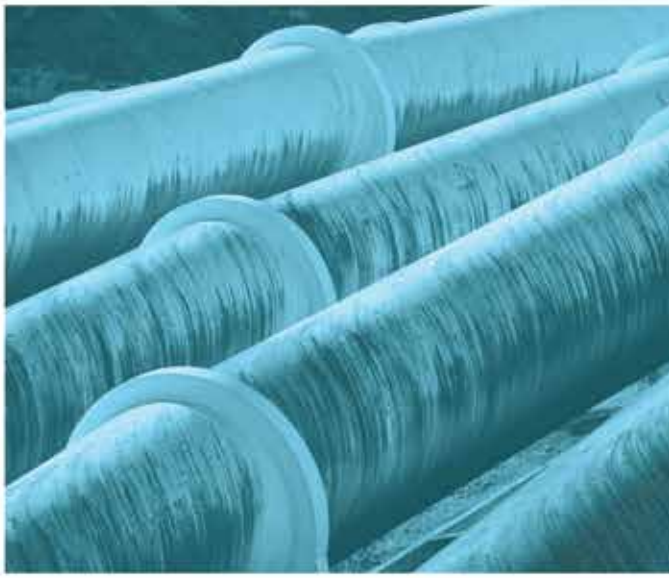



Rasp Mine Modification 9

Modification Report

Prepared for Broken Hill Operations Pty Limited
August 2021

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Rasp Mine Modification 9

Modification Report

Report Number

J210513 RP1

Client

CBH Resources Pty Ltd

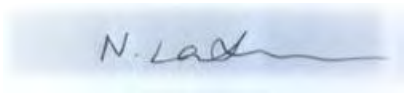
Date

24 August 2021

Version

v2

Prepared by



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Graduate Environmental Scientist
24 August 2021

Approved by

Paul Freeman
Associate Director
24 August 2021

Executive Summary

The Rasp Mine (Rasp) is an operating zinc and lead mine which is located within the City of Broken Hill, in the far west of New South Wales (NSW). Rasp has operated since 1885. It is owned and operated by Broken Hill Operations Pty Limited (BHOP), which is a wholly owned subsidiary of CBH Resources. BHOP has owned Rasp since 2001.

Rasp is regulated under Project Approval 07_0018 pursuant to the *Environmental Planning and Assessment Act 1979* (EP&A Act). The approval allows ore mining, processing, ore concentrate transportation and waste emplacement operations. The approval has been modified seven times (MOD 6 is pending), since it was granted in 2011.

BHOP has made a modification request (07_0018 Mod 9) to the Minister for Planning and Public Spaces for approval under Section 4.55(1A) of the EP&A Act for two development drives and an emergency egress ladderway at Rasp (this report).

These activities are required to allow the continued access to future ore reserves and to augment the safety systems at the mine in accordance with relevant safety legislation and guidelines.

As the proposed activities the subject of the modification request would be underground, there would be negligible impacts at the surface. The proposed development would be strictly controlled in accordance with current approved limits, using the existing strict site protocols and in accordance with approved management plans and relevant guidelines.

One of the proposed development drives would be partially located beneath the Blackwood Tailings Storage Facility (also known as TSF2). TSF2 is a 'declared dam' under *The Dams Safety Act 2015*. Therefore a range of geotechnical controls would be applied to limit the risk of inrush from TSF2 to the development drive, the principal of which is a significant pillar buffer between the development drive and the base of TSF2 and historic workings. Closely controlled development blasting would also ensure the continued integrity and stability of TSF2.

The blasting impacts of the underground development would be well within approved limits in the project approval and would result in negligible impacts for all residential receivers. The closest receiver to the proposed underground blasting is around 390 m away. Underground blasting would also be designed to meet relevant Dam Safety NSW (previously Dam Safety Committee, or DSC)) vibration limits for TSF2.

During construction, the impacts from the emergency egress ladderway would be minimal, as a raise bore method would be used, and all works would occur within the site in a bunded area and underground. Noise impacts from the raise bore would meet all approved noise criteria at all established assessment locations. Air quality impacts would also be minimal due to the raise bore boring from underground to the surface. Dust curtains will be used underground to contain any dust along with water for dust suppression. Once it is constructed and in operation, the ladderway will have no impact either on or offsite.

The proposed modification would result in a range of benefits for on-site efficiency and safety and would allow access to further extractable resources at the site. The proposed modification is considered to be in the public interest as it would enable BHOP to continue to provide social and economic benefits through increased job security for its employees, contractors and suppliers with subsequent benefits to the local and regional economy from the Rasp mine.

Overall, the benefits of the proposed modification outweigh the potential minimal environmental impacts. The proposed modification therefore has merit and warrants granting of approval.

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1 Introduction

1.1 Overview

This Modification Report accompanies a modification request (07_0018 Mod 9) by Broken Hill Operations Pty Limited (BHOP) for the establishment of two development drives and an emergency egress ladderway at the Rasp Mine (Rasp) under Project Approval 07_0018, pursuant to Section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This modification report has been prepared on behalf of BHOP by EMM Consulting Pty Ltd (EMM) in accordance with *State significant development guidelines – preparing a modification report* (Department of Planning Industry and Environment, 2021).

1.2 Rasp Mine

Rasp is an operating zinc and lead mine which is located centrally within the City of Broken Hill, in the far west of New South Wales (NSW). The mine has operated since 1885. Rasp has been owned and operated since 2011 by BHOP, which is a wholly owned subsidiary of CBH Resources.

The mine comprises:

- current and historic underground workings;
- four open-cut pits, with one used to access the underground mine workings (Kintore Pit), one used for tailings deposition (Blackwood Pit), one used for ancillary mining activities (BHP Pit), and one not currently used (Little Kintore Pit);
- a processing plant;
- concentrate rail load out area;
- waste rock and tailings emplacements;
- extensive non-active mining areas (free areas); and
- ancillary mine infrastructure, including a water management system, workshops, offices and other facilities.

Rasp operates under Ministerial project approval 07_0018 which was granted in January 2011. The approval has been modified seven times since it was granted. Mining activities are also regulated under Consolidated Mine Lease 7 (CML7) which covers the whole of the mine site (refer Figures Figure 2.1 and Figure 2.2). The mine produces zinc and lead concentrates which are dispatched via rail to Port Pirie in South Australia (SA) and Newcastle in New South Wales (NSW).

Rasp and its surrounding areas are dominated by mining infrastructure, including historic mining buildings and structures. The area surrounding the site has also been shaped by mining activities and includes a range of infrastructure, commercial and residential developments immediately adjacent to the mine.

1.3 Approved activities

Under project approval 07_0018, BHOP is approved to:

- extract 750,000 tonnes of ore per year until 31 December 2026, and extract no more than 8.45 million tonnes in total;
- process ore at the on-site processing plant;
- transport ore concentrate via rail to Port Pirie in SA and Newcastle in NSW;
- store tailings material generated from the ore processing at Tailing Storage Facility TSF1 and the Blackwood TSF (TSF2);
- backfill underground voids with tailings and waste rock;
- conduct crushing and screening activities in the Kintore Pit or the BHP pit;
- use the stored waste rock material in Kintore Pit or BHP pits to increase the capacity of TSF2 from 4 to 5 million tonnes; and
- use waste rock material with less than 0.5% lead content for road repair, TSF2 embankment construction and bunding within the project area, and for rehabilitation of the site.

Ancillary mining infrastructure is also operated at the site, including crushing and processing plants, a tailings backfill plant, rail siding facilities, as well as administration offices, workshops and a storage warehouse.

1.4 The proponent

The proponent for the proposed modification Mod 9 is BHOP. The relevant address for BHOP is:

Broken Hill Operations Pty Limited

130 Eyre Street

Broken Hill NSW 2880

2 Background

2.1 The site and surrounds

Rasp is located centrally within the City of Broken Hill and is surrounded by transport infrastructure, areas of commercial and industrial development and some residential areas (refer Figure 2.1).

The general area surrounding the mine is comprised of Eyre Street to the south, Holten Drive to the east, Perilya Broken Hill North Mine to the east and South Mine to the west, and the commercial centre of Broken Hill to the north. The Mawsons Concrete and Quarry Pty Ltd is adjacent to the mine on Holten Drive.

Two major State roads are near the mine, South Road (Silver City Highway SH22) to the south-west and Menindee Road (MR66) to the north-east. Directly to the north of the Mine is the Broken Hill Railway Station that is the main Sydney – Perth railway line.

There are several surface exclusion zones within the mining lease (CML7), which contain rail lines and stock yards to the north, Perilya employee housing to the north-east, the former Italo International (Bocce) Club (now Southern Cross Care Broken Hill Ltd) and previous lawns bowling clubs to the south-west (now Silver City Removals) and other commercial and residential properties.

There is an extensive local monitoring network in place at the mine which is used to assess and measure air quality impacts in the local community. The assessment locations are shown in Figure 2.3 and Figure 2.4, while the proximity of the proposed modification to sensitive receptors are described in Section 6.2 Blasting and Section 6.3 Noise.

The site has been mined for over 135 years and contains a number of heritage buildings and structures. The majority of the site has been highly disturbed from mining activities with very little topsoil and native vegetation remaining onsite.

2.2 Current approvals

The Rasp Underground Lead-Zinc-Silver Mine Project (07_0018) was approved on 31 January 2011 for underground mining, the construction and operation of a processing plant to produce lead and zinc concentrates and the rail transport of concentrates via rail to Port Pirie in S and Newcastle in NSW.

The mine is also regulated under mining lease CML 7 and Environment Protection Licence (EPL 12559).

The project approval 07_0018 has since been transitioned to State significant development due to the repeal of Part 3A. The approval has been modified seven times. The modifications made to the approval are summarised in Table 2.1.

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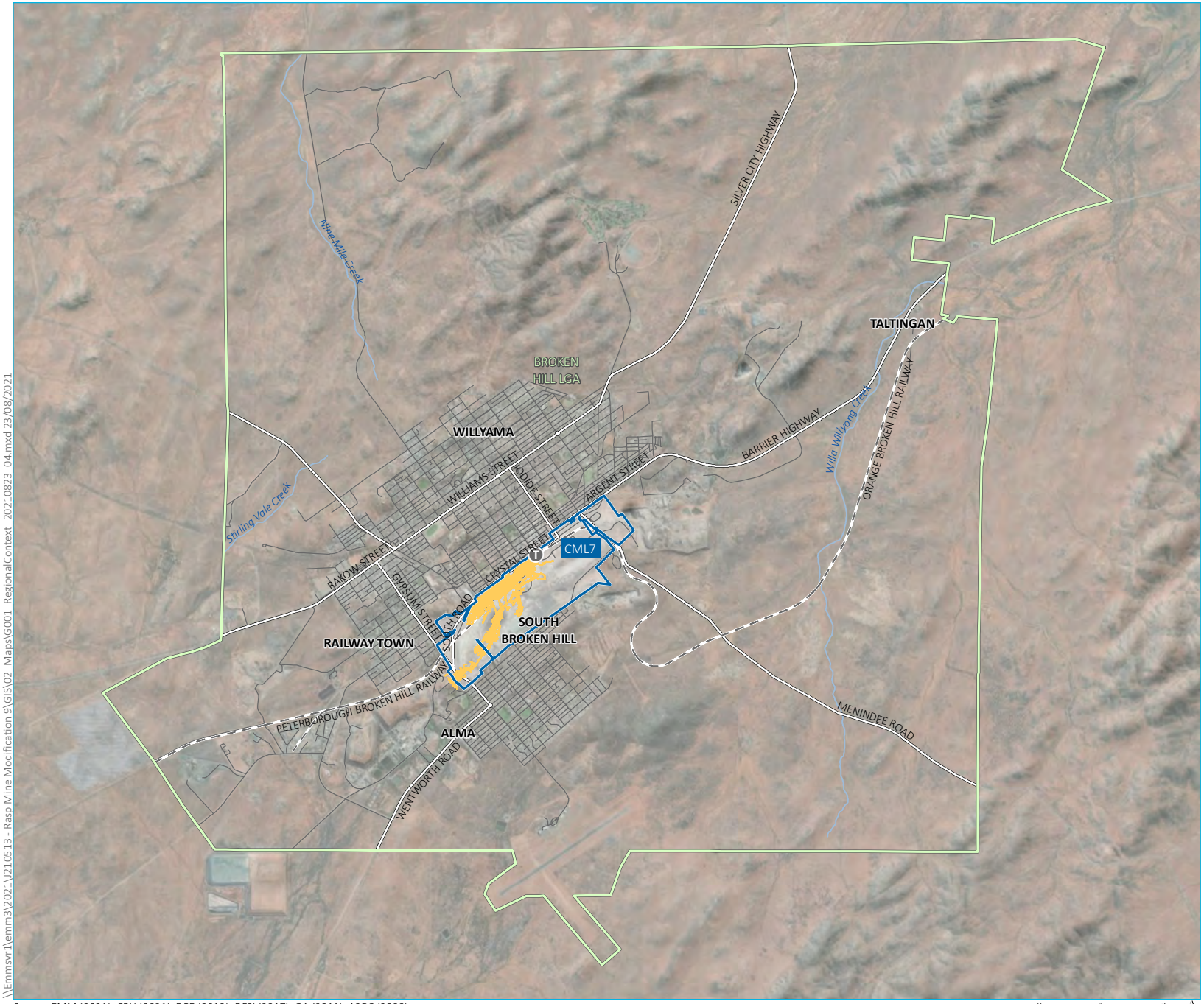
Table 2.1 Summary of previous modifications to PA 07_0018

MOD	Mine life	Mining rate and total production	Mining methods	Waste rock management	Processing rate	Processing methods	Concentrate production	Tailings disposal	Water supply	Employment numbers	Other	Key changes
EA	15 years from 2011 to 2026	750,000 tpa Total production over life of Project: 8,450,000 t	Underground mining using various methods including long hole, benching, modified Avoca, room and pillar or uphole retreat.	Underground: Backfill Surface: Inert material to be used for road repair and bunding and rehabilitation at closure. Permitted storage in Kintore Pit and BHP Pit.	250 tph crushing plant 93.8 tph grinding plant	Crushing, grinding , flotation, thickening and filtration at on-site processing facilities.	Lead: 44,000 tpa (concentrate 73% Pb and 985 g/t Ag) Zinc: 87,000 tpa (concentrate 50% Zn)	Fine tailings disposal (approximately 320,000 tpa):- – TSF1 (10 m raise), and – TSF2 Blackwood Pit Coarse tailings disposal (approximately 320,000 tpa) as underground stope back fill.	Potable 9 ML/a Raw 139 ML/a Reclaimed /Recycled 300 ML/a Extraction up to 370 ML/a	143		
PPR	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	Relocation of processing plant with concentrate trucked to new Rail Loadout, Removed secondary and tertiary crushers and screens from the crushing circuit.	No change to overall air quality as decrease in crushing is off-set by increase in trucking (of concentrate). However less receptors impacted as new location is further away from residents.
MOD1	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	Relocation of ventilation shaft and installation of ventilation fans U/G.	Some increase in NOX exposure as new location closure to residents
MOD2	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	Allow crusher to be operated at any time (24 hours per day 7 days per week).	Increase to night noise however all criteria met.
MOD3	No change Replacement tonnes.	No change Replacement tonnes	No change	No change	No change	No change	No change	No change	No change	No change	Extension of underground mining to include Block 7 (also included the Zinc Lodes).	Increase in vibration to residents. Increase in noise from intake vent shaft
MOD4	No Change	No change	No change	Material <0.5% lead would be used in TSF2 embankment construction	No change	No change	No change	No change	No change	195 (updated 2 additional related to MOD4)	Cement silo, Concrete Batching Plant	Increase in noise to some residents. Visual amenity impacted. Minor increase to air quality however no HHRA required as impact not material.
MOD5	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	Cement silo, and warehouse extension	No future impacts.
MOD7	No change	No change	No change	Material <0.5% lead would be used in TSF2 embankment construction	No change	No change	No change	No change	No change	No change	Mobile crushing in BHP Pit for embankment construction	Increase in air emissions offset by decrease in distance for trucking material.
MOD8	No change	No change Tonnes swap with Perilya	No change.	No change	No change	No change	No change	No change	No change	No change	U/G mining extension (20x250m) across Perilya Lease ML1249.	No future impacts.



KEY

- Existing underground workings
- Mining lease
- Train station
- Rail line
- Major road
- Minor road
- Named watercourse
- Local government area

INSET KEY

- Major road
- NPWS reserve
- State forest

Source: EMM (2021); CBH (2021); DPE (2019); DFSI (2017); GA (2011); ASGC (2006)

0 1 2 km

GDA 1994 MGA Zone 54

N

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Regional context

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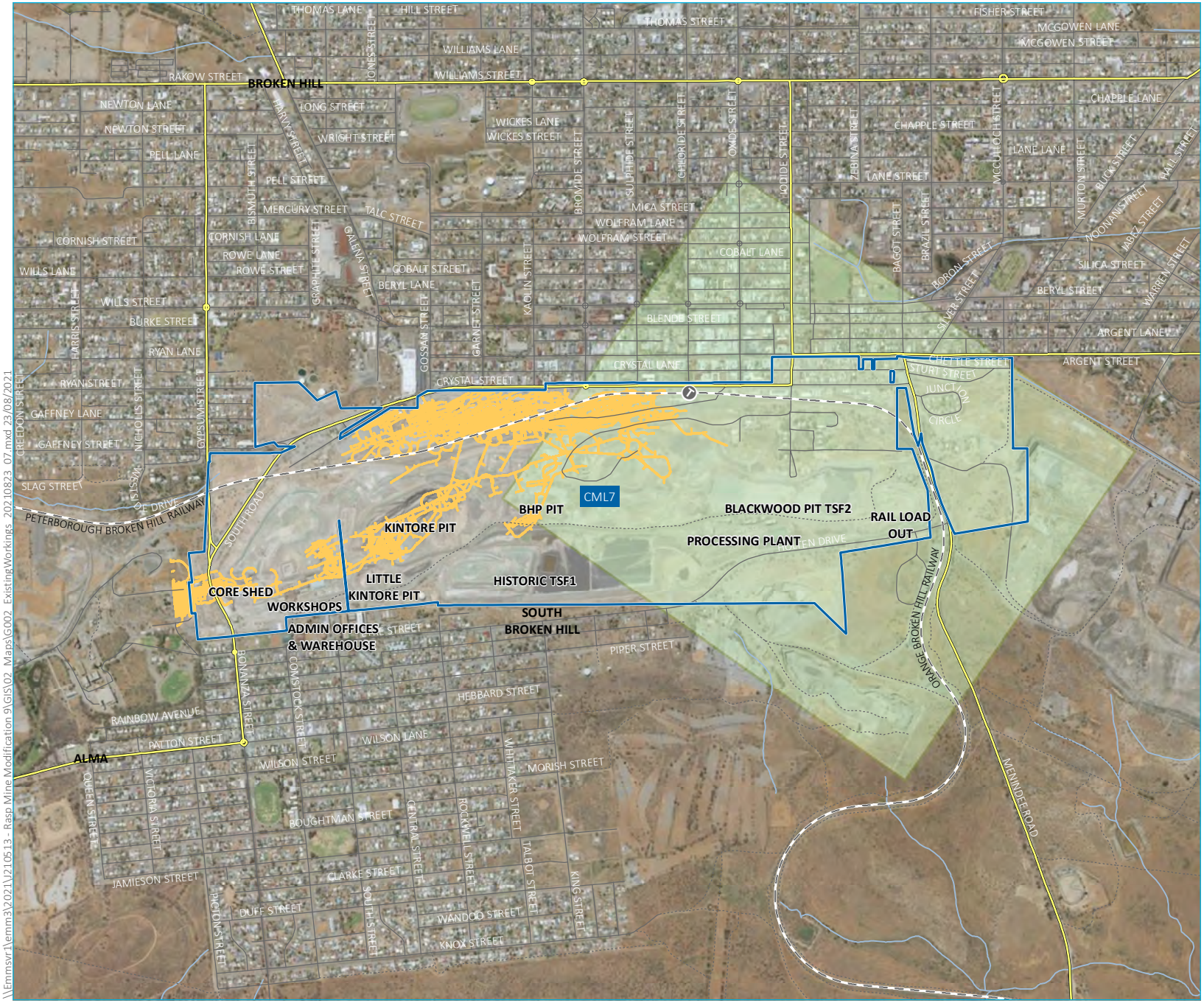
Figure 2.1

EMM creating opportunities



Source: EMM (2021); CBH (2021); DPE (2019); DFSI (2017)

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Existing operations

Rasp Mine Modification 9
Modification report
Figure 2.2

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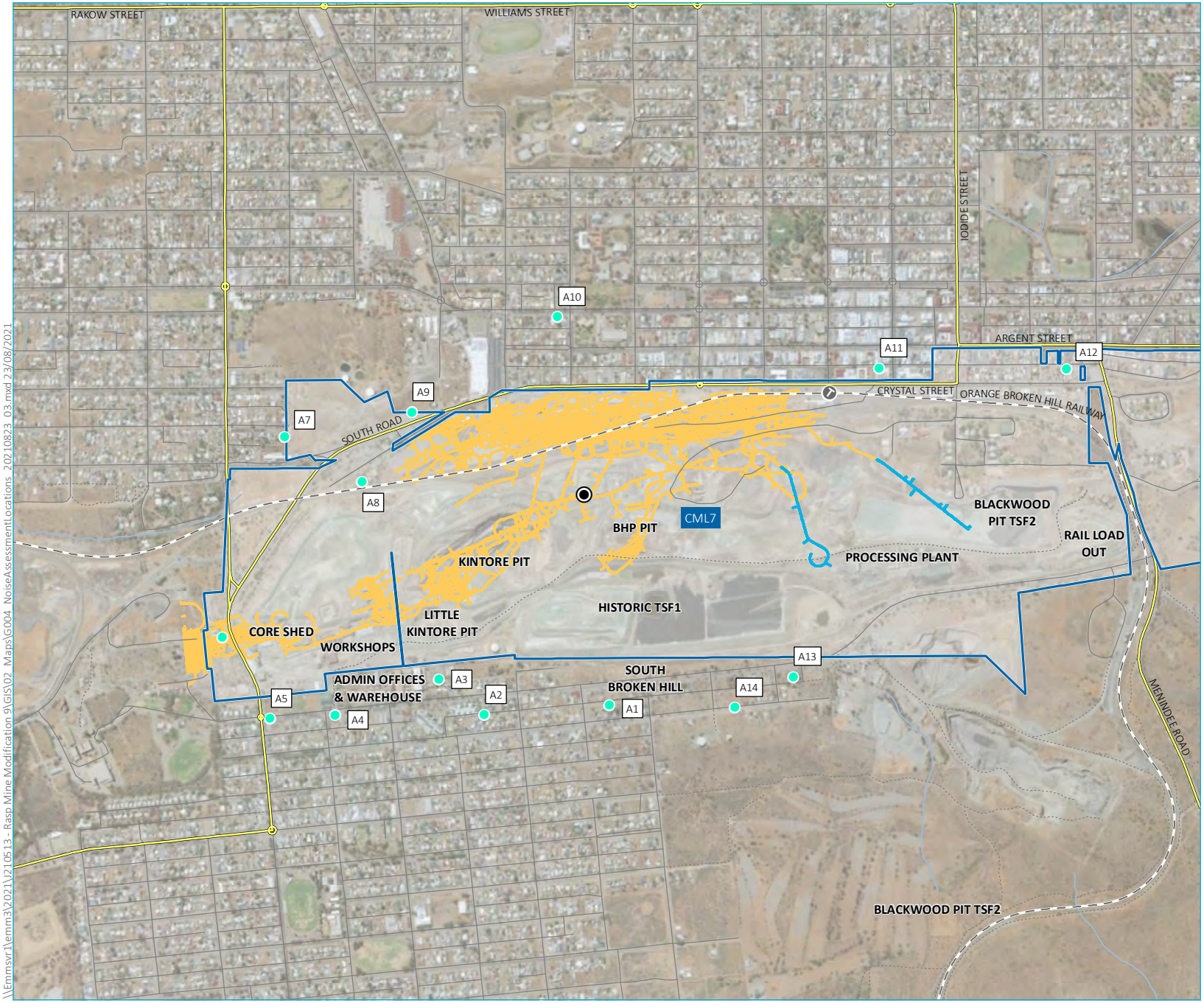

KEY

- Noise assessment location
- Proposed ladder way surface exit
- Proposed development workings
- Existing underground workings
- Mining lease
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line

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Source: EMM (2021); CBH (2021); DPE (2019); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 54

Noise assessment locations

Rasp Mine Modification 9
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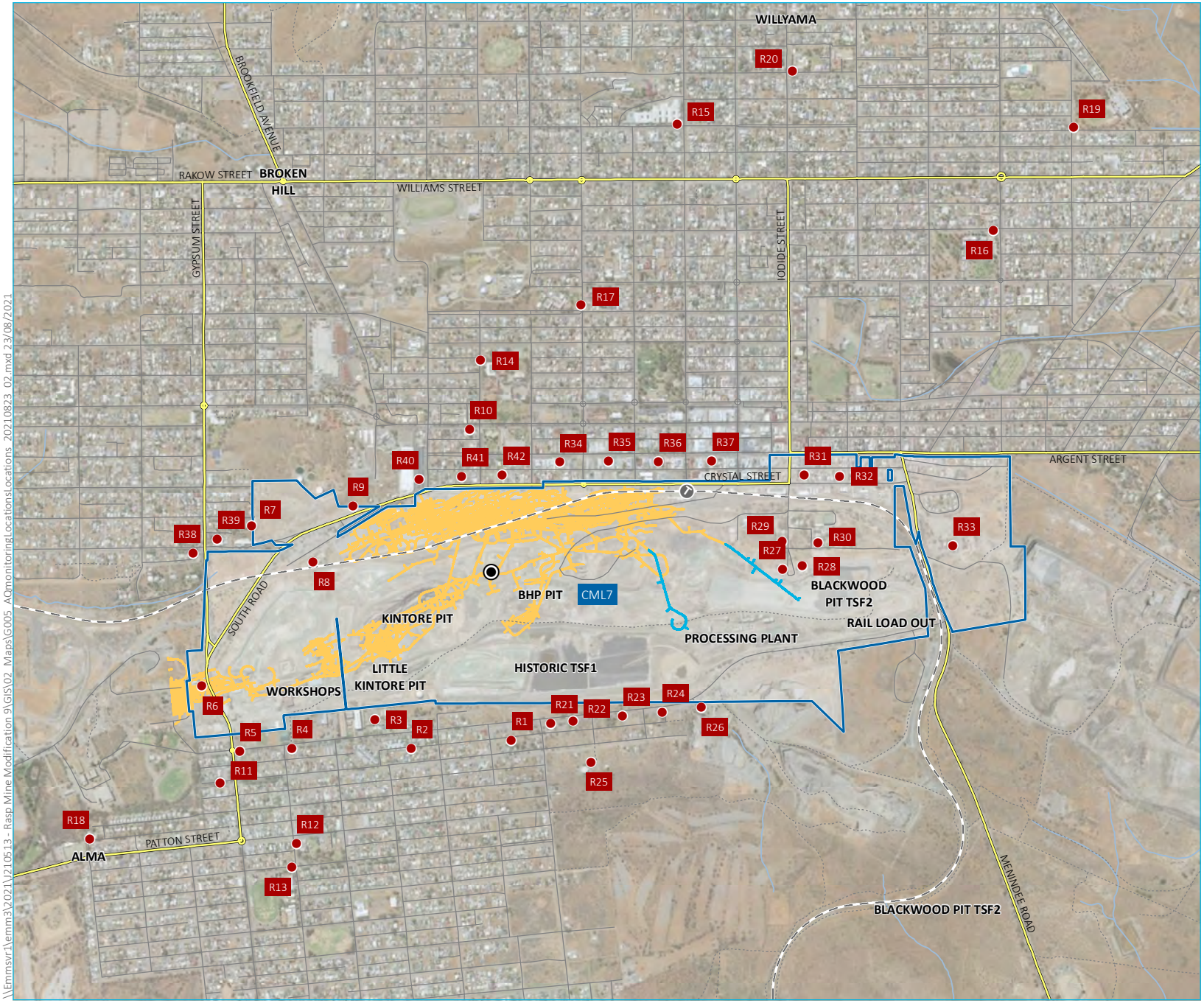
Figure 2.3

EMM creating opportunities



KEY

- Air quality monitoring location
- Proposed ladder way surface exit
- Proposed development workings
- Existing underground workings
- Mining lease
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line

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Source: EMM (2021); CBH (2021); DPE (2019); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 54

Air quality monitoring locations

Rasp Mine Modification 9
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Figure 2.4

EMM creating opportunities

3 Proposed modification

3.1 Overview

BHOP is proposing Mod 9 for the establishment of development drives to facilitate access to future underground resources at the Rasp Mine.

BHOP is also proposing to augment safety systems at the site by installing a new emergency egress ladder for mine workers from existing mine workings.

Mod 9 compared to the current approved activities in 07 0018 is outlined in Figure 3.1.

Table 3.1 Comparison of approved activities under 07_0018 and Mod 9

Aspect	Approved under 07_0018 (as modified)	Proposed modification Mod 9
Mine life	Approved until 31 December 2026	No change
Mining Rate and Total Production	750 000 tpa ore. Total production over life of Project is approximately 8,450,000 t	No change
Mining methods	Underground mining using various methods including long hole, benching, modified Avoca, room and pillar or uphole retreat.	No change
Waste rock management	Waste rock is handled underground and at the surface. All waste rock is tested for its lead content. Waste rock which has a lead content above 0.5% is retained underground and stockpiled for use for backfilling stopes and voids. Waste rock which has a lead content below 0.5% is brought to the surface and is approved for use for TSF2 embankment construction and to be stored in BHP Pit	No change
Processing methods	Ore is processed using crushing, milling and flotation processes in a dedicated processing plant on site	No change
Concentrate production	Lead: 44,000 tpa (concentrate 73% Pb and 985 g/t Ag) Zinc: 87,000 tpa (concentrate 50% Zn)	No change
Concentrate transport	Concentrate is transported in covered containers to the site rail siding and transported in covered wagons.	No change
Tailings disposal	Course stream returned to mine void (via Backfill Plant) and finer stream to be directed to TSF1 (capacity of 960,000 t) and/or TSF2 (capacity 3.12 Mt)	No change
Water supply	Potable / treated water 9 ML/annum, Raw untreated water 139 ML/a, Reclaimed / recycled water 300 ML/a Extraction up to 390 ML/a.	No change
Employment	The mine employs 186 employees and 35 permanent contractors at full production	No change to production workforce. A small contract drilling crew would be employed for the duration of the raise bore works

Table 3.1 Comparison of approved activities under 07_0018 and Mod 9

Aspect	Approved under 07_0018 (as modified)	Proposed modification Mod 9
Tenement status	CML7 – Incorporates the Rasp Mine. Western Lands Leases 2368 and 2369 – within original Project Area and held by BHOP, permitted use is for "Storage Purposes".	No change
Mining area	Underground mining area is covered by CML7 (refer Figure 1.1) Within Western and Centenary Mineralisation and Main Lodes Blocks 7 to 12.	No change to the extent of CML7. An extension of the permitted Main Lode (ML) mining area beyond ML Block 12 to include blocks ML 13, ML 14 and ML 15, to conduct exploration drilling of identified mineralised areas (refer Figure 3.1)
Operation of ancillary mining infrastructure	Other associated facilities such as Ventilation systems, egress winder, backfill plant, concrete batching plant, rail loadout, warehouse, core preparation and storage and workshops.	Emergency egress ladderway to be installed near the egress winder (refer Figures 3.1 and 3.2)
Hours of operation	Underground Operations: 7 days per week, 24 hours per day Shunting 7 days per week, 7am to 6pm (not conducted). Construction hours 7am to 6pm Mon-Fri and 8am to 1pm Sat, no construction work on Sundays or Public holidays. Activities not listed above – 7 days per week, 24 hours per day	No change to operational hours Raise bore construction hours of operation required 24 hours a day, 7 days a week for 50 days

3.2 Modification description

BHOP is seeking to extend its permitted Main Lode mining area by developing drives to conduct exploration drilling of identified potential mineralised areas and to link in with future works proposed in Modification 6 (establishing a new boxcut and mine portal entry). This will be conducted in the Main Lode (ML) blocks ML 13, ML 14 and ML 15.

The proposed modification also seeks to change the way emergency egress from the mine is managed with the installation of a 1.1 m wide emergency egress ladderway from the workings to the surface, formed using a raise bore.

3.2.1 Modification components

The proposed modification would be undertaken on land previously disturbed by historic mining operations and are substantially the same as the project under the approval originally granted. Any proposed changes will not affect any existing surface structures and landforms. The proposed modification components are shown in Figure 3.1.

i Development workings

The proposed development workings are required to access further potential extractable resources and to link in with future works including a new boxcut and mine portal entry which will be proposed under future Modification 6. The development workings will be conducted in the ML 13 to ML 15 blocks (refer inset A and inset B in Figure 3.1). The development workings would comprise of approximately 5.0 m x 5.8 m tunnel/drive which would be supported in accordance with the site's current ground support installation standard (BHO-STD-MIN-003).

The proposed development in ML 13 to ML 15 would be a continuation of existing approved underground development workings. The development activities would be conducted using conventional hard rock mining methods of drill and blasting techniques. These methods are the same well established drill and blast methods currently in use at the mine.

The development blasts would occur approximately 200 m below the natural ground surface. The development blasts result in minimal blast induced vibration by their nature. These development blasts have been modelled, and analysis (by an independent third party) has demonstrated that the blasting induced vibration resulting from the proposed development activities in ML 13 to ML 15 with have minimal impact to on or off site infrastructure and residents (refer Appendix B).

All waste rock generated by the development workings above 0.5% lead would be retained underground and stockpiled for use for backfilling stopes and voids in the future. Waste rock less than 0.5% lead may be used on the surface for already approved purposes and under existing approvals.

Part of the ML 14 block development would pass beneath the TSF2, which is a 'declared dam' under the *Dams Safety Act 2015.* It is noted that BHOP currently has an approval for mining within the notification area of the dam which was received from Dam Safety NSW (formerly Dams Safety Committee) in 2019. Development activities will be carried out in consultation with Dam Safety NSW, and any additional requirements Dams Safety NSW may have in relation to undertaking this activity beneath the dam will be considered.

ii Emergency egress ladderway

BHOP proposes to install an emergency egress ladderway from Stockpile 1 (SP1) underground to the surface.

The new egress ladderway would replace the current emergency egress winder/shaft. This new ladderway will ensure that BHOP meets the requirements outlined in the Work, Health and Safety (Mines and Petroleum sites) Regulations 2014 (section 96 Emergency Exits), BHOP as '*the mine operator of an underground mine must ensure that all parts of the mine have at least 2 exists to the surface..'* of any underground mine.

The proposed surface egress ladderway would be located in the western centre of CML 7 near the existing main vent shaft and current egress winder (refer to inset C in Figure 3.1). From this location it is approximately 150 m from underground stockpile SP1 to the surface and it is in an unmined/undisturbed area where there are no historic workings. The egress ladderway would surface within a bunded area which is not visible from outside the site.

The egress ladderway would be constructed by excavating a small diameter near vertical raised bore shaft and the subsequent installation of a fully enclosed 1.1m diameter ladderway.

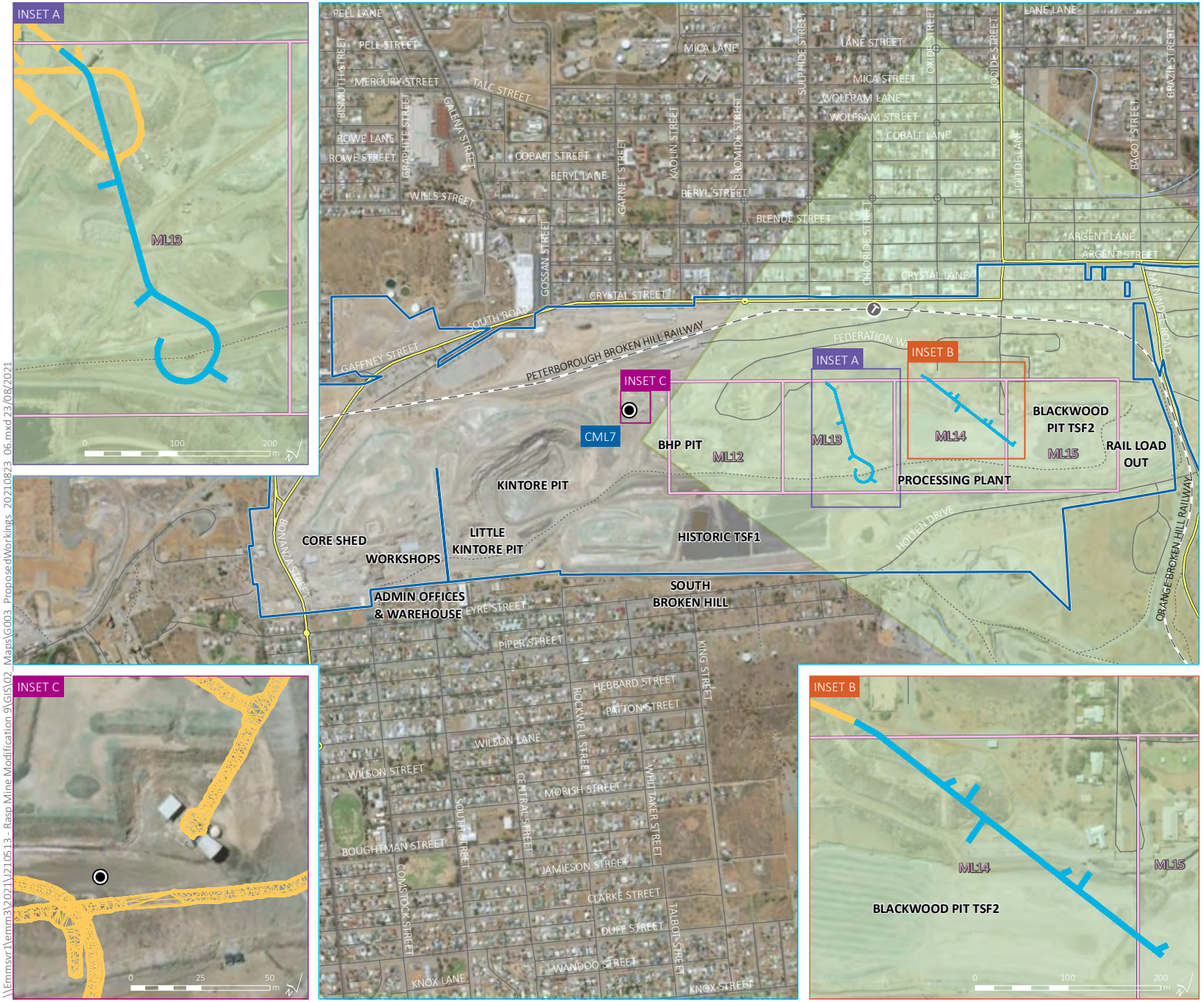
The small diameter excavation will be excavated using conventional raise boring technique utilising a dedicated raiseboring rig. This non entry mining method is commonly used in the construction of vertical development in underground mines.

Once the vertical shaft has been excavated, the fully-enclosed Safescape ladderway would be installed. The Safescape ladderway is a modular system that is made from durable polyethylene product, which is not be impacted by water, salt or other mineral deposits.

The proposed ladderway would be approximately 150 m in length and would have opening/closing platforms every 6 m. The exit of the ladder way at the surface would be housed in a secured and well ventilated surface infrastructure facility (likely to be a 20ft shipping container).

Once the ladderway has been installed there will be no impacts on or off site as the infrastructure is static and inert in nature. BHOP has installed more than 20 similar egress ladderways (totaling approximately 750 m in length) in the current operating mine.

BHOP would submit a High Risk Activity (HRA) notification to the Resources Regulator for establishing a new mine entry prior to the installation of the ladderway.



KEY

- Proposed ladder way surface exit
- Proposed development workings
- Dam notification area
- Mining lease
- ML block
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line

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Source: EMM (2021); CBH (2021); DPE (2019); DFSI (2017)

Proposed activities

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Figure 3.1

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Figure 3.2 **Location of emergency egress ladderway in relation to the current egress winder**

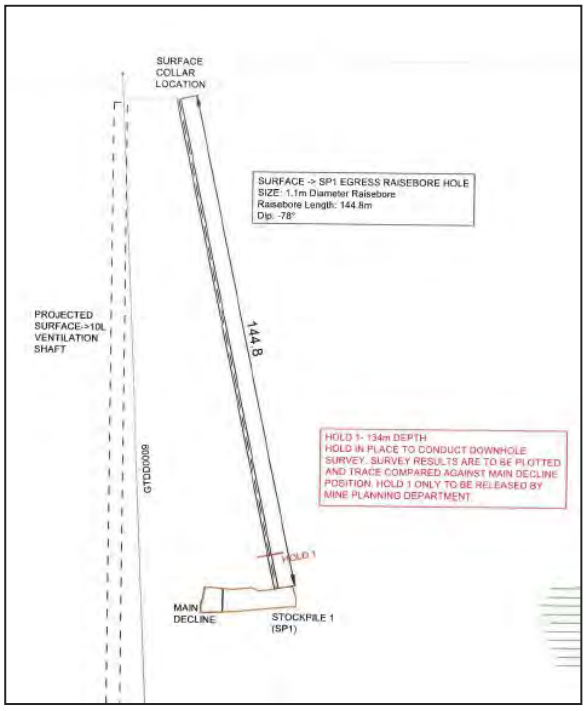


Figure 3.3 **Proposed emergency egress ladderway works**

3.2.2 Hours of operation

The proposed development workings would be undertaken wholly underground and as they are not anticipated to result in any impacts at the surface, the workings would be carried out 24 hours a day.

The excavation of the vertical shaft using the raiseboring technique required for the installation of the egress ladderway would also be undertaken on a continuous 24 hours period, given the continual nature of the drilling that is required. The duration of this activity is relative short duration (1-2 months) with all the works being conducted in either a shielded location (~8m bunds) on the surface, or underground.

As a result, the proposed development workings and construction of the egress ladderway would result in negligible additional amenity impacts (ie noise and air quality) at the closest residential receivers, which are approximately 390 m away from the raise bore site.

3.2.3 Workforce

The proposed development workings would use existing personnel at the site with no additional workforce required to be employed, while the raised bore drilling and ladderway installation crews would be contractors, supervised by BHOP staff.

3.2.4 Schedule of works

Development works would commence as soon as possible following approval and would be ongoing (ie there would be no specific construction completion timeframe).

The raisebore and ladderway installation works are expected to take approximately 1-2 months to complete in total and would be also commence as soon as possible following approval of Mod 9.

3.2.5 Waste management

All waste rock generated by the development workings which has a lead content above 0.5% would be retained underground and stockpiled for use for backfilling stopes and voids in the future. Waste rock less with a lead content less than 0.5% may be used on the surface for approved uses and within limits allowed under existing approvals (ie 07_0018 and EPL 12559).

4 Statutory context

4.1 Introduction

4.2 Commonwealth legislation

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of Agriculture, Water and Environment (DAWE). It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places If significant impacts are considered likely to 'matters of national environmental significance' (MNES) the application is required to be submitted to DAWE for assessment.

The project site is an active mine site and has been generally cleared of vegetation. The proposed modification would not result in further clearing. There are also no non- Aboriginal cultural heritage sites within the site.

The proposed modification is therefore considered not have a significant impact on any MNES listed under the EPBC Act and consequently the application has not been referred to DAWE.

4.3 NSW legislation

4.3.1 NSW Environmental Planning and Assessment Act 1979

i Section 4.55(1A) modification

The proposed modification is a modification to a State significant development consent, and the modification process described under Section 4.55 of the *Environmental Planning and Assessment Act 1979* applies to the application.

The Department of Planning, Industry and Environment (DPIE) confirmed on 29 June 2021 that the appropriate approval pathway is Section 4.55(1A) of the EP&A Act (ie minimal environmental impact).

> (1A) **Modifications involving minimal environmental impact**
>
> A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if—
>
> (a) it is satisfied that the proposed modification is of minimal environmental impact, and
>
> (b) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified (if at all), and
>
> (c) it has notified the application in accordance with—
>
> (i) the regulations, if the regulations so require, or
>
> (ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a development consent, and
>
> (d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be.

BHOP considers that the application can be characterised as a modification involving minimal environmental impact, as the proposal:

- would not increase the environmental impacts of the project as approved;
- is substantially the same development as approved prior to its transition from Part3A to SSD; and
- would not change the lateral extent of the approved mining areas, which would remain wholly within CML7; and
- would not change the approved mining, ore processing and ore concentrate transport methods.

4.3.2 Approval authority

The Minister for Planning and Public Spaces (or delegate) is the approval authority for the proposed modification.

4.3.3 NSW Environmental Planning and Assessment Regulation 2000

Clause 115 of the EP&A Regulation states the required information that must accompany a modification application under Section 4.55(1A) of the EP&A Act. Table 4.4.1 shows where the required information is addressed in this document.

Table 4.4.1 EP&A Regulation Clause 115 information requirements

Clause 115 information requirement	Where addressed
(a) the name and address of applicant	Section 1.2 of this report.
(b) a description of the development to be carried out under the consent (as previously modified)	Section 3 of this report.
(c) the address, and formal particulars of title, of the land on which the development is to be carried out,	Section 1.4 of this report.
(d) a description of the proposed modification to the development consent,	Section 3 of this report.
(e) a statement that indicates either: i. that the modification is merely intended to correct a minor error, misdescription or miscalculation, or ii. that the modification is intended to have some other effect, as specified in the statement,	Section 4.3.1 of this report.
(f) a description of the expected impacts of the modification,	Chapter 6 of this report.
(g) an undertaking to the effect that the development (as to be modified) would remain substantially the same as the development that was originally approved,	Section 4.3.1 of this report.
(g1) in the case of an application that is accompanied by a biodiversity development assessment report, the reasonable steps taken to obtain the like-for-like biodiversity credits required to be retired under the report to offset the residual impacts on biodiversity values if different biodiversity credits are proposed to be used as offsets in accordance with the variation rules under the *Biodiversity Conservation Act 2016*,	Not applicable, as there would be no increase in impacts to biodiversity values (refer Section 6.4).

Table 4.4.1 EP&A Regulation Clause 115 information requirements

Clause 115 information requirement		Where addressed
(h)	if the applicant is not the owner of the land, a statement signed by the owner of the land to the effect that the owner consents to the making of the application (except where the application for the consent the subject of the modification was made, or could have been made, without the consent of the owner),	Not applicable, as the project is 'public notification development' and the original application was made, or could have been made, without the consent of the owner.
(i)	a statement as to whether the application is being made to the Court (under Section 4.55) or to the consent authority (under Section 4.56)	Not applicable, as the modification application is not being made to the NSW Land and Environment Court.
	and, if the consent authority so requires, must be in the form approved by that authority.	Not applicable.

4.3.4 NSW Protection of the Environment Operations Act 1997

The mine is classified as a 'premises-based scheduled activity' under the *Protection of the Environment Operations Act 1997* (POEO Act) and is therefore required to operate under an EPL.

Licensed activities are detailed in the EPL 12559 which include the processing, handling, movement and storage of materials. These activities are inclusive of the activities related to the proposed modification. The environmental impacts of the proposed modification are predicted to be within the thresholds of the original project. As such, the EPL is not required to be varied as a result of Mod 9.

4.3.5 Dams Safety Act 2015

The Blackwoods TSF is a 'declared dam' under the *Dams Safety Act 2015* (DS Act). The DS Act includes requirements for consent authorities to consult with Dams Safety NSW before granting development consent for the carrying out of any mining operations under the *Mining Act 1992* in the notification area of the dam (refer Section 6.2).

Despite that the proposed modification involves minor works to create development drives which are not strictly mining but are considered to be mining activities, as the works are located within the notification area of the dam, BHOP has nevertheless considered the proposal in accordance with *Guideline Mining near declared dams* (Dams Safety NSW, 2020).

BHOP has undertaken the necessary risk assessments for the works in accordance with the guideline (refer Section 6.2) and notified the Dams Safety Committee of the proposed activities to be undertaken within the notification area on 6 August 2021. Any comments BHOP receives from Dams Safety NSW will be taken into consideration in managing any potential impacts to TSF2.

4.4 Environmental planning instruments and policies

4.4.1 State Environmental Planning Policies

i State Environment Protection Policy (Mining, Petroleum Production and Extractive Industries)

The State Environment Protection Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW.

Part 3, Clauses 12 to 17 of the Mining SEPP require consideration to be given to the significance of the resource, the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

The information presented in this modification report addresses each of the matters for consideration prescribed in the abovementioned clauses, as applicable.

Clauses 12 and 14 of the Mining SEPP requires the consent authority to consider the compatibility of the Project with other nearby land uses and impacts on significant water resources, threatened species and greenhouse emissions. Existing and approved land uses in the vicinity of the proposed modification consist of:

- Delprats Shaft historic workings; and
- current mining infrastructure and operations of BHOP.

The proposed modification would not change these existing uses and would operate without impacting these users beyond the impacts currently approved. The Café and Line of Lode lookout and Miners Memorial are also located on CML7 beyond Delprats Shaft and would not be impacted by the proposed modification.

There would be no additional water usage requirements in addition to that already assessed and approved for the site.

4.4.2 Broken Hill Local Environmental Plan 2013

The majority of the mine, including the area proposed for Mod 9 activities, is within Special Purpose Zone 1 (SP1) Special Activities – Mining [BHCC Local Environment Plan (LEP), 2013]. Therefore under the Broken Hill Local Environmental Plan 2013 the site is zoned for mining purposes and mining is permissible with consent.

4.4.3 Broken Hill Development Control Plan No 11 Management of Lead Contamination

Development Control Plan (DCP) 11 provides guidelines for the management of issues relating to lead contamination. Lead contamination is closely controlled under the approved management plans for the site. The activities would be mostly undertaken beneath the surface. Any minor surface preparation works required for the egress ladderway will be within in a bunded area and closely controlled and monitored so that the currently approved levels of lead contamination would not change.

5 Stakeholder consultation

5.1 NSW Department of Planning, Industry and Environment

BHOP held an online meeting and presentation on proposed Mod 9 works with DPIE on 21 May 2021. During the meeting, information on the minor nature of the proposal was presented and the approval pathway was also discussed (ie Section 4.55(1A) of the EP&A Act).

Following the online meeting, BHOP wrote to DPIE on 15 June 2021 asking for confirmation that the appropriate approval pathway is Section 4.55(1A). The letter also included details of the emergency egress ladderway, which had not been discussed in the online meeting.

On 29 June 2021, DPIE wrote to BHOP, confirming that the approval pathway is Section 4.55(1A) of the EP&A Act, with the scope of Mod 9 to include:

- extend underground exploration and development in the Main Lode Blocks 13 to 15 areas, located within the project's CML7 Mining Lease; and
- install an emergency egress ladder way from the project's Stockpile 1 (SP1) underground to the surface.

5.1.1 Department of Regional NSW – Resources Regulator

BHOP held an online meeting on 27 July 2021 jointly with Resources Regulator – Mine Safety and Department of Regional NSW – Mineral Exploration Group. A further meeting was held with the Resources Regulator Environment Team on 4 August 2021.

The proposed modification was discussed in detail at the meetings. No significant safety of operational issues were raised. Resources Regulator asked about the proposed ventilation system within the egress ladderway and within housing/container at the surface. BHOP confirmed that appropriate ventilation would be provided within the ladderway and the container at the surface.

5.1.2 Department of Regional NSW – Mineral Exploration Group

Department of Regional NSW – Mineral Exploration Group (MEG) was represented at the meeting on 21 July 2021.

MEG asked about how the exit through the surface housing would be managed. BHOP confirmed that the container would be able to be opened from outside by the Emergency Services Officer and also from inside the surface housing.

5.1.3 Dams Safety NSW

BHOP held an online meeting with Dams Safety NSW on 23 July 2021. The proposed modification was discussed at the meeting. Dams Safety NSW did not raise any concerns or issues during the meeting. As agreed during the meeting BHOP has written to Dams Safety NSW outlining the proposed activities.

5.1.4 Environment Protection Authority

BHOP held an online meeting with Environment Protection Authority (EPA).The proposed modification was discussed at the meeting. EPA did not raise any concerns or issues during the meeting. EPA and BHOP discussed the potential for complaints from different areas of the community due to the shift in development mining activities, however as the proposed development would be wholly underground, development blasting would be likely to be well within existing EPL limits.

5.1.5 Broken Hill City Council

BHOP met with Broken Hill City Council on 26 July 2021 on site. The proposed modification components were discussed and BHOP staff provided Council officers with a site tour. No issues or concerns were raised by Council officers during the meeting and site tour.

6 Impact assessment

6.1 Geotechnical stability

6.1.1 Development

A geotechnical review of the proposed development workings (referred to as the Blackwoods access development) has been undertaken for the proposed modification (BHOP 2021) – see Appendix A.

The Blackwoods access development would partially traverse below the former Blackwoods Open Cut, which is now used as a tailings storage facility (known as TSF2) with development workings designed to be approximately 160 m below the base of TSF2, 235 m below the ground surface and 70 m below historic workings.

The geotechnical review considered two potential hazards that require management and mitigation. These are the potential liquefaction of TSF2 tailings caused by blasting vibrations with increased risk of leading to failure of the rock between TSF and old workings or damage to the tailings dams and spillway initiated by development blasting.

The geotechnical review concluded that the size of the intervening 160 m pillar is sufficient to be stable and not result in a connection between the proposed development workings and TSF2.

The geotechnical review concluded that the size of the intervening 70 m pillar is sufficient to be stable and not result in a connection between the proposed development workings, any intervening historic development workings and TSF2.

The risk due to blast vibrations is considered in section 6.2 Blasting.

The Block 13 development (also referred to as the 7L NTH EXD development access) has been designed to be below any old or historical workings and an adequately sized pillar (as determined by the Geotechnical Engineer) will be left between the Block 13 development and historical workings. Development works will be managed through the mine instruction process which includes assessment of ground conditions by a range of skilled personnel including Geotechnical Engineer, Geologist and Mining Engineers.

Geotechnical probe drilling and monitoring would be undertaken in accordance with the current site management plan, procedures and protocols established for development drives, which includes detailed controls and responses that would be implemented in the unlikely event that stability issues result from any of the proposed development workings.

6.1.2 Inrush risk

There are strict existing procedures in place at the mine to manage the risks of inrush from TSF2 and the historic underground workings. The geotechnical review concluded it is unlikely that the proposed Blackwoods development workings would result in any connectivity from the drives to TSF2 or historical workings due to the large pillar in place. Potential risks posed by blast vibrations are covered in Section 6.2 Blasting.

There is the potential for the old workings in the area of the Block 13 development to be connected to the Blackwoods pit and filled with water. The design of this development would be a suitable distance from the historic workings as determined by the Geotechnical Engineer and mine planning process.

Current controls that are observed are that no existing workings intersect the potentially water filled workings, and monitoring of the mine pumping system water balance as detailed in the Inrush and Inundation Principal Hazard Management Plan. It is therefore necessary that stable pillars be maintained with old workings in the area.

These cannot be specified with current information, however will be reviewed as the area is accessed and more information becomes available on the rockmass in the area through diamond drilling and probe drilling as per existing remnant mining and development procedures.

Notwithstanding, there is a detailed Inrush or Inundation Principal Hazard Management Plan in place at Rasp, with Inrush Control Zones (ICZs) required if a risk of inrush and inundation is identified. ICZs are areas with additional controls in place to minimise the risk of inundation and must extend a minimum of 50 m from the potential inrush source.

ICZs are a prescribed control in Division 5, Subdivision 1, Part 45 Inrush Hazards, in the WHS (Mines and Petroleum sites) Regulations 2014. Rasp Mine uses ICZs to limit inrush risks and makes provision for extending at least 50 m from the location of an inrush hazard where the location is known, or extended by a greater distance, as determined by a risk assessment.

The following controls are observed with regards to inrush control zones:

- ICZs are used to restrict activities in areas with an inrush or inundation risk.
- ICZ areas are demarcated with signage to prevent unauthorised access.
- Any work required to be performed an in ICZs must be risk assessed prior to that work commencing.

These control procedures will continue to be strictly observed during the development of the drives proposed under the modification.

In addition, there is a surface drainage system at the site which diverts rainfall and significant flow events away from active mining and operational areas. This includes a well-established surface topographical layout that drains rainfall into flow channels that subsequently direct runoff into settlement ponds that are located away from active mine workings or to where there is a low risk of inrush or inundation that would continue to be implemented for the modification.

The site drainage system is regularly checked and maintained, and this includes inspection both before and after extreme weather events. A pumping system is also operated and maintained as per the maintenance management system to ensure redundancy and capacity to manage the risk of inrush from a 1 in 100 year extreme weather event.

6.1.3 Egress ladderway

A geotechnical assessment of the egress ladderway was undertaken (BHOP 2021 – refer Appendix A). It is not anticipated that the raisebore would result in any geotechnical stability impacts, given the minor nature of the works and the controlled manner in which the works would be undertaken.

However the geotechnical analysis of the proposed ladderway location suggests there is a possibility of poor ground in the upper 30m of the raisebore hole which may require some form of support.

The rockmass assessment for the proposed ladderway is based on two diamond drill holes located 50 m to the northwest of the ladderway location which were put in place to assess the rockmass for the Exhaust Shaft. To confirm the competency of the upper section of the raisebore hole a camera survey could be undertaken to confirm if support is needed in the raise. If more information is required before the commencement of drilling a diamond drill hole would be put in place closer to the area of the proposed ladderway or remote logging could be undertaken of the pilot hole.

Pilot hole deviation is a risk in the weathered zone and issues may be encountered while drilling through the areas of poor ground and the recorded face wedge if the raisebore head is lowered from the face. However the majority of the ladderway length will be within competent ground and due to the small hole diameter no support should be required, apart from the top of the raise, which will be within weathered ground where shallow dipping structures may be intersected. Therefore support in the form of shotcrete lining could be required.

Notwithstanding, an assessment of the ground conditions when possible will be made by the Geotechnical Engineer to determine if shaft lining or additional support in that area is required.

As currently happens with other installed ladderways at the site, the proposed egress ladderway will be regularly inspected and monitored to ensure its integrity and operational readiness.

6.2 Blasting

A blast and vibration impact assessment and an addendum impact assessment has been undertaken for the proposed access development by Prism Mining (see Appendix B).

Blasting for the development workings would use much smaller charge than stope blasting and therefore impacts from development blasting are considered to be no greater than negligible and represent a low risk to sensitive receivers. All development blasts would be manageable within existing blast limits for the mine site. The development blasting would be carried out using methods already in use at the mine, comprising 45mm diameter blastholes, an approximate charge mass of 5kg to 6kg per hole, and long period delay detonators.

Dams Safety NSW has imposed a peak particle vibration (PPV) limit of 30mm/s (peak vector) at the TSF2 embankment structures. Golder Associates (2019) suggests a PPV target of 15mm/s for stope blasting for the embankments foundations that may be vibration sensitive, including some of the TSF2 embankments which are partially founded on desiccated tailings. All three recently constructed embankment structures have dedicated blast vibration monitors that will be used to specifically monitor any ground vibration impacts at TSF2 from the proposed development workings. An additional monitor is located on the Line of Lode lookout and Miners Memorial to provide vibration data.

The initial assessment modelled the ground vibration limits at a range of sensitive receivers (refer Figure 1 in Appendix B1), including seven locations at TSF2, two nearby representative residential locations (Jamieson House and 408 Crystal Street) and two non-residential receivers (Cameron Pipe Band Hall and the Rasp Mill). The addendum assessment considered four nearby residential locations (refer Figure 1 in Appendix B2), including Site 1 - Perilya Residence, Site 2 - Crystal Street Motel, Site 3 - 408 Crystal Street and Site 4 - 419 Eyre Street.

The estimated peak ground vibration impacts for the proposed development workings at the assessment locations are shown in Figure 6.1 for the initial assessment and Figure 6.2 for the addendum assessment.

Location	K factor (average) [1]	K factor (upper) [1]	Exp, b [1]	Minimum distance (m)	Peak vibration (average) (mm/s)	Peak vibration (upper) (mm/s)	Target / Limit (mm/s)	Achieved (Yes/No)	Notes
TSF2 Facility									
TSF2 Floor (closest point)	152	245	-1.025	174	0.8	1.2	25mm/s	Y	2
TSF2 Embankment 1 (midpoint)	152	245	-1.025	216	0.6	1.0	15 (30) mm/s	Y	3, 4, 5
TSF2 Embankment 1 (closest point)	152	245	-1.025	205	0.6	1.0	15 (30) mm/s	Y	
TSF2 Embankment 2 (midpoint)	152	245	-1.025	372	0.4	0.6	15 (30) mm/s	Y	3, 4, 5
TSF2 Embankment 2 (closest point)	152	245	-1.025	238	0.6	0.9	15 (30) mm/s	Y	
TSF2 Embankment 3 (midpoint)	152	245	-1.025	216	0.6	1.0	15 (30) mm/s	Y	3, 4, 5
TSF2 Embankment 3 (closest point)	152	245	-1.025	193	0.7	1.1	15 (30) mm/s	Y	
Residential									
Jamieson House (Crown property)	152	245	-1.025	222	0.6	1.0	5 - 10mm/s	Y	6
408 Crystal Street	152	245	-1.025	435	0.3	0.5	5 - 10mm/s	Y	7
Non residential infrastructure									
Cameron Pipe Band Hall	152	245	-1.025	255	0.5	0.8	15mm/s	Y	8
Rasp Mill	152	245	-1.025	283	0.5	0.8	25mm/s	Y	9

Notes

1. PVS modelled against distance (NOT scaled distance using an MIC) as a consistent maximum charge cannot be achieved with LP detonators.
2. Provisional limits. If TSF2 contains 'wet' tailings, ground vibration limits for liquefaction at the pit floor may need validation, subject to blast monitoring with piezometers.
3. Limit suggested by Golder Associates of 15mm/s for 'vibration sensitive' embankment foundations (dessicated tailings).
4. Limit required by DSC anywhere on the embankment walls. This allows an amplification factor up to 2 times the vibration levels at the foundations.
5. Distances to mid-span of embankments used as a worst-case for amplification, but also need to consider distances to the closest point of each embankment floor.
6. Residential limit at Jamieson House (non residential) used as a reference for nearby Prop Square residences owned by Perilya.
7. Residential limits at closest private residences on Crystal Street (or elsewhere), <5mm/s (95%), <10mm/s (100%). Target <5mm/s peak vector.
8. Conservative commercial building limits of 15mm/s peak vector (refer AS2187).
9. Conservative industrial facilities limit of 25mm/s peak vector, subject to risk assessment of electronic, electrical and mechanical systems.

Figure 6.1 Blast vibration estimates (initial assessment)

				Distance along development (m)	0	50	100	150	200	250	300	350	400	420
				Easting	544390	544439	544488	544537	544587	544636	544686	544735	544784	544804
				Northing	6463871	6463873	6463871	6463868	6463866	6463863	6463861	6463858	6463856	6463855
				RL	73	76	83	90	97	104	111	118	125	128
Receptor	Easting	Northing	RL	Separation										
Site 1	544630	6463960	310	distances	349	314	282	256	237	**228**	229	241	263	273
Site 2	544193	6464086	307	(m)	**374**	399	428	462	498	536	576	618	660	678
Site 3	544371	6464215	303		**414**	416	425	440	459	483	511	542	576	590
Site 4	544592	6463105	296		823	813	801	792	786	**783**	783	787	793	797
				Distance along development (m)	0	50	100	150	200	250	300	350	400	420
				Easting	544390	544439	544488	544537	544587	544636	544686	544735	544784	544804
				Northing	6463871	6463873	6463871	6463868	6463866	6463863	6463861	6463858	6463856	6463855
				RL	73	76	83	90	97	104	111	118	125	128
Receptor	Easting	Northing	RL	Estimated										
Site 1	544630	6463960	310	ground vibration	0.6	0.7	0.8	0.8	0.9	**0.9**	0.9	0.9	0.8	0.8
Site 2	544193	6464086	307	(mm/s)	**0.6**	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
Site 3	544371	6464215	303		**0.5**	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Site 4	544592	6463105	296		0.3	0.3	0.3	0.3	0.3	**0.3**	0.3	0.3	0.3	0.3

Figure 6.2 Blast and vibration estimates (addendum assessment)

As Figure 6.1 and Figure 6.2 show, the average and peak vector ground vibration levels at the nearest residential locations, TSF2 facilities and nearest non-residential infrastructure will remain well below regulated limits and negligible impacts are expected from the blasts at all sensitive receivers. Monitoring of ground vibration levels will be undertaken as blasting takes place, with design modifications made if required to ensure ongoing compliance with the relevant limit project approval and EPL limits.

Monitored surface vibration data from current development blasting would be used to validate provisional estimates. The use of shorter round lengths and electronic sequencing should provide additional vibration mitigation if required. There are a range of monitoring actions which are undertaken to ensure blast impacts remain within limits, including prisms, vibrating wire piezometers and regular inspections. The strict controls outlined in the TSF2 Principal Hazard Management Plan would also continue to apply to the proposed modification.

Overall, the blasting assessments (Prism 2021) conclude that:

- Compliant development blasting should be achievable using conventional tunnel development blasting methods, based on the identified distances to the TSF2 facilities, nearest residential locations and nearest non-residential infrastructure, and the ground vibration limits referenced.

- Monitored data should be used to validate modelled assumptions and adjust blast design parameters to maintain compliant blasting, as development proceeds. Blast monitoring should include vibration monitors at the TSF2 embankments, including the closest point on the closest embankment, and the nearest residential location.

- Additional control methods that are available in the event of non-compliant blasting outcomes include (i) the use of accurate electronic initiation to control maximum instantaneous charge effects, and (ii) the use of shorter round length to reduce charge mass per hole when blasting at the closest proximity to sensitive receivers.

The current blast and vibration management plan for the site will continue to apply to the proposed modification. The plan details the vibration monitoring locations, control measures and mitigation strategies to ensure development blasting does not impact surface infrastructure and surrounding land-uses.

6.2.1 Tailings liquefaction

The tailings material in TSF2 has been found to be potentially liquefiable due to blast vibrations or the failure of the pillar between the TSF and old workings which has an indirect pathway through a series of backfilled stopes and via the 1480 drive. There is a good understanding at Rasp of the development blast design to limit the risk of tailings liquefaction.

This knowledge will continue to be applied to the design of the development blasts for the proposed modification, and the risk of tailings liquefaction from the development blasts will be very low and manageable. As shown in Figure 6.1, the blast vibration impacts at TSF2 will be negligible and unlikely to result in levels under which tailings would become liquified.

Golder Associates (2019) suggests a PPV target of 15mm/s for stope blasting as a suitable control for management of liquefaction risks to TSF2. This aligns with the limits for embankments foundations that may be vibration sensitive as mentioned in section 6.2. Modelled blast vibrations shown in Figure 6.1 and Figure 6.2 show the predicted development blasts to be well below this limit (approximately 1mm/s).

Mill Control Room Operators continually monitor the density of tailings being pumped to the TSF. Control room operators aim to keep the tailings density above 1.5SG (specific gravity).

Generally the tailings density sits around 1.7, which is the equivalent of approximately 35% water or 65% solids in the tailings unless when shutting down the Mill which requires flushing the tailings pipes for a short time. This limits the amount and percentage of water being placed in TSF2 and acts to prevent tailings saturation and subsequently limits the risk of liquefaction.

There is natural permeation of water through the TSF which prevents over saturation of tailings and reduces liquefaction risks. Water from the TSF drains naturally into the underground workings through a series of backfilled historic stopes and travels along the 1480 drive and to pump station 2 where it is captured and reused as part of the mining and milling process.

These established processes would continue to apply while the development workings are being undertaken. These processes, in addition to the careful design and operation of the blasts required for the access development will continue to limit the risk of tailings liquefication.

6.3 Noise

A noise impact assessment has been undertaken for Mod 9 by EMM Consulting (see Appendix C).

The assessment was undertaken in accordance with the *Noise Policy for Industry* (EPA 2017) and incorporated noise modelling of the proposed ladder way installation was based on information received from BHOP, including the location and type of activities, the equipment required and approximate schedule.

A review of the proposed construction activities determined that the raise boring activities including pilot hole drilling (approximately 10 days in duration) and reaming (approximately 40 days in duration) will be the worst-case scenarios. The closest residential receivers to the location of the raisebore activities are on Crystal Street, around 400 m away. For the purposes of the assessment of noise impacts for Mod 9, noise emissions were modelled at the 14 established assessment locations which are representative of residential areas near the mine.

Noise levels predicted for the raise boring activities at assessment locations during the day, evening and night periods are presented in Table 6.1. The modelling adopted the EPA accepted ISO 9613 noise-enhancing meteorological conditions and a sound power level of 103 dB(A) for the raise boring activities. As a conservative approach, predicted construction noise levels were compared to current site operational noise limits as per the PA and EPL.

Table 6.1 Predicted raise boring noise levels at established noise assessment locations

Assessment location	Predicted raise boring $L_{Aeq,15min}$ noise levels, dB			PA/EPL operational noise limits, $L_{Aeq,15min}$, dB			Future increase to existing site noise levels, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
A1	10	11	11	38	37	35	Nil	Nil	Nil
A2	11	12	12	38	37	35	Nil	Nil	Nil
A3	12	12	12	44	41	39	Nil	Nil	Nil
A4	14	15	15	44	41	39	Nil	Nil	Nil
A5	12	12	12	44	41	39	Nil	Nil	Nil
A6	10	11	11	48	41	39	Nil	Nil	Nil
A7	24	24	24	35	35	35	Nil	Nil	Nil
A8	22	23	23	48	39	39	Nil	Nil	Nil
A9	29	29	29	46	39	39	Nil	Nil	Nil

Table 6.1 Predicted raise boring noise levels at established noise assessment locations

Assessment location	Predicted raise boring $L_{Aeq,15min}$ noise levels, dB			PA/EPL operational noise limits, $L_{Aeq,15min}$, dB			Future increase to existing site noise levels, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
A10	21	22	22	42	41	35	Nil	Nil	Nil
A11	11	11	11	46	39	39	Nil	Nil	Nil
A12	15	16	16	46	39	39	Nil	Nil	Nil
A13	10	10	10	38	35	35	Nil	Nil	Nil
A14	10	11	11	35	35	35	Nil	Nil	Nil

Notes: 1. Day period: Monday to Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm. Evening period: Monday to Saturday: 6 pm to 10 pm, on Sundays and public holidays: 6 pm to 10 pm. Night period: Monday to Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.

The modelling results show that predicted noise levels for the proposed Mod 9 construction activities will not increase site noise received at the representative assessment locations above the current PA and EPL noise limits during for the day, evening and night periods. Furthermore, predicted noise levels for the proposed Mod 9 construction activities combined with existing approved operational noise levels will be well below the current PA noise limits Therefore, the raisebore activities are unlikely to be discernable over other site noise and no additional noise impact is predicted from the proposed Mod 9 construction activities.

The key noise mitigation control during construction of the emergency egress ladderway would be to locate it in a bunded area which would shield the activities from sensitive receivers outside of the site.

The current approved noise management plan (NMP) includes a range of other controls that would be implemented to minimise noise during the raise bore activities. The NMP would be reviewed for its suitability to mitigate the noise impacts of the proposed works, however the shielded location of the proposed egress ladderway would provide appropriate mitigation for any noise impacts, while the underground nature of the development workings and blasting will not present any noise impacts at the surface.

The current protocols include a complaints management process that would continue to be applied to the proposed modification. The noise assessment concluded that noise levels for the proposed Mod 9 construction activities during worst-case raise boring activities are not predicted to increase existing approved site operational noise levels at assessment locations above the current PA and EPL noise limits for the day, evening and night periods. Therefore, no additional noise impact over that already assessed and approved is predicted from the proposed Mod 9 construction activities.

6.4 Other impacts

The assessment of other potential impacts of the proposed modification are summarised in Table 6.1.

Table 6.1 Summary of other impact assessment

Issue	Assessment
Air Quality	• Air quality impacts are unlikely to be materially different than the experienced and approved at the mine. • This is because the raise bore method of drilling for the emergency ladder egress would be undertaken from the underground to the surface. • Waste material from the development workings would be preferentially handled underground and emplaced in existing underground emplacement. However if waste is brought to the surface for handling it will be tested first for its lead content before it is brought to the surface, in accordance with current site practices. When handled at the surface the strict controls in the approved Air Quality Management Plan would apply. • The existing strict air quality criteria, lead level criteria and associated management protocols would be observed, as described in the approved Air Quality Management Plan for the site, which include: – only placing waste rock in approved locations at the surface; – water carts and chemical suppressants at exposed areas across the site; – review of operational controls during adverse weather conditions; and – regular monitoring at nearby residences would also continue to be undertaken as the works progress. • The strict protocols in the Community Lead Management Plan, including the regular monitoring undertaken for the approved project at the established assessment locations (refer Figure 2.4), would continue to apply to the activities under the proposed modification.
Biodiversity	• The proposed new location for the emergency ladder egress is within an area which has already been disturbed and cleared of all vegetation to allow mining activities. The proposal would not require any further vegetation clearing to be undertaken. • The proposed modification would not increase the impact on biodiversity values and does not trigger the requirements for a Biodiversity Development Assessment Report under the *NSW Biodiversity Conservation Act 2016*.
Water	• The only requirement for water for the proposed modification would be for the raise bore drilling method and to manage any dust generation should it occur. • This water would be sourced from existing approved on-site supply. • The rock within which the development drives would be developed is largely unsaturated. Therefore no significant inflows would be expected when the development is being undertaken. • Any inflows would be managed in accordance with current mine site protocols, which include storage in underground workings or brought to surface through the shaft 7 pumping system or alternatively the rising main.
Waste	• All waste rock generated by the development workings above 0.5% lead would be preferentially retained underground and stockpiled for use for backfilling stopes and voids in the future. However waste rock less than 0.5% lead may be used on the surface for approved purposes and within allowable limits in accordance with 07_0018 and EPL 12559. • If there is significant economic potential for the material it may be brought to the surfaced and processed, however this is unlikely to occur, based on previous experience with development workings. • Existing strict protocols to manage the emplacement of waste rock in the underground workings will continue to apply for the proposed modification.

Table 6.1 Summary of other impact assessment

Issue	Assessment
Visual	• The proposed new location for the emergency ladder egress would be located in a 8 m high bunded area and shielded from view of all residential receivers, to eliminate any potential visual impacts. • Following completion of the raise bore the surface component of the emergency egress ladderway would be housed in a dedicated surface infrastructure facility (likely to be a 20ft shipping container) which would also be shielded in the existing bunded area.

7 Evaluation of merits

7.1 Mod 9 impacts

This report has examined the potential impacts that may result from the proposed modification. The assessment of environmental issues has been multi-disciplinary and involved consultation with DPIE and other agency stakeholders (including Dams Safety NSW, BHCC, Resources Regulator, and the EPA).

The proposed modification will not result in significant biophysical, social or economic impacts and this report has identified that any residual impacts can be appropriately managed in accordance with the existing conditions of approval. All aspects relating to environmental management will continue in accordance with the approved management plans for the mine.

7.2 Mod 9 benefits

The proposed modification is seeking to extend existing development workings and install an emergency egress ladderway.

The proposed modification will allow BHOP meets its legislative requirements as outlined in the Work, Health and Safety (Mines and Petroleum sites) Regulations 2014 and will allow access future potential extractable resources. Therefore the proposed modification is critical to the continued operation of the Rasp Mine in both legislative and operational contexts.

The ongoing development of the resource at Rasp will provide indirect social and economic benefits through increased job security for its employees, contractors and subsequent benefits to the local and regional economy through income and expenditure, and more widely in NSW through royalty payments.

The proposed modification is an alteration with minimal environmental impact to an approved facility, which allows orderly and economic access to and use of a resource.

All aspects relating to environmental management will continue in accordance with the project approval and the approved management plans for the mine.

7.3 Ecological sustainable development

Under Section 516A of the EPBC Act, Commonwealth organisations have a statutory requirement to report on their environmental performance and how they accord with, and advance, the principles of ESD.

Australia's *National Strategy for Ecologically Sustainable Development* (AGESDSC 1992), defines ESD as "using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased".

The principles of ESD, for the purposes of the EP&A Act, are provided in Clause 7(4) of Schedule 2 of the EP&A Regulation. The four principles of ESD are:

- precautionary principle – the precautionary principle states that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- inter-generational equity – the principle of inter-generational equity is that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

- conservation of biological diversity and maintenance of ecological integrity – the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and

- improved valuation and pricing of environmental resources – improved valuation, pricing and incentive mechanisms should be promoted.

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future. BHOP is committed to the principles of ESD and understands that biophysical, social and economic objectives are interdependent. BHOP acknowledges that a well-designed and effectively managed operation will avoid significant and/or costly environmental impacts or degradation.

The proposed modification has been designed to minimise impacts to a level which is as low as is reasonably practicable. The proposed modification does not change the approved functions of the mine and would not result in any new surface disturbance. No additional management measures are therefore required to mitigate residual impacts.

Consideration has also been given to appropriately identifying, avoiding, mitigating and managing environmental risks to demonstrate environmental due diligence and will provide for ongoing and adaptive monitoring and management of the operation in line with the principles of ESD.

7.4 Conclusion

BHOP has made a modification request (Mod 9) to the Minister for Planning and Public Spaces for the approval of development drives and an emergency egress ladderway at the Rasp Mine.

These activities are required to allow the continued access to develop future ore reserves and to augment the safety systems at the mine, to comply with relevant safety legislation and guidelines.

The proposed modification would result in negligible environmental impacts over that already assessed and approved at Rasp, and the proposed modification would be strictly controlled in accordance with current approved limits, using the existing strict site protocols and in accordance with approved management plans and relevant guidelines.

A range of geotechnical controls would be applied to the proposed development drives, with inrush protocols observed and sufficient buffer pillar to ensure the continued integrity of the Blackwoods TSF2.

The blasting impacts of the underground development would be carefully managed, to ensure that recommended vibration limits are met at residential receivers and for infrastructure. Blasting occurring beneath and in the vicinity of the Blackwoods TSF2 would be designed to meet relevant Dams Safety NSW vibration limits.

The excavation of the vertical shaft (raiseboring technique) required for the subsequent installation of the ladderway would be undertaken on a continuous 24 hours period, given the continual nature of the drilling that is required. The duration of this activity is relative short duration (1-2 months) with all the works being conducted in a shielded location (ie behind 8 m bunds) on the surface and underground.

Therefore Impacts from the emergency egress ladderway would be negligible both during the construction and subsequent operation. The utilisation of commonly used raising boring techniques, existing surface landforms and relative short construction duration will ensure that the impacts are minimised, if not eliminated. Once the ladderway has been installed there will be no impacts on or off site as the infrastructure is static and inert in nature.

The proposed modification would result in a range of benefits for on-site efficiency, sustainably and safety. It would allow access to further potential extractable resources at the site. The proposed modification is also considered in the public interest and would enable BHOP to continue to provide social and economic benefits through increased job security for its employees and subsequent benefits to the local and regional economy from the Rasp mine.

Overall, the proposed modification has merit and warrants granting of approval.

8 References

Australian Government Ecologically Sustainable Development Steering Committee (AGESDSC) 1992, *National Strategy for Ecologically Sustainable Development,* Ecologically Sustainable Steering Committee

Broken Hill City Council 2013, *Local Environmental Plan 2013*

Broken Hill Operations Pty Ltd 2019, *Blackwoods Preliminary Geotechnical Review*, prepared for BHOP

Department of Planning, Industry and Environment, Dams Safety NSW2020, *Guideline – Mining near declared dams*

Department of Planning, Industry and Environment 2021, *State Significant guidelines – preparing a modification report*

EMM Consulting Pty Ltd 2021, *Noise Impact Assessment*, prepared for BHOP

Prism Mining Pty Ltd 2021, *Blast Vibration Assessment – Mod 9 Development*, prepared for BHOP

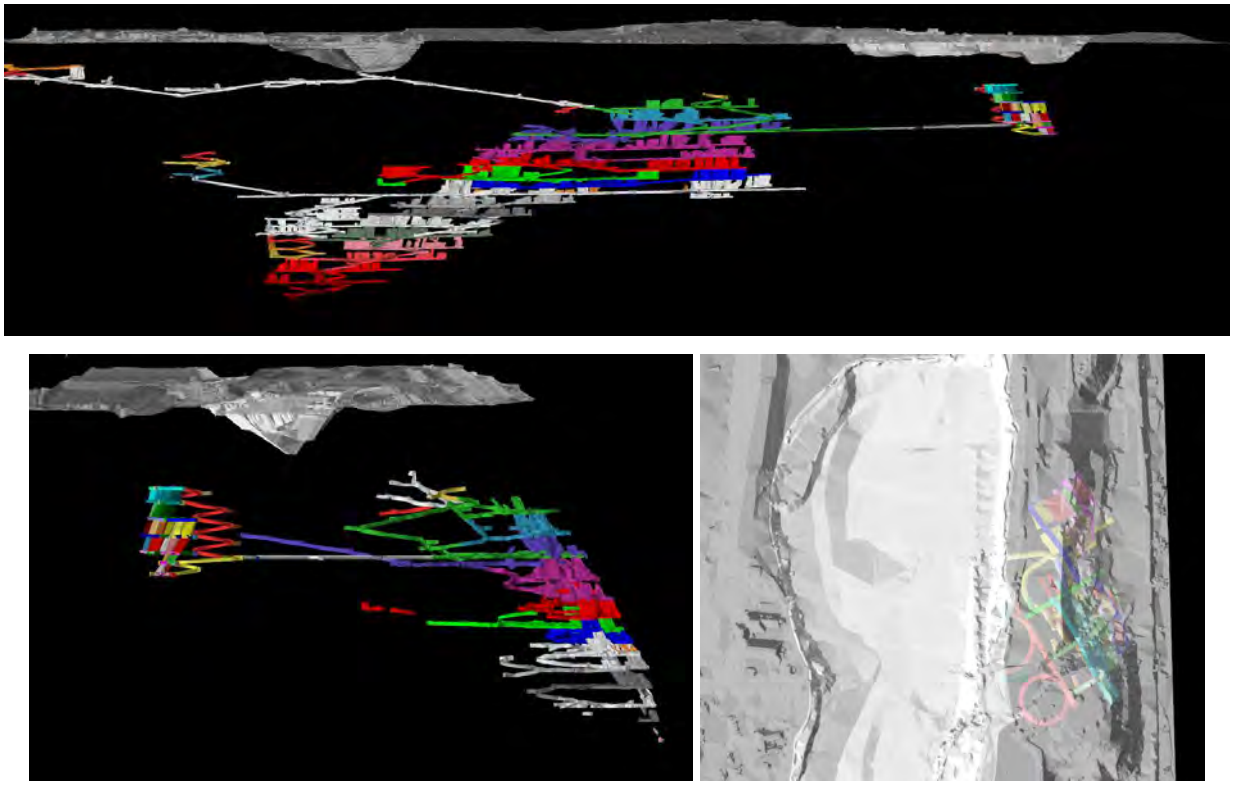
Appendix A

Mod 9 Geotechnical review

Blackwoods Access Development Geotechnical Review

1. Introduction

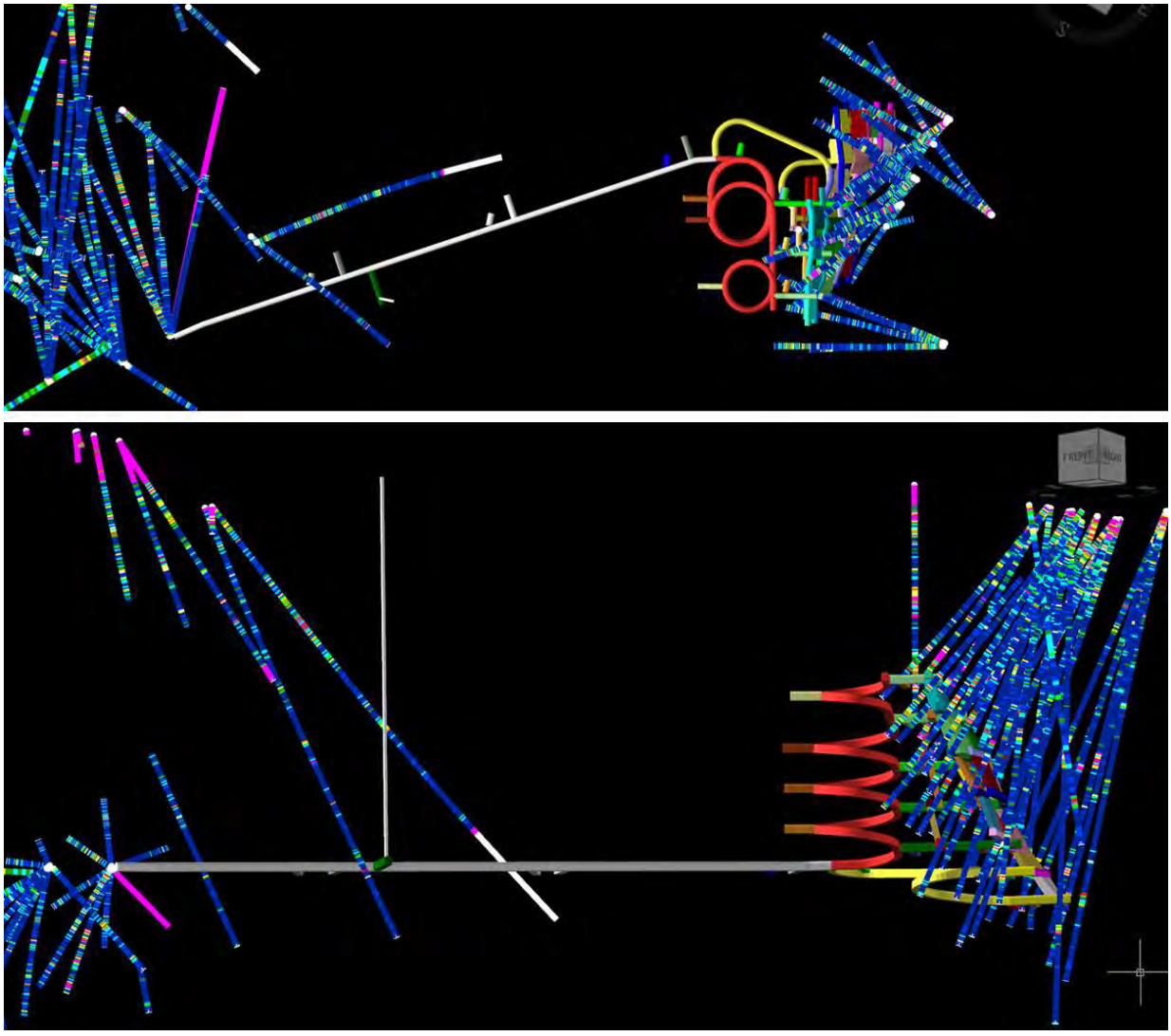
The Blackwoods Block is located in the northern part of the Rasp Lease between approximately 120m and 250m from surface below the eastern wall of the Blackwoods Pit. It will be accessed from the 7L at the northern end of the western mineralisation to Blackwoods 05L with incline up to 01L and decline down to 07L, both in the FW of the Block. This report is for the access development for the block, from the existing 7L development to the start of the Blackwoods Incline and Decline.



1: Blackwoods Block with existing Rasp workings. Top - looking west, bottom left – looking south and bottom right – in plan.

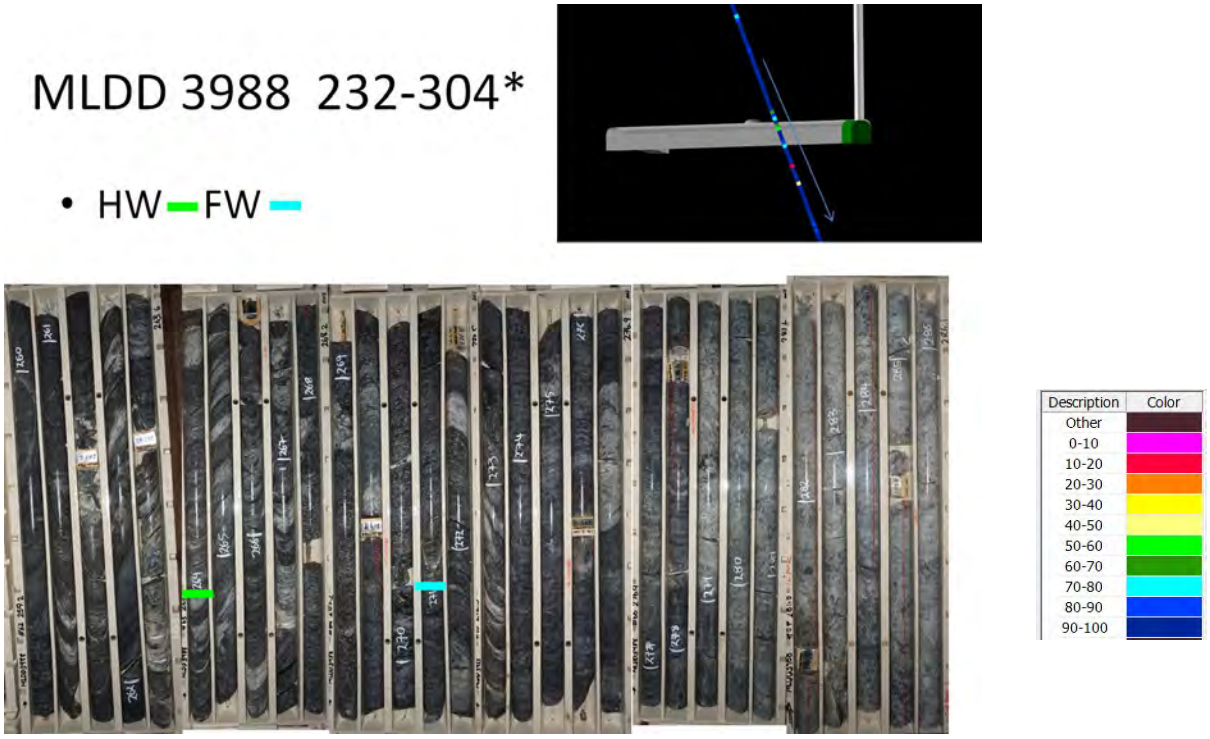
2. Rockmass

A review of the diamond drillhole photos in the area of the Blackwoods Access Development has been undertaken. There is very limited coverage of the area of the access development from the 7L.



2: Diamond drill coverage of the Blackwoods Block in plan (top) and looking NW (bottom).

The two drillholes through the area of the access development and vent raise indicate a competent rockmass, which is supported by inspection of the 7L Exploration drive current face (30/7/21).



3: One of 2 DDH through access development area. On right is key to DDH RQD colours used in this section.

The following Q rating has been assigned for the access development, however the limited data on which the classification has been made should be noted.

Based on the above assessment the country rockmass is rated as good, with a Q rating of 16.

Parameter	Rating	Description
RQD	60	From Drillcore
Jn	6	2 joint sets + random
Jr	1.5	Planar Rough
Ja	1	Surface staining only
Jw	1	Dry
SRF	2	Low Stress, near surface

4: Q rockmass rating.

3. Geology

The Rocktypes shown in the area of the access development are metasediments with Garnet Bearing Pelites, Psammopelites and Psammites with Pegmatite Veining and minor shears.

Rock Type	Density (t/m3)	UCS (MPa)	E (GPa)	Poisson's Ratio
Pegmatite	2.857	123	64.2	0.244
Potosi Gneiss	2.834	228	76.8	0.229
Lode Quartz	2.92	103	57.4	0.03
Garnet Bearing Psammopelite	2.95	98	-	-
Garnet Bearing Pelite	3.22	83	-	-
Psammopelite	3.1	96	-	-

5: Strengths of Rasp Major Rocktypes

Stressed for the mine are:

Sigma 1 = 5 + 0.040 D, orientation NE-SW

Sigma 2 = Sigma 3 = 0.025 D, orientation NW-SE and vertical

Where D = the depth below surface in metres, orientations with respect to mine grid.

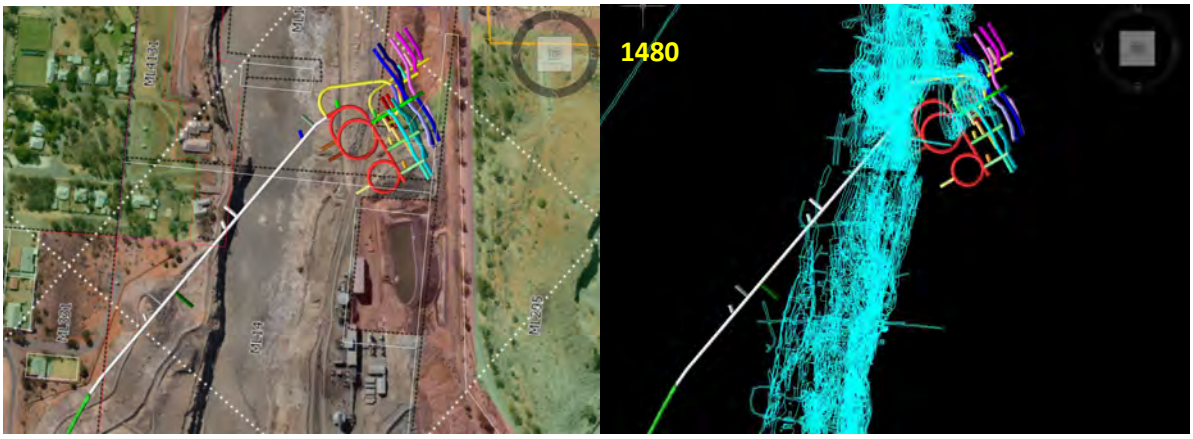
Therefore for the access development at 235m depth Sigma 1 will be 14.4MPa and Sigma 2/3 10.88 MPa. Issues with seismicity are not expected in the area.

4. Previous Workings

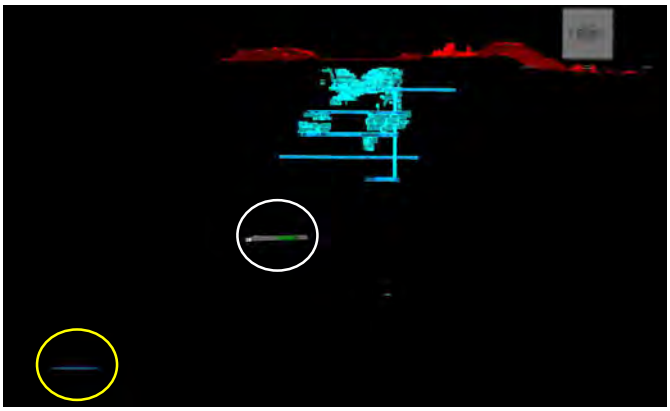
The Blackwoods Block sits in the SE corner of ML15 with the access development passing through ML 14 to reach it from the existing mine. Both Leases were part of the historic British Mine. In the 36 years from 1887 when the mine was operated independently the mine produced 2.9 million tonnes of Ore. The lease was then operated with others until 1976. The main shaft for the lease was Thompsons shaft, which was also the deepest at 365m and last sunk in 1910. The two shafts in proximity to the Blackwoods Block are Howell Shaft (1888, 204m) and Blackwoods (1888, 244m), however both are within the footprint of the TSF2 (see next section) and cannot be observed on surface.

Only a 20m deep mining exclusion exists in the area. The available historic plans have been reviewed. Historic plans for the Blackwoods Shaft area appear to be incomplete but no historic workings are expected in the area of the Blackwoods access development.

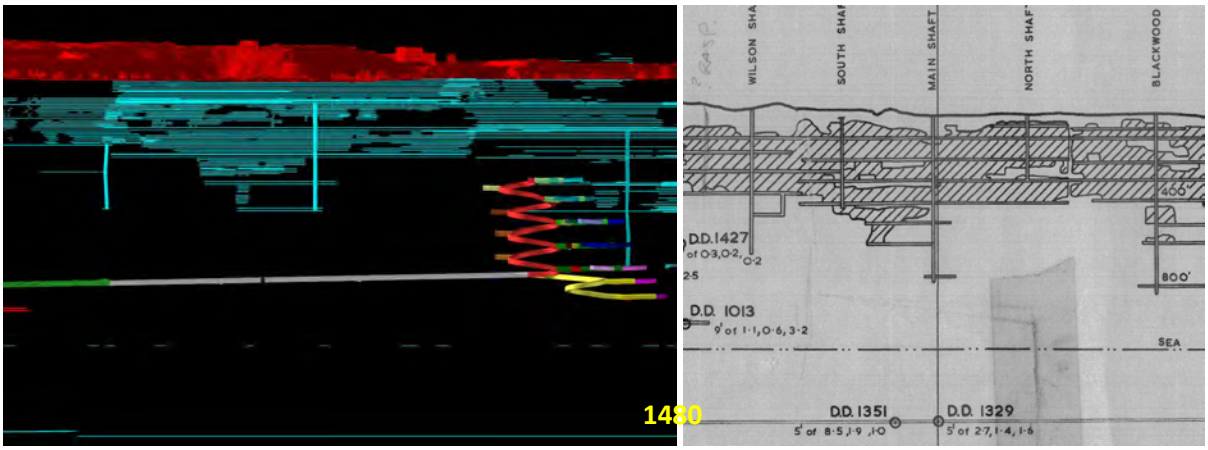
While the Blackwoods Block itself is in close proximity to historic workings the access development is located 70m below the deepest recorded historic workings in the area and 160m above the 1480 Access drive which is located to the west.



6: Location of Blackwoods Access Development in ML 14 & ML15.



7: Section looking north on Main shaft. Access development circled in white, 1480 drive yellow.



8: Section looking NW through historic workings with shafts, and cross section with shaft names.

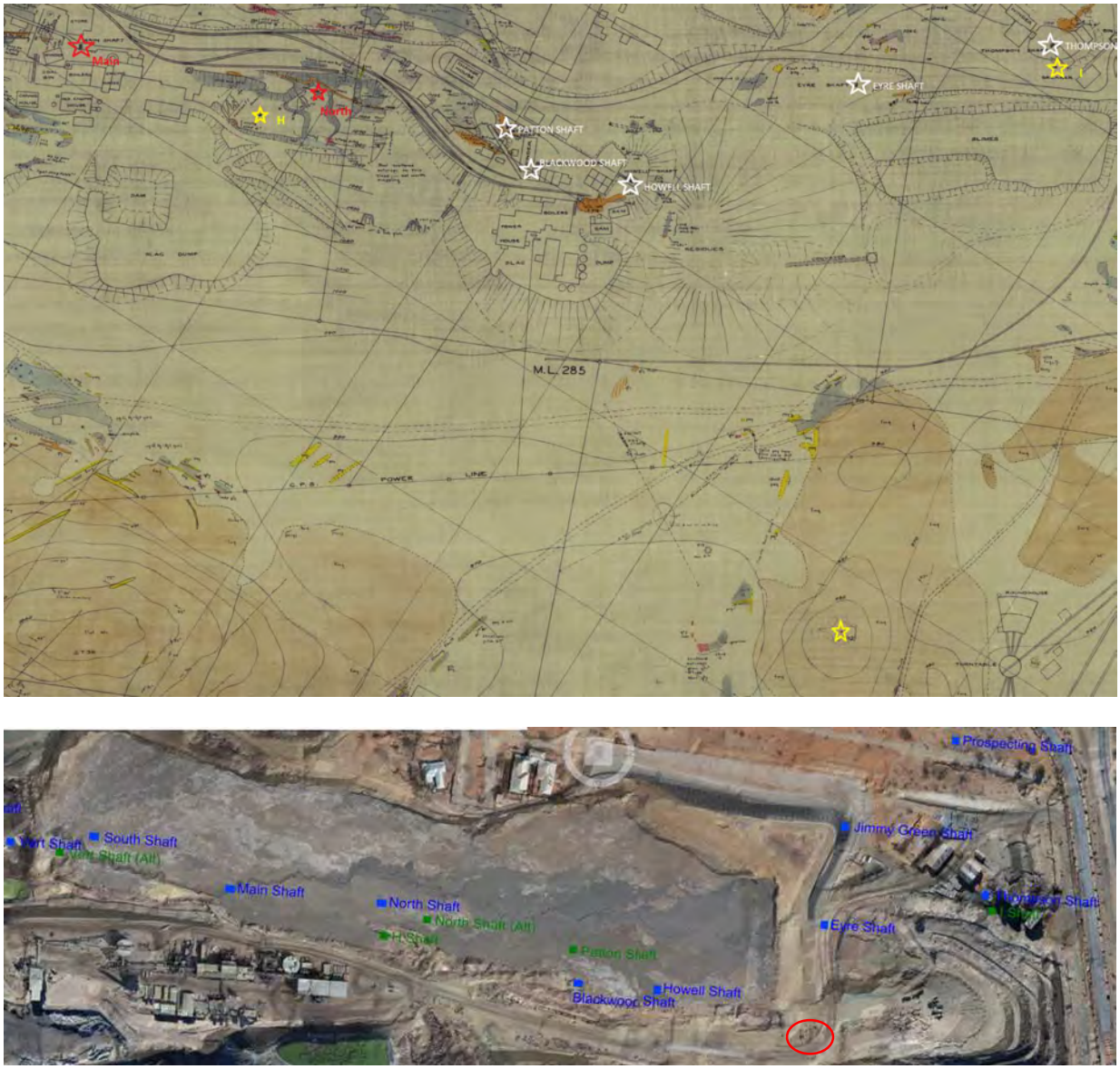
5. TSF2

As shown in figure 5 the Blackwoods Access Development will pass below Blackwoods Open Cut, now used as a tailings storage facility, TSF2. Due to the distance of the access development from the historic workings the two hazards posed by mining of the Blackwoods Access Development are:

- Liquefaction of the Tailings material caused by either:
    - Failure of the pillar between the TSF and old workings initiated by development firings
    - Liquefaction of the tailings material due to development firings
- Damage to the Tailings dams and spillway by development firings

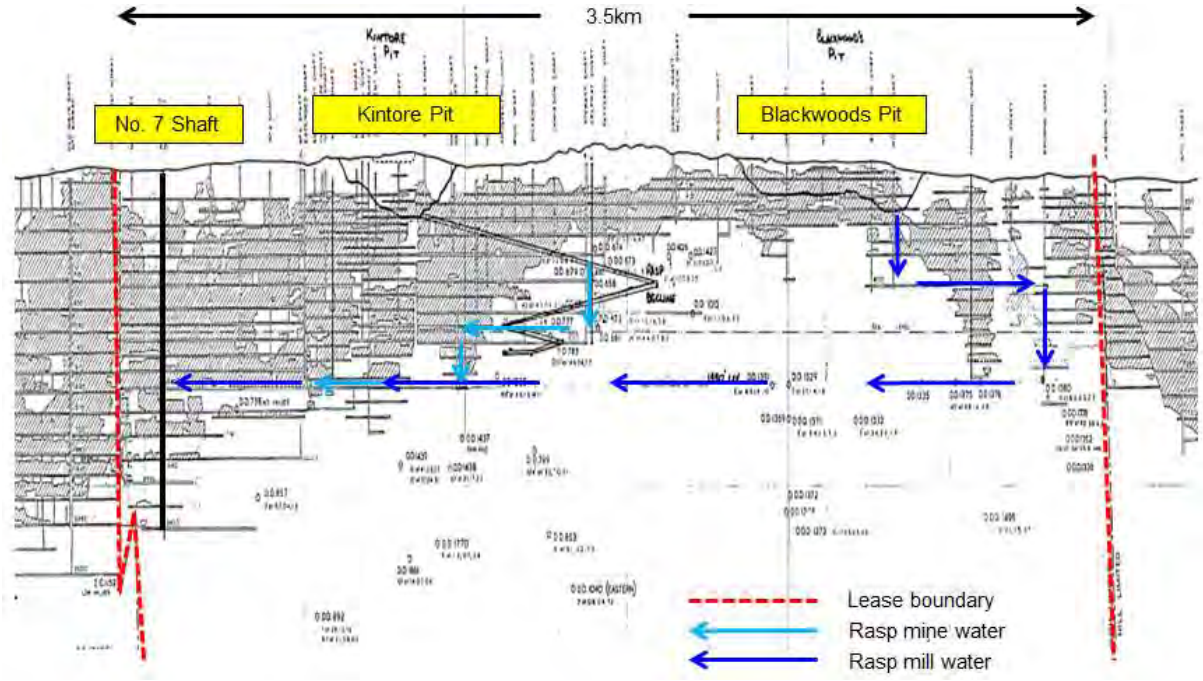
The tailings material in TSF2 has been found to be potentially liquefiable (see Golders reports) due to either a high blast vibrations or the failure of the pillar between the TSF and old workings. In the case of pillar failure this is expected to cause a large enough stress change to liquefy the tailings. If the TSF2 tailings liquefies there is a known pathway between the TSF and the existing mine workings via the 1480 drive.

Both Howells and Blackwoods shafts are located within the TSF and no record can be found of any securing works done for the shafts. A number of other shafts are also shown within the TSF and one is reported to have been found during the recent tailings dam construction works in the NE corner of the TSF – details have been requested from the Dam construction team.



9: Shafts within TSF 2 and surrounds. Approx. area of reported shaft in red.

An inrush event associated with TSF 2 is recorded from May 2012. The tailings placed into TSF 2 were expected to seal off the old workings in the pit with water slowly seeping through the fill and old workings to report to No. 7 shaft via the old workings. However due to a number of factors including low density tailings being placed into the pit and high rainfall the water in shaft 7 started rising at a rapid rate necessitating the withdrawal of workers from the lower levels of Perilya's Southern Operations.



10: Water pathways from inrush event.

Following the event the base of the northern part of Blackwoods pit was sealed by a liner and the southern part by compacted clay.

The second hazard is damage to the tailings dams by development firings from the Blackwood Access Development. The Blackwoods Block lies within the notification area for TSF2, however the vertical limits of the Notification Area is unknown along with what the notification applies to. On review of the permission it is for surface mining and the extraction of ore – it is not known if this applies to underground development and this should be verified. Three dams and a spillway comprise the TSF2. The Block lies between and slightly to the west of the spillway and Embankment 1. The spillway is thought to have been built on rock while Embankment 1 is partially built on tailings. Embankment 3 in the NW corner of the TSF is complete. Blast vibration monitoring is underway as specified in as specified in the Blackwood Tailing Storage Facility PHMP (BHO-PLN-MET-003).

The effect of subsidence on the dams is covered in the pillars section.

Therefore both of the above risks are directly related to blast vibrations from development firings.

A report by Golder from June 2019 (before Blackwoods Block was identified) on the potential impact of blasting tailing on tailings storage facility (1896239-024-M-RevA) has the table below for PPV limits for tailings dams. As embankment 1 is on existing tailings a maximum PPV of 15mm/s will be used.

Table 2: General Guidelines to Vibration Damage Thresholds for Blasting Near Dams and Embankments

Dam and Embankment Construction	PPV Limit (mm/s)
Dams and embankments constructed of or having foundation materials consisting of loose sand or silts that are sensitive to vibration	15
Dams and embankments having medium-dense sand or silts within the dam or foundation materials	50
Dams and embankment having materials insensitive to vibrations in the dam or foundation materials	100

Source: Charlie et al. 1987.

11: PPV limits for tailings dams.

No PPV limit for liquefaction of tailings is given in the Golder report and one should be requested.

Blast vibration monitoring equipment has been installed to monitor the mining of 4L development. This should be reviewed by a Subject Matter Expert and the Blackwoods Access Development Blast vibrations modelled to ensure they do not exceed the above limits. However due to the small blast vibrations produced by development firings no issues are expected.

The risk of blast vibration initiated pillar failure liquefying TSF 2 Tailings is a current risk and is not expected to be increased by Blackwoods Access Development. However it is expected to be increased by extraction of the block itself. Golders have recommended a Plug be built on the 1480 drive to control this risk.

6. Support

7L NFWD and 7L EXD, the access to Blackwoods Block were inspected on the 30/7/21. The drives are predominantly supported to the old F2 standard, shotcrete shoulder to shoulder with lightly corroded resins in the backs and split sets in the sidewalls. There are some areas of F1 where surface support is extended down to the gradeline. No major ground stability issues were noted in the drives however it was recommended that the drives be scaled to identify any hidden hazards. The drive has been check scaled and re-inspected on the 11/5/21 with no rehab being required.

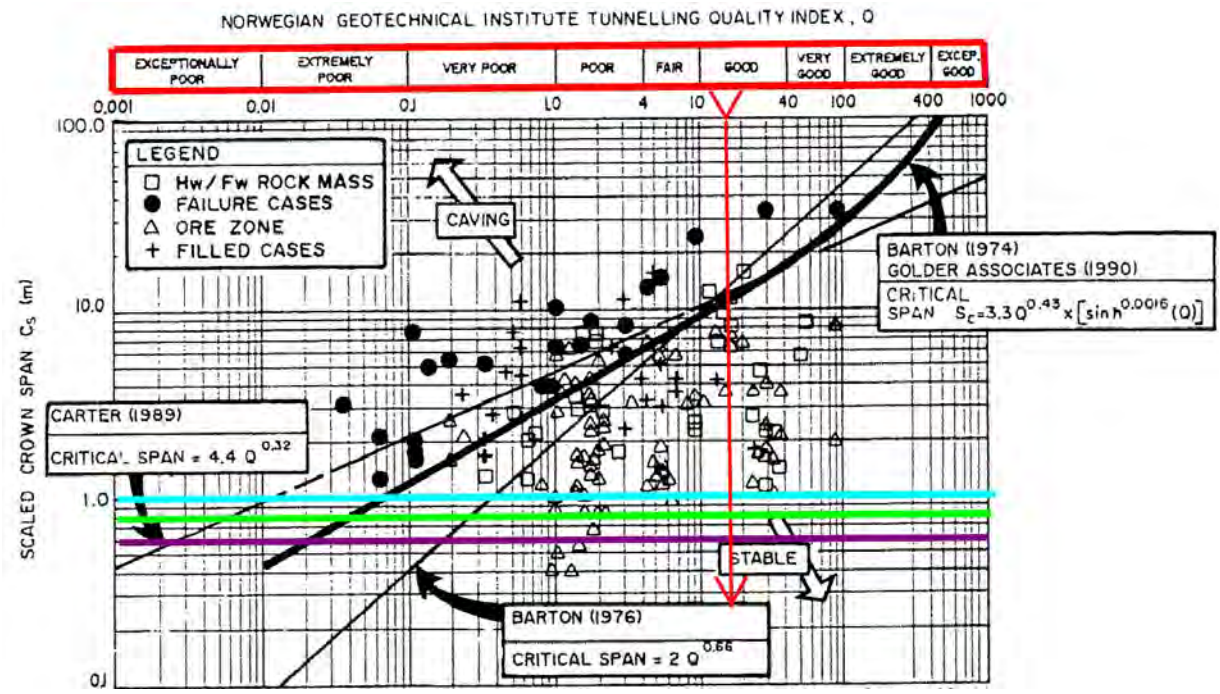
The northern end of the drive is currently barricaded NEUA for DDH collar locations and is supported to F1 standard, including the face. The drive appears slightly larger than standard and water inflow was noted from split sets installed in the left (west) shoulder just back from the face. The water was Iron stained. Testing of the water could be taken to ascertain the source.

12: Current face of 7L EXPD.

It is anticipated from the DDH analysis that block access development will be bolts and mesh (AM support Standard), unless the area is damp with tailing water which may require additional, corrosion resistant support. As noted above DDH coverage of access development is poor and additional support may be required if unrecorded structures are intersected or the rockmass is poorer than expected.

7. Pillars

The Blackwoods Access Development will be 160m below the recorded base of TSF2, 235m below surface and 70m below the closest historic workings. All of these pillars plot well within the stable zone of the Scaled Crown Pillar Stability Graph, and do not plot on the Lunder Pillar Stability Graph due to their large size. They would therefore be expected to remain stable.



13: Scaled Crown Pillar Graph for Blackwood access development. Surface pillar in purple, Base of TSF2 in green and Historic Workings in blue.

8. Conclusions and Recommendations

While Geotechnical information on the area of the Blackwoods Access Development is limited no major structures are shown to be intersected by the development and good ground conditions are expected. The Ground Support TARP will be enacted if any adverse conditions are found.

The development is located sufficiently far from historic workings and is not expected to be affected by them. Long Hole probing is not thought to be necessary based on the available mine plans.

Blast vibrations from development headings are the only major hazard identified, with the potential to:

- Damage pillars between the historic workings and TSF initiating liquefaction,
- Initiate liquefaction of the Tailings
- Damage the Tailings Dam and spillway.

However due to the low blast vibrations initiated by development firings these are considered extremely unlikely. Modelling of blast vibration data from a near surface heading will be assessed and modelled by a subject matter expert to verify this.

Golders should be contacted to provide a PPV which may potentially cause liquefaction of the tailings and for further details of the Tailings Dam Notification Area.

If damage to the pillar or liquefaction of tailings is considered an unacceptable risk the 1480 Plug will be required, however it is not anticipated that this will be required until Blackwoods stoping begins.

New Surface Egress Ladderway Geotechnical Review

1. Introduction

The planned surface egress ladderway will be located in the western centre of the lease, approximately 50m south east of the Exhaust Shaft. It is planned to be a 1.1m diameter raisebored raise 145m in length dipping 78° to the east with its base in WM DEC SP 1. It will have a Safescape ladderway installed on completion of raiseboring. RL of the top is 10,323m, base 10,181m.

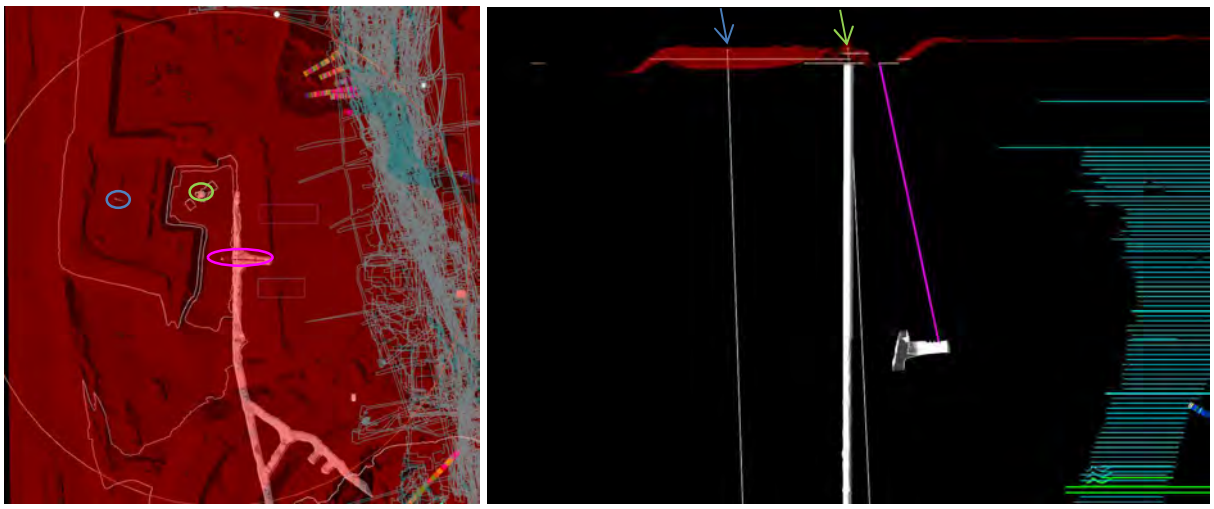


Figure 1: Planned ladderway in plan (left) and looking north (right). GTDD0007 circled blue, GTDD0009 circles green and ladderway circled pink.

2. Previous Raises in Area

The only new surface raisebored vertical opening at Rasp Mine is the Surface to 10L Exhaust Shaft which is 5m in diameter and 378m in length with its base on 10L. Information on the shaft is extremely limited. A Geotechnical Assessment dated November 2011 has been obtained from Mining One Consultants for the shaft which was based on 2 diamond drillholes (see next section).

The report recommended to:

- Support the shaft collar to 30mwith a ring of closely spaced grouted cables
- Apply 100mm shotcrete (depending on risk tolerance either all of the shaft or just fault zones)
- Ensure strict survey control on the shaft to maintain 15m pillar with decline
- Complete regional stress modelling if mining plan changes for effect on shaft
- Investigate effects of stope blasting on proximity to shaft.

However following the report there is no available information on the shaft. Routine camera surveys of the shaft are undertaken by the electrical department as detailed below, however it cannot be determined if the raise was shotcreted due to poor video definition and accumulated dust.

The Mining one reports that there was 26m of fill encountered in GTDD0007 and 15m in GTDD0009 which required casing. Hole GTDD0008 was located 1m east of GTDD0009 but was abandoned due to excessive hole deviation in the weathered domain at 32.7m depth. GTDD0009 was located at approximately the current location of the exhaust shaft. Given the reported RL of GTDD0009 collar at 10,330 RL and the current shaft collar RL of 10,323m it appears that 7m of fill was excavated down to the current shaft collar, however no record of what the top of the shaft was located in can be found.

Geotechnical assessments of the camera survey are made when the camera surveys are undertaken. Overall the shaft is in good condition with no deterioration shown between the recent surveys (started 2020) and the first (and previously only) available survey which was taken in March 2013. The only changes noted are varying amounts of water in the raise which appears related to surface rain fall.

The table below shows the monitoring points in the area of the shaft from surface to the depth of the planned ladderway. The intervening areas have good profile.

RL (m)	Description	Photo
10,323	(surface down) Dry, good, smooth profile, thick dust build up.	a
10,266	Few small scats missing from perimeter	b
10,259	Large block missing ~1/4 of perimeter, minor cracks	c
10,247	Few small scats missing from perimeter	
10,238	Large scats failure from perimeter	d
10,235	Dry, good, smooth profile	
10,229	0.2m wide horizontal band of wider profile	e
10,225	Good, smooth profile with damp patches	
10,181	Good, smooth profile, damp (to 10,155\m)	

Figure 2: Exhaust Shaft camera survey monitoring points.

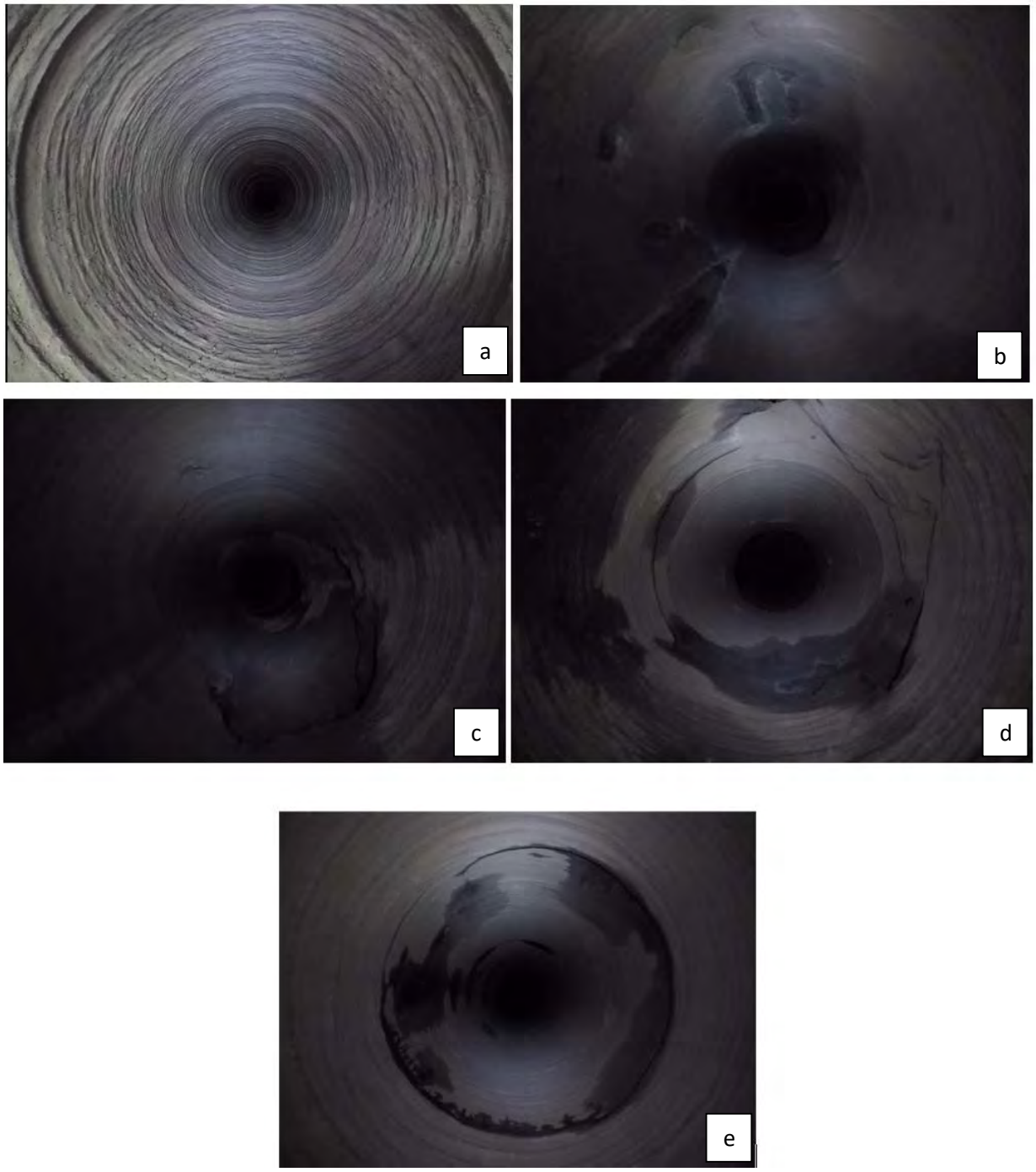


Figure 3: Exhaust shaft monitoring points, letters correspond to table above.

3. Available information

As figure 1 shows there is extremely limited diamond drilling from surface in the area of the proposed ladderway. Only the 2 holes drilled for the exhaust shaft exist and these have been used for the stability assessment of the proposed ladderway. GTDD0009 is located 50m NW and GTDD0007 85m WNW. Logs and core photos are located in the same folder as the Mining One Report linked above.

As these holes are the only information on the rockmass available for the majority of the ladderway length a degree of caution should be used. If further information is required additional information could be obtained through a diamond drill hole located closer to the proposed ladderway or remote logging of the raisebore pilot hole. It is strongly recommended that a detailed camera survey be undertaken of the raisebored raise before the ladderway is installed to assess if the raise requires support. This could be required due to poorer than anticipated ground conditions, unrecorded structures or increase in diameter during raiseboring.

Figure 4: Close up of diamond drill holes used in this report looking north. Note difference in elevation between GTD0009 site and current ground surface.

The Mining One report notes inconsistencies with the metre markings provided by Rasp which may have impacted on the collected RQD data.

Very good core recovery was noted with the main area noted at GTDD009 24.7-27m which corresponded with a Fault.

The rocktypes for the two holes were metasediments ranging from Pelites to Psammites which was noted to be consistent with the existing geological interpretation. No major structures were modelled through the area – which has not changed.

Weathering was noted to a depth of 54m in GTDD0007 and 49m in GTDD0009, RLs of 10,275m and 10,281m respectively. The weathering was characterised by bleaching of the rockmass and staining of joint surfaces with the rockmass appearing to be generally intact.

Some core from GTDD0007 was sent for laboratory testing, which was considered representative of GTDD0009 rockmass as well.

Rock Type		Density	Strength		Young's Modulus	Poisson's Ratio
			UCS	UTS		
		t/m3	MPa	MPa	GPa	
Pelite – Weathered	Count	8	3	5	3	3
	Average/Value	2.57	7.2	1.6	2.5	0.02
	St. Dev.	0.06	4.1	0.6	0.4	0.001
Pelite	Count	8	4	4	4	4
	Average/Value	2.69	29.6	4.6	19.0	0.05
	St. Dev.	0.14	23.5	2.5	11.5	0.03
Psammopelite	Count	8	4	4	4	4
	Average/Value	2.75	97.6	16.2	74.7	0.05
	St. Dev.	0.06	33.7	6.7	32.1	0.01
Psammite	Count	2	1	1	1	1
	Average/Value	2.76	79.5	12.79	37.4	0.03
	St. Dev.	0.04				
Potosi Gneiss	Count	2	1	1	1	1
	Average/Value	2.78	69.9	12.38	84.1	0.15
	St. Dev.	0.05				

- Weathered rock and weakness zones were assigned a UCS value of 15 MPa;
- Pelitic, foliated fresh rock types were assigned a UCS value of 60 MPa;
- Siliceous fresh rock types (such as Psammites, Psammopelites and Potosi Gneiss) were assigned a UCS value of 90 MPa; and

Figure 5: Rock Strength Test results from GTDD0007 core and strengths assigned in analysis (Mining One).

The report notes that as the holes were drilled vertically core orientation was not completed, however α and β readings are included in the logs and appear to be comparable to the joint sets seen at Rasp (see kinematic analysis).

Several minor fault and shear zones were identified in the DDH logs. It was noted that the majority of the faults were discrete and foliation parallel, with the main structure being that noted above in GTDD009 between 24.7-27m (~10,305m RL) with similar zones of weakness being seen at similar depths in GTDD0007 and GTDD0008 – indicating the possible presence of a relatively flat fault or shear zone in this area.

No ground water was intercepted during the drilling.

The base of the ladderway in WM SBY 1 was inspected on 26/2/21 for a proposed diamond drill site and a rehab plan was issued, which will now be used for the ladderway. Regular inspections have taken place since but the rehab is not complete at the time of writing.

It is supported by lightly corroded resin bolts through shotcrete in the backs with the shotcrete stripped of the sidewalls by use as a SBY with only split sets remaining. The rockmass was blocky with a Q value of 17 or 'Good' assigned.

Figure 6: WM DEC SP 1.

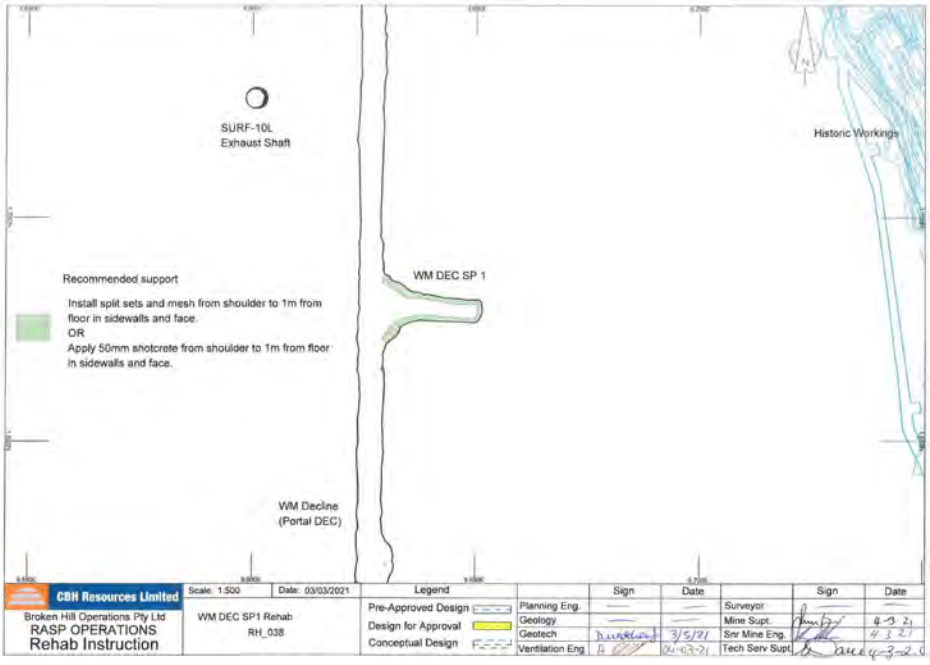


Figure 7: WM DEC SP 1 rehab plan.

4. Analysis

4.1. Rockmass Classification

The shaft log was broken into 1m intervals by Mining One to allow classification of the rockmass by the Q system. This work is included in Appendix 1 of this report for the relevant sections of GTDD0009 and GTDD0007. It should be noted that the top 15 – 26m of the holes are not shown as this section was through fill.

An RMR classification was also undertaken to assess stand-up time.

These classifications are used in the analysis below for the proposed ladderway. The report used a probability of failure of 5%, as suggested by McCracken and Stacey for an unsupported ventilation shaft, which is also used in this report for the ladderway.

4.2. Maximum Unsupported Span (MSUS)

The MSUS was calculated per metre of the two diamond drillholes according to the McCracken and Stacey Method.

3 areas of MSUS below 1.1m were calculated in GTDD0009, 25m to 29m, 39m to 42m and 43m to 44m, photos of which have been included in Appendix 2. All three areas are in the weathered zone and apply to both walls and crown stability. The distinction is made in the McCracken and Stacey method as while the walls of the raise and permanent for the life of the raise the crown is only temporary during raise boring. The raisebore head itself also provides a degree of support. However as McCracken and Stacey note that whenever the head is withdrawn so is this support and failures are most likely at this point. Failures from the edges of the face can undercut the sidewalls and an uneven face and diameter causes difficulties in recommencing raise boring.

3 areas of MSUS below 1.1m were also calculated in GTDD0007 between 31m to 33m, 34m to 35m and 113m to 114m. The upper two are again in the weathered zone while the lower corresponds to an area of Quartz veining.

There are also a number of areas where anything larger than a 1.1m raise would be unstable within the upper weathered zone. However, the majority of the length of the proposed ladderway is shown to be stable for the smaller 1.1m diameter raisebore.

4.3. Lower Bound Q_R

The lower bound Q_R method allows comparison of raisebore stability across mine sites. It uses a rolling 3m average based on observations that zones of poor quality rockmass need to be greater than 3m in length to significantly impact raise wall stability. For zones smaller than this overbreak may be experienced but continual unravelling does not tend to occur.

As the logs in Appendix 1 show this reduces the potentially unstable areas in GTDD0009 to the area between 25m to 27m and in GTDD000 7 to 31 to 32m and 34m to 35m. These are thought to correspond to the shallow dipping fault noted above.

The method uses the lowest QR calculated using a 3m rolling average which is 1.6 for GTDD0009and 0.85 for GTDD0007. However as Mining one note this low area in GTDD0009 comes below the area of coreloss and may in reality be lower.

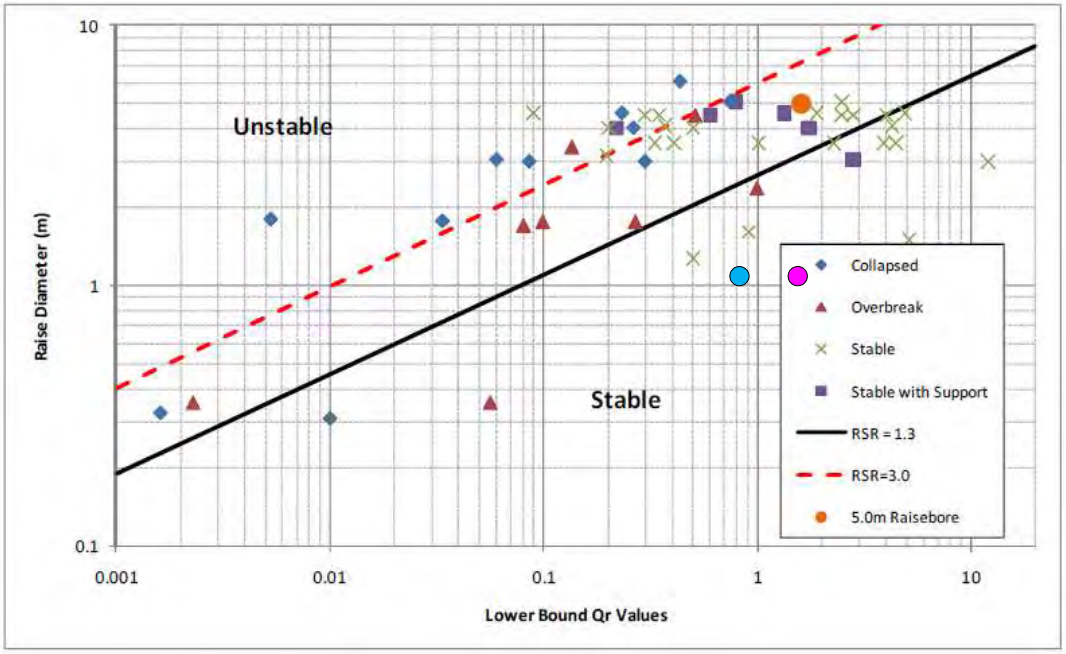


Figure 8: Lower Bound QR for the exhaust shaft (orange), and the ladderway using GTDD0009 (pink) and GTDD0007 (light blue).

4.4. Stand Up time

Stand up time assessment determines how quickly poor areas of the raise might deteriorate after reaming and assesses the long term stability of the raise independently of the McCracken and Stacey method. The stand-up times should be considered as a risk indicator rather than an absolute time to

failure. The stand-up times should be considered as a risk indicator rather than an absolute time to failure.

By adding a 1.1m line to the chart below from the Mining One Report and assigned RMR classifications moved down to that line it can be seen that the raise should not require support using this assessment method.

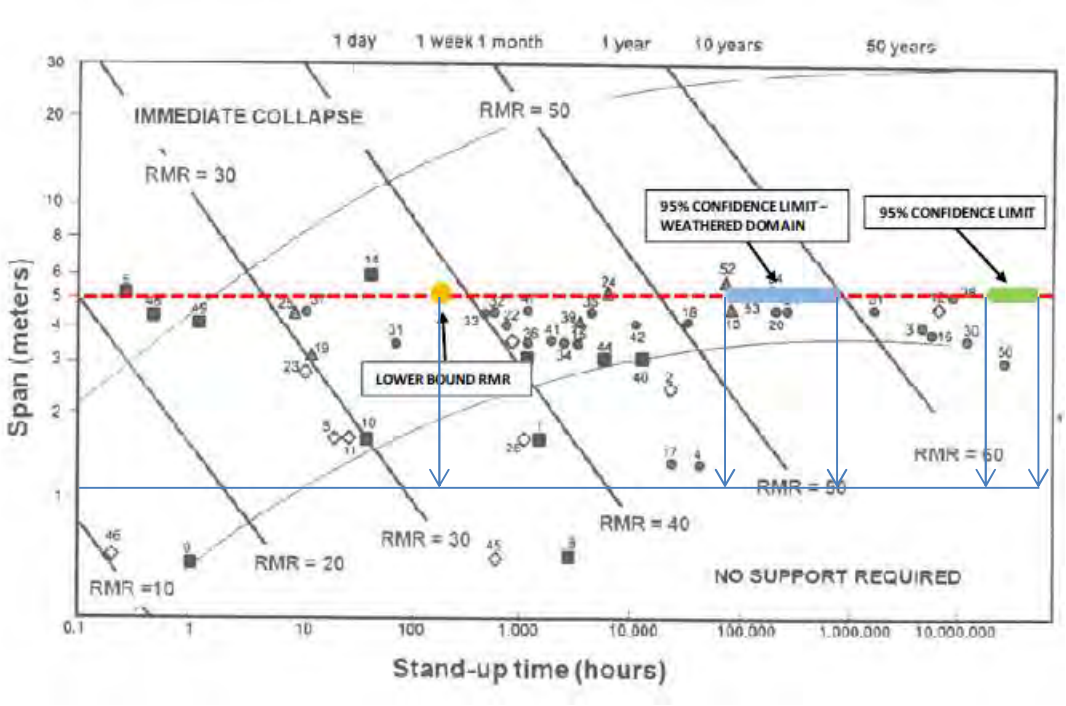


Figure 9: Stand up time assessment for the planned ladderway (blue horizontal line for the RMR classifications from the Mining One assessment.

4.5. Numerical Modelling Assessment

Numerical modelling was not undertaken for this assessment. Elastoplastic numerical modelling was done for the exhaust shaft using Phase2. Models were run at 50m, 200m and 400m. The 50m model showed that a yield zone extended 1.7m (1/3 of shaft diameter) perpendicular to foliation strike, NE-SW, with similar damage shown at 200m. This is thought to be a good indicator of potential damage for the proposed ladderway with 30-40cm of damage predicted to the NE and SW.

4.6. Kinematic analysis

A Kinematic analysis was undertaken using discontinuity measurements contained in the logs and measurements from the Mining One report. Dips was used to determine the major joint sets from the data. The measurements from the complete length of the two diamond drill holes were used to

ensure enough data points, however no major difference was noted from the stereonet for the few readings from the upper part of the holes where the ladderway will be located.

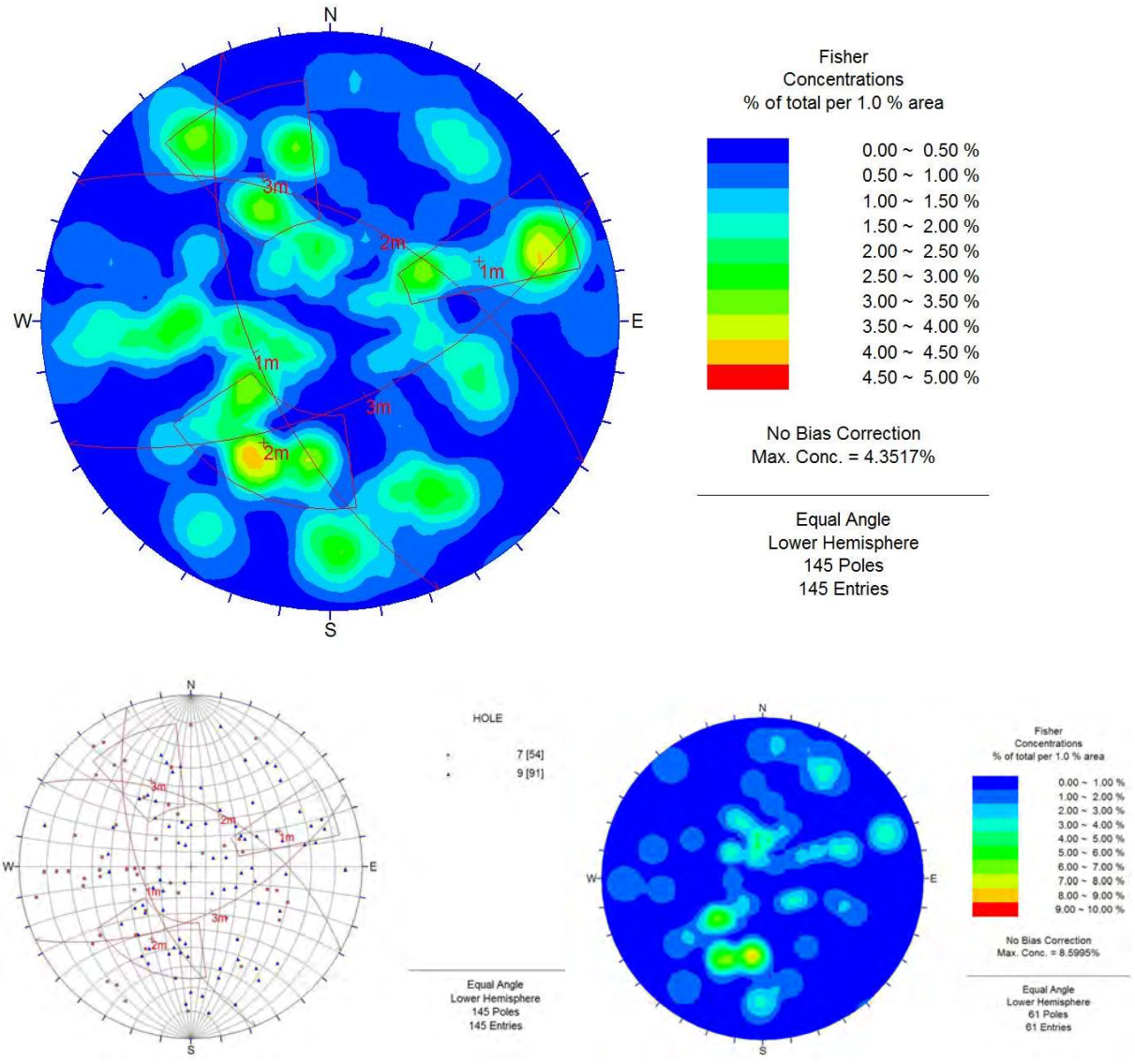


Figure 10: Discontinuity readings from GTDD0007 and GTDD0009. Top - contour plot with major joint sets. Bottom left - pole plot showing hole. Bottom right - contour plot of top 160m of the two holes.

The anlysis showed 7 potential wedges around the perimeter of the proposed ladderway but of small size (less than 10kg) and with high factors of safety, all over 1.

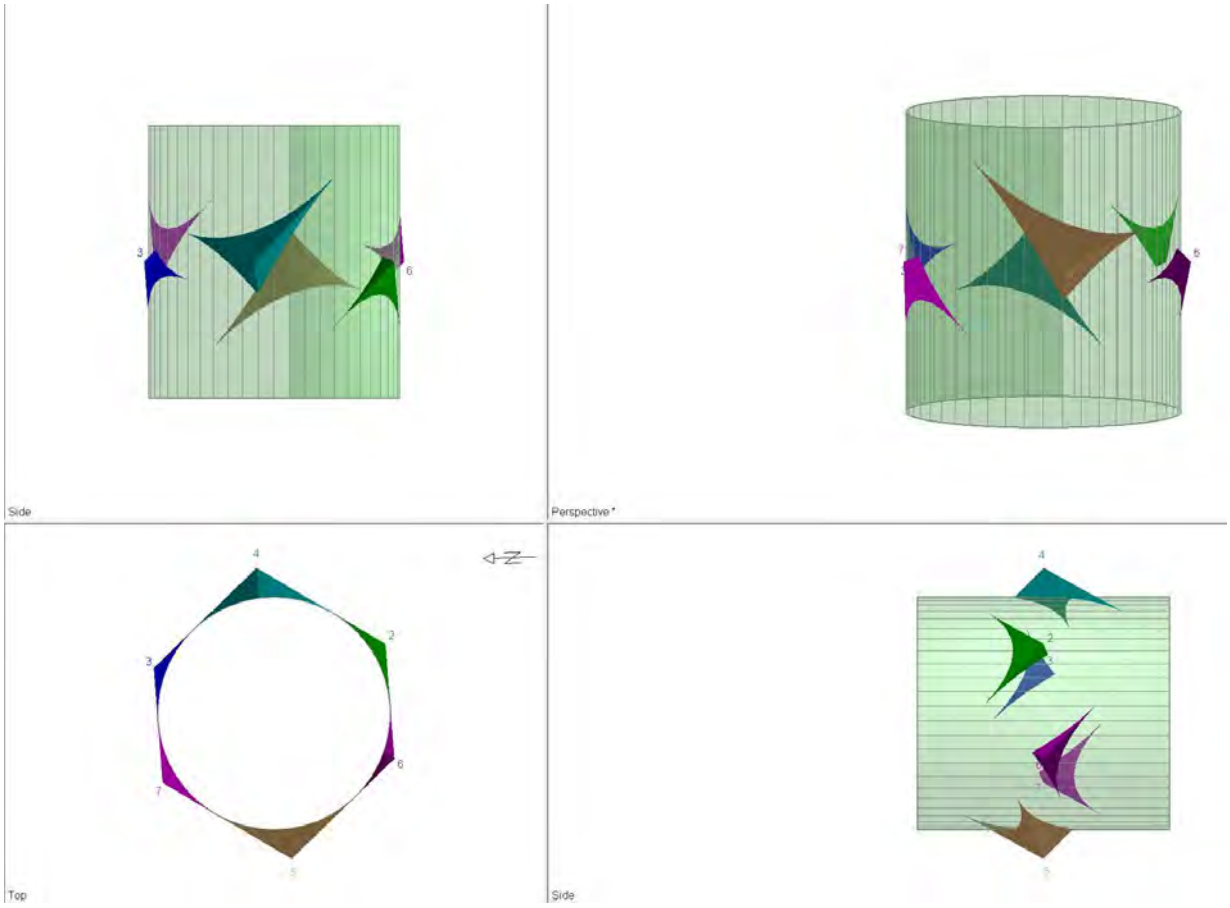


Figure 11: Unwedge analysis for proposed ladderway.

South East wedge [2] Factor of Safety: 286.994 Wedge Weight: 0.002 tonnes	South wedge [6] Factor of Safety: 201.925 Wedge Weight: 0.001 tonnes
North wedge [3] Factor of Safety: 212.821 Wedge Weight: 0.001 tonnes	North West wedge [7] Factor of Safety: 197.565 Wedge Weight: 0.002 tonnes
East wedge [4] Factor of Safety: 75.429 Wedge Weight: 0.008 tonnes	Roof wedge [9] Factor of Safety: 0.000 Wedge Weight: 0.062 tonnes
West wedge [5] Factor of Safety: 168.670 Wedge Weight: 0.008 tonnes	

Figure 12: Wedge information.

A roof wedge was shown of 60 Kg with a factor of safety of 0. This may be an issue if the reamer is removed from the face of the raise during boring.

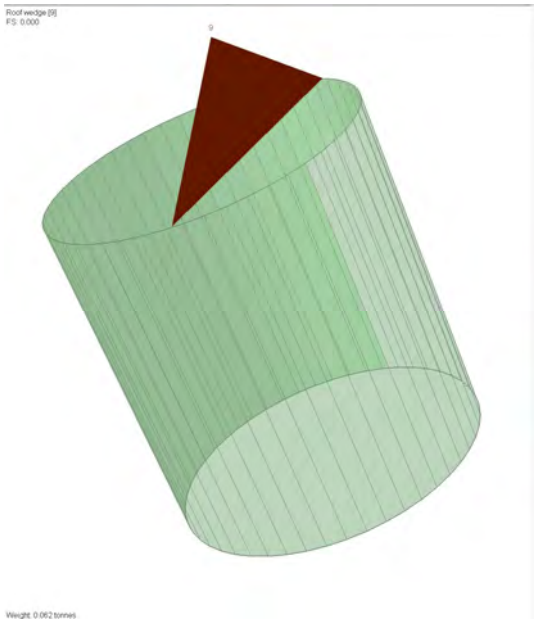


Figure 13: Potential roof wedge.

5. Nearby Stoping

The proposed ladderway is located approximately 300m from the closest western min stope, but the areas closest are inactive. The Inactive Block 11 is located approximately 200m below the proposed ladderway and the effect of stoping on the ladderway is to be assessed if stoping in the area recommences, however none would be expected.

The top sill of the Dickenson Orebody is located approximately 170m to the north and should be considered if an UH retreat is taken in that orebody. However, once again the effects of the lift on the ladderway would be expected to be minimal.

The DSR lift 1 is located approximately 120m to the NE. While the firings at present are small if an UH retreat is taken the effect of the firings on the shaft should be considered. Depending on the size of the firing planned some damage may be expected. An assessment should be made on the preliminary firings to see if a limit is required on firing size.

If a risk of liquefaction is identified in TSF3 (Kintore Pit) a plug will be required below Dickenson's Orebody Access in the Main decline. An alternative means of egress will then be required.

6. Ground Support and reinforcement

Using an ESR (=RSR) of 1.3 the proposed ladderway does not plot on the empirical ground support chart. If the calculated rockmassess are plotted down to the base of the chart the majority of the ladderway would be expected to lie in the area of the chart which can be left unsupported. The lower bound Q value would plot just within area 6, however given the small vertical extent of the poor ground shotcrete lining would be expected to be sufficient.

As stated above it is recommended that a camera survey be taken soon after the completion of raiseboring to assess if support is required before the placement of the ladderway. This would be expected to be limited to the weathered section of the raise, but additional may be required if unrecorded structures are intersected. Annual inspections of the ladderway are recommended.

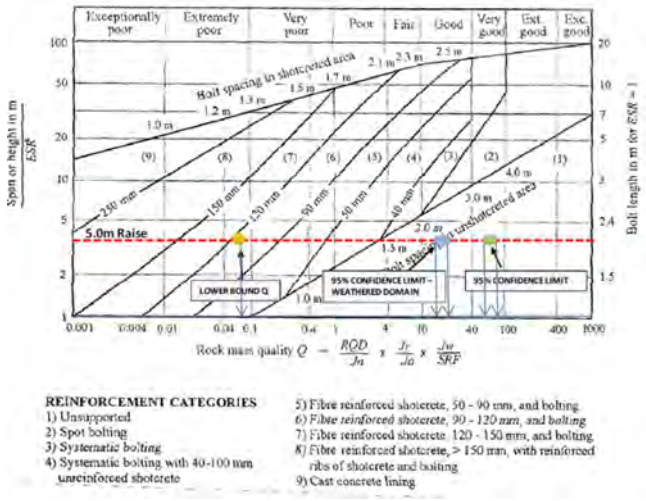


Figure 14: Support requirements for proposed ladderway.

7. Collar

The plans for the ladderway collar are not known at present. The diamond drill cores suggest a 15m layer of fill in the area of which 7m has been excavated for the exhaust shaft access. Trial pitting showed a 3.0m depth to natural ground (report pending).

Any excavations required for the raisebore which will have personnel access must have an engineering design, and care must be taken to ensure that the existing fill slopes are not undercut. Support may be required such as shoring.

Drainage around the final opening should be assessed to prevent water flowing down the ladderway.

8. Summary

The rockmass assessment for the proposed surface to WM DEC SP 1 ladderway is based on two diamond drill holes located 50m to the NW which were put in place to assess the rockmass for the Exhaust Shaft. This information is considered adequate if a camera survey of the raisebore is undertaken before installation of the ladderway to see if support is needed in the raise due to poorer than anticipated ground conditions. If more information is required before the commencement of drilling a diamond drill hole should be put in place closer to the area of the proposed ladderway or remote logging can be undertaken of the pilot hole.

Pilot hole deviation is a risk in the weathered zone and issues may be encountered while drilling through the areas of poor ground and the recorded face wedge if the raisebore head is lowered from the face.

The majority of the ladderway length will be within competent ground and no support should be required. The top 40m of the raise will be within weathered ground and shallow dipping structures may be intersected which may require support in the form of shotcrete lining.

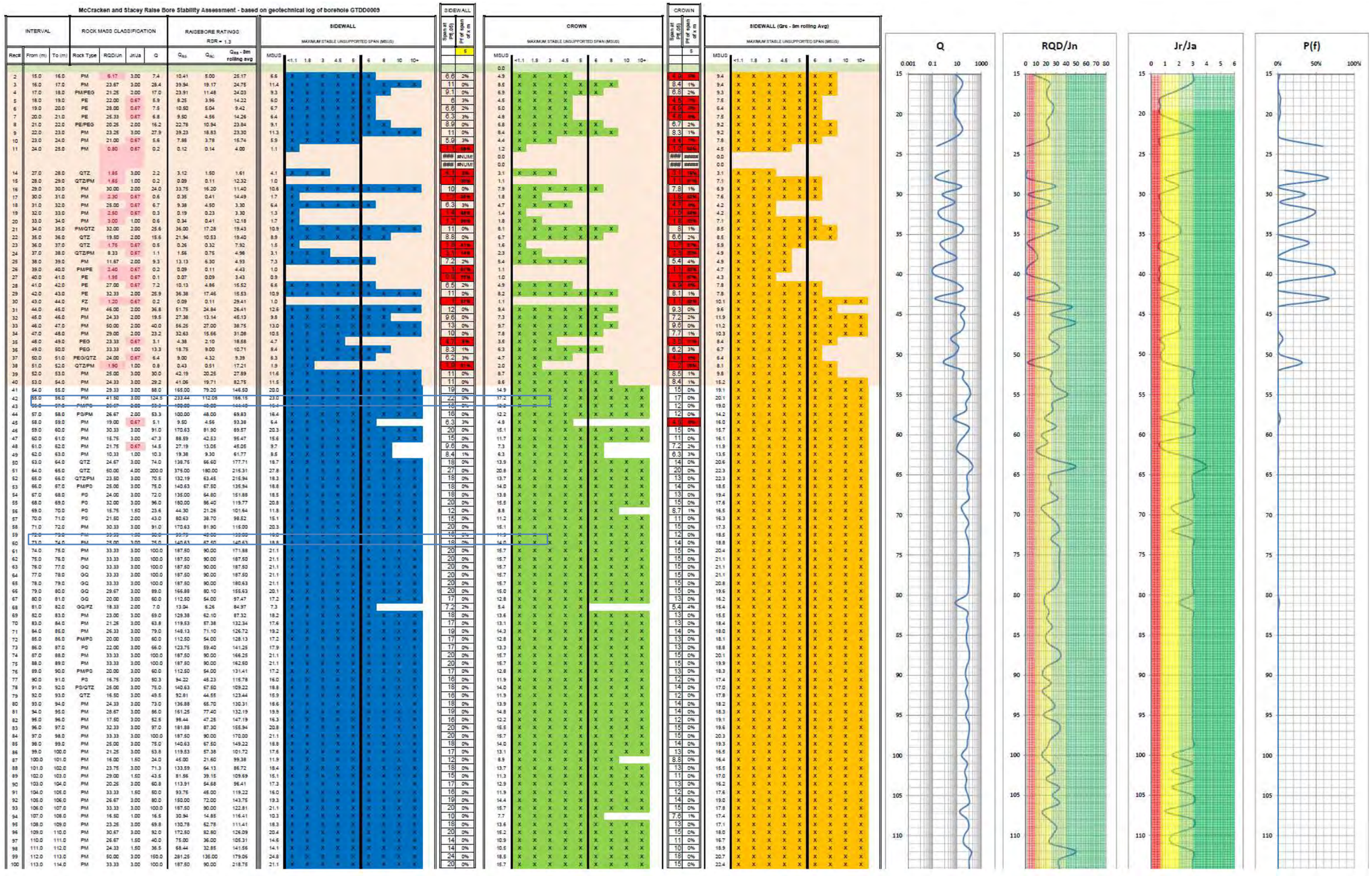
The design of the surface works is yet to be finalised however care should be taken that any excavations do not undercut the existing fill slopes. If access is required to the excavations then they should be excavated to an engineering design to assess if any support is required.

Minor rehab has been specified for the base of the raise in WM DEC SP 1.

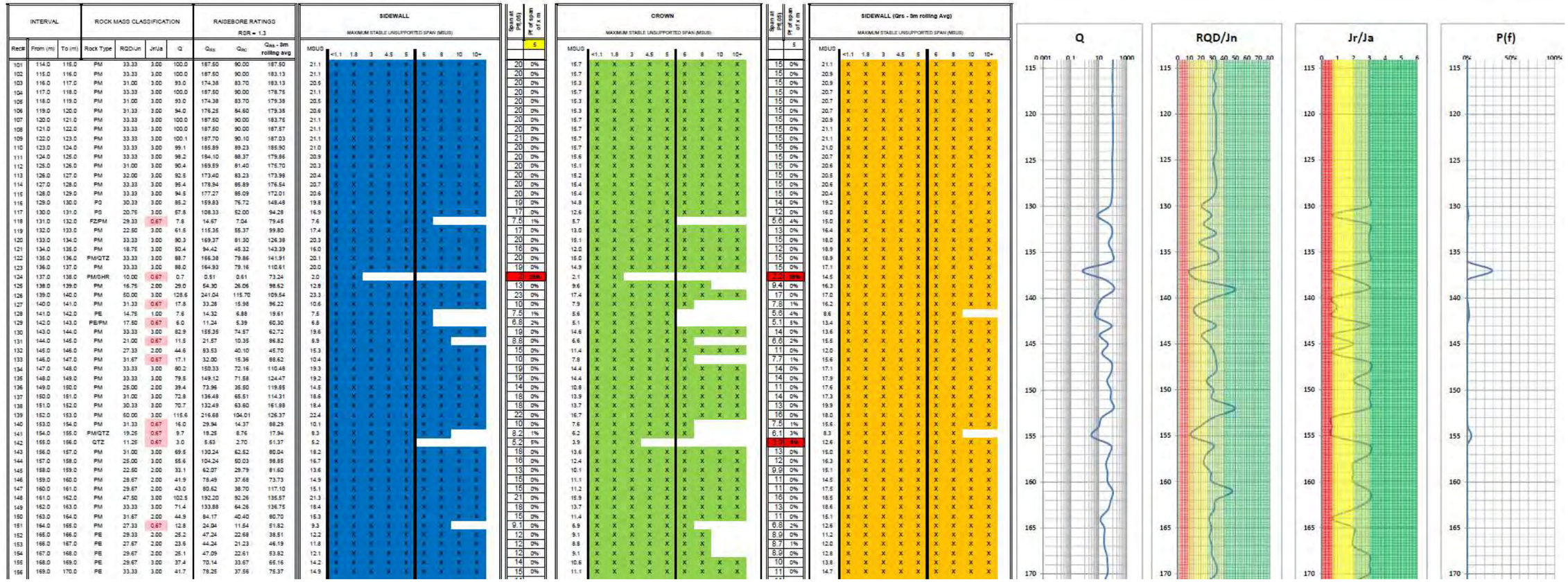
If a risk of liquefaction is identified in TSF3 (Kintore Pit) a plug will be required below Dickenson's Shaft in the Main decline and an alternative means of egress will then be required.

Annual inspections of the ladderway are recommended.

Appendix 1 – Raisebore Stability Assessment



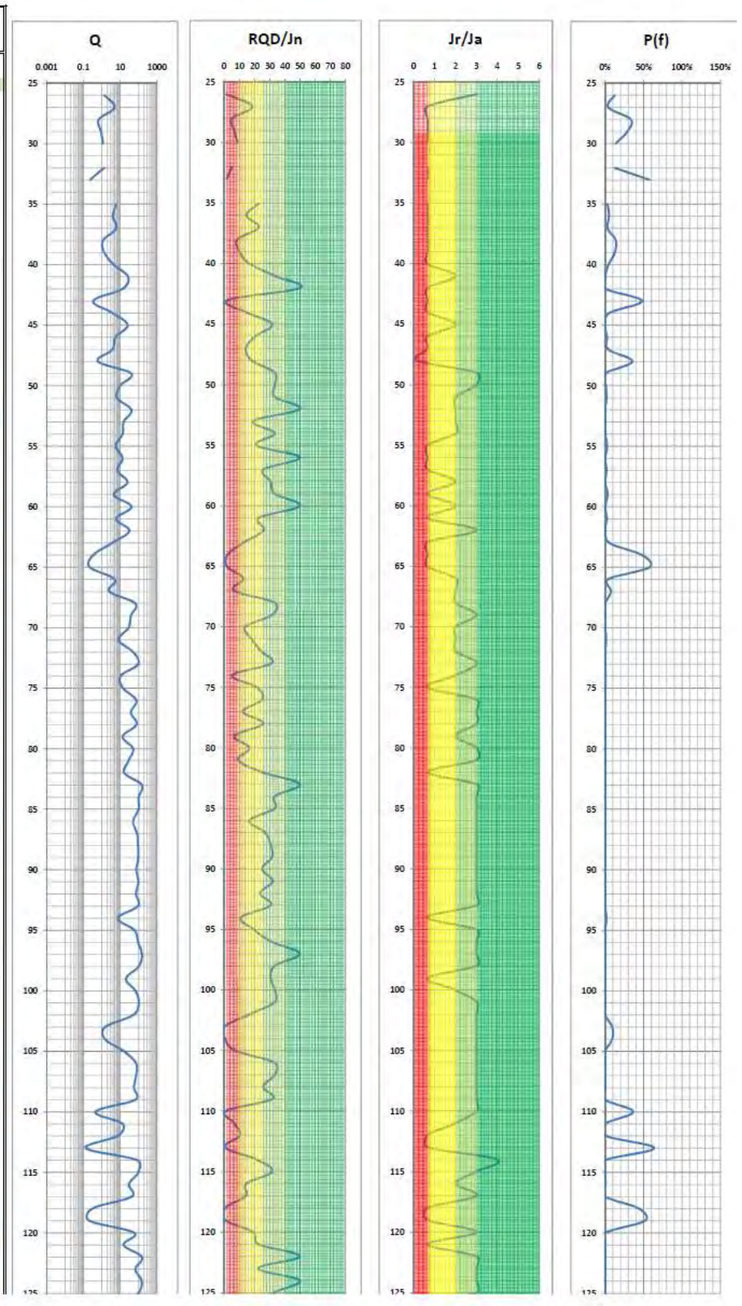
GTDD0009 - 1



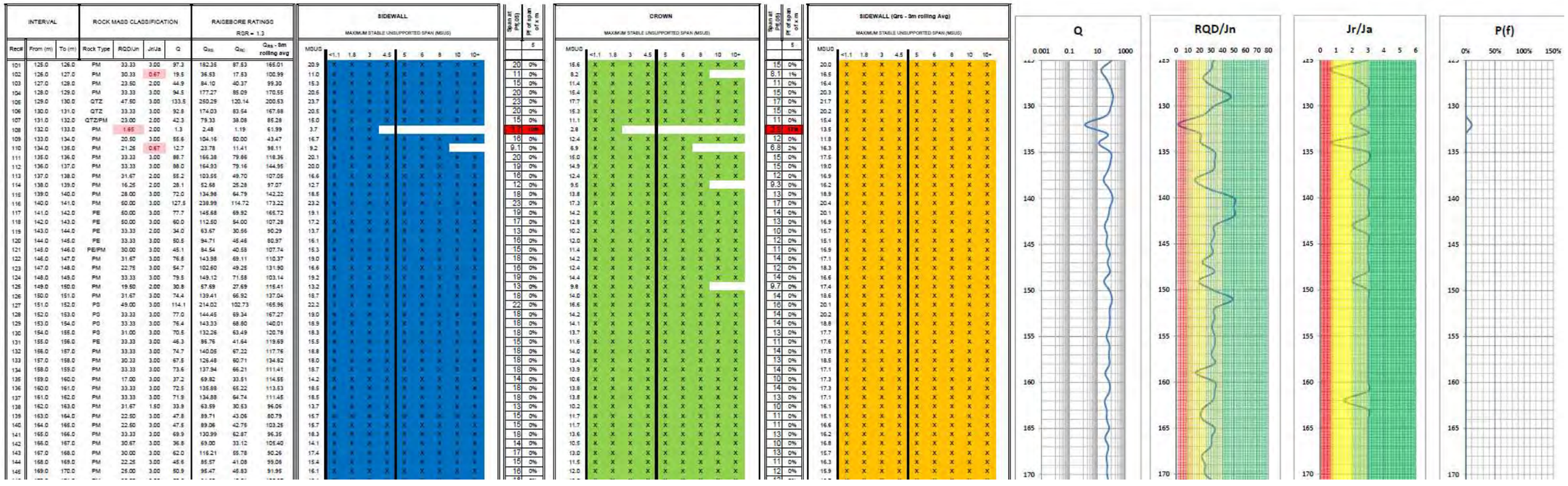
GTDD0009 – 2

McCracken and Stacey Raise Bore Stability Assessment - based on geotechnical log of borehole GTDD0007

INTERVAL			ROCK MASS CLASSIFICATION			RAISEBORE RATINGS RSR = 1.3			SIDEWALL			CROWN			SIDEWALL (Qrs - 3m rolling Avg)
Rec#	From (m)	To (m)	Rock Type	RQD/Jn	Jn/Ja	Q	Q_{RS}	Q_{RC}	Q_{RS} - 3m rolling avg	MSUS	Span at Int. obs.	Pr of span at x m	MSUS	Span at Int. obs.	Pr of span at x m	MSUS
2	26.0	27.0	PM	1.11	3.00	1.3	1.88	0.90	4.41	3.3	3.3	12%	0.0	2.5	20%	4.7
3	27.0	28.0	PM	18.50	0.67	4.9	6.94	3.33	3.07	5.6	5.6	4%	4.2	4.2	5%	4.1
4	28.0	29.0	PM	5.11	0.67	0.7	0.38	0.46	2.61	1.8	1.8	62%	1.9	1.9	92%	3.8
5	29.0	30.0	PM	6.67	0.67	0.9	0.50	0.60	0.85	2.0	2.0	59%	2.1	2.1	89%	2.4
6	30.0	31.0	PM	8.83	0.67	1.2	1.66	0.80	1.08	3.2	3.2	44%	2.4	2.4	28%	2.7
										0.0	###	#NUM!	0.0	###	#####	0.0
8	32.0	33.0	PM	5.00	0.67	1.3	1.88	0.90	1.00	3.3	2.5	27%	2.5	2.5	28%	2.6
9	33.0	34.0	PM	1.67	0.67	0.2	0.13	0.15	1.00	1.1	1.2	68%	1.2	1.2	68%	2.6
										0.0	###	#NUM!	0.0	###	#####	0.0
11	35.0	36.0	PM	23.00	0.67	6.1	9.63	4.14	7.08	6.2	6.1	3%	4.6	4.6	1%	5.7
11	36.0	37.0	PM	14.75	0.67	3.9	5.53	2.66	7.56	6.2	5.1	5%	3.8	3.8	11%	5.8
11	37.0	38.0	PM	22.75	0.67	6.1	9.53	4.10	5.23	6.1	6.1	3%	4.6	4.6	1%	5.0
11	38.0	39.0	PM	8.67	0.67	1.2	1.63	0.78	4.01	3.2	2.4	41%	2.4	2.4	27%	4.6
15	39.0	40.0	PM	10.00	0.67	1.3	1.88	0.90	3.26	3.3	2.5	31%	2.5	2.5	32%	4.2
16	40.0	41.0	PM	16.75	0.67	4.5	6.28	3.02	18.22	5.4	5.4	4%	4.0	4	6%	7.7
17	41.0	42.0	PM	33.33	2.00	26.7	37.50	18.00	20.84	11.1	11	0%	8.3	8.2	1%	8.8
18	42.0	43.0	PM	50.00	0.67	13.3	18.75	9.00	18.81	8.4	8.3	1%	6.3	6.2	3%	8.4
19	43.0	44.0	SHR	2.50	0.67	0.3	0.19	0.23	8.10	1.3	1.3	82%	1.4	1.3	88%	6.0
20	44.0	45.0	PE	14.33	0.67	3.8	5.38	2.58	13.73	5.1	5.1	6%	3.8	3.8	10%	7.4
21	45.0	46.0	PE	31.67	2.00	26.3	35.63	17.10	17.08	10.9	11	0%	8.1	8	1%	8.1
22	46.0	47.0	PM/GG	20.50	0.67	5.5	10.25	4.92	17.67	6.5	6.5	2%	4.9	4.8	3%	8.2
23	47.0	48.0	GG/PM	14.25	0.67	3.8	7.13	3.42	5.91	5.7	5.7	4%	4.3	4.2	6%	5.3
24	48.0	49.0	PM	18.25	0.17	0.6	0.34	0.41	27.49	1.7	1.7	88%	1.8	1.6	88%	9.8
25	49.0	50.0	PE	33.33	3.00	40.0	75.00	36.00	31.36	14.6	14	0%	10.9	11	0%	10.3
26	50.0	51.0	PE	33.33	3.00	10.0	18.75	9.00	36.42	9.4	8.3	1%	6.3	6.2	3%	10.8
27	51.0	52.0	PE	33.33	2.00	6.7	12.50	6.00	36.42	7.1	7.1	2%	5.3	5.3	5%	10.8
28	52.0	53.0	PE	50.00	2.00	40.0	75.00	36.00	38.67	14.6	14	0%	10.9	11	0%	11.2
29	53.0	54.0	PE	19.00	2.00	15.2	28.50	13.68	42.83	9.9	9.8	0%	7.4	7.3	2%	11.7
30	54.0	55.0	PE	33.33	2.00	13.3	25.00	12.00	21.38	9.4	9.3	0%	7.0	7	2%	8.8
31	55.0	56.0	PE	21.25	0.67	5.7	10.63	5.10	20.21	6.7	6.6	2%	5.0	5	4%	8.7
32	56.0	57.0	PE	50.00	0.67	13.3	25.00	12.00	16.21	9.4	9.3	0%	7.0	7	2%	7.9
33	57.0	58.0	PE	26.00	0.67	6.9	13.00	6.24	29.00	7.3	7.2	2%	5.4	5.4	4%	9.9
34	58.0	59.0	PE	30.67	2.00	24.5	46.00	22.08	22.44	12.0	12	0%	9.0	8.8	0%	9.0
35	59.0	60.0	PE	33.33	0.67	4.4	8.33	4.00	43.11	6.1	6	3%	4.5	4	7%	11.7
36	60.0	61.0	PE	50.00	2.00	40.0	75.00	36.00	31.67	14.6	14	0%	10.9	11	0%	10.3
37	61.0	62.0	PE	22.75	0.67	6.1	11.38	5.46	48.29	6.9	6.8	2%	5.1	5.1	5%	12.3
38	62.0	63.0	PE/PM	26.00	3.00	31.2	58.50	28.08	24.96	13.2	13	0%	9.9	9.7	2%	9.4
39	63.0	64.0	PM	13.33	0.67	3.6	5.00	2.40	21.23	4.9	4.9	5%	3.7	3.7	10%	8.8
40	64.0	65.0	PM	2.50	0.67	0.3	0.19	0.23	1.77	1.3	1.4	88%	1.4	1.5	88%	3.3
41	65.0	66.0	PM	1.67	0.67	0.2	0.13	0.15	2.45	1.1	1.2	88%	1.2	1.3	88%	3.7
42	66.0	67.0	PM	12.50	2.00	5.0	7.03	3.38	3.57	5.7	5.6	4%	4.2	4.2	5%	4.3
43	67.0	68.0	PM	5.33	2.00	2.1	3.25	1.71	15.20	4.2	4.2	15%	4.2	4.2	15%	11.9
44	68.0	69.0	PM	33.33	2.00	66.7	125.00	60.00	66.60	17.5	17	0%	13.4	13	0%	13.9
45	69.0	70.0	PM	31.67	3.00	38.0	71.25	34.20	82.92	14.3	14	0%	10.7	10	0%	16.2
46	70.0	71.0	PM	14.00	2.00	28.0	52.50	25.20	46.24	12.7	12	0%	9.8	9.3	0%	12.0
47	71.0	72.0	SHR	18.00	2.00	8.0	14.96	7.18	52.90	7.7	7.6	1%	5.7	5.7	4%	12.7
48	72.0	73.0	PM/PEGG	24.33	2.00	48.7	91.25	43.80	94.15	15.8	15	0%	11.8	12	0%	16.0
49	73.0	74.0	PM	31.33	3.00	94.0	176.25	84.60	95.63	20.6	20	0%	15.3	15	0%	16.1
50	74.0	75.0	PM	5.17	2.00	10.3	19.38	9.30	74.24	9.5	8.4	1%	6.3	6.3	3%	14.6
51	75.0	76.0	PM	21.67	0.67	14.4	27.08	13.00	62.36	9.7	9.6	0%	7.3	7.2	2%	13.6
52	76.0	77.0	PM	25.00	3.00	75.0	140.63	67.50	79.34	18.8	18	0%	14.0	14	0%	16.0
53	77.0	78.0	PM	12.50	3.00	37.5	70.31	33.75	118.44	14.2	14	0%	10.6	10	0%	17.6
54	78.0	79.0	PM	25.67	3.00	77.0	144.38	69.30	80.00	19.0	18	0%	14.2	14	0%	15.0
55	79.0	80.0	PM	6.75	2.00	13.5	26.31	12.15	67.81	9.5	9.3	0%	7.1	7	2%	15.6
56	80.0	81.0	PM	16.67	3.00	50.0	93.75	45.00	97.03	16.0	16	0%	11.9	12	0%	13.1
57	81.0	82.0	PM	9.25	3.00	27.8	52.03	24.98	59.01	12.6	12	0%	9.4	9.3	0%	13.3
58	82.0	83.0	PM	26.00	0.67	16.7	31.25	15.00	131.51	10.3	10	0%	7.7	7.7	1%	17.1
59	83.0	84.0	PM	50.00	3.00	150.0	281.25	135.00	166.57	24.8	24	0%	18.5	18	0%	20.1
60	84.0	85.0	PM	33.33	3.00	100.0	187.50	90.00	218.75	21.1	20	0%	15.7	15	0%	22.4
61	85.0	86.0	PM	50.00	3.00	100.0	187.50	90.00	150.25	21.1	20	0%	15.7	15	0%	19.6
62	86.0	87.0	PM	16.67	3.00	50.0	93.75	45.00	144.38	16.0	16	0%	11.9	12	0%	19.0
63	87.0	88.0	PM	27.00	3.00	81.0	151.88	72.90	139.38	19.4	19	0%	14.5	14	0%	18.7
64	88.0	89.0	PM	30.67	3.00	92.0	172.50	82.80	167.50	20.4	20	0%	15.2	15	0%	20.2
65	89.0	90.0	PM	31.67	3.00	95.0	178.13	85.50	163.75	20.7	20	0%	15.4	15	0%	20.0
66	90.0	91.0	PM	25.00	3.00	75.0	140.63	67.50	166.25	18.8	18	0%	14.0	14	0%	20.1
67	91.0	92.0	PM	32.00	3.00	96.0	180.00	86.40	151.41	20.8	20	0%	15.5	15	0%	19.4
68	92.0	93.0	PM	23.75	3.00	71.3	133.59	64.13	162.03	18.4	18	0%	13.7	13	0%	19.9
69	93.0	94.0	PM	30.67	3.00	92.0	172.50	82.80	106.61	20.4	20	0%	15.2	15	0%	16.8
70	94.0	95.0	PM	11.00	0.67	7.3	13.75	6.60	98.65	7.4	7.3	2%	5.6	5.5	4%	16.3
71	95.0	96.0	PM	19.50	3.00	58.5	109.69	52.66	99.27	17.0	17	0%	12.7	12	0%	16.4
72	96.0	97.0	PM	31.00	3.00	93.0	174.38	83.70	168.44	20.5	20	0%	15.3	15	0%	21.1
73	97.0	98.0	PM	50.00	3.00	150.0	281.25	135.00	214.38	24.8	24	0%	18.5	18	0%	22.3
74	98.0	99.0	PM	33.33	3.00	100.0	187.50	90.00	169.03	21.1	20	0%	15.7	15	0%	20.2
75	99.0	100.0	PM	30.67	0.67	20.4	38.33	18.40	116.94	11.2	11	0%	8.3	8.2	1%	17.5
76	100.0	101.0	PM	33.33	2.00	66.7	125.00	60.00	116.94	17.9	17	0%	13.4	13	0%	17.5
77	101.0	102.0	PM	33.33	3.00	100.0	187.50	90.00	136.04	21.1	20	0%	15.7	15	0%	18.6
78	102.0	103.0	PM	17.00	3.00	51.0	95.63	45.90	95.31	16.1	16	0%	12.0	12	0%	16.1
79	103.0	104.0	PM	0.50	3.00	1.5	2.81	1.35	33.75	3.9	3.8	9%	2.9	2.9	19%	10.6
80	104.0	105.0	PM	0.50	3.00	1.5	2.81	1.35	11.53	3.9	3.8	9%	2.9	2.9	19%	6.9
81	105.0	106.0	PE	7.00	3.00	15.4	28.97	13.90	56.06	10.0	9.8	0%	7.5	7.4	1%	13.0
82	106.0	107.0	PE	33.33	3.00	72.7	136.39	65.47	100.09	18.6	18	0%	13.8	14	0%	16.4
83	107.0	108.0	PE	33.33	3.00	71.9	134.88	64.74	124.66	18.5	18	0%	13.8	13	0%	17.9
84	108.0	109.0	PE	25.67	3.00	54.8	102.71	49.30	120.98	16.6	16	0%	12.4	12	0%	17.7
85	109.0	110.0	PE	31.67	3.00	66.8	126.34	60.16	76.13	18.0	17	0%	13.4	13	0%	14.7
86	110.0	111.0	SHR	1.10	3.00	0.4	0.33	0.39	60.22	1.7	1.8	84%	1.8	1.8	84%	12.5
87	111.0	112.0	QTZ	6.67	2.00	13.3	25.00	12.00	12.75	9.4	9.3	0%	7.0	7	2%	7.2
88	112.0	113.0	QTZ	10.33	0.67	6.9	12.92	6.20	25.67	7.2	7.4	2%	5.4	5.4	4%	7.2
89	113.0	114.0	QTZ	0.50	0.67	0.1	0.10	0.12	57.67	1.0	1.1	94%	1.1	1.1	94%	13.2
90	114.0	115.0	QTZ	21.33	4.00	85.3	160.00	76.80	112.74	19.8	19	0%	14.8	14	0%	17.2
91	115.0	116.0	QTZ	31.67	3.00	95.0	178.13	85.50	131.04	20.7	20	0%	15.4	15	0%	18.3
92	116.0	117.0	QTZ	14.67	2.00	29.3	55.00	26.40	104.43	12.9	13	0%	9.6	9.5	0%	16.7
93	117.0	118.0	QTZ	14.25	3.00	42.8	80.16	38.48	46.13	15.0	15	0%	11.2	11	0%	11.9
94	118.0	119.0	QTZ/SHR	0.70	0.67	0.3	0.22	0.27	26.86	1.4	1.5	84%	1.5	1.5	84%	9.7
95	119.0	120.0	SHR	0.50	0.67	0.2	0.16	0.19	38.75	1.2	1.3	89%	1.3	1.3	89%	10.9
96	120.0	121.0	PM	19.00	3.00	57.0	106.88	51.30	48.12	16.8	16	0%	12.6	12	0%	11.9
97	121.0	122.0	PM	22.67	0.67	15.1	28.33	13.60	138.92	9.9	9.7	0%	7.4	7.3	2%	18.7
98	122.0	123.0	PM	50.00	3.00	150.2	281.55	135.15	144.81	24.8	24	0%	18.5	18	0%	19.0
99	123.0	124.0	PM	22.33	3.00	66.4	124.54	59.78	227.42	17.9	17	0%	13.4	13	0%	22.8
100	124.0	125.0	PM	50.00	3.00	147.3	276.16	132.55	194.35	24.6	24	0%	18.4	18	0%	21.4



GTDDD0007 – 1



INTERVAL			ROCK MASS CLASSIFICATION			RAISEBORE RATINGS RQR = 1.3			SIDEWALL MAXIMUM STABLE UNSUPPORTED SPAN (MSUS)											Span at P(50)	% of span o.f. x m	CROWN MAXIMUM STABLE UNSUPPORTED SPAN (MSUS)											Span at P(50)	% of span o.f. x m	SIDEWALL (Qrs - 9m rolling Avg) MAXIMUM STABLE UNSUPPORTED SPAN (MSUS)										
Rec#	From (m)	To (m)	Rock Type	RQD/Jn	Jr/Ja	Q	Q_{RR}	Q_{RC}	MSUS	<1.1	1.8	3	4.5	5	6	8	10	10+	5		MSUS	<1.1	1.8	3	4.5	5	6	8	10	10+	5		MSUS	<1.1	1.8	3	4.5	5	6	8	10	10+
101	126.0	126.0	PM	33.33	3.00	97.3	182.36	87.53	165.01	20.9	X	X	X	X	X	X	X	X	X	20	0%	15.6	X	X	X	X	X	X	X	X	X	15	0%	20.0	X	X	X	X	X	X	X	X	X
102	126.0	127.0	PM	30.33	0.67	19.5	36.53	17.53	100.99	11.0	X	X	X	X	X	X	X			11	0%	8.2	X	X	X	X	X	X	X	X		8.1	1%	16.5	X	X	X	X	X	X	X	X	
103	127.0	128.0	PM	23.50	2.00	44.9	84.10	40.37	99.30	15.3	X	X	X	X	X	X	X	X	X	15	0%	11.4	X	X	X	X	X	X	X	X	X	11	0%	16.4	X	X	X	X	X	X	X	X	X
104	128.0	129.0	PM	33.33	3.00	94.5	177.27	85.09	170.55	20.6	X	X	X	X	X	X	X	X	X	20	0%	15.4	X	X	X	X	X	X	X	X	X	15	0%	20.3	X	X	X	X	X	X	X	X	X
105	129.0	130.0	QTZ	47.50	3.00	133.5	250.29	120.14	200.53	23.7	X	X	X	X	X	X	X	X	X	23	0%	17.7	X	X	X	X	X	X	X	X	X	17	0%	21.7	X	X	X	X	X	X	X	X	X
106	130.0	131.0	QTZ	33.33	3.00	92.8	174.03	83.54	167.88	20.5	X	X	X	X	X	X	X	X	X	20	0%	15.3	X	X	X	X	X	X	X	X	X	15	0%	20.2	X	X	X	X	X	X	X	X	X
107	131.0	132.0	QTZ/PM	23.00	2.00	42.3	79.33	38.08	85.28	15.0	X	X	X	X	X	X	X	X	X	15	0%	11.1	X	X	X	X	X	X	X	X	X	11	0%	15.4	X	X	X	X	X	X	X	X	X
108	132.0	133.0	PM	1.65	2.00	1.3	2.48	1.19	61.99	3.7	10m									3.7	10m	2.8	X	X								3.7	10m	13.6	X	X	X	X	X	X	X	X	X
109	133.0	134.0	PM	20.50	3.00	56.6	104.16	50.00	43.47	16.7	X	X	X	X	X	X	X	X	X	16	0%	12.4	X	X	X	X	X	X	X	X	X	12	0%	11.8	X	X	X	X	X	X	X	X	X
110	134.0	135.0	PM	21.25	0.67	12.7	23.78	11.41	98.11	9.2	X	X	X	X	X	X	X			9.1	0%	6.9	X	X	X	X	X	X				6.8	2%	16.3	X	X	X	X	X	X	X	X	
111	135.0	136.0	PM	33.33	3.00	88.7	166.38	79.86	118.36	20.1	X	X	X	X	X	X	X	X	X	20	0%	15.0	X	X	X	X	X	X	X	X	X	15	0%	17.5	X	X	X	X	X	X	X	X	X
112	136.0	137.0	PM	33.33	3.00	88.0	164.93	79.16	144.95	20.0	X	X	X	X	X	X	X	X	X	19	0%	14.9	X	X	X	X	X	X	X	X	X	15	0%	19.0	X	X	X	X	X	X	X	X	X
113	137.0	138.0	PM	31.67	2.00	55.2	103.55	49.70	107.05	16.6	X	X	X	X	X	X	X	X	X	16	0%	12.4	X	X	X	X	X	X	X	X	X	12	0%	16.9	X	X	X	X	X	X	X	X	X
114	138.0	139.0	PM	16.25	2.00	28.1	52.68	25.28	97.07	12.7	X	X	X	X	X	X	X			12	0%	9.5	X	X	X	X	X	X				9.3	0%	16.2	X	X	X	X	X	X	X	X	
115	139.0	140.0	PM	28.00	3.00	72.0	134.98	64.79	142.22	18.5	X	X	X	X	X	X	X	X	X	18	0%	13.8	X	X	X	X	X	X	X	X	X	13	0%	18.9	X	X	X	X	X	X	X	X	X
116	140.0	141.0	PM	50.00	3.00	127.5	238.99	114.72	173.22	23.2	X	X	X	X	X	X	X	X	X	23	0%	17.3	X	X	X	X	X	X	X	X	X	17	0%	20.4	X	X	X	X	X	X	X	X	X
117	141.0	142.0	PE	50.00	3.00	77.7	145.68	69.92	165.72	19.1	X	X	X	X	X	X	X	X	X	19	0%	14.2	X	X	X	X	X	X	X	X	X	14	0%	20.1	X	X	X	X	X	X	X	X	X
118	142.0	143.0	PE	50.00	3.00	60.0	112.50	54.00	107.28	17.2	X	X	X	X	X	X	X	X	X	17	0%	12.8	X	X	X	X	X	X	X	X	X	13	0%	16.9	X	X	X	X	X	X	X	X	X
119	143.0	144.0	PE	33.33	2.00	34.0	63.67	30.66	90.29	13.7	X	X	X	X	X	X	X	X	X	13	0%	10.2	X	X	X	X	X	X	X	X	X	10	0%	15.7	X	X	X	X	X	X	X	X	X
120	144.0	145.0	PE	33.33	3.00	50.5	94.71	45.46	80.97	16.1	X	X	X	X	X	X	X	X	X	16	0%	12.0	X	X	X	X	X	X	X	X	X	12	0%	15.1	X	X	X	X	X	X	X	X	X
121	145.0	146.0	PE/PM	30.00	3.00	45.1	84.54	40.58	107.74	15.3	X	X	X	X	X	X	X	X	X	15	0%	11.4	X	X	X	X	X	X	X	X	X	11	0%	16.9	X	X	X	X	X	X	X	X	X
122	146.0	147.0	PM	31.67	3.00	76.8	143.98	69.11	110.37	19.0	X	X	X	X	X	X	X	X	X	18	0%	14.2	X	X	X	X	X	X	X	X	X	14	0%	17.1	X	X	X	X	X	X	X	X	X
123	147.0	148.0	PM	22.75	3.00	54.7	102.50	49.20	131.90	16.6	X	X	X	X	X	X	X	X	X	16	0%	12.4	X	X	X	X	X	X	X	X	X	12	0%	18.3	X	X	X	X	X	X	X	X	X
124	148.0	149.0	PM	33.33	3.00	79.5	149.12	71.58	103.14	19.2	X	X	X	X	X	X	X	X	X	19	0%	14.4	X	X	X	X	X	X	X	X	X	14	0%	16.6	X	X	X	X	X	X	X	X	X
125	149.0	150.0	PM	19.50	2.00	30.8	57.69	27.69	115.41	13.2	X	X	X	X	X	X	X			13	0%	9.8	X	X	X	X	X	X				9.7	0%	17.4	X	X	X	X	X	X	X	X	
126	150.0	151.0	PM	31.67	3.00	74.4	139.41	66.92	137.04	18.7	X	X	X	X	X	X	X	X	X	18	0%	14.0	X	X	X	X	X	X	X	X	X	14	0%	18.6	X	X	X	X	X	X	X	X	X
127	151.0	152.0	PG	49.00	3.00	114.1	214.02	102.73	165.96	22.2	X	X	X	X	X	X	X	X	X	22	0%	16.6	X	X	X	X	X	X	X	X	X	16	0%	20.1	X	X	X	X	X	X	X	X	X
128	152.0	153.0	PG	33.33	3.00	77.0	144.45	69.34	167.27	19.0	X	X	X	X	X	X	X	X	X	18	0%	14.2	X	X	X	X	X	X	X	X	X	14	0%	20.2	X	X	X	X	X	X	X	X	X
129	153.0	154.0	PG	33.33	3.00	76.4	143.33	68.80	140.01	18.9	X	X	X	X	X	X	X	X	X	18	0%	14.1	X	X	X	X	X	X	X	X	X	14	0%	18.8	X	X	X	X	X	X	X	X	X
130	154.0	155.0	PG	31.00	3.00	70.5	132.26	63.49	120.78	18.3	X	X	X	X	X	X	X	X	X	18	0%	13.7	X	X	X	X	X	X	X	X	X	13	0%	17.7	X	X	X	X	X	X	X	X	X
131	155.0	156.0	PE	33.33	3.00	46.3	86.76	41.64	119.69	15.5	X	X	X	X	X	X	X	X	X	15	0%	11.6	X	X	X	X	X	X	X	X	X	11	0%	17.6	X	X	X	X	X	X	X	X	X
132	156.0	157.0	PM	33.33	3.00	74.7	140.05	67.22	117.76	18.8	X	X	X	X	X	X	X	X	X	18	0%	14.0	X	X	X	X	X	X	X	X	X	14	0%	17.6	X	X	X	X	X	X	X	X	X
133	157.0	158.0	PM	30.33	3.00	67.5	126.48	60.71	134.82	18.0	X	X	X	X	X	X	X	X	X	18	0%	13.4	X	X	X	X	X	X	X	X	X	13	0%	18.6	X	X	X	X	X	X	X	X	X
134	158.0	159.0	PM	33.33	3.00	73.6	137.94	66.21	111.41	18.7	X	X	X	X	X	X	X	X	X	18	0%	13.9	X	X	X	X	X	X	X	X	X	14	0%	17.1	X	X	X	X	X	X	X	X	X
135	159.0	160.0	PM	17.00	3.00	37.2	69.82	33.51	114.55	14.2	X	X	X	X	X	X	X			14	0%	10.6	X	X	X	X	X	X	X	X	X	10	0%	17.3	X	X	X	X	X	X	X	X	X
136	160.0	161.0	PM	33.33	3.00	72.5	135.88	65.22	113.53	18.5	X	X	X	X	X	X	X	X	X	18	0%	13.8	X	X	X	X	X	X	X	X	X	14	0%	17.3	X	X	X	X	X	X	X	X	X
137	161.0	162.0	PM	33.33	3.00	71.9	134.88	64.74	111.45	18.5	X	X	X	X	X	X	X	X	X	18	0%	13.8	X	X	X	X	X	X	X	X	X	13	0%	17.1	X	X	X	X	X	X	X	X	X
138	162.0	163.0	PM	31.67	1.50	33.8	63.59	30.53	96.06	13.7	X	X	X	X	X	X	X	X	X	13	0%	10.2	X	X	X	X	X	X	X	X	X	10	0%	16.1	X	X	X	X	X	X	X	X	X
139	163.0	164.0	PM	22.50	3.00	47.8	89.71	43.06	80.79	15.7	X	X	X	X	X	X	X	X	X	15	0%	11.7	X	X	X	X	X	X	X	X	X	11	0%	15.1	X	X	X	X	X	X	X	X	X
140	164.0	165.0	PM	22.50	3.00	47.5	89.06	42.75	103.25	15.7	X	X	X	X	X	X	X	X	X	15	0%	11.7	X	X	X	X	X	X	X	X	X	11	0%	16.6	X	X	X	X	X	X	X	X	X
141	165.0	166.0	PM	33.33	3.00	69.9	130.99	62.87	96.35	18.3	X	X	X	X	X	X	X	X	X	18	0%	13.6	X	X	X	X	X	X	X	X	X	13	0%	16.2	X	X	X	X	X	X	X	X	X
142	166.0	167.0	PM	30.67	3.00	36.8	69.00	33.12	105.40	14.1	X	X	X	X	X	X	X			14	0%	10.5	X	X	X	X	X	X	X	X	X	10	0%	16.8	X	X	X	X	X	X	X	X	X
143	167.0	168.0	PM	30.00	3.00	62.0	116.21	55.78	90.26	17.4	X	X	X	X	X	X	X	X	X	17	0%	13.0	X	X	X	X	X	X	X	X	X	13	0%	15.7	X	X	X	X	X	X	X	X	X
144	168.0	169.0	PM	22.25	3.00	45.6	85.57	41.08	99.06	15.4	X	X	X	X	X	X	X	X	X	15	0%	11.5	X	X	X	X	X	X	X	X	X	11	0%	16.3	X	X	X	X	X	X	X	X	X
145	169.0	170.0	PM	25.00	3.00	50.9	95.47	45.93	91.95	16.1	X	X	X	X	X	X	X	X	X	16	0%	12.0	X	X	X	X	X	X	X	X	X	12	0%	15.9	X	X	X	X	X	X	X	X	X

Appendix 2 – Core photos of MSUS < 1.1m

Appendix B

Mod 9 blast and vibration assessment

B.1 Blast and vibration assessment

Prism Mining
Prism Mining Pty Ltd
ABN 43 144 650 126

16 Rosewood St
Bardon QLD 4065

TO: Eamonn Dare, Technical Services Superintendent, Broken Hill Operations Pty Ltd

FROM: Mike Humphreys, Principal D&B Engineer, Prism Mining Pty Ltd
Email: Mike.Humphreys@PrismMining.com.au

SUBJECT: BLAST VIBRATION ASSESSMENT – MOD9 DEVELOPMENT, JULY 2021

DATE: 8TH JULY 2021

BLAST VIBRATION IMPACT ASSESSMENT FOR THE PROPOSED MOD9 DEVELOPMENT (7L NTH EXD / BLACKWOODS ACCESS) AT RASP MINE

SUMMARY

New development is required as part of a modification to the project approval at Rasp Mine (Mod9) in order to access the proposed Blackwoods mining area (see Figure 1).

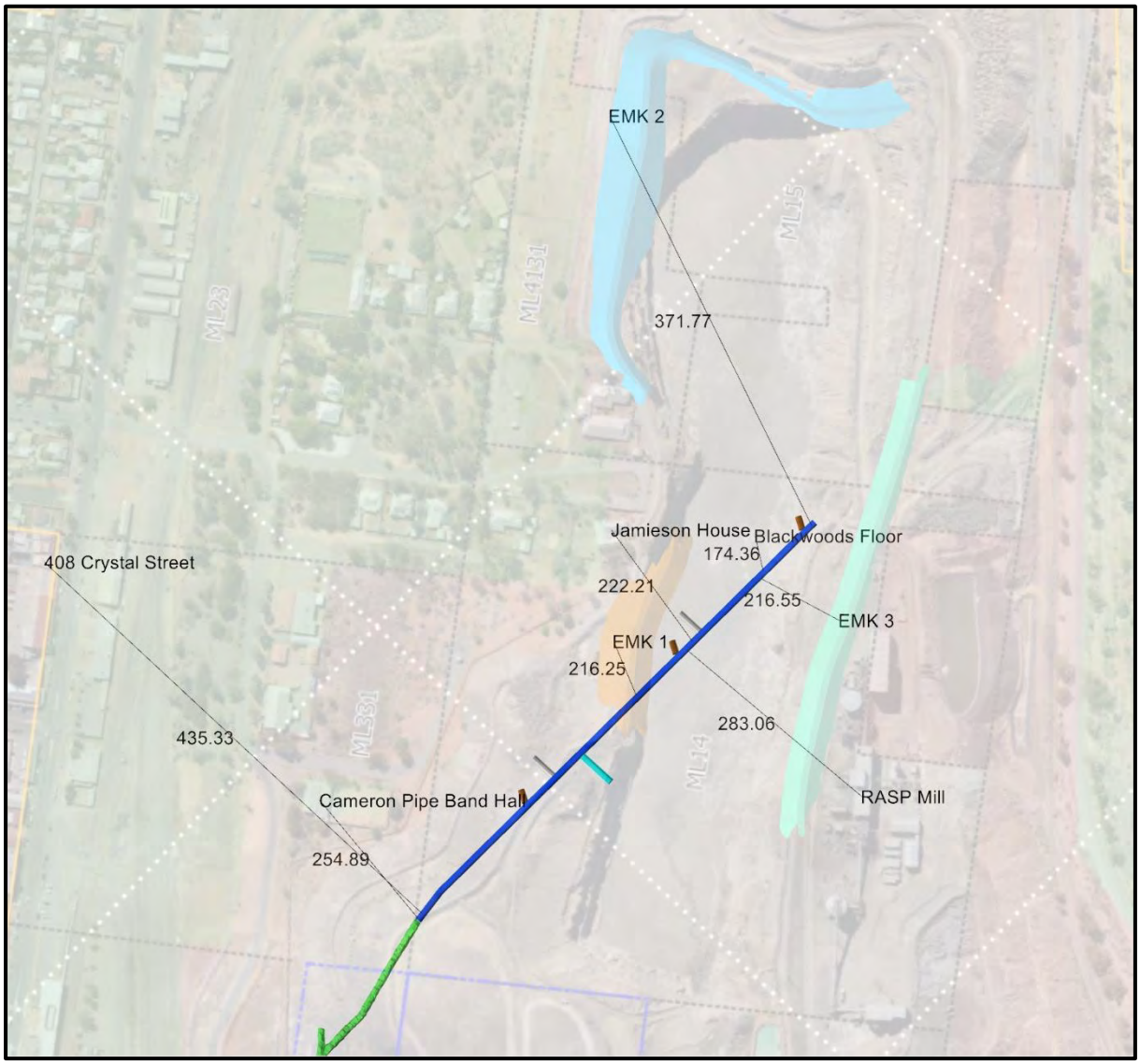
Development blasting for 7L NTH EXD / Blackwoods Access will be carried out using methods already in use at Rasp Mine, with 45mm diameter blastholes, an approximate charge mass of 5kg to 6kg per hole, and long period delay detonators (Orica Exel LP). An example of a Rasp Mine development blast layout and initiation sequence is illustrated in Appendix 1.

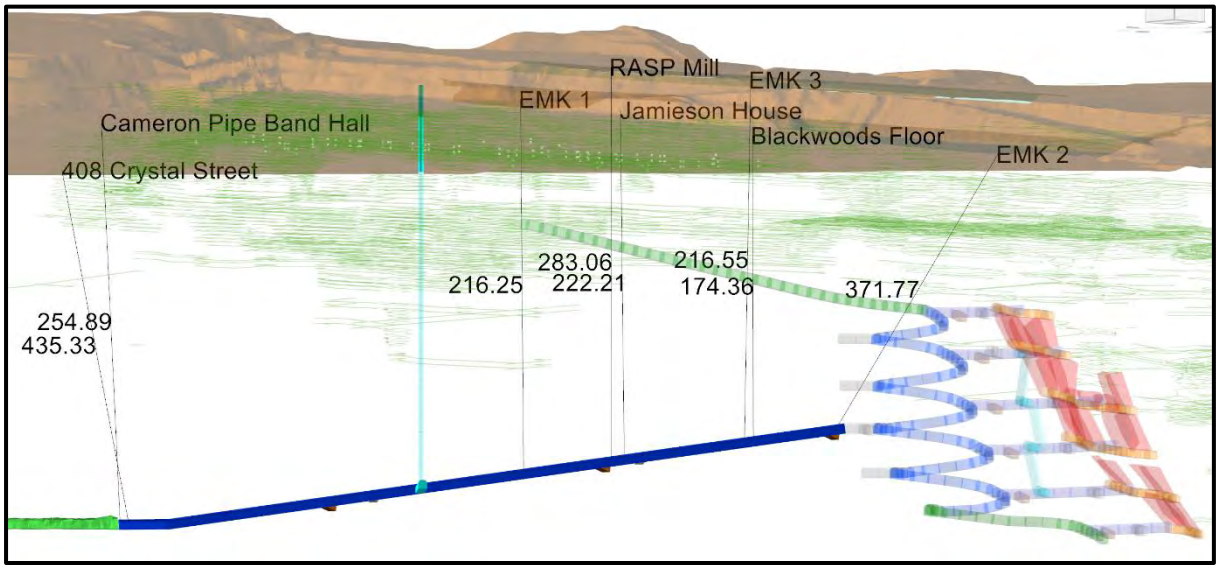
This report confirms that, based on available data, development blasting can be carried out in compliance with ground vibration limits specified by Dams Safety NSW (Reference #1) and suggested by Golder Associates Pty Ltd, for the TSF2 Tailings Facility at Blackwood Pit (Reference #2).

Such blasting is also highly unlikely to exceed residential amenity limits at the closest residential locations, as specified by the Rasp Mine EPL conditions (Reference #3) and as suggested by the ANZEC guidelines for the minimisation of annoyance at sensitive residential locations (Reference #4). Higher limits for the closest non-residential infrastructure, as suggested by Australian Standard AS2187 (Reference #5), are similarly unlikely to present any compliance difficulties with respect to ground vibration from the proposed development blasting.

Mike Humphreys, Principal D&B Engineer, Prism Mining Pty Ltd, July 2021

Figure 1 – Location of the proposed 7L NTH EXD / Blackwoods Access development with respect to identified sensitive locations (plan, long section).





GROUND VIBRATION ASSESSMENT METHODOLOGY AND LIMITS

A method for estimating the mean peak vector ground vibration (V mm/s), produced by a blast at a sensitive receiver, is provided in AS2187.2-2006 (Reference #5) as: **$V = K \times [\text{distance}/\sqrt{(\text{charge mass})}]^b$**.

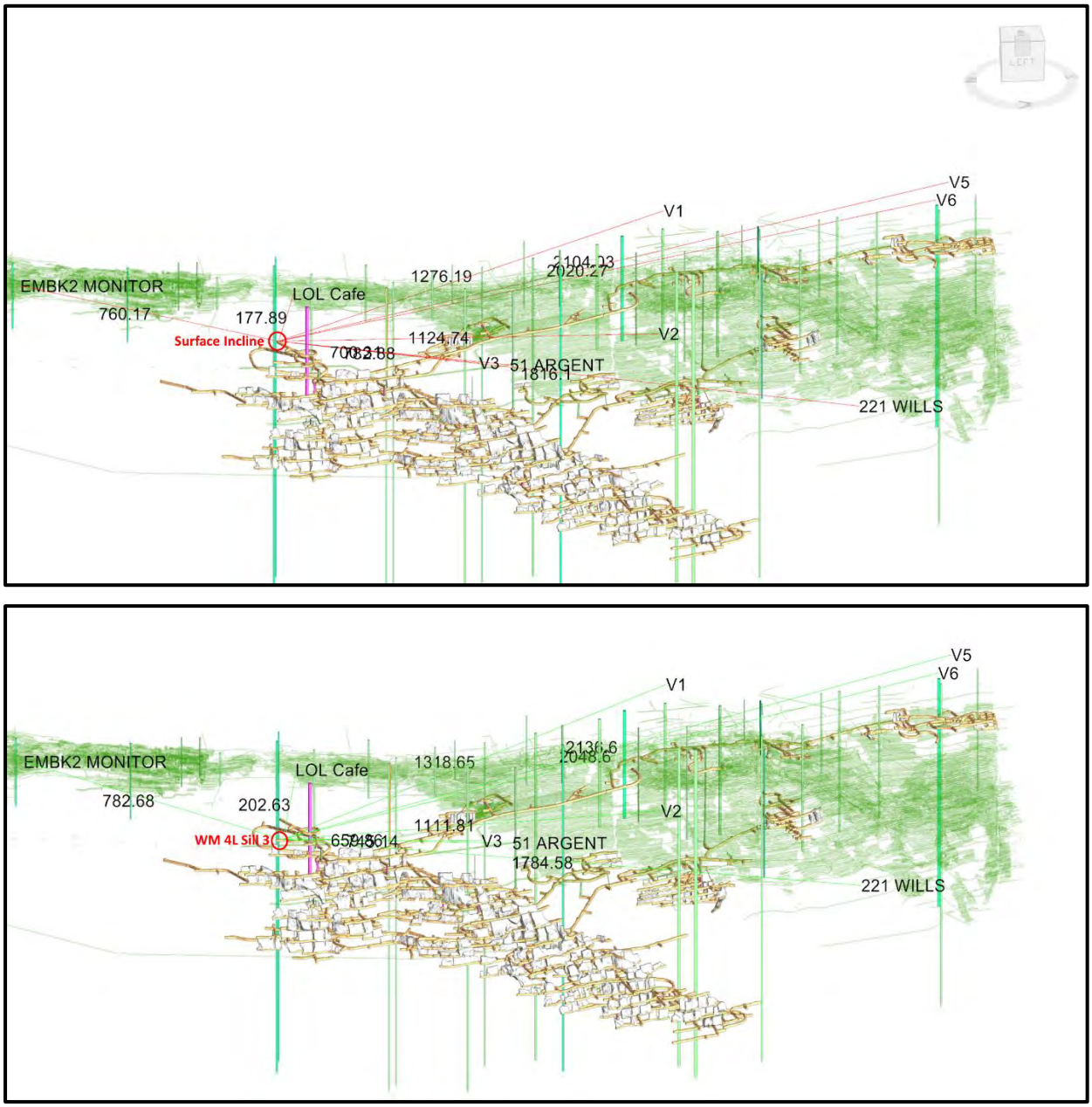
Distance is from the blast to the monitoring location (m) and charge mass is the maximum charge per hole (kg) for sequential firing, or within a specified timeframe for blasts where multiple blastholes fire together or reinforce each other in some manner. Site constants K and b are suggested by the standard for 'average' free face blasting conditions, with a range of 0.4 to 4 times the value of V estimated above, but these constants must be validated for the blast site, based on the monitoring of actual blasts.

While development blasting is carried out at a high level of blasting intensity (high powder factor) and in confined conditions (with limited relief), such blasting should also be expected to generate relatively low ground vibration impacts at surface as they are of such small size, with a blasted volume up to 150m^3. For this exercise, models utilising a 'maximum charge' can also be problematic, as the variability of timing with LP series detonators (high scatter) can significantly change the 'effective' MIC from blast to blast, for otherwise identical development rounds. Given that development blasts have very similar geometry and charging methodology, a simpler model that excludes charge mass has been used in this case, being **$V = K \times [\text{distance}]^b$**, where K and b values are derived from the most representative available site data.

Blast induced ground vibration at Rasp Mine is currently recorded at fixed monitoring locations (V1 to V6), all of which are to the south of the proposed Blackwoods area and not in the vicinity of TSF2 or the proposed Mod9 development blasting. While ground vibration levels from development blasts have not presented compliance problems in the past, the available data collected was considered unsuitable for this exercise due to the lack of close proximity monitoring and the fact that development blasts were not necessarily fired individually. Two additional monitors have therefore been used for this exercise, to specifically monitor ground vibration impacts at TSF2 (Embankment 2) and at close proximity to current development activities (LOL Café), for blasting at the Surface Incline and WM 4L Sill 3 areas. The locations of blast areas and monitoring points are shown in Figure 2.

Dams Safety NSW (DSC) has imposed a peak particle vibration limit of 30mm/s (peak vector) at the TSF2 embankment structures being constructed (Reference #1). Given the potential for amplification of vibration from the foundations to the top of an embankment, this 30mm/s DSC limit could result in ground vibration level limits at the foundations as low as 15mm/s (assuming an amplification factor up to 2). Work by Golder Associates (Reference #2) suggests a PPV limit of 15mm/s for embankments foundations that may be vibration sensitive, and applicable at some of the TSF2 embankments which are partially founded on desiccated tailings. Golder Associates has also suggested preliminary ground vibration limits of 25mm/s PVPPV, with reference to saturated tailings at the floor of TSF1 and this will be used for TSF2 until further monitoring can be carried out to validate this.

Figure 2 – Proximity of monitored development blasts to nearest sensitive receivers (Surface Incline, WM 4L Sill 3).



For residential locations, peak vector ground vibration limits less than 5mm/s (95% of blasts) and 10mm/s (100% of blasts) are applicable under current EPL conditions (Reference #3), excluding underground blasting in Block 7, where a more restrictive 3mm/s (95%) limit applies. These limits are also reflected in the ANZECC guidelines (Reference #4).

For non-residential locations, a number of criteria are referenced in the applicable Australian Standard (AS2187, Reference #5). Ground vibration limits to avoid cosmetic damage to light commercial buildings are suggested by AS2187 as a peak component particle velocity of 15mm/s at 4Hz to 50mm/s at 40Hz. Ground vibration limits for occupied non-sensitive industrial sites are suggested as peak component particle velocities below 25mm/s unless

agreement is reached with the owner for higher levels. Peak vector particle velocity limits of 15mm/s to 25mm/s therefore provide conservative preliminary thresholds, when assessing impacts at non-residential locations and non-sensitive industrial sites respectively.

Estimated ground vibration impacts for the proposed Mod9 development blasts have been assessed at the nearest distances to the TSF2 facilities, residential locations, and non-residential infrastructure, as 'worst-case' scenarios.

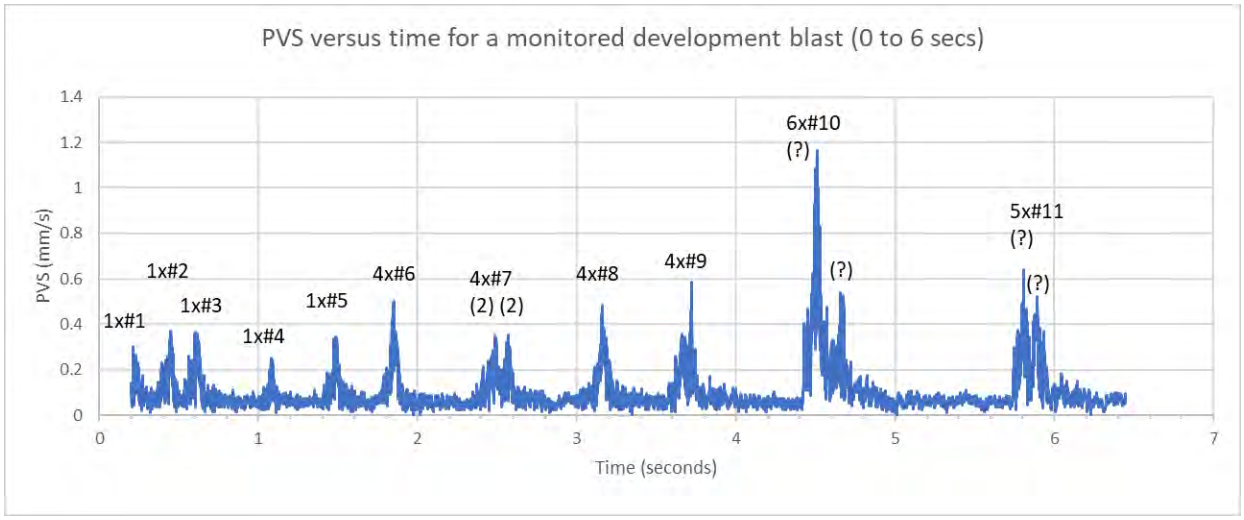
ASSESSMENT OF GROUND VIBRATION IMPACTS

While the development round illustrated in Appendix 1 has 72 blastholes, with a specific timing sequence, the number of blastholes, charging methodology and timing sequence can vary at Rasp Mine, subject to operational constraints and ground conditions. The high degree of firing time scatter for long period (LP) delays also makes estimation of a maximum 'instantaneous' charge problematic. This is illustrated in Figure 3, where the specific number of blastholes firing for each 'number' in the LP series, for a particular blast, have been annotated on the resultant waveform for that blast event. In this case, the waveform was recorded at the closest monitor of interest (PVS of 1.16mm/s at the LOL Café on 24/06/2021). While the variable effect of firing time and charge mass on vibration level can be estimated early in the waveform, this becomes harder as delay time and the number of holes per delay increases.

Comparing results between recent blast events (May-June 2021) suggests that correlation between peak vibration results and the nominal charge mass per blasthole, or per LP delay interval, will be unreliable for development blasting. Blasts monitored at the LOL Café (as close as practical to recent development blast locations) and TSF2 (Embankment 2) have therefore been plotted against distance from the monitor, rather than scaled distance, and a trend range used to estimate peak ground vibration impacts from Mod9 development blasts at the nearest sensitive receivers (see Figure 4 and Table 1).

These estimates suggest that peak vector ground vibration levels at the TSF2 facilities, nearest residential locations, and nearest non-residential infrastructure will remain below regulated or recommended limits. The estimates provided will need to be validated by monitoring ground vibration levels as blasting takes place, with design modifications made to ensure ongoing compliance with limits if required.

Figure 3 – Resultant (vector) waveform for a surface incline development blast, fired 24/06/21 and monitored at the LOL Café.



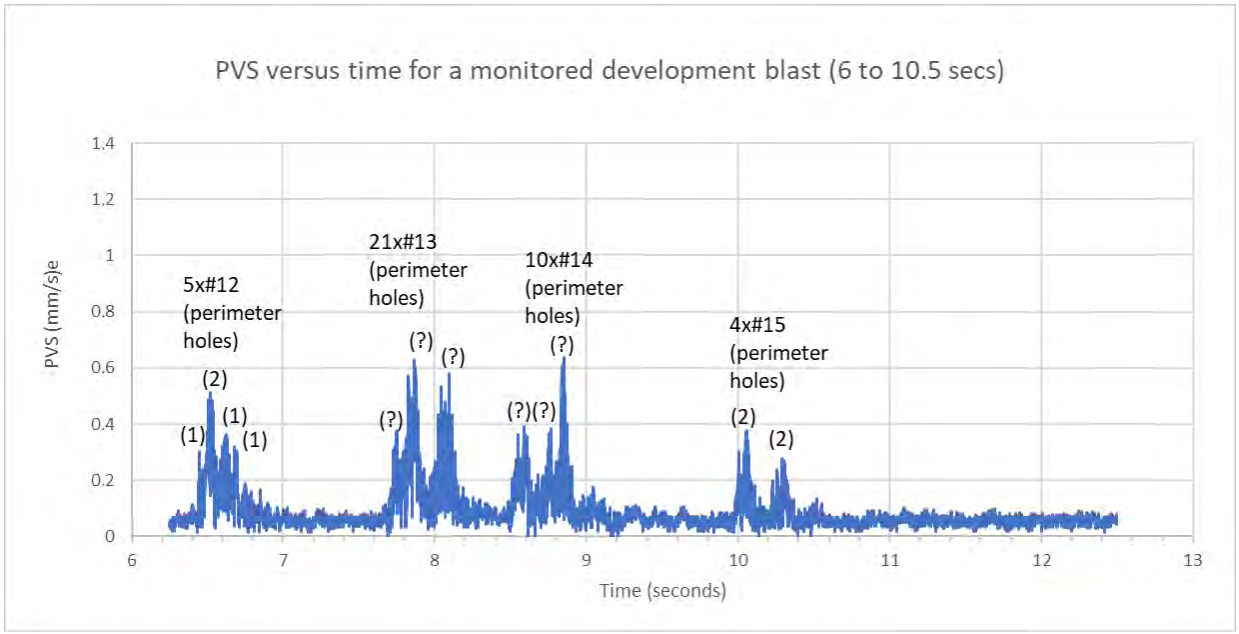
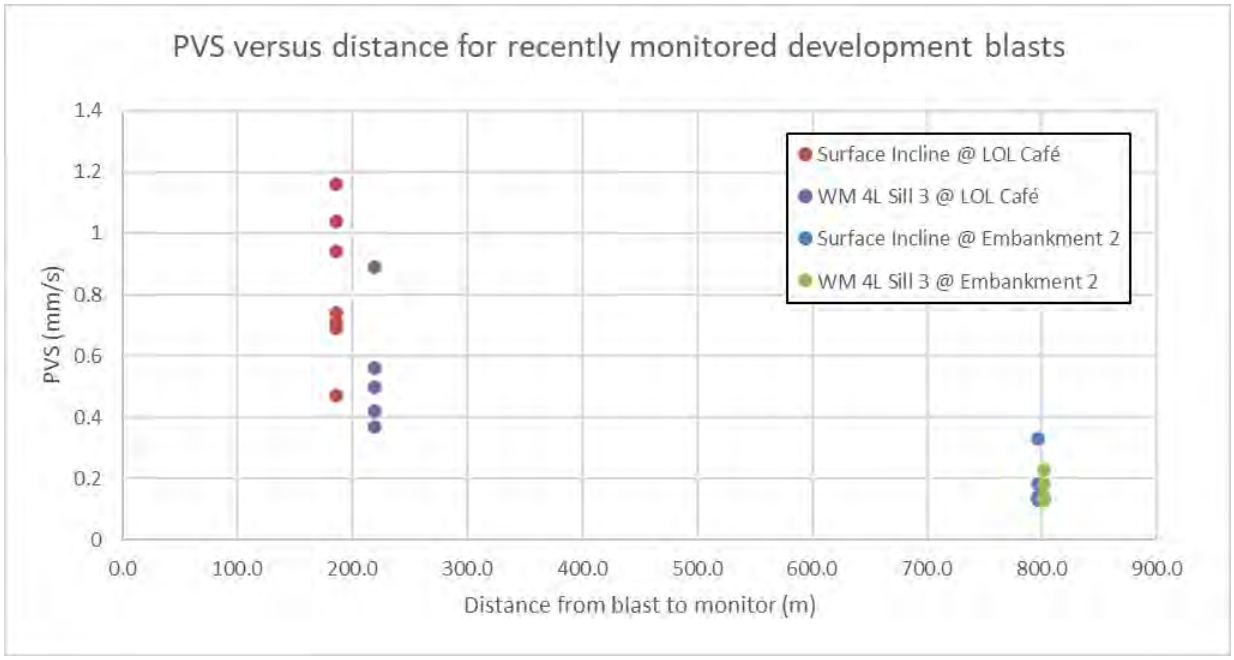


Figure 4 – PVS versus distance for recently monitored development blasts. Blasts shown by location and monitor (top) and with trends (bottom).



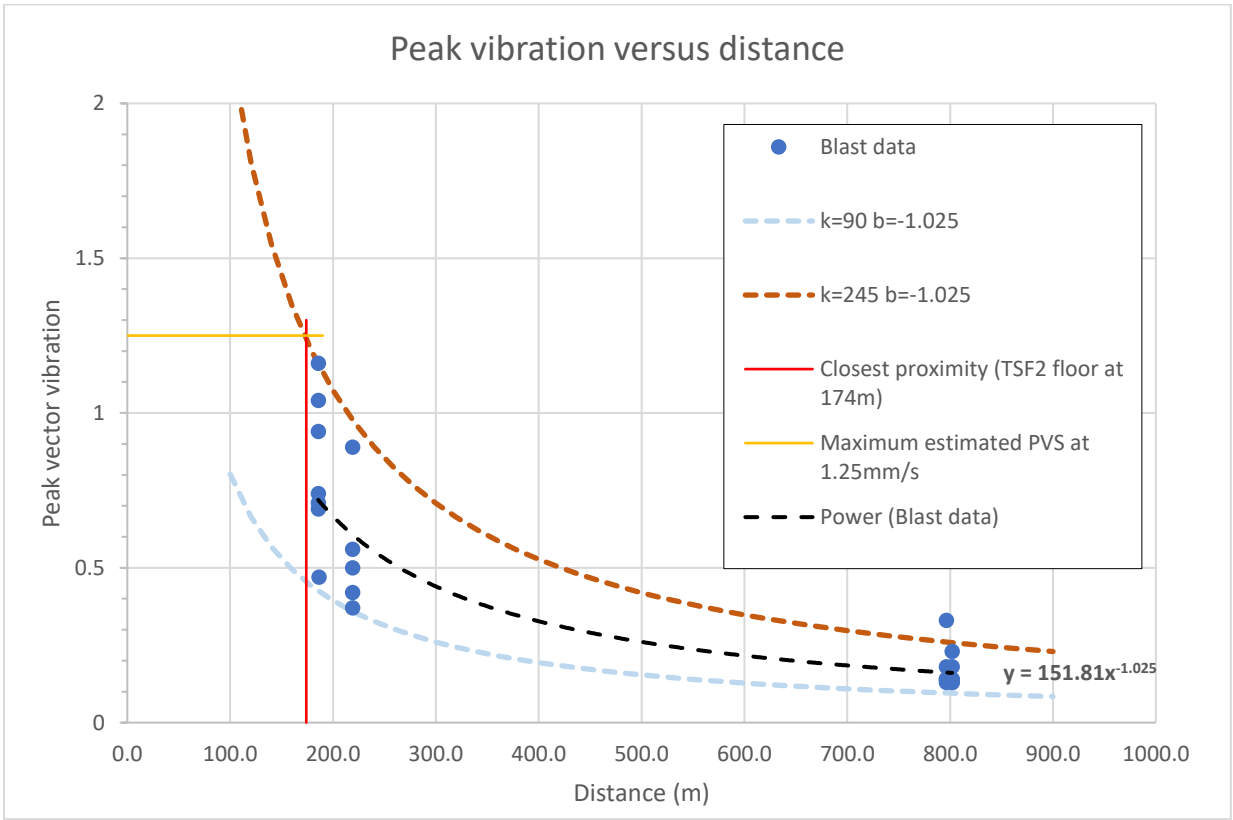


Table 1 – Estimated peak ground vibration impacts for proposed 7L NTH EXD / Blackwoods Development Access (Mod9).

Location	K factor (average) [1]	K factor (upper) [1]	Exp, b [1]	Minimum distance (m)	Peak vibration (average) (mm/s)	Peak vibration (upper) (mm/s)	Target / Limit (mm/s)	Achieved (Yes/No)	Notes
TSF2 Facility									
TSF2 Floor (closest point)	152	245	-1.025	174	0.8	1.2	25mm/s	Y	2
TSF2 Embankment 1 (midpoint)	152	245	-1.025	216	0.6	1.0	15 (30) mm/s	Y	3, 4, 5
TSF2 Embankment 1 (closest point)	152	245	-1.025	205	0.6	1.0	15 (30) mm/s	Y	
TSF2 Embankment 2 (midpoint)	152	245	-1.025	372	0.4	0.6	15 (30) mm/s	Y	3, 4, 5
TSF2 Embankment 2 (closest point)	152	245	-1.025	238	0.6	0.9	15 (30) mm/s	Y	
TSF2 Embankment 3 (midpoint)	152	245	-1.025	216	0.6	1.0	15 (30) mm/s	Y	3, 4, 5
TSF2 Embankment 3 (closest point)	152	245	-1.025	193	0.7	1.1	15 (30) mm/s	Y	
Residential									
Jamieson House (Crown property)	152	245	-1.025	222	0.6	1.0	5 - 10mm/s	Y	6
408 Crystal Street	152	245	-1.025	435	0.3	0.5	5 - 10mm/s	Y	7
Non residential infrastructure									
Cameron Pipe Band Hall	152	245	-1.025	255	0.5	0.8	15mm/s	Y	8
Rasp Mill	152	245	-1.025	283	0.5	0.8	25mm/s	Y	9

Notes

1. PVS modelled against distance (NOT scaled distance using an MIC) as a consistent maximum charge cannot be achieved with LP detonators.
2. Provisional limits. If TSF2 contains 'wet' tailings, ground vibration limits for liquefaction at the pit floor may need validation, subject to blast monitoring with piezometers.
3. Limit suggested by Golder Associates of 15mm/s for 'vibration sensitive' embankment foundations (dessicated tailings).
4. Limit required by DSC anywhere on the embankment walls. This allows an amplification factor up to 2 times the vibration levels at the foundations.
5. Distances to mid-span of embankments used as a worst-case for amplification, but also need to consider distances to the closest point of each embankment floor.
6. Residential limit at Jamieson House (non residential) used as a reference for nearby Prop Square residences owned by Perilya.
7. Residential limits at closest private residences on Crystal Street (or elsewhere), <5mm/s (95%), <10mm/s (100%). Target <5mm/s peak vector.
8. Conservative commercial building limits of 15mm/s peak vector (refer AS2187).
9. Conservative industrial facilities limit of 25mm/s peak vector, subject to risk assessment of electronic, electrical and mechanical systems.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are made, based on the assessment of currently available data and the assumption of good blast design, implementation and record keeping.

- Compliant development blasting at 7L NTH EXD / Blackwoods Access should be achievable using conventional tunnel development blasting methods, based on the identified distances to the TSF2 facilities, nearest residential locations and nearest non-residential infrastructure, and the ground vibration limits referenced.
- Monitored data should be used to validate modelled assumptions and adjust blast design parameters to maintain compliant blasting, as development proceeds. Blast monitoring should include vibration monitors at the TSF2 embankments, including the closest point on the closest embankment, and the nearest residential location.
- Additional control methods that are available in the event of non-compliant blasting outcomes include (i) the use of accurate electronic initiation to control maximum instantaneous charge effects, and (ii) the use of shorter round length to reduce charge mass per hole when blasting at the closest proximity to sensitive receivers.

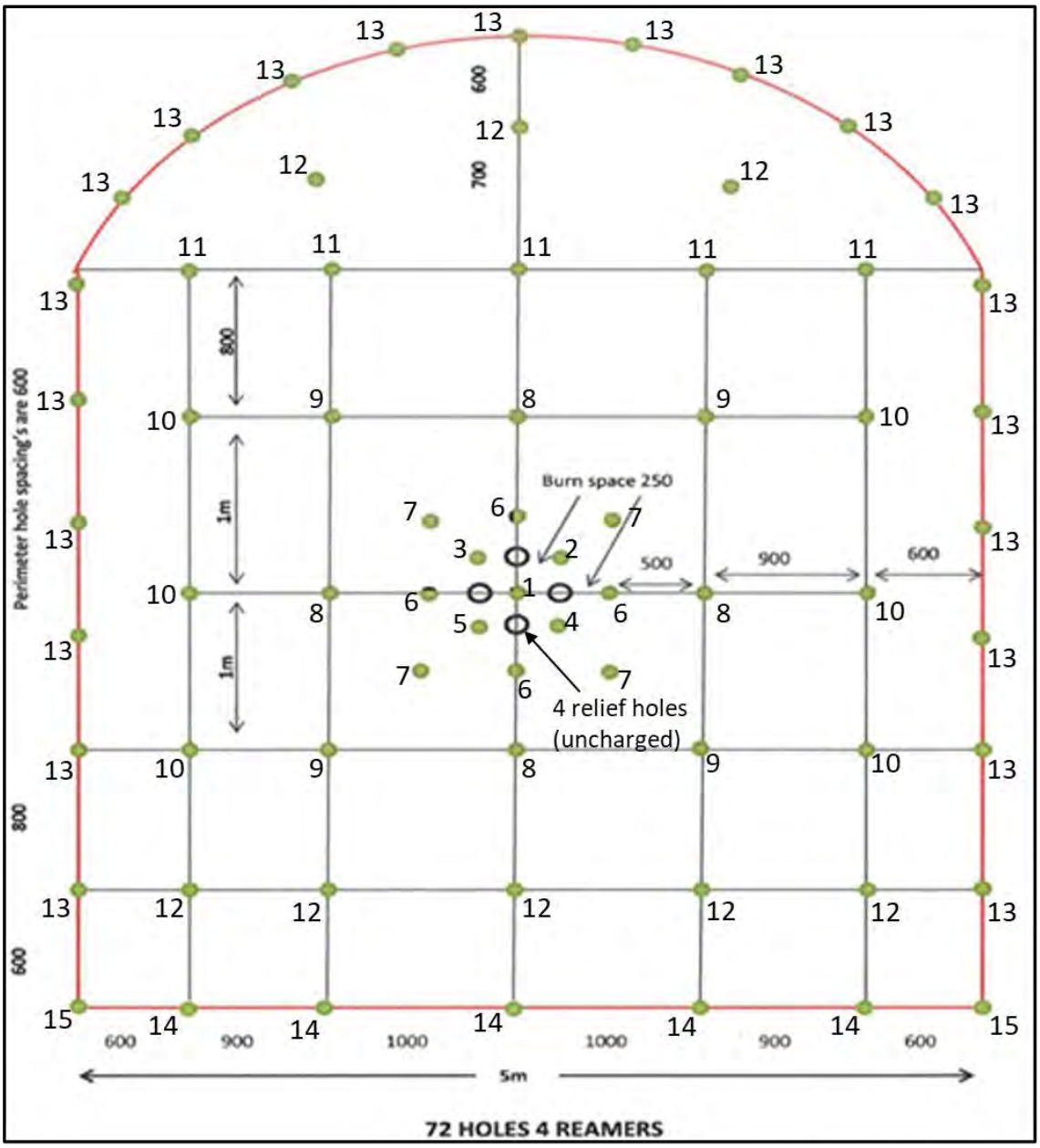
For further clarification contact:

Mike Humphreys, Principal D&B Engineer, Prism Mining Pty Ltd

Email: Mike.Humphreys@PrismMining.com.au

Disclaimer: This document provides general guidance based on information provided by the client, using generic methodologies for calculating blast parameters and blasting impacts. Site-specific adjustments may be required to achieve desired results and minimise impacts as the project is implemented and additional information collected. For further assistance during implementation contact the author, or other suitable qualified person.

Appendix 1 – Development round example at Rasp Mine



Overall dimensions
Height 5.8m, Width 5.5m

Blastholes – 72 charged holes, 45mm diam, 4.5m length, with 4 uncharged relief holes.

Charging – 5kg to 6kg emulsion explosive, plus Orica Senatel primer with Exel LP detonator.

Available Delay Range

Delay #	0	1	2	3
Nominal Time (s)	0.025	0.2	0.4	0.6
Delay #	**4**	**5**	**6**	**7**
Nominal Time (s)	1.0	1.4	1.8	2.4
Delay #	**8**	**9**	**10**	**11**
Nominal Time (s)	3.0	3.5	4.5	5.5
Delay #	**12**	**13**	**14**	**15**
Nominal Time (s)	6.5	7.5	8.5	9.5

Firing sequence – Between 1 and 21 holes per delay. LP series scatter will result in fewer holes firing together, but will not be consistent from blast to blast.

Appendix 2 - References

The following references have been used in preparing this report.

1. Annexure "D" Standard Mining Conditions, NSW Dams Safety Committee, October 2019.
2. Rasp Mine – Potential Impact of Blasting on Tailings Storage Facility, Technical Memorandum, October 2019, Golder Associates Pty Ltd.
3. Environment Protection Licence for Broken Hill Operations Pty Ltd, NSW EPA.
4. Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration, Australian and New Zealand Environment Council, September 1990.
5. Appendix J, Australian Standard for Explosives Storage and Use, AS2187.2-2006.

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B.2 Blast impact assessment (addendum)

Prism Mining
Prism Mining Pty Ltd
ABN 43 144 650 126

16 Rosewood St
Bardon QLD 4065

FINAL

TO: Eamonn Dare, Technical Services Superintendent, Broken Hill Operations Pty Ltd

FROM: Mike Humphreys, Principal D&B Engineer, Prism Mining Pty Ltd
Email: Mike.Humphreys@PrismMining.com.au

SUBJECT: BLAST VIBRATION ASSESSMENT – MOD9 DEVELOPMENT
ADDENDUM FOR SENSITIVE RESIDENTIAL RECEIVERS, AUGUST 2021

DATE: 16TH AUGUST 2021

BLAST VIBRATION IMPACT ASSESSMENT FOR THE PROPOSED MOD9 DEVELOPMENT (7L NTH EXD / BLACKWOODS ACCESS) AT RASP MINE

ADDENDUM FOR SENSITIVE RESIDENTIAL LOCATIONS

New development is required as part of a modification to the project approval at Rasp Mine (Mod9) in order to access the proposed Blackwoods mining area, and is described in a previous report (*Blast Vibration Impact Assessment for the Proposed Mod9 Development at Rasp Mine*, Prism Mining Ltd, 8th July 2021).

That previous report demonstrated compliance with the usual EPL ground vibration limits (5 to 10mm/s peak vector PPV) at a minimum distance of 222m to Jamieson House (non-residential Crown property), compared to more distant residential locations from 228m and beyond.

This addendum uses the same methodology to estimate potential ground vibration impacts from development blasts, at the closest surrounding residential locations identified in Figures 1 and 2.

Estimated peak ground vibration impacts at those locations are illustrated in Figure 3 and listed in Table 1, and are not expected to reach 1mm/s PVPPV on the basis of the close proximity monitoring of current development blasting, carried out specifically for this exercise.

Mike Humphreys,
Principal D&B Engineer, Prism Mining Pty Ltd.

Figure 1 – Location of the proposed 7L NTH EXD / Blackwoods Access development with respect to identified residential locations.

Mod 9 Deve - MGA Coordinates			
Dist (m)	MGA Coords		
	Easting	Northing	RL
0	544389.581	6463871.430	72.563
50	544438.507	6463873.003	75.974
100	544487.930	6463870.509	83.001
150	544537.353	6463868.016	90.027
200	544586.777	6463865.523	97.054
250	544636.200	6463863.030	104.081
300	544685.623	6463860.537	111.108
350	544735.046	6463858.044	118.134
400	544784.470	6463855.550	125.161
420	544804.239	6463854.553	127.972

Figure 2 – Location of the closest residential locations, Sites 1, 2, 3 (top) and Site 4 (bottom).

Figure 3 –PVPPV trends with distance for recently monitored development blasts, and minimum distances to residential locations.

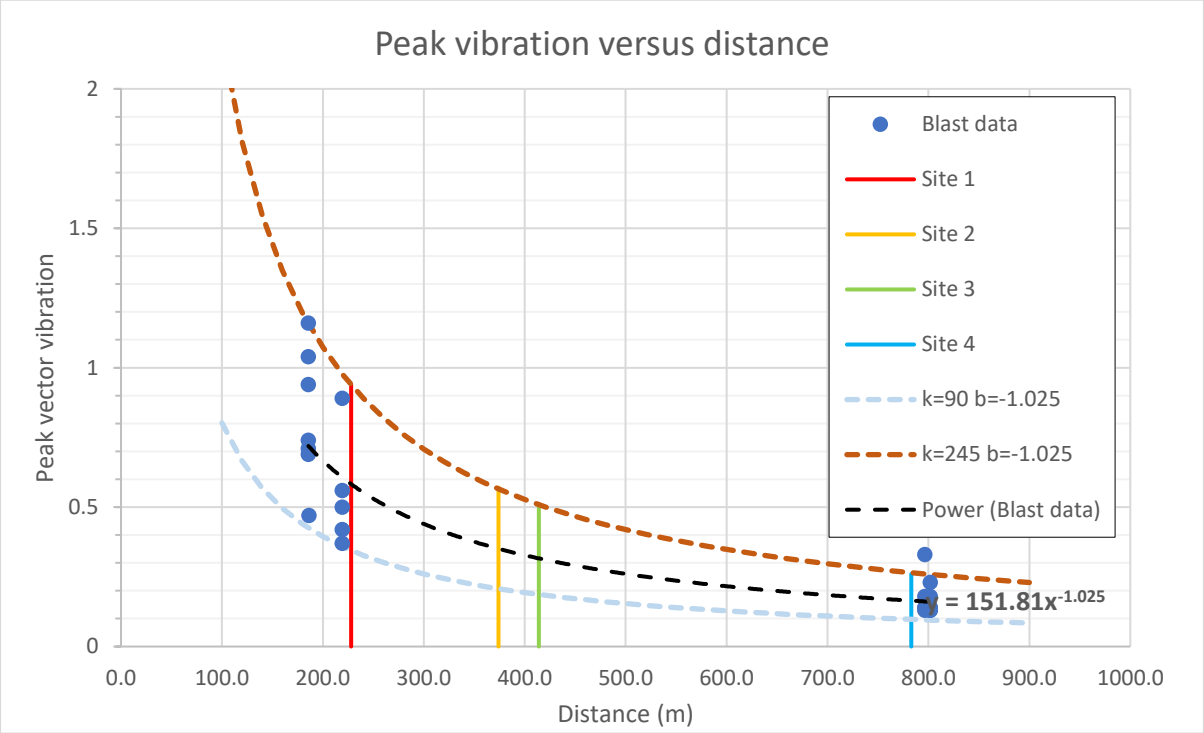

Table 1 – Estimated distances (top) and peak ground vibration impacts (bottom) for proposed 7L NTH EXD / Blackwoods Development Blasts at Residential Locations.

				Distance along development (m)	0	50	100	150	200	250	300	350	400	420
				Easting	544390	544439	544488	544537	544587	544636	544686	544735	544784	544804
				Northing	6463871	6463873	6463871	6463868	6463866	6463863	6463861	6463858	6463856	6463855
				RL	73	76	83	90	97	104	111	118	125	128
Receptor	**Easting**	**Northing**	**RL**	**Separation**										
Site 1	544630	6463960	310	distances	349	314	282	256	237	**228**	229	241	263	273
Site 2	544193	6464086	307	(m)	**374**	399	428	462	498	536	576	618	660	678
Site 3	544371	6464215	303		**414**	416	425	440	459	483	511	542	576	590
Site 4	544592	6463105	296		823	813	801	792	786	**783**	783	787	793	797

				Distance along development (m)	0	50	100	150	200	250	300	350	400	420
				Easting	544390	544439	544488	544537	544587	544636	544686	544735	544784	544804
				Northing	6463871	6463873	6463871	6463868	6463866	6463863	6463861	6463858	6463856	6463855
				RL	73	76	83	90	97	104	111	118	125	128
Receptor	**Easting**	**Northing**	**RL**	**Estimated**										
Site 1	544630	6463960	310	ground vibration	0.6	0.7	0.8	0.8	0.9	**0.9**	0.9	0.9	0.8	0.8
Site 2	544193	6464086	307	(mm/s)	**0.6**	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
Site 3	544371	6464215	303		**0.5**	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Site 4	544592	6463105	296		0.3	0.3	0.3	0.3	0.3	**0.3**	0.3	0.3	0.3	0.3

Note: Site-specific adjustments may be required to achieve desired results and minimise impacts as the project is implemented and additional information collected. For further assistance during implementation contact the author, or other suitable qualified person.

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Appendix C

Mod 9 noise impact assessment

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23 August 2021

Joel Sulicich
Health Safety Environment and Training Manager
Broken Hill Operations Pty Ltd
Eyre St, Broken Hill NSW

Re: Rasp Mine Modification 9 - Noise impact assessment

Dear Joel,

1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Broken Hill Operations Pty Ltd (BHOP) to assess the potential noise impacts for the proposed Modification 9 (MOD9) of Project Approval PA 07_0018 (PA) for the Rasp Mine in Broken Hill, NSW.

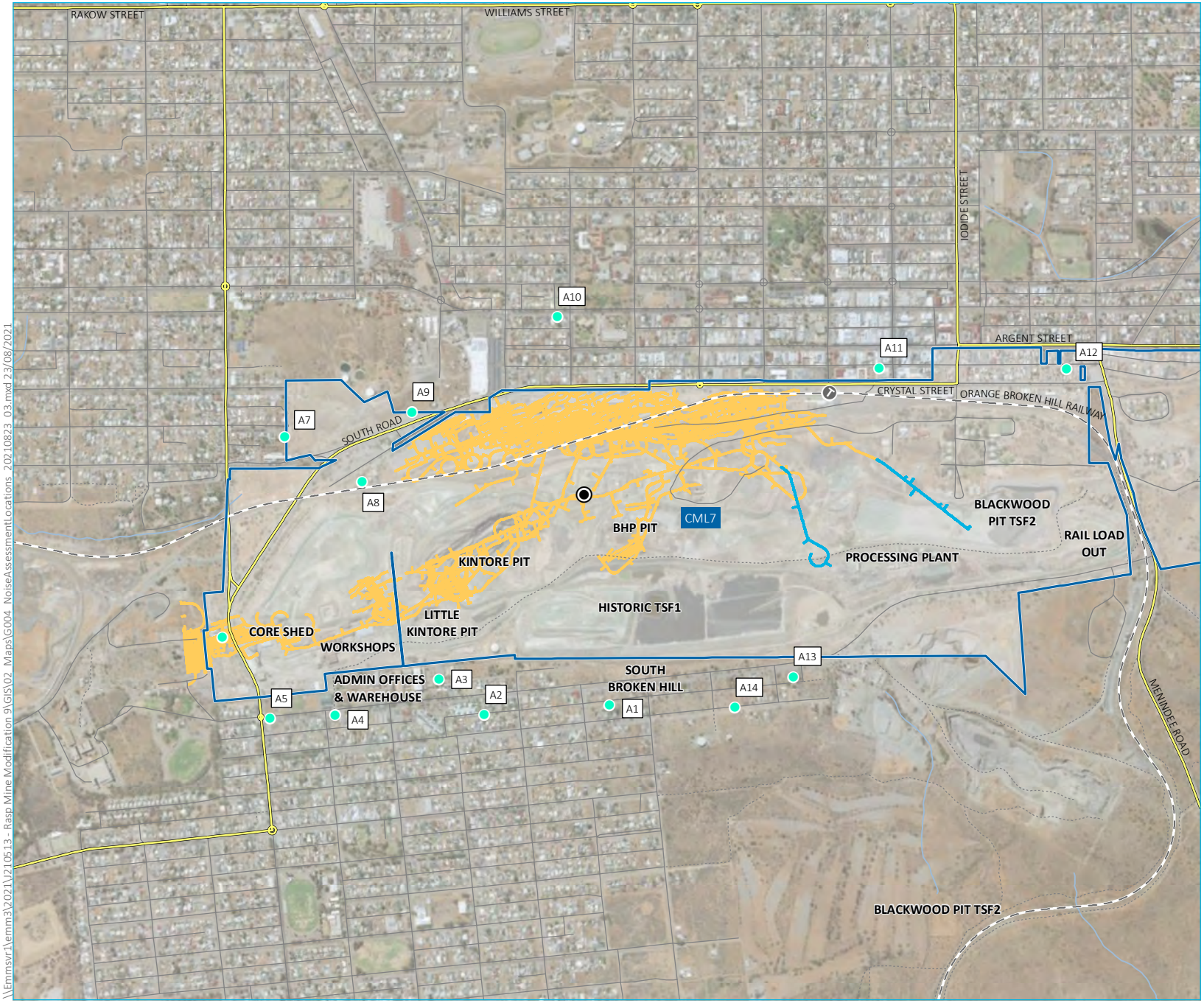
BHOP was granted approval for Modification 8 (MOD8) of its PA in April 2021 to mine a predefined region of Mine Lease 1249 under a sublease arrangement with Perilya Broken Hill Limited (the lease holder). MOD8 was a minor modification with no additional surface activities or environmental impacts and was consistent with the original development application.

BHOP is now seeking to modify its PA (MOD9) to allow for the installation of a safety ladder way from Stockpile 1 (SP1) (located approximately 150 m underground) to the surface. The exit of the ladder way at the surface is proposed to be housed in a secured 20-foot shipping container. The ladder way is proposed to be located approximately between the BHP Pit and Kintore Pit and immediately to the south-west of the existing egress winder. The proposed location for the ladder way and surrounding assessment locations are shown in Figure 1.1. A more detailed view of the proposed location for the ladder way and shipping container housing is shown in Figure 1.2.

The purpose of this letter is to provide the findings of our assessment of the proposed MOD9 construction activities, noise levels likely to be generated as a result and an assessment of potential noise impacts at surrounding residential receivers.

This assessment references the project approval, environment protection licence and relevant noise guideline as follows:

- NSW Department of Planning, Industry and Environment, Consolidated Project Approval PA 07_0018 Mod 8, April 2021;
- NSW Environment Protection Authority, Environment Protection Licence 12559, 4 October 2019; and
- NSW Environment Protection Authority, Industrial Noise Policy, 2000;
- NSW Environment Protection Authority, Noise Policy for Industry, 2017.



KEY

- Noise assessment location
- Proposed ladder way surface exit
- Proposed development workings
- Existing underground workings
- Mining lease
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line

\\Emmsvr1\emm3\2021\J210513 - Rasp Mine Modification 9\GIS\02 Maps\G004 NoiseAssessmentLocations 20210823 03.mxd 23/08/2021

Source: EMM (2021); CBH (2021); DPE (2019); DFSI (2017)

0 0.5 1 km

GDA 1994 MGA Zone 54

Noise assessment locations

Rasp Mine Modification 9
Noise impact assessment
Figure 1.1

EMM creating opportunities

Figure 1.2 Proposed location for the ladder way and shipping container housing

2 Proposed construction activities

The proposed ladder way installation will require the use of a raise boring machine (raise borer) to excavate a circular hole between SP1 (underground) and the surface. The raise borer will be set up on the surface on an evenly laid platform. A small-diameter hole (pilot hole) is drilled to SP1; the diameter of the pilot hole is typically 230-445 mm, large enough to accommodate the drill string. Once the drill has broken into the opening in SP1, the drill bit is removed, a reamer head (required diameter of 1.1 m) is attached to the raise borer string and raised back towards the surface. The boring cuttings from the reamer head fall to the floor of the lower level and will remain underground.

The ladder way tubes of approximately 2.1 m in length will be installed in the 1.1 m diameter raise bored hole utilising a pulley system. The shipping container is then placed to house the ladder way exit at the surface.

The proposed location for the ladder way is surrounded by existing bunding (refer to Figure 1.2) and hence offsite receivers will be relatively shielded from noise emissions associated with its proposed construction.

Construction activities, schedule and duration associated with the proposed ladder way installation are as follows:

1. Raise boring from underground SP1 to the surface:

    a) Pilot hole drilling – 24-hours for approximately 10 days;

    b) Reaming of 1.1 m diameter hole (from underground to the surface) – 24-hours for approximately 40 days.

2. Installation of ladder tube – 24-hours for approximately 10 days; and

3. Placement of shipping container housing – approximately 1 day.

It is noted that BHOP is currently going through Modification 6 to its PA (MOD6) to develop the Kintore Pit into a new tailings storage facility (TSF3) for naturally dried tailings co-disposed with excess waste rock. Activities associated with MOD6 (if approved) are not expected to occur until after the proposed MOD9 construction activities and therefore noise from MOD6 activities have not been included in this assessment. Furthermore, no other construction activities are expected to occur on-site at the time of the proposed MOD9 construction activities.

3 Existing environment and noise limits

3.1 Assessment locations

The assessment locations adopted for this assessment are provided in Table 3.1 (refer to Figure 1.1). These are representative of nearest and/or most-affected residential receivers surrounding the site. The nearest assessment location (ie A10) is located approximately 600 m to the north-west of the proposed ladder way and MOD9 construction activities.

Furthermore, these locations are consistent with those adopted in previous noise assessments, listed in the PA and Environment Protection Licence 12559 (EPL).

Table 3.1 Assessment locations

Assessment location ID	Location	Coordinates (MGA56)	
		Easting	Northing
A1	Piper St North	544110	6462598
A2	Piper St Central	543763	6462312
A3	Eyre St North	543555	6462322
A4	Eyre St Central	543324	6462003
A5	Eyre St South	543140	6461859
A6	Bonanza and Gypsum Streets	542833	6462000
A7	Carbon St	542604	6462718
A8	South Rd	542923	6462744
A9	Crystal St	542926	6463052
A10	Garnet and Blende Streets	543158	6463633
A11	Crystal St	544210	6464144
A12	Crystal St	544761	6464527
A13	Eyre St North	544592	6463059
A14	Piper St North	544532	6462860

3.2 Current site noise limits

Condition 17 of Schedule 3 of the project approval (PA 07_0018), modified (MOD8) and approved in April 2021, provides noise limits the site must meet during its operational phase. These are consistent with the noise limits provided in the EPL.

Site operational noise limits are based on project specific noise levels adopted in the noise impact assessment completed for the site in 2007. The project specific noise levels adopted in the 2007 noise impact assessment were derived based on measured or assumed minima rating background level (RBL) +5 dB for all assessment locations (residential), in accordance with the NSW Environment Protection Authority (EPA) Industrial Noise Policy (INP) (2000).

Current operational noise limits as per the PA and EPL are provided in Table 3.2.

Table 3.2 Current PA and EPL operational noise limits

Assessment location	PA/EPL operational noise limits, $L_{Aeq,15min}$, dB		
	Day[1]	Evening[2]	Night[3]
A1	38	37	35
A2	38	37	35
A3	44	41	39
A4	44	41	39
A5	44	41	39
A6	48	41	39
A7[4]	35	35	35
A8	48	39	39
A9	46	39	39
A10	42	41	35
A11	46	39	39
A12	46	39	39
A13	38	35	35
A14	35	35	35

Notes: 1. Day period: Monday to Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
2. Evening period: Monday to Saturday: 6 pm to 10 pm, on Sundays and public holidays: 6 pm to 10 pm.
3. Night period: Monday to Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.
4. More recent ambient noise monitoring has been completed for this location and will be adopted for MOD6.

4 Noise impact assessment

4.1 Modelling software and meteorological conditions

Quantitative modelling of construction noise was completed using DGMR 'iNoise' noise prediction software (from the developers of the long standing 'Predictor' product). This software applies the EPA accepted ISO 9613 approach (including noise-enhancing meteorological effects) and calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources.

The model incorporated factors such as the lateral and vertical location of plant and equipment, source-to-receiver distances, ground effects, atmospheric absorption, topography and meteorological conditions. Three-dimensional digitised ground contours of the site and surrounding land were incorporated to account for topographic effects.

4.2 Modelling methodology

The noise modelling of the proposed ladder way installation was based on information received from BHOP including the location and type of activities, the equipment required and approximate schedule (refer to Section 2). The noise model established by EMM for previous noise assessments completed for the site was used for the purpose of this assessment. It is noted that the INP (EPA 2000) is now superseded by the Noise Policy for Industry (NPfI) (EPA 2017) and hence this noise assessment has adopted the NPfI assessment requirements (eg modelling methodology) where relevant. This is consistent with the approach adopted in the noise and vibration impact assessment completed by EMM in 2018 for the Modification 5 of the PA.

A review of the proposed construction activities determined that the raise boring activities including pilot hole drilling (approximately 10 days in duration) and reaming (approximately 40 days in duration) will be the worst-case scenarios. Therefore, for the purpose of this assessment, noise emissions from these activities were modelled at assessment locations.

Minimal noise is expected from the raise borer machine on the surface. However, the raise borer will require a diesel generator (500 KVA or equivalent) on the surface for power supply. The literature for such equipment suggests that the sound power level for a 500 KVA diesel generator is typically 97 dB(A). Preliminary noise modelling indicated that predicted noise levels at assessment locations will be well below levels that would cause an increase in existing operational site noise levels if a sound power level of 97 dB(A) was adopted for the raise boring activities. Hence, a reverse engineering modelling exercise to determine the 'maximum' sound power level for the raise boring activities was completed. The modelling showed that a 'maximum' sound power level of 103 dB(A) will not cause an increase in existing operational site noise levels. Therefore, a conservative sound power level of 103 dB(A) was adopted for modelling of the raise boring activities to demonstrate that no noise impacts is likely at assessment locations from the proposed MOD9 construction activities.

4.3 Modelling results

Noise levels predicted for the raise boring activities at assessment locations during the day, evening and night periods are presented in Table 4.1. The modelling adopted the EPA accepted ISO 9613 noise-enhancing meteorological conditions and a sound power level of 103 dB(A) for the raise boring activities. As a conservative approach, predicted construction noise levels were compared to current site operational noise limits as per the PA and EPL.

Table 4.1 Predicted raise boring noise levels

Assessment location	Predicted raise boring $L_{Aeq,15min}$ noise levels, dB			PA/EPL operational noise limits, $L_{Aeq,15min}$, dB			Future increase to existing site noise levels, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
A1	10	11	11	38	37	35	Nil	Nil	Nil
A2	11	12	12	38	37	35	Nil	Nil	Nil
A3	12	12	12	44	41	39	Nil	Nil	Nil
A4	14	15	15	44	41	39	Nil	Nil	Nil
A5	12	12	12	44	41	39	Nil	Nil	Nil
A6	10	11	11	48	41	39	Nil	Nil	Nil
A7	24	24	24	35	35	35	Nil	Nil	Nil
A8	22	23	23	48	39	39	Nil	Nil	Nil
A9	29	29	29	46	39	39	Nil	Nil	Nil
A10	21	22	22	42	41	35	Nil	Nil	Nil
A11	11	11	11	46	39	39	Nil	Nil	Nil
A12	15	16	16	46	39	39	Nil	Nil	Nil
A13	10	10	10	38	35	35	Nil	Nil	Nil
A14	10	11	11	35	35	35	Nil	Nil	Nil

Notes: 1. Day period: Monday to Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm. Evening period: Monday to Saturday: 6 pm to 10 pm, on Sundays and public holidays: 6 pm to 10 pm. Night period: Monday to Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.

Assuming a maximum sound power level of 103 dB(A) for the raise boring activities and that existing approved site operational noise levels currently achieve the relevant limits, the modelling results show that predicted noise levels for the proposed MOD9 construction activities will not increase site noise at assessment locations above the current PA and EPL noise limits during for the day, evening and night periods. The modelling results show that the most affected assessment locations from raise boring noise emissions are located to west and north-west of the proposed MOD9 construction activities, namely A7, A8, A9 and A10 (refer to Figure 1.1).

Therefore, it can be concluded that no additional noise impact is predicted from the proposed MOD9 construction activities.

5 Conclusion

Noise levels for the proposed MOD9 construction activities during worst-case raise boring activities are not predicted to increase existing approved site operational noise levels at assessment locations above the current PA and EPL noise limits for the day, evening and night periods.

Therefore, it can be concluded that no additional noise impact is predicted from the proposed MOD9 construction activities.

We trust the above is satisfactory and if you have any further questions please contact our office.

Yours sincerely

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Review by Najah Ishac.