined and italicised, deletions struck out).
Reissued at Dunedin on this 16th day of June 2004, to reflect a name change, and changes to condition 3 (additions underlined and italicised, deletions struck out).
Reissued at Dunedin on this 11th day of October 2005, to reflect changes to the standard conditions (additions underlined and italicised, deletions struck out).
Reissued at Dunedin on this 27th day of October 2005, to reflect changes to condition 3 (additions underlined and italicised, deletions struck out).
Reissued at Dunedin on this 19th day of March 2015, to reflect changes to the address of the consent holder, the purpose of the consent, the consent location, the expiry date, Conditions 2, 4, 7 – 12, 14 – 17 and 19 – 21, Appendix II, the addition of conditions 8a, 16a, 16b, 21a, 21b and 21c, and the deletion of Conditions 13, 18 and 23.

Christopher P Shaw
Manager Consents

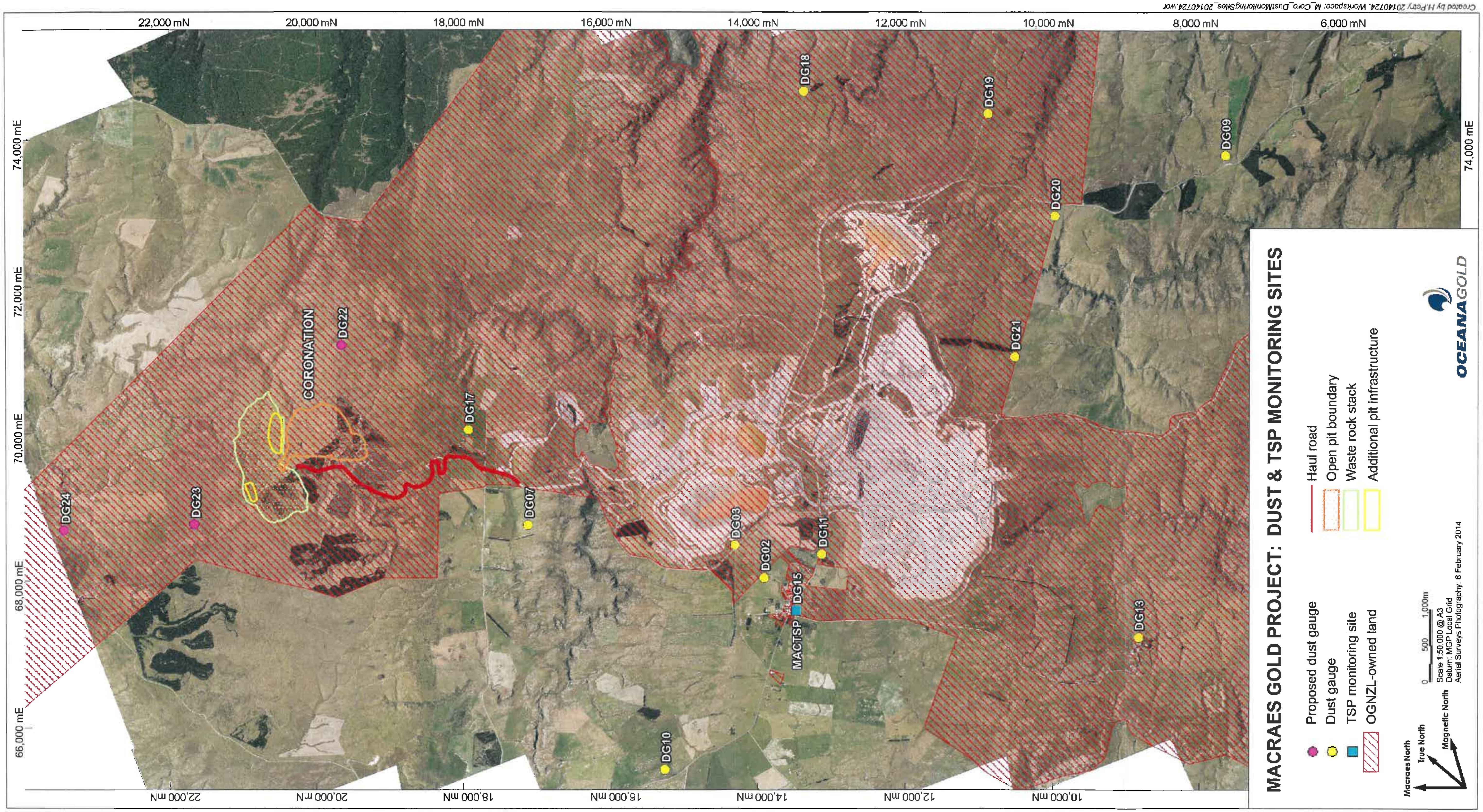
Telarc REGISTERED
QUALITY ISO 9001

ORIGINAL

Otago Regional Council

Appendix I

Telarc REGISTERED
QUALITY ISO 9001


MACRAES GOLD PROJECT: DUST & TSP MONITORING SITES
Proposed dust gauge
Dust gauge
TSP monitoring site
OGNZL-owned land
Haul road
Open pit boundary
Waste rock stack
Additional pit infrastructure
OCEANAGOLD
Scale 1:50 000 @ A3
Datum: MGP Local Grid
Aerial Surveys Photography: 6 February 2014
Macraes North
True North
Magnetic North
CORONATION
MACTSP
DG02
DG03
DG07
DG09
DG10
DG11
DG13
DG15
DG17
DG18
DG19
DG20
DG21
DG22
DG23
DG24
22,000 mN
20,000 mN
18,000 mN
16,000 mN
14,000 mN
12,000 mN
10,000 mN
8,000 mN
6,000 mN
74,000 mE
72,000 mE
70,000 mE
68,000 mE
66,000 mE

Appendix II

Our Reference: A384183 Consent No. RM10.351.52

DISCHARGE PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Oceana Gold (New Zealand) Limited
Address:

To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations

For a term expiring: 31 August 2032

Location of consent activity: Macraes Gold Project, Macraes Flat

Legal description of consent activity: Various

Map Reference: Within a three kilometre radius of NZTM 2000 E1400484 N4973117

Conditions
Specific

1. This consent shall be exercised in conjunction with Discharge Permit 96785 and Discharge Permit 2006.689.

2. For the purpose of this consent, the "Macraes Gold Project site" is that property owned by the Consent Holder as identified on Appendix I attached.

3. This consent will be exercised substantially in accordance with the Macraes Phase III Assessment of Environmental Effects dated 2 May 2011 and Appendix 31, Beca Infrastructure Ltd, Assessment of Environmental Effects of Air Discharges, 7 April 2011, except to the extent that any condition in this consent is inconsistent with such material. If there is an inconsistency the conditions and terms of this consent prevail.

4. This consent authorises the discharge of contaminants to air from the Macraes Gold Project site, other than where the discharge of contaminants to air in that area is authorised by Discharge Permit 96785 or Discharge Permit 2006.689.

5. There shall be no visible dust beyond the boundary of the Macraes Gold Project site that, in the opinion of an enforcement officer, is offensive or objectionable to such an extent that it has an adverse effect on the environment.

Performance Monitoring

6. Insoluble dust deposition rates at sites DG07, DG20 and DG21, as shown on Appendix I attached, must not exceed 3 grams per square metre per 30 days ($g/m^2/30$ days) of insoluble dust above background more than twice in any

calendar year. Compliance with this condition shall be demonstrated by the monitoring required in Condition 11 of this consent.

7. Insoluble dust deposition rates at sites DG02 and DG15, as shown on Appendix I attached, must not exceed 3 grams per square metre per 30 days ($g/m^2/30$ days) of insoluble dust above background. Compliance with this condition will be demonstrated by the monitoring required in Condition 11 of this consent.

8. Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG17 as shown on Appendix I attached.

9. Twenty-four hour average total suspended particulate at site DG15, as shown on Appendix I attached, must not exceed $120\mu g/m^3$. Compliance with this condition will be demonstrated by the monitoring required in Condition 12 of this consent.

10. In the event of any exceedance of those limits specified in Conditions 6, 7 and 9 of this consent, the Consent Holder must undertake an immediate review of the cause of the exceedance. A report detailing the findings of this review shall be provided to the Consent Authority within 1 month of the non-compliant result(s) being received. If it is shown that activities within the Macraes Gold Project site were the cause of the exceedance, then dust mitigation measures within the Macraes Gold Project shall be reviewed by an independent consultant engaged in consultation with the Consent Authority. The independent consultant shall provide a report summarising the cause of the exceedance and recommending measures to improve dust mitigation at the Macraes Gold Project site so that the exceedance does not occur again. This report shall be provided to the Consent Authority within 2 months of the non-compliant result(s) being received.

11. The consent holder shall monitor dust deposition rates at monthly intervals in accordance with draft ISO Standard ISO/SIS 4222.2 ("Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method" 1980), or another method approved in writing by the Consent Authority. The monitoring shall be undertaken at the sites shown on Appendix I attached.

12.

(a) The consent holder shall monitor real time total suspended particulate concentrations at site DG15 as shown on Appendix I attached. The monitoring shall be undertaken using a nephelometer, or other instrument as agreed in writing by the Consent Authority. The instrument shall be sited in accordance with AS/NZS 3580.1.1:2007.

(b) The consent holder shall monitor total suspended particulate at monitoring site DG15 as shown on Appendix I in accordance with Australian Standard AS/NZS3580.9.3:2003 (Determination of suspended particulate matter - Total Suspended Particulates [TSP] - High Volume Sampler Gravimetric Method), or another method approved by the Consent Authority. Twenty-four hour measurements must be taken every six days March to October inclusive, and every three days November to February inclusive, for a minimum period of twelve months or for however long is required to ensure that adequate data is collected to achieve the objectives of Condition 12(d).

(c) Parameters to be recorded shall include, but not be limited to:
   i. Hourly average TSP concentrations as measured by the instrument installed in accordance with Condition 12(a) of this consent;
   ii. 24-hour average TSP concentrations as measured by the instruments installed in accordance with Conditions 12(a) and 12(b).

(d) The instruments installed in accordance with Conditions 12(a) and 12(b) shall be operated concurrently for a period of no less then twelve months to ensure that twelve months of coincident data is collected. A correlation between the data shall be established by an independent consultant engaged in consultation with the Consent Authority. A report detailing this investigation shall be provided to the Consent Authority within two months of the data being collected.

13.

(a) Meteorological conditions shall be continuously monitored and recorded at site DG03 as shown on Appendix I attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall. Sufficient information shall also be measured to allow an estimate of atmospheric stability. These estimates shall be obtained from measurements of solar radiation and temperature at two heights above ground level, or other parameters as approved by the Consent Authority.

(b) Meteorological conditions shall be continuously monitored and recorded at site DG15 as shown on Appendix I attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall.

14. The consent holder shall keep a daily record of water used for dust suppression. These records shall be made available to the Consent Authority on request.

15. Results of all monitoring undertaken in accordance with this consent shall be reported to the Consent Authority on a quarterly basis. The format of the report shall be agreed upon in consultation with the Consent Authority.

16. Prior to the exercise of this consent, the consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:

(a) A description of potential dust sources and the factors influencing dust generation;

(b) Dust mitigation measures and procedures including, but not limited to:
   i) Minimising the areas of disturbed ground;
   ii) Watering, with water trucks and fixed sprinklers;
   iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;
   iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;
   v) Ensuring materials being moved are kept in a coarse state;
   vi) Covering materials; and

vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.

(c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;

(d) Procedures for managing and addressing air quality or odour related complaints; and

(e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Condition 18 of this consent.

17. The consent holder shall review the Dust Management Plan annually taking into account the following:

(a) The outcomes of reviews completed in accordance with Condition 10 and 18 of this consent; and

(b) Whether management practices are resulting in compliance with the conditions of this consent.

Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring.

18. An independent consultant, engaged by the Consent Holder in consultation with the Consent Authority, shall undertake an annual review and assessment of all dust monitoring data. The reviewer's report shall include:

(a) The name, qualifications, and experience of the reviewer;

(b) The methods used and the investigations undertaken for the review;

(c) Interpretation of the monitoring data reviewed;

(d) An assessment of the quality of the monitoring data;

(e) An assessment of the monitoring regime;

(f) A description and evaluation of each of the dust mitigation measures used by the consent holder;

(g) Recommendations on whether:

i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended;

ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended; and

iii) Any changes should be made to the conditions of this consent; and

(h) Any other matters that the reviewer considers should be drawn to the attention of the consent holder or the Consent Authority.

19. The annual report required by Condition 18 shall be provided to the Consent Authority by 30 April each year.

20. In the event of any non compliance with the conditions of this consent, the consent holder shall notify the Consent Authority within 24 hours of the non

compliance being detected. Within five working days the consent holder shall provide written notification to the Consent Authority providing details of the non-compliance. This notification will at a minimum include an explanation of the cause of the non compliance, the steps taken to remedy the situation and steps taken to mitigate any future occurrence of the non compliance.

21. The consent holder shall pay to the Consent Authority, the costs for monitoring, enforcing and administering this consent as agreed upon between the consent holder and the Consent Authority pursuant to Section 36 of the Resource Management Act 1991.

22. The consent holder shall maintain a record of any complaints received regarding their operation. The register shall include, but not be limited to:
(a) name and location of site where the problem is experienced;
(b) nature of the problem;
(c) date and time problem occurred, and when reported;
(d) action taken by consent holder to remedy the situation and any policies or methods put in place to avoid or mitigate the problem occurring again.

The register of complaints shall be incorporated into the Project Overview and Annual Work and Rehabilitation Plan.

General

23. The Consent Authority may, within 6 months of receipt of the Cultural Impact Assessment prepared by Kai Tahu ki Otago on behalf of Te Runanga o Moeraki and Kāti Huirapa Rūnaka ki Puketeraki, commissioned in 2011, serve notice of its intention to review the conditions of this consent for the purpose of amending or adding conditions to address mitigation of the effect(s) of the exercise of this consent on cultural values and associations. All costs associated with any such review shall be borne by the consent holder.

24. (a) The consent holder shall provide and maintain in favour of the Consent Authority one or more bonds to secure:
    i) The performance and completion of rehabilitation in accordance with the conditions of this consent; and
    ii) The carrying out of the monitoring required by the conditions of this consent; and
    iii) The remediation of any adverse effect on the environment that may arise from the exercise of this consent.
    iv) Compliance with Conditions 24(m) to 24(q) of this consent.

(b) Before the first exercise of this consent, the consent holder shall provide to the Consent Authority one or more bonds required by Condition 24(a).
(c) Subject to the other provisions of this consent, any bond shall be in the form and on the terms and conditions approved by the Consent Authority.
(d) Any bond shall be given or guaranteed by a surety acceptable to the Consent Authority.
(e) The surety shall bind itself to pay for the carrying out and completion of the conditions of consent which are the subject of the bond on default by the consent holder or the occurrence of any adverse environment effect requiring remedy; during or after the expiry of this consent.

(f) The amount of each bond shall be fixed annually by the Consent Authority which will take into account any calculations and other matters submitted by the consent holder relevant to the determination of the amount to be bonded in the Project Overview and Annual Work and Rehabilitation Plan, or otherwise.

(g) The amount of the bond(s) shall include:

i) The estimated costs of complete rehabilitation in accordance with the conditions of consent on the completion of the mining operations proposed for the next year and described in the Project Overview and Annual Work and Rehabilitation Plan.

ii) The estimated costs of:

- Monitoring in accordance with the monitoring conditions of the consent;
- Monitoring for and of any adverse effect of the activity authorised by this consent which may become apparent during or after expiry of this consent;
- Monitoring any rehabilitation required by this consent.

iii) Any further sum which the Consent Authority considers necessary for monitoring and dealing with any adverse effect on the environment that may arise from the exercise of the consent whether during or after the expiry of this consent.

(h) The amount shall be calculated for the duration of this consent and for a period of 20 years after its expiry.

(i) If, on review, the total amount of bond to be provided by the consent holder is greater or less than the sum secured by the current bond(s), the consent holder, surety and the Consent Authority may, in writing, vary the amount of the bond(s).

(j) While the liability of the surety is limited to the amount of the bond(s), the liability of the consent holder is unlimited.

(k) Any bond may be varied, cancelled, or renewed at any time by written agreement between the consent holder, surety and Consent Authority.

(l) The costs (including the costs of the Consent Authority) of providing, maintaining, varying and reviewing any bond shall be paid by the consent holder.

(m) For a period of 20 years from the expiry or surrender of this consent the consent holder shall provide in favour of the Consent Authority one or more bonds.

(n) The amount of the bond to be provided under Condition 24(m) shall include the amount (if any) considered by the Consent Authority necessary for:

i) Completing rehabilitation in accordance with the conditions of this consent.

ii) Monitoring for and of any adverse effect on the environment that may arise from the exercise of the consent.

iii) Monitoring any measures taken to prevent, remedy or mitigate any adverse effect on the environment that may arise from the exercise of this consent.

iv) Dealing with any adverse effect on the environment which may become apparent after the surrender or expiry of this consent.

v) Contingencies.

(o) Without limitation, the amount secured by the bond given under Condition 24(m) may include provision to deal with structural instability or failure, land

and water contamination, and the failure of rehabilitation in terms of the rehabilitation objectives and conditions of this consent. Costs shall include costs of investigating, preventing, remedying or mitigating any adverse effect.

(p) The bond(s) required by Condition 24(m) must be provided on the earlier of:

i) 12 months before the expiry of this consent.

ii) Three months before the surrender of this consent.

(q) Conditions 24(c), (d), (e), (h), (i), (j) and (k) apply to the bond(s) required by Condition 24(m).

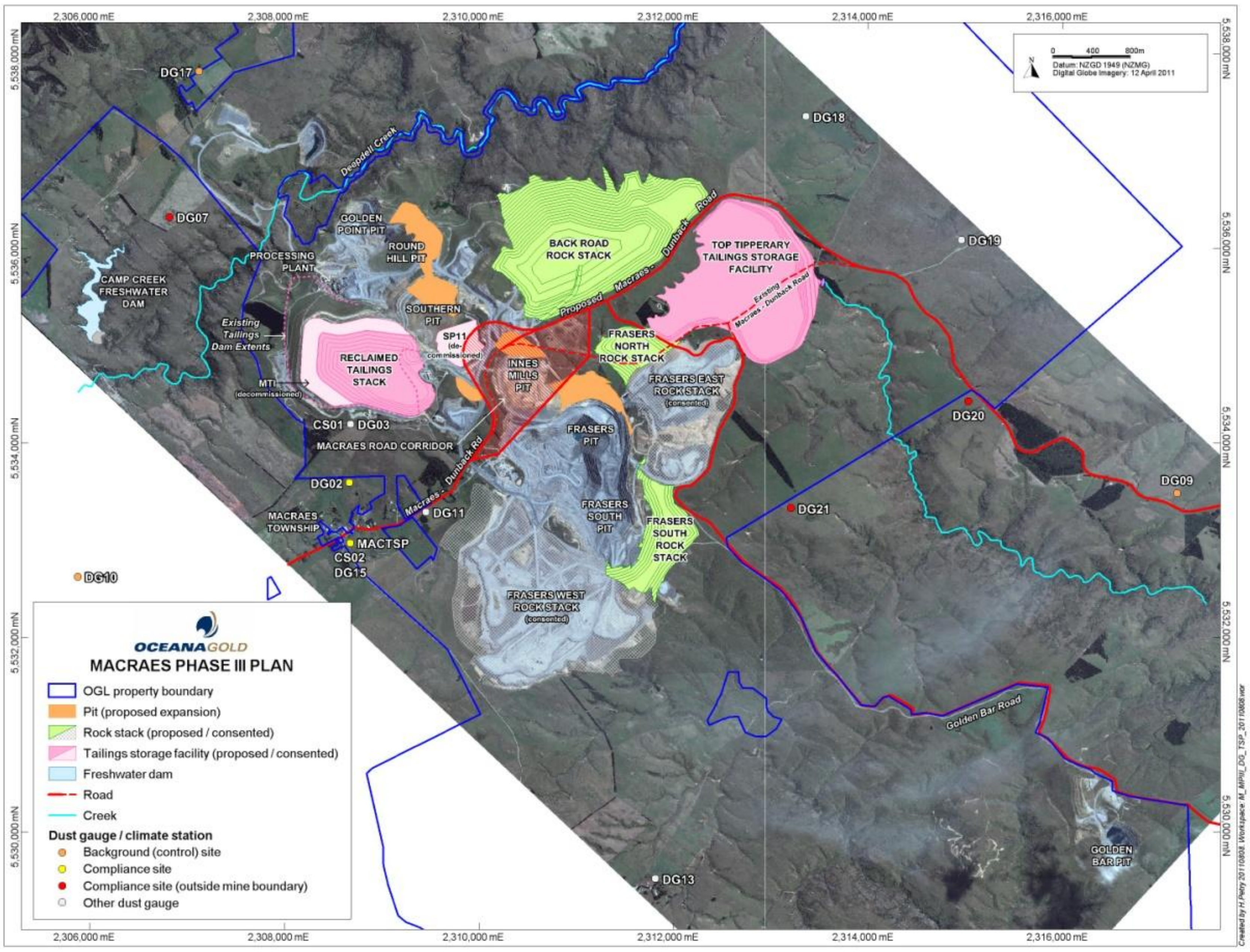
25. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within three months of each anniversary of the commencement of this consent, for the purpose of:

(a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent; or

(b) ensuring the conditions of this consent are consistent with any National Environmental Standards; or

(c) requiring the consent holder to adopt the best practicable option, in order to remove or reduce any adverse effect on the environment arising as a result of the exercise of this consent.

Appendix I



OCEANAGOLD
MACRAES PHASE III PLAN
OGL property boundary
Pit (proposed expansion)
Rock stack (proposed / consented)
Tailings storage facility (proposed / consented)
Freshwater dam
Road
Creek
Dust gauge / climate station
Background (control) site
Compliance site
Compliance site (outside mine boundary)
Other dust gauge
Datum: NZGD 1949 (NZMG)
Digital Globe Imagery: 12 April 2011
BACK ROAD ROCK STACK
TOP TIPPERARY TAILINGS STORAGE FACILITY
RECLAIMED TAILINGS STACK
GOLDEN POINT PIT
ROUND HILL PIT
SOUTHERN PIT
PROCESSING PLANT
CAMP CREEK FRESHWATER DAM
Existing Tailings Dam Extents
INNES MILLS PIT
FRASERS NORTH ROCK STACK
FRASERS EAST ROCK STACK (consented)
FRASERS PIT
FRASERS SOUTH PIT
FRASERS SOUTH ROCK STACK
FRASERS WEST ROCK STACK (consented)
MACRAES ROAD CORRIDOR
MACRAES TOWNSHIP
GOLDEN BAR PIT
Golden Bar Road
Deepdell Creek
DG17
DG07
DG18
DG19
DG20
DG09
DG21
DG11
DG02
DG10
DG13
CS01
DG03
MACTSP
CS02
DG15
2,306,000 mE
2,308,000 mE
2,310,000 mE
2,312,000 mE
2,314,000 mE
2,316,000 mE
5,538,000 mN
5,536,000 mN
5,534,000 mN
5,532,000 mN
5,530,000 mN

Our Reference: A571409 Consent No. RM12.378.15

DISCHARGE PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Oceana Gold (New Zealand) Limited

Address: Level 3, Taunton Mews, 22 Maclaggan Street, Dunedin

To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations

For a term expiring: 31 August 2032

Location of consent activity: Macraes Gold Project, approximately 6.5 kilometres to the northwest of the intersection of Macraes Road and Red Bank Road, Macraes Flat.

Legal description of consent activity: Pt Section 2 Blk V Highlay SD, Pt Section 2 Blk VII Highlay SD, Section 2 Blk VII Highlay SD, Pt Secs 11 and 12 Blk VII Highlay SD, Road Reserve

Map Reference: Within a 1 kilometre radius of NZTM2000 1395770 E 4977492 N

Conditions

Specific

1. This consent shall be exercised in conjunction with Discharge Permit 96785, Discharge Permit 2006.689, Discharge Permit RM10.351.52 and any subsequent variations to these permits.

2. This consent authorises the discharge of contaminants to air from the Coronation Waste Rock Stack, Coronation Pit and associated haul roads, as shown on Appendix I attached.

3. There shall be no visible dust beyond the boundary of the Macraes Gold Project site that, in the opinion of an enforcement officer, is offensive or objectionable to such an extent that it has an adverse effect on the environment, including the human environment.

Performance Monitoring

4. Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG23, as shown on Appendix I and Appendix II attached, must not exceed 3 grams per square metre per 30 days (g/m^2/30 days) of insoluble dust above background more than twice in any calendar year. Compliance with this condition shall be demonstrated by the monitoring required in Condition 9 of this consent.

5. Insoluble dust deposition rates at sites DG02 and DG15, as shown on Appendix I and Appendix II attached, must not exceed 3 grams per square metre per 30 days (g/m^2/30 days) of insoluble dust above background. Compliance with this condition will be demonstrated by the monitoring required in Condition 9 of this consent.

6. Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24 as shown on Appendix I and Appendix II attached.

7. Twenty-four hour average total suspended particulate at site DG15, as shown on Appendix I attached, must not exceed $120 \mu g/m^3$. Compliance with this condition will be demonstrated by the monitoring required in Condition 10 of this consent.

8. In the event of any exceedance of those limits specified in Conditions 4, 5 and 7 of this consent, the Consent Holder must undertake an immediate review of the cause of the exceedance. A report detailing the findings of this review shall be provided to the Consent Authority within 1 month of the non-compliant result(s) being received. If it is shown that activities within the Macraes Gold Project site were the cause of the exceedance, then dust mitigation measures within the Macraes Gold Project shall be reviewed by an independent consultant engaged in consultation with the Consent Authority. The independent consultant shall provide a report summarising the cause of the exceedance and recommending measures to improve dust mitigation at the Macraes Gold Project site so that the exceedance does not occur again. This report shall be provided to the Consent Authority within 2 months of the non-compliant result(s) being received.

9. The consent holder shall monitor dust deposition rates at monthly intervals in accordance with draft ISO Standard ISO/DIS 4222.2 ("Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method" 1980), or another method approved in writing by the Consent Authority. The monitoring shall be undertaken at the sites shown on Appendix I and Appendix II attached.

10.
   (a) The consent holder shall monitor real time total suspended particulate concentrations at site DG15 as shown on Appendix I attached. The monitoring shall be undertaken using a nephelometer, or other instrument as agreed in writing by the Consent Authority. The instrument shall be sited in accordance with AS/NZS 3580.1.1:2007 (Methods for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment).
   (b) The consent holder shall monitor total suspended particulate at monitoring site DG15 as shown on Appendix I in accordance with Australian Standard AS/NZS3580.9.3:2003 (Determination of suspended particulate matter - Total Suspended Particulates [TSP] - High Volume Sampler Gravimetric Method), or another method approved by the Consent Authority. Twenty-four hour measurements must be taken every six days March to October inclusive, and every three days November to February inclusive, for a minimum period of twelve months

or for however long is required to ensure that adequate data is collected to achieve the objectives of Condition 10(d).

(c) Parameters to be recorded shall include, but not be limited to:

i) Hourly average TSP concentrations as measured by the instrument installed in accordance with Condition 10(a) of this consent;

ii) 24-hour average TSP concentrations as measured by the instruments installed in accordance with Conditions 10(a) and 10(b).

(d) The instruments installed in accordance with Conditions 10(a) and 10(b) shall be operated concurrently for a period of no less then twelve months to ensure that twelve months of coincident data is collected. A correlation between the data shall be established by an independent consultant engaged in consultation with the Consent Authority. A report detailing this investigation shall be provided to the Consent Authority within two months of the data being collected.

11.

(a) Meteorological conditions shall be continuously monitored and recorded at site DG03 as shown on Appendix I attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall. Sufficient information shall also be measured to allow an estimate of atmospheric stability. These estimates shall be obtained from measurements of solar radiation and temperature at two heights above ground level, or other parameters as approved by the Consent Authority.

(b) Meteorological conditions shall be continuously monitored and recorded at site DG15 as shown on Appendix I attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall.

12. The consent holder shall keep a daily record of water used for dust suppression. These records shall be made available to the Consent Authority on request.

13. Results of all monitoring undertaken in accordance with this consent shall be reported to the Consent Authority on a quarterly basis. The format of the report shall be agreed upon in consultation with the Consent Authority.

14. Prior to the exercise of this consent, the consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:

(a) A description of potential dust sources and the factors influencing dust generation;

(b) Dust mitigation measures and procedures including, but not limited to:

i) Minimising the areas of disturbed ground;

ii) Watering, with water trucks and fixed sprinklers;

iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;

iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;

v) Ensuring materials being moved are kept in a coarse state;
vi) Covering materials; and
vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.

(c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;
(d) Procedures for managing and addressing air quality or odour related complaints; and
(e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Condition 18 of this consent.

15. The consent holder shall review the Dust Management Plan annually taking into account the following:
(a) The outcomes of reviews completed in accordance with Conditions 8 and 16 of this consent; and
(b) Whether management practices are resulting in compliance with the conditions of this consent.

Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring.

16. An independent consultant, engaged by the Consent Holder in consultation with the Consent Authority, shall undertake an annual review and assessment of all dust monitoring data. The reviewer's report shall include:
(a) The name, qualifications, and experience of the reviewer;
(b) The methods used and the investigations undertaken for the review;
(c) Interpretation of the monitoring data reviewed;
(d) An assessment of the quality of the monitoring data;
(e) An assessment of the monitoring regime;
(f) A description and evaluation of each of the dust mitigation measures used by the consent holder;
(g) Recommendations on whether:
i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended;
ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended; and
iii) Any changes should be made to the conditions of this consent; and

(h) Any other matters that the reviewer considers should be drawn to the attention of the consent holder or the Consent Authority.

17. The annual report required by Condition 16 shall be provided to the Consent Authority by 30 April each year.

18. In the event of any non compliance with the conditions of this consent, the consent holder shall notify the Consent Authority within 24 hours of the non compliance being detected. Within five working days the consent holder shall provide written notification to the Consent Authority providing details of the non-compliance. This notification will at a minimum include an explanation of the cause of the non compliance, the steps taken to remedy the situation and steps taken to mitigate any future occurrence of the non compliance.

19. The consent holder shall maintain a record of any complaints received regarding their operation. The register shall include, but not be limited to:
(a) name and location of site where the problem is experienced;
(b) nature of the problem;
(c) date and time problem occurred, and when reported;
(d) action taken by consent holder to remedy the situation and any policies or methods put in place to avoid or mitigate the problem occurring again.

The register of complaints shall be incorporated into the Project Overview and Annual Work and Rehabilitation Plan.

General

20. The Consent Authority may, within 6 months of receipt of the Coronation Project Addendum to the MPIII Cultural Impact Assessment prepared by Kai Tahu ki Otago on behalf of Te Runanga o Moeraki, Te Runanga o Otakou and Kati Huirapa Runaka ki Puketeraki, commissioned in 2013, serve notice of its intention to review the conditions of this consent for the purpose of amending or adding conditions to address mitigation of the effect(s) of the exercise of this consent on cultural values and associations. All costs associated with such review shall be borne by the consent holder

21. (a) The consent holder shall provide and maintain in favour of the Consent Authority one or more bonds to secure:
    i) The performance and completion of rehabilitation in accordance with the conditions of this consent; and
    ii) The carrying out of the monitoring required by the conditions of this consent; and
    iii) The remediation of any adverse effect on the environment that may arise from the exercise of this consent.
    iv) Compliance with Conditions 21(m) to 21(q) of this consent.

(b) Before the first exercise of this consent, the consent holder shall provide to the Consent Authority one or more bonds required by Condition 21(a).
(c) Subject to the other provisions of this consent, any bond shall be in the form and on the terms and conditions approved by the Consent Authority.
(d) Any bond shall be given or guaranteed by a surety acceptable to the Consent Authority.
(e) The surety shall bind itself to pay for the carrying out and completion of the conditions of consent which are the subject of the bond on default by the consent holder or the occurrence of any adverse environment effect requiring remedy; during or after the expiry of this consent.
(f) The amount of each bond shall be fixed annually by the Consent Authority which will take into account any calculations and other matters submitted by the

consent holder relevant to the determination of the amount to be bonded in the Project Overview and Annual Work and Rehabilitation Plan, or otherwise.

(g) The amount of the bond(s) shall include:

i) The estimated costs of complete rehabilitation in accordance with the conditions of consent on the completion of the mining operations proposed for the next year and described in the Project Overview and Annual Work and Rehabilitation Plan.

ii) The estimated costs of:

- Monitoring in accordance with the monitoring conditions of the consent;
- Monitoring for and of any adverse effect of the activity authorised by this consent which may become apparent during or after expiry of this consent;
- Monitoring any rehabilitation required by this consent.

iii) Any further sum which the Consent Authority considers necessary for monitoring and dealing with any adverse effect on the environment that may arise from the exercise of the consent whether during or after the expiry of this consent.

(h) The amount shall be calculated for the duration of this consent and for a period of 20 years after its expiry.

(i) If, on review, the total amount of bond to be provided by the consent holder is greater or less than the sum secured by the current bond(s), the consent holder, surety and the Consent Authority may, in writing, vary the amount of the bond(s).

(j) While the liability of the surety is limited to the amount of the bond(s), the liability of the consent holder is unlimited.

(k) Any bond may be varied, cancelled, or renewed at any time by written agreement between the consent holder, surety and Consent Authority.

(l) The costs (including the costs of the Consent Authority) of providing, maintaining, varying and reviewing any bond shall be paid by the consent holder.

(m) For a period of 20 years from the expiry or surrender of this consent the consent holder shall provide in favour of the Consent Authority one or more bonds.

(n) The amount of the bond to be provided under Condition 21(m) shall include the amount (if any) considered by the Consent Authority necessary for:

i) Completing rehabilitation in accordance with the conditions of this consent.

ii) Monitoring for and of any adverse effect on the environment that may arise from the exercise of the consent.

iii) Monitoring any measures taken to prevent, remedy or mitigate any adverse effect on the environment that may arise from the exercise of this consent.

iv) Dealing with any adverse effect on the environment which may become apparent after the surrender or expiry of this consent.

v) Contingencies.

(o) Without limitation, the amount secured by the bond given under Condition 21(m) may include provision to deal with structural instability or failure, land and water contamination, and the failure of rehabilitation in terms of the rehabilitation objectives and conditions of this consent. Costs shall include costs of investigating, preventing, remedying or mitigating any adverse effect.

(p) The bond(s) required by Condition 21(m) must be provided on the earlier of:

i) 12 months before the expiry of this consent.

ii) Three months before the surrender of this consent.

(q) Conditions 21(c), (d), (e), (h), (i), (j) and (k) apply to the bond(s) required by Condition 21(m).

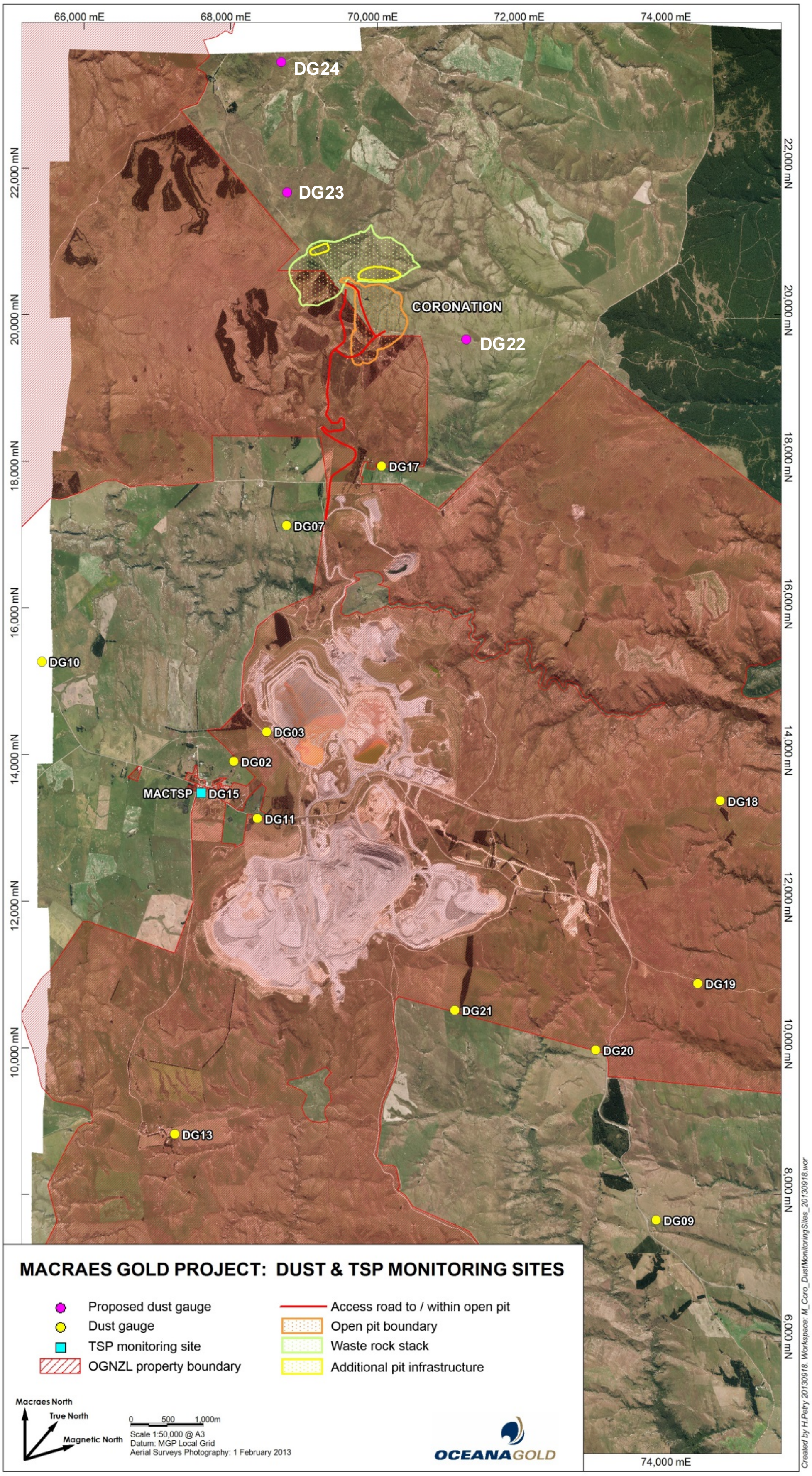
22. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within three months of each anniversary of the commencement of this consent, for the purpose of:

(a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent; or

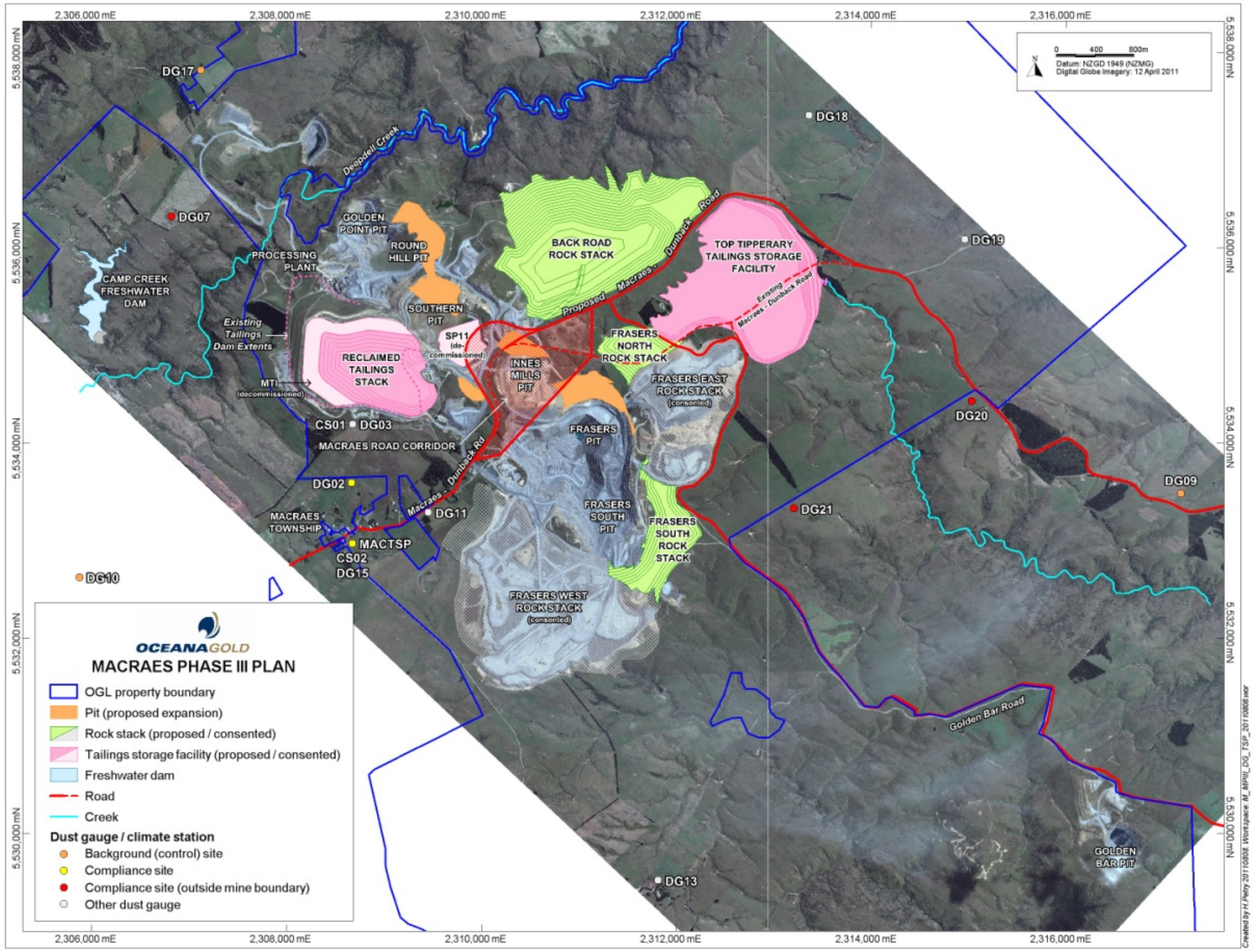
(b) ensuring the conditions of this consent are consistent with any National Environmental Standards; or

(c) requiring the consent holder to adopt the best practicable option, in order to remove or reduce any adverse effect on the environment arising as a result of the exercise of this consent.

Appendix I
RM12.378.15



Appendix II
RM12.378.15



Appendix B

Tailings Storage Facilities Dust Control Manual

Tailings Storage Facilities

Dust Control Manual

April 2019

Table of Contents

1 INTRODUCTION

The Macraes operation currently has three tailings storage facilities. Two of these, the Southern Pit Tailings Impoundment option 11A and the Mixed Tailings Impoundment, are currently in a resting state. There is currently no tailings discharge to these embankments however both have not yet been decommissioned and so have the potential to receive more tailings material. All tailings material is currently being deposited into the Top Tipperary Tailings Storage Facility which is located to the east of the Frasers Pit.

This manual details dust control methods that are used to control and minimise the transmission of dust particles around and away from the tailings facilities.

The design of all three tailings storage facilities has been carried out by Engineering Geology Ltd (EGL) and a description of the embankment design and operation is contained in the Design Report for each impoundment. Reference should be made to these as required.

Details of the operation, maintenance and surveillance of the tailings storage facilities can be found in the respective Operation, Maintenance and Surveillance Manuals.

2 RESPONSIBILITIES

Oceana Gold (NZ) Ltd (OceanaGold), as owners of the tailings storage impoundments are ultimately responsible for the control of dust.

Supervision and monitoring of the quality of construction is undertaken by OceanaGold as is regular monitoring, maintenance and surveillance as detailed in the respective Manuals.

The installation and maintenance of dust control systems is the responsibility of the Projects and Civil Works departments.

The operation of dust control systems and the tailings distribution system is the responsibility of the Process Supervisor. A Daily Decision Tree (attached) is available to assist with operation of dust control systems.

Whilst the above listed departments are responsible for the control of dust, it is the responsibility of all staff to ensure that the systems in place are adequate and being operated correctly and when required. The impoundments are inspected periodically throughout the day however conditions may change between inspections. Any reports of excess dust should be alerted to the Environmental, Projects or Processing departments.

3 ENVIRONMENTAL CONDITIONS

During spring, the Macraes District is frequently subjected to strong drying winds. Wind gusts in excess of 100km/hr are not uncommon and the winds can continue for several days without ceasing. The worst of the winds are often experienced between August and October although strong winds at other times are not uncommon.

Dust generation does not however only occur during periods of strong wind. Particles begin to be mobilised at wind speeds of 5m/s. This means that lower winds also have an effect on the tailings surface and can move large amounts of dust. As the wind speed increases, the mobilised particles start to dislodge other particles and this can result in large movements of particles or dust. Also the finer the particles are, the more prone to movement they are.

When conditions have been dry and windy for extended periods of time, the surface of the embankments becomes dry which leads the particles to become more easily entrained by the wind. The water on the surface of the tailings binds the surface and increases the cohesion between particles making them harder to move. Whilst wind speed cannot be controlled, the moisture of the tailings surface can and so this can determine the dust suppression technique used to control dust as seen in the below section.

To assist with predicting times of high wind and limited rain, a weather forecasting service is provided at www.metconnect.co.nz, Login: Oceana, Password: au weather.

4 METHODS OF DUST CONTROL

4.1 Tailings Discharge

During and immediately following periods of active tailings discharge the tailings beach surface remains sufficiently damp that the potential for windborne dust generation is very low.

Tailings deposition is sequentially moved around the impoundment to decrease the chance that the tailings surface could dry out and become prove to dust creation. Tailings deposition is manually redirected around the impoundment through the use of knife gate valves to direct the tailings to a general area while spigots are used to control localised tailings deposition. This method of deposition also helps to keep the tailings surface level which limits localised drying conditions.

Tailings discharge to the Top Tipperary Tailings Storage Facility commenced in October 2013. Both the Southern Pit 11 Tailings Impoundment and Mixed Tailings Impoundment are therefore currently not in use and tailings discharge will only occur into these impoundments at times of maintenance to the Top Tipperary tailings discharge system. Dust control requirements on the Top Tipperary Tailings Storage Facility will therefore be minimal as tailings will be continuously discharged to this facility and the beach is unlikely to dry sufficiently to generate dust.

4.2 Rock Mattress Cover

Experience has shown that the area of the tailings surface with the most potential for dust generation is the tailings beach adjacent to the embankment crest.

As construction of both the Southern Pit 11 and Mixed Tailings Impoundments has been completed, capping of the outer regions of the surface has commenced. This involves placing a rock mattress over the tailings surface of the impoundment. This rock mattress can consist of topsoil, grey rock or brown rock. The rock mattress will gradually extend across the entirety of the impoundment and will be covered in topsoil and vegetation. The purpose of the mattress is to prevent tailings surface exposure which removes the chance that it could be mobilised.

For details of the rock mattress and capping refer to the design documents and closure plan for each impoundment.

4.3 Dust Suppression System

A dust suppression system will be established following each stage of rockfill mattress construction to enable the distribution of water onto the inner surface not covered by the rock mattress. This system needs to be operational from August to March each year however it is prudent to continue to have this system in place at all times.

The dust suppression system generally consists of an outer ring main feeding soak hoses or sprinklers laid out over the tailings surface, however various combinations of open ended pipe discharge can be utilised as necessary to ensure good coverage and wetting.

The dust suppression system should be installed as soon as possible to prevent the risk of the tailings surface drying out. Whilst the strongest drying winds are during August to October, dust can be generated throughout the year.

Preservation of the crust on the dam surface is to be maximised by limiting traffic on the tailings surface wherever possible.

4.4 Existing covers

A layer of topsoil approximately 100mm to 200mm thick has been placed on the dry outer perimeter of the Southern Pit 11 impoundment. In total, approximately 15.5 ha has been topsoiled and vegetated.

Capping of a portion of the Mixed Tailings Impoundment with a rock mattress cover commenced in 2016. Sowing of this surface will occur during the first half of 2017.

5 OPERATION

The tailings distribution system is operated by the Processing Superintendent and follows plans implemented by the Senior Mine Engineer and EGL.

A site-specific model that predicts hourly wind speed, direction and rainfall (provided by the Met Service) is used to assist in the prediction of wind events (note – if heavy rain or rainfall warnings are indicated for Fiordland and the West Coast this will often indicate strong winds on the East Coast). It is the responsibility of the Processing Superintendent to initiate action in accordance with the Model predictions.

The tailings or dust suppression system is to be used 12 hours prior to any anticipated high wind event (defined as an event of greater than 40km/hr winds for greater than 4 hours from a west or northwest direction).

Should wind speeds increase without warning then the system will be activated as required by process operations personnel and the Processing Superintendent will be notified.

6 TRIAL DUST SUPRESSION TECHNIQUES

6.1 Vital Bon-Matt Stonewall

Stonewall is a co-polymer that is applied to the surface of the tailings. The product is diluted in water and then applied through a spray by any method. This could be from a water cart or a knapsack sprayer. The product creates a hard surface that is similar to that which would be seen if glue was applied to the surface. The tailings surface then becomes encapsulated underneath the Stonewall surface. This limits the dust generation by removing the potential for wind to erode the surface. Trials of this dust suppression technique occurred in 2015.

6.2 Vital Strike

Strike is a co-polymer-based fertiliser to promote the growth of seed below its surface and increase soil stability. After seed has been broadcast, Strike is applied in much the same way as Stonewall. There is however fertiliser incorporated into the product which aids in the germination and growth of the seed. Trials of this dust suppression technique occurred in 2015.

6.3 Atomiser

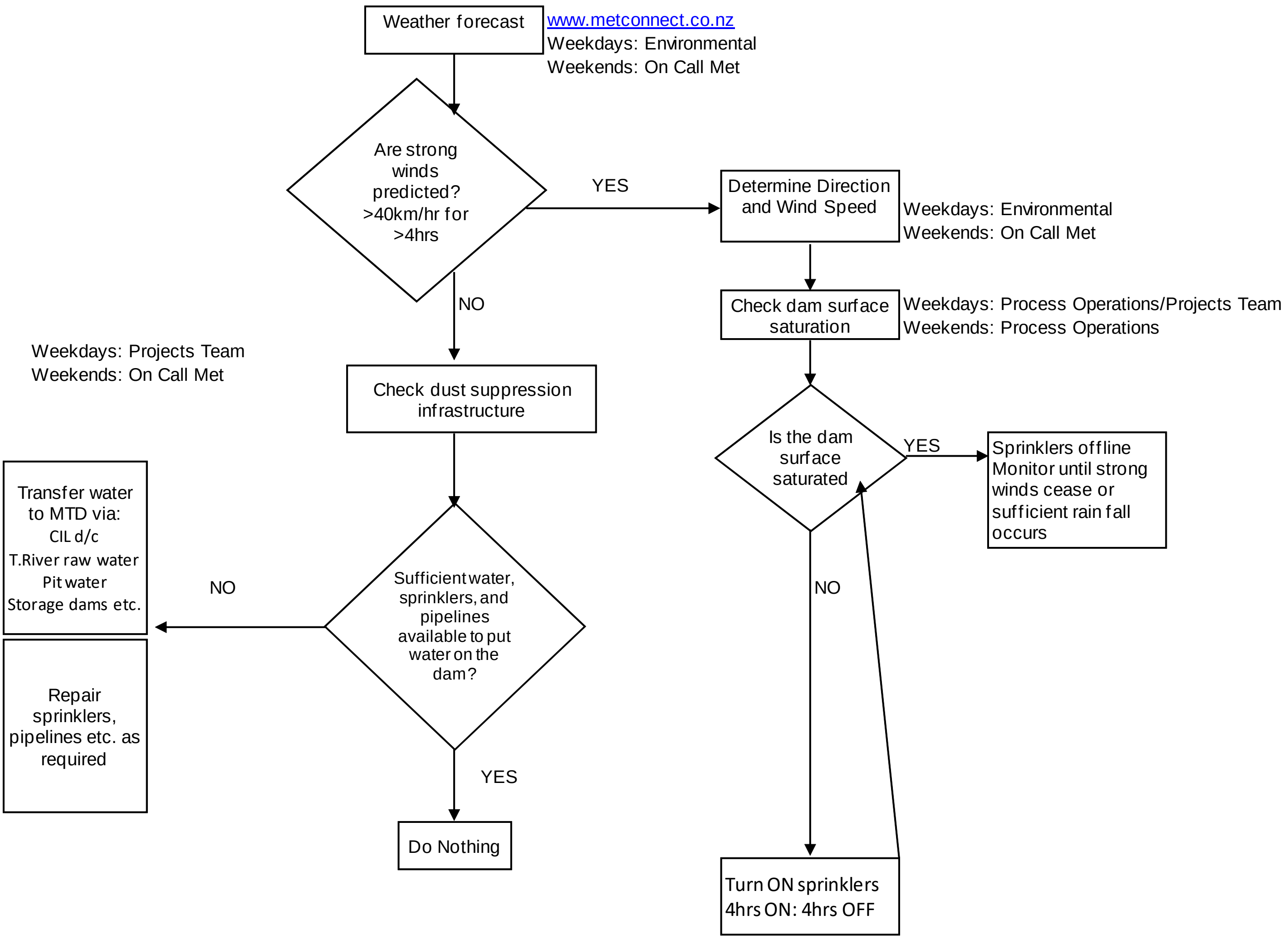
There have been many investigations into atomisers that can generate fog or mist using the process water available inside the impoundment. The aim of these investigations was to try to keep the tailings surface wet, act as a dust curtain, and evaporate any excess water that is inside the impoundment when there is a surplus. To date no trials have been undertaken.

7 MAINTENANCE

The installation and commissioning of any tailings or water distribution system for dust control is the responsibility of the Project Supervisor who once commissioned, hands it over to the Processing Superintendent. Thereafter inspections, monitoring and maintenance activities are the responsibility of operational personnel.

It is also the responsibility of all staff to report breakages or leaks in the pipes to their supervisor or the environmental team. Reports also need to registered as an Environmental Incident Report through INX InControl.

8 DUST SUPPRESSION DAILY DECISION TREE



Appendix C

Beaufort Wind Scale

The Beaufort Wind Scale (Land)

The Beaufort scale was long in use as a system for estimating wind speeds. It was introduced in 1806 by Admiral Sir Francis Beaufort (1774-1857) of the British navy to describe wind effects on a fully rigged man-o-war sailing vessel, and it was later extended to include descriptions of effects on land features as well. Today the accepted international practice is to report wind speed in knots (1 knot equals about 1.85 km, or 1.15 mi, per hour).

The Beaufort scale is divided into a series of values, from 0 for calm winds to 12 and above for hurricanes. Each value represents a specific range and classification of wind speeds with accompanying descriptions of the effects on surface features, as follows:

Beaufort	Avg miles per hour	Avg km per hour	Knots	Surroundings
0 (calm)	0	0	0 – 1	Smoke rises vertically.
1 (light air)	1 – 3	2 – 5	1 – 3	Smoke drift indicates wind direction.
2 (light breeze)	4 – 7	6 – 12	4 – 6	Wind felt on face; leaves rustle.
3 (gentle breeze)	8 – 12	13 – 20	7 – 10	Leaves, small twigs in constant motion.
4 (moderate breeze)	13 – 18	21 – 30	11 – 16	Dust and leaves raised up, branches move.
5 (fresh breeze)	19 – 25	31 – 40	17 – 21	Small trees begin to sway.
6 (strong breeze)	26 – 31	41 – 50	22 – 27	Large branches of trees in motion/
7 (moderate gale)	32 – 38	51 – 61	28 – 33	Whole trees in motion; resistance felt walking against wind.
8 (fresh gale)	39 – 46	62 – 74	34 – 40	Twigs and small branches break from trees.
9 (strong gale)	47 – 55	75 – 89	41 – 47	Larger branches break from trees.
10 (whole gale)	56 – 64	90 – 103	48 – 55	Trees broken and uprooted.
11 (storm)	65 – 74	104 – 119	56 – 63	Widespread damage.
12 (hurricane)	75+	120+	64+	Violence and destruction.

2004, Jeffers Petroglyphs Historic Site

from http://www.kites.org/jo/beaufort.html
and http://www.mountwashington.org/discovery/arcade/wind/beaufort.html

Appendix D

Watercare Services Limited Ambient Air Quality Monitoring Methods

5. Methods

This section provides the methodology and processes used in the measurement of TSP and the meteorological parameters. The instrument maintenance history is recorded in Appendix A.

5.1. Total Suspended Particulates – E-Sampler

TSP was continuously monitored using a Met One E-Sampler-9800. The E-Sampler is a type of nephelometer that measures suspended particulates using a forward laser light scatter system with a gravimetric filter system.

The sample air is drawn into the E-Sampler at 2 litres per minute and passes through the laser light. The suspended particulates in the sample scatter a portion the laser light. This scattered light detected by the sensor is proportional to the particulate mass. The exiting sample air is deposited onto a 47mm filter. The mass on the filter is used to calculate the gravimetric K-factor to correct the E-Sampler light scattering signal. For this monitoring period the TSP concentrations were not corrected by the calculated K-factor.

5.1.1. Quality Assurance

The instrument was operated by Watercare in accordance with the manufacturer’s instructions. This means that the instrument was installed, configured, calibrated and maintained in accordance with the manufacturer’s operational manual.

Maintenance checks, including operational parameter examinations, are conducted, quarterly and 6-monthly. Instrument performance and data checks are carried out daily.

Every hour the E-Sampler operates an automatic self-test for 2-3 minutes. This span/zero test period was excluded from the total flow over the sample period. Particulate matter concentrations have been calculated to standard temperature (0°C) and pressure (1atm). The barometric pressure and temperature used were checked and collected manually from the E-Sampler.

5.2. Total Suspended Particulates – HiVol

TSP was measured on a 1 day in 3 cycle in March 2014 to May 2014, using a Lear Siegler HiVol TSP particulate monitor. The instrument uses a gravimetric method in which a known volume of air is passed through a pre-weighed filter over 24 hours. The filters are then used to calculate the ambient TSP concentration in the air. The result is a 24-hour average, which can be compared to consent limits and other guidelines. OceanaGold was responsible for the monitoring program and analysis of the filters. The sampling information and concentrations in this report were sent via email by OceanaGold.

5.3. Meteorological Parameters

Measurements of meteorology were made with reference to Australian Standard AS 3580.14–2011 *Meteorological monitoring for ambient air quality monitoring applications* and Watercare’s quality system. The make and model of each meteorological sensor is in Appendix A.

5.3.1. Quality Assurance

To ensure compliance with the above method, all meteorological sensors must meet the method performance specifications as well as being installed, configured, calibrated and maintained in accordance with the method's requirements and the manufacturer's instructions. This includes:

- Instrument meets AS 3580.14–2011 performance specifications, including precision and accuracy, and is configured accordingly.
- Daily instrument performance and data checks.
- Six monthly calibration and maintenance including cable and system integrity checks; wind speed and direction sensor sensitivity checks; calibration of ambient temperature, relative humidity, solar radiation and pressure; and rain gauge checks.
- Annual calibration and maintenance as per every six months plus calibration of sensor signal conditioning unit and bearing friction checks of wind speed and wind direction sensors.

5.4. Data Collection

Continuous data from the instruments were logged on-site by a Campbell datalogger every ten minutes at DG15 and every hour at DG03. This data was automatically downloaded every day and checked at Watercare. The 10-minute analogue data were used to check the TSP data on a daily basis and the 1-hour TSP data manually collected were used in this report .

All data were then entered into Watercare's air quality database, Envista, which is used to validate and report all parameters. All data are stored as time ending averages and at New Zealand Standard Time (NZST).

Appendix E

Site Personnel Contact Details

Site Personnel Contact Phone Numbers

(Complaints and Emergencies)

General Manager Macraes Operation

Matthew Hine

Mobile: 027 211 6759

Email: matthew.hine@oceanagold.com

Open Pit Mine Operations Manager

Mike Dodd

Mobile: 021 396 180

Email: mike.dodd@oceanagold.com

Process Manager

Quenton Johnston

Mobile: 021 248 8195

Email: quenton.johnston@oceanagold.com

Environment and Community Manager

Gavin Lee

Mobile: 021 872 488

Email: gavin.lee@oceanagold.com

Appendix B

Summary of Annual Deposited Dust Results

Annual summary of insoluble dust deposition above background 2004 – 2018

Insoluble Deposited dust above background		Mine Monitoring Sites							Expansion Sites				MPII Sites				Coronation Sites			
(g/m^2/30 days)		2	3	5	6*	7*	14	15*	11	12	13	17*	18	19	20	21	22	23	24	
2004	Average	0.1	7.9	1.6	0.2	0.3	1.2	0.2	0.3	46	0.1	0	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	0.9	20.4	3.6	0.7	1.1	3.4	0.5	0.9	77.1	0.5	0.1								
	Minimum	0	1.4	0	0	0	0.2	0	0	14.9	0	0								
	No.above 3 g/m^2/30 days	0	6	2	0	0	1	0	0	9	0	0								
2005	Average	0.2	5.3	0.2	0.2	0.9	0.6	0.3	0.6	46.4	0	0	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	0.6	9.9	1	1	2.6	2.6	0.6	1.1	105.8	0.1	0.3								
	Minimum	0	0	0	0	0	0	0	0	12.4	0	0								
	No.above 3 g/m^2/30 days	0	8	0	0	0	0	0	0	12	0	0								
2006	Average	0.4	14.5	0.7	0.5	1.3	1.2	0.4	0.8	7.4	0.6	0	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	1.5	41.7	1.7	1.7	4.7	4.3	1.2	1.2	30.1	2.1	0								
	Minimum	0	0.6	0	0	0	0	0	0	0.1	0	0								
	No.above 3 g/m^2/30 days	0	10	0	0	2	1	0	0	6	0	0								
2007	Average	0.7	5.7	1	0.2	0.2	1.8	0.6	1.1	1.7	0.5	0	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	2.1	15.7	2.3	0.4	1.2	4	1.5	1.9	7.6	2.8	0.1								
	Minimum	0	0	0	0	0	0	0	0	0.3	0	0								
	No.above 3 g/m^2/30 days	0	6	0	0	0	3	0	0	1	0	0								
2008	Average	1	1.4	0.7	1.9	1.9	0.9	1.4	1.5	2	0.4	0.5	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	3.1	4.5	2.9	15.7	10.4	3.2	4.7	4.1	7	1.2	3.1								
	Minimum	0	0	0	0	0	0	0	0	0	0	0								
	No.above 3 g/m^2/30 days	1	1	0	1	3	1	2	1	3	0	1								
2011	Average	0.4	1.8	1.1	0.1	0.7	1	0.4	0.8	1	0.3	0	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	1.5	3.6	4.6	0.6	3.4	2.5	1.4	1.9	2.2	1.4	0.3								
	Minimum	0.1	0.7	0	0	0	0	0	0.2	0	0	0								
	No.above 3 g/m^2/30 days	0	1	2	0	1	0	0	0	0	0	0								
2012	Average	0.4	3.9	0.8	0.1	0.1	0.5	0.2	0.6	0.7	0.1	0	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	Not yet installed	
	Maximum	1.4	11.6	2.3	0.6	0.6	2.1	1.3	1.5	2.8	0.4	0.2								
	Minimum	0	0.9	0	0	0	0	0	0	0	0	0								
	No. above 3 g/m^2/30 days	0	5	0	0	0	0	0	0	0	0	0								
2013	Average	0.39	3.62	Removed	Removed	0.2	Removed	0.1	0.29	Removed	0.07	Removed	0.18	0	0.12	0.55	Not yet installed	Not yet installed	Not yet installed	
	Maximum	2.83	8.31			0.9		0.6	1.33		0.4		1.46	0	0.67	2.12				
	Minimum	0	0			0		0	0		0		0	0	0	0				
	No. above 3 g/m^2/30 days	0	4			0		0	0		0		0	0	0	0				
2014	Average	0.2	3.5	Removed	Removed	0.1	Removed	0.1	0.6	Removed	0.2	Removed	0.3	0.1	0	0.3	0	0	Background site	
	Maximum	0.9	11.2			0.6		0.7	4.0		0.8		1.8	0.9	0	1.3	0	0		
	Minimum	0	0			0		0	0		8		0	0	0	0	0	0		
	No. above 3 g/m2/30 days	0	7			0		0	0		0		0	0	0	0	0	0		
2015	Average	0.2	3.4	Removed	Removed	0.3	Removed	0.2	0.6	Removed	0.2	1.4	0.2	0.2	0.2	0.5	0.1	0.3	Background site	
	Maximum	0.9	6.8			0.9		0.6	1.7		1.1	4.5	0.9	1.3	2.5	1.1	0.5	1.6		
	Minimum	0.0	1.2			0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	No. above 3 g/m^2/30 days	0.0	6.0			0.0		0.0	0.0		0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0		
2016	Average	0.2	3.2	Removed	Removed	0.1	Removed	0.1	0.8	Removed	0.2	0.3	1.1	0.8	0.0	0.2	0.1	0.0	Background site	
	Maximum	0.5	5.0			0.4		0.6	1.8		0.7	1.5	5.1	4.7	0.0	1.2	0.4	0.1		
	Minimum	0.0	0.7			0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	No. above 3 g/m^2/30 days	0.0	7.0			0.0		0.0	0.0		0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0		
2017	Average	0.3	5.1	Removed	Removed	0.5	Removed	0.6	0.5	Removed	0.4	1.7	0.2	0.3	0.3	0.2	1.7	0.2	Background site	3.5
	Maximum	1.0	13.7			1.5		4.2	1.8		1.0	3.8	0.9	2.3	1.2	1.2	5.9	0.3		6.8
	Minimum	0.0	0.8			0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.7
	No. above 3 g/m^2/30 days	0	0			0		1	0		0	2	0	0	0	0	1	0		1
2018	Average	0.2	7.1	Removed	Removed	0.3	Removed	0.1	0.3	Removed	0.1	0.6	0.1	0.0	0.0	0.1	0.5	No data	Background site	1.3
	Maximum	1.2	0.3			0.9		0.5	1.2		0.5	1.6	1.2	0.1	0.2	0.6	2.2			3.8
	Minimum	0.0	0.5			0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	No. above 3 g/m^2/30 days	0	10			0		0	0		0	0	0	0	0	0	0			1

*** Note that background sites were changed in May 2013**

Appendix C

Consent RM16.138.19

Our Reference: A1026254

9 August 2017

Oceana Gold (New Zealand) Limited
PO Box 5442
Dunedin 9058

Attention: Jackie St John

Dear Sir/Madam

Reissue of Resource Consent Application No RM16.138.19 – Oceana Gold (New Zealand) – Discharge to Air – Coronation North Project

Further to our recent letter advising a decision on the above resource consent, I wish to advise a correction to condition 1.

Instead of 'This consent shall be exercised in conjunction with Discharge Permit 96785, Discharge Permit 2006.689, Discharge Permit RM10.351.52, Discharge Permit RM12.373.15 and any subsequent variations to these permits.

It should have read 'This consent shall be exercised in conjunction with Discharge Permit 96785, Discharge Permit 2006.689, Discharge Permit RM10.351.52, Discharge Permit RM12.378.15 and any subsequent variations to these permits.'

I enclose an original re-issued consent that replaces the previous consent.

I apologise for any inconvenience this may have caused.

Should you have any queries please contact **Elyse Neville** at this office.

Yours sincerely

RM Stevenson

Rochelle Stevenson
Senior Consents Support Officer
Encl.

ORIGINAL

Our Reference: A942120

Consent No. RM16.138.19

DISCHARGE PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Oceana Gold (New Zealand) Limited

Address: 22 MacLaggan Street, Dunedin

To discharge contaminants from mining operations and post mining rehabilitation to air for the purpose of undertaking mining operations

For a term expiring 31 August 2032

Location of consent activity: Coronation North Project, approximately 7.5 kilometres to the northwest of the intersection of Macraes Road and Red Bank Road, Macraes Flat.

Legal description of consent location: Pt Section 2 Blk V Highlay SD, Pt Section 2 Blk VII Highlay SD, Lot 1 DP 465577, Pt Section 11 Block VII Highlay SD,

Map Reference: Within a 2.5 kilometre radius of NZTM 2000: E1395000 N4979000

Conditions

Specific

1. This consent shall be exercised in conjunction with Discharge Permit 96785, Discharge Permit 2006.689, Discharge Permit RM10.351.52, Discharge Permit RM12.378.15 and any subsequent variations to these permits.

2. This consent authorises the discharge of contaminants to air from the Coronation North Waste Rock Stack, Coronation Pit extension, Coronation North Pit and associated haul roads and working areas, as shown on Appendix I attached.

3. There shall be no visible dust beyond the boundary of the Macraes Gold Project site that, in the opinion of an enforcement officer, is offensive or objectionable to such an extent that it has an adverse effect on the environment, including the human environment.

ORIGINAL

Performance Monitoring

4. Insoluble dust deposition rates at sites DG07, DG20, DG21, DG22 and DG25, as shown on Appendices' II-IV attached, must not exceed 3 grams per square metre per 30 days (g/m2/30 days) of insoluble dust above background more than twice in any calendar year. Compliance with this condition shall be demonstrated by the monitoring required in Condition 9 of this consent.

5. Insoluble dust deposition rates at sites DG02 and DG15, as shown on Appendices' II-IV attached, must not exceed 3 grams per square metre per 30 days (g/m2/30 days) of insoluble dust above background. Compliance with this condition will be demonstrated by the monitoring required in Condition 9 of this consent.

6. Background concentrations will be calculated by averaging the insoluble dust deposition rates at sites DG09, DG10 and DG24 as shown on Appendices' II-IV attached.

7. Twenty-four hour average total suspended particulate at site DG15, as shown on Appendix II attached, must not exceed 120µg/m3. Compliance with this condition will be demonstrated by the monitoring required in Condition 10 of this consent.

8. In the event of any exceedance of those limits specified in Conditions 4, 5 and 7 of this consent, the Consent Holder must undertake an immediate review of the cause of the exceedance. A report detailing the findings of this review shall be provided to the Consent Authority within 1 month of the non-compliant result(s) being received. If it is shown that activities within the Macraes Gold Project site were the cause of the exceedance, then dust mitigation measures within the Macraes Gold Project shall be reviewed by an independent consultant engaged in consultation with the Consent Authority. The independent consultant shall provide a report summarising the cause of the exceedance and recommending measures to improve dust mitigation at the Macraes Gold Project site so that the exceedance does not occur again. This report shall be provided to the Consent Authority within 2 months of the non-compliant result(s) being received.

9. The consent holder shall monitor dust deposition rates at monthly intervals in accordance with draft ISO Standard ISO/DIS 4222.2 ("Air Quality Measurement of Atmospheric Dustfall – Horizontal Deposit Gauge Method" 1980), or another method approved in writing by the Consent Authority. The monitoring shall be undertaken at the sites shown on Appendices' II-IV attached.

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10. (a) The consent holder shall monitor real time total suspended particulate concentrations at site DG15 as shown on Appendix I attached. The monitoring shall be undertaken using a nephelometer, or other instrument as agreed in writing by the Consent Authority. The instrument shall be sited in accordance with AS/NZS 3580.1.1:2007 (Methods for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment).
(b) The consent holder shall monitor total suspended particulate at monitoring site DG15 as shown on Appendix II in accordance with Australian Standard AS/NZS3580.9.3:2003 (Determination of suspended particulate matter - Total Suspended Particulates [TSP] - High Volume Sampler Gravimetric Method), or another method approved by the Consent Authority. Twenty-four hour measurements must be taken every six days March to October inclusive, and every three days November to February inclusive, for a minimum period of twelve months or for however long is required to ensure that adequate data is collected to achieve the objectives of Condition 10(d).
(c) Parameters to be recorded shall include, but not be limited to:
   i) Hourly average TSP concentrations as measured by the instrument installed in accordance with Condition 10(a) of this consent;
   ii) 24-hour average TSP concentrations as measured by the instruments installed in accordance with Conditions 10(a) and 10(b).
(d) The instruments installed in accordance with Conditions 10(a) and 10(b) shall be operated concurrently for a period of no less then twelve months to ensure that twelve months of coincident data is collected. A correlation between the data shall be established by an independent consultant engaged in consultation with the Consent Authority. A report detailing this investigation shall be provided to the Consent Authority within two months of the data being collected.

11. (a) Meteorological conditions shall be continuously monitored and recorded at site DG03 as shown on Appendix II attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall. Sufficient information shall also be measured to allow an estimate of atmospheric stability. These estimates shall be obtained from measurements of solar radiation and temperature at two heights above ground level, or other parameters as approved by the Consent Authority.
(b) Meteorological conditions shall be continuously monitored and recorded at site DG15 as shown on Appendix II attached. As a minimum, the meteorological data collected shall include wind speed, wind direction, temperature and rainfall.

12. The consent holder shall keep a daily record of water used for dust suppression. These records shall be made available to the Consent Authority on request.

13. Results of all monitoring undertaken in accordance with this consent shall be reported to the Consent Authority on a quarterly basis. The format of the report shall be agreed upon in consultation with the Consent Authority.

14. Prior to the exercise of this consent, the consent holder shall submit a Dust Management Plan to the Consent Authority. The Dust Management Plan shall include, but not be limited to, the following:
(a) A description of potential dust sources and the factors influencing dust generation;

(b) Dust mitigation measures and procedures including, but not limited to:
i) Minimising the areas of disturbed ground;
ii) Watering, with water trucks and fixed sprinklers;
iii) Avoiding as far as possible, ground disturbance when wind may cause dust nuisance;
iv) Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;
v) Ensuring materials being moved are kept in a coarse state;
vi) Covering materials; and
vii) Replanting disturbed ground as soon as possible, including temporary planting if necessary.

(c) A description of dust monitoring equipment and procedures, including methods of analysis and details of the method used for the calculation of background dust concentration should values from one or all of the background sites be unavailable;
(d) Procedures for managing and addressing air quality or odour related complaints; and
(e) Key responsibilities, consultation and reporting, including details of the annual review and independent consultant used as required by Condition 18 of this consent.

15. The consent holder shall review the Dust Management Plan annually taking into account the following:
(a) The outcomes of reviews completed in accordance with Conditions 8 and 16 of this consent; and
(b) Whether management practices are resulting in compliance with the conditions of this consent.
Confirmation of the review and any revisions will be included in the Project Overview and Annual Work and Rehabilitation Plan for the Macraes Gold Project site. The consent holder shall provide the Consent Authority with any updates of the Dust Management Plan within one month of any update occurring.

16. An independent consultant, engaged by the Consent Holder in consultation with the Consent Authority, shall undertake an annual review and assessment of all dust monitoring data. The reviewer's report shall include:
(a) The name, qualifications, and experience of the reviewer;
(b) The methods used and the investigations undertaken for the review;
(c) Interpretation of the monitoring data reviewed;

(d) An assessment of the quality of the monitoring data;
(e) An assessment of the monitoring regime;
(f) A description and evaluation of each of the dust mitigation measures used by the consent holder;
(g) Recommendations on whether:
i) The monitoring of dust is adequate or should be changed, and if changed the changes that are recommended;
ii) The dust mitigation measures used by the consent holder are adequate, or should be changed, and the changes that are recommended; and
iii) Any changes should be made to the conditions of this consent; and
(h) Any other matters that the reviewer considers should be drawn to the attention of the consent holder or the Consent Authority.

17. The annual report required by Condition 16 shall be provided to the Consent Authority by 30 April each year.

18. In the event of any non compliance with the conditions of this consent, the consent holder shall notify the Consent Authority within 24 hours of the non compliance being detected. Within five working days the consent holder shall provide written notification to the Consent Authority providing details of the non-compliance. This notification will at a minimum include an explanation of the cause of the non compliance, the steps taken to remedy the situation and steps taken to mitigate any future occurrence of the non compliance.

19. The consent holder shall maintain a record of any complaints received regarding their operation. The register shall include, but not be limited to:
(a) name and location of site where the problem is experienced;
(b) nature of the problem;
(c) date and time problem occurred, and when reported;
(d) action taken by consent holder to remedy the situation and any policies or methods put in place to avoid or mitigate the problem occurring again.

The register of complaints shall be incorporated into the Project Overview and Annual Work and Rehabilitation Plan.

General

20. (a) The consent holder shall provide and maintain in favour of the Consent Authority one or more bonds to secure:
i) The performance and completion of rehabilitation in accordance with the conditions of this consent; and
ii) The carrying out of the monitoring required by the conditions of this consent; and

iii) The remediation of any adverse effect on the environment that may arise from the exercise of this consent.

iv) Compliance with Conditions 20 (m) to 20(q) of this consent.

(b) Before the first exercise of this consent, the consent holder shall provide to the Consent Authority one or more bonds required by Condition 20(a).

(c) Subject to the other provisions of this consent, any bond shall be in the form and on the terms and conditions approved by the Consent Authority.

(d) Any bond shall be given or guaranteed by a surety acceptable to the Consent Authority.

(e) The surety shall bind itself to pay for the carrying out and completion of the conditions of consent which are the subject of the bond on default by the consent holder or the occurrence of any adverse environment effect requiring remedy; during or after the expiry of this consent.

(f) The amount of each bond shall be fixed annually by the Consent Authority which will take into account any calculations and other matters submitted by the consent holder relevant to the determination of the amount to be bonded in the Project Overview and Annual Work and Rehabilitation Plan required for by condition 6 of RM16.138.05, condition 6 of RM16.138.10, condition 8 of RM16.138.17 and condition 10 of RM16.138.18.

(g) The amount of the bond(s) shall include:

i) The estimated costs of complete rehabilitation in accordance with the conditions of consent on the completion of the mining operations proposed for the next year and described in the Project Overview and Annual Work and Rehabilitation Plan.

ii) The estimated costs of:

- Monitoring in accordance with the monitoring conditions of the consent;
- Monitoring for and of any adverse effect of the activity authorised by this consent which may become apparent during or after expiry of this consent;
- Monitoring any rehabilitation required by this consent.

iii) Any further sum which the Consent Authority considers necessary for monitoring and dealing with any adverse effect on the environment that may arise from the exercise of the consent whether during or after the expiry of this consent.

(h) The amount shall be calculated for the duration of this consent and for a period of 20 years after its expiry.

(i) If, on review, the total amount of bond to be provided by the consent holder is greater or less than the sum secured by the current bond(s), the consent holder, surety and the Consent Authority may, in writing, vary the amount of the bond(s).

(j) While the liability of the surety is limited to the amount of the bond(s), the liability of the consent holder is unlimited.

(k) Any bond may be varied, cancelled, or renewed at any time by written agreement between the consent holder, surety and Consent Authority.
(l) The costs (including the costs of the Consent Authority) of providing, maintaining, varying and reviewing any bond shall be paid by the consent holder.
(m) For a period of 20 years from the expiry or surrender of this consent the consent holder shall provide in favour of the Consent Authority one or more bonds.
(n) The amount of the bond to be provided under Condition 20(m) shall include the amount (if any) considered by the Consent Authority necessary for:

i) Completing rehabilitation in accordance with the conditions of this consent.
ii) Monitoring for and of any adverse effect on the environment that may arise from the exercise of the consent.
iii) Monitoring any measures taken to prevent, remedy or mitigate any adverse effect on the environment that may arise from the exercise of this consent.
iv) Dealing with any adverse effect on the environment which may become apparent after the surrender or expiry of this consent.
v) Contingencies.

(o) Without limitation, the amount secured by the bond given under Condition 20(m) may include provision to deal with structural instability or failure, land and water contamination, and the failure of rehabilitation in terms of the rehabilitation objectives and conditions of this consent. Costs shall include costs of investigating, preventing, remedying or mitigating any adverse effect.
(p) The bond(s) required by Condition 20(m) must be provided on the earlier of:

i) 12 months before the expiry of this consent.
ii) Three months before the surrender of this consent.

(q) Conditions 20(c), (d), (e), (h), (i), (j) and (k) apply to the bond(s) required by Condition 20(m).

Review

21. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within three months of each anniversary of the commencement of this consent, for the purpose of:
(a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent; or
(b) ensuring the conditions of this consent are consistent with any National Environmental Standards; or

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(c) requiring the consent holder to adopt the best practicable option, in order to remove or reduce any adverse effect on the environment arising as a result of the exercise of this consent.

Issued at Dunedin this 24th day of April 2017.
Reissued at Dunedin this 9th day of August 2017 to reflect a correction to condition 1 to reference the correct consent number.

Christopher P. Shaw
Manager Consents

Telarc. QUALITY ISO 9001

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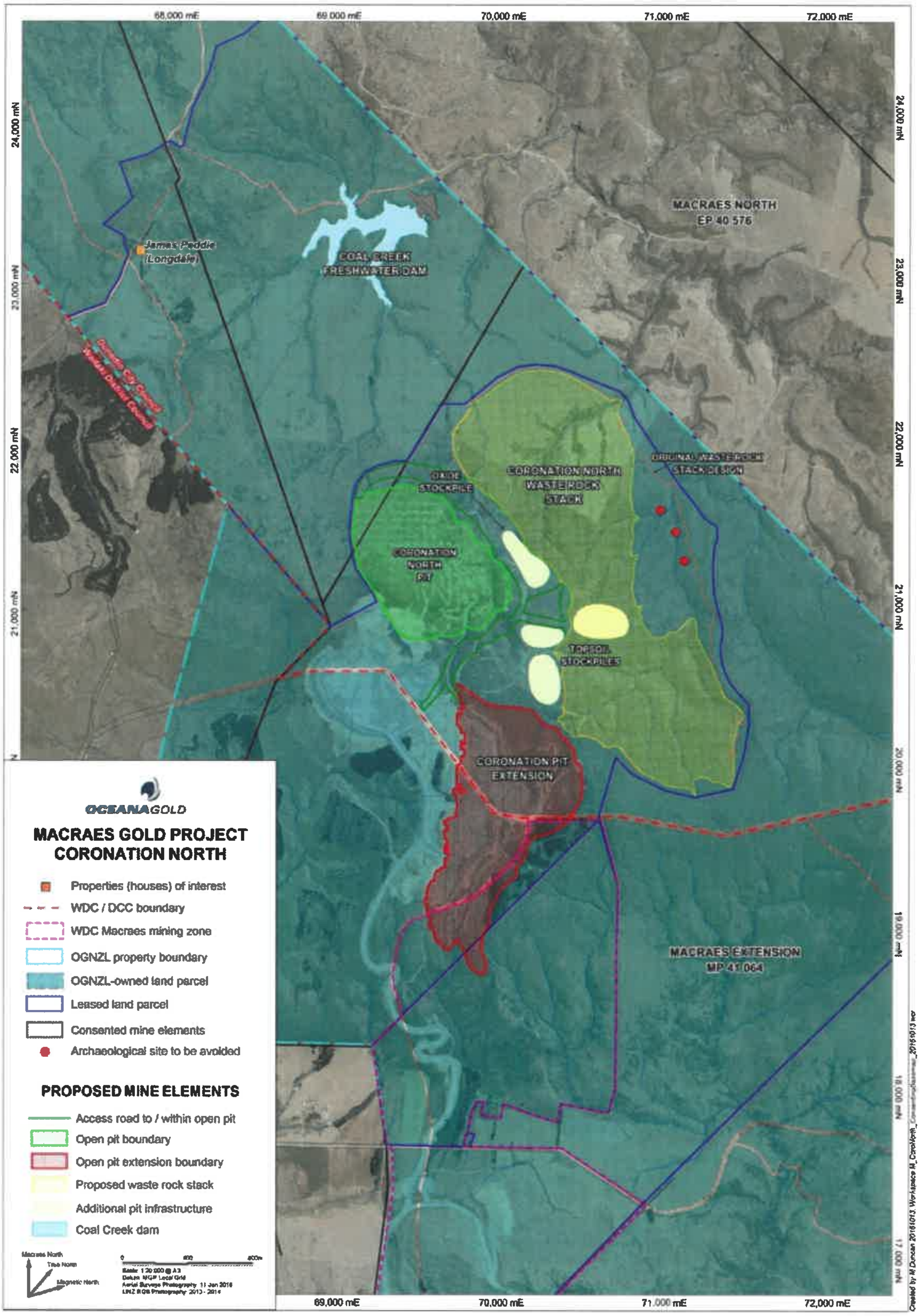
Appendix I
RM16.138.19



Telarc.
QUALITY
ISO 9001

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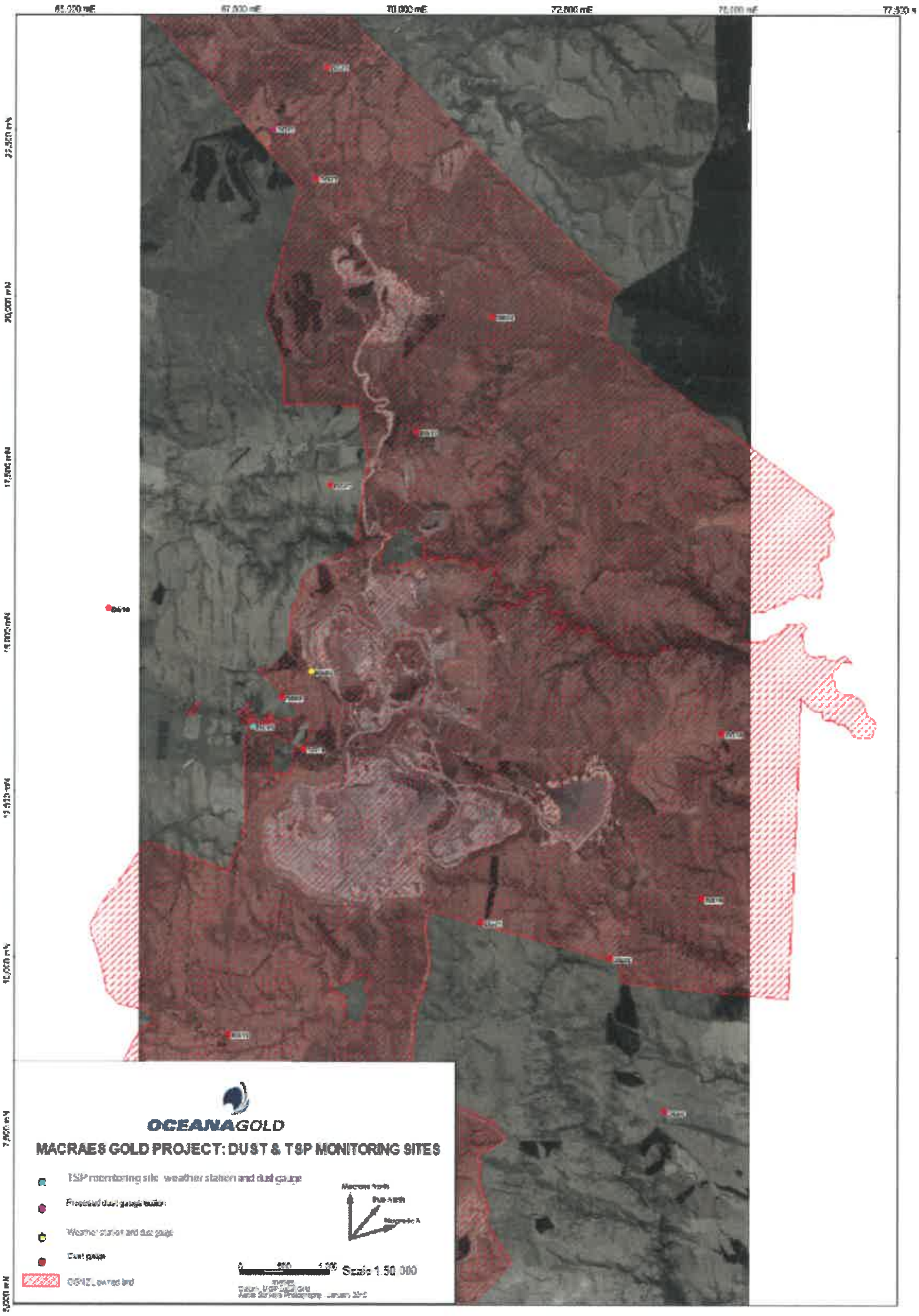
Appendix II
RM16.138.19



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Appendix III
RM16.138.19

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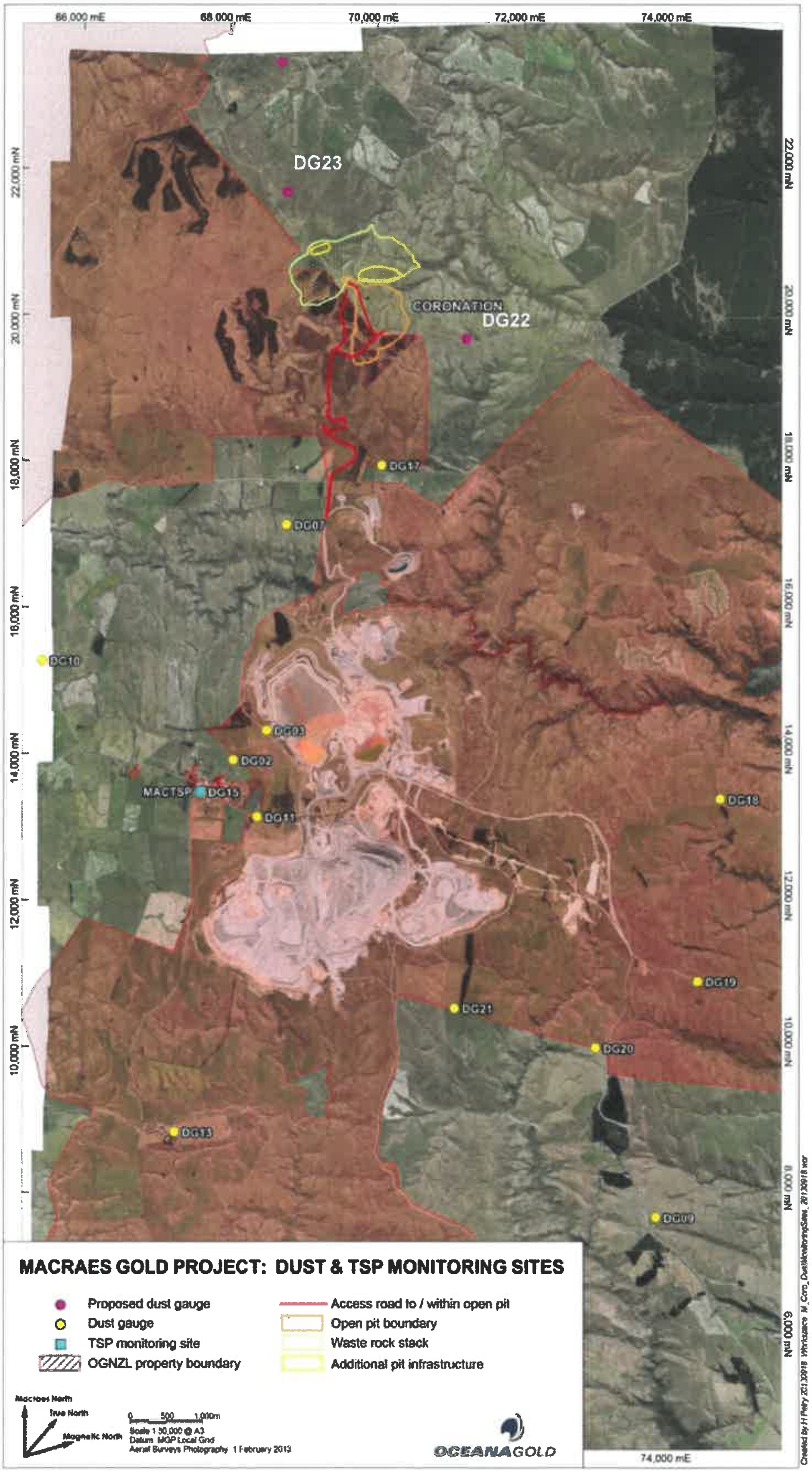

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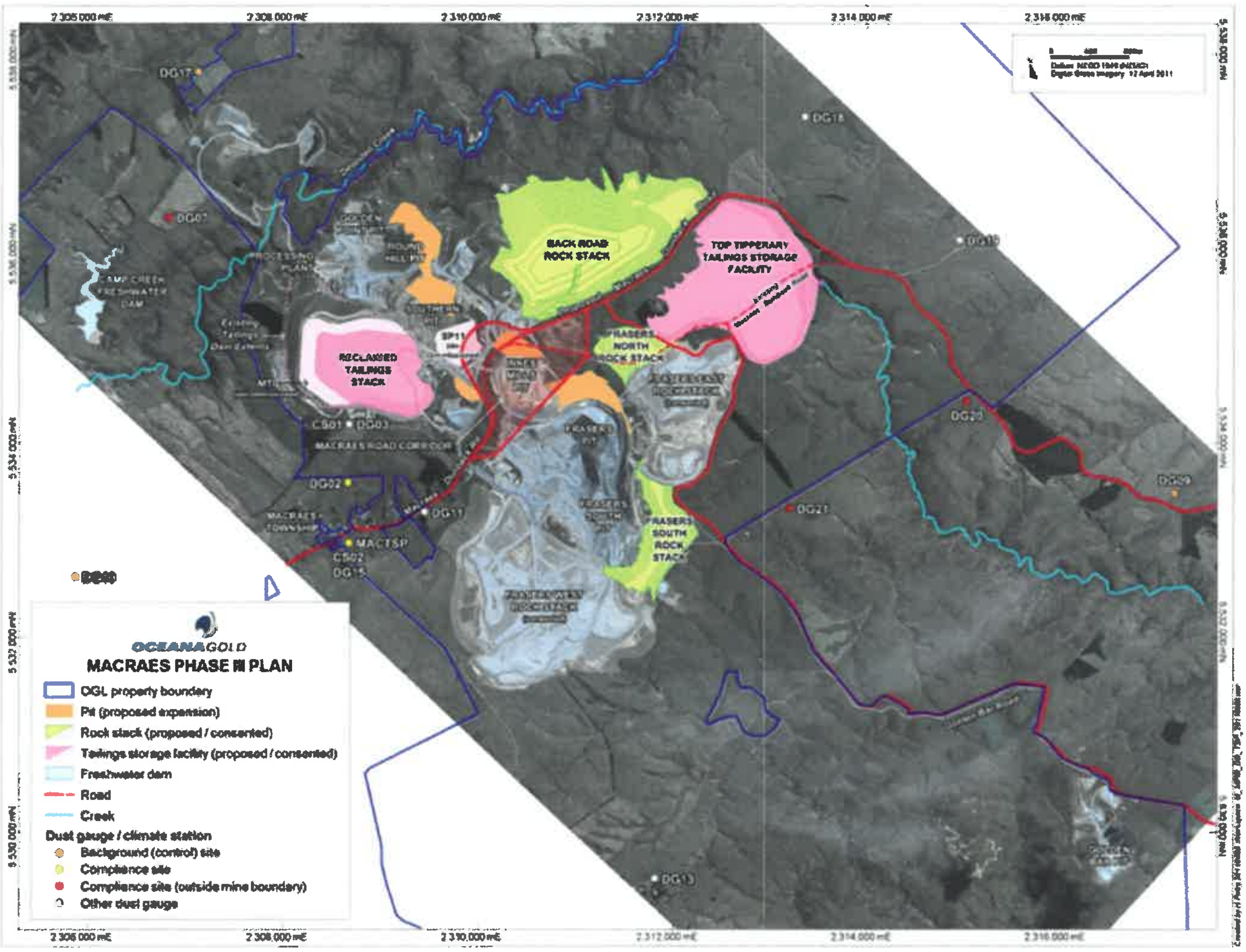
Appendix IV
RM16.138.19



Deepdell North Stage III

Landscape and Visual Assessment

Oceana Gold (NZ) Ltd

Contact Details

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Status: Final

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Senior Landscape Architect

Approved for Release By

Zoe Burkitt
WGM: Environmental Services

Contents

Abbreviations and Definitions

Abbreviation	Full name
OceanaGold	Oceana Gold (New Zealand) Ltd
The Project	Deepdell North Stage III Project
Macraes Operation	OceanaGold's gold mining operation at Macraes Flat
Macraes Mining Zone	Macraes Mining Project Mineral Zone
MPIII	Macraes Phase III expansion
Coronation Mine	The consented Coronation Mine
WRS	Waste rock stack
Macraes	The village of Macraes
Macraes Flat	The locality of Macraes Flat
WDC	Waitaki District Council
DCC	Dunedin City Council
ORC	Otago Regional Council
DOC	Department of Conservation
RMA	Resource Management Act 1991
RPS	Regional Policy Statement
ORPS	Operative Otago Regional Policy Statement
OLA	Outstanding Landscape Area
RAP	DOC's Recommended Area of Protection
ED	Ecological District
LVA	Landscape and Visual Assessment
ha	hectares
Mt	million tonnes
km	kilometre
m	metre
mRL	metres as a relative level

1 Executive Summary

This landscape and visual assessment is based on the Deepdell North Stage III Project Description, along with the Deepdell North Stage III Base Plan, which shows the location and extent of the individual components of the Project. This base information, along with a full range of other relevant environmental information, is included in the Project's Assessment of Environmental Effects.

The landscape and visual assessment describes the landscape context in terms of the broad Macraes landscape, the Macraes Operation landscape and the more specific Deepdell North Stage III Project landscape; the latter includes the consented Coronation mine haul road, the Deepdell waste rock stack and the Deepdell South open cut pit. The existing waste rock stack and the open cut pit were constructed/excavated in 2001-2003. This assessment also considers the planning context relative to potential landscape and visual effects, defines the visible aspects of the Deepdell North Stage III Project, assesses the landscape and visual effects of the Project and their likely cumulative effect and makes the following conclusion.

In this landscape and visual assessment, it has been found that:

- The effect on visual amenity values that will arise from the Project are low relative to those effects already consented for the existing mining activities with the Macraes Operation and are therefore accepted as contributing to the central landscape identity for the Macraes Land Unit in the Waitaki District Council's district-wide landscape study.
- With respect to eleven salient and common public viewpoints considered, the Project or aspects of the Project will not be visible from three of these viewpoints – Views 0, 5 and 9, and the potential visual effect is **'Negligible'** or less from another two viewpoints – View 2 and 10. From a further three viewpoints, the potential visual effect will be **'Low'** or **'Low'** to **'Negligible'** – View 1, 6 and 7.
- With respect to the remaining three viewpoints, all are on or at the end of local, gravel, no-exit roads and have direct views to the proposed open cut pit and the proposed Deepdell East Waste Rock Stack. The effect on Views 3 and 4 is considered to be **'Moderate-Low'**, while the effect on View 8 is considered to be **'Moderate-High'**.
- Once the final shaping and revegetation of the proposed Deepdell East Waste Rock Stack has been completed, along with that of the redundant haul roads, the general shape, slopes and colour of the completed and revegetated 'hill' landform will be in sympathy with the natural slopes of the area. In time, relative to the most effected viewpoint – View 8 - the visual effect of the WRS will reduce from **'Moderate-High'** to **'Moderate'.**
- In a much greater length of time, the Deepdell North Pit void will become a lake, though still confined within the pit. The shaping and 'naturalising' of the upper pit walls in response to slope stabilisation works will also assist in moderating the overall visual effect of this aspect of the Project.
- Backfilling the defunct Deepdell South Pit will provide the opportunity to re-instate the natural slope close to and upstream of the Golden Point Historic reserve, while 'balancing' the creation of a new open cut pit with removal of an old pit.
- In terms of the overall cumulative landscape and visual effect of the Project, the effect will be **'Low'** to **'Negligible'** when seen from the broader Macraes Flat area. From closer to the Project Area, where more than one WRS will be visible, there will be a degree of cumulative effect that will be **'Moderate-High'** in the first instance but will become **'Moderate'** with time.

Overall, mitigation measures will be built into the Deepdell North Stage III Project from the outset. These include:

- careful design of the form of the WRS to integrate it with the existing landform character of the area;
- progressive rehabilitation of the WRS;
- shaping the upper pit walls of the open cut pit in response to slope stabilisation works to a naturalised form that enables the establishment of vegetation cover and an accessible margin to the eventual pit lake, where possible;
- restoration of the areas disturbed around the margins of the Project; and
- removal and restoration of the haul roads used during closure phase of the Project.

These proven measures have been effective in mitigating the potential visual effects of the existing waste rock stacks, being the most visible, elevated mining elements that have so far been constructed as part of the OceanaGold Macraes Operation.

This new mining activity – Deepdell North Stage III Project - is an extension of previously consented activity and is not unexpected and will be seen in this landscape context as a continuation of the existing mining operation.

2 Introduction

2.1 Purpose of Document

Oceana Gold (New Zealand) Ltd proposes to develop the Deepdell North Stage III Project as an extension to the Macraes Operation, Macraes Flat, East Otago. The Project will involve the creation of a new open cut pit – Deepdell North Pit – and its associated waste rock stack (WRS) – Deepdell East WRS; along with the backfilling of the defunct Deepdell South open cut pit and sections of haul road extension. The Project will also include a topsoil stockpile, a low-grade ore stockpile, silt pond(s), an area for pit infrastructure and access roading. The original Deepdell section of the current Coronation haul road will be the connection to the Macraes Operation processing plant.

The Project Area is located approximately 1.5 km north of the processing plant and is approximately 4 km to the north[1] of Macraes village on northern side of Deepdell Creek and either side of the existing Horse Flat Road. At **Appendix 1** the Deepdell 'Project Elements for Consenting' plan provides an overview of the Project Area at a relatively broad scale (1:10,000 @ A3) showing the local topography and stream catchments on the base aerial photo overlaid with road lines and land tenure aspects, along with the mining-related components of the Project. The Waitaki District Council (WDC) planning zones for the Deepdell North Stage III Project Area are also shown on the plan at Appendix 1.

The purpose of this report is to identify the landscape and visual amenity values of the Project Area and identify the potential effects of the construction and operation of the Project on those values.

This landscape and visual assessment describes the Project and its planning context and then considers the existing landscape context and character as a baseline for determining the landscape and visual effects of the Project. Alternatives that have been considered relative to the Deepdell East WRS, appropriate mitigation measures, likely landscape and visual effects are discussed where a conclusion about the visual acceptability of the Project is reached. Cumulative effects of the proposed expansion of mine elements in combination with the existing Macraes Operation are also considered.

Given that the Project Area comes within the jurisdictions of WDC and Otago Regional Council, the assessment also takes consideration of the expectations of the:

- Waitaki District Plan[2], in particular, the objectives, policies, implementation methods and rules relating to mineral extraction within the Macraes Mining Project Mineral Zone ("the Macraes Mining Zone") and district wide objectives, policies and rules relating to the Rural sector, in particular the Rural Scenic Zone;
- Otago Regional Policy Statement ("RPS")[3] in regard to relevant landscape-related issues as identified in Chapter 5, Land; and
- The Proposed Otago Regional Policy Statement in regard to Chapter 2 and Schedules 3 and 4.

Landscape effects are relevant to Sections 6(a) *("the preservation of the natural character of … wetlands,… and rivers and their margins…"*) and 6(b) *("the protection of outstanding natural features and landscapes…"*) of the Resource Management Act 1991 ("RMA"). Such effects can be regarded as the consequence of changes in the natural and physical landscape.

Visual effects relate to Sections 7(c) (*"the maintenance and enhancement of amenity values"*) and 7(f) (*"maintenance and enhancement of the quality of the environment"*) of the RMA. Such effects are concerned with the changes that arise in the composition of a view as a result of changes to the landscape and with people's responses to those changes. People's responses to changes in the landscape are intrinsically linked to visual amenity.

[1] As all plans generated for the Macraes Operation have Macraes Local Grid as their datum and are orientated to Macraes North, which is approximately 45° west of Magnetic North, this same orientation is used in the text.

[2] *Waitaki District Plan*, Waitaki District Council, fully operative 23 August 2010

[3] *Regional Policy Statement*, Otago Regional Council, fully operative 1 October 1998

2.2 Background Information

Between 2002 and 2019 OceanaGold have advanced a number of Projects within the overall Macraes Operation that have required landscape and visual assessments and, in some cases, preparation of landscape evidence for various resource consent applications and variations. The earlier inputs included:

- Golden Bar mine consent application;
- Deepdell mine rehabilitation consent variation;
- Expansion of the Frasers West Waste Stack consent variation;
- Frasers East Waste Stack consent application;
- Macraes Phase III expansion;
- Coronation Mine Project; and
- Coronation North Project.

The most recent consented mine expansion – Coronation North Mine - involved the creation of a further open cut pit, a further WRS and extending the Coronation Mine haul road; along with various other related infrastructure on a section of the Taieri Ridge at and immediately to the east of Sisters Peaks.

The closure plan for Coronation Mine and for the subsequent closure of Coronation North Mine, comprises the progressive rehabilitation of the associated waste rock stacks, opportunistic backfilling of the open pits during operations, formation of pit lakes, removal of any buildings and other temporary structures, decommissioning of the silt ponds to become stock water ponds, removal of the haul road crossing over Horse Flat Road and rehabilitation of the main haul road from the pit and WRS to Matheson Road and re-establishment of Golden Point Road from Matheson Road to Horse Flat Road using the Haul Road alignment. On the completion of mining and rehabilitation Golden Point Road will be reopened for public access. A similar approach to this closure plan will be adopted and added to in order to address closure of the Deepdell North Stage III Project elements, if and when this new project is consented.

The resource consent application for Coronation North Mine was lodged and heard before a joint ORC/DCC/WDC hearings panel in October 2016. The resulting consents were appealed in relation to several conditions, but the appeals were resolved by agreement and the consents were commenced by order of the Environment Court and have been given effect to.

2.3 Outline of the Deepdell North Stage III Project

2.3.1 Project Area Location

The Project Area of the proposed Deepdell North Stage III Project is located within the northern flanks of the incised Deepdell Creek[4] valley that runs west to east to the north of Macraes Flat. The overall Macraes Operation is located approximately 30 km inland from Palmerston, East Otago.

All of the Deepdell North Stage III Project 'footprint' will be within the Macraes Mining Zone or Rural Scenic Zone of the Waitaki District.

The active Frasers Pit and its current Frasers West WRS are located to the east and south of the Macraes village. Up until recently, Frasers Pit was the most obvious component of the Macraes Gold Project to be seen when arriving at Macraes Flat from the northeast on the Macraes Road. Now one of the first components that is visible when arriving from the east is the Top Tipperary Tailings Storage Facility, which 'sits' in front of Frasers East WRS; both of which were consented in 2006. The Back Road WRS is also visible to the north as the local road rises up past the tailing storage facility and on towards Frasers Pit and Macraes.

The overall site of the current Macraes Operation is owned by OceanaGold and largely has been within the WDC's Macraes Mining Zone. As part of Macraes Phase III expansion in 2012, activities outside the Macraes

[4] Various local features are shown on the 'viewpoints' plan at Appendix 4

Mining Zone were authorised, for instance, the Camp Creek dam and reservoir are in the Rural Scenic Zone. The Coronation Mine Project subsequently brought the overall Macraes Operation into the Dunedin City district.

2.3.2 *Project Description*

The main features[5] of the Project are:

Open Pit Excavation

- The proposed open cut pit currently has a footprint of 38 ha, involving 18.7 ha of disturbing previously mined areas and 19.6 ha of new disturbance
- The likely quantities involved are:
  - Ore 3.5 Mt,
  - Backfill waste 9.4 Mt,
  - In-situ oxide waste (brown rock) 2.4 Mt,
  - In-situ fresh waste 41.5 Mt, with
  - Total movement 57 Mt.
- Haul roads will be 30 m wide, metalled and contained within the pit footprint.
- The top of the pit excavation is at about 520 mRL and the base of the pit is at 370 mRL, making the total pit depth 150 m.
- Water management during operations will consist of in-situ water being drained to the pit. Subsequent to sufficient dewatering of the pit and depending on the water quality, stormwater runoff will be used for dust suppression, process water or discharged via the existing drain that drains to the Deepdell North silt pond.
- Ancillary infrastructure associated with the open pit (park-up areas, smoko and ablutions portacoms, portable fuel tank and the like) will be located immediately west of the pit in the same areas previously used for these purposes.

Waste Rock Disposal – Deepdell East Waste Rock Stack

- Backfill of the exiting Deepdell South Pit (13.2 ha)
- Extending north from Deepdell South Pit to beyond Horse Flat Road covering a total area of approximately 70.8 ha (of which 57.6 ha will be new disturbance).
- Storage quantity 21.6 Mm^3 to 540 mRL (current design height) but has the potential be constructed to 580 mRL.
- A short haul road required between Deepdell North Pit and the Deepdell East WRS.
- Water run-off drains either back to the Deepdell North Pit from the western side of the WRS (20.2 ha) or into Highlay Creek from the eastern side of the stack (50.5 ha). No additional infrastructure will be required.

Other earthworks-related features or aspects include noise bunding and a pit expansion buffer zone.

- A noise bund(s) will be located on the west side of the adjacent section of the Coronation haul road on either side of Horse Flat Road. Stripped rehabilitation materials (ie topsoil and oxidised schist) from ‘opening-up’ the pit and WRS sites will be used to construct the bunds. This material will subsequently be re-spread as part of the rehabilitation of the Project site at closure. The bunds will be up to 5 m high. The bunds on the north side of Horse Flat Road will be within the footprint shown on the plan at Appendix 1, but may be narrower to minimise to cropping of the adjoining paddock.
- A buffer zone has been included for the potential expansion of the pit on the northeast ‘corner’ of the proposed pit. The extent of this zone is yet to be defined.

[5] Deepdell North Stage III Project Description, May 2019

Other aspects include:

Mining Method & Equipment

This aspect of the Project will be the same as existing operations. Operations will run 24/7 using two digging units.

Peak production will load 67,000 t / shift (380 loads / shift & peak of 42 loads /hour).

Stockpiles

Temporary stockpiles for rehabilitation materials are to be formed along the Coronation Haul Road and Horse Flat Road in currently disturbed areas and paddocks adjacent to the pit, to the north east.

Roads

Horse Flat Road will be permanently moved to the north due to the construction of the WRS. The realignment of this road will involve the installation of at least one culvert.

Project Closure

The pit will not be backfilled but left to become a pit lake. Surface and ground water flow is to be directed into the pit void to create the lake, along with seepage from the Deepdell East WRS. The resultant lake is not expected to overflow until approximately the year 2120.

Where possible, such as where the rock is soft or where excavating within the existing fill of the Deepdell WRS, the excavation levels above the final lake level will be shaped to provide a naturalised and aesthetically pleasing slope at the lake edge and to provide suitable areas for vegetation establishment.

Surface and ground water flow to be directed into the pit void to create a lake. This lake to drain as per notes above.

Landscape Mitigation

An initial step in landscape mitigation will be the backfilling of the Deepdell South Pit, which has been left as an open, previously mined pit (c. 2001).

The Deepdell East WRS slopes have been designed to blend into the surrounding topography as far as possible, but the slopes will frequently be less steep than some of the surrounding natural slopes in order to establish stable vegetation growth and minimise erosion damage.

In the final shaping of the WRS, slopes will be dozed down to a 3H:1V slope and rehabilitated back into pasture. Site establishment areas and haul roads will be rehabilitated using standard site techniques. For these areas and the completed WRS, this will include spreading the stockpiled topsoil and strippings, some of which will have been stockpiled as noise bunding on the north side of Horse Flat Road parallel to the Coronation haul road.

Alternatives Considered

Multiple options have been considered for the WRS location, three of which are described at Section 5 – Alternatives.

A full alternatives analysis will be reported as part of the development of the consent application.

Project Timeline

The current Life-of-Mine programming has the following major project milestones:

Site establishment and first overburden stripping: October 2020

First ore: November 2020

Mining finished: November 2022

3 Relevant Statutory and Policy Documents

3.1 Relevant Planning Documents

As noted in the Introduction, the Deepdell North Stage III Project Area comes within the jurisdictions of WDC and ORC and the local and regional planning documents that need to be considered are the following:

- Waitaki District Plan, in particular, the objective, policies and implementation methods relating to mineral extraction and the Macraes Mining Project Mineral Zone ("the Macraes Mining Zone") and district wide objectives and policies relating to Rural Zones, particularly regarding Landscapes at 16.8, Issue 7 and the Rural Scenic Zone and relevant Resource Consent Assessment matters at 18.2 xxiii (a) – (d);
- Otago Regional Policy Statement in regard to relevant landscape-related issues as identified in Chapter 5, Land.
- The Proposed Otago Regional Policy Statement in regard to Chapter 2 and Schedules 3 and 4.

The RMA sets out the parameters determining landscape outcomes for the Coronation North Project resource consent applications.

Pertinent landscape matters are to be found in Part 2 of the RMA:

- Section 5: Purpose
- Section 6: Matters of National Importance
- Section 7: Other matters.

3.2 Waitaki District Plan

The Project Area falls within the Waitaki District Council Area and the underlying zoning of the area is shown on Map 72 of the Waitaki District Plan. It shows the Project Area overlaps two zones - Macraes Mining Zone and Rural Scenic Zone.

The Waitaki District Plan sets out the issues, objectives and policies for the District's rural landscapes in Part II: District Wide Issues, Objectives and Policies – 16. The matters of most relevance to this assessment of the Project are 16.7 (Mineral Extraction) and 16.8 (Landscapes) and these are outlined below.

Rural Issues – Section 16

Section 16.7 Issue 6 Mineral Extraction discusses the unique amenity of sites like Macraes Flat as well as adverse amenity effects that can arise from mining operations. Section 16.8 Issue 7 - Landscapes discusses the value of the district's landscapes including the schist plateau and hills around Macraes Flat (Section 16.8.1 Explanation). The issue states the need to manage use and development in the district to protect the characteristics of these landscapes. Both of these issues are relevant to the Deepdell North Stage III Project.

District Wide Objectives – Section 16

Objective 16.7.1 seeks to ensure that extractive industries (such as Oceana Gold's Macraes Operation) are given the ability to extract minerals in a manner that avoids remedies or mitigates adverse effects on the environment. Objective 16.8.2 manages the use and development of land so that the overall landscape qualities of the Rural Scenic Zone are retained.

Rural Policies

Policies relevant to the proposal include 16.7.2 (1), (2), (3), (4) and (5), 16.8.3 (3), (6)(f), (6)(h), (6)(i) and (7).

Waitaki Landscape Study

The broader landscape aspects of the district were defined in the Waitaki Landscape Study which, through Plan Change 2, has now been included within the Waitaki District Plan. Those aspects of the Waitaki Landscape Study that relate to the Macraes Operation are described at Section 4.5.2.1 of this assessment

3.3 Otago Regional Policy Statement

The Operative Otago Regional Policy Statement is under review and parts of that document have been revoked as of 14 January 2019. Decisions on submissions on the Proposed Otago Regional Policy Statement were released after appeals on 17 May 2019. OceanaGold has appealed the Decisions. Any Council assessing the resource consent applications for the Deepdell North Stage III Project will have regard to both the Current (partially revoked) and partially operative Otago Regional Policy Statements.

Operative Otago Regional Policy Statement (ORPS)

Of relevance to the Deepdell North Stage III Project, Section 5 – Land (not revoked) of the ORPS addresses 'outstanding natural features and landscapes' at Issue 5.3.4, Objective 5.4.3 and Policy 5.5.6. The latter states:

To recognise and provide for the protection of Otago's outstanding natural features and landscapes which:

a. Are unique to or characteristic of the region; or

b. Are representative of a particular landform or land cover occurring in the Otago region or of the collective characteristics which give Otago its particular character; or

c. Represent areas of cultural or historic significance in Otago; or

d. Contain visually or scientifically significant geological features; or

e. ~~Have characteristics of cultural, historical and spiritual value that are regionally significant for Tangata Whenua and have been identified in accordance with Tikanga Maori~~.[6]

These provisions have been given effect to by the Waitaki District Council in the Operative District Plan.

Proposed Otago Regional Policy Statement (PRPS) 17 May 2019

Chapter 2 of the PRPS contains a number of issues, objectives and policies that are relevant to the Deepdell North Stage III Project. The policies also refer to Schedule 3 which outlines a significance threshold when determining whether adverse effects are 'significant' and Schedule 3 which sets out the criteria for the identification of outstanding natural features, landscapes and seascapes, and highly valued natural features, landscapes and seascapes. (refer Appendix 5 of the PRPS)

Issues

The issues are not numbered in the PRPS however the relevant issue in Chapter 3 for objective 3.1 relates to the knowledge of natural systems and the degradation of their values.

The relevant issue for objective 3.2 relates to Otago's identified significant and highly valued natural resources and the risk of these becoming degraded if they are not adequately protected. The issue includes that these natural resources deserve a higher level of recognition due to their importance to Otago's identity and wellbeing.

Objectives:

Objective 3.1 recognises the value attached to Otago's natural resources and the need to maintain these and to enhance them where they are degraded.

Objective 3.2 relates to significant and highly-valued natural resources, including outstanding natural features and landscapes as outlined in the accompanying Issues statement. The objective outlines the need to protect these.

Policies

[6] Superseded by PORPS 14 January 2019 (Policy 2.2.1 Kāi Tahu wellbeing, Policy 2.2.2 Recognising sites of cultural significance, Policy 2.2.3 Wāhi tūpuna and associated sites)

Policy 3.1.10 recognises the vales of natural features, landscapes and seascapes. Policy 3.2.3 identifies outstanding natural features, landscapes and seascapes using the attributes listed in Schedule 3.

Policy 3.2.4 outlines the requirements to be used in protecting and enhancing or restoring (managing) outstanding natural features, landscapes and seascapes

These matters will be taken into account when the Council are assessing the resource consent applications related to this project.

3.4 Resource Management Act

The matters contained in Part 2 of the RMA apply to the assessment of all resource consent applications.

In reaching a decision on a consent application, a consent authority must be satisfied that by granting the application, the purpose of the RMA will be achieved.

Section 5 sets out the purpose of the RMA which is to 'promote the sustainable management of natural and physical resources'. In determining what promotes sustainable management in a particular context, decision makers are guided by the various matters listed in Part 2 of the RMA.

Section 6 of the RMA sets out those matters of national importance that are to be recognised and provided for in achieving the purpose of the RMA. The matters of national importance considered to be of relevance to this landscape and visual assessment are:

- *6(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development.*
- *6(b) the protection of outstanding natural features and landscapes from inappropriate subdivision, use and development.*

Section 7 of the RMA sets out those 'other matters' that a consent authority must have particular regard to in achieving the purpose of the RMA; those matters of relevance to this assessment of the proposal are:

- *Section 7(c) the maintenance and enhancement of amenity values.*
- *Section 7(f), the maintenance and enhancement of the quality of the environment.*

3.4.1 Section 6(a): Natural Character of Water Bodies and their Margins

The upper extent of a minor tributary to Deepdell Creek drains west through the Project Area parallel to the south side of Horse Flat Road. The southern extent of the Project drains directly to Deepdell Creek immediately upstream of the Golden Point Historic Reserve. The minor tributary has its surroundings modified by farming practices and past mining activities and the flow in the upper extent is intermittent.

The proposed open cut pit will truncate the upper extent of this minor tributary to Deepdell Creek. At its upstream extent, this tributary is an ephemeral linear depression or swale across the farm paddock and will drain into the pit in due course.

There is a small, degraded ephemeral wetland within the footprint of the Project. The location and residual ecological value of this wetland is described in the Project's Ecological Assessment[7].

These activities will trigger consideration of section 6(a) of the RMA and the natural character of these water bodies.

3.4.2 Section 6(b): Outstanding Landscapes

Under Section 6(b) of the RMA it is a matter of national importance to recognise and provide for the protection of outstanding landscapes from inappropriate subdivision and development. An assessment of landscape and visual effects of the Deepdell North Stage III Project therefore needs to consider whether or not the area

[7] *Deepdell North III Project, Impact of Project on Vegetation, Avifauna, Herpetofauna and Invertebrates, prepared for Oceana Gold (NZ) Limited by Ahika Consulting, Dunedin, June 2019.*

proposed for the Project lies within an outstanding natural landscape or contains natural features that are outstanding and if so in what context they are outstanding.

An interpretation of 'outstanding natural features and landscapes' is not provided in the Act, but a useful interpretation is to be found in the Canterbury Regional Landscape Study Review[8].

'Outstanding' has been described as meaning conspicuous, standing out from the group, distinguished. Landscapes can be outstanding within a local, regional or national context. The RMA does not state that 'outstanding natural features and landscapes' need to be of national importance before they will be considered under s6 (b), but rather that it is "a matter of national importance" that such resources should be protected. Section 6(b) of the RMA indicates that 'natural' applies to both features and landscapes and should be read as 'outstanding natural features and (outstanding) natural landscapes'[9].

3.4.2.1 Outstanding Natural Features and Landscapes of the Area

A district-wide landscape study was initiated by Waitaki District Council in July 2002 with the purpose of advising Council on the nature and extent of any areas of outstanding landscapes in the Rural Scenic Zone of the District. This study was subsequently extended to provide an analysis of the entire District, including the Rural General zone. The study then formed the basis for a variation to the then Proposed District Plan aimed at better identifying and protecting outstanding natural landscapes within Waitaki District.

The assessment findings of the Waitaki Landscape Study for the Macraes Land Unit, within which the Macraes Operation lies, are as follows:

- *This unit contains no landscapes that meet the 'Outstanding' criteria.*
- *The Macraes Ridge area, which forms the western or southern skyline for much of the Palmerston and Pigroot Land Units, is assessed as locally Significant landscape, for visual reasons;*
- *Parts of the Taieri Ridge are assessed as Significant for visual and natural character reasons;*
- *The reserve containing historic mining activities, and its setting, are assessed as a significant landscape feature.*

The landscape study also notes that: *The Waitaki/Dunedin boundary follows a convoluted course along Taieri Ridge and includes within Waitaki District slopes overlooking the Taieri between Middlemarch and Hyde.* None of these particular slopes within Waitaki District are affected by the Project.

The landscape study found that there are no outstanding natural landscapes within or in close proximity to the Deepdell North Stage III Project Area; the nearest outstanding feature[10] noted in the landscape study are the Moeraki Boulders, which are approximately 30 km to the east. The 'Macraes Ridge area' referred to is the landform 'edge' to the east of the Macraes Operation site that marks the change between the Shag Valley and the Macraes upland area. This landform 'edge' is 6-8 km east of the site and will not be impacted upon by the Project.

The 'reserve containing historic mining activities' is the Golden Point Historic Reserve and will not be directly affected by the Project but is near to the proposed Deepdell South Backfill portion of the Project

The 'parts of Taieri Ridge' considered significant for visual and natural character reasons relates to the upper slopes of the ridge. The plateau where the Project Area is located is well below the ridge and, therefore, quite distant from this area of landscape significance.

The Waitaki Landscape Study notes at section 4.28, some 'elements' by which Waitaki District is known to outsiders. Of the 14 'elements' noted, the one relevant to the Coronation North Project is *Gold mining at Macraes – New Zealand's biggest 'holes'*.

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[8] Boffa Miskell Ltd (2010). *Canterbury Regional Landscape Study Review*. Prepared for Canterbury Regional Council.

[9] *Ibid.*

[10] The Waitaki Landscape Study and subsequently the Waitaki District Plan confines the outstanding landscapes of the District to the Upper Waitaki catchment only. It is also noted that the Waitaki Landscape Study was carried out at least 5 years before the subsequent DCC study that lead to OLA status of land north of the Taieri Ridge.

In summary, according to the Waitaki Landscape Study, there are no outstanding natural features or landscapes in the Waitaki District that require protection that will be affected by the Deepdell North Stage III Project.

3.4.3 Section 7(c) and 7(f): Visual Amenity Values

The RMA Section 7(c) is concerned with the maintenance and enhancement of amenity values which are defined in the Act as those natural or physical qualities of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence and cultural and recreational attributes. Amenity values encompass a broad range of issues. They are also relevant to Section 7(f) because the Act's definition of 'environment' includes reference to amenity values. This part of this report focuses on visual amenity values. Other amenity issues such as cultural matters are covered in the reports prepared by other relevant specialists for the Deepdell North Stage III Project application.

In the upland area that encompasses the Macraes Operation and its general surroundings the environment is both a working resource, in terms of land-based activities such as farming and mining, and a living environment for its residents. Like many rural areas, it is an environment that is appreciated for its sense of open space, for its lack of buildings and for its degree of 'naturalness[11]'. This appreciation is gained by the users of the local main road from Dunback through to Hyde and its side roads. This rural environment differs from the typical rural scene in the locality, in that large-scale open pit mining activities are a distinct, existing component of this environment.

The Waitaki Landscape Study notes under 'Values' for the Macraes Land Unit that: *The central identity derives from the settlement of Macraes Flat which is of national significance as the site of New Zealand's largest goldmine. Open cast hard-rock mining is carried out here at a massive scale, involving possibly the largest earthworks ever undertaken in New Zealand. Besides the large scale modern mine is preserved the historic early workings in this area, providing for a unique comparison of old and new technological development.*

It is understood that many of the current visitors to Macraes come to see the mine and its large earthmoving equipment in operation with the working mining landscape and the activities undertaken within it, being an attraction in their own right.

There have been no organised mine tours for a number of years. However, OceanaGold does, from time to time and on request, escort school groups and other community and educational groups around the mine operations.

The mining activity of Macraes Operation is now part of the visual amenity of Macraes Flat.

3.5 Summary Consideration

The previous paragraphs 'set the scene' relative to the broader Macraes Flat context and baseline environment. The Deepdell North Stage III Project will add a small component of further mining activity within the broader area where large-scale open cut mining is currently present on an extensive scale. Relative to the Waitaki District Plan, the effect on visual amenity values that will arise from this proposed project are minor relative to those effects previously consented and now existing within the Macraes Operation. These activities are accepted as contributing to the central landscape identity for the Macraes Land Unit.

All of the visual amenity effects of the Deepdell North Stage III Project will be appropriately mitigated by backfilling the defunct Deepdell South open cut pit and by the progressive rehabilitation of the Deepdell East WRS as the WRS is developed, and by the completion of the Project's closure plan.

Broadly speaking, the landscape changes implied by the Deepdell North Stage III Project are in-keeping with the local landscape. This is the case given the backfilling of the defunct pit, and the progressive rehabilitation of

[11] Naturalness in this case is a relative term. The broader area of Macraes Flat has been highly modified by pastoral farming and now gold mining, but the broad, simple, open landscape with its scattered schist outcrops and remnant areas of tussock grassland, albeit grazed, provides a more natural character and amenity than, say, the intensively developed farmland of coastal Otago.

the final surface of the infilled pit and the proposed WRS with a vegetation cover that reflects the pre-existing landuse and can withstand the local climatic conditions.

Overall, based on the above and the detailed assessment at Section 7, it is considered the proposal is consistent with the objectives, and policies of the WDC District Plan and Operative and Proposed Otago Regional Policy Statements relating to visual amenity and character, noting in particular that:

- The site is not part of an Outstanding Natural Feature or Landscape;
- The disturbed areas will be restored and finished to a contour sympathetic to the surrounding physiography and will also be revegetated with a cover appropriate to the site and setting;
- The overall landscape qualities, character and amenity value of the Rural Scenic Zone will be retained; and
- There will be a nett overall improvement to the current condition of the mined landscape.

4 Landscape Description

4.1 Landscape Context

Macraes sits within a rural upland landscape of fluvially dissected rolling hills of moderate relief and with characteristic broad ridge crests; being the coastal extent of Central Otago' s basin and range topography.

Prominent regional landscape features include the Nenthorn Valley, Taieri Ridge, Taieri Valley and the Rock and Pillar Range, which lie to the south[12] and west, the Shag Valley and Horse Range to the east and the coastal hills and extinct volcanic cones of Palmerston and Waikouaiti to the south.

Pastoral farming is the broad land use in the area, followed by gold mining; the latter has a history in this area that goes back to the nineteenth century. Macraes is off-the–beaten track and on the eastern edge of the schist country and the broader historic goldfields of Central Otago. The presence of the relatively large scale Macraes Operation is a noticeable and culturally interesting element in the current landscape. The Macraes Operation is the modern 'face' of open pit gold mining and its presence and effect relative to landscape change is now a major feature contributing to the local landscape character.

The long term, focal and cultural landscape feature of Macraes Flat is the Macraes village with its hotel, school, churches, cemeteries and small clusters of houses and various outbuildings and shelterbelts. The village sits in splendid isolation within 'the flat', and various local roads lead to even more isolated farms and homesteads. Scattered and isolated habitation is a feature of the open, rolling, landscape on the edge of basin and range topography that expands through to the upper Taieri and the Maniototo.

The Waitaki Landscape Study[13] provides further information on the landscape context of Macraes under its description of the 'Macraes Land Unit (P2)'; the current Macraes Operation lies within this landscape unit as does the southern portion of the Coronation Mine Project that is within the Waitaki District. The full text of this landscape unit description is attached at **Appendix 2**. **Photo 1** provides an overview of the broader Macraes area.

Photo 1 - **View of the broader Macraes Flat area as seen from Golden Bar Road looking west.**

4.2 Macraes Operation Landscape

Many of the more recent expansion phases of the Macraes Operation have been located to the east and north of the current Frasers Pit which is the central feature of the operation. **Photo 2** shows the Frasers Pit and surrounding mine area relative to Macraes village, Deepdell Creek and the Taieri Ridge beyond.

[12] As noted at Footnote 1, the orientation of the geographic features in the broader landscape are given relative to 'Macraes North'

[13] Densem, G, Landscape Architect (2004) *Waitaki Landscape Study.* Prepared for Waitaki District Council

Photo 2 – View of the central portion of the Macraes Operation looking west. The Deepdell North Stage III Project Area is in the middle upper right of photograph in the area between the red arrows**.**

The Coronation Mine is located on the Taieri Ridge in the upper right of the photo and its haul road ascends the front slope of the ridge north of Horse Flat Road. The Deepdell section of the haul road can be seen in the middle right of Photo 2.

Following are descriptions of the landform and drainage, landcover and land use history of the area of the Macraes Operation.

4.2.1 Landform and Drainage

As previously noted, Macraes Flat sits within a rural upland landscape of fluvially dissected rolling hills of moderate relief and with characteristic broad ridge crests; being the coastal extent of Central Otago's basin and range topography. This upland area is defined in the Waitaki Landscape Study as having the 'Macraes Ridge' to the east and south, the eastern extent of the 'Taieri Ridge' to the north with Highlay Hill as the local high point.

'Macraes Ridge' is not a ridge as such, but a series of upper slopes that form the western to northern skyline when looking up from the Shag Valley and from Palmerston and Goodwood – Flag Swamp area. The Taieri Ridge trends west towards Middlemarch and separates Macraes, Moonlight and the Nenthorn Valley from the Taieri Valley; it forms much of the northern skyline when viewed from Macraes Flat.

The broader, southern extent of Macraes Flat area generally trends or slopes to the west via Moonlight and the Nenthorn Valley to the Middlemarch – Taieri basin. To the south towards the coast are lower hills and then the more distinctive ancient volcanic cones of the Waikouaiti – Palmerston area. The somewhat more contained extent of the Macraes Flat area slopes to the east via Deepdell Creek to the Shag Valley.

Three named waterways have their sources and/or upper tributaries within the Macraes Operation – Murphys Creek to the south, Tipperary Creek to the east and Deepdell Creek to the north. The headwaters of the North Branch of the Waikouaiti River are contained in the low flats between Macraes village and the Frasers East WRS; these flats drain to the west and then south. Numerous small streams drain the various plateau tops and their scattered small wetlands by short and often steep gullies to the larger creeks. One of these is Highlay Creek that has its headwaters between the Coronation haul road and Highlay Peak on the south-facing flank of the Taieri Ridge and drains to Deepdell Creek. Deepdell Creek drains the Horse Flat Road area and the broader and flatter area to the east of the Nenthorn Road section of Macraes Road east to Shag River. The incised catchment pattern that drains the broader upland area is an important feature of the natural character of Macraes Flat.

4.2.2 *Landcover*

From the information provided in the MPIII Project's ecological assessment[14], which covered the broader Macraes Flat area, the past vegetation cover of the Macraes Ecological District (ED) within which the Macraes Operation lies was *comprised of montane short tussockland grading into subalpine tall tussockland, with areas of hardwood forest (including a podocarp element), kanuka forest and Coprosma-flax scrub. Destruction of the forest cover began with natural fires around 2500 years ago and was exacerbated by Polynesian (800 to 400 years ago) and European settlement (1840 AD).*

The present vegetation of the Macraes ED is of a highly modified nature with approximately 50% of the district dominated by improved pastureland. This is because of the long farming history associated within the Macraes ED.

Much of Macraes Flat that is in proximity of Macraes village is now flat to undulating improved pastureland and that has been extensively modified by mining. Various steeper gullies within the open paddocks of improved pasture contain remnant tussock grassland and low shrubland and there are occasional wetter, swampy areas on flat ridges and in gully areas. To the north and east are more deeply incised gullies such as that which contains Deepdell Creek. Numerous, scattered, outcrops of schist are a feature of the Macraes Flat plateau.

One of the more obvious vegetation features of Macraes Flat are various pine and macrocarpa shelterbelts, along with some pine forestry plantations. Many of these are associated with the local homesteads and their surrounding paddocks. There are further shelter and ornamental tree plantings around Macraes.

4.2.3 *Land use History*

As noted in the MPIII Project's Archaeological Assessment[15] there is *limited knowledge or understanding of pre-European land use within the Macraes Flat area. The nearest recorded Maori site is approximately 20 km to the south in Nenthorn. This is not to say Maori did not use the area, however extensive modification of the area by large scale mining in the 19th century has probably resulted in the disturbance or removal of any evidence of such sites. It is possible that evidence of such sites may be found in remote areas. There is also potential for occupation or rock art sites to be present in some of the outcrops.*

As further outlined in the Archaeological Assessment, since the 1860s pastoral farming and both alluvial and quartz mining for gold have taken place in Macraes. Alluvial mining continued with varying intensity until the 1930s and 1940s, with quartz mining being at its peak in the late 1800s and early 1900s. The Department of Conservation's Golden Point Historic Reserve next to Deepdell Creek at the end of Golden Point Road contains remnants of the quartz mining period.

The Macraes village was established at the time of the early gold mining when the population of the locality may have peaked at around 380 but fell away to a much smaller number later. Between the demise of active mining in the 1940s and the start-up of the Macraes Operation in the early 1990s, the village was a small, but active, focus of the local farming community consisting of a hotel, school, two churches and several houses. Not much has changed in more recent years, but, through support from OceanaGold, the hotel and school remain viable. In hand with tourism development in the broader region, the future land use of Macraes will focus on the cultural heritage aspects of gold mining, with continued pastoral farming and gold mining.

4.3 Deepdell North Stage III Project Landscape

The landscape of the Deepdell North Stage III Project Area is steep to rolling country, rising steeply from the north side of Deepdell Creek to a relatively flat plateau on either side of Horse Flat Road and then rising steeply again to the Taieri Ridge.

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[14] Ryder Consulting (2011). *Ecological Assessment – Macraes Proposed Phase III Extension.* Prepared for Oceana Gold (New Zealand) Ltd.
[15] Opus International Consultants Ltd (2011). *Archaeological Survey – Macraes Proposed Phase III Extension.* Prepared for Oceana Gold (NZ) Ltd

The obvious current mining components of the Project Area are the current Coronation Mine haul road, existing Deepdell WRS that was completed in 2003 and the defunct Deepdell South Pit. The Golden Point Road section of the haul road was built to access the Deepdell South Pit and the associated WRS and from Horse Flat Road up to the Coronation Mine. The Coronation haul road section has been in place for over four years.

The Deepdell WRS 'sits' on the plateau or terrace above Deepdell Creek and a residual section of haul road runs from the WRS down and across to the Deepdell South Pit, which has been excavated into the terrace face just upstream from the Golden Point Historic Reserve.

The eastern extent of the plateau within the Project Area drains east to Highlay Creek. Most of the plateau within the Project Area drains via a minor tributary to Deepdell Creek. This creek that has an ephemeral flow westward, parallel to the south side of Horse Flat Road. The southern extent of the Project Area drains directly to Deepdell Creek immediately upstream of the Golden Point Historic Reserve. As previously mentioned, this minor tributary has had its surroundings modified by farming practices and past mining activities and the flow in its upper extent is intermittent.

Assessments on the aquatic[16] and terrestrial[17] ecology, along with the archaeology[18] of the Project Area have been carried out and can be referred to within the Application.

In terms of natural character and visual amenity value, the Taieri Ridge forms a distinct skyline and visual backdrop to the Project Area to the north. The incised Deepdell Creek demarcates the southern extent of the Project Area. The block faulted skyline ridge with frequent outcrops of schist is distinctive and its various incised gullies that drain to Deepdell Creek give the ridge a rugged character. The visual amenity of the Taieri Ridge is further defined by its predominant vegetation cover of tussock grassland, which has been maintained by extensive pastoral farming practices and its elevation and isolation.

The plateau landscape running south from the toe of the Taieri Ridge, where the Project Area is located is distinctive due to its cultivated and grazed paddocks of higher producing pasture; many of which are cut for hay. This more intensively farmed landscape also contains numerous conifer shelterbelts and several farm dwellings and barns. The slopes of Deepdell Creek are again, more rugged with areas of scrubby native vegetation and tussock.

[16] 'Deepdell North Stage III Project Impact of Project on Vegetation, Avifauna, Herpetofauna and Invertebrates', Ahika Consulting, September 2019
[17] Refer Footnote 6
[18] 'Deepdell North Stage III Macraes Archaeological Assessment', Origin Consultants, September 2019

5 Alternatives

Gold mines are based on extracting gold bearing ore from where this resource is found through various forms of exploration. How the ore is extracted is a result of mining economics and physical practicalities. In this instance, there is no alternative to the proposed mine's location and proposed open cut mining process.

One major component of the Project for which alternative sites were considered has been the WRS. At least three alternative sites were considered that were on the north side of Horse Flat Road opposite the proposed open cut pit as shown on the 'Waste Dump Options' plan at **Appendix 3**.

5.1 Horse Flat West (Option A)

An alternative location for the proposed WRS was to the northwest of the proposed open cut pit on the north side of Horse Flat Road. This WRS would have had a similar footprint to the proposed stack and would have risen up the face of the Taieri Ridge to an elevation of approximately 640 mRL; approximately 100 m higher than the proposed WRS. Its construction would require the removal of the Bellfield shelterbelt and it would be closer to the Howard homestead than the proposed stack; both of these factors would make it more visible from the Howard property and Horse Flat Road than the proposed stack.

5.2 Horse Flat Road (Option B)

Another alternative location for the proposed WRS was directly to the west of the proposed open cut pit on the north side of Horse Flat Road. This WRS would have had a somewhat smaller footprint than the proposed WRS, but, like Option A, would have risen up the face of the Taieri Ridge to an elevation approximately 640 mRL; approximately 100 m higher than the proposed WRS. In this case, the Bellfield shelterbelt may have been able to be retained, but it would be closer to the Howard homestead than the proposed stack; this would make it more visible from the Howard property than the proposed stack.

5.3 Highlay Creek (Option C)

This alternative location for the WRS is to the northeast of the proposed open cut pit on the north side of Horse Flat Road. This WRS would have a larger footprint than the proposed WRS, with a 'spread-out' form. Being relatively flat, it would have limited visibility with a final surface that could readily be returned to productive pasture. It is also further away from the Howard homestead than the proposed WRS and at the Horse Flat Road road-end.

5.4 Deepdell East (Option D)

This is the preferred location for the proposed WRS immediately to the east of the proposed open cut pit.

6 Potential Landscape and Visual Amenity Issues

In general, gold mining, and in particular open pit mining, has direct and often irreversible effects on the landscape in which they are located. These effects result from the stripping of overburden and the extraction of ore from the mine itself, the creation of waste rock stacks to accommodate the overburden, the placement of processing plant to extract the mineral from the ore and the creation of tailings storage facilities to contain the fluid waste from the ore processing process. By necessity, all but the processing phase of open pit gold mining results in large voids, materials stacks and containment areas that have a large physical 'footprint' and are therefore likely to be visible and bring about a distinct change to the local landscape. Examples of these visual effects already exist within the consented Macraes Operation site. However, being highly visible does not necessarily equate to an adverse landscape or visual effect or even if it is adverse, it may not be inappropriate, on balance, in terms of overall sustainable management.

6.1 Permanent Modifications to the Landscape

In terms of the Deepdell North Stage III Project, permanent modifications to the landscape will result from excavating a new pit, backfilling a redundant pit, developing a new WRS and developing a connecting section of haul road within the immediate mine. The Project also entails the continued use of associated ancillary structures and activities, and a number of temporary facilities that are commonplace within the existing mining operation. As with the current operating Coronation Mine, there will be mitigation measures that focus on the Project's closure plan, but in many cases, these will be progressively implemented through the life of the Project.

The following discussion relates back to the components of the Project described in the Project Description at Section 2.3.2 in terms of what is being proposed.

The location and plan area of the larger components of the Project are shown in the 'Project Elements for Consenting' plan at **Appendix 1**. The potential effects of these components, and measures to mitigate any adverse effects, are described in Section 7 and in that section's supporting graphics in **Appendix 4** – Viewpoint Map, Photographs and Visual Simulations.

6.1.1 Deepdell North Pit

The excavation of the proposed open cut pit will start with the stripping of topsoil, which will be stockpiled and shaped to form noise bunding adjacent to the existing Coronation haul road during the first year of operation. Topsoil from the footprint of the adjoining WRS will be stockpiled along the south edge of Horse Flat Road and between the pit and the WRS.

Low grade ore will also be stockpiled between the pit and the haul road and subsequently hauled to the processing plant in the latter period of the Project's operation.

The final excavation of the open cut pit will form a void that will, in part, remove the eastern third of the existing Deepdell WRS. Opportunistic backfilling of the pit may take place and ultimately the pit void will become a lake, like that currently consented for Coronation Mine.

Given the proposed pit's location, the pit itself will only be visible from its immediate edge of the adjacent section of Horse Flat Road and the rising country to the north. In the first instance, the pit will be screened, in part, from Horse Flat Road by a topsoil stockpile running parallel to the road edge. This topsoil will subsequently be removed as part of the rehabilitation of the WRS. It is unlikely that the pit lake, deep within the pit, will be visible from Horse Flat Road in the foreseeable future. Aspects of the upper walls of the pit void may be visible from sections of Golden Point Road to the south, but it is unlikely that the pit lake will be visible.

When looking up and north from the Golden Point Historic Reserve, the 'cut-out' of the southern extent of the pit will create a new section of skyline and possibly sections of the west and east pit walls may be visible, but the pit itself will not be visible due to its incised nature.

6.1.2 *Deepdell East Waste Rock Stack*

Approximately a quarter of the waste that is to be excavated will backfill the existing defunct Deepdell South Pit and placed around the northeast margin of this pit. The stockpiled topsoil will be uplifted and re-spread over the surface of the backfill as part of the Project's progressive rehabilitation and will continue to be applied until the backfill WRS formation is complete.

The Deepdell South Pit is clearly visible from sections of Golden Point Road leading down to the Golden Point Historic Reserve, but it is not visible from other local roads, such as Horse Flat Road due to intervening landform.

The backfilling of the defunct pit will provide the opportunity to re-instate the natural slope close to and upstream of the historic reserve.

Given that the proposed WRS will be the largest visible component of the Project, the form of the Deepdell East WRS is based on the inputs that OceanaGold's consultant landscape architect provided to the existing, now-consented Coronation Mine and Coronation North WRSs. This was during the previous consenting processes and the development of the 'landscape' conditions that followed. This approach has the intention of ensuring that the proposed WRS will be visually integrated into the landscape as far as practicable.

At the outset, the base core of the WRS will be built-up and its outer, lower slopes will have the grey colour of freshly dumped waste rock. During the second year of operation of the Project, brown rock and topsoil from either the Rehabilitation Materials Stockpile/Noise Bund or newly stripped areas of the Deepdell North Pit will be uplifted and re-spread over the WRS. This forms part of the Project's progressive rehabilitation, which will continue to be applied as part of the environmental mitigation to reduce sulphate expression in the WRS seepage and in order to progressively rehabilitate the WRS formation.

As noted previously, with opportunistic backfilling of the cut pit, the scale of the Deepdell East WRS has the potential to reduce. OceanaGold will involve its consultant landscape architect in the re-design and final design of the WRS, as has previously been required by past consent conditions.

6.1.3 *Haul Road 'connection'*

The proposed WRS will be accessed by a short haul road direct from the pit utilising the existing haul road to Deepdell South Pit in the first instance. A new section of new haul road will rise up the west face of the WRS as the stack is developed and be incorporated into the form of the WRS. The short western extent of the existing haul road will link the proposed pit to the Coronation haul road and back to the processing plant.

6.1.4 *Horse Flat Road Diversion*

The eastern most extent of the regularly maintained section of Horse Flat Road will be permanently moved to the north due to the construction of the WRS. The realignment of this road will involve the installation of at least one culvert.

6.1.5 *Ancillary Structures and Activities*

Silt ponds and clean water diversion drains will be constructed for the proposed WRS. The actual need for and extent of such will be defined in the Project's Surface Water Study.

6.1.6 *Temporary Facilities*

The activities that will be visible will be the stripping of overburden – topsoil and waste rock and the excavation of the top 'lifts' of portions of the pit and the placement of waste rock. The extraction of ore is not likely to be visible as that will take place within the increasingly incised pit. However, one of the more obvious activities will be the movement of dump trucks between the pit and the backfill and WRS and between the pit and the processing plant; the visual effects of the latter were previously considered and consented, relative to the existing Coronation Mine.

As with the current Macraes Operation surface mining activities, the stripping and dumping of waste rock will continue through the night with the excavation and dump sites being floodlit. The actual location of these work sites within the broader mine site will be constantly changing as the mining operation progresses. However, potential night lighting effects will be mitigated by facing the floodlighting inwards, wherever possible, in accordance with existing night lighting procedures. This is already done elsewhere within the Macraes Operation as per the consent requirements.

6.1.7 Mitigation Measures

Existing resource consents for the mining activities at Macraes Operation require compliance with a number of consent conditions including a specific landscape rehabilitation condition. The particular 'landscape' condition 4.4 from the current Coronation North consents (refer **Appendix 5**) that relates to the rehabilitation of waste rock stacks states:

The consent holder shall design and construct the WRS in accordance with the following principles:

- *(a) Slopes shall be suitably shaped in cross-profile to match nearby natural slopes;*
- *(b) Slope gradients shall be no steeper than nearby natural surfaces;*
- *(c) Transitions between natural and formed surfaces shall be rounded and naturalised.*
- *(d) Contours should be curvilinear in plan form, in keeping with original natural contours in that area.*
- *(e) The skyline shall be variable and curved, simulating natural skylines;*
- *(f) New landforms shall be aligned and located so they seem to continue, not cut across, existing landscape patterns; and*
- *(g) Silt ponds shall be removed and the site rehabilitated or be converted to stock water drinking ponds following completion of mining operations and rehabilitation.*

Back Road WRS and the Frasers West WRS are good examples of existing waste rock stacks that meet the principles of the rehabilitation conditions.

It is anticipated that the backfilling of the Deepdell South Pit and the construction of the Deepdell East WRS will meet similar conditions to those that have been previously applied to the expansion of the Macraes Operation and the Coronation Mine and Coronation activities. The latter being the most recent mining activities to be consented. These conditions have been taken into account in the preliminary design of the earthworks relative to the Deepdell North Stage III 'Project Elements for Consenting' plan and carried through into the visualisations referred to in this assessment.

Implementing these principles is governed by the mechanics and economics of shifting vast quantities of dump material with very large earthmoving equipment. However, in general terms, the final form of the WRS will be of a similar character to the existing natural form of the broad local topography and will closely replicate the surrounding landforms.

The final vegetation cover of the Deepdell East WRS, as with previous completed waste rock stacks, will be predominately pasture grass that also matches the colours and finer grained textures of the surrounding landscape. A similar vegetation cover will be established on the restored formation and batters of the haul road.

Overall, mitigation measures will be built into the Deepdell North Stage III Project from the outset. These include:

- careful design of the form of the backfill and the WRS to integrate them with the existing landform character of the area;
- progressive rehabilitation of the backfill and the WRS;
- restoration of the areas disturbed around the margins of the Project;

- removal and restoration of the haul roads used during construction of the Project; and
- formation of a lake within the open cut pit.

7 Assessment of Landscape and Visual Effects

The following assessment is based upon observation of the existing open cut pits, waste rock stacks, haul roads and other operational aspects of the current Macraes Operation, the current extent of the previous Deepdell Mine, an understanding of the likely visual effects of creating the proposed Deepdell North Stage III Project and from experience in defining and implementing appropriate measures to mitigate these types of effects. The latter includes an understanding of how the current consent conditions have been implemented in the development of the various mine components.

A site visit was carried out on 18 January 2018 under clear and sunny weather conditions visiting the defunct Deepdell Mine area via Golden Point Road and Horse Flat Road. This provided for a good understanding of the mining operations and potential landscape and visual effects going forward to the proposed Deepdell North Stage III Project. The previous 'Coronation Mine' and 'Coronation North' viewpoints from which the current Project might be visible were re-visited and photos taken.

This initial LVA input was developed into an April 2018 draft that focussed on the Horse Flat Road (Option B) as the proposed WRS, along with the current open pit and the backfilling of defunct Deepdell South Pit. This input was then put on hold while OceanaGold re-considered aspects of the Deepdell North Stage III Project. The current LVA was recommenced in May 2019. The Project Area has not been re-visited, however, OceanaGold has provided current site photos of the Project Area taken from Horse Flat Road, just east of the Coronation haul road crossing. These photos; along with several previous photos, have been used to prepare new visual-simulations for this assessment.

The description and discussion in previous sections about setting, site, planning context and proposed activities forms the baseline discussion to this assessment.

7.1 Deepdell North Stage III Project Visibility

Macraes Flat as a locality is situated on an elevated plateau that is quite isolated from the main highways and towns of northeast Otago. Only one sealed, local authority road – Macraes Road - connects Macraes Flat and the associated Macraes Operation with State Highway 85 (SH85, the Pigroot) to the east and State Highway 87 (SH87, the Middlemarch-Hyde road) to the west. The eastern hill section of Macraes Road ascends quite steeply over a distance of approximately 8 km from SH85 at Dunback in the Shag Valley to a point known as Sailors Cutting and the first broad view of Macraes Flat upland from the east. The western section of the local road, known locally as Hyde-Macraes Road, also ascends quite steeply from the north to a point known as Hyde Hill and the first broad view of the upper Deepdell Creek catchment and the Macraes upland from the west. Due to the elevated nature of the topography, Macraes Flat has low visibility in a district-wide sense.

With its agricultural history of extensive pastoral farming, the smaller local roads running off Macraes Road are few in number; all are gravel roads, and most are no-exit. The farm homesteads are also very few in number; all are sheltered by conifer shelterbelts and are physically and visually isolated from one another. Macraes village is a central feature of the locality and sits on low, sloping land with an outlook to the south and to the west.

In this context, aspects of the Deepdell North Stage III Project will be visible from various points along Macraes Road and the other local roads. This is on the basis that if the original Deepdell WRS on the 'plateau' between Deepdell Creek and Horse Flat Road is visible, the proposed Deepdell East WRS may also be visible. In these instances, the predominant 'viewer' will be motorists travelling along these roads and the extent, direction and focus of their view will be constantly changing.

Relative to the visibility of the WRS, the potential visual effects of night lighting will be considered in respect to neighbours and the local community. However, this consideration will focus just on where these effects differ from those of the night operation of the consented Coronation Mine.

7.1.1 *Viewshed Mapping*

Viewshed maps were produced for the 'Coronation Mine' and the 'Coronation North' given their elevated and stand-alone nature. This exercise has been considered unnecessary for this current Project as the proposed Deepdell North Pit is in a relatively low-lying location, the to-be-backfilled Deepdell South Pit already exists and the 'front face' section of the existing Coronation Mine haul road forms a good 'marker' for where the Project Area 'sits' next to Horse Flat Road.

A set of viewpoints was previously chosen for the Coronation Mine and the Coronation North LVAs and those viewpoints relevant to this Project, that is those viewpoints south of the Taieri Ridge, were used again as the basis to this current LVA.

As previously considered, there are also a number of salient viewpoints, such as gateways to local farms; being the Howard and the Roy properties. Other such viewpoints are those that provide an overview of the broader Macraes Flat landscape such as Sailors Cutting or Hyde Hill where visitors to the area will gain their first view of Macraes Flat, along with where local residents might commonly meet such as the Macraes Old Cemetery car park. From these salient viewpoints, the Deepdell North Stage III Project may or may not be visible and, again, this was confirmed from the ground.

These representative and salient views were then considered from the point of view of a visitor to the Macraes Flat area travelling from the Sailors Cutting in the east along Macraes Road, then travelling north along Golden Point Road and down to the Golden Point Historic Reserve, followed by east along Horse Flat Road and north on Hyde-Macraes Road to its summit on the Taieri Ridge. The reasoning behind considering a particular view and the specific discussion regarding the visibility of the various aspects of the Deepdell North Stage III Project is provided in Section 7.3 relative to the particular viewpoints.

7.2 Visual Simulations

Following an analysis of where the main components of the Deepdell North Stage III Project are likely to be visible from, along with site photos from all viewpoints, three visual simulations have been prepared to assist in assessing the potential landscape and visual effects of the Project. The visual simulations involve incorporating into photographs from the selected viewpoints, permanent elements of the proposed mine activities such as the proposed WRS as this element will be both large and/or distinctive relative to the scale of the surrounding landscape. While the current design height of the proposed WRS is 540 mRL, it has the potential to be constructed to 580 mRL. Therefore, the visual simulations for the WRS are based on a digital terrain model that raises to 580 mRL.

A statement of the methodology used to prepare the visual-simulations is contained in **Appendix 4** of this assessment.

Visual simulations, like photographs, can be somewhat limited in their ability to represent some of the subtle details in a landscape, which may ordinarily be seen with the naked eye. Also, variations in atmospheric conditions and light, which are dependent on prevailing weather conditions and the time of day, can affect the visibility and appearance of a large earthworks-type development such as a gold mine. Notwithstanding such constraints, simulations can represent the layout, positions, design and extent of the elements of a proposed development including the effects of sun and shade, precisely.

Site photos, along with visual simulations from the selected representative and/or salient viewpoints are at **Appendix 4**. The viewpoint images have been formatted in the following order:

- "Before" – This image is the current panoramic view from the particular viewpoint and is the base photograph from which the subsequent visual-simulation has been generated.
- "Intermediate" – This is an 'artificial' visual simulation image where the base CAD image of the visible mine elements are shown in a distinctive colour. This has been done so that it is possible to readily see or 'read' the created image of the mine elements within the simulation and, therefore, clearly define the visible change at the site.

- "After" – The visual simulation includes the particular aspects of the Project that are expected to be seen from the particular viewpoint. The Project's components, such as the outer slopes of rock stacks, have been coloured and textured to show the components fully revegetated as they will be when the proposed mitigation measures have fully taken effect.

The various local features noted in the description of each view are labelled on the "Before" photograph of the particular view and the larger components of the Deepdell North Stage III Project are labelled on the relevant "After" visual-simulations.

The fact that aspects of the Deepdell North Stage III Project will be visible and will change aspects of the character of the existing landscape does not necessarily mean that these effects will be inappropriate or unacceptable. The visibility, scale, nature and duration of the effect, the visual complexity and scale of the existing landscape, the visual sensitivity of the viewer and the size of the viewing audience; all influence the significance of the Project's potential effects. Visual sensitivity is a measure of how critically changes to a landscape will be regarded and depends upon a range of viewer and view characteristics.

The visual simulations have been used to assist in the assessment of the visibility and landscape and visual effects, including cumulative effects, of the Deepdell North Stage III Project. The assessment that follows endeavours to focus on an objective description of the degree of change to the status quo that a viewer will experience from each particular viewpoint, rather than whether the change represents an adverse or a positive effect.

The visual simulations show the degree of mitigation that was expected under the previous Coronation North 'landscape' consent conditions, i.e. shaping and grassing of rock stack slopes, as described in section 6.1.7, and that it is expected will be replicated in conditions of consent for the Deepdell North Stage III Project.

7.3 Landscape and Visual Effects relative to Specific Viewpoints

This assessment is based upon:

- observation of existing mining activities;
- what the development of further, similar, mine features under proposed conditions that will mirror the current consent conditions implies;
- an understanding of the likely landscape and visual effects of excavating the open cut pit, backfilling the closed pit and constructing the proposed rock stack and haul road; and
- experience in defining and implementing appropriate measures to mitigate these types of effects.

The methodology for this assessment is modelled on the NZ Transport Agency's Landscape and Visual Assessment Guidelines[19] and has been framed in response to RMA matters.

What has been used to define a potential visual effect ranking is a combination of the extent to which the Deepdell North Stage III Project is a focus, the extent to which the Project has changed the landscape; both relative to the consented mining activities in the broader area and also the effects of distance.

Based on the environmental and design information available, the nature of the potential effect is described. It is noted that change is not an effect per se. By way of example, it is not the quantity of the earthworks that is relevant, rather the effect of the earthworks on (say) visual amenity values or on the natural character of a stream.

An evaluation of the magnitude of the effect is then provided. Magnitude is influenced by variables[20], for example the dimensions of the WRS, distance from a viewpoint, the effects of intervening landform or vegetation. A relative scale is used to rank magnitude and reasons provided to justify the ranking. The following 7-point scale based on the Transport Agency LVA Guidelines is utilised. **Table 1** outlines these rankings in descending order.

[19] Refer to NZ Transport Agency Landscape Guidelines (Final Draft) September 2014 – Appendix 1 *NZTA Landscape and Visual Assessment Guidelines*; https://www.nzta.govt.nz/resources/nzta-landscape-guidelines/

[20] In other words, an assessment of magnitude can be thought of as an assessment of variables.

Table 1: Ranking of Effects Table

Comments	Potential for Visual Effect
The components of the Project can be a very strong visual focus and tend to dominate the landscape	High
The components of the Project can be highly prominent and although the combined components of the Project may not dominate the landscape, it will be a strong visual focus	Moderate-High
The components of the Project can be prominent and very distinctive features in the landscape	Moderate
The components of the Project can be quite noticeable and a somewhat distinctive feature in the landscape, although not prominent	Moderate-Low
The components of the Project can be noticeable and the combined components of the Project appear as a minor feature in the wider landscape	Low
The components of the Project can be discernible, and the combined components of the Project appear as a very minor feature in the wider landscape	Negligible
From some salient viewpoints, the Project will not be visible	Nil

The mitigation component that is factored in to the above actual effects 'equation' is a combination of the Projects' mitigation measures previously outlined in Section 6.1.7 and known effectiveness of previous 'landscape' rehabilitation conditions.

Nature of Effect + Magnitude - Mitigation = Actual Effect

In this assessment, the focus is on long term effects of the Deepdell North Stage III Project post-closure; being the 'Actual Effect'. Mention is made of a number of short-term effects that will appear and then disappear during the life of the Project. That is, as the Project proceeds, the initial effects; being 'Nature of Effect' and it's 'Magnitude' are reduced via the proposed landscape mitigation measures – 'Mitigation', resulting in the 'Actual Effect'.

For example, the bulk and the form of the Deepdell East WRS will grow within the landscape in that it will start small and then gradually get bigger. The working surfaces will be grey waste rock, which will be progressively shaped, topsoiled and re-vegetated. The Deepdell North Pit will sink down into the landscape and will initially be outwardly invisible. However, the pit will open up a 'notch' in the skyline that will be visible from the Golden Point Historic Reserve and the pit will expose cut faces when viewed from Horse Flat Road to the north.

Relative to the WDC's Rural Scenic and Macraes Mining Zones, as shown at **Appendix 1**, almost all of the infilled Deepdell South Pit and the south, east and north flanks of the Deepdell East WRS are within the Rural Scenic Zone. The proposed Deepdell North Pit, and the western 'third' of the WRS and the ancillary activities are within the Macraes Mining Zone.

7.3.1 View 0 – Sailors Cutting, Macraes Road

Approaching Macraes Flat from the east via Macraes Road, which is the local main road, there is an elevated point on the north side of Sailors Cutting that is on the crest of the hill when arriving from Dunback. This part of the local road provides a salient view of what is the first broad vista of the Macraes Flat area having ascended the steep hill from Dunback and the Shag Valley.

As shown in **Appendix 4 – Location of Photo Viewpoints**, the 'Sailors Cutting' viewpoint would be approximately 8 km from the central high point of the proposed Deepdell East WRS. The **View 0 photo** shows the general locality of the Project Area in the distance at the centre of the photo.

Experience has shown that this distance is too great to differentiate landscape and visual effects, especially when the proposed WRS, if visible, will be set against an existing larger landform. The existing Deepdell WRS and Deepdell South Pit are not visible from this point due to the intervening landform of the broad ridge that rises up to Back Road WRS.

The proposed Deepdell North Pit and associated WRS will not be visible in this view and the potential visual effects are considered to be '**Nil**'.

7.3.2 View 1 – Back Road Section, Macraes Road

Continuing towards Macraes, an elevated view towards the Horse Flat Road section of the Taieri Ridge can be gained from the east end of 'Back Road' section of Macraes Road. At this particular point on the local road, the tussock-covered farmland immediately to the north gently slopes away then drops off to the north. This viewpoint is approximately 4.3 km from the central high point of the proposed Deepdell East WRS.

The **View 1 photo** shows the sweep of this view from Station Hill along Taieri Ridge to Highlay Hill and east. The northern extent of the Rock and Pillar Range in the distant background is obscured by an approaching rain storm in the centre left of the photo.

The pine shelterbelt on the west side of the Bellfield homestead is an obvious feature in the centre of the photo and Horse Flat Road traverses the flats in front of these trees. The Coronation Mine haul road can be seen above the pine shelterbelt as it takes a serpentine course up the 'front slope' of Taieri Ridge

The eastern slopes of Deepdell WRS are visible to the left of the shelterbelt just above tussock pasture in the foreground.

As shown in **'intermediate' View 1 visual simulation, t**he proposed Deepdell East WRS will occupy much of the 'plateau top' in the centre left of the view from the Bellfield shelterbelt to and including the shelterbelt to the right or east end of the 'bright green' paddock in the centre of the photo. The upper aspect of the proposed open cut pit will also be visible to the right of the existing Deepdell WRS.

As seen in the **'after' View 1 visual simulation** that while both the pit and the WRS will be visible from this viewpoint, the duration of this view will be short as it is a glimpsed view when travelling west on Macraes Road and the land to the immediate north of the road rises and falls. The visibility of the cut void will be countered by being contained in the middle ground that is the incised Deepdell valley or gully system. The Deepdell East WRS, though broad in this view, will have its visibility diminished by being setback against the base of the Taieri Ridge and being shaped and vegetated in response to the proposed 'landscape' conditions.

Distance and the broad scale of the view will also limit the visual effect; the result being that the potential overall effect of the Project on this view will be '**Low**.'

7.3.3 View 2 – 'Evacuation Point B', Golden Point Road

Progressing 'west' and closer to the Project Area, an elevated and relatively direct view towards the local section of the Taieri Ridge can be gained from Golden Point Road at a location known as 'Evacuation Point B' (though the sign has now disappeared…). Golden Point Road runs north from Macraes Road, past the Macraes Operation site office and 'Evacuation Point B' and then descends to the Golden Point Historic Reserve and also to Horse Flat Road. The latter part of the local road traverses what was the Deepdell Mine haul road, which has been re-activated as the initial section of the Coronation Mine haul road. The 'Evacuation Point B' viewpoint is approximately 3.5 km from the central high point of the proposed Deepdell East WRS.

The **View 2 photo** shows the localised section of the Taieri Ridge from Camp Creek east along the ridge to Highlay Peak. The yet-to-be-completed built form of the consented Coronation Mine WRS can be seen behind and to the left of the foreground radio mast as a grey plateau of rock fill.

The Coronation Mine haul road is clearly visible to the right of the mast, along with the Bellfield homestead pine shelterbelt, the established Deepdell WRS and a portion of the Mixed Tailings Storage Facility embankment can be seen at close hand in the centre right of the photo (behind the bulldozer).

The existing Deepdell WRS screens the area of the proposed open cut and the Mixed Tailings Storage Facility embankment obscures the proposed Deepdell East WRS. The Projects' noise bunding that will be placed parallel to the Bellfield shelterbelt section of the Coronation haul road in the central right of the photo. No other part of the Deepdell North Stage III Project will be visible from this viewpoint.

The potential visual effects on View 2 will be limited to the 'Bellbird' noise bunding. These effects will be negated by distance and the broad scale of the view where the proposed changes will constitute a very small part. Therefore, the potential visual effect of the Project relative to this view will be '**Negligible'.**

7.3.4 View 3 – Golden Point Road Viewpoint

Further down Golden Point Road and just beyond the turn-off to the Macraes Processing Plant, there is a roadside carpark and a walking track that leads to a schist outcrop that has a commanding view of the front slope of the Taieri Ridge to the north and Highlay Hill to the northeast, the local slopes that fall to Deepdell Creek and artefacts of the current mining period - various waste rock stacks, sections of haul road and aspects of the adjacent process plant. Given the depth of local 'folds of the land', neither the Golden Point Historic Reserve nor the stream flow of Deepdell Creek are visible from this point. This viewpoint is approximately 2 km from the central high point of the proposed Deepdell East WRS.

The **View 3 photo** has the Coronation Mine haul road traversing the 'face' of Taieri Ridge at the left edge of the photo, with Deepdell WRS in the left mid-background and the currently unused section of the Deepdell haul road traversing the upper extent of the middle ground slopes to the defunct Deepdell South Pit in the centre right. The downstream extent of the Deepdell Creek valley is at the right edge of the photo. Closer at hand is the continuation of Golden Point Road.

The **'intermediate' View 3 visual simulation** shows the proposed open cut pit to the right of the Deepdell WRS having been cut down into the eastern extent of the existing WRS and into the upper extent of the middle ground slopes. To the right, the existing Deepdell South Pit and its immediate upper margins are shown as being backfilled, along with the residual section of haul road. The upper extent of the proposed Deepdell WRS will extend above the proposed open cut pit and the backfilled Deepdell South Pit, obscuring part of the skyline to the east of Highlay Hill.

As seen in the **'after' View 3 visual simulation**, the most obvious feature of the Deepdell North Stage III Project that will be seen from this viewpoint will be a section of the eastern, internal face of the open cut pit, which, like the pit faces currently visible from this viewpoint, will be grey in colour and contain sections of cut benches. The other aspect that will be visible, but not so obvious, in due course, will be the upper slopes and crest of the Deepdell East WRS.

The 'void' of the existing Deepdell South Pit will be replaced and rehabilitated to a relatively uniform slope that rounds off to the adjoining natural contour. The overall new WRS slopes will, in time, take on the colour and texture of the lower extent of the middle ground slopes to the immediate left of the existing pit.

While the proposed Deepdell North Pit will be obvious, it 'sits' within the context for various consented mining activities where the progression of these activities through this Project will 'remove' another equally visible mining feature – the Deepdell South Pit. The mass and form of the completed Deepdell East WRS will also be quite noticeable. Due to intervening topography – the existing Deepdell WRS – and distance, the potential visual effect of the proposed Project-related noise bunds adjacent to the Bellfield shelterbelt on this view will be negligible. Overall, the visual effect of the Project on this view will be '**Moderate-Low'**. It is noted that the purpose of this viewpoint is to facilitate a broad view of local mining activities; both current and past.

7.3.5 View 4 – Golden Point Historic Reserve

The endpoint of Golden Point Road down within the valley is Golden Point Historic Reserve[21]. The reserve contains the first stamper battery in the area that is now marked by remnants of concrete foundations and stone-walling. Remaining from a subsequent battery is the original well in which its waterwheel was located and some battery stampers which are possibly original. All the equipment associated with the mineral extraction process is now enclosed in the 'Golden Point Battery' corrugated iron building. Above the battery building, a track leads up to a hopper and a collection of rusting metal equipment, including a Huntingdon mill from the Bonanza Mine. The remaining historic stamper is next to the creek in the foreground right at the left/upstream end of the track

This viewpoint within the reserve is approximately 1.2 km from the central high point of the proposed Deepdell East WRS.

The **View 4 photo** provides a panoramic view of the immediate northern slopes above Deepdell Creek, with a 'corner' of exiting Deepdell WRS visible to the upper left, the defunct section of Deepdell haul road traversing the top of the central slopes and void of Deepdell South Pit in the slope to the right. The remaining historic stamper is next to the creek in the foreground right.

Adjacent to the viewpoint, but not visible in the photo is the wooden mine manager's house, which is still in good order; two mudbrick dwellings and their associated outhouses occupy terraces a short distance along the road and the concrete foundations and fallen brick chimney of another building sit among the tailings on the valley floor. Sections of sluice pipe, along with several interpretation panels, define the reserve.

The **'intermediate' View 4 visual simulation** shows the proposed open cut pit as a 'cut-out' void at the top of the central slopes, some sections of the upper, internal faces of the pit and the 'removal' of a section of the existing haul road. To the right, the existing Deepdell South Pit 'void' and its immediate upper margins are shown as being backfilled, along with the residual section of haul road. The upper southern flank of the proposed Deepdell East WRS rises above the backfilled pit.

As seen in the **'after' View 4 visual simulation**, the most obvious change resulting from the Deepdell North Stage III Project that will be seen from this viewpoint will be the infilling and rehabilitation of the Deepdell South Pit. As noted previously, the 'void' of the existing pit will be replaced by a relatively uniform slope that rounds off to the adjoining natural contour. This new 'surface' will, in time, take on the colour and texture of the lower extent of the central slopes in the midground of this view. The new skyline created by the cutting down of the proposed Deepdell North Pit and the placement of the upper extent of the proposed WRS will also be obvious to those who are familiar with the current view. The open cut pit aspect of this particular change may include glimpses of sections of the internal cut faces of pit.

While the new skyline to the north created by the proposed Deepdell North Pit and Deepdell East WRS will be obvious to some, as before, it 'sits' within the context for various consented mining activities and a foreground of past mining activities. As a counter to this 'negative' void and the 'rising up' of the proposed WRS, there will be the creation of the 'positive' surface of the infilled and rehabilitated Deepdell South Pit. The 'balance' of these three effects will mean that, overall, the visual effect of the Project on this view will be **'Moderate-Low'**.

7.3.6 View 5 - Macraes Flat Old Cemetery

In considering the potential effect of the Deepdell North Stage III Project on Macraes Flat, the majority of the village has a southerly aspect with the outlook from most residences being 'down the flat' to Red Bank Road

[21] http://www.doc.govt.nz/parks-and-recreation/places-to-go/otago/places/macraes-flat-area/golden-point-historic-reserve/

and beyond. A location within the village from where it is possible to see to the north, to varying degrees, is the Macraes Flat Old Cemetery, which is approximately 4.5 km from the central point of the proposed Deepdell East WRS. However, it is not possible to see any aspect of the Project from this viewpoint or elsewhere in the village, so the potential visual effect of the Project on the village is **'Nil'**.

7.3.7 View 6 – Frasers Road to Nenthorn Road, Macraes Road

Progressing further 'west' beyond Macraes Flat and towards Horse Flat Road and the Taieri Ridge, a relatively broad view of the local, eastern extent of the Taieri Ridge can be gained from the section of Macraes Road from Frasers Road through to the 'pigskin fence' area north of Nenthorn Road. This viewpoint is approximately 5.5 km from the central high point of the proposed Deepdell East WRS.

The **View 6 photo** shows the eastern section of the Taieri Ridge from Station Hill in the left to the rising flank of Highlay Hill in the right with Kakanui Peak and the tops of the Horse Range to the left and right of Highlay Hill, respectively. Camp Creek is the wide gully in the centre of the photo and Bellfield pine shelterbelt can be seen below and to the left of Highlay Hill, with Deepdell WRS below and to the right of Highlay Hill. The pine plantation in the centre of the photo is within the Howard farm in the foreground and the grazed slope to the right of the photo rises up to the north side of Macraes village. The almost full length of the existing consented Coronation Mine haul road rising from Horse Flat Road up to the skyline above Camp Creek can be seen in this view. The western extent of the yet-to-be completed Coronation Mine WRS is visible on the skyline at the top of the haul road.

The top of the proposed Deepdell East WRS will be visible in the distance rising above and to the right of the Deepdell WRS. A small section of the backwall of the proposed Deepdell North Pit may be visible at the right or east end of the Deepdell WRS. The Deepdell South Pit and therefore the backfill portion of the proposed WRS will not be visible from this point.

In essence, the visible landscape effects of the Deepdell North Pit and the Deepdell East WRS will be countered, to a reasonable degree, by the consented mining context it sits within, by the 'backdrop' formed by the local ridges, by distance and the broad scale of the view implying that the potential visual effect of the Deepdell North Stage III Project on this view will be **'Low'** to **'Negligible'**.

7.3.8 View 7 – Howard's Gateway, Horse Flat Road

Travelling east along Horse Flat Road, the front slopes of the local section of the Taieri Ridge rise to the north beyond a series of flat to rolling, relatively intensely grazed paddocks that bound the road. Approaching the area of the proposed Deepdell North Stage III Project from Macraes Road, Horse Flat Road undulates through open farmland, crossing various small creeks that drain down off the ridge to Deepdell Creek. The land also rises somewhat to the south obscuring potential views back towards Macraes Flat.

The current Deepdell Station homestead and its associated farm buildings on the Vanderley property are located to the north of Horse Flat Road about 1 km from the Macraes Road intersection; refer to **Photo 7a**. The previous Coronation North LVA noted that no elements of that project would be visible from this area as a local ridge rises immediately to the east of the homestead paddocks. The same follows for the Deepdell North Stage III Project.

As indicated on the Viewpoint Map, the View 7 viewpoint is approximately 4 km along Horse Flat Road from Macraes Road. At the driveway entrance to the Howard homestead, the view opens to the Camp Creek gully on the left. In the centre distance of the **View 7 photo** is the shelterbelt on the west side of the Bellfield homestead and beyond the second shelterbelt on the right is Golden Point Road. The Coronation Mine haul road can be seen traversing across in front of the Bellfield shelterbelt and rising up the front slope of the Taieri Ridge. A small portion of the consented Coronation Mine WRS is visible at the head of Camp Creek at the skyline from this viewpoint but is not shown in this photo. This viewpoint is approximately 2.5 km from the central point of the proposed Deepdell East WRS.

The **'intermediate' View 7 visual simulation** shows the upper extent of the proposed Deepdell East WRS rising above the Golden Point Road shelterbelt in the background of this view. The proposed Deepdell North Pit will not be visible from this viewpoint due to intervening vegetation; being a series of evergreen shelterbelts on the south side of the road. These shelterbelts also obscure the existing Deepdell WRS, which is beyond the further Golden Point Road shelterbelt. The Project's noise bunding will be placed parallel to the lower section of haul road in front of the Bellfield shelterbelt.

As seen in the **'after' View 7 visual simulation,** the most obvious change resulting from the Deepdell North Stage III Project that will be seen from this viewpoint will be the creation of the Deepdell East WRS. In this image, it is shown as having relatively rounded form with uniform slopes. This new 'surface' will, in time, take on the colour and possibly texture of the less intensively grazed slopes visible in the midground of this view below the haul road.

From this viewpoint, the new skyline profile of proposed Deepdell East WRS will appear as a singular 'hill' standing separate from other elevated landforms that recedes into the distance. This new landform, though large, will have its potential visual effect mitigated through the presence of the various shelterbelts, in particular, the Golden Point Road shelterbelt and the shaping and revegetation of the surface of the WRS. The former will screen much of the stack and the latter will, with time, naturalise this new landform relative to the colour and texture of the adjacent front face of the Taieri Ridge. Overall, the visual effect of the Project on this view will be **'Low'**.

The proposed noise bunding on west side of Coronation Mine haul road will be 4 – 5 m high and will screen the adjoining section of the existing haul from views to the west. This bunding will be a temporary feature as it will be removed, and the stockpiled material used as part of the rehabilitation at Deepdell North mine closure.

The Howard homestead is the closest private residence to the Project. The View 7 visual simulation process indicates that the proposed Deepdell East WRS will be clearly visible from the property's gateway and given that the homestead is set back by approximately 200 m from the gateway, the upper extent of the WRS may be visible from the homestead. However, as shown at **Photo 7b**, the homestead is surrounded by amenity tree and shelter plantings. This, coupled with the existence of two sets of mature shelterbelts on the south side of Horse Flat Road between the homestead and the proposed WRS will mean the visual effect on the homestead will be negligible to nil. Photo 7b was taken from the upper slopes above Bellfield homestead at a level that equated to the upper extent of the possible Option B Alternative Horse Flat Road WRS.

If the two mature shelterbelts were to be removed, which the landowner could do as they are within private property and outside the control of OceanaGold, then the potential view from Viewpoint 7 towards the Project would open up. Given that these shelterbelts provide shelter to the 'home paddocks', it is unlikely that they will be removed. Likewise, it is assumed that the tree planting around the homestead itself provide much needed shelter and amenity in a locality that has a harsh climate and it is unlikely that these trees would be removed, either. Distance from the Project will also negate the potential effect of the Project.

7.3.9 View 8 – East of Bellfield, Horse Flat Road

Travelling further east along Horse Flat Road to beyond the intersections with Golden Bar Road and the Coronation haul road and close to the end of the formed section of Horse Flat Road affords a direct view of the open paddocks on the east side of the Deepdell WRS. The **View 8 photo** shows the sweep of this view from out from the toe of the Taieri Ridge, looking east along the no-exit end of Horse Flat Road across farmland to the site. This viewpoint is approximately 1 km from the central point of the proposed Deepdell East WRS.

The **'intermediate' View 8 visual simulation** shows that the proposed Deepdell East WRS will occupy all of the middle distance in this view and include the removal of the distant section of Horse Flat Road and the adjoining shelterbelt. The realigned section of Horse Flat Road will follow round the base of the WRS to the left.

The open cut pit will be to the right and setback approximately 80 m from the road. During the life of the Project, a 4-5 m high topsoil stockpile will run parallel to the fence line down the length of the road that is visible in this view. After the Mine Closure process when this topsoil will be re-spread over the surface of the WRS, there will be a clear view to the open pit.

As seen in the **'after' View 8 visual simulation,** the proposed Deepdell East WRS will be very obvious from this particular viewpoint as it rises from the end of road and up and across to the right/south. Once its final outer surface is shaped and re-grassed, it will appear as a grazed rolling hillside much the same as existing completed waste rock stacks that are close to local roads. Examples of these are Frasers East WRS and Back Road WRS.

With the north edge of the pit only 75-80 m from the road, it will be possible see down into the pit with the side walls and the internal haul road visible. At mine closure, the upper edge of the pit walls is to be re-worked, which will 'naturalise' their form and allow for pockets of grass and other vegetation to establish. The pit will eventually fill with water to form a lake.

Overall, the visual effect of the Project from this viewpoint will be **'Moderate-High'**. This is due to the proximity of both the WRS and the pit, their respective height and depth and large-scale relative to the road 'corridor' running past the pit and towards the WRS. The ranking of this effect is lessened to a degree in respect to the broader Macraes Flat area as this east end of Horse Flat Road is quite isolated and infrequently visited by the travelling public.

It is noted that the proposed open cut pit and its associated western flank of the waste rock stack will be an extension of that activity which is already provided for within the WDC Macraes Mining Zone. The rest of the proposed Deepdell East WRS, including the Deepdell South Backfill portion, however, 'sits' within the WDC Rural Scenic Zone.

7.3.10 View 9 – Roy's Gateway, Hyde-Macraes Road

Progressing 'north' beyond Macraes Road and Horse Flat Road intersection and ascending the Taieri Ridge on the Hyde – Macraes Road, the view to the east initially is of the Deepdell homestead area with Station Hill rising above. As can be seen in the **View 9 photo**, Station Hill is on the skyline in the left of the photo and in the centre of the photo, the upper portion of the eastern slopes of Taieri Ridge form the skyline. The crest of Highlay Hill can be seen above this. The shelterbelts associated with the Deepdell homestead can be seen in the near midground, along with local ridge mentioned at 7.3.7 regarding the Deepdell homestead. A section of the upper extent of the consented Coronation Mine haul road is just visible through the tree tops to the right of the power pole in the centre of the photo.

As indicated on the Viewpoint Map, the View 9 viewpoint is at the road entrance to the driveway to the Roy homestead and is approximately 6.3 km from the central point of the proposed Deepdell East WRS. The farmland in the foreground and Station Hill and the slopes beyond are all within the WDC's Rural Scenic Zone.

Given that the lower extent of the Coronation Mine haul road, the adjoining Bellfield shelterbelt and the existing Deepdell WRS are not visible from this viewpoint, the likely effect of the Project on this viewpoint is **'Nil'**. Should the very top of the proposed Deepdell East WRS become visible, the effect would be negligible as any effect would remain diminished by distance.

7.3.11 View 10 – Hyde Hill east, Hyde-Macraes Road

Progressing further up the Hyde Hill section of the Hyde – Macraes Road and looking back to the Macraes Operation and Macraes village in the east to southeast, the view shown in the **View 10 photo** takes in the broad panorama of the upper Deepdell Creek catchment and the rolling country of Macraes Flat. As indicated on the Viewpoint Map, the View 10 viewpoint is approximately 7 km from the central point of the proposed Deepdell East WRS. The farmland in the foreground and Station Hill beyond are all within the WDC's Rural Scenic Zone; the distant farmland towards Macraes village is Rural General and the land and mine workings at and beyond the Macraes Operation Processing Plant and the adjacent Mixed Tailing Storage Facility are within the Macraes Mining Zone.

In the View 10 photo, Station Hill forms the skyline in the centre left of the photo and in the centre right of the photo are a pine plantation and various shelterbelts that bound or run perpendicular to Horse Flat Road; the second of the shelterbelts shelters the Howard homestead and the more distant shelterbelt bounds Golden Point Road where it intersects with Horse Flat Road. The western flank of the existing Deepdell WRS rises above the last of these shelterbelts. In the middle distance to the right can be seen the Macraes Operation processing plant and also the surface of the Mixed Tailings Storage Facility. To the right of the tailings area are the pine plantation and shelterbelts that are just to the north of Macraes.

Given that the existing Deepdell WRS is visible from this viewpoint, it is possible that some aspects of the proposed Deepdell North Stage III Project may also be visible. The top of the proposed Deepdell East WRS may rise above the existing Deepdell WRS. However, the existing Deepdell WRS and the flank of Station Hill in the middle ground, coupled with distance, would mean any likely visual effect of the Project on this viewpoint would be **'Negligible'** to **'Nil'**.

7.4 Night Time Visibility

With much of the proposed Deepdell East WRS being elevated, in due course, and separate from the central, current Macraes Operation site, though 'attached' to the consented Coronation Mine via the existing haul road, the potential visual effect of night lighting has been considered relative to neighbours and the local community.

The current Coronation Mine and Coronation North consent conditions 10.1 Lighting states that:

All flood lighting luminaires that could potentially cause a glare nuisance or a traffic hazard shall be fitted with shields and, as far as is practicable, orientated so that the principal output is directed away from residences and traffic.

It is anticipated that the same or a very similar condition will be applied to the Deepdell North Stage III Project and therefore mobile flood lights on the proposed Deepdell East WRS will be positioned to face inward with no outward light effect. However, dump truck and other mine traffic movement will result in some headlights shining out from this proposed WRS and parts of the haul road. Lights in isolated and elevated locations have the potential to attract the eye.

Obviously, the potential and amount of light visible from the overall Coronation Project has changed relative to the phase of that combined mine operation. For instance, with the pit being excavated and the waste rock being carted out, the excavator descended into the pit and becomes invisible and the dumping operations have risen up and become more visible. There will not be as many machines working at night on the Deepdell North Stage III Project as there are currently or have been working the Coronation Pits or Frasers Pit, so the potential amount of light being emitted from the Deepdell North Stage III Project will be less than from consented parts of the Macraes Operation site within the southern Macraes Flat area.

The distance between the elevated portion of the Deepdell North Stage III Project Area and Macraes Road, which is the main 'public' view point in the local area, will also limit the potential effect of night lighting from the proposed Project. Other than for the placement of the Project's noise bunds, there will be no 'direct' traffic effect at the Horse Flat Road and Golden Point Road intersection where the Coronation haul road meets the only section of public road in proximity to the Project.

Haul trucks will travel to and from the processing plant during daylight hours only and other mine traffic at night will be low. It is also considered that the traffic volumes at night will be so low on Horse Flat Road that the potential for glare nuisance or traffic hazard issues will be very limited.

The Howard homestead is the closest private residence to the Project at approximately 2.5 km from the proposed Deepdell East WRS. While it will be possible to see the upper third of the proposed Deepdell East

WRS from the gateway to the Howard homestead on Horse Flat Road, as shown in the View 7 visual simulation at Appendix 4, it is expected that the actual activity on the rock stack will be not visible from the homestead, which is set back from the gateway and enclosed by evergreen shelter and amenity planting as shown in Photo 7b.

7.5 Summary of Landscape and Visual Effects

The following summarises the potential landscape and visual effects of the Deepdell North Stage III Project relative to the specific viewpoints.

This assessment, relative to the various viewpoints that have been considered, endeavours to focus on an objective description of the degree of change to the status quo that a viewer will experience from each particular viewpoint, rather than whether the change represents an adverse or a positive effect. However, this can be inferred from the NZ Transport Agency scale of effects table used for each viewpoint.

The fact that the Project will be visible and will change aspects of the character of the existing landscape does not necessarily mean that its effects will be adverse, inappropriate or unacceptable. Its visibility, the scale, nature and duration of the effect, the visual complexity and scale of the existing landscape, the visual sensitivity of the viewer and the size of the viewing audience influence the significance of the Project's effects. Visual sensitivity is a measure of how critically changes to a landscape will be regarded and depends upon a range of viewer and view characteristics.

In regard to the eleven viewpoints discussed at section 7.3, **Table 2** summarises the level of potential landscape and visual effect for each. It is noted, however, that some views are broad and all encompassing, others are quite focussed and others, such as Roy's gateway, have been considered to confirm that little or nothing of the Project will be seen from the particular viewpoint.

Once the final shaping and revegetation of the proposed Deepdell East WRS and associated Deepdell South Backfill that the visual simulations illustrate has been completed, the general shape, slopes and colour of the completed and revegetated landforms will be in sympathy with the natural slopes of the area.

Overall for the majority of viewpoints considered from which the aspects of the Deepdell North Stage III Project will be visible, the potential visual effect does not exceed what is considered to be a moderate effect. In the one instance where the effect is considered to be moderate-high, the particular viewpoint on Horse Flat Road is considered to be quite isolated on a small, local no-exit road that is infrequently used. It is also expected that once site rehabilitation has been completed at mine closure and the revegetation of the WRS has become well established and the adjacent pit has 'naturalised' and the pit lake 'filled-up', the effect will be moderate-high to moderate in the longer term.

Table 2: Ranking of Effect relative to Specific Viewpoints

Viewpoint	Location	Visual Effect
0	Sailors Cutting, Macraes Road	Nil
1	Back Road section, Macraes Road	Low
2	'Evacuation Point B', Golden Point Road	Negligible
3	Golden Point Road Viewpoint	Moderate-Low
4	Golden Point Historic Reserve	Moderate-Low
5	Macraes Flat Old Cemetery	Nil
6	Frasers to Nenthorn Road, Macraes Road	Low to Negligible
7	Howard's Gateway, Horse Flat Road	Low
8	East of Bellfield, Horse Flat Road	Moderate-High
9	Roy's Gateway, Hyde-Macraes Road	Nil
10	Hyde Hill east, Hyde-Macraes Road	Negligible to Nil

There will be night light effects associated with the operation of the Deepdell North Stage III Project. However, compliance with existing night light conditions will adequately mitigate these effects. There are not expected to be any night light effects on the one private residence that is in proximity of the Deepdell North Stage III Project.

The Deepdell North Stage III Project will entail the extension of mining activity, both in extent and in time, within a relatively contained and confined part of the local landscape – the 'plateau' between Taieri Ridge and Deepdell Creek – and much of this activity will be within the Macraes Mining Zone, with a smaller portion within the WDC's Rural Scenic Zone.

8 Cumulative Effects Assessment

Cumulative landscape effects are considered to be those that affect the physical landscape such as earthworks for the haul road 'connection', site works, topsoil stripping, excavating the open cut pit, placement of noise bunding and longer-term brown rock stockpiles for subsequent use in rehabilitation and the progressive development of the backfill and elevated waste rock stacks. Cumulative visual effects can affect visual amenity values and it is generally recognised that this can occur in three ways[22]. These are:

- **Combined effects** – resulting from two or more waste rock stacks, for instance, being seen from one viewpoint in the human field of vision (i.e., spanning 124° horizontally).
- **Succession effects** – resulting from two or more waste rock stacks being seen from one viewpoint but not in the human field of vision, i.e., the viewer has to turn to see one or other waste rock stacks.
- **Sequential effects** – resulting from the observer moving to another viewpoint and then seeing one or other waste rock stacks. Sequential effects are most commonly experienced along regularly used routes such as roads and cycle/walkways.

As discussed relative to a number of the representative and salient viewpoints considered, cumulative effects of the combined, succession and sequential type relate to possible visual effects caused by the proposed Deepdell North Stage III Project and the consented aspects of the existing Macraes Operation, which includes the currently operating Coronation Mine and Coronation North Project.

From the viewpoints considered within the Macraes Flat area from which aspects of the Deepdell North Stage III Project will potentially be seen - Views 1, 2, 3, 4, 6, 7 ,8 and 10 - the main additional mining component that will be seen in Views 1, 3, 4, 6, 7, 8 and 10 will be the elevated, proposed Deepdell East WRS. In Views 1, 3, 4, 6, 8 and 10 at least one other WRS close to the Deepdell North Project – Deepdell WRS – will be visible. In the case of View 1 and 3, other existing waste rock stacks such as Back Road WRS, Round Hill WRS and Coronation WRS are visible.

In a number of these cases, the proposed Deepdell East WRS and/or the existing waste rock are some considerable distance away. In relation to Viewpoints 1, 2, and 6 that distance will be such that the scale of WRS(s) will be reduced to the extent that does not equate as a cumulative effect from these particular viewpoints. For View 7, it is possible to see a small part of the Coronation WRS in the far distance at the 'top' of Camp Creek, but this is quite removed from the direct view along Horse Flat Road to the proposed Deepdell East WRS.

For View 8, there is likely to be a cumulative effect as from this viewpoint. The existing Deepdell WRS and the proposed Deepdell East WRS will be in relatively close proximity and directly visible. While the proposed pit will also be visible in View 8, no other pits will be visible from this viewpoint.

In terms of Views 3 and 4, the proposed Deepdell North Pit will be the main additional mining component visible. In View 3, the existing Deepdell South Pit is visible, along with the cut terraces of the Round Hill pit on the south side of Deepdell Creek. For View 4, a small portion of the cut face or pit wall within the Deepdell South Pit is visible. With this Project, the Deepdell South Pit is going to be infilled and the resultant surface rehabilitated, so there will be no 'gain' relative to an additional open cut pit being visible.

[22] Scottish Natural Heritage (2005). *Guidance Note: Cumulative Effects of Windfarms.*

Except for View 8, the effects of scale and distance, combined with the continuation of established landscape mitigation measures, limits the visual effect of the existing and proposed waste rock stacks when seen in the same view. For View 8, the large-scale landform change brought about by the additional proposed Deepdell East WRS will remain and be a cumulative landscape effect.

In terms of the overall cumulative landscape and visual effect of the Project, the effect will be negligible to low from the majority of viewpoints considered. However, the effect will moderate-high from the one viewpoint on Horse Flat Road looking west to the existing Deepdell WRS and the proposed Deepdell East WRS. Once site rehabilitation has been completed at mine closure and when the proposed landscape-related mitigation measures have become well established, the cumulative effect relative to this viewpoint will become moderate in the longer term.

9 Conclusion

The current and recent mining activities of the Macraes Operation are a transient element within the Macraes landscape that starts with the raw and large-scale transformation of low to medium production farmland into the open pits, waste rock stacks and tailings storage facilities. Given the depth of the pits, the height of the stacks and the length and height of the tailings containment embankments, this degree of change is considered to be an extreme landscape transition in New Zealand. However, this process in itself is transient and moves on to the rehabilitation phase of naturalised landforms of shaped and grassed hills and, ultimately, lakes within the pit voids. The former will replicate the scale and shape of the existing hills at Macraes. While the mining activities involve large scale earthworks, they occur within a large-scale landscape. It is this scale and the simple forms of the Macraes Flat landscape that means the mining activities are capable of being assimilated into the landscape, once rehabilitation is complete.

The Deepdell North Stage III Project will bring further mining activity to the northern margin of the Macraes Flat area. This will be contained within the broader Macraes Operation site which extends above the Project Area up and over the Taieri Ridge and onto the northern flank of the ridge. All of the proposed Project is within Waitaki District and much of it 'sits' within the MDC Macraes Mining Zone.

In this landscape and visual assessment, it has been found that:

- The effect on visual amenity values that will arise from the Project are low relative to those effects already consented for the existing mining activities with the Macraes Operation and are therefore accepted as contributing to the central landscape identity for the Macraes Land Unit.
- With respect to eleven salient and common public viewpoints considered, the Project or aspects of the Project will not be visible from three of these viewpoints – Views 0, 5 and 9, and the potential visual effect is **'Negligible'** or less from another two viewpoints – View 2 and 10. From a further three viewpoints, the potential visual effect will be **'Low'** or **'Low'** to **'Negligible'** – View 1, 6 and 7.
- With respect to the remaining three viewpoints, all are on or at the end of local, gravel, no-exit roads and have direct views to the proposed open cut pit and proposed Deepdell East WRS. The effect on Views 3 and 4 is considered to be **'Moderate-Low'**, while the effect on View 8 is considered to be **'Moderate-High'**.
- Once the final shaping and revegetation of the proposed Deepdell East WRS has been completed, along with that of the redundant haul roads, the general shape, slopes and colour of the completed and revegetated 'hill' landform will be in sympathy with the natural slopes of the area. In time, relative to the most effected viewpoint – View 8 - the visual effect of the proposed Deepdell East WRS will reduce from **'Moderate-High'** to **'Moderate'.**
- In a much greater length of time, the proposed Deepdell North Pit void will become a lake, though still confined within the pit. The shaping and 'naturalising' of the upper pit walls in response to slope stabilisation works will also assist in moderating the overall visual effect of this aspect of the Project.
- Backfilling the defunct Deepdell South Pit will provide the opportunity to re-instate the natural slope close to and upstream of the Golden Point Historic reserve, while 'balancing' the creation of a new open cut pit with removal of an old pit.
- In terms of the overall cumulative landscape and visual effect of the Project, the effect will be **'Low'** to **'Negligible'** when seen from the broader Macraes Flat area. From closer to the Project Area, where more than one WRS will be visible, there will be a degree of cumulative effect that will be **'Moderate-High'** in the first instance but will become **'Moderate'** with time.

Overall, mitigation measures will be built into the Project from the outset. These include:

- careful design of the form of the WRS to integrate it with the existing landform character of the area;
- progressive rehabilitation of the WRS;
- shaping the upper pit walls of the open cut pit in response to slope stabilisation works to a naturalised form that enables the establishment of vegetation cover and an accessible margin to the eventual pit lake, where possible;
- restoration of the areas disturbed around the margins of the Project; and
- removal and restoration of the haul roads during closure phase of the Project.

These measures have been proven to be effective in mitigating the potential visual effects of the existing waste rock stacks, which are the most visible, elevated mining elements so far constructed as part of the Macraes Operation.

This new mining activity – Deepdell North Stage III Project - is an extension of previously consented activity and is not unexpected and will be seen in this landscape context as a continuation of the existing mining operation.

www.wsp-opus.co.nz

Appendix 1
Deepdell North III
‘Project Elements for Consenting’ Plan

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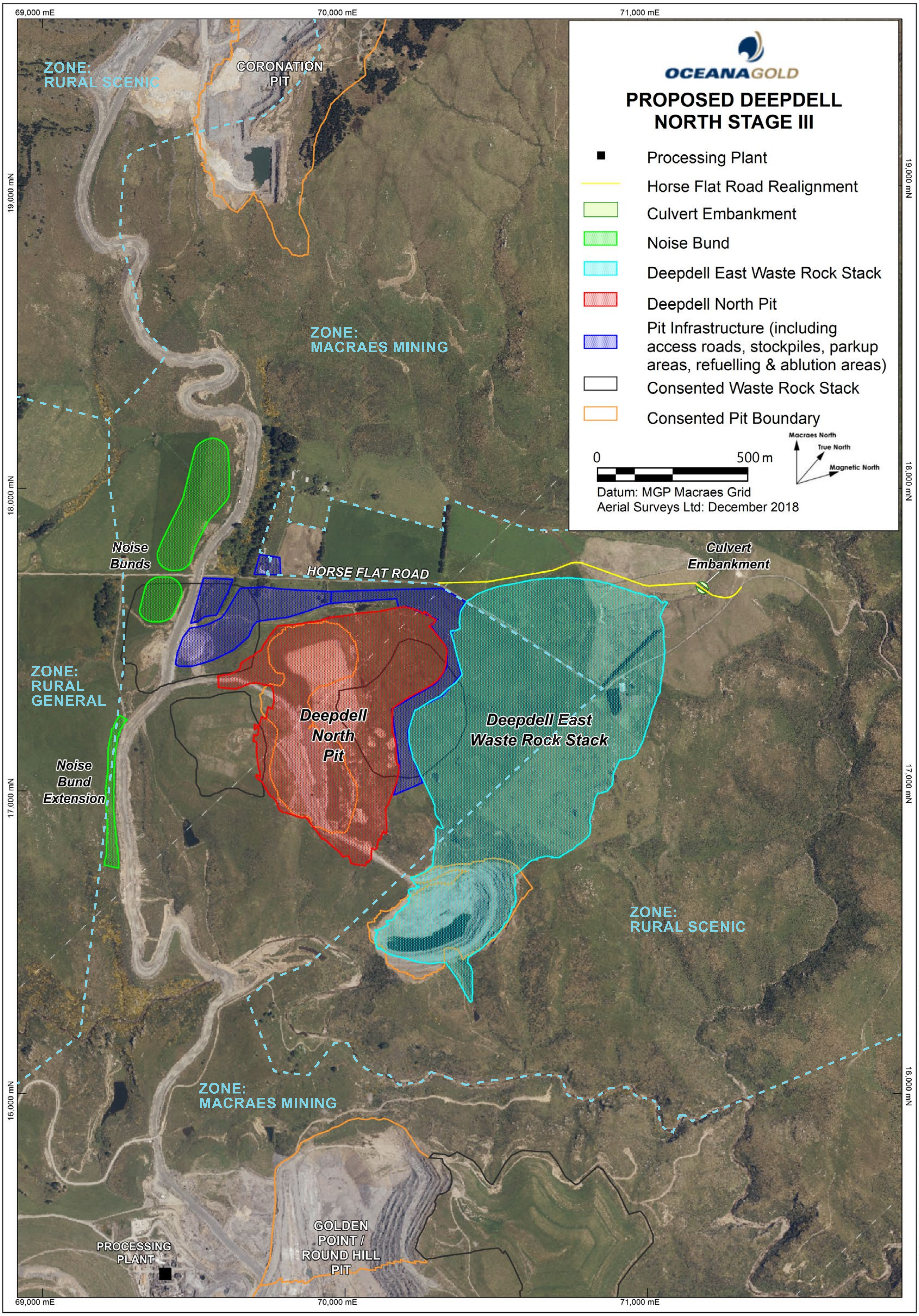
OCEANAGOLD
PROPOSED DEEPDELL
NORTH STAGE III
Processing Plant
Horse Flat Road Realignment
Culvert Embankment
Noise Bund
Deepdell East Waste Rock Stack
Deepdell North Pit
Pit Infrastructure (including access roads, stockpiles, parkup areas, refuelling & ablution areas)
Consented Waste Rock Stack
Consented Pit Boundary
Macraes North
True North
Magnetic North
0
500 m
Datum: MGP Macraes Grid
Aerial Surveys Ltd: December 2018
69,000 mE
70,000 mE
71,000 mE
19,000 mN
18,000 mN
17,000 mN
16,000 mN
ZONE: RURAL SCENIC
CORONATION PIT
ZONE: MACRAES MINING
Noise Bunds
HORSE FLAT ROAD
Culvert Embankment
ZONE: RURAL GENERAL
Deepdell North Pit
Deepdell East Waste Rock Stack
Noise Bund Extension
ZONE: RURAL SCENIC
ZONE: MACRAES MINING
GOLDEN POINT / ROUND HILL PIT
PROCESSING PLANT
Created by H.Petry 20191106. Workspace: M_Deepdell_Consenting_20191106.wor

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Appendix 2
Waitaki Landscape Study
Macraes Landscape Unit Description

.20 *MACRAES LAND UNIT (P2)*

6.20.1 *Values*

i) The Macraes Land Unit is a complex and sometimes rugged upland block of land forming the western boundary and visual skyline of the Palmerston group of land units, and part of the boundary of Waitaki District bordering the Dunedin City territory.

ii) The central identity derives from the settlement of Macraes Flat which is of national significance as the site of New Zealand's largest goldmine. Open cast hard-rock mining is carried out here at a massive scale, involving possibly the largest earthworks ever undertaken in New Zealand. Besides the large scale modern mine is preserved the historic early workings in this area, providing for a unique comparison of old and new technological development.

iii) The central and western portion of the Macraes Land Unit consists of a complex pattern of open upland valleys and ridges between 550-650m with rugged upstanding hardrock 'tor' features and tussock grasslands, much of which has now been 'smoothed' into pasturelands. The rugged landscape features make this a visually interesting area, and of landscape value due to its uniqueness within Waitaki District.

iv) Another significant value of the Macraes Land Unit is its northern and eastern margin, which forms a western skyline for the lowlands of the Palmerston Land Unit. The boundary between these two land units is more of a transition than the firm line shown on Map 7, the skyline consisting of a dissected and visually-open rolling edge.

v) The southwestern portion of this land unit consists of the Moonlight valley, a typical farmland landscape, and the more rugged Nenthorn area. These are unique in Waitaki in being raised areas with wide south-facing views, aligned firmly to the Taieri catchment of Dunedin City.

vi) The Waitaki/Dunedin boundary follows a convoluted course along Taieri Ridge and includes within Waitaki District, and therefore the scope of this study, slopes overlooking the Taieri between Middlemarch and Hyde.

6.20.2 *Assessment*

- *This unit contains no landscapes that meet the 'Outstanding' criteria.*
- *The Macraes Ridge area, which forms the western or southern skyline for much of the Palmerston and Pigroot Land Units, is assessed as locally Significant landscape, for visual reasons;*
- *Parts of the Taieri Ridge are assessed as Significant for visual and natural character reasons;*
- *The reserve containing historic mining activities, and its setting, are assessed as a significant landscape feature;*

6.20.3 *Recommendations:*

i) That the above Significant areas be adopted for inclusion in the Plan variation;

ii) That further discussions be held aimed at identifying an area of 'tor and tussock' landscape in the Macraes Flat to Nenthorn area, capable of becoming a 'no change' area that represents this increasingly rare landscape type."

Appendix 3
Deepdell North III
‘Waste Rock Stack Options’ Plan

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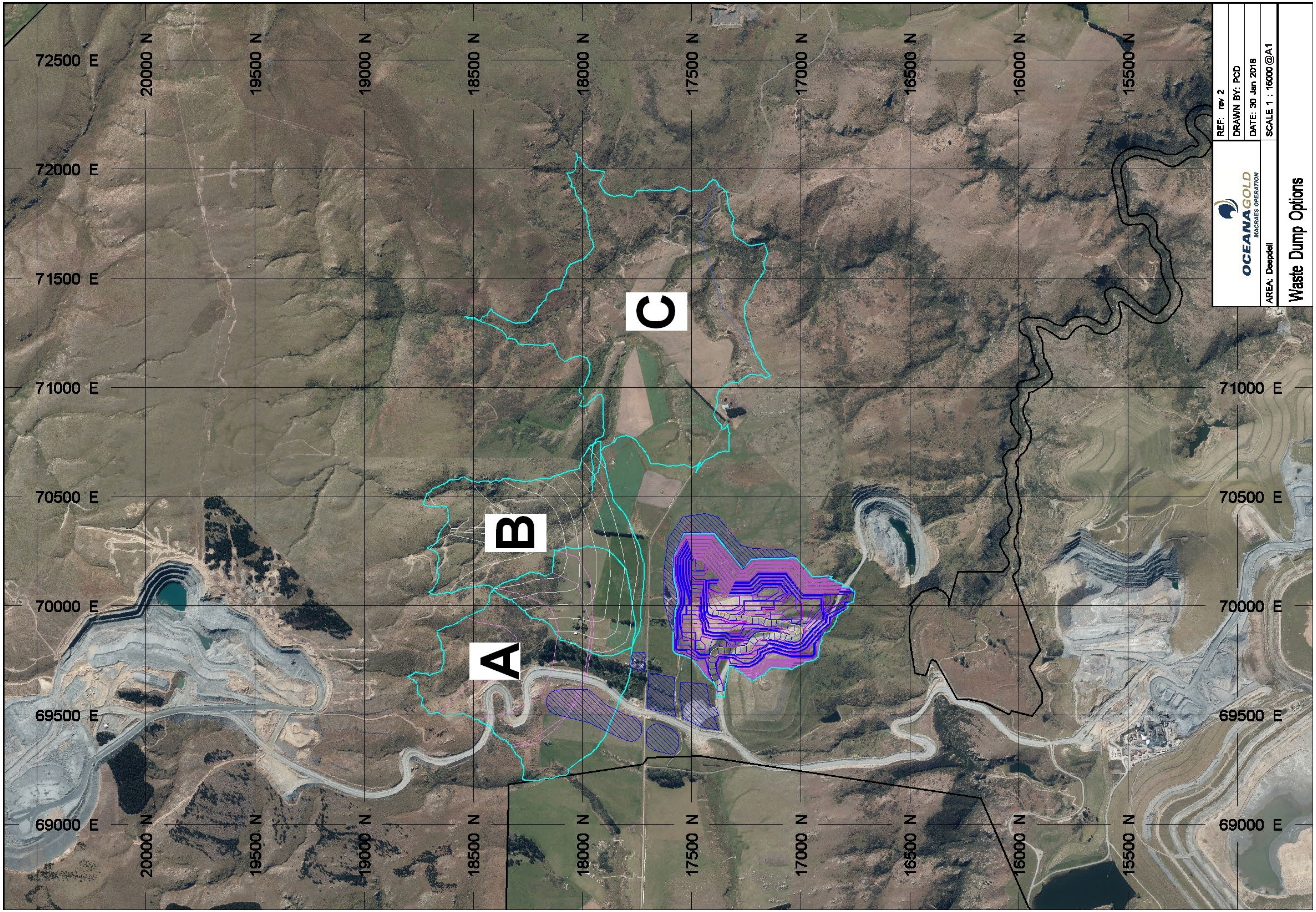

Waste Dump Options
AREA: Deepdell
OCEANAGOLD
MACRAES OPERATION
REF: rev 2
DRAWN BY: PCD
DATE: 30 Jan 2018
SCALE 1 : 15000 @A1
A
B
C
72500 E
72000 E
71500 E
71000 E
70500 E
70000 E
69500 E
69000 E
20000 N
19500 N
19000 N
18500 N
18000 N
17500 N
17000 N
16500 N
16000 N
15500 N

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Appendix 4
Deepdell North III
Viewpoint Plan, Photographs and Visual Simulations

Preparation of Visual Simulations

Introduction

The visual simulations were prepared by Meg Back, Landscape Architect, using best visualisation practices. The photographs were taken by David McKenzie, Technical Principal, Landscape Architecture; all of Opus.

Methodology

Viewpoint locations were decided, marked and surveyed to later tie into the mine design CAD model. Local visual reference points, such as local roads and shelterbelts were also identified and surveyed for location and level for use as height and location checks in later modelling.

Photographs have been taken using a DSLR camera (Pentax K-r) with a 50 mm lens setting and this focal length was used consistently for all the photographs taken. The 50 mm setting was used as this produces a reasonably focussed representation of what is seen by the human eye. It is also our understanding that by using a 50mm lens an image is achieved that is of the same size as seen by the human eye, as opposed to a 38mm lens (wide angle) which reduces the size of the image.

As a wide field of view was required to best represent particular components of the Project over a relatively wide area of view, each view was made up of a series of photographs tiled together to form a panoramic simulation with the individual images 'stitched' or digitally merged in "Adobe Photoshop".

A computer model was created in "Autodesk Civil3D" using topographical data as part of the overall mine design for the Project. This model was then transferred to '"3D Studio Viz" (a 3D visualisation programme) and was used as a basis for illustrating the waste rock stack formations and associated components of the Project depicted in the visualisations.

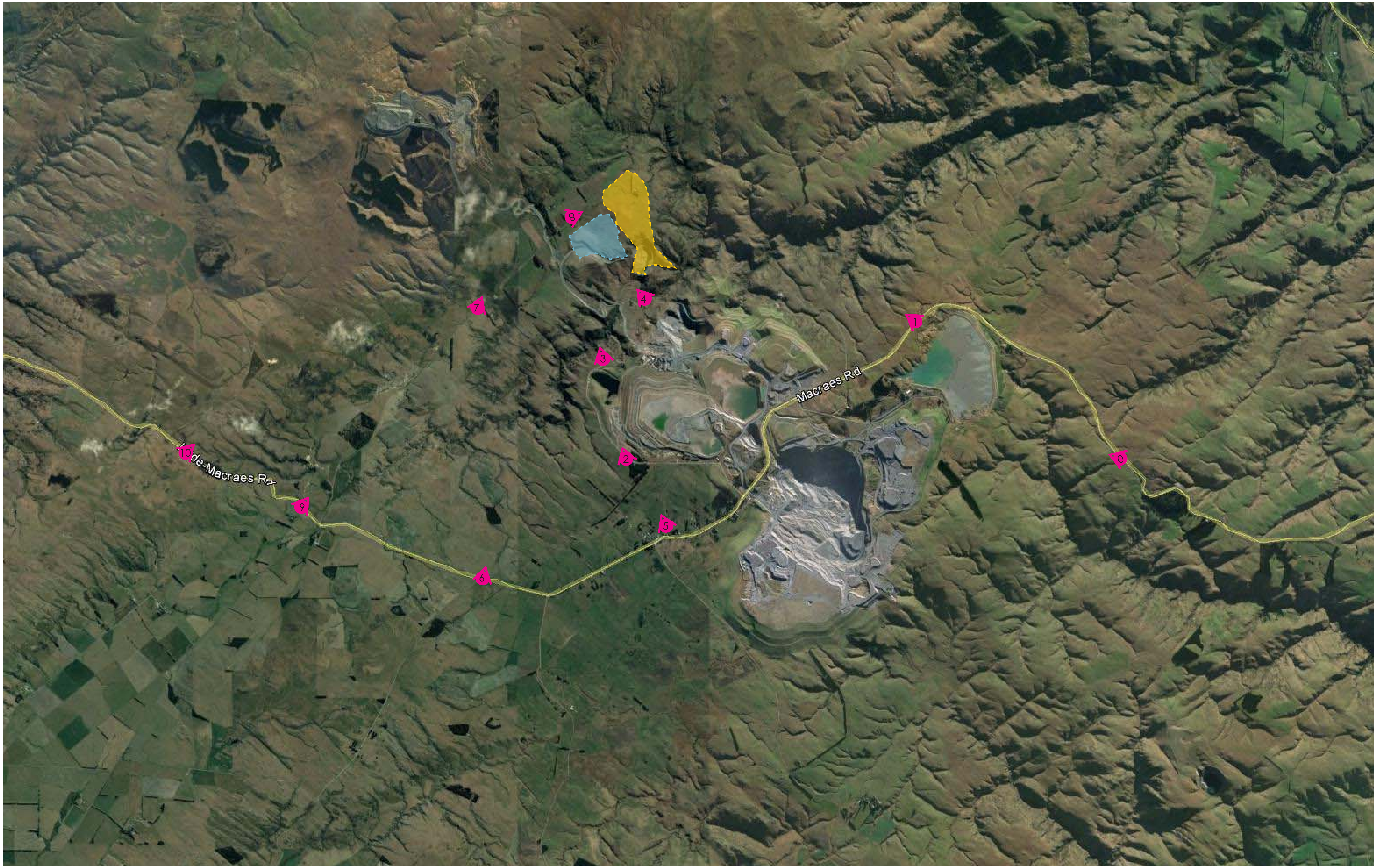
The viewpoint position, height and focal length of the lens of the original photo images were used to define a representative camera setting in 3D Studio Viz model at the same position, height and focal length. The 3D Studio Viz software has camera matching capability and by using the photo panoramic image as a background and by employing utilities within the programme, the model was orientated, sized and positioned to best represent how each component of the Project will look against the panoramic background.

Rendered images of the roading model were produced in 3D Studio Viz as a reference for the graphic designer. These rendered images were to the same height and width proportions as the base photo panorama.
The image of the rendered model alone was then brought into "Adobe Photoshop" as a unique layer and overlaid on the base photo panorama.

Using "Adobe Photoshop" effects and tools, the landscape Architect then enhanced the combined image. For instance, brought foreground objects to the front, erased background objects that would be hidden or removed, and added a visual representation of the indicative landscape mitigation measures. Further digital manipulation has been carried out to provide "realistic" effects to the modelled simulation and rendered materials.

Conclusion

The visualisations provided show the Project's waste rock stacks and other mine components digitally placed into photo backgrounds in proportion to landforms and objects in the same location. They have been manipulated in an attempt to produce a "realistic" impression and they should be treated as artist's impressions only.



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APPENDIX 4 Location of Photo Viewpoints

DEEPDELL NORTH STAGE III - LANDSCAPE & VISUAL ASSESSMENT

DATE: October 2018 PROJECT NUMBER: 3-C1680.06

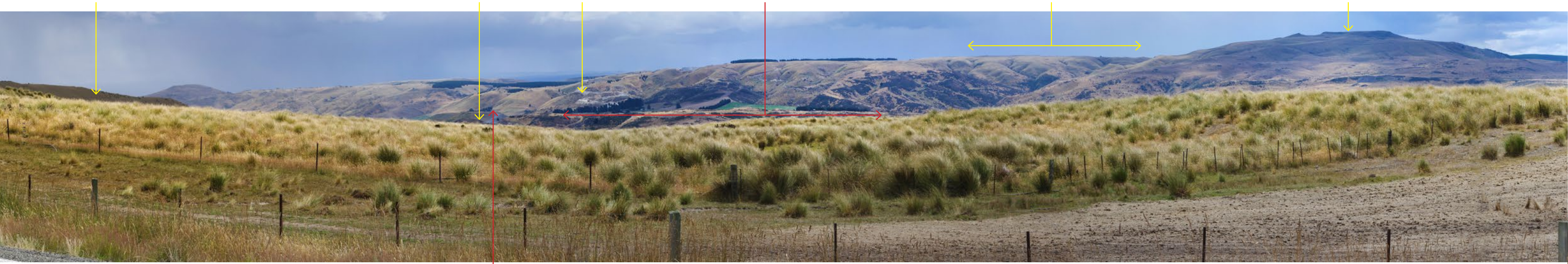


PHOTO - as seen 18-01-2018 - before view

VISUAL SIMULATION - intermediate view

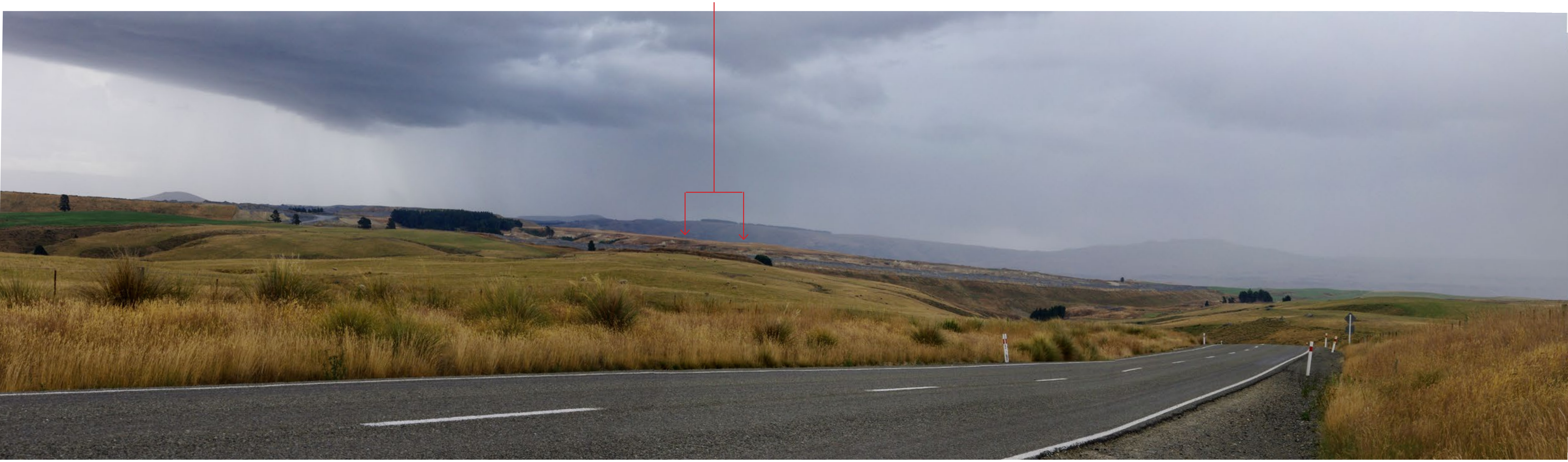
VISUAL SIMULATION - after view

VIEW 1 - Back Road Section, Macraes Road

APPENDIX 4 View 1

DEEPDELL NORTH STAGE III - LANDSCAPE & VISUAL ASSESSMENT

DATE: October 2019 PROJECT NUMBER: 3-C1680.06



VIEW 0 - Sailors Cutting, Macraes Road.

VIEW 2: 'Evacuation Point B', Golden Point Road.

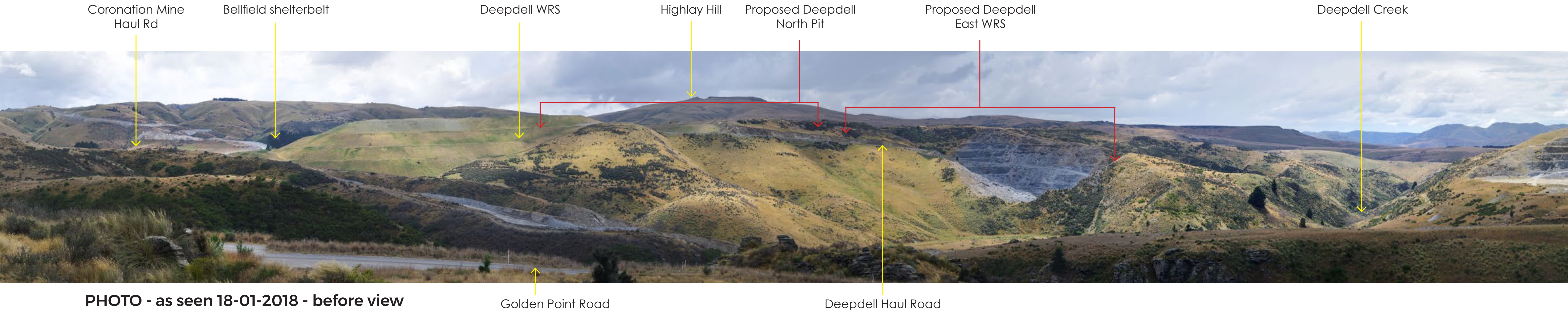
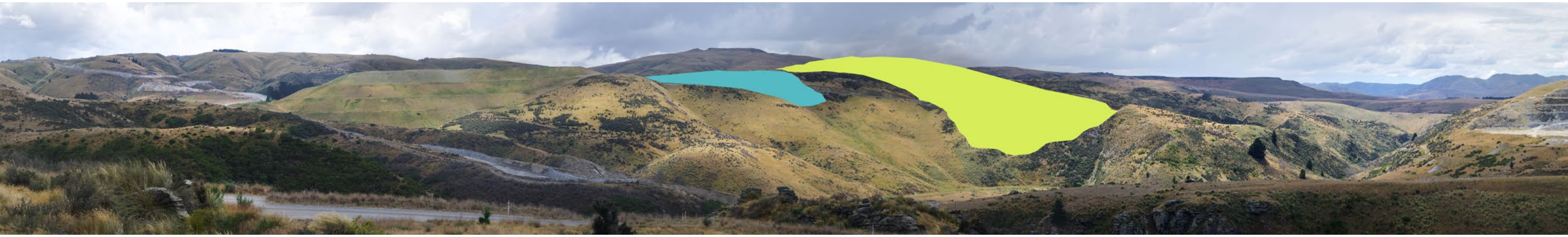


PHOTO - as seen 18-01-2018 - before view



VISUAL SIMULATION - intermediate view

VISUAL SIMULATION - after view

APPENDIX 4: View 3

DEEPDELL NORTH STAGE III - LANDSCAPE & VISUAL ASSESSMENT

DATE: October 2019 PROJECT NUMBER: 3-C1680.06

VIEW 3 - Golden Point Road Viewpoint

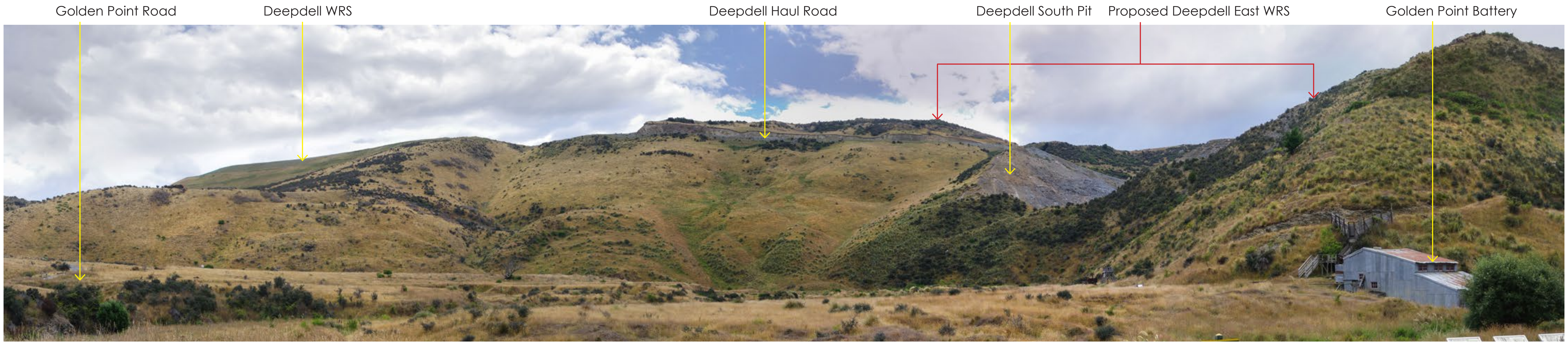
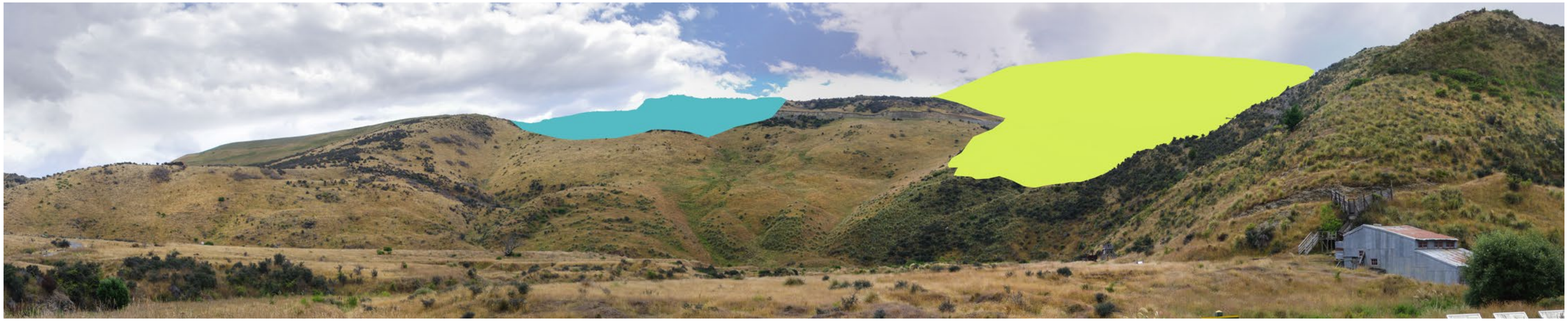
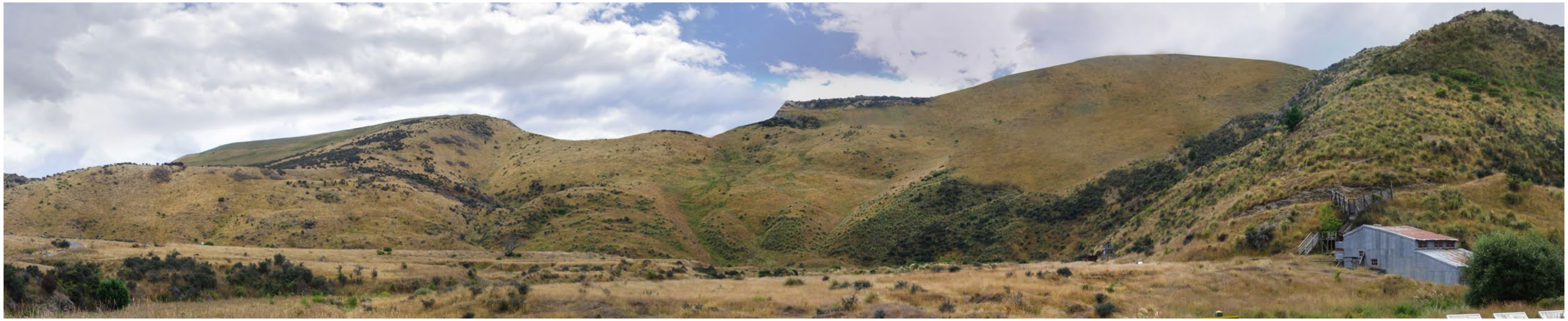


PHOTO - as seen 18-01-2018 - before view



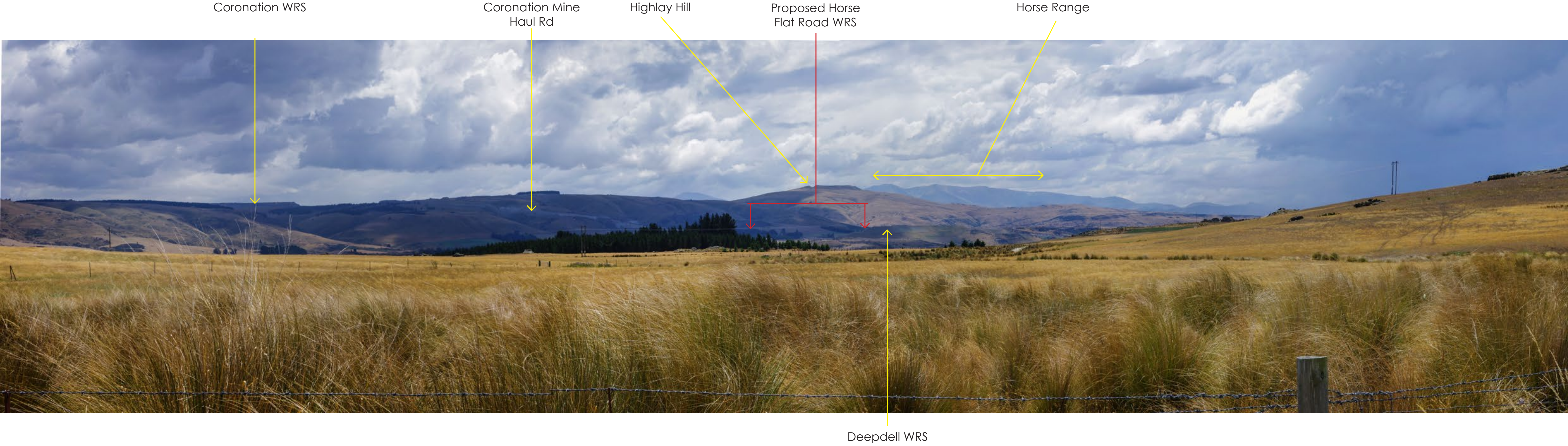
VISUAL SIMULATION - intermediate view



VISUAL SIMULATION - after view

VIEW 4: Golden Point Historic Reserve

VIEW 5 - Macraes Flat Old Cemetery



VIEW 6 - Frasers Road to Nenthom Road, Macraes Road

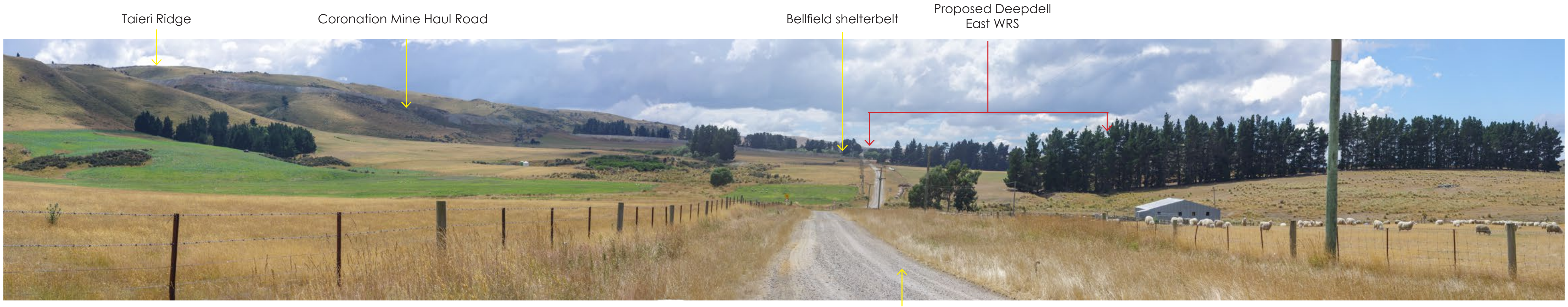


PHOTO - as seen 18-01-2018 - before view

VISUAL SIMULATION - intermediate view

VISUAL SIMULATION - after view

VIEW 7 - Howard's Gateway, Horse Flat Road

APPENDIX 4 View 7

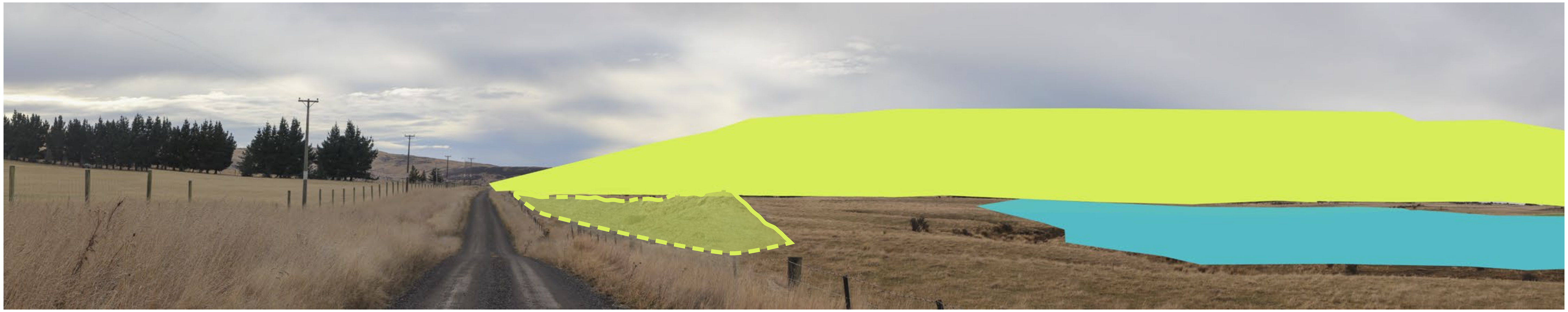
DEEPDELL NORTH STAGE III - LANDSCAPE & VISUAL ASSESSMENT

DATE: October 2018 PROJECT NUMBER: 3-C1680.06

Photo 7a - Deepdell Station Homestead - Vanderley Property as seen from Horse Flat Road

Photo 7b - Howard Homestead as seen from upper slopes of Taieri Ridge

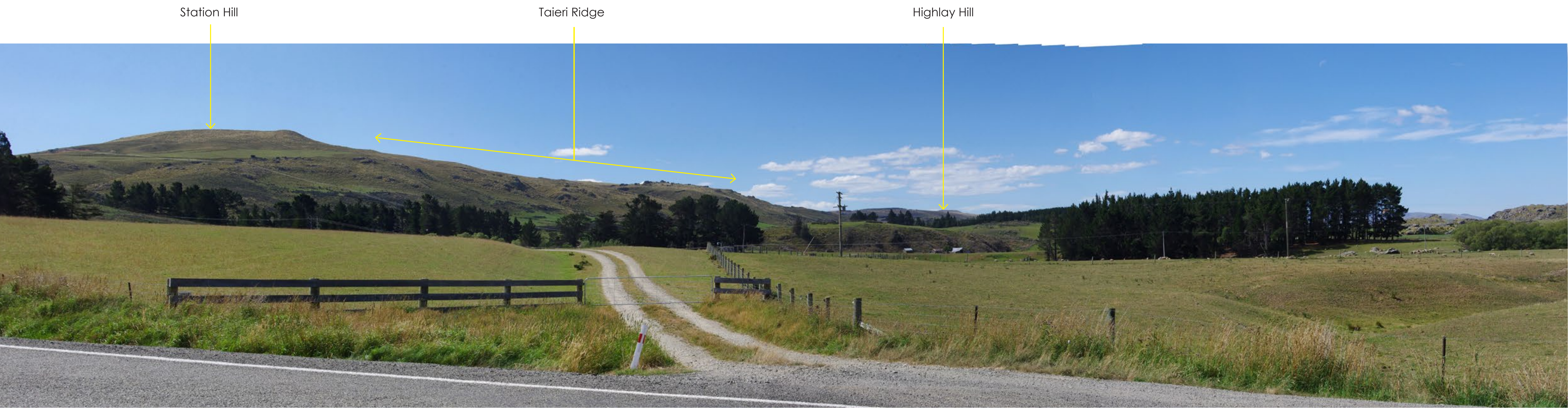
PHOTO - as seen 14-06-2019 - before view



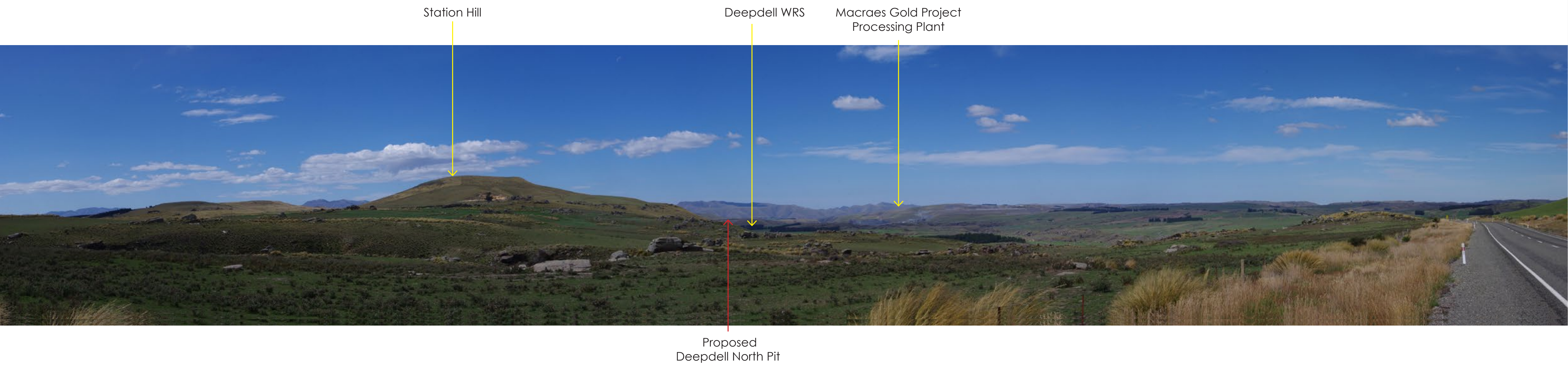
VISUAL SIMULATION - intermediate view

VISUAL SIMULATION - after view

VIEW 8 - East of Bellfield, Horse Flat Road



VIEWPOINT 9 - Roy's Gateway, Hyde - Macraes Road



VIEW 10 - Hyde Hill east, Hyde - Macraes Road

Appendix 5
Coronation North
'Landscape' Conditions

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Extract from:

OCEANA GOLD CORONATION AND CORONATION NORTH PROJECT DCC & WDC CONSENT AND CONDITIONS 20 December 2016

WAITAKI DISTRICT COUNCIL AND DUNEDIN CITY COUNCIL
LAND USE CONSENT "CORONATION & CORONATION NORTH" – OCEANA GOLD (NEW ZEALAND) LTD

WDC Reference: 201.2016.779 and 201.2013.360.1
DCC Reference: LUC-2016-234 and LUC-2013-225A

4. REHABILITATION

4.1 The rehabilitation objectives to be achieved by the consent holder are:-

a) To ensure short and long term stability of all structures and works and their surrounds;
b) To avoid maintenance after completion of rehabilitation requirements;
c) To protect soil from erosion and to protect water from contaminants affected by mining operations;
d) To stabilise and rehabilitate the banks and surrounds of any waterbodies;
e) To return land as closely as possible to its original condition, including any exotic pastoral and indigenous species appropriate to the area; and
f) To visually integrate finished structures, land-forms and vegetation into the surrounding landscape so they appear to be naturally occurring features; and,
g) To control invasive environmental weeds, including wilding conifers, in the Disturbed Land for the Life of the Macraes Gold Project.

Earth Shaping and Visual

4.2 The consent holder shall locate, form and shape all earthworks so that their profiles, contours, skylines and transitions closely resemble and blend with the surrounding natural landforms. If earthworks cannot be fully naturalised, the consent holder shall minimise the extent of their visibility and maximise their integration into the surroundings.

4.3 The consent holder shall use a Landscape Architect in the planning and design of all permanent earthworks and structures.

Waste Rock Stack

4.4 The consent holder shall design and construct the waste rock stack in accordance with the following principles:

a) Slopes shall be suitably shaped in cross-profile to match nearby natural slopes;
b) Slope gradients shall be no steeper than nearby natural surfaces;
c) Transitions between natural and formed surfaces shall be rounded and naturalised;

d) Contours should be curvilinear in plan form, in keeping with original natural contours in that area;
e) The skyline shall be variable and curved, simulating natural skylines;
f) New landforms shall be aligned and located so they seem to continue, not cut across, existing landscape patterns; and
g) Silt ponds shall be removed and the site rehabilitated or be converted to stock water drinking ponds following completion of mining operations and
h) rehabilitation.

4.5 The consent holder shall stage the construction of Coronation North Waste Rock Stack (WRS) as follows:

a) Waste rock deposition will commence in Area A shown on "Coronation North Waste Rock Stack Option Figure 1" annexed.
b) Once Area A is constructed to its maximum practicable extent, the consent holder shall next deposit waste rock in Area B shown on "Coronation North Waste Rock Stack Option Figure 1" annexed.
c) When Area B is constructed to its maximum practicable extent the consent holder shall finally deposit waste rock in Area C shown on "Coronation North Waste Rock Stack Option Figure 1" annexed.

Advice Note:

The purpose of staging construction of the WRS is to avoid the deposit of waste rock in Area B or Area C, or as a minimum to defer the waste rock deposit in those areas. The consent holder has committed to examine the feasibility of expanding Area A of the waste rock stack as a means to reduce encroachment into an area recommended for protection (RAP).

4.6 Where practicable the waste rock shall be backfilled into pits in order to minimise the size of waste rock stack.

4.7 Prior to the commencement of the Coronation North waste rock stack, the consent holder shall in consultation with the Councils, design the shape and construction details of the stack. The final design and construction details shall be lodged with the Councils and include a report prepared by a Landscape Architect that includes, but is not limited to, the following:

a) A detailed description of the proposed waste rock stack;
b) A detailed description of the adjoining landforms; including their slopes and transitions; and
c) A detailed discussion on how the proposed waste rock stack meets the principles set out in condition 4.4 (a) – (f).

4.8 If after commencement of the construction of the Coronation North waste rock stack, the consent holder wishes to change the design or construction details it shall design the changes in consultation with the Councils. The design or construction changes shall be lodged with the Councils. The change document shall include a report by a Landscape Architect that details the proposed changes and reassess whether the design changes better meet the principles set out in condition 4.4 (a) – (f).

Soil

4.9 The consent holder shall, as far as practicable, stockpile soil from any disturbed land, unless the soil is required to be left in place to protect water and soil values.
4.10 All salvaged soil shall be used on disturbed land for rehabilitation purposes.

Revegetation

4.11 The consent holder shall in accordance with the rehabilitation objectives undertake progressive rehabilitation of disturbed land as operational activities allow. It shall be revegetated with:

a) Exotic pastoral species; and
b) Tussock species which are as far as practicable sourced from the Macraes Ecological District and include *Chionochloa rigida subsp. rigida* (narrowleaved snow tussock) *Festuca novae-zelandiae* and *Poa cita*. Details of area, density and methods of planting are set out in the Ecological Management Plan required under Condition 15.

4.12 The consent holder shall maintain vegetation cover until the expiry of this consent and ensure that the vegetation, including any vegetation established on disturbed land, shall be self-sustaining after expiry.

Soil and Vegetation Monitoring

4.13 At three yearly intervals, the consent holder shall complete a review of all soil and pasture on land that has been rehabilitated. The first review shall be not later than the third anniversary of the commencement of this consent. The review shall include, but not be limited to, the following:

a) Monitoring for ground cover, species components, plant nutrition status, soil organic matter and concentrations of exchangeable nutrients in the soil;

b) Analysis and interpretation of the monitoring results by a suitably qualified soil or agricultural scientist;

c) Evaluation of the vegetation and its potential to be self-sustaining for pastoral farming after mining ceases; and

d) Any necessary recommendations for future rehabilitation, including plant species or varieties to be used, cultivation and seeding methods to be introduced, or fertilisers to be used; and,

e) A copy of the review will be forwarded to the Councils and Department of Conservation within three months of the review being completed.

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APPENDIX N

Rehabilitation Report

OceanaGold Macraes rehabilitation assessment

Prepared for: OceanaGold NZ Ltd

May 2019

OceanaGold Macraes rehabilitation assessment

Contract Report: LC3472

Robyn Simcock

Manaaki Whenua – Landcare Research

Reviewed by:	*Approved for release by:*
Dr Craig Ross Research Associate Manaaki Whenua – Landcare Research	Chris Phillips Portfolio Leader – Managing Land & Water Manaaki Whenua – Landcare Research

Contents

Summary

Project and Client

- OceanaGold requested a review of the Macraes Mine pastoral rehabilitation. Many rehabilitated areas are part of leases and have been monitored over 25 years using 3-yearly soil and pasture sampling. Most leases are currently being reviewed or have been recently updated.
- This project has three objectives: first, to review rehabilitation to pasture and its management – this was addressed by reading the numerous monitoring reports, seeing a range of rehabilitated areas, and discussing these with mine environmental staff and groups of farmers who lease the land. These methods also informed the second objective, by identifying issues around leasing in general, and leases that include rehabilitated land specifically. The third objective was to identify leasing processes and conditions that will help ensure OceanaGold meet mine resource consent conditions and environmental responsibilities through the leases.
- The review did not include the flat areas of tailings impoundments. Pasture monitoring sites have been established on tailings embankments (e.g. site 14) but not the flats and tailings sites were not visited. The review does not include indigenous biodiversity other than in the context of lease land.

Results

- The key resource consent conditions for rehabilitated pasture require establishing and maintaining a vegetation cover that is stable in the short and long term (including being 'self-sustaining after consent expiry') and has similar productivity and condition as was present pre-mining – similar wording has been used through the various consents as the mine has expanded over the last 25 years. Over this time, cocksfoot-dominated pasture has been successfully rehabilitated over more than 460 hectares of overburden landforms (AgResearch 2017). Three-yearly AgResearch monitoring since 1996 consistently show high pasture cover that has stabilised surfaces against erosion and supports about 8 stock units/ha (similar to pre-mining). Grazing is fundamental to land recovery, as it establishes nutrient cycling into the soil, and this is done by farmers through formal and informal leases.
- The comprehensive AgResearch monitoring shows most rehabilitated pasture sites retain pH levels near-optimum for exotic legume/grass production (5.5 – 6.25), and soil recovery continues as soil organic content and nitrogen builds. However, 9 of 17 sites had pH above the optimum range, probably reflecting slight over-application of lime, and pasture production is limited at most sites by inadequate phosphorus. This can be rectified by capital applications of superphosphate and higher maintenance applications. In some years and at some sites production is affected by over-grazing that removes more-palatable legumes and/or grasses and allows establishment of thistles, flatweeds, browntop, broom, and gorse.
- Farmers with experience of rehabilitated land identified the absence of reliable, proven-quality stock water supply and limited fencing constrain the value of some rehabilitated land by restricting stock and pasture management. Limited options for renovating rehabilitated pastures to improve productivity also impact the value of

rehabilitated land, as does the absence of areas that can support high-producing, reliable pastures and crops. Limited shelter on rehabilitated landforms due to the absence of tall tussock, gullies or rocky tor outcrops concerned a minority of farmers, but shelter is an important factor in general farming in this somewhat harsh environment, especially at lambing/calving.

- Lease agreements focus on production and 'good husbandry', defined as maintenance of fertility, weed control, pasture renewal/cropping and shelter belt maintenance. Lease agreements do not include ecological requirements, other than weed control, nor identify areas where specific management is not wanted (e.g. tussock clearance/burning, grazing wetlands with cattle), and this is a potential risk for OceanaGold. Farmers are not provided with information on how rehabilitated land grazing and fertiliser needs differ from unmined land. Farmers may also not be aware of newer Otago Regional and Waitaki District Council rules (e.g. preventing tussock clearance), or the implications of covenants within, or adjacent to, their leases.
- Most farmers identified that lease management would be improved with: more baseline information on soils and pastures (to guide fertiliser and lime management); increased certainty about lease duration, and better two-way communication with OceanaGold. Clarity over the needs of rehabilitated land management (e.g. AgResearch data), and weed management priorities could also improve farming and mine rehabilitation outcomes. Effects of mining operations on farm activities were sometimes positive, for example, mining may have ready supply of suitable rock to surface races, while mining equipment can effectively and quickly help manage trees, culverts or dismantling yards. Adverse effects for some farmers included damage to fences from spillage/trucks, some access and grazing restrictions, variable ability to control access (although some leases restrict access during lambing), and truck noise from a main haul road. Farmers seek clarity about new rules on N-leaching,[1] tussock/land clearance, planting shelter belts and other recent changes (including NPS-plantation forestry). This is an area where collaboration could help both farmers and OceanaGold (e.g. water quality and flow data/modelling, understanding N and P losses).

Conclusions

- Rehabilitation to pasture has been, and remains, successful, at the scale assessed by AgResearch. However some rehabilitated areas are vulnerable to declining productivity, reflected as suboptimal P and less productive, weedy pasture species. Over half the rehabilitated pastures are now over 15 years old. Degraded pastures, for example, those with high proportion of *Hieracium*, would benefit from renovation.
- Conditions requiring self-sustaining pasture after consent expiry are problematic as persistence of pasture (especially high-productivity pastures) and tussock is dependent on supportive and specific management, and this is OceanaGold's control.
- Farming is managed at a whole-farm scale. Variation across each farm is integral to overall farm performance and resilience. Most farms have some high-producing

[1] required by 1 April 2020 under Otago Regional Council plan change 6A water quality

'engine rooms' of hay paddocks and cropped areas that 'finish' stock and carry capital stock through droughts. Steep-sided gullies have low-productivity but provide stock shelter, ecological and landscape values, especially southern slopes with tall tussock. Such farm-scale management is not explicitly addressed in rehabilitated areas. The cultivatable 'engine rooms', and sheltered areas of tussock and native shrubland with reliable water supplies should be included in rehabilitation.

Recommended Actions – Rehabilitation

- Manage rehabilitated areas <10 years old or soil carbon < 2% to accelerate organic matter build-up by maintaining Olsen P >16 and residual organic matter post grazing of 1500 kg DM/ha (Boswell 2003). Map these areas.
- Develop 'whole-farm' rehabilitation plans that identify cultivatable 'engine rooms', reliable water supplies, and sheltered areas of tussock and native shrubland. Fences, races, shelter belts, and stockyard locations should deliver efficient farm management to maximise farm values. Some resources may be delivered by areas adjacent to rehabilitation, e.g. stock shelter, if rehabilitation abuts natural landforms containing shelter and fences allow stock movement between the areas.
- Agree the location of 'permanent' and temporary fences, gates, yards and gravelled access races on rehabilitated land with farmers to improve stock security and timely grazing that includes rotational grazing (mob-stocking for short periods to allow persistence of palatable species). AgResearch reports emphasise the values of grazing within about 12 to 24 months of pasture establishment. Ensure strong boundaries are maintained between leases, reinforcing with shelter, natural barriers or covenants.
- Develop, with farmers (and AgResearch), methods for renovating pasture on backfill slopes that retain soil development, re-establish desired pasture species, and avoid erosion. Direct drilling / no-tillage methods are likely most suitable for trafficable slopes, depending on the size of stones in the surface 5 cm. The demonstration of effective renovation is a key step proving sustainability of rehabilitated pasture.
- Use results of native planting to develop and test farm shelter belts of non-weedy shrubs, trees and flaxes that are consistent with Waitaki District Council rules (i.e. locations in Scenic Zone) that can be used to replace pine shelter belts on leased land.
- Investigate rehabilitation methods that create farm 'engine rooms' of (irrigated?) hay paddocks / fodder crops on the tailings dam surface and flatter sites. These areas would have deeper topsoils with few or smaller stones and replaced loess subsoils. Such sites may allow higher nitrogen applications without impacting surface waters because runoff is captured and can be re-circulated. A trade-off may be using shallower, stony soils on steeper slopes where plants that provide other values (shelter, honey, carbon sequestration, oils) are planted, such as tussock or shrubland.
- Identify potential for sediment ponds, mine lakes and other mine features to supply suitable stock water on rehabilitated areas. Farmers can identify surfaces and access that minimises stock danger while maximising water supply value.
- In the 2020 AgResearch monitoring, include earthworm monitoring, measure slope at each monitoring site and include a south to south-west facing control site to represent less drought-prone, shadier rehabilitated areas. Trial sod-seeding of

earthworms into newly established rehabilitated pasture to improve nutrient cycling and pasture production. Earthworm sod seeding was pioneered in this region.

Recommended Actions – Leases

- Provide leases with large, high-quality aerial maps with accurate paddock boundaries, fences and races/roads. This helps communicate and cross-reference information if the paddock identifiers (names) are consistent with those used by their fertiliser company, and on farm plans when developed.
- Map high value ecological areas on lease land in which farming management is restricted, e.g. areas within the Waitaki Scenic Zone where rules state land with >60% tussock cover must not be burnt or cleared. New areas of cultivation should be jointly agreed and carefully considered by OceanaGold since restoration of ecological values is unlikely once 'lost'. High value ecological areas include wetlands from which cattle should be excluded. Sheep access would require grazing to enhance ecological outcomes, e.g. control of palatable weeds without removing native species. New cultivation around tors should not occur to conserve 'corridors' across the landscape.
- Within rehabilitated areas, map 'landscape areas' where consent conditions, through a Landscape Plan, require maintenance of tall tussock. Tussock on cultivatable land and areas subject to woody weed regeneration will be particularly vulnerable.
- Collaborate with farmer/s to develop farming methods that maintain ecological values within grazed areas of tussock and ephemeral wetlands, using a 'research by management' approach. If successful, this could be a more sustainable and locally acceptable alternative to stock-excluded covenants (because grazing delivers income).
- OceanaGold should invest in quantitative baselines on all leased areas to underpin lease conditions (where these are inadequate). Baseline information would include soil fertility per 'paddock' (Olsen P and pH, with the addition of total C to indicate soil organic matter levels for rehabilitated areas), identifying cultivatable areas; mapping the location of key weeds (gorse, broom, pines, hieracium, elderberry), and condition/type of fencing (especially along races, roads, boundaries, covenants). What is useful to map will depend on the lease and agreed development plans (e.g. removal of 'capital' gorse/broom, expanding a reticulated water supply, shelter belt planting). It will be influenced by industry agreements, e.g. fencing wetlands/streams, and stream stock crossings, and District Council rules (e.g. vegetation clearance).
- Help farmers and Beef+Lamb NZ develop farm plans that meet likely nitrogen limits by contributing surface and subsurface water quality and quantity, and aquatic ecology that is specific to the Macraes Mine area. There may be value in assessing crops (e.g. lucerne and fodder crops) or management strategies (e.g. value of ungrazed wetlands for N attenuation, using tailings runoff for crop irrigation) that benefit rehabilitation and overall farm value (on divestment). Identify N and P leaching potential from rehabilitated land relative to unmined land (AgResearch 2017)
- Apply similar or higher standards of weed control to (non-leased) land under direct OceanaGold management as to lease land. Wilding pine, broom and gorse (and other woody weeds) are abundant on some areas under OceanaGold management. OceanaGold should also eradicate new weeds from roads in leases to reduce long term costs when weeds invade covenants, e.g. tree lupin (*Lupin angustifolius*), ox eye

daisy (*Leucanthemum vulgare*), vipers bugloss (*Echium vulgare*). Mine traffic and earthworks probably spread roadside weeds; covenant surveys identify weeds.

- Develop a plan to remove and replace potential wilding pine species across all lease land to reduce long-term liability, especially costs of controlling pines on high walls.

Other recommendations

- Digitise the reports in the library so they are easily searchable and the valuable old reports are conserved, such as the Whitaker 1986 report.
- Review plantings on leased land, especially around houses and yards, to identify habitat features that should be retained (e.g. for lizards) or removed (e.g. weeds)

Figure 1. One of the oldest areas of rehabilitation at Macraes Mine showing the excavated pit with lake developed, highwalls with rocky bund, and gently sloping top of the overburden landform below a natural slope supporting tussock.

Figure 2. Tussock established in trial area on overburden backfill within grazed pasture demonstrates potential for achieving production and landscape values, although a more natural planting pattern could enhance landscape values.

1 Background and Brief

Modern opencast and underground gold mining has operated at Macraes Mine for nearly three decades; the first rehabilitation was completed in 1991 and formally grazed in 1995/96. The first major rehabilitation review in 2003 reported pasture had been established on 275 ha of overburden landforms and trials of native trees shrubs and tussock had been installed. By 2017, over 466 ha had been rehabilitated to drought-resistant, low productivity, non-native pastures. The wider Macraes area has a long history of gold mining and low-intensity pastoral farming. The mining company has bought over 12,000 ha of land (Appendix One) to facilitate its mining operation and leases out most of this land to farmers. These include families that originally sold farms, some of which have farmed in the area for generations. For much of the 2000s, leases were managed on a 'hands off' basis by mine office staff without formal reviews and with little interaction. There are no records of baseline conditions at the start of these older leases; some areas had, and have, no formal signed lease.

In 2016/17, the leases and lease process were reviewed and updated; some leases were tendered on the open market, and new leases signed within the last 12 months. This means it is timely to review how the leasing process meets needs of both farmers and mining company. OceanaGold needs to understand how lease arrangements ensure obligations set out in its resource consents, in associated agreements (e.g. with Department of Conservation, QEII Trust) and in Regional/Territorial Authority rules are met.

An increasing area of leased farmland is rehabilitated. The value and quality of this rehabilitated land has been questioned by some farmers, particularly in relation to the quality of the land pre-mining. I was asked to establish if there was a 'quality gap' and if so, what the causes and solutions may be. The rehabilitation assessment, therefore, focuses on pastoral land; however, it is relevant to touch on broader ecology and landscape values, as these occur within the matrix of farmland. Also, the removal of farmland from grazing into QE2 covenants or DOC reserves, as part of ecological mitigation/compensation is locally controversial, as are limitations to farm activities based on maintaining some ecological values (e.g. restrictions on burning tussock) and landscape values (restricting tussock clearance and shelter belts). This project involved informal discussions with farmers and mine staff over four days in November 2018 and review of reports to achieve three objectives identified below. A wide range of stakeholders, including farmers leasing OceanaGold land, will be formally interviewed as part of the extensive 'Common Ground' study by University of Otago in 2018/2019, and as part of a KPMG Stakeholder engagement project.

2 Objectives and methods

This report has three objectives, all of which include rehabilitation of land after mining:

- review rehabilitation to pasture and its management
- identify issues around leasing in general, and leases that include rehabilitated land specifically.
- identify leasing processes and conditions that will help ensure mine resource consent conditions and environmental responsibilities are upheld, and are likely to deliver value to farmers, and the community, when divested (post mining, or when the farms are no longer adding value to the mining process).

Delivering these objectives was informed by reading the numerous contract reports and leases, seeing rehabilitated areas, and discussing leases and rehabilitation with mine environmental staff and four groups of farmers who lease this land. The farmers covered the range of leases:

- Glendale lease. McCone family started February 2018, formerly Alistair Sutton. A 5+3-year lease covering 5200 stock units and 1404 ha, which includes a QEII covenant, fenced wetlands and small area of rehabilitated tailings embankment. Soil testing from multiple sites underpinned lease valuation. This is the only farm that is not wholly or partly within the Waitaki Rural Scenic Zone. (Monday & Friday)
- Peddie leases. Two blocks, Longdale (including a covenant that has been fenced but not yet registered) and part of Redbank, include some of the oldest rehabilitated pasture at the southern-most extent of the Macraes mine area (Fig. 1). Early AgResearch reports assessed the potential impact of groundwater drawdown on adjacent unmined paddocks was negligible. (Wednesday)
- O'Connell lease. Includes part of Redbanks and areas of rehabilitated overburden landforms, also adjacent to sculpture park with wetlands/historic features. (Thursday)
- Howard lease. Significant areas of rehabilitated overburden landforms with landscape art features (on top of the dump) and major haul road (noise). (Thursday)

Figure 3 Tailings dam with partly rehabilitated cap supporting pasture. Note the three shallow ponds amid pasture on the backfill which may provide or supplement a suitable stock water supply, or be suitable locations for red tussock (Chionochloa rubra) establishment.

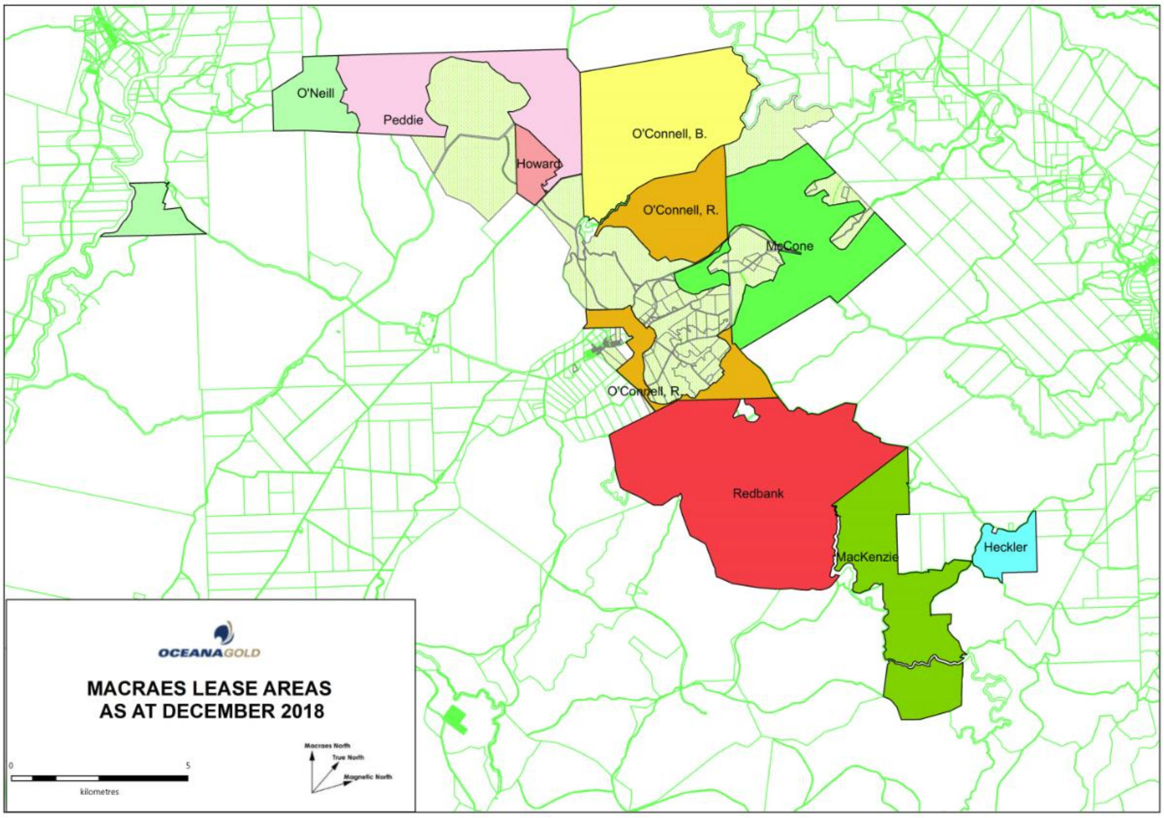

Figure 4. OceanaGold Leases as at December 2018.

An extensive library of contract reports dates back to about 1986. Scott Mossman and I used search functions for key authors (e.g. AgResearch) and keywords (pasture, rehabilitation, restoration and ecology) to locate relevant reports. The AgResearch reports reviewed as part of this contract are listed in Appendix One. I focused on the 3-yearly reports assessing soil and pasture on rehabilitated sites by AgResearch, and farm assessments used for leases. The 2018 annual ecology report was also useful. With more time it would be useful to analyse the previous annual ecology reports and this would be needed to understand outcomes of ecological mitigation, particularly trials establishing native herbs, tussocks, shrubs, trees and ecosystems.

Dozens of reports on ecology and rehabilitation have been written over 30+ years as the mining expanded and rehabilitation initiated. Over 25 years both staff and consultants have changed; given such an extensive history, it would be helpful to have more readily accessible summaries by topic, although this may have been done for newer resource consents, and be part of research projects with University of Otago. Every ecological consultant should read the 1986 report by AH Whitaker reporting terrestrial fauna in the Deepdell catchment (Appendix Three) as it beautifully summarises the ecology, farming impacts and environment.

Recommendation: Digitise the reports in the library so they are easily searchable and the valuable old reports are conserved, such as the Whitaker 1986 report.

3 Results

3.1 Resource consent requirements

Resource consent conditions require rehabilitation of farmland. The two key conditions are 'the consent holder is responsible for maintaining vegetation cover until the expiry of the consent and shall ensure that vegetation cover will be self-sustaining after the expiry of the consent' (2003) and similar pasture productivity. These conditions are repeated in most resource consents for new areas of mining (Appendix 1). For example, consents granted for the Coronation and Coronation North projects in December 2016 set out the following objectives in Condition 4.1:

- Short- and long-term stability,
- To avoid maintenance after completion of rehabilitation requirements,
- To protect soil from erosion,
- To return land as closely as possible to its original condition, including any exotic pastoral and indigenous species appropriate to the area,
- To control invasive weeds, including wilding conifers, in the disturbed land for the life of the Macraes Gold Project.

Independent, 3-yearly monitoring of representative rehabilitated pastures is a condition of resource consent, and has been done by AgResearch scientists for 25 years. The monitoring includes soil chemistry analyses to track soil fertility, soil depth and condition score (based on soil structure, aggregation and root exploration) along with pasture composition, biomass and foliar chemistry. Nineteen sites were monitored in 2017; the location and number of sites have increased and changed as the rehabilitated area has increased and new areas developed. They include three control sites in unmined pasture (Appendix 1 has a map and table of these sites).

Revegetation requirements (e.g. Coronation North Conditions 4.11 – 4.12) also specify rehabilitation of tussock species, including *Chionochloa rigida* subsp. *rigida* (narrow-leafed snow tussock), *Festuca novae-zealandiae* (hard tussock) and *Poa cita* (silver tussock), as set out in an Ecological Management Plan. As for pasture, the tussock cover must be maintained until the expiry of the consent and be self-sustaining after consent expiry. However, ensuring rehabilitation is self-sustaining after consent expiry, and 'avoiding maintenance after completion of rehabilitation requirements' are problematic conditions, as the persistence of pasture, especially high-productivity pasture, and of tussock (particularly tall tussock), is dependent on supportive management. All landscape components require ongoing maintenance, whether farmed pasture or native ecosystems. For example, all pasture requires ongoing fertiliser (and sometimes lime) inputs to maintain productivity; high-producing pasture requires higher maintenance inputs because more biomass is removed during farming and plant species are competitive under high fertility. The maintenance of both tussock and pasture depends on specific grazing timing, intensity, duration and types (cattle/sheep) to retain adequate biomass, especially in dry years. Further, in most areas ongoing weed control is important to prevent smothering of pasture and tussock, along with pest control.

‘Returning land to its original condition’ appears to be narrowly interpreted in older consents as maintaining farm productivity. Such productivity is measured as stock units/ha based on the dominant plant species and Land Use Capability (LUC) class, which together indicate the long-term capability to sustain farming based on physical limitations and site-specific management needs at a nominal 1:50,000 scale.[2] LUC is therefore fundamental to farm valuations. For example, the Loganstone (2017) lease valuation of the Sutton property uses LUC to calculate the potential stock carrying capacity (Fig. 4) under an ‘average operator’. The valuation identifies that not all cultivatable land has been cultivated – this is critical to the valuation, as this land is considered by farmers and valuers as ‘recognising the potential under good management’. However, some of these ‘cultivatable areas’ are likely to be of higher value to OceanaGold if retained as undeveloped dense tussock or buffers and connectors of rock outcrops and buffers within lizard conservation zones.

LUC	Land Type	Approx Area	(ha)	Stock Units per hectare	Total Stock Units
IVc2	Cultivated paddock with gully grazing	944	ha	7	6608
IVe13	Cultivated paddock	15	ha	7	105
IVe9 & VIe14	Cultivated paddock with gully	116	ha	5	580
VIe11	Gully grazing	161	ha	2	322
VIe10	Gully grazing	145	ha	4	580
VIIe3	Steep grazing and scrub	20	ha	0.5	10
	Title Area	**1,401**	**ha**	**Total SU**	**8205**

Figure 5. Sutton property LUC analysis shows an average stock carrying capacity of 5.9 SU/ha, but was conservatively farmed at 3.8 SU/ha, and 4.2 SU/ha per effective ha was used in the valuation (LoganStone 2017).

Although LUC can be assessed as individual units, the variety and location of LUC units at a farm scale is also important, especially in areas such as Macraes Mine that are subject to highly variable year to year pasture production (Fig. 6). For example, units with wetness limitations may hold grass production into a drought, steep gullies with low productivity may have value as stock shelter in storms, and areas with drought /stone limitations may be useful as stock stand-offs in winter, protecting soils vulnerable to compaction. Mine landforms generally create relatively coarse and homogenous LUC variation; e.g., relatively flat tailings dam or overburden backfill tops vs. sloped embankments (Fig. 7).

[2] The LUC is used across New Zealand https://soils.landcareresearch.co.nz/soil-data/nzlri-soils/

Figure 6. The natural landscape typically has tall tussock on southern steep slopes, and cultivated high-producing pasture on flat tops. These would be different LUC units (photo November 2018).

Figure 7. A rehabilitated overburden dump showing benching on steeper older landform and not on the more gently sloping landform behind the cabbage tree.

The Coronation North consent contains specific fencing conditions (16.1 – 2) requiring stock-proof fencing to keep livestock away from all working areas, and fencing around pit lakes. Not all pit lakes need to be fenced as parts of lakes abut high walls that prevent stock access (e.g. Fig. 1). Further conditions relate to permanent earthworks (such as waste rock stacks) and silt ponds that emphasise integration with, and simulation of, natural contours and skylines. These have led to a change away from strongly benched landforms more typical of early rehabilitation (Fig. 7).

Coronation North consents includes requirements to establish and maintain two specific covenanted areas to protect indigenous flora and fauna. The management includes fencing and removal of all stock, felling of all exotic wilding trees,[3] maintaining of fences and allowing natural ecological successional processes by 'undertaking no farming or mining activities' (Condition 15.3 – 15.5).

3.2 Pasture rehabilitation methods and outcomes

The general methods of pasture rehabilitation have been documented since 1999 in 3-yearly AgResearch reports. Key reports are summarised in Appendix 1. The assessments are based on repeated soil and pasture sampling at representative sites. The most recent report, Rutherford et al. (2017) is based on 16 sites within 466 ha of rehabilitated land and 3 control sites on unmined pasture. The report reviews data from ten sites that provide a continuous site time series for 2007, 2011, and 2014 – this repeated sampling, including control sites is particularly useful to establish trends over time and compliance with the 'sustainability' and 'similarity' consent conditions.

Reports show the method of pasture rehabilitation has changed relatively little since the early 2000s. Over most areas the process is described as the following steps:

- Spreading an average 10 cm of mixed topsoil and/or loess subsoil over at least 10 cm of crushed, oxidised waste rock to create a 20 cm rooting depth (Fig. 8).
- Applying basal fertiliser and lime. Since at least the late 2000s this has been 250 kg/ha of Mo superphosphate (0:9:0:11 N:P:K:S) and 125 kg/ha Cropmaster 20 (a 50:50 mix of di-ammonium phosphate and ammonium sulphate 20:10:0:2), with 1 t/ha lime. This continues to be recommended (Houlbrooke & Rutherford 2007; Rutherford et al. 2017). The addition of nitrogen to basal fertiliser was a change from the 1990s when 400 kg/ha of 50% sulphur superphosphate[4] was used and considered to supply sufficient nutrients for three years (Boswell 1994, 1996).
- Since about 2007, seeding a pasture mix at about 38 kg/ha comprising 10 kg/ha 'Nui' perennial ryegrass, 10 kg/ha 'Ruanui' perennial ryegrass, 6 kg/ha 'Manawa' hybrid ryegrass, 5 kg/ha 'Huia' white clover, 4 kg/ha 'Sensation' red clover and 3 kg/ha 'Greeny' cockfoot grass (a total higher rate is used for aerial seeding). Prior to about 2007, seeding a Bush Burn' mix at 50 kg/ha with additional 20 kg/ha rye or ryecorn. Bush Burn is made up of perennial ryegrass and 'Wana' cocksfoot at 20 kg/ha each with 5 kg/ha each of inoculated red and white clover. Mountain rye or ryecorn are very large (up to 1 m tall), erect grasses. They were included to provide rapid erosion protection and act as a nurse crop. This mix has varied over the years with different legumes, such as birdsfoot trefoil, sometimes included.

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[3] No small task if required in perpetuity as one is adjacent to extensive commercial pine plantations.

[4] This may not now be available, Ravensdown produces Sulphur Super 30 (0:7:0:30 N:P:K:S), a Sulphur SuperP 15 (0:8.6:0:14.8:0:19.2 N:P:K:S:Mg:Ca) and Sulphur Super 20 (0:8:0:20.6:0:18). Balance produce Sulphur gain (0.6.4.10 10 0 15.8) or (0 6.8 7.5 17 0 16.8) & Superten (0 6.4 10 16 0 15.8) and Pasturezeal also has S & N.

After 2007, a key change was a move back to tractor harrowing across suitable slopes, with only steeper slopes (greater than about 1:3 Vertical: Horizontal) being aerially seeded. Absence of harrowing creates a rougher surface with uneven pasture growth because plants mainly grow in the hollows of bulldozer treads and not on the elevated parts of treads or on the low 'ridges' between bulldozer passes (see diagram from Boswell 2003, Appendix One)

A second important change has been in grazing, which was for a long time described as mostly uncontrolled by 'marauding stock' (Boswell 2003), or low intensity and haphazard, by wandering stock (Houlbrookle & Rutherford 2007). Now, more areas have managed grazing, which is considered to benefit pasture quality and some aspects of soil quality (Rutherford et al. 2017). However, avoiding grazing within 1 to 2 years of pasture establishment is important to retain legume component of pastures, especially if birdsfoot trefoil is included, and allow the slower-developing cocksfoot to establish.

Figure 8. Profile of typical rehabilitated overburden showing organic-enriched topsoil/loess containing some stones over dark oxidised rock. The pen is 14 cm long.

Over the years the AgResearch reports have provided data that supports management recommendations. Nearly every report, from 2003 (Boswell) to 2017 has concluded:

- High plant cover is established and maintained, protecting the soil surface from erosion (wind or water), consequently the land is stable and risk of erosion is low

- Pastures are typical of 'maintenance pastures found on adjacent farmland, dominated by low fertility grasses such as cocksfoot and browntop'.[5]
- Annual maintenance fertiliser is required[6], and additional capital applications are needed in some areas to raise Olsen P to between 20 and 30.[7] In the 1990s, the former was 250 kg/ha of sulphur superphosphate (Boswell 1996). Rutherford et al. (2011) recommended 200 kg/ha of molybdenum super phosphate[8] every year for younger pastures and every 2 years for pastures established before 2000, as well as 65 kg/ha urea if stocking rate increased on grazed pastures, but not to add nitrogen to ungrazed sites to avoid depressing clover growth. New pastures were considered to need capital applications of superphosphate.[9] The 2017 report recommended three different maintenance applications depending on soil test results, of 250 or 300 kg/ha of PastureZeal 15S (9.5:6:0:15 NPKS – a Balance product) to mitigate foliar nitrogen deficiencies that were measured at most sites. Additional 'capital' applications were recommended to one group, and lime recommended at one site (Rutherford et al. 2017, Table 16). The 2011 monitoring reported nine of seventeen sites had pH values above optimum top range of 6.25/6.3, with mean pH increasing from 5.9 in 206/07 to 6.8 in 2010/11, suggesting soils were (unnecessarily) supplemented with lime (Rutherford et al. 2011).
- Grazing is important and its management is critical, especially in spring prior to droughts. Reports over the first 10–15 years recommend starting grazing to increase animal returns, kick-start nutrient cycling and build-up soil organic matter. Since grazing started, reports have continued to emphasise benefits of grazing, but also adverse outcomes of over-grazing and/or grazing too soon after establishment, such as more flatweeds and fewer clovers or other legumes.

Repeated sampling at the same sites over many years shows how soils and pasture have changed and developed. Soils data is particularly useful to assess compliance with the consent condition of ensuring 'vegetation cover will be self-sustaining after the expiry of the consent' (2003) as reports consistently show pasture production can be linked to soil and pasture indicators. Key soil indicators are Olsen P (with a target of 20 mg/L to support legumes and production of 8 stock units/ha[10]), total carbon (Rutherford et al.

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[5] For example, Boswell (2000) 'Revegetated pastures remain superior to existing farmed pastures in the immediate vicinity of the mine site at Macraes Flat in terms of the pasture species they contain'. North and north-west aspect pastures are relatively dry and dominated by browntop; some pastures to the east have hieracium dominant or invading.

[6] See summaries of reports in Appendix One. In early years little or no maintenance fertiliser was applied.

[7] Although farmers only target such Olsen P in higher-producing areas, not for low-producing tussock-slopes.

[8] The molybdenum supports clover nitrogen fixation, but if clover did not respond, urea was advised.

[9] The objective was to bring Olsen P up from about 12 to 20 by applying 400 kg/ha of superphosphate in two successive years; this repeated the 2007 recommendation when mean Olsen P was 14.

[10] Brown (1999) reports likely production and farm profitability if the Macraes Mine site were to be reinstated into farmland uses a predicted average effective stocking rate of 4.1 stock units/ha for a 1500 ha property, noting that differences between properties are high, and are influenced by fertiliser management and pasture species. He considered the capital cost of achieving a high standard of development (Olsen P >25) was not warranted given the year to year pasture production variability that limited net profitability. This probably remains true over large areas, however, stocking rates have increased over the last 15 years.

2017 suggest 3% is an optimal level for these soils (Fig. 9), C:N ratio 10 to 11 and pH 5.5-6.25 (to support clovers and minimise aluminium toxicity). Presumably this is based on soil under long-term developed pasture on the Nth Otago uplands, C:N ratio is unlikely to change much unless woody material is incorporated into rehabilitated soils.

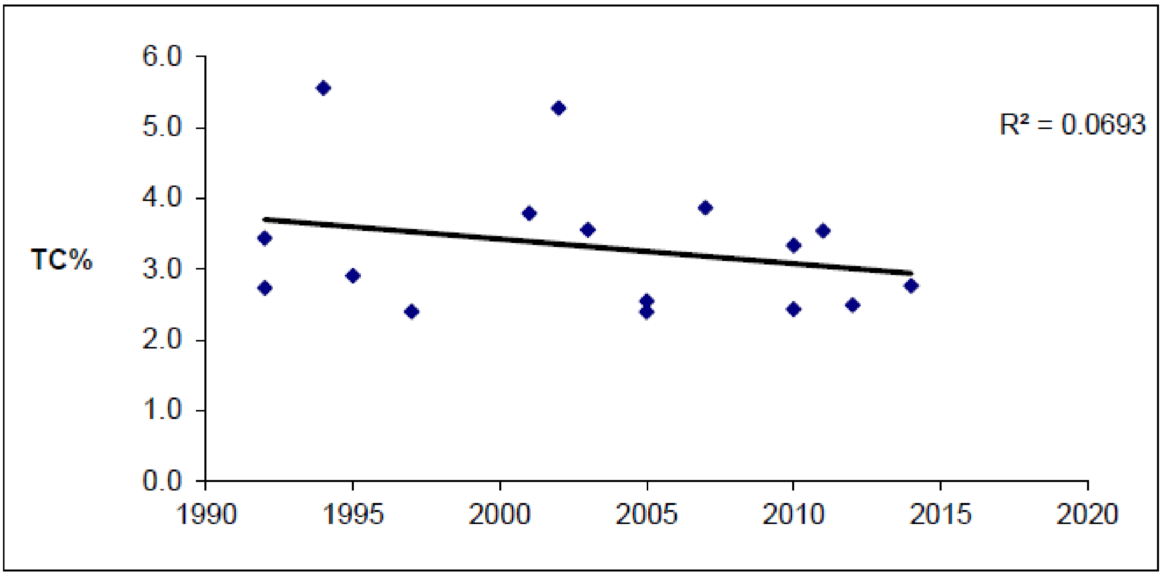

Figure 9. Total Carbon (%) across all sampled rehabilitated sites in December 2016 by year of rehabilitation; age has no significant influence on total carbon content. Control site values were 4.7 (recently renovated), 5.0 and 6.5 % (Rutherford et al. 2017).

The weakly acid pH of most rehabilitated areas contrasts with generally more acidic natural soils in the area, farmers in the areas are used to applying lime regularly. Soil organic carbon levels also underpin sustainability – most results show organic carbon continues to increase over time[11], and some sites are reaching levels of the controls (Fig. 9). Soil organic carbon is linked to water holding capacity in these loess soils (increasing drought resilience) and to supply of nitrogen. Building soil organic carbon and reaching pre-mining organic carbon concentrations would be a strong indicator of post-consent compliance with conditions requiring sustainable pasture productivity. Rapid build-up of organic carbon and nitrogen is probably most important for younger rehabilitated areas, and areas that are renovated, as ploughing and other cultivation lowers soil carbon concentrations.

Recommendation: manage rehabilitated areas <10 years old or soil carbon <2% to accelerate organic matter build-up by maintaining Olsen P >16[12] *minimum and >20 in areas ear-marked for renovation or with higher production pastures (e.g., higher ryegrass/white clover content) and residual organic matter post grazing of 1500 kg DM/ha (Boswell 2003). Identify (on a map) these areas in the lease agreements.*

[11] The 2007 report showed organic carbon has been building up at 0.2%/yr and total nitrogen at 0.007%/yr, but variation between sites has increased over time. The most recent report, stated Total carbon and organic matter are stable, and Olsen P levels appear to have plateaued in rehabilitated areas.

[12] Farmers varied in their target Olsen P values for uncultivated pasture.

Recommendation: Include measure of slope at each of the pasture monitoring sites. At the next assessment in 2020, include one or more south- to south-west facing control site (the current controls are north-facing so more drought-prone).

Recommendation: Show farmers relevant AgResearch report results, and use to encourage management interventions that ensure productivity and soil fertility continues to improve (as per lease conditions). Results are also useful to emphasise management differences between rehabilitated and 'natural' areas, e.g. maintenance lime is not generally needed on rehabilitated land.

The most common recommendations that would enhance rehabilitation outcomes are application of greater rates of maintenance fertiliser to achieve a minimum Olsen P of 20 (Fig. 10), with grazing management that helps restore soil organic matter, conserve legumes and help drought resilience. This means not grazing when pastures are too young (<12–24 months old) and/or too hard (which stunts regrowth and making more vulnerable to drought) and/or too long (which results in selective removal of higher-producing species such as clovers). Both maintenance fertiliser and grazing management are important as they influence the ability to meet the consent condition specifying similar pasture productivity for rehabilitated areas. However, there is a trade-off between production of high quality pasture and sustainability because high quality pasture is dominated by ryegrass and clovers. These pastures are vulnerable to drought and to inadequate phosphorus levels. Under either condition the risk of invasion of flatweeds and the low fertility, low biomass browntop grass is increased, therefore a conservative approach is used by farmers in the district: relatively large areas of drought-resilient pasture suitable for maintenance of stock (which can have high biomass), and smaller areas of high quality, high biomass pasture /crops.

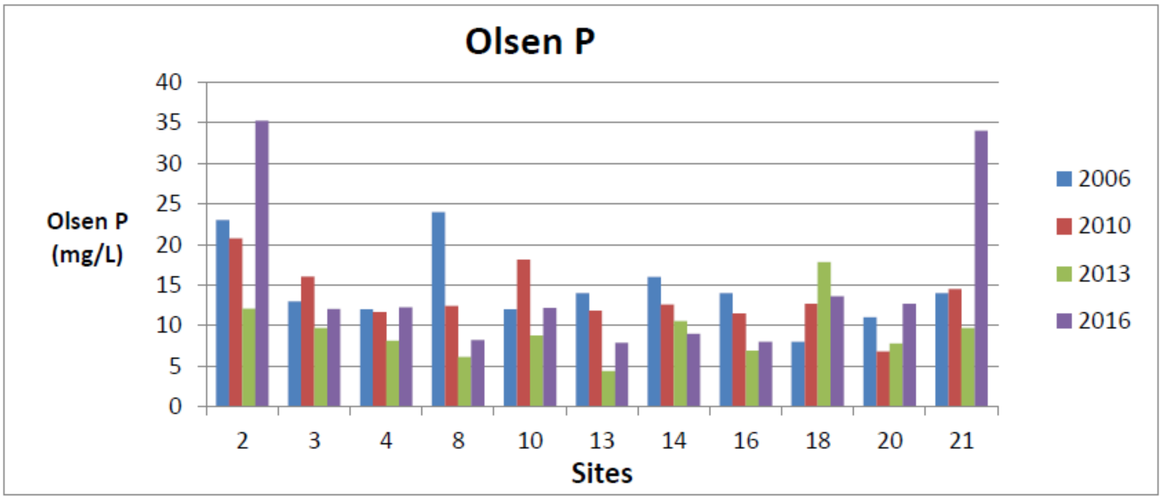

Figure 10. Olsen P levels at pasture monitoring sites sampled over 10 years. Site 21 is a control site renovated in September 2016; the other control sites had pastures over 20-years-old and Olsen P of 7 and 27 mg/L (AgResearch 2017, Figure 8)

Recommendation: create areas of rehabilitated, high-producing pasture only on areas that can be cultivated/readily renovated with minimal risk of erosion or leaching. Such areas are likely to have low slopes, and may include the flats of tailings ponds.

3.3 Infrequent and one-off issues in pasture rehabilitation

Over the years, one-off rehabilitation issues have been identified in AgResearch reports that impact outcomes. These issues are listed below as a summary of the sorts of factors to look out for:

- Weed infestation – thistles, potentially through possible seed mixture contamination, and dense gorse from soil seed bank (e.g. top of the Northern rock stack, site 38). Broom and hieracium are also mentioned as weed issues in some reports
- Marauding stock that graze for a duration and at an intensity that removes legumes
- Drought – overgrazing impacting legumes and ryegrass pasture due their lack of competitiveness under the dry conditions, such as the 1997/98 drought, exacerbated by their removal by selective grazing in cocksfoot-dominant swards
- Drought – check fencing around ponds to ensure they remain effective as water levels drop and ensure stock have adequate supply water in rehabilitated areas
- Drought – fire risk where pasture biomass has built up (ungrazed areas)
- Iron and Manganese contents in pasture, maybe due to related to dust (from haul roads)
- Compaction by cattle degrading soil structure at one site (consider likelihood of similar conditions being created in future and mitigation)
- Inappropriate fertiliser application, for example, applying lime in areas that do not need it, resulting in reduced phosphate availability.

Figure 11. Rehabilitated and grazed 3:1 slopes (left) and 2:2 slopes (right, with benching) on either side of the fresh-water storage dam with planted willows (the tussock outcrop with non-native pines is a natural landscape). Resource consent conditions now specify neither pines nor willows (or alders or larches) are allowed to be planted (these should be replaced with native species over time).

3.4 Farmer assessment of rehabilitated land quality

The farmers interviewed drew on long experience of farming this elevated tussock country with its relatively extreme seasonal and year-to-year variation; they are also deeply invested in the land and community and would be likely interested in purchasing divested OceanaGold farms. When farmers were asked about the quality of rehabilitated land, they considered more than pasture productivity (which is reported in detail by the AgResearch pasture assessments). Farmers assessed how the rehabilitated land was farmed, and how this complemented or contrasted with wider farm operations. All farmers were interested in the AgResearch reports but had not been sent them in the past. Farmers with control sites were particularly interested in the results.

Farmers generally considered the rehabilitated pastures suitable for maintaining stock weights but not suitable for finishing stock. This assessment is consistent with the AgResearch reports. Farmers identified three key issues that limit the value of (some) rehabilitated land compared with their 'normal' farming operations: the absence of reliable, proven-quality stock water supply; unsuitable or insufficient fencing; and limited options to renovate rehabilitated pastures to improve productivity due to generally thin replaced topsoils (around 10 cm), stones in the topsoil in some areas, and steep (2:1) slopes over large areas. Linked to these was the absence of rehabilitated areas that could be cultivated for fodder crops – this factor is likely to be increasingly important as areas of rehabilitation form a higher proportion of lease areas, and/or if lease farms have limited areas where such crops, or hay paddocks, can be established.

A reliable stock water supply is a fundamental requirement for grazing stock, particularly cattle (as they have large water requirements). The water needs to be proven to have suitable quality for stock water, supply an adequate daily volume through summer, and be distributed across the farm paddocks. Farms in the area typically supply stock water using small dams (e.g. Fig. 6) that may be fed from springs, and reticulated water supplies. Under national farming agreements to protect water quality, stock water supplies in future should not include larger streams, lakes and wetlands, as stock need to be excluded from these areas. Leases pre-date these national agreements; severe pugging damage of some wetlands near the sculpture park indicates improved fencing and/or stock control is required on some lease land. Potential sources of stock water on some rehabilitated areas include pit lakes (Fig. 1), the water storage lake (Fig. 11), dis-established sediment ponds, and, potentially, lakes on the tailings ponds. One farmer raised the potential issue of arsenic in water supplies. If sediment ponds are shown to have suitable water quality and quality, then adjacent surfaces need to ensure safe stock access (without churning up sediment or getting stuck).

The location, 'density', and type and timing of fencing constrain the ability of farmers to graze rehabilitated areas efficiently (e.g. optimise feed allocation) and maintain both pasture quality and quantity. Adequate fencing also limits stock fertility transfer (concentration on camp sites), which helps reduce maintenance fertiliser. Paddock sizing should enable rotational grazing, i.e. a relatively high socking rate for relatively short periods – which helps retain palatable pasture species (ryegrass and legumes) and so maintain pasture quality. AgResearch reports recommend such rotational grazing rather than set stocking for long periods. They also recommend initial grazing should start no earlier than 12 months and no later than about 24 months after establishment. Achieving this requires timely construction of suitable fences, relative to the class of stock being grazed, to keep stock safe and away from operational mining areas. In the past, timely early grazing has been limited by poor access to rehabilitated areas from adjacent farms or poor stock security ('marauding stock'). It is particularly important to ensure rehabilitated areas have fences that prevent stock moving between farms – especially given biosecurity issues (e.g. *Mycoplasma bovis*) and the more stringent 'farm to plate' animal tracking now required. Finally, the location of fences and gates in rehabilitated paddocks influence the efficiency and safety of moving stock. A poor gate location increases time and difficulty moving stock, and can increase risk of sheep smothering; allowing all parts of a paddock to be readily viewed so stock aren't missed increases farm efficiency; gates and fencelines should also help ensure farm machinery doesn't need to corner or travel on unsafe slopes and has adequate room to turn /park and unload. The location and layout of fences on rehabilitated areas should also support efficient use of farm races and stock yards, as does the location of any shelter belts.

Farmers identified a limitation of rehabilitated land was the difficulty using traditional methods of renovating rehabilitated pastures. No rehabilitated areas have been renovated to date, so there is no directly relevant data or experience to draw on. Traditional methods of cultivation or drilling are limited to areas that have trafficable slopes; rehabilitated areas include large areas of 1:3 slopes and some areas as steep as 1:2. Rehabilitated areas also have generally thin topsoils (about 10 cm depth) and some of these have a gravel or stone component likely to damage machinery used in pasture renovation. Some farmers considered the 'spray and pray'[13] method as an option – this is chemical pasture renovation using an herbicide followed by broadcast seeding, often of a fodder brassica. Farmer comments on the limitations of steeper rehabilitated areas complement observations on the absence of high-quality rehabilitated land that could be repeatedly cropped, used for making hay, or (ideally) as a farm 'engine room' to finish stock and provide secure pasture production in drought periods.

A minority of farmers considered the limited shelter on rehabilitated landforms an issue. The limited shelter is due to the absence of tall tussock, gullies or rocky tor outcrops in rehabilitated areas. This view may be linked to the relatively small proportion of farms that is rehabilitated land, and to some paddocks containing both rehabilitated land and landscapes with good shelter (Fig. 13). Shelter belts are present on most farms, and most are pine species that should be replaced to reduce wilding pines establishing on pit walls and in ungrazed covenants. Farmers did not want pine plantations on rehabilitated land, and some farmers had strong views on alternative shelter-belt species – notably flax – with some scepticism that shelter belts of native species could be successful. Most farmers were neutral about the establishment of tussock or rock outcrops in rehabilitated areas for shelter, as long as their location did not impede potential cultivation or access. However,

[13] Professor Peter Kemp considers the risk of soil erosion is too high and it is also not economically sustainable https://www.stuff.co.nz/business/farming/92676884/spray-and-pray-farming-method-too-risky-masseys-peter-kemp . The 'modern' spray and pray is probably best suited to climates with reliable summer rainfall.

most farmers took a dim view of tussock if it was required to be maintained to achieve landscape values, either on rehabilitated or general lease areas.

Farmers did not express concern about any adverse effects from dust generated by haul road traffic, or any difficulty managing areas that contained highwalls or pit lakes (given existing bunds and fencing).

3.5 Overall rehabilitated landscape and farm management

The 3-yearly AgResearch reports focus on pasture productivity at analysed sites and in defined representative areas. They do not generally include discussion of the overall landforms or landscape, or integration with broader farm management or operations (e.g. trafficability or paddock shapes), or with native ecosystems. This may be because rehabilitated areas to date have been relatively isolated and not of the 'whole farm scale'. An exception is Boswell (2003), who notes a company commitment to rehabilitating tussock for visual and stock shelter benefits. More recent reports have identified pasture renewal as an activity that needs to be considered as over 25% of rehabilitated pastures are more than 20-years old (Rutherford et al. 2017).

Overall farm production is important. This includes a variety of landscape units, pasture productivities, and aspects across rehabilitated areas and adjacent areas. Overall production is not assessed but is important, especially now some farms will soon have significant rehabilitated areas. Whole-farm assessment is probably important to achieving resource-consent conditions of similar productivity after mining, or greater farm productivity.

Farms in Macraes Mine typically have three to four main types of landscape units covering LUC classes III and IV, VI and VII that are managed to complement each other. LUC classes I to IV are cultivatable land, typically with production limited by susceptibility to erosion.

The classes may include:

- small areas of 'Hay paddocks' (highest productivity), the 'engine room' of the farm, which carry capital stock through adverse events such as droughts (Class III)
- gently sloping cultivatable land for fodder cropping as part of pasture renewal with improved pasture species and sometimes outcrops of rock; will provide feed for growing and/or lactating stock (Class IV)
- low-production downs and moderate to steep land in tussock; low-fertility grasses, such as cocksfoot and browntop dominate (large proportion of the farm); will provide maintenance feed for stock but not finishing feed (Class VI)
- low-production gullies/woody areas (with gorse/broom regrowth); useful for shelter post-shearing, not fertilised and with steeper sides (Class VII)

Rehabilitated landscapes have larger homogenous areas: low production moderate to steep land in low fertility grasses with largely 1:3 or 1:4 slope (with the exception of tailings dams) and smaller areas of gently sloping tops (Fig. 6). Gullies are absent from rehabilitated areas, but in some places, overburden landforms have been wrapped round, or abut, natural features (e.g. Fig. 7). Similarly, there is negligible tussock (both tall and short), native woody species, and shelter belts on rehabilitated areas. One lease has high walls – these may have value to OceanaGold as ungrazable areas where native palatable and non-palatable (e.g. matagouri) species can be established (trials are underway).[14]

Gently sloping land (i.e. readily cultivated if rocks are minimised) lies on the top of overburden dumps and on tailings dams. These are where the highest producing hay paddock 'engine rooms' have potential to be created with suitable depth of rock-free substrate. Mining has also included creating some large water features as dams (Fig. 7) and as pit lakes, and smaller sediment ponds. Where permanent, of adequate quality for irrigation/stock water, and with suitable pumping costs, these new lakes and flats have potential to underpin enhanced pasture productivity through irrigation. These areas need to be cultivatable (including ploughing or other form of primary cultivation) or harrowed / drilled without major damage to machinery[15] from rocks and stones.

Recommendation: When leasing and divesting farms, establish paddocks, races, water supplies, and boundaries that optimise whole-farm productivity by complementing rehabilitated and undisturbed land, for example, having paddocks that include non-rehabilitated land to provide shelter.

Recommendation: Invite farmers with leased rehabilitated land to identify features of rehabilitated landforms that enable safe machine and stock movement/access routes (gate location), and logical paddock boundaries (e.g. in relation to shelter, location of stock water supplies), and create paddocks that divide areas so they can be logically and easily rotationally grazed with cattle. Consider potential for pasture renewal that may include tillage or be direct drilled after herbicide treatment.

Recommendation: Explore costs and benefits of creating specific (large) farm water supplies within rehabilitated areas, or within unmined areas, to increase farm production values through increasing certainty and volume of water supply.[16]

Recommendation: consider production of rehabilitated areas overall, with some areas having higher production (e.g. flatter areas without rocks that are able to be renovated) and some lower (steeper slopes, high walls, slopes with replanted tussock). Vary the rehabilitation method so higher-production areas have deeper less stony soils (up to 250–300 mm depth).

[14] At the oldest site, if establishment of native species is wanted, it would probably be helpful to enhance adjacent remnant seed sources to provide a source of 'free', ongoing propagules. This could include fencing to exclude grazing, or strategic weeding, pest herbivore management and even methods to enhance seed viability (inter-planting and/or fertilisation).

[15] Drill depth for optimum seeding of most of the grass clover species is just 10–12 mm). So deeper cultivation is unnecessary for sowing on newly rehabilitated ground but may be needed to get rid of some weeds, if herbicide is not applied before sowing.

[16] Whitaker (1986) noted the value of the old dredge and mine ponds for native waterfowl and suggested the construction of ponds could have values for these birds, albeit none were threatened. The use of ponds for recreational shooting is also valued by some farmers.

Recommendation: Given the cost and potential difficulties of rehabilitating highly productive, cultivatable hay paddocks, avoid building mine infrastructure on these parts of the landscape.[17]

Recommendation: Integrate landscape cover requirements to leases, specifically areas where maintenance of tussock is required in both rehabilitated and unmined areas.

Recommendation: Increase areas of tussock in rehabilitation using salvaging and translocation methods but select areas that will complement farm production/management.

Recommendation: Before divestment of properties, conduct DDT testing of lease land (not rehabilitated land) to identify and confirm properties have satisfactory levels for dairy supply (rehabilitated areas do not need such testing due to dilution).

Figure 12. Typical backfill surface is smooth and has absence of gully features or tall tussock. Here, scattered Matagouri has established into pasture on an overburden embankment and if encouraged, could help enhance landscape (and easier to establish than tussock).

[17] This may be supported by new national/regional emphasis on 'high class soils' but needs to be balanced against a) ecological priorities for protection of remnant native ecosystems, and b) likely ability to rehabilitate highly productive areas, which has yet to be demonstrated but is technically feasible.

Figure 13. Retaining outcrops and small natural section abutting rehabilitation is a method to create paddocks with sheltered areas for stock (and potentially add to with tussock transplants)

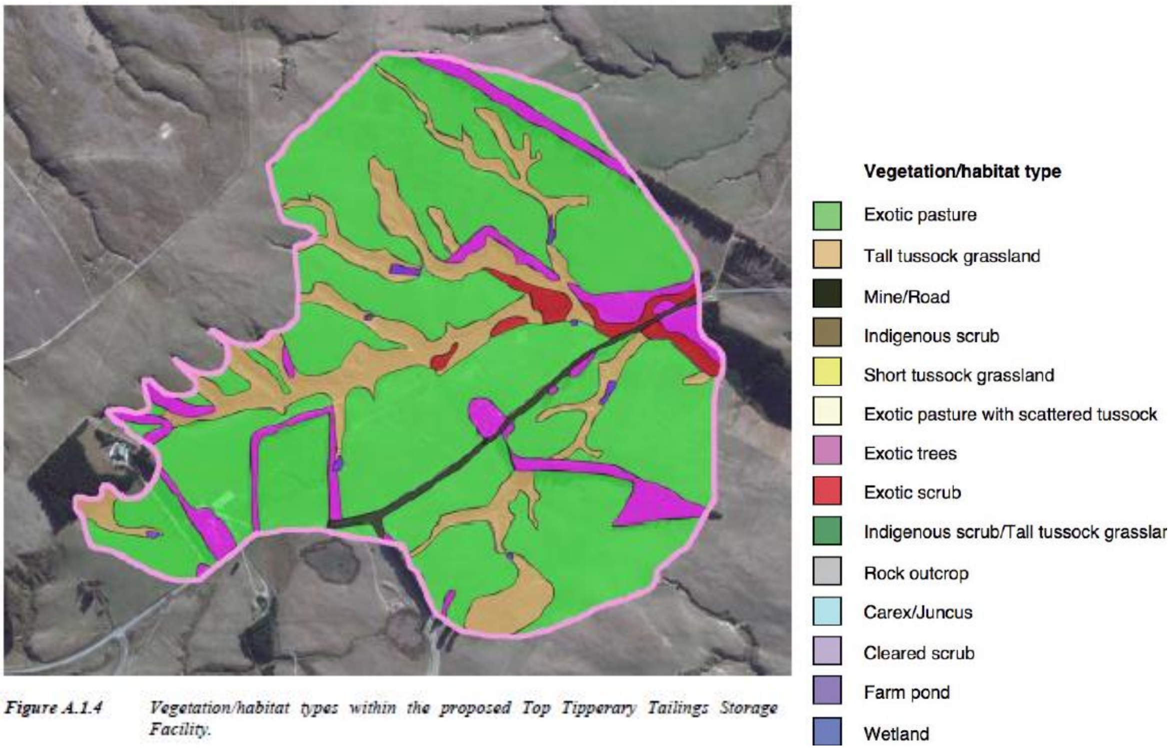

Figure 14. The natural landscape typically has tussock on southern slopes, a stock pond, and cultivated, high-producing pasture on flat tops; a similar pattern is clearly seen on a map of vegetation types within the proposed Tipperary tailings Storage Facility (Ryder Consulting 2011).

Figure 15. 'Pocket' wetlands on the upper level of downs are a landscape feature not yet replicated in rehabilitated areas, but may be suited to appropriately vegetated sediment ponds (particularly red tussock, C. rubra) ; some of these natural wetlands have been fenced to exclude cattle to help maintain tussock and ecological values (especially where they include ephemeral wetlands).

3.6 Leases

Copies of the leases were provided. These can be divided into old and new leases. They differ in lease process (including information provided), conditions (including baseline condition). and review period. In this section, I focus mainly on new lease process and conditions.

3.6.1 New leases

Three new leases have been offered through a formal tendering process in 2017/18 that included a valuation of farm condition and lease rental. The valuation was supported by some soil fertility sampling. The lease value includes an estimate of the area of cultivatable land (e.g. Sutton lease). Lease values may also be influenced by the area that can be enhanced by removing pasture-suppressing woody weeds or by improving drainage; where significant areas of land yet to be cultivated or developed are in native vegetation, particularly tall tussock.[18] Hence, it is important to clarify if drainage or removal/burning of tussock is permitted as part of the lease, or if specific weed removal is required as part of the lease, because both influence lease pastoral value as well as ecological values.

The new leases have a 5-year term with a 3-year right of renewal. Most farmers talked to considered 5 years was an adequate term that encouraged investment, and the right of renewal had additional value – if linked to an assessment of lease condition. Conditions of the new leases are clearer and more concise than the old leases, with single paragraphs

[18] For example, a 2018 draft agreement proposes to develop tussock blocks to 'turn them from very unproductive tussock to grass pasture'. I suggest leasees should instead be encouraged to focus on increasing productivity from areas that have already been cultivated, and areas with weed invasion.

covering weeds and pests, fencing, fertiliser requirements, good husbandry, crop and pasture renewal, and requisitions.[19] However, some of the language is archaic and does not clearly relate to current District or Regional Council rules. For example, the terms 'noxious weeds and vermin' are used instead of pest plants and animals.

Recommendation – use the same terms as current Pest Management Plan and consents

- Weeds. It would be useful to refer to the current Otago Regional Pest Management Plan and Biosecurity Strategy,[20] which provides lists of pest plants (weeds) that also include those listed in resource consents[21] and the level of control required (or might be expected). It would be helpful to identify the shelter belts, woodlots, and wildings on each lease that would be useful to remove and replace (as capital works[22]). A condition in one lease specifies '*in particular spray and keep clear of gorse and broom all ditches, banks and roadsides*'. Most farms have some areas of gorse and broom that should be targets for clearance to improve land quality (capital value) and minimise long-term liability (especially in areas that may be mined). Limiting the spread of existing gorse and broom should be a requirement of leases,[23] and this would require baseline mapping from aerial photographs. This would also support agreements on any removal of broom and gorse considered 'capital' expenditure. Limiting the spread of these weeds is crucial where farms abut covenants or high value ecological areas in which gorse and broom control is a requirement; both weeds have very long-lived seed banks.
  Because the areas have been settled for so long, some homesteads include ornamental pest plants such as rowan, some ornamental cherries, hawthorn, and elderflower. The identification and removal of these pest plants (and their replacement with alternatives agreed with the farmer) would reduce future liabilities. Conversely, the maintenance of homestead gardens and their enhancement could contribute to skink and native bird habitat through plant species selection, retention of stumps/logs, and provision of dense shelter (Whitaker 1986)
- Fencing. Fencing is required to be maintained. Again, a baseline is required, given the poor condition of some fencing. Covenants require stock-proof fencing – an annual assessment, therefore, achieves compliance with this condition.
- Fertiliser. A condition in recent leases requires a minimum annual quantum spent on fertiliser and lime. Useful clauses require 'a soil test from multiple monitoring sites at the commencement of this agreement to determine the fertility levels', 'the areas to be fertilised and type of fertiliser used approved by the lessor with fertiliser local representative', and, in another agreement, 'transparent proof of placement of GPS

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[19] 'this requires the lessee to comply with all Acts, Regulations and Bylaws

[20] The new plan and Biosecurity Strategy was proposed on 1 November 2018 https://yoursay.orc.govt.nz/pestplan

[21] For example, Coronation Hill Revegetation Condition 4.8 (b) lists 7 tree species and 3 genus (alders, larches and willows) that shall not be planted for shelter.

[22] The O'Connell and Howard leases contain significant pine plantations; a Peddie lease has very little in trees but borders a plantation to the southeast (pines south and south-west of Coronation North).

[23] Particularly into high value farmland and high-value ecological areas (usually tors and gullies with woody vegetation and/or seepages)

records… and fertiliser receipts available online on an annual basis'. Through consultation with fertiliser representatives and farmers, it would probably be useful to clarify the minimum proportion or number or paddocks, for OceanaGold to invest in additional measurements,[24] and that same sites are assessed towards the need of the lease duration to demonstrate the expectation of 'fertility levels will gradually increase'. Mapping the location of sites used by AgResearch on 3-yearly basis may help – as the information can be useful for farming operations. For example, the 2011 monitoring reported nine of seventeen rehabilitated sites had pH values above optimum, with mean pH increasing from 5.9 in 206/07 to 7.4 in 2010/11, suggesting soils were supplemented with lime (Rutherford et al. 2011, Table 12 of the report).

- Good husbandry. The special requirements of rehabilitated land need to be clarified to ensure farmers understand what is required. This impacts their management plan, especially in a drought year, when greater residual biomass needs to be retained in younger areas. Any lease farm may also contain unmined areas with ecosystems or species that have high ecological value, and would benefit from specific management to retain or enhance these values. Such management actions primarily benefit OceanaGold, so may be contracted/funded directly by them, but farmers need to know what the values are and what management is aiming to achieve, so they can also support the outcomes, and not inadvertently compromise them. Examples are preventing spread of broom, gorse, etc. into gullies with native vegetation, and excluding stock in areas with high-value palatable plants (e.g. *Celmisia hookeri*, *Carmichaelia spp*) or ecosystems (e.g. rock outcrops and flush zones). This may link with improved sources for seed/cutting collection or natural spread onto pit walls and other ungrazed areas.

The leases provided did not have supporting information identifying specific obligations regarding conservation covenants, or land subject to specific controls, such as not fertilising, grazing, burning or clearing specific vegetation. No information is provided on how rehabilitated land is required to be managed in droughts, or what fertiliser/lime response is likely (from AgResearch reports).

3.7 Emerging issues

3.7.1 Farm divestment

The company does not have a lease divestment process for identifying and selling farms or parts of farms that are no longer required as part of mining operations. Clarity on the timing and process of divestment would be useful – the farms are highly valued locally, regionally, and nationally as indicated by the interest in leases offered on the open market in 2017. The divestment process would be enhanced if integrated with water supplies and/or extraction consents (from the Taieri River) as these are increasingly valuable with

[24] For example, in areas of low productive value to farmers but where OceanaGold consent conditions specify no fertiliser or lime should be added.

increased intensity of land use over the last 25 years, and with discharge consents (given new controls on nitrogen for farmland).

3.7.2 Emerging farm constraints

Farming is becoming more complicated and more constrained as new local rules and national legislation are developed (see the next section). Farms in the Macraes area are affected by the National Policy Statement – Freshwater, which requires regional councils to establish limits to nitrogen in surface waters from pasture, and this is driving new farm plans (using the Overseer tool). Sheep and Beef NZ is also involved in new environmental standards; following the Dairy industry – these are likely to include riparian and wetland management.

The Macraes Mine area includes large areas that are vulnerable to wilding pines, and leased farms include pine plantations which now need to be compliant with the June 2018 NPS-Plantation Forestry. Regional councils are completing the second generation of Pest Plant and Animal plans, and a draft National Biodiversity Strategy will affect farm management – at the least, preventing further clearance of the high value ecosystems. These plans can complement rules Local Councils have implemented to protect landscape values, and support the tourism industry.

4 A shifting baseline – changes over 25 years

Over the years the baseline productivity of pasture production in the wider Macraes area has increased as more land is cultivated, and fertiliser inputs are increased to sustain a greater area of more nutritious pasture species, more frequent fodder crops, and bailage (replacing hay). These high-producing pastures are based on ryegrass, but are more vulnerable to drought, overgrazing or reduced fertiliser and lime inputs compared with the traditional cocksfoot, browntop and tussock pastures that can tolerate severe drought if their biomass is not depleted. These traditional species provide maintenance pasture. The mining company is required to rehabilitate sustainable pastures – therefore, a prudent approach is not to establish large areas of high-producing rye-grass-based pasture, especially on slopes that risk erosion if plant cover drops (or plants are desiccated as part of pasture renovation).

Over the last 25 years, at least some of the farms now owned by OceanaGold have probably had less investment in maintenance fertilisers and intensification than is typical of the broader area. The lower investment may be partly due to lack of security of tenure. Lower leasee investment may also be linked to perceived past 'lack of interest' by the company through lack of communications and farm visits to review leases or confirm acceptable baselines for fencing, weed control. Fluctuations in farm incomes have also been an influence – as farmers in this landscape typically vary (or pulse) fertiliser inputs in response to farm production and price fluctuations (both of which vary from year to year).

A lower level of farming intensity and development on some farms owned by OceanaGold may have provided some ecological benefits where tussock/shrubland has not been converted into pasture (not burned or cultivated) and paddocks not subdivided to allow more intensive grazing. Some of the areas with high ecological values have been used as part of mine mitigation. However, it also means some capital investment is likely needed on some farms to apply capital fertiliser/lime, weed control and upgrade fences.

Over 25 years the regional and national regulatory environment has changed. These changes have been driven by new opportunities (e.g. growth in tourism) and increasing awareness of adverse impacts of business as usual approaches. Some of the major influences that influence how OceanaGold farms (including rehabilitated land) are managed are tourism, biosecurity, biodiversity and freshwater:

- Growth in tourism. The Waitaki District Council Zone Rules control specific activities in areas defined as 'Outstanding Natural Landscapes', 'An outstanding or significant Natural Feature' or 'Rural Scenic Zone'. Most of the OceanaGold farms lie within the Rural Scenic Zone, which prevents planting of many exotic trees (pines, larches, willows, alders, and sycamores), including species that are already present as shelter belts, and the planting of shelter belts near roads. Restrictions on clearance of tussock are also linked to tourism as tussock cover is regarded as providing landscape values; most tussock have relatively low biodiversity values.
- Growth in pest plant and biosecurity pressures (e.g. *Mycoplasma bovis*). Although Whitaker (1986) had warned that 'many exotic conifers with wind-dispersed seed (P*. contorta, P. nigra, Larix decidua* – European larch and *Pseudotsuga menziesii* – Douglas fir) spread rapidly in sub-alpine tussockland and cause severe environmental problems', in the early 2000s, plantations of wilding pines were being planned and planted, e.g. GRD Macraes (2001) reported that the company hoped to commence planting of 5 hectares of *P. radiata/P. nigra* in 2002. In the last 10 years the number of pest plants has increased. Wilding pines are now, however, subject to control from regional rules: under the National Policy Standard for Plantation forestry (which has only applied since June 2018) new plantings are controlled where wilding seedlings are pests.
- Freshwater. Farms in the wider Macraes area are under increasing compliance requirements to protect freshwater and groundwater quality in response to the National Policy Statement on freshwater, which has driven new council requirements and industry agreements. For example, preparation of Nutrient budgets and fencing to exclude stock from specific areas (e.g. streams and wetlands) through Beef and Lamb NZ. OceanaGold has the advantage of an extensive baseline of surface and ground water quality data collected over decades that may support farm nutrient plans.
- Indigenous biodiversity. Over 25 years, indigenous biodiversity has continued to decline nationally. The need to conserve this within 'production landscapes' and not just the national conservation estate is now accepted and required through specific rules. Although much of the Macraes Mine landscape has relatively low biodiversity values because it has been farmed for over 100 years, some important species and ecosystem remain. Ecological Assessments have identified a range of vertebrates (especially Otago skink/grand skinks and falcon), plants, and ecosystems (ephemeral wetlands, tall tussock, and schist tors) that have highest conservation values. New mining consents have included mitigation actions including covenants. Waitaki District Council Zone Rules restrict clearance of indigenous vegetation (Part III Section

4.4.8). For example, over any 5-year continuous period there must be clearance of no more than 5,000 m^2 of indigenous vegetation generally, except where the clearance is carried out within and for the purposes of maintaining an area of improved pasture (>70% improved pasture species by cover or number).[25]

Figure 16 Gully outcrop adjacent to overburden backfill (right) supporting the large mountain daisy, which is a target for current rehabilitation

5 Recommendations

Recommendations are grouped into three areas: rehabilitated areas, leases, and general areas. These are largely repeated in the summary at the beginning of this document.

5.1 Rehabilitated areas

- Manage rehabilitated areas <10 years old or soil carbon <2% to accelerate organic matter build-up by maintaining Olsen P >16 and residual organic matter post grazing of 1500 kg DM/ha (Boswell 2003). Map these areas.

[25] Improved pasture is defined as ‘an area of pasture where species composition and growth has been clearly modified and enhanced for livestock grazing… and where exotic improved pasture species dominate’, i.e. where either the coverage of indigenous species or the number of species present, as estimated on per hectare basis does not exceed 30%. Pasture species excludes brown top and sweet vernal

- Develop ‘whole-farm’ rehabilitation plans that identify cultivatable ‘engine rooms’, reliable water supplies, and sheltered areas of tussock and native shrubland. Fences, races, shelter belts, and stockyard locations should deliver efficient farm management to maximise farm values. Some resources may be delivered by areas adjacent to rehabilitation, e.g. stock shelter, if rehabilitation abuts natural landforms containing shelter and fences allow stock movement between the areas.
- Agree the location of ‘permanent’ and temporary fences, gates, yards and gravelled access races on rehabilitated land with farmers to improve stock security and timely grazing. AgResearch reports emphasise the values of grazing within about 12–24 months of pasture establishment. Ensure strong boundaries are maintained between leases, reinforcing with shelter, natural barriers or covenants.
- Develop, with farmers (and AgResearch), methods for renovating pasture on backfill slopes that retain soil development, re-establish desired pasture species, and avoid erosion. Direct drilling/no-tillage methods are likely most suitable for trafficable slopes, depending on the size of stones in the surface 5 cm. Demonstration of effective renovation is a key step proving sustainability of rehabilitated pasture.
- Use results of native planting to develop and test farm shelter belts of non-weedy shrubs, trees and flaxes that are consistent with Waitaki District Council rules (i.e. locations in Scenic Zone) that can be used to replace pine shelter belts on leased land.
- Maintain the current rehabilitation method that establishes resilient, maintenance pasture dominated by cocksfoot and legumes over most areas, particularly slopes.
- Investigate rehabilitation methods that create farm ‘engine rooms’ of (irrigated?) hay paddocks/fodder crops on the tailings dam surface and flatter sites. These areas would have deeper topsoils with few or smaller stones and replaced loess subsoils. This may require separate loess-subsoil stripping. Such sites are ideally located where higher nitrogen applications can be used without impacting surface waters, e.g. because runoff is captured as part of tailings management and so is re-circulated. A trade-off may be using shallower, stony soils on steeper slopes where plants that provide other values (shelter, honey, carbon sequestration, oils) are planted, such as tussock or shrubland. Creating these areas will require commitment from lease farmers to a higher fertiliser maintenance regime (higher Olsen P target) in these areas that will maintain ryegrass-dominated pastures.
- Continue a high level of woody weed control in stockpiles and do not throw any soil away even if contaminated from broom- and gorse-infested areas
- Include more tussock in rehabilitated areas to provide shelter as well as landscape outcomes. Place tussock on slopes or in ways that maximise long-term protection from cultivation and inappropriate grazing (i.e. consider location in relation to fences and landforms; protecting with rock by combining with ‘outcrops’). Taller tussock (requiring higher water supply) might be more sustainably established at toe-slopes of overburden landforms and other areas where runoff accumulates or springs occur.
- Identify potential for sediment ponds, mine lakes, and other mine features to supply suitable stock water on rehabilitated areas. Farmers can identify surfaces and access that minimises stock danger while maximising water supply value.
- In the 2020 AgResearch monitoring, include earthworm monitoring, measure slope at each monitoring site and include a south- to south-west-facing control site. Trial sod-

seeding earthworms into newly established rehabilitated pasture to improve nutrient cycling and pasture production. Earthworm sod seeding was pioneered in this region.

- Develop a pre-grazing handover checklist procedure. This would be a walkover by OceanaGold or their representative (farm manager or valuer or maybe stock agent) and the farmer before new areas come into formal grazing. Discuss best locations for permanent fencing, gate locations, shelter, water supplies that will achieve efficient farming, optimise health and safety, etc.

5.2 Leases

- Provide leases with large, high quality aerial maps with accurate paddock boundaries, fences and races/roads. This helps communicate and cross-reference information if the paddock identifiers (names) are consistent with those used by their fertiliser company, and on farm plans when developed.
- Map high value ecological areas on lease land in which farming management is restricted, e.g. areas within the Waitaki Scenic Zone where rules state land with >60% tussock cover must not be burnt or cleared. New areas of cultivation should be jointly agreed and carefully considered by OceanaGold since restoration of ecological values is unlikely once 'lost'. High value ecological areas include wetlands from which cattle should be excluded. Sheep access would require grazing to enhance ecological outcomes, e.g. control of palatable weeds without removing native species. New cultivation around tors should not occur to conserve 'corridors' across the landscape.
- Within rehabilitated areas, map 'landscape areas' where consent conditions, through a Landscape Plan, require maintenance of tall tussock. Tussock on cultivatable land and areas subject to woody weed regeneration will be particularly vulnerable.
- Collaborate with farmer/s to develop farming methods that maintain ecological values within grazed areas of tussock and ephemeral wetlands, using a 'research by management' approach. If successful, this could be a more sustainable and locally acceptable alternative to stock-excluded covenants (because grazing delivers income).
- OceanaGold should invest in quantitative baselines on all leased areas to underpin lease conditions (where these are inadequate). Baseline information would include soil fertility per 'paddock' (Olsen P and pH, with the addition of total C to indicate soil organic matter levels for rehabilitated areas), identifying cultivatable areas; mapping the location of key weeds (gorse, broom, pines, hieracium, elderberry), and condition/type of fencing (especially along races, roads, boundaries, covenants). What is useful to map will depend on the lease and agreed development plans (e.g. removal of 'capital' gorse/broom, expanding a reticulated water supply, shelter belt planting). It will be influenced by industry agreements, e.g. fencing wetlands/streams, and stream stock crossings, and District Council rules (e.g. vegetation clearance).
- Help farmers and Beef+Lamb NZ develop farm plans that meet likely nitrogen limits by contributing surface and subsurface water quality and quantity, and aquatic ecology that is specific to the Macraes Mine area. There may be value in assessing crops (e.g. lucerne and fodder crops) or management strategies (e.g. value of ungrazed wetlands for N attenuation, using tailings runoff for crop irrigation) that benefit rehabilitation and overall farm value (on divestment). Identify N and P

leaching potential from rehabilitated land relative to unmined land (AgResearch 2017).

- Apply similar or higher standards of weed control to (non-leased) land under direct OceanaGold management as to lease land. Wilding pine, broom, and gorse (and other woody weeds) are abundant on some areas under OceanaGold management. OceanaGold should also eradicate new weeds from roads in leases to reduce long-term costs when weeds invade covenants, e.g. tree lupin (*Lupin angustifolius*), ox eye daisy (*Leucanthemum vulgare*), vipers bugloss (*Echium vulgare*). Mine traffic/earthworks probably spread roadside weeds; covenant surveys already identify weeds.
- Develop a plan to remove and replace potential wilding pine species across all lease land to reduce long-term liability, especially costs of controlling pines on high walls.

5.3 Other recommendations

- Digitise the reports in the library so they are easily searchable and the valuable old reports are conserved, such as the Whitaker 1986 report.
- Review plantings on leased land, especially around houses and yards, to identify habitat features that should be retained (e.g. for lizards) or removed (e.g. weeds)
- Summarise regional and district rules for farmers, for example, 'indigenous bush', 'tall tussock grassland communities of genus *Chionochloa*' 'improved pasture', 'generally closed canopy matagouri with canopy >1.5 m height associated with ridges and bluffs' with photographs.

Figure 17 Flax is a potential shelter belt species in some areas if double-fenced to protect from cattle browsing along with mānuka/kānuka, olearia and corokia (see trial data).

6 Acknowledgements

Many thanks to Scott Mossman and Gavin Lee, OceanaGold, for sharing their experience, arranging interviews with groups of farmers, and their tolerance in answering a myriad of questions and requests. Review and discussions with Dr Craig Ross, New Zealand's most experienced mine rehabilitation researcher/reviewer, provided valuable input, especially on pasture renovation and the use of worms to enhance pasture productivity. Editing by Anne Austin was also valuable.

Farmers who are leasing land were extremely generous, giving their time from busy schedules, being very open to discussing rehabilitation issues and ideas, and providing welcome shelter and tea in an unusually cold, wet week.

This report benefits from 25 years of detailed pasture monitoring by a large group of AgResearch staff, especially Colin Boswell, who set up the monitoring framework and so clearly defined the rehabilitation objectives, their implications and outcomes, especially in his 1999 and 2003 reports. Similarly, the clear descriptions of the areas remnant ecology and impacts of management has been clearly described in reports by Whitaker, notably the 1986 report with its precious hand-drawn landscape classifications.

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Appendix 1. Consent conditions relating to landscape and pastoral rehabilitation

Summarised by Gavin Lee, April 2019.

Org Name & start date	Obligation	Condition	Summary
Deepdell South 26 Feb 2008	Water Permit 2005.341_V2 Dam Deepdell South Pit	11 v1	The consent holder shall record any displacement of rehabilitated areas or rock from terraces or shear faces and provide an annual report due 1 October each year which shall include, but not be limited to the following matters: • the nature of displacement, and material displaced; • an approximate volume of material displaced; • the effect of the displacement on the stability on the immediate area and site as a whole; • what measures where undertaken to rehabilitate the displacement; and • what measures where undertaken to minimise the likelihood of the displacement occurring again in the future. Keywords; land displacement
Macraes Phase III Land Use 28 May 2012	Land Use Consent LRC 201.2011.35 Macraes Phase III	04.13 v1	At the three-year anniversary of this consent, the consent holder shall complete a review of all soil and pasture on land that has been rehabilitated. The review shall include, but not be limited to, the following: (a) Monitoring for ground cover, species components, plant nutrition status, soil organic matter and concentrations of exchangeable nutrients in the soil; (b) Analysis and interpretation of the monitoring results by a suitably qualified soil or agricultural scientist; (c) Evaluation of the vegetation and its potential to be self-sustaining for pastoral farming after mining ceases; and (d) Any necessary recommendations for future rehabilitation, including plant species or varieties to be used, cultivation and seeding methods to be introduced, or fertilisers to be used. (e) A copy of the review shall be forwarded to the Council within three months of the three-year anniversary of this consent. Keywords; soil and pasture monitoring
Golden Bar 23 Feb 2010	Land Use Consent LRC 02-68 Golden Bar Land Use Consent	13 v1	The objectives to be met by the consent holders in rehabilitating the site shall be: i. To ensure short and long term stability of the site; ii. To minimise post operational maintenance; iii. To protect water and soil; iv. To restore all disturbed water bodies, including their banks and beds, to a natural and stable condition;

Org Name & start date	Obligation	Condition	Summary
			v. To restore all disturbed water bodies, including their banks and beds, to a natural and stable condition except if the silt ponds are to be retained and converted to stock water drinking- ponds. *** as amended *** vi. To return land, as closely as possible, to its original productive potential or to another appropriate use, specified in the detailed rehabilitation plan. vii. To visually integrate finished structures, landforms and vegetation into the surrounding landscape so they appear to be naturally occurring features. **Soil** The consent holder shall, as far as practical, stockpile soil from any disturbed ground, unless top soil is required to be left in place to protect water quality. All salvaged soil shall be used for rehabilitation purposes. **Waste rock stacks** A. The waste rock stacks shall be located, designed and constructed so that they conform to the footprint, height and contours specified in the plans (plan 380046.00 36a1 and plan 380017.00 036a1, dated 20/11/002) attached with this consent. B. Should any of the waste rock stacks be of a lesser volume, the consent holder shall proportionally reduce the footprint size, height and slope of the stacks so that the stacks meet the following landscape principles: i. Slopes suitably concave or convex in cross-profile to match nearby natural slopes; ii. Slope gradients no steeper than nearby natural surfaces; iii. Transitions between natural and formed surfaces rounded and naturalised; iv. Contours curvilinear in plan form; v. Skylines variable and curved, according to natural skylines. C. Tree planting and re-vegetation shall be of species and location similar to vegetation already in the district. **Earth shaping and visual** The following requirements shall apply to the rehabilitation of permanent earthworks: A. The consent holder shall design and construct all earthworks to forms shown in the detailed rehabilitation plans. B. Except with written approval from the council, the consent holder shall locate, form and shape all earthworks so that their profiles, contours, skylines and transitions closely resemble and blend with the surrounding natural landforms. C. If the council accepts that the earthworks can not be fully naturalised, the consent holder shall minimise the extent of their visibility and maximise their visual interest and visual integration to their surroundings.

Org Name & start date	Obligation	Condition	Summary
			Vegetation A. As mining operations or other works are completed in any area, the consent holder shall carry out land rehabilitation as follows: i. Either into improved pasture with plantings of appropriate shelter trees; or, ii. Indigenous species which visually blend into the surroundings. B. Rehabilitation by planting shall be carried out progressively as land becomes available. C. The consent holder shall maintain vegetation cover until the expiry of the consent and shall ensure that vegetation cover will be self-sustaining after expiry of consent. D. The pit lake and the pit lake margin shall be established with the indigenous species, including phorium tenax, carex secta and other carex spp., cortaderia spp., myriophyllum triphyllum, mimulus repens, ranunculus trichophyllus, rorippa sp., and potamogeton cheesemanii and ocreatus. **Buildings** Before the expiry of the consent the consent holder shall remove all buildings, plant and equipment (whether attached to the land or not) associated with the exercise of this consent.This condition does not apply to any A. Waste rock stack, permanent earthworks, water body, road or other work and any associated plant and equipment which under this or any other resource consent is permitted or required to remain after this consent expires. B. Rehabilitation required by this or any other resource consent. C. Monitoring structure required by this or any other resource consent to remain after the expiry of this consent. D. Silt ponds to be converted to permanent stock water drinking ponds.*** new clause *** **Detailed rehabilitation plan** As part of the Annual Work and Rehabilitation Programme, the consent holder shall prepare annually a detailed rehabilitation plan containing: A. An overall rehabilitation programme for the next five years. B. A description of final rehabilitation. C. The details of the location, design (including shape form and contour) and construction of all permanent structures. D. Details of all topsoil to be stripped and stockpiled in the coming year and of surface pre-treatment and reuse of topsoil on finished areas. E. Drainage details for disturbed and rehabilitated areas.

Org Name & start date	Obligation	Condition	Summary
			F. Details of any vegetation rehabilitation planned for the next 12-month period, including the areas to be rehabilitated. Methods proposed, time results of previous trials and rehabilitation work, any further trials proposed, and any vegetation or rehabilitation problems encountered, and the steps being taken to resolve these. G. Details of the management of all areas previously rehabilitated. H. Details of all proposed rehabilitation for the next 12 months. I. Details of Actual contours to an accuracy of 5 metres of all existing pits, backfill and waste rock stacks. **Final site rehabilitation plan** A. Within two years of the first exercise of this consent, the consent holder shall submit to the Consent Authority in the Annual Work and Rehabilitation Programme, a final site rehabilitation plan. B. The final site rehabilitation plan shall demonstrate compliance with the objectives and terms of the rehabilitation conditions of this consent. C. The final site rehabilitation shall describe in detail the consent holder's proposal for the completion of rehabilitation. The final site rehabilitation plan shall include: i. The final design of all works and structures. ii. A plan of the intended final contours, drawn at five metre contour intervals, of all permanent structures and works, including pits, waste rock stacks and roads. iii. A plan showing intended final footprints for all works and structures. iv. Details of proposed vegetation rehabilitation. v. Details of management, maintenance, monitoring and reporting proposed by the consent holder for the completion of rehabilitation. **Landscape architect** The consent holder shall demonstrate that a landscape architect was engaged to assist with the basic planning of all earthworks, and to assist with the planning and shaping of all earthworks shown in the Rehabilitation Plans. Keywords; rehabilitation
Coronation 22 Nov 2013	Land Use Consent WDC 201.2013.360 DCC LUC-2013-225 Coronation Project	04.11 v1	The consent holder shall maintain vegetation cover until the expiry of this consent and ensure that the vegetation, including any vegetation established on disturbed land, shall be self-sustaining after expiry. Keywords; vegetation

Appendix 2. Synopsis of key points from AgResearch 3-yearly pasture rehabilitation reports

Boswell CC. 1996. Report on pasture development at Macraes Mine site Autumn 1996. 18 p.

This report is useful to explain the rationale for the pasture establishment methods that have been used, with minor modifications, for 25 years. The objectives are also largely unchanged, being to demonstrate rehabilitated pasture at least as high a quality as those they replace or those pastures existing in the mine vicinity.

Pasture rehabilitation is based on spreading 10 cm of topsoil, loess subsoil or mixed topsoil/subsoil to create 20 cm rooting depth. A 'Bush Burn' seed mix is then drilled at 50 kg/ha with 20 kg/ha rye or ryecorn. The Bush burn mix is perennial ryegrass and 'Wana' cocksfoot at 20 kg/ha each, and inoculated red and white clover at 5 kg/ha each. Mountain rye or ryecorn, very large (up to 1 m tall), erect grasses were included to provide rapid erosion protection and act as a nurse crop. Cocksfoot has low feed value and is slow to establish but highly competitive in dry and low fertility – and more valuable than browntop as it has higher biomass and supports clovers (rather than excluding them). The inclusion of a legume is critical to supply nitrogen for pasture growth, with red clover diminishing and white clover increasing over time. Other legumes have also been used.

First rehabilitation was in 1991 and grazing started in 1995/96 season. Grazing was beneficial, reducing weeds and increasing tillering. There was no detrimental effect on pasture cover and no adverse effects on animals. Selenium deficiency is expected in stock in the area; farmers use selenium prills with fertiliser and drench; mined land is also expected to require this approach. Recommendations were to:

- control thistles (by spraying herbicide)
- add stock water dams in rehabilitated areas
- withhold grazing for at least the first 2 years after pasture establishment to allow ryegrass/cocksfoot pasture development
- speed soil recovery by grazing laxly (leaving 5–7 cm of grass height after grazing), keeping grass vegetative (not reproductive), encouraging spread of clover and controlling weed growth.
- provide guidelines to farmers because the mining company has ultimate responsibility for vegetation cover
- apply annual fertiliser maintenance at 250 kg/ha/annum of super phosphate.

Special notes report very limited earthworm populations and similarly restricted micro-organism fauna and using sheep to graze the young pasture that have higher legumes to avoid bloat in cattle. In summary, the report recommends that '*the role of Macraes staff is to keep a watch to ensure what they want from the grazing is what they get; it may not match entirely what the farmer thinks he can get*'.

Boswell C. 1999. Report on pasture at Macraes Mine 1998/99. 29 p.

This monitoring followed a drought. A key observation was the reductions of clovers, and to a lesser extent ryegrass, in rehabilitated pastures due to their lack of competitiveness under the dry conditions of the 1997/98 drought exacerbated by their removal by selective grazing in cocksfoot-dominant swards. This reduction increased the risk of establishment of thistle and *Hieracium lepigulum* (hawkweed), especially given large seed sources of Hieracium were present around revegetation areas. Boswell reminds Macraes 'at times of drought feed is at a premium and there is a danger of being sucked into an "unusual management for an unusual season" scenario. Recommendations:

- Reintroduce legumes that are drought resistant such as birdsfoot trefoil (*Lotus corniculatus*) and subterranean clover (*Trifolium subterraneum*) at 5 kg/ha, but only with a 2-year delay to grazing and with light grazing to allow their establishment and maintenance.
- If drought is predicted (by MetService and NIWA seasonal forecasts [26]), avoid severe defoliation and allow spring accumulation[27] by ensure farmers restrict sheep grazing from mid-October to late December so that a residual 1500 kg DM/ha pasture is maintained to ensure plants survive drought (the total accumulated biomass was 2500 kg DM/ha).
- Check fencing around ponds to ensure they remain effective as water levels drop and ensure stock have adequate supply water in rehabilitated areas.

Boswell 2003. Land rehabilitation survey summer 2003. Review of rehabilitated pasture and soils at Macraes. 73 p.

This was the first major summary of pasture rehabilitation, based on about 12 years of rehabilitation and together with the equivalent 2017 report are valuable sources of information for managers of rehabilitated farmland. By April 2002 about 450 ha had been affected and 275 ha (61%) rehabilitated. Boswell concluded 'land rehabilitation to pasture has been very successful'. This was despite the rehabilitation method changed between 1998 to 2003 from cross-slope harrowing and sowing by tractor to aerial seeding. Aerial seeding resulted in poorer pasture cover because seed germination was lower (seed not covered with earth), and seeds tended to grow only in bulldozer lugs.

Key points

- Rehabilitated pasture typically had a total cover of the soil surface which removed erosion risk and prevented weed invasion; Hieracium was seldom seen in rehabilitated areas. In areas with controlled grazing, white clover had persisted with red clover for 9–11 years and in areas with no grazing birdsfoot trefoil and red clover performed well.

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[26] https://www.niwa.co.nz/climate/seasonal-climate-outlook; https://www.metservice.com/rural/monthly-outlook i.e. this means grazing with ewe hoggets because lambing ewes are set stocked for a relatively long period and need higher quality pasture

[27] The majority of these tussocks have probably persisted to 2018

- Few areas were grazed and this was slowing soil recovery, however, grazing was difficult due to the physical discontinuity of rehabilitated areas, inadequate stock water supply or stock handling facilities, and difficulty moving stock between blocks.
- In some areas 'marauding stock' (uncontrolled, early grazing within 1 to 2 years of pasture establishment) had removed the birdsfoot trefoil, as 'wandering stock find legume-dominant pasture and concentrate on them'.
- Little or no maintenance fertiliser was applied (recommending 250 kg/ha superphosphate, with a change to the basal application to increase potassium and add 1 T/ha lime).
- Key influences on pasture production are slope, aspect and surface roughness.
- A longer-term risk is invasion of scrub weeds, especially gorse. The benefit of managing stripped soils to avoid spreading gorse into rehabilitated areas was highlighted. An example was the top level of the Northern rock stack had topsoil with a gorse seedbank; solutions proposed were early spot spraying to avoid blanket sprays (so avoiding adverse impacts on clover), using grazing to control occasional germination, and separately placing topsoil that has a gorse seedbank under a layer of loess to benefit from organic matter but prevent its growth.

Shifting baseline

The report has a pertinent discussion on the shifting baseline of pasture success (p. 41), warning of 'jumping the gun', with farmers now wanting ryegrass, not cocksfoot or unimproved tussock. The discussion being by reiterating that pasture rehabilitation has four objectives:

- Produce grassland cover
- For the cover to persist in a seasonally dry environment
- For grassland to contribute to building up organic matter in the soil
- Produce pastures that stack up against neighbouring pastures.

Boswell considered the first three objectives to have been achieved 'spectacularly well' and 'initial confidence that designer cocksfoot pastures on rehabilitated land would at least be the equal of mainly unimproved existing neighbouring pastures has proved accurate'. However, he notes, the rehabilitated pastures are 'not currently the best in the district'. The best pastures in the district were ryegrass dominant with 20–30% clover and a high (fertiliser) input system, with hay paddocks of the Peddie estate on Horse Flat Road given as an example. Boswell considered that such pastures could be converted from cocksfoot dominant areas, but only following an initial establishment period of ten or more years (and I would add, only on topography that minimises erosion risk).

Native species within pasture

Boswell notes that a commitment was made before 2003 to include more tussock to provide stock shelter and visual amenity by breaking up the regularity and monotony of the rehabilitated land, especially as seen against the skyline. He noted successful transplanting of *C. rubra* (red tussock) and *C. rigida* to ungrazed areas of the Frasers West lower lift,[28] so tussock should now be established in areas of low-biomass pasture. About this time, several trials using native species were installed that could help integrate non-weedy shelter belts and tussocks within rehabilitated areas. These included:

- Golden Point Backfill native trial, an area 'covered with brown rock, deliberately not seeded with pasture'. Is this the area Scott and I overlooked on our first visit that appeared to have a particularly low grass cover and occasional tussock – which may be the trial remnant, so not indicative of succession/pasture development on conventionally rehabilitated areas?
- Blueskin Nursery native tree and shrub trial on a 'rocky, exposed haul road face' on the north-east facing slope of Frasers haul Road, comprising 4, 40 by 30 m sections planted in April and August 2002

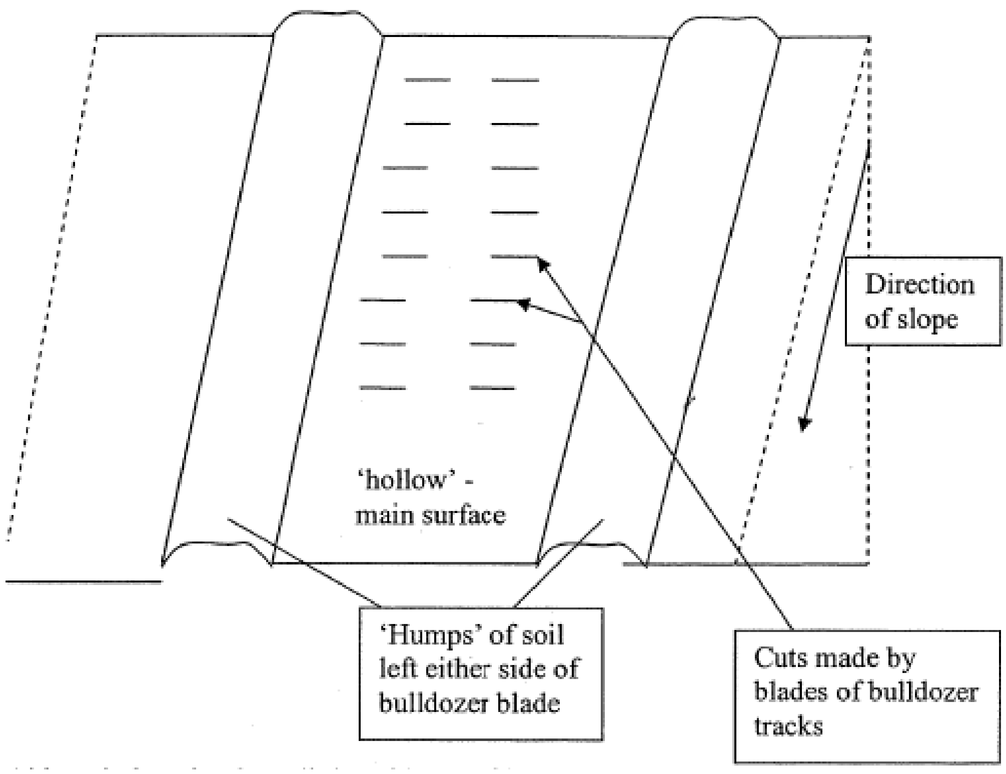


Figure 18. Stylised surface prepared for aerial sowing of seed. The cuts made by bladed of the bulldozed track are the main sites of seedling establishment. (Figure 10 in Boswell 2003)

Houlbrookle DJ and Rutherford AJ. 2007. Soil and pasture rehabilitation assessment. AgResearch. 42 p.

This report reviews 350 hectares of rehabilitated pasture over 16 years of assessments. It is consistent with previous reports in concluding that pasture establishment is 'in general successful' with 'almost total cover of the surface with pasture' (except site 11) that is cocksfoot and white clover dominant and representative of low intensity agricultural

[28] The majority of these tussocks have probably persisted to 2018

production. The authors explain the rehabilitated pastures are of low nutritional value, and maintain stock weight, compared to pastures with higher ryegrass and clover contents. However, the rehabilitated cocksfoot pastures have at least as much feeding value (kg DM/ha) as the major species in surrounding pastures (which were dominated by browntop). Overall, the rehabilitated pasture was similar to some existing pastures in the area. Aerial seeding was still being used to establish pasture.

The reports' main findings were:

- Cocksfoot was the only grass species found on all old ungrazed sites and 'to an extent (is) very effective because it provides extensive cover and accumulates soil and plant organic matter'. Some grazed areas had minor Hieracium, thistles and dandelion.
- The depth of topsoil varies from a minimum of 10 cm to 20 cm or more near the top of each bench.
- Soil organic carbon was building at about 0.2% /yr and nitrogen at 0.007%/yr with no significant difference rates at grazed and ungrazed sites. This was a very positive trend that demonstrates over time rehabilitated areas 'are becoming suitable for pastoral agriculture albeit in a low intensity manner suitable for climate and topography'
- About 85% of monitored sites had sub-optimal Olsen Phosphorus levels for pasture growth
- Most grazing was low intensity and haphazard, by wandering stock. Grazing improves forage production and reduces fire risk. The area and effectiveness of grazing was expected to improve as the restrictions caused by the active mining operation reduced.

Recommendations:

- Return to harrowing rather than aerial seeding where this was safe.
- Increase basal and maintenance fertiliser applications to improve pasture production and allow increased intensity of sheep grazing that generates quicker and larger organic matter turnover and soil recovery. Basal fertiliser should be 250 kg/ha of Mo super phosphate (0:9:0:11 N:P:K:S) and 125 kg/ha Cropmaster 20 (50:50 mix of di-ammonium phosphate and ammonium sulphate 20:10:0:2), with 1 t/ha lime. A 'catch-up' application of capital fertiliser to lift Olsen P to 22 over 2 years, using 400 kg/ha superphosphate in each year. The optimum Olsen P agronomic target was 20–30. No potassium-containing fertilisers were recommended, given high potassium and low calcium concentrations, which increase the risk of ryegrass staggers (hypomagnesaemia).
- Nitrogen, Iron (Fe), and Manganese (Mn) contents in pasture should continue to be monitored (elevated Fe and Mn was potentially related to dust). Authors noted that Mn interferes with Fe and P to give symptoms of deficiency, and excessive Fe can reduce phosphate and copper uptake.

Rutherford AJ, VanDer Weerden TJ, Johnstone P, Dodds K. 2017. Soil and pasture assessment. March 2017. 54 p.

This report reviews data collected during the four surveys since 2006 and is the most recent of the 3-yearly reports on pasture rehabilitation. Over a quarter of the pastures are now more than 20 years old, consistent with 2 of the 3 control sites (which were last renovated in about 1996). Of the sixteen sample sites within 466 hectares of rehabilitation, ten provide a continuous site time series for 2007, 2011, and 2014. Pasture is being established by tractor harrowing across the slope with only steeper slopes aerially seeded.

The area of managed grazing is noted as significantly increased, and this is considered to have benefitted pasture quality and some aspects of soil quality. Stocking density is reported as 8 stock units/ha, considered 'in keeping' with the local region. Californian thistles are reported as very well managed and a wetter than normal year resulted in very good pasture growth and a higher number of sites with white and suckling clover. However, a higher number of flatweeds, particularly Hieracium, may suggest overgrazing of some sites. The C:N ratio is now comparable with control sites suggesting soil biological development is beginning to stabilise, while total carbon and organic matter have remained stable. Soil and plant P levels remain at deficient to low levels, with mean Olsen P on all rehabilitated sites being 13.1 ppm (compared with 22.6 ppm for the control sites) suggesting previous fertiliser regimes have not sufficiently met plant growth requirements'. Again, key recommendations focus on increasing pasture production through improving grazing and soil fertility management. Recommendations are to:

- increase capital an annual maintenance fertiliser to achieve Olsen P >20, and for the first time, to apply capital lime to some older sites. This aims to mitigate current deficiency in plant nutrients N, P, K, and S, and help build soil organic matter
- continue grazing and reduce the risk of over-grazing by formalising grazing arrangements covering fertiliser, grazing and pasture management
- develop a plan to re-sow pastures over 20 years old. This will need to take into account that topsoils are about 10 cm depth, with about two-thirds of the sampled sites having less than 10 cm depth of topsoil/loess mix, and presence of gravels in some topsoils and in the underlying oxidised 'ground schist ore'.
- investigate mechanism for loss of nitrogen and phosphorus, including subsurface runoff through the poorly developed stony subsoils
- continue to monitor the potential toxicity and deficiency of Fe, Mn, N and main cations (K, Mg) at specific identified sites (some may be affected by dust).

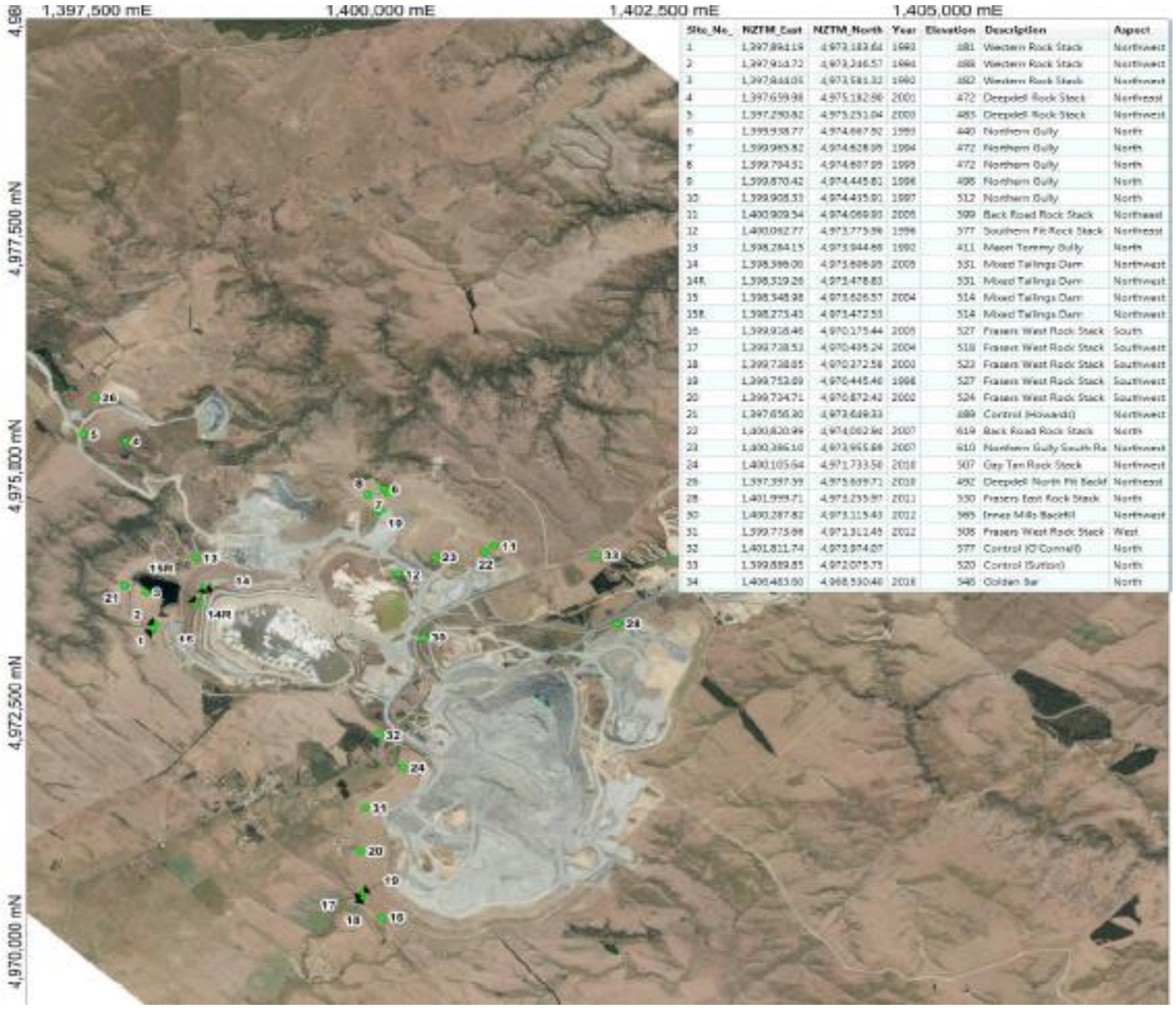


Figure 19. Pasture monitoring site locations for sites post 2006 (Appendix 1 of AgResearch 2017).

Soil biological analyses for samples collected in December 2016

Site	Location	Age of Pasture (years)	Grazing	TC%	OM%	TN%	OS%	C:N
2	Western Rock Stack	22	grazed	5.56	9.59	0.52	7.60	10.7
3	Western Rock Stack	24	grazed	2.73	4.71	0.26	4.44	10.4
4	Deepdell Rock Stack	15	grazed	3.79	6.53	0.34	5.79	11.1
8	Northern Gully	21	grazed	2.91	5.01	0.27	4.39	10.8
10	Northern Gully	19	partially grazed	2.40	4.13	0.20	4.46	11.9
13	Maori Tommy Gully	24	grazed	3.44	5.93	0.34	4.93	10.1
14	Mixed Tailings Dam	11	partially grazed	2.40	4.13	0.21	5.15	11.4
18	Fraser's West Rock Stack	11	grazed	2.55	4.39	0.23	4.79	10.9
19	Fraser's West Rock Stack	13	grazed	3.56	6.13	0.34	7.47	10.4
20	Fraser's West Rock Stack	14	grazed	5.28	9.10	0.42	15.00	12.5
22	Back Road Rock Stack	9	grazed	3.87	6.67	0.35	6.41	11.1
24	Gay Tan Rock Stack	6	grazed	2.43	4.19	0.24	5.74	10.3
26	Deepdell North Pit Backfill	5	grazed	3.33	5.75	0.33	5.85	10.3
28	Frasers East Rock Stack	5	partially grazed	3.54	6.10	0.29	6.91	12.1
31	Frasers West Rock Stack	4	grazed	2.49	4.29	0.24	5.07	10.4
34	Golden Bar	2	grazed	2.76	4.76	0.25	7.25	11.3
21	Control (Howard)	4mths	grazed	4.66	8.04	0.41	11.79	11.3
32	Control (O'Connell)	22	grazed	5.02	8.65	0.46	6.90	10.9
33	Control (Sutton)	22	grazed	6.52	11.23	0.58	8.26	11.2
	Mean Rehabilitated Sites			3.39	5.85	0.31	6.65	11.00
	Mean Control Sites			5.40	9.31	0.49	8.99	11.12

Appendix 3. Ecology of Deepdell Creek. Whitaker 1986

This seminal study describes the ecology of 5558 ha mostly in Deepdell Creek, a tributary of the Shag River, that was surveyed, using 35 days of field work, in February 1986 to provide basic resource data on fauna and faunal habitats. Whitaker describes the main habitats: tussock grassland, rough pasture (having a high proportion of exotic species), improved pasture (29% of the areas and exclusively exotic), plantations, scrubland and rock outcrops. Scrubland (4.8% of the area) was the most diverse vertebrate faunal habitat: with rock outcrops and tall tussock grassland (south-facing steep slopes, rarely exceeding 0.75m height) being the only habitats of biological significance. Although Banded dotterel were noted breeding in pasture habitat. The survey included all the land within mining and prospecting licences. .The survey used pitfall and malaise trapping, plus searching 'loose rock or bark, crevices, logs rotten wood or matted vegetation'.

Early graziers regularly burnt scrub and tussock – distributed vast quantities of seed of introduced species and hastened their spread with top-dressing. Where cultivated and re-sown, native plants are entirely eliminated. Woody weeds; gorse, broom, *Sambucus nigra* (elderberry), *Ribes grossularia* (gooseberry) and *Rosa rubiginosa* (wild brair rose). Over a century of burning, grazing, browsing mean no unmodified communities remain.

Ridge tops are gently rounded; valleys steep-sided; rocky outcrops form bluffs and cliffs along streams or tors on ridge tops of Otago block mountain formations of an elevated peneplain mostly 400-500 m ASL that have a NE-SW orientation. Red tussock (*C. rubra*) dominated wetter areas, narrow-leafed snow tussock the drier sites (*C. rigida*). Low scrub (<2m) of matagouri, Dracophyllum, divaricating *Coprosmas propinqua* et al. Palatable shrubs – *Celmisia hookeri,* (Hookers mountain daisy), *Anisotome aromatic* (kopoti, native carrot)*, Dracophyllum uniflorum* (turpentine bush)*, Corallospartium crassicaule* (now *Carmichaelia crassicaulis*, native broom) in crevices with *Aciphylla aurea* (taramea, golden Spaniard),[29] and *Chionochloa rigida*. The schist is strongly foliated and weathers to form horizontal fissures and crevices which provide retreat sites for lizards and a variety of invertebrates. Rock outcrops are important foraging and roosting sites for possums and hunting grounds for feral cats, which have a relatively high population. Hedgehogs, hares, and rabbits were in low numbers; harriers and falcons used outcrops as vantage points when hunting; falcons use bluffs for nesting sites (but NOTE plantations are also potential).

In a landscape virtually devoid of indigenous trees, the plantations and homesteads have added significance for fauna. Most homesteads have shelter belts of radiata or macrocarpa. These provide important cover, roosting and nesting sites for many mammals and birds (possums abundant in plantations; rabbits and hedgehogs; feral cats and ferrets). The avifauna is almost entirely introduced passerines plus grey warblers and

[29] This fragrant plant was highly valued by Ngai Tahu for oil – see a 2014 report Assessing the feasibility of commercial cropping of taramea: gathering current knowledge and questions at https://ngaitahu.iwi.nz/wp-content/uploads/2018/04/Assessing-the-feasibility-of-commercial-cropping-of-taramea-gathering-current-knowledge-and-questions.pdf.

occasional silvereyes. Common geckos and spotted form of common skinks were found in low numbers under logs or debris within this habitat type.

Otago skinks, grand skinks (small colonies of extremely high value) and green skinks are of national significance, along with falcons. Skinks need deep crevices to in which to hide, inaccessible to livestock so the crevices do not become fouled, suitable protected basking sites, and plants with fleshy fruit nearby. Although inhabitants of outcrops, they are dependent on surrounding vegetation for invertebrate and fleshy fruit food; dense subalpine tussock grassland allows safe movement between outcrops (possums and sheep have removed some berry-producing plants); repeated burning reduces habitat value; cultivating removes the habitat. Key native plants in gullies included *Olearia virgata, Muehlenbeckia complexa, Corokia cotoneaster, Coprosma propinqua* with isolated *Cordyline australis* (ti kouka, cabbage tree)*, Sophora microphyllla* (kowhai) and *Griselinia littoralis* (broadleaf). Structural diversity provided by these plants, especially the latter three 'trees' supported the most diverse vertebrate fauna.

Whitaker warned 'any plants used for amenity plantings or sound/dust control must be selected to avoid introducing new pest species to the district', with examples being species with bird-dispersed seeds such as *Sorbus aucuparia* (rowan) and 'many exotic conifers with wind-dispersed seed (*P. contorta, P. nigra, Larix decidua* – European larch and *Pseudotsuga menziesii* – Douglas fir) spread rapidly in sub-alpine tussockland and cause severe environmental problems, e.g. IAE Atkinson 1977 – *Pinus contorta* in the North Island mountains'. He also refers to an unpublished report to the Nature Conservation Council Wellington by Hunter GG and Douglas MH (1984 Spread of exotic conifers on South Island rangelands. NZ J Forestry 29(1): 78-96).

Whitaker suggests purchasing land for biological reserves to preserve remnants of the original biota (especially skinks) as compensation.

Figure 20. Incorporating occasional low stacks of flatter rocks could enhance stock health by providing drier, warmer resting places during wet and cold periods, and shelter in windy periods.

Appendix 4. Lease management

The following notes relate to management of leases. I have no comments on how leases are selected, other than to note it is difficult to balance local political interests.

- Until the most recent leases, soil fertility data have not been provided to farmers (e.g. AgResearch reports) and farmers have not provided their soil test or fertiliser records to OceanaGold to show 'good husbandry'. There was a period of 10 or more years with minimal farmer liaison. Without baseline information and fertiliser records, lease conditions requiring maintenance/ enhancement of fertility (or fences or weeds) cannot be readily assessed. This increases the risk of pastures degrading, particularly without pasture renewal techniques for overburden backfill slopes.
- New lease processes and agreements in 2017/18 improve on past leases. At least some of these new leases were underpinned by soil test data and farm walk-overs with independent third parties, the farmers, and OceanaGold representatives. New leases require soil fertility results and fertiliser application records to be provided (direct from the fertiliser supplier), are shorter, and in plain English. Some leases include agreed development (capital) plans to increase productivity by broom or gorse control, or new infrastructure.
- Lease rental assessments do not **specifically** take into account the conservative (lower) production that is consistent with short- and long-term aims of ensuring recovery of rehabilitated land, and ensuring resilient farming in an environment with large year to year variation in pasture production (driven by droughts) and, broader environmental objectives of OceanaGold.

Recommendations

- Where possible, ensure leased land includes suitable living quarters to allow farmer or farm worker to live on site, as this enhances site security and flexibility of interaction with mining company, and stock management.
- Remove the lease condition that requires maintenance of shelter belts in good condition where these are species that should be removed as they are sources of wilding pines. Add a condition to all leases (regardless of whether in Zone) to encourage removal of all exotic trees listed as not permitted to be planted in the 'Rural Scenic Zone',[30] e.g. removal of pine shelterbelts (with revenue retained by the farmer) and replacement with suitable native species where shelter is needed.
- OceanaGold should be explicit about the outcomes it requires and communicate these to the lease valuer, i.e. that:
  - conservative farming adapted to the region is highly desirable due to relatively short growing seasons (between frost and drought) and high year to year variation in pasture growth.
  - leasees are balancing needs of farmer, OceanaGold and the broader community (defined through resource consent conditions and agreements with national

[30] These may have some value to farmers for firewood

bodies such as Department of Conservation and QE2 Trust). Balancing these needs mean limiting production in some areas by restricting areas that can be cultivated, burnt and grazed by different stock. It also means controlling an expanded range of weeds (environmental weeds such as wilding pine, as well as agricultural weeds, such as thistle or broom).

- OceanaGold should be explicit about the outcomes it requires and communicate these to leasing farmers to reduce potential for poor and inadvertent outcomes, especially outcomes that are inconsistent with consent conditions (for rehabilitated land or covenanted areas) or in breach of District or Regional Council rules, e.g. clearance of tussock in scenic zones.
- OceanaGold should be consistent in their monitoring and response to non-compliant conditions. This maybe by having consistency in representatives from OceanaGold and independent advisors (whether valuer, farm advisor or fertiliser representative). Key areas are stock-proof fencing, weed management, fertiliser applications and adverse environmental impacts (wetland pugging/destruction, tussock degradation). A list of clear penalties would be useful, e.g. OceanaGold doing weed control.

Appendix 5. Flow chart. Planning and agreeing pasture and farm rehabilitation

This flow chart was created to help alluvial gold mining in Westland, where land ownership is retained by the farmer so farmers are much more involved with decision-making, mine duration is much shorter (<5 years), and scale is smaller than at OceanaGold Macraes Mine. Although alluvial gold mines can usually plan at a paddock scale and individual paddocks are much smaller, many of the considerations and principles are consistent with those at the very large, long-lived OceanaGold Macraes Mine. The flow charts are available online at the following sites

- Fact Sheet 6. Planning and agreeing rehabilitation to pasture https://www.landcareresearch.co.nz/__data/assets/pdf_file/0005/76892/FS6-Pasture-Farm-Rehab.pdf
- Fact Sheet 7. Implementing rehabilitation to pasture https://www.landcareresearch.co.nz/__data/assets/pdf_file/0006/76893/FS7-Pasture-Method.pdf
- https://www.wcrc.govt.nz/Documents/Environmental%20Management/Guidelines%20for%20mine%20rehabilitation%20in%20Westland.pdf (Appendix 1)
- Cavanagh JE, Pope J, Harding JS, Trumm D, Craw D, Simcock R, Ross C 2015. *New Zealand minerals sector environmental framework: a user's guide*. Christchurch: CMER. @ https://www.cmer.nz/publications/pubsbyyear.html

Fact Sheet 7. Implementing rehabilitation to past

1. Identify rehabilitation resources and constraints

- Calculate approximate volumes of suitable materials available and volumes needed (Fact Sheet 5)
- Identify resources that can be produced Run of Mine, e.g. boulders, fines for root zone, gravels for surfacing races

2. Strip

- Identify, mark, and protect riparian zones and agreed no go zones , e.g. remnant forests, wetlands, buildings
- Survey weeds and ID weedy areas; decide on management , e.g. spraying, separate stripping and stockpiling or disposal
- Fell/remove trees and direct transfer; remove and salvage fences, troughs, etc.
- Identify stockpiling areas and prepare these areas with access., firm bases, cut-off drains, sediment control and fences
- Reduce pasture mass by intensive, close, grazing immediately prior to stripping, or herbicide 2–3 weeks earlier
- Preferably use low ground-pressure machinery to strip topsoil separately from subsoil
- Strip and stockpile free-draining materials that will be used in root zone separate from general backfill
- Remove poorly-drained or hostile subsoil and overburden. Dispose in suitable backfill areas below root zone

3. Stockpile and conserve root zone

- Separately stockpile topsoil, subsoil, and other materials for rehabilitation in accessible areas
- No surface water should enter stockpiles ; reduce 'dirty water' needing treatment by diverting clean water away from stockpiles
- Create soil stockpiles by back-dumping to minimise compacting the soil . Do not drive over stockpiles
- If stockpiles will be unused for > 3 months, sow with grasses or legumes to conserve quality

4. Reinstate landform or create modified landform

- Place overburden to minimise the amount of reshaping (bulldozing) and re-handling required
- Identify and mark watercourses and water detention areas; confirm flood capacity is adequate;
- Reinforce flood zones and water-courses with rock armouring if necessary; install culverts and crossings
- Check site safety : remove steep drops and dangerous areas , e.g., soft, deep sediment or mitigate hazards, e.g. excluding vehicle access using boulders, fenced ditches or other contouring

5. Create root zone

- For pasture: Create a free-draining root zone of minimum 300 mm depth over compacted gravels or overburden. The root zone should include at least 100 mm topsoil, unless fine sands and silts are substituted (silts increase risk of surface sealing)
- Trees (shelter belts & native plantings) grow best in a 1 m root zone depth to ensure stability and reduce stress
- Minimise compaction of topsoil by avoiding handling in wet periods and using light or low ground-pressure tractors
- Soil tests will confirm initial (capital) fertiliser and lime recommendation for good pasture growth

HINT: ROM (Run of Mine) materials may be more cost-effective than separately stockpiling during stripping, especially where stockpile area is limited, haul distances or handling can be reduced

HINT: Placing stockpiles adjacent to areas that will be rehabilitated may reduce or eliminate haulage

HINT: The cost of double handling is avoided by managing the mining schedule to allow direct placement of soil and rock from stripped area s to rehabilitated area s

HINT: Keep track of topsoils and root zone volumes needed and used or stored; many mines run out of suitable root zone material. An inadequate root zone increases costs and the risk of poor plant growth

HINT: Check compliance:
- with land-owner access agreement,
- with WCRC requirements and relevant bond release conditions

HINT: Ensure treatment of permanent water-courses (e.g. streams) is consistent with WCRC 2004 'Clean Streams' Guide and WCRC stock crossing policy

HINT: Wet and pond margins also need soil. Protect this from wave erosion using a sheeting of gravel, placing logs in the water parallel to the edge, and/or using diggers to remove and place buckets of rushes/raupo /flax into pre-dug holes or offshore islands

6. Establish pasture, re-vegetate

- Stone pick or rake, remove metal or concrete and other stock and vehicle hazards as necessary
- Decide if a pre-sowing spray of weeds is needed
- Apply fertiliser (lime/gypsum, phosphate, nitrogen, etc.)
- Minimise compaction of topsoil by combining fertilising, harrowing, sowing operations during drier periods
- Minimise erosion by cultivating with the contour
- Best results (germination and growth) are in spring and autumn
- See native vegetation establishment flowchart for TREE and SHRUB establishment

HINT: Keep records of what root zone, pasture sowing rates and fertiliser were used and when. Mark the areas on a map. This helps identify best methods for your site

7. Monitor pasture outcome

- After first storm and/or 3–6 weeks after planting
- For each rehabilitation area

HINT: This is a good time to establish permanent photo points to show rehabilitation progress

Check and Control Weeds

- Identify source of weeds and why weeds are dominant
- Decide weed control method (including grazing

Check Pasture Vigour

- Will pasture resist grazing?
- If grass is yellow check soil drainage, then nitrogen deficiency by spot fertilising

Check Pasture Cover

- Successful if >90% cover after three months
- Find causes of poor cover (weather, soil, erosion, pests) and do remedial work

Check Erosion*

- Check land surface, watercourses, cut-off drains
- Identify cause of erosion, then do remedial work
- Amend rehabilitation method (slope, surface roughness, timing) unless erosion is caused by an unusual rainfall

Decide if the area is ready for grazing or topping

8. Prepare for grazing or topping/mowing

- Is the area stock-proof (permanent or temporary fences in place) and watercourses excluded from grazing?
- Can stock get to and from the area to be grazed without impacting mining?
- Is the ground surface safe for stock or mowing (no wire, concrete, etc.)? Is an adequate water supply present (not a unfenced stream or drain)?
- Are wet areas present that are likely to be pugged (damaged)?
- Walkover with grazing manager/ farmer and confirm objectives: short duration with light stock under dry conditions leaving adequate pasture height

Grazing / Topping
Record the duration, and weather (e.g. rain)

9. Monitoring after grazing

- Pasture health and density (was pasture pulled out by roots, is residual pasture adequate for rapid regrowth or has it been over-grazed with bare soil evident?). Grass/legume balance (high legume cover indicates nitrogen stress)
- Weed species and cover (was grazing effective in controlling weeds?)
- Erosion or pugging, damage or runoff from grazed areas to watercourses
- Check fences remain stockproof

Feedback with farmer/ manager

- Did grazing go to plan?
- Review access, fencing, stock health, pasture health
- Does grazing intensity, timing or duration need to be altered?

10. Maintain and complete rehabilitation

- Post-grazing fertilisation, weed and pest control as needed
- Annual maintenance fertiliser as needed (phosphate, potassium, nitrogen, trace elements as needed)
- Complete permanent fencing, races, water troughs, shelter, etc. as agreed
- If soil fertility levels are part of agreement, soil test and fertilise as indicated by results

HINT: This is a good time to photograph permanent photopoints and identify the best rehabilitation method for this site

11. Closure assessment for hand-over to landowner and Bond Release *(part/whole)*

- Confirm agreed outcomes with land manager/owner and administrator

1 Decide what is possible at the site

A. Site assessment

What are current site conditions?

Land-use capability measures versatility (e.g. cropping potential and the main limitations to farm production).

Current productivity is a useful guide (stock units/ha, Dry Matter/ha/year), seasonality of growth may be important.

Consider trees, shelter belts, ponds, drains, watercourses and their values and farm infrastructure: fences, races, sheds, reticulated water, silage pits and stand-off areas.

B. Site assessment

What are current site limitations? These may be reduced or removed in rehabilitation:

- Poor drainage due to perched water table (iron pan) -> mining breaks this pan
- Poor drainage due to flat site with slowly-permeable soils (pakihi) -> mining can create humps and hollows Floods frequently -> deeper gravel mining may raise the land
- Chemical infertility and low-producing pasture species -> rehabilitation can establish high-producing pasture
- Gorse and weeds -> heavily-infested soils may be replaced if adequate alternatives and moderate to high fertiliser rates are used

HINT: Using aerial photos or farm map to mark key features helps clarify discussions

C. What resources are available?

The mine machinery and equipment influences what resources can be salvaged and separated, e.g. size of fines, ability to access slopes.

See Fact Sheet 5.

Is any mine infrastructure useful to retain after mining? E.g. access roads (races), power supply, dredge pond (with reshaped batters), culverts and bridges, sheds .

Are farm resources useful ? E.g., seeding equipment, light stock for grazing new pasture, dairy shed effluent, hay bales for erosion control.

D. How does the mine plan influence resource availability and use?

When will areas be available to separately stockpile resources for rehabilitation?

What areas are likely to be rehabilitated each year, and when? (This can help farm operations.)

HINT: Access, bridges, and culverts may need to be upgraded to support mining equipment, and can add value to the farm

2. Agree general and specific success criteria to guide rehabilitation

General criteria are needed to allow mine flexibility and guide decisions when mine plans need to change. Farm/landscape-scale criteria and paddock-scale criteria should be developed.

A. Farm-scale criteria

- Location of mine access, mine infrastructure, general location of ex-pit stockpiles or overburden dumps
- General location of farm races, gates, stand-off areas/feed-pads after mining
- General location and width of shelter belts, water courses (with riparian buffers) and crossings
- Specific location of areas that are not to be mined

B. Paddock-scale criteria

- General paddock sizes and shapes
- General land contour (minimum and maximum slopes and lengths, especially if hump and hollowing)
- General water reticulation density and capacity
- Standards for temporary, electric, permanent fences
- Treatment of high-wear areas such as gateways and troughs (may use gravels, not topsoil in these areas)

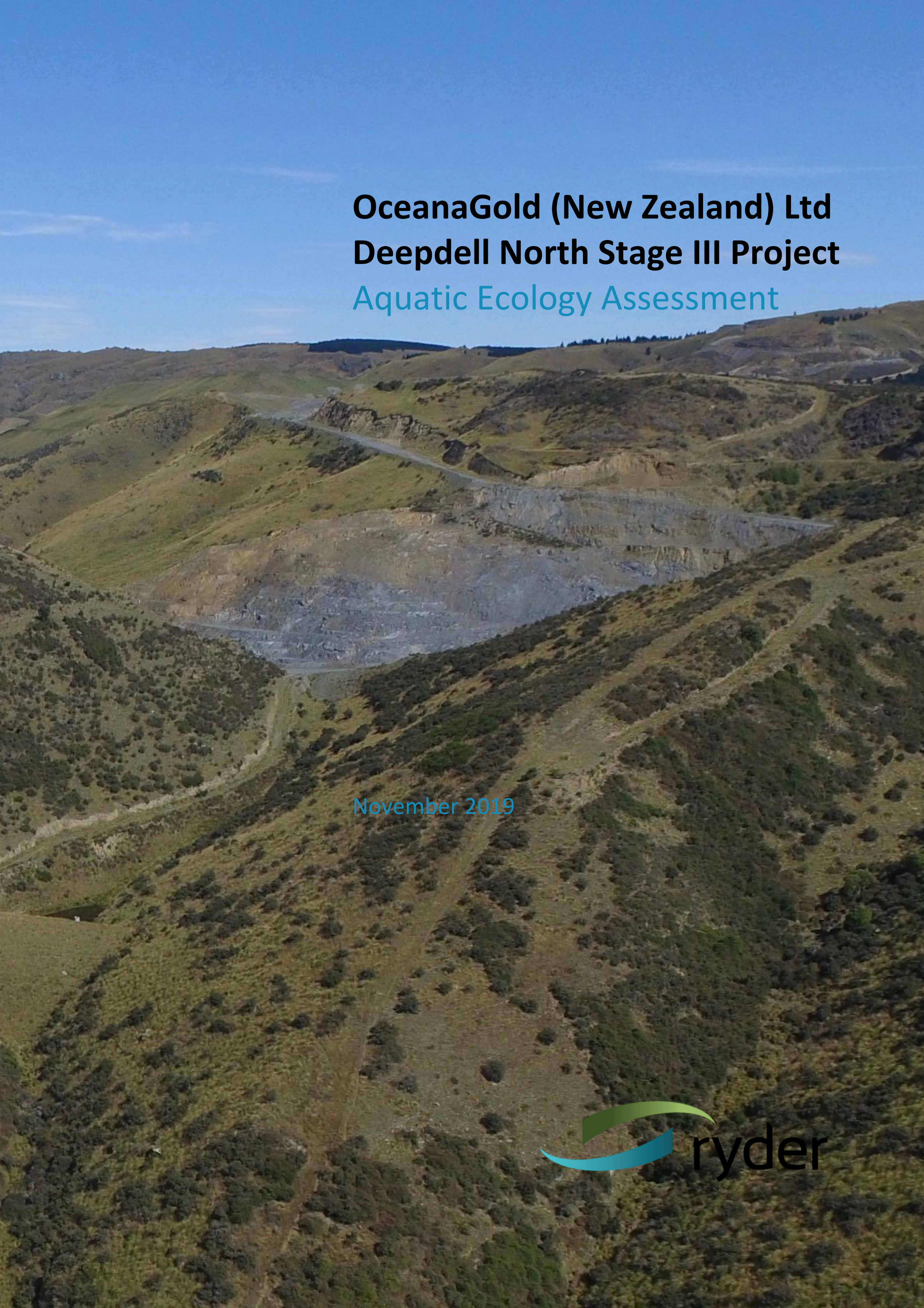
HINT: Ensure treatment of permanent watercourses (e.g. streams) is consistent with WCRC 2004 'Clean Streams' Guide and WCRC stock crossing policy

3. Agree administrative and health and safety criteria

- Treatment of high-walls and ponds (sediment ponds, dredge ponds, new amenity ponds) to make them safe
- Agreement on access and exclusion times for shared areas (e.g. during milk tanker or school bus runs), or places
- Agreement on access and exclusion times or places in mining areas (e.g. operational zones, water treatment areas)
- Identify responsibility for security of fences and gates
- Agreement on any assistance with rehabilitation, pasture management, e.g. stock or machinery for pre-stripping grass removal or post-rehabilitation grazing. Post rehabilitation grazing needs to be done by light stock for short periods
- Agreement on signoff for first grazing (stock & vehicle safety) and closure signoff
- Agreement on process to resolve disputes, e.g. contracting an independent farm advisor

HINT: It is often better to use contractors to establish grass and carry out weed control. This decreases the risk to the miner of poor pasture establishment or grazing outcomes related to poor timing and provide useful feedback

OceanaGold (New Zealand) Ltd
Deepdell North Stage III Project
Aquatic Ecology Assessment



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OceanaGold (New Zealand) Ltd
Deepdell North Stage III Project
Aquatic Ecology Assessment

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Table of Contents

1. Introduction

1.1 Background

OceanaGold (New Zealand) Limited (OceanaGold) own and operate an open pit and underground gold mine, known as the Macraes Gold Project, in the Macraes Flat area of East Otago. The company's operation extends into catchments that drain to the Shag, Taieri and Waikouaiti rivers.

OceanaGold are seeking to re-mine the Deepdell North Pit and have named this proposal the Deepdell North Stage III Project (or the Project). The key elements of the proposal are:

- A new pit (Deepdell North Stage III Pit) covering an area of approximately 38 ha, that includes excavation of 18.7 ha of existing rehabilitated waste rock stack. This pit could potentially be expanded if exploration is successful.
- A new waste rock stack (Deepdell East Waste Rock Stack), that would back-fill the existing Deepdell South Pit, extending north from the Deepdell South Pit to beyond Horse Flat Road, covering a total area of 70.8 ha.
- A short haul road will be required between the Deepdell North Pit and the Deepdell East Waste Rock Stack.
- Associated diversion drains, silt and sediment control structures.

The Project footprint of the new pit and waste rock stack are shown in Figure 1, but greater detail of the Project are presented in The Deepdell North Stage III Resource Consent application. Aerials photos of the affected catchments are presented in figures 2 and 3. Potential diversion routes for clean and mine drainage water to surrounding catchments are identified in Figure 4.

1.2 Report content

OceanaGold engaged Ryder Environmental to provide an assessment of the existing aquatic ecology of the area potentially affected by the Deepdell North Stage III Project and to determine the nature and magnitude of any aquatic ecological and water quality effects with the proposal. The assessment includes the following components:

- an overview of the existing aquatic ecology of the Highlay Creek catchment, Camp Creek catchment and Deepdell Creek catchment adjacent to Deepdell South Backfill and downstream of Highlay Creek;
- an assessment of the values of aquatic habitat within these catchments;
- an assessment of the potential effects of the Deepdell North Project on aquatic ecology and water quality;
- suggested mitigation and monitoring.

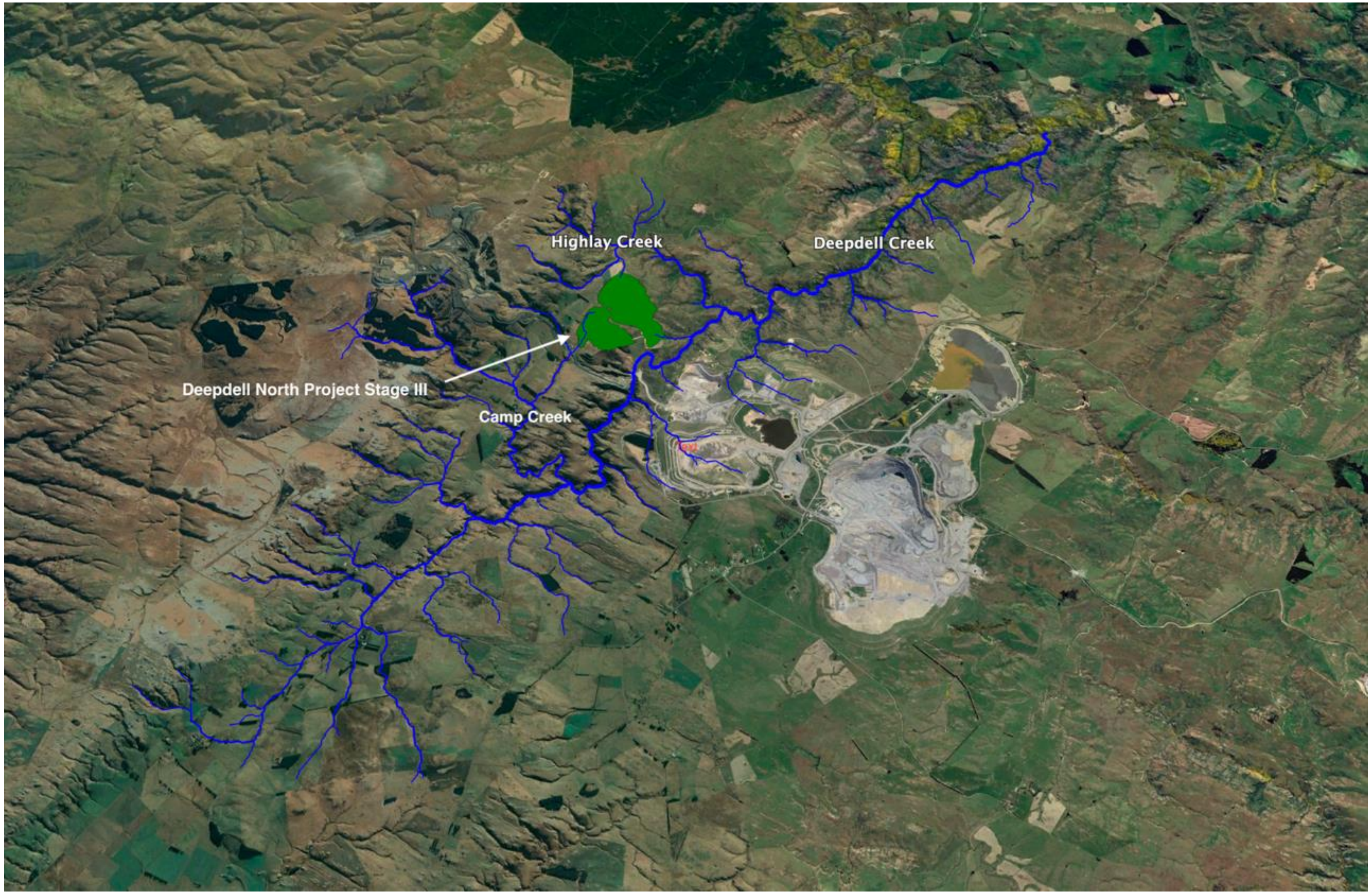

Figure 1 Map showing location of the proposed Deedell North Project area in relation to surface waters of the Deepdell Creek catchment.

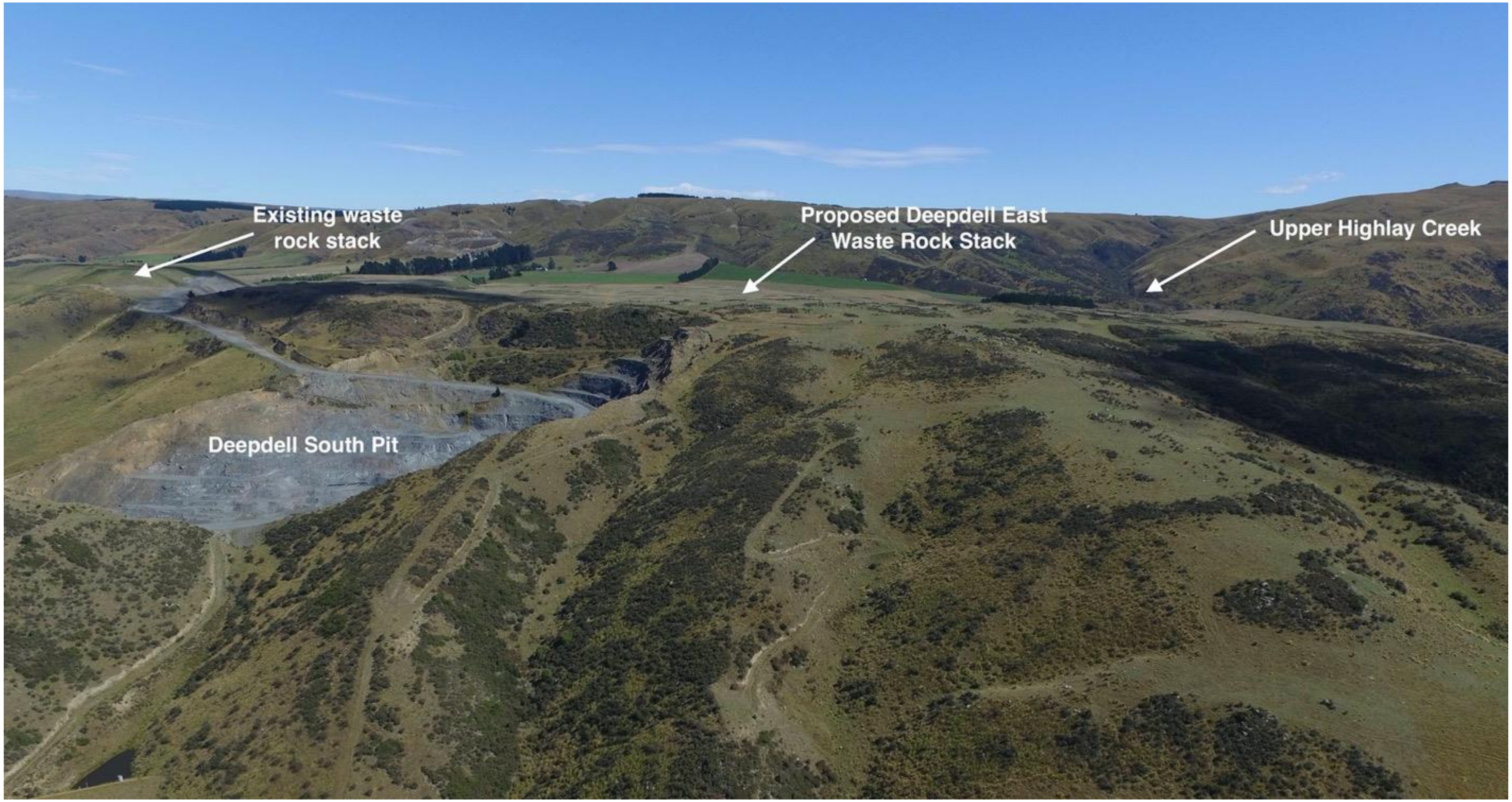

Figure 2 Aerial photo looking across land affected by the Deepdell North III Project (photo: 12 February 2018).

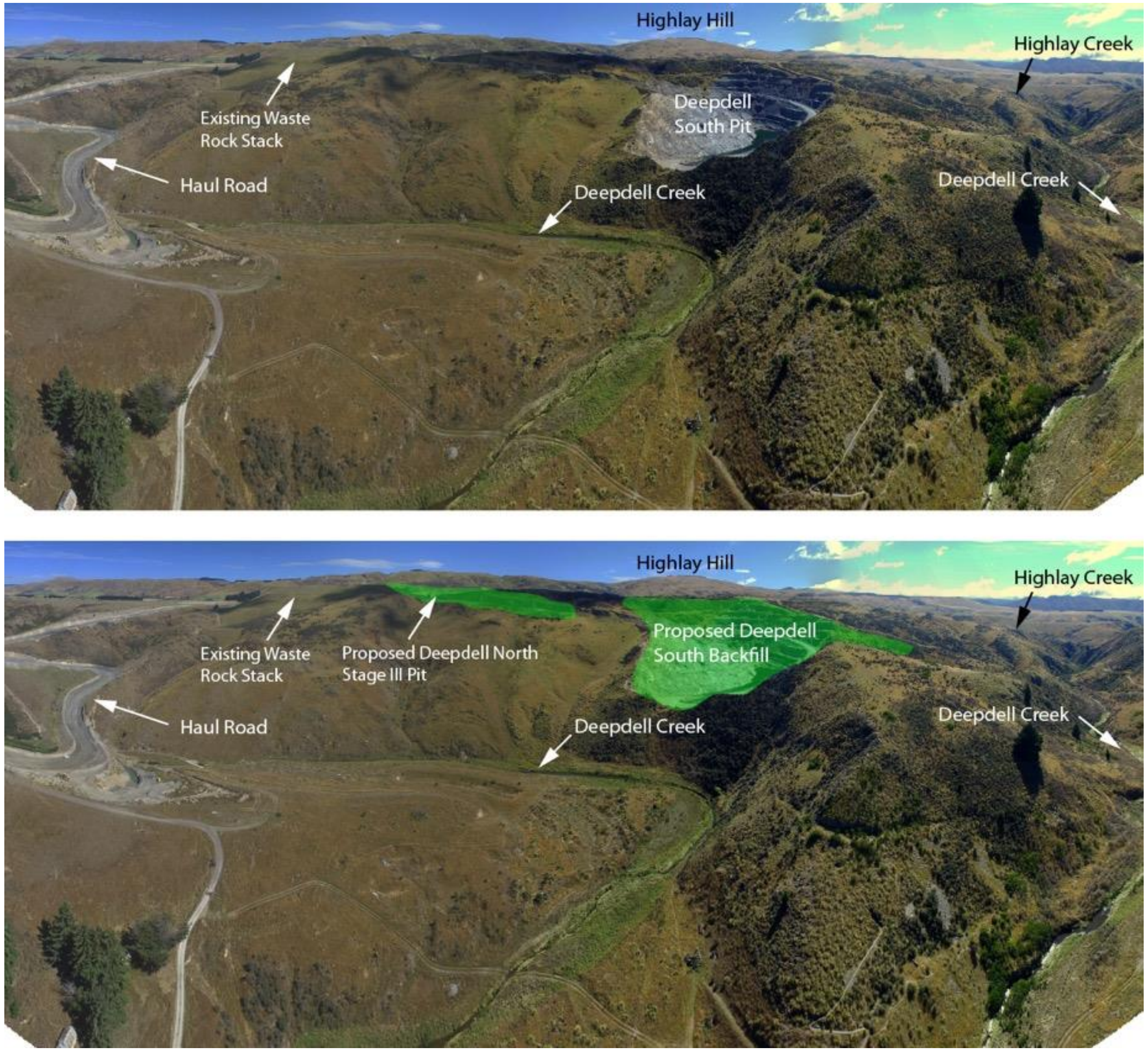

Figure 3 Aerial photo looking west/north-west showing land that drains directly to Deepdeall Creek affected by the proposed Deedell North Project. Highlay Creek catchment can be seen in the distance (photo: 12 February 2018).

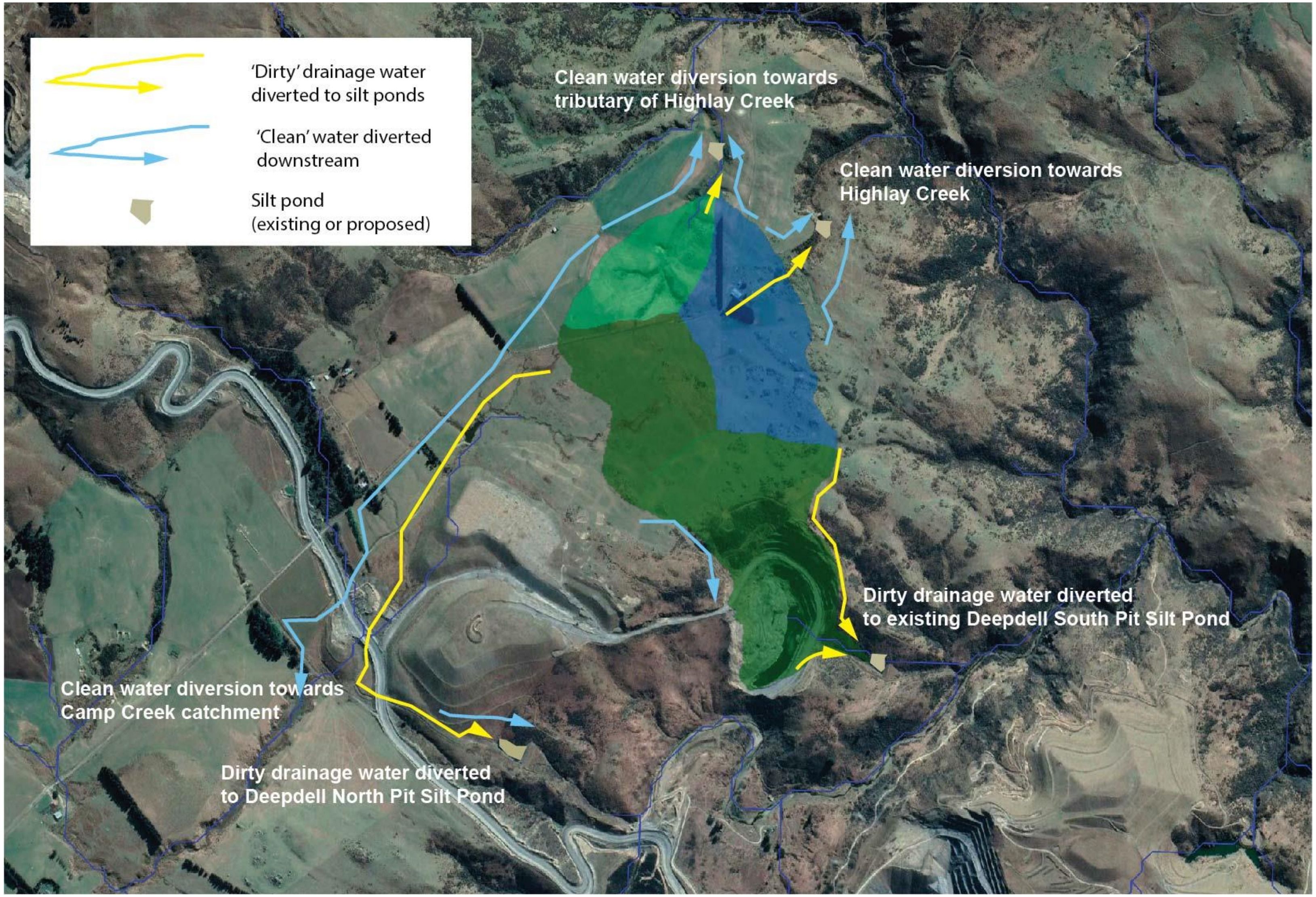

Figure 4 Aerial photo showing existing drainage patterns and proposed diversions of 'clean' water and 'dirty' drainage water on land within and adjacent to the proposed Deepdell North Project.

2. Assessment methodology

Previous freshwater surveys of Camp Creek, Highlay Creek and Deepdell Creek catchments (Ludgate *et al*. 2011, Ryder Consulting 2013, Ryder Consulting 2018) were reviewed to obtain existing information on aquatic communities within the vicinity of the Deepdell North Project Area. Information contained within these surveys was supplemented with surveys and visual inspections of selected sites within the relevant watercourses in February 2018 and September 2019 (Figure 3). For these inspections, instream habitat was noted and described including observations of instream habitat (wetted width and depth, substrate composition, fine sediment cover, periphyton and macrophyte cover) and riparian cover. In addition to the above surveys, sites on Deepdell Creek and Camp Creek have been monitored in 2019 as a part of monitoring requirements associated with Macraes Gold Project existing resource consents. Only some of the data from this most recent monitoring was available for assessment.

Quantitative benthic macroinvertebrate Surber samples were collected from long-term Deepdell Creek monitoring sites throughout 2018 and 2019. These were supplemented with samples collected in February 2018 using the kick-net method. Macroinvertebrate community health was assessed by assessing a range of health indices, as used for previous surveys, and as described in Appendix One.

Over many years now, creeks of the Macraes Flat area have been surveyed for fish largely using electric fishing techniques and visual observations. This latter method was adopted in the February 2018 survey, along with use of a scoop net, as viewing conditions were ideal and many sites contained insufficient channel width and depth of water for effective electric fishing due to low summer flow conditions. Crayfish distribution was also assessed using the above methods. In September 2019, baited minnow traps were deployed over-night at several sites surrounding the Project area.

Fisheries records from the New Zealand Freshwater Fish Database (NZFFD) for the wider Macraes area, and records for the distribution of key non-migratory galaxiids species in Otago, were assessed (5 October 2019) and plotted onto a GIS map of the area. By far the most comprehensive fish survey data for the Macraes Flat area is that associated with surveys undertaken on behalf of OceanaGold. However, fish records from the New Zealand Freshwater Fish Database (NZFFD) are available for other surveys undertaken in the general Macraes area by the Department of Conservation (DOC), Fish and Game Otago, NIWA and the University of Otago.

OceanaGold monitor water quality in Deepdell Creek upstream and downstream of the Highlay Creek confluence and in Highlay Creek at the Horse Flat Road ford (see Figure 5). Water quality data from downstream site DC07 was examined along with monitoring data from two silt ponds: Deepdell North Silt Pond and Deepdell South Silt Pond, which both drain to Deepdell Creek. All water quality and freshwater ecology sampling sites are shown in Figure 5.

When describing surface water features in this report, the Auckland Unitary Plan definitions for surface waters have been adopted for convenience. The relevant definitions are:

Ephemeral stream

Stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. This category is defined as those stream reaches that do not meet the definition of permanent or intermittent.

Intermittent stream

Stream reaches that cease to flow for some periods of the year because the bed can be above the water table at some times.

This category is defined by those stream reaches that do not meet the definition of permanent and meet at least three of the following criteria;

- It has natural pools
- It has a well-defined channel, such that the bed and banks can be distinguished
- It contains surface water more than 48 hours after a rain event which results in stream flow
- Rooted terrestrial vegetation is not established across the entire cross- sectional width of the channel
- Organic debris resulting from flood can be seen on the floodplain
- There is evidence of substrate sorting process, including scour and deposition.

River (or stream or creek)

Means a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal).

Note that the definition of river is that found in the Resource Management Act and is also contained in the Regional Plan: Water for Otago glossary.