Rasp Mine Modification 10

Modification Report

Prepared for Broken Hill Operations Pty Limited

November 2022

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Modification Report

Broken Hill Operations Pty Limited

E210998 RP#1

November 2022

Version	Date	Prepared by	Approved by	Comments
V1	7 November 2022	Paul Freeman	Paul Freeman	
V2	8 November 2022	Paul Freeman	Paul Freeman	Final

Approved by

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8 November 2022

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1 Introduction

1.1 Overview

This Modification Report accompanies a modification request (07_0018 MOD10) by Broken Hill Operations Pty Limited (BHOP) pursuant to Section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act), for minor infrastructure works at the Rasp Mine (Rasp).

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

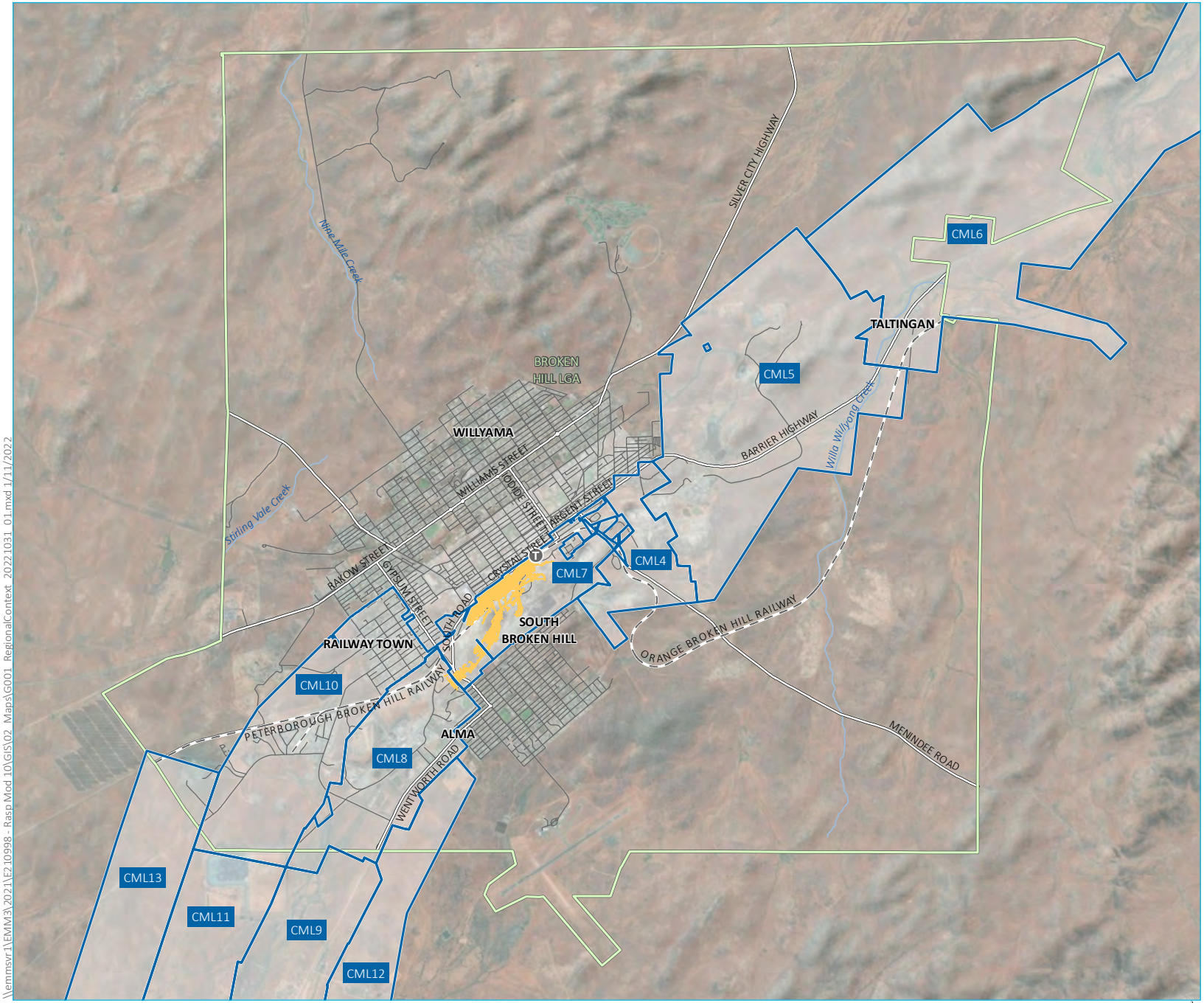
Rasp is an operating zinc and lead mine which is located centrally within the City of Broken Hill, in the far west of New South Wales (NSW) (Figure 1.1). The mine has operated since 1885. Rasp has been owned and operated since 2011 by BHOP, which is a wholly owned subsidiary of CBH Resources. The mine produces zinc and lead concentrates which are dispatched via rail to Port Pirie in South Australia and Newcastle in NSW.

Rasp comprises current and historic underground workings, tailing and waste emplacements, an ore processing plant, ore concentrate rail load out area and ancillary mine infrastructure (Figure 1.2).

Mining operations are regulated under a Ministerial project approval (07_0018) which was granted in January 2011, and also under a mining lease (CML7). The project approval has been modified nine times since it was first granted. The key approved operating activities at Rasp are summarised in Table 1.1.

Table 1.1 Rasp approved activities

Activity	
Mine Life	• To 31 December 2026.
Ore extraction	• 500,000 tonnes per annum (up to 750,000 tpa with approval of the EPA). • Total of 8.5 million tonnes over the life of the mine.
Ore processing	• On-site ore processing.
Ore concentrate transport	• By rail to Port Pirie and Newcastle.
Underground mine access	• Via a box-cut.
Tailing emplacement	Tailing stored in: • Tailing Storage Facility (TSF1); • Blackwoods TSF (TSF2); • former Kintore Pit (TSF 3); and • in underground voids.
Waste rock	• Waste rock emplaced in underground voids. • 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 infrastructure	• Ancillary mining infrastructure includes crushing and processing plants, a tailing backfill plant, water management systems, rail siding facilities, internal roads, ventilation systems, administration offices, workshops and a storage warehouse.



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 (2022); CBH (2021); DPE (2019); DFSI (2017); GA (2011); ASGC (2006)

0 1 2 km

GDA 1994 MGA Zone 54

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Regional context

Rasp Mine Modification 10
Modification report
Figure 1.1

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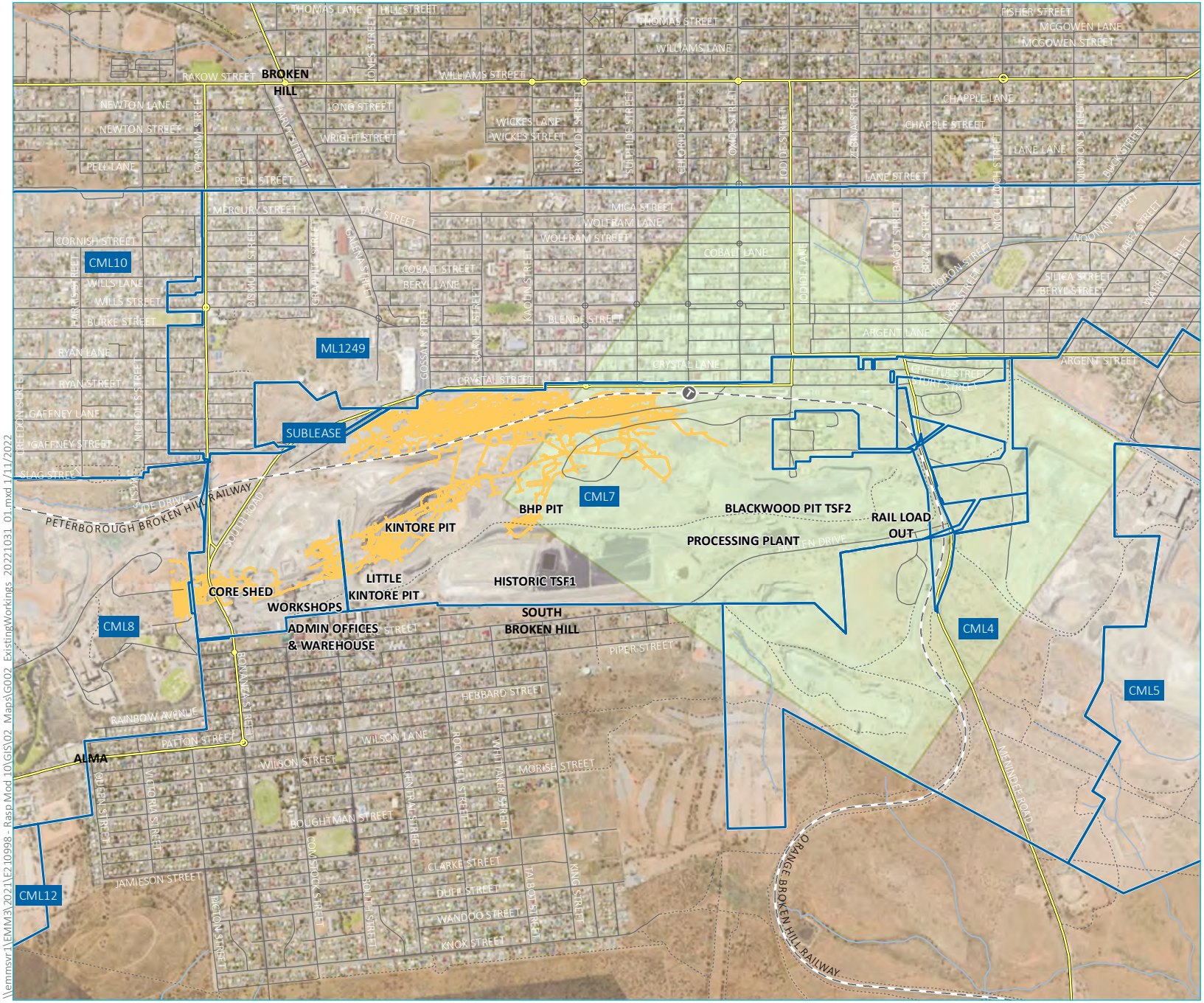

KEY

- Existing underground workings
- Dam notification area
- Mining lease
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line

Source: EMM (2022); CBH (2021); DPE (2019); DFSI (2017)

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Existing operations

Rasp Mine Modification 10
Modification report
Figure 1.2

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1.3 Previous modifications

The previously approved modifications to 07_0018 are summarised in Table 1.2.

Table 1.2 Previously approved modifications

Application	Determination date	Mine life	Mining rate and total production	Mining methods	Waste rock management	Processing rate	Processing methods	Concentrate production	Tailing disposal	Water supply	Employment numbers	Other
EA	31/01/2011	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 tailing disposal (approximately 320,000 tpa): • TSF1 (10 m raise); and • TSF2 Blackwood Pit. Coarse tailing 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.
MOD1	16/03/2012	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.
MOD2	29/08/2014	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).
MOD3	17/03/2015	No change	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).
MOD4	06/09/2017	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.
MOD5	02/11/2018	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.
MOD7	29/07/2019	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.

Table 1.2 Previously approved modifications

Application	Determination date	Mine life	Mining rate and total production	Mining methods	Waste rock management	Processing rate	Processing methods	Concentrate production	Tailing disposal	Water supply	Employment numbers	Other
MOD8	15/04/2021	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 (20 x 250 m) across Perilya Lease ML1249.
MOD9	23/12/2021	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	The establishment of two development drives and an emergency egress ladderway.
MOD6	16/03/2022	No change	500,000 tonnes	No change	Excess waste rock to be: • co-placed with tailing in TSF3; • used for rehabilitation capping where material <0.5% lead; and • permanently stored in Little Kintore Pit and BHP Pit (all material from construction of the boxcut and new decline development from surface).	No change	No change	No change	Establish a tailing storage facility at Kintore Pit as TSF3 with an approximate 14 year life. Utilise the surface of TSF2 to naturally dry tailing which would be harvested and transferred to TSF3.	• Potable/treated water 10 ML/a. • Raw untreated water 324 ML/a. • Reclaim/recycled water 525 ML/a . • Extraction – no change.	No change	A new access portal and decline to the underground mine, to be located within a boxcut. Land disturbance in MOD6 activities is 40.2 Ha, increasing land disturbance (from Rasp Mine activities) to 70 Ha.

2 Strategic context

2.1 Need for the project

The Rasp Mine (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 1.1).

Mining has been undertaken at the Rasp site for over 135 years. The site therefore 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. The mine has and continues to be a strategic asset for Broken Hill and its community.

The proposed MOD10 will not change the strategic context of the existing Rasp Mine. The proposed modification is very minor in that it seeks to introduce a temporary emplacement method which is within the existing disturbance area of mine site.

One of the most significant aspects of Rasp is that it will continue to support economic diversity to the Broken Hill local government area. Rasp continues to provide significant local jobs, investment, purchase of goods and services and taxes to the local and regional economy. Compared to its physical impact, Rasp has a disproportionately large beneficial economic influence in the region.

2.2 Strategic planning

2.2.1 Far West Regional Action Plan 2021

The project continues to be acknowledged for its importance under the *Far West Regional Action Plan 2021*, which recognises the ability of the mining sector in the Far West to be leveraged on to maximise the net social and employment benefits from mining growth, focused on housing availability, local skill formation and jobs, and maintenance and improvement of roads and community infrastructure. The plan also highlights that funding from Restart NSW (which includes Resources for Regions) will be invested as a way to assist regional communities to improve the local infrastructure required to support the growth in population associated with mining.

2.2.2 Far West Regional Plan 2036

The *Far West Regional Plan 2036* acknowledges and promotes a sustainable mining sector in Broken Hill, Cobar, Wentworth and Balranald which recognises that this industry generates direct employment and provides flow-on benefits to communities.

2.2.3 Broken Hill Community Strategic Plan 2040

The *Broken Hill Council Community Strategic Plan "Your Broken Hill 2040"* sets a vision for Broken Hill over the next two decades. Rasp is integral to the delivery of the community strategic plan given its close links with Council and the local funding opportunities and partnerships is has with community organisations.

3 Proposed modification

3.1 Modification description

In March 2022 a modification application was approved for Rasp (MOD6), which allowed:

- converting the Kintore Pit into a new TSF (TSF3) with a total estimated capacity of 4.3 Million m^3 (Mm^3);
- harvesting and transferring 480,000 tonnes per annum (about a total of 2.4 Mm^3) of dry tailing from TSF2 to TSF3 until the end of project life (2022–2026); and
- co-placing excess waste rock from underground mining into TSF3.

TSF3 and the new box-cut underground access are currently being constructed. However construction activities are taking longer than previously anticipated, and at the current ore production level it is likely that there will be a short-term deficit of tailing storage. There is an urgent need to create a suitable temporary emplacement area, in order to continue mining operations and prevent any disruption to ore production.

BHOP is therefore seeking to introduce a temporary tailing management strategy at Rasp, which involves emplacing harvested tailing in a stockpile within the existing TSF2.

3.1.1 Current Tailing deposition

Tailing is currently deposited into TSF2. The depth of TSF2 varies from about 40 metres (m) at its western end to about 70 m at its eastern end. In the past, portions of the eastern end of the Pit have been backfilled with mine waste. TSF2 was partially lined at the commencement of tailing deposition. Tailing deposition commenced in TSF2 in April 2012 and approximately 5.45 million tonnes of tailing (October 2022) has been deposited. At current production rates, TSF2 will reach its maximum capacity in December 2022 if tailing is not harvested and emplaced.

3.1.2 Proposed activity

TSF3 is under construction and will take until late 2023 to be ready to accept dry tailing from TSF2. Therefore in this interim period there will be the need to emplace harvested tailing in an alternative location, until TSF3 is operational.

BHOP proposes to temporarily emplace harvested tailing produced in this interim period by creating a stockpile at the south-western end of TSF2 (Figure 3.1). The activity would occur only while TSF3 construction is completed.

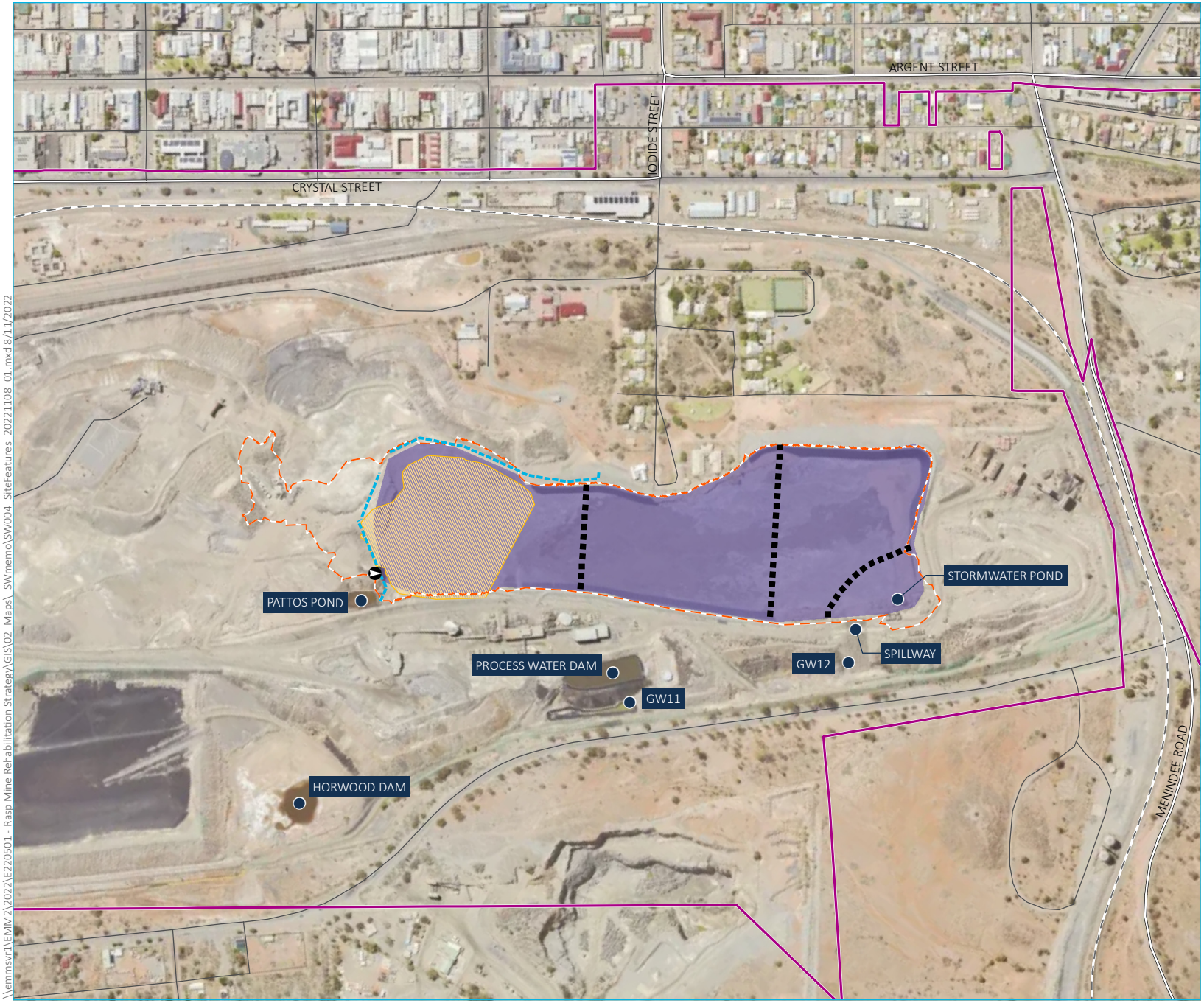
In order to evaluate the feasibility of the activity, Investigations have been undertaken for Two stockpile options were considered:

- Option 1: 28,000 m^2 footprint stockpile, to handle 265,000 m^3 of harvested tailing over a 12 month period.
- Option 2: 33,000 m^2 footprint stockpile, to handle 332,000 m^3 of harvested tailing over a 16 month period.

BHOP has decided to seek approval for Option 1, as it anticipates that it will only require to stockpile harvested tailing for up 12 months, to give it operational flexibility and to ensure TSF3 is constructed and can handle tailing before the stockpile is removed. When TSF3 is operational, the stockpile will be preferentially removed from TSF2 and emplaced in TSF3.

The harvested tailing would be emplaced in TSF2 to form a self-draining beach that would direct run-off into the existing surface water management system within TSF2. The proposed emplacement area is within the existing contours/walls of TSF2 (Figure 3.2).

The TSF2 sprinkler system would be extended to mitigate any dust from the stacked tailing in addition to the use of water trucks and application of chemical dust suppressant. When TSF3 is available to accept tailing, the stockpiled material would be preferentially used as the first tailing to be emplaced in TSF3. The extensive air quality monitoring network which has automated alert systems will continue to be employed at the site to monitor potential air quality impacts.



KEY

- Broken Hill Operations mining lease
- Temporary stockpile location
- TSF2 footprint
- Existing catchment extent
- Photo point
- Site feature
- Safety berm
- Approximate cell embankment

Existing environment

- Rail line
- Major road
- Minor road

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Source: EMM (2022); DPE (2021); DFSI (2020); Metromap (2022)

0 250 500 m

GDA2020 MGA Zone 54

TSF2 site features and temporary stockpile location

Rasp Mine
TSF2 Temporary Stockpiling of Harvested Tailings
Figure A.1

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Figure 3.2 Conceptual stacked harvested tailing within TSF2

3.1.3 Modification background and need

The Kintore Pit is approved to receive and emplace tailing and waste rock. An alternative mine access is being constructed to enable Kintore Pit to be used as a tailing and waste rock emplacement. The necessary construction is being undertaken to seal the former access to the underground mine which is currently accessed through the Kintore Pit.

Fresh tailing are approved to be placed into TSF2 with cells alternating between fresh and dried tailing. Thin layers of tailing (up to 1.0 m) are harvested once the material is sufficiently dry using load and haul equipment (eg by loader and by truck) and will be transported by truck to TSF3.

Due to unforeseen delays and scheduling issues, and delays to the construction schedule of the new box-cut entry to the underground and the transition of the Kintore Pit for its use as a tailing emplacement, there is an urgent need to manage harvested tailing while the works are being completed.

Due to a potential tailing storage deficit that if not addressed quickly would halt the operation of the mine, BHOP is looking to undertake a temporary campaign of dry tailing emplacement at the western end of TSF2 until the Kintore Pit can safely handle tailing.

3.1.4 Alternatives considered

The alternatives considered for this proposal included:

- delaying ore production until TSF3 is ready to accept dry stacked tailing;
- reducing ore production and consequent tailing production;
- emplacing tailing in other areas of the site (eg TSF1); or
- storing tailing underground.

Delaying or reducing ore production would likely result in significant economic implications for Rasp and its workforce. It may result in the mine shutting operations with consequent layoffs of personnel. Emplacing tailing in/on TSF 1 is not feasible as this emplacement has reached capacity. Storage of material underground presents additional risk. The proposed temporary stockpiling activity is therefore considered a suitable and feasible option to provide a solution to the short-term tailing storage deficit.

4 Statutory context

4.1 NSW Environmental Planning and Assessment Act 1979

4.1.1 Approval pathway

The project was originally approved under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Under clause 6 of Schedule 2 of the Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017, the project was transitioned to State significant development (SSD) by order, which took effect by publication in the NSW Government Gazette on 4 July 2018.

The MOD10 modification application is considered to meet the classification under Section 4.55(1A) of the EP&A Act, as a modification involving minimal environmental impact, as:

- there would be no change to key aspects of the project, including annual and total ore extraction, ore processing and transportation systems;
- there would be no material change to the approved environmental impacts of the project;
- it does not change the general tails harvesting operation of TSF2, and only introduces a temporary tailing management process in a portion of TSF2; and
- the activity will be undertaken within an approved disturbance area, and there would be no additional surface disturbance at the mine to accommodate the activity.

The proposed modification is therefore also considered to allow the project to remain substantially the same development as approved under the last modification prior to the project's transition to SSD.

4.1.2 Approval authority

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

4.2 Changes to conditions

There are no conditions which are considered that require to be changed as a result of the proposed modification.

5 Stakeholder consultation

5.1 Introduction

BHOP has undertaken a commensurate level of targeted consultation with Government agencies and Broken Hill City Council for the proposed modification, given the minor nature of the proposal. Consultation activities are summarised in Table 5.1.

Table 5.1 Consultation summary

Stakeholder	Consultation
Department of Planning and Environment	BHOP met with the Department of Planning and Environment on 5 September 2022 to introduce the proposal and to confirm the approval pathway and level of assessment required for the proposed modification.
Department of Regional NSW - Resources Regulator	BHOP met with Resources Regulator on 7 October 2022 and the Resources Regulator is understanding of the proposal, and discussed the key safety risks associated with the temporary dry tailing stacking.
Dams Safety NSW	BHOP met with Dams Safety NSW on 2 November 2022. Dams Safety NSW requested written confirmation from the TSF Design Engineer that the proposed works were suitable and would not impact the dam or embankments (see Appendix A).
Environment Protection Authority	BHOP met with EPA on 28 October 2022 to introduce and discuss the proposal. EPA noted that the existing controls utilised by the mine to control dust emissions from TSF2 would also need to be applied to the activity.
Broken Hill City Council	BHOP met with BHCC on 4 November 2022 to explain the proposed modification. BHCC did not raise any concerns about the proposed activity.
Perilya Mine Broken Hill	BHOP met with Perilya Mine Broken Hill 3 November 2022 to explain the proposed modification. Perilya did not raise any concerns about the dry tailing stockpiling activity.

6 Impact assessment

6.1 Geotechnical stability

6.1.1 Impact assessment

A stability assessment and volumetric analysis of two proposed stockpile options was undertaken for the proposed modification (see Appendix A) and recommendations made related to dry tailings placement, stockpile monitoring and excavation.

i Slope stability

The stability assessment considered the following two cases, being a 13 m high stockpile above the forecasted slurry deposited tailings surface and a similar geometry stockpile with a flat top dry tailings stockpile with a maximum slope of 15 m height.

Given that the stockpile is intended to be a temporary stockpile, the assessment adopted a high factor of safety of 1.4. The geotechnical assessment considers that the undrained strength of the deeper tailings is expected to increase with time as the pore water pressure dissipates from the existing tailings. The stability of the slope will therefore be expected to increase as the underlying tailings continue to consolidate.

The slope stability assessment does not rely on using the perimeter embankment of TSF2 for stability of the stockpile slope. The stability assessment has found that the proposed stockpile will have no meaningful effect on the stability of the perimeter embankments of TSF2.

ii Geometry and volume

For a 265,000 m^3 stockpile of harvested tailing, the top of stockpile is proposed to merge with the existing level at the western and southern sides of the existing overburden slopes at the edge of the pit.

The crest of the stockpile slope at the west side is proposed to be up to RL 336 m and the north-eastern slope crest of stockpile is proposed to be up to RL 338. This is approximately the same height as the current bunding on the western and north-western perimeter of TSF2. The eastern side of the stockpile outer slope will grade down to the existing edge bund along the pit edge. The outer slopes of the stockpile have been designed to not be steeper than 2H:1V.

A range of management measures can be implemented to maintain stability. The tailings deposited in TSF2 is to be suitably dried prior to excavation and transporting to the temporary stockpile located at the south western end of TSF2. The dry tailings should be spread in nominal 300 mm thick horizontal layers and track rolled using dozers or other similar equipment.

The geotechnical assessment has recommended that a spoon drain should be included along the eastern toe of the stockpile on the west side of the existing bund of the pit to direct runoff and sediment from the stockpile slope into the TSF to the north. Some additional stormwater measures may be required along the southern and western edges of the top of the stockpile as the top of the stockpile elevation extends above the existing crest elevations of the overburden slopes. These measures are considered feasible and will be included in the final design of the stockpile.

6.1.2 Conclusion

The stability and volume assessments show that the dry tailing stockpile can be constructed safely and will not have a significant impact on the current tailing management within TSF2. Minor engineering works to drainage systems can be implemented to reduce erosion risk and the designs are feasible in terms of maintaining stability.

6.2 Noise

6.2.1 Impact Assessment

A screening noise assessment was undertaken for the proposed activity (see Appendix B) in accordance with the *Noise Policy for Industry* (EPA 2017) based on the noise model established for the MOD6 noise impact assessment and associated reports prepared by EMM in 2021 *Rasp Mine Modification 6 – Kintore Pit TSF3 – Noise impact assessment* and *Addendum to MOD6 noise impact assessment – TSF2 tailing harvesting haul road update*.

Harvested tailing stockpiling is proposed to occur in accordance with the approved hours of operation for TSF2. Harvested tailing would be stockpiled using load haul equipment. Tractor scoops have been considered in noise modelling, as this equipment is additional to the previously modelled tailing management equipment (ie excavators, dozers and trucks). The maximum sound pressure level (L_{Amax}) for a tractor towing equipment is 80 dB(A)[1]. This would equate to a maximum sound power level of 108 dB(A). Assuming two tractor scoops operating simultaneously, the total sound power level for the dry tailing stacking activities could be up to 111 dB(A).

A review of the noise model identified that the total sound power level adopted for the TSF2 tailing harvesting activities (as approved under MOD6) include the operation of an excavator, two dozers and one grader, would be 116 dB(A). Therefore, the harvested tailing activities would not increase the total noise level produced from other tailing management in TSF2, and would not be discernible over other operational activities.

6.2.2 Conclusion

As site noise levels generated during the TSF2 tailing harvesting activities were predicted in the MOD6 impact assessment to satisfy the relevant noise limits at all residential assessment locations, the same conclusion can be reached for the proposed harvested tailing stockpile activities.

Therefore, total noise levels from site operations including the proposed modification, are expected to be consistent with the noise levels from MOD6 approved operations and satisfy the relevant noise limits at all residential assessment locations.

The current conditions of approval require compliance with strict noise criteria which will continue to apply to the proposed modification. The site has an active noise monitoring network in order to measure compliance and an established complaints management protocol which would continue to be observed.

6.3 Air quality

6.3.1 Impact Assessment

i Air quality

An air quality impact assessment has been undertaken for the proposed modification which builds on the assessment previously undertaken for MOD6 (see Appendix C).

The air quality assessment has focussed on the additional particulate emissions resulting from the dry stacking activities, occurring in conjunction with the construction scenario modelled in the MOD6 assessment.

[1] Based on data in Table 4 of the Department of Environment, Food and Rural Affairs (UK) (DEFRA) noise database (ref: *Update on noise database for prediction of noise on construction and open sites*, 2005)

Air quality impacts will be managed as they are under the current management regime on site. The current mitigation measures include both proactive and reactive processes. The extensive monitoring network already in place at Rasp informs the Trigger Action Response Plans (TARPs), providing alerts to staff when conditions are such that measures such as additional watering of TSFs or haul routes is required.

It is noted that the tailing material is inherently moist, with a moisture content of 10%–12% when harvested. Finally, the location of the proposed activity, at the southern end of TSF2, against the TSF2 embankment provides significant shelter from higher wind speeds and will thus mitigate wind erosion from this source. It is therefore anticipated that the above, in conjunction with current mitigation measures will be sufficient to control emissions and adequately reduce off-site air quality impacts.

The real time air quality monitoring network will continue to be used to ensure impacts remain within approved levels. The existing strict air quality criteria, lead level criteria and associated management protocols will 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
- continuous monitoring at site boundaries would also be undertaken as the works progress.

ii Human health

A Human Health Risk Assessment review was undertaken for the proposed modification (see Appendix C) which considered the air quality assessment and the human health risk assessment prepared for MOD6.

In the MOD6 assessment, it was estimated that the predicted incremental increases in soil Pb potentially arising from the MOD6 construction phase are in the range 0.03–2 mg/kg (rounded) which represent only 0.005%–0.43% of existing soil Pb concentrations.

Taking into consideration the potential modelled increase in annual Pb deposition rate at each receptor location as a result of tailing harvesting for MOD10, this would result in negligible change to the soil Pb concentration attributable to the construction phase of the project.

Similarly, the modelled incremental increase in annual average Pb in PM10 in air is negligible, resulting in an unchanged range of annual average Pb in PM10 (from MOD6) of 0.0005 to 0.014 µg/m^3, depending on receptor location. Therefore, the activities in MOD10 do not change the HHRA conclusions with respect to the construction scenario.

6.3.2 Conclusion

An evaluation of the anticipated increase in particulate, at both the emissions inventory and off-site impact level (using dispersion modelling) has been completed for the proposed modification. This concludes that, under the site's current and proposed dust mitigation methods, the proposed activity will result in a minimal change to the predicted impacts approved under MOD6 and the current conditions of approval remain suitable to regulate air quality impacts.

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 effect on human health from the proposed modification is considered to be negligible. The strict protocols in the Rasp Community Lead Management Plan, including the regular monitoring undertaken for the approved project at the established assessment locations, would continue to apply to the activities under the proposed modification.

6.4 Surface water

6.4.1 Impact assessment

A broad assessment has been undertaken of the existing water management systems at TSF2, to confirm that they remain appropriate for the temporary tailing stockpiling (see Appendix D).

The assessment detailed the design parameters of TSF2, describes the risks to surface water systems as a result of the proposal and shows that with appropriate control measures in place, that the proposal is unlikely to materially change the surface water regime on site.

This is because TSF2 has been designed to function with a storage above the tailing layer. This storage volume is necessary to detain poor quality water from overwhelming the downstream water management system and potentially result in an offsite release.

i Drainage

As the height of the temporary stockpile will exceed the existing pit crest, there is a potential for drainage capture points to form and erosion and uncontrolled flow paths within the stockpiles to result. The occurrence of these events would still be dependent on rainfall that is of a specific intensity and duration. Therefore minor modifications to the diversion drainage and bunding, external to the TSF2 may be necessary as part of the proposed activities. This would be managed under existing controls and is an operational matter which would not result in offsite environmental risks.

TSF2 has been designed to function with a storage above the tailing layer. This storage volume is necessary to detain poor quality water from overwhelming the downstream water management system and mitigate against the potential for offsite release.

ii Freeboard

While the available environmental containment freeboard may reduce in one of the cells in TSF2 under the proposed modification when compared with MOD6, this will be balanced by the harvesting of tailing that will create additional storage volume as depths within the TSF are increased. The balance of these cut and stockpile activities will be undertaken such that the risks of a reduced freeboard volume are mitigated as far as practicable.

BHOP has consulted with Dams Safety NSW on the proposed modification and Dams Safety NSW has not raised concerns about the longer-term management of the freeboard of TSF2. BHOP will continue to liaise with Dams Safety NSW throughout the operation of TSF2 as necessary to ensure the consequences of any reduction on freeboard from the proposed modification can be effectively managed.

Notwithstanding, the potential risks of not having sufficient containment storage on the TSF2 area can be managed, as the activities are temporary and the activities should result in a gain in storage capacity through the tailing harvesting. The Rasp Site Water Management Plan contains appropriate controls that will be used to manage the resulting risk of impacts.

iii Water quality

Water quality data captured between 2012 and 2022 for groundwater, and 2021 to 2022 for surface water, has been reviewed for monitoring sites specific to the TSF2 area.

The results of the review indicate that water collected from the surface of the TSF is not suitable for discharge and must be collected and reused on site or as part of the mineral processing system as per current practices. This will continue to occur under the proposed modification.

Groundwater quality data collected indicated varying groundwater levels over time not necessarily connected to rainfall variability and records indicate that perched groundwater environments have some variability both in level and quality due to the emplacement of tailing. This is due to the gradual filling of past mine workings that occur extensively across the site but in many cases are discontinuous.

However there has been no seepage events of perched groundwater, from the TSF2 into surface waters downstream and therefore the risk of seepage from the proposed modification is low. Based on the monitoring results, the local geology and the history of mining in the area, it is unlikely that specific changes in surface or groundwater quality will result from the temporary stockpiling of harvested tailing within TSF2.

6.4.2 Conclusion

The temporary stockpile has a conceptual design that is within the far south-western portion of TSF2, abutting against the previous Blackwoods pit walls. The height of the stockpile is proposed to be 10m which will theoretically be above the crest of the pit wall.

A range of controls at TSF2 will continue to apply to TSF2 as described in the Rasp Site Water Management Plan and the Environmental Protection Licence. These include drainage systems to direct any potential seepage or stormwater away from the toe of the facility to a nominated stormwater collection pond, lining of the TSF2 and sediment capture and disposal in TSF2. Regular monitoring of the TSF2 will continue in accordance with the Water Management Plan and its associated trigger action response plans

Existing drainage patterns surrounding the TSF2 have been developed on an as needed basis with the focus being on management of seepage through fill embankments and offsite discharge risks. Given the infrequent rainfall internal interfaces between catchments contributing to the TSF2 have been focused on safety bunding rather than water management.

Areas of harvested and temporary stockpile of tailings should be undertaken such that it does not impact on the ability to store the Environmental Containment Freeboard volume, of at least 48 ML, below the invert of the spillway. Required flood storage capacity for the Environmental Containment Freeboard is conservatively considered based on a minimal loss assumption.

The Site Water Management Plan will be reviewed and updated if necessary, in accordance with the current conditions of approval. The Continue existing surface and groundwater monitoring programs will continue to operate for the proposed dry tailing stacking activity.

6.5 Visual

The dry tailing stacking would be undertaken within an existing and highly disturbed mine site. The area that will be used for the proposal sits within the middle of the site, where it is currently shielded from view by waste rock stockpiles, bunding and ancillary mine infrastructure and buildings.

The stacking would occur progressively and to a maximum height of RL 338 and will remain far lower than the highest point in the landscape, being the Line of Lode Miners Memorial and café site. The top of stockpile is proposed to merge with the existing level at the western and southern sides of the existing overburden slopes at the edge of the pit, which will reduce the visual impact.

The dry tailing stacking will occur gradually and progressively and will not appear substantially different to other emplacement activities occurring at the Rasp mine. The tailing that are stacked will be emplaced into TSF3 when it is ready and the visual impact of the stockpile will reduce commensurately during that time.

Figure 6.1 shows the worst-case visual impact of the completed tailing stockpile from the public viewpoint at the Miners Memorial. As the Figure shows, the landform would not appear to be materially different to existing waste rock stockpiles and the Line of Lode memorial area. The stockpile therefore blends into the surrounding operational environment.

Figure 6.1 View of the harvested tailing stockpile from the Miners Memorial

6.5.1 Conclusion

The visual impacts of the proposed modification are not considered to be significant as the temporary stockpile will blend in with other site features. The current conditions of approval will continue to apply in terms of visual impacts.

7 Conclusion

BHOP is requesting to modify project approval 07_0118 to introduce a temporary tailing stacking procedure at the Rasp Mine. There is a clear need for the proposed modification, as there will shortly be a deficit of tailing storage areas due to unforeseen delays in the scheduling of the commencement of TSF3. This has serious continuity implications for the whole of site operations at Rasp and the proposal is therefore necessary to ensure the continued operation of the site while TSF3 is being constructed.

The proposed solution to the tailing deficit is to use part of an existing TSF for a temporary stockpiling activity. This is considered a feasible response to an operational continuity issue and can be undertaken with minimal environmental impacts.

The MOD10 modification application is considered to meet the classification under Section 4.55(1A) of the EP&A Act, as a modification involving minimal environmental impact, as:

- there would be no change to key aspects of the project, including annual and total ore extraction, ore processing and transportation systems;
- it does not change the general operation of TSF2, and only introduces a temporary tailing management process and the stacked tails will be emplaced in TSF3 as soon as possible; and
- there would be no additional surface disturbance outside of the areas already approved for disturbance.

The environmental impacts of the proposed modification will be minimal and unlikely to be materially different to approved operations. The residual impacts will be effectively managed under existing site operational practices, in accordance with the conditions of approval and the various management plans which apply to the site.

Appendix A
Geotechnical assessment

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7 November 2022 1896230-090-L-Rev1

Carlos Vanegas
BHOP
by email: Carlosvanegas@cbhresources.com.au

BLACKWOOD PIT TSF – STACKING OF DRIED TAILINGS

Carlos

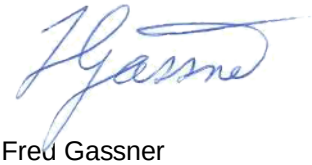
BHOP intends to harvest dried tailings from the deposited tailings in Blackwood Pit TSF (TSF 2). While Kintore pit is being prepared to receive the future deposition of dried tailings from TSF 2, BHOP intends to temporarily stack dried tailings in the southern part of TSF 2. We developed a conceptual stacking profile at the southern end of TSF 2 and assessed the slope stability of the facility related to the proposed stacking profile, noting that the stacking profile considered is the maximum extent and elevation of stacked tailings. The stacking operation is intended to be progressive over the footprint area of the Option 1 layout, and the elevation of the stack increased as required depending on the required volume of dried tailings to be temporarily stored. Option 2 layout may be adopted subsequently if extra dried tailings volume is required if Kintore pit pre-deposition works are delayed due to unforeseen circumstances.

The results of the conceptual shape and slope stability assessment are presented in the attached report, ref 1896230-067-M-Rev2.

The slope stability assessment doesn't rely on a perimeter embankment for the stability of the stack slope. The existing south east corner of the stack is located next to the recently constructed wide haul road embankment extending to the inside of the existing TSF perimeter. The eastern slope of the stack will therefore be located west of the haul road.

The proposed tailings stack has no meaningful impact on the integrity of the perimeter embankments of TSF 2.

Golder Associates Pty Ltd



Fred Gassner
Senior Principal

FWG/BPW/fwg

Attachments: A - Golder report 1896230-067-M-Rev2
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ATTACHMENT A

Golder report 1896230-067-M-Rev2

TECHNICAL MEMORANDUM

DATE 7 November 2022 **Reference No.** 1896230-067-M-Rev2

TO Bruce Dudgeon
Broken Hill Operations Pty Ltd

CC

FROM Md Abdur Rouf **EMAIL mrouf@golder.com.au**

STACKING OF DRY TAILINGS IN BLACKWOOD PIT AT RASP MINE, BROKEN HILL, NSW

1.0 INTRODUCTION

Broken Hill Operations Pty Ltd (BHOP) has engaged Golder Associates Pty Ltd (Golder) to undertake a stability and volumetric assessment for a proposed dry stack tailings stockpile at the south west end of Blackwood Pit Tailings Storage Facility (TSF 2) Rasp Mine, in Broken Hill, New South Wales. This option was proposed to enable mine production to continue should the available slurry storage capacity in TSF 2 be consumed before TSF 3 is ready to receive tailings.

This Technical Memorandum presents outcomes of the stability assessment and volumetric analysis of two proposed stockpile options and recommendations related to dry tailings placement, stockpile monitoring and excavation.

2.0 STABILITY ASSESSMENT

A slope stability assessment was conducted to assess the required batter of the stockpile slope. The assessment was conducted using the Morgenstern-Price method within the Slope/W software, GeoStudio 2019. The stability assessment considered the following two cases:

Case 1: A 13 m high dry tailings stockpile above the forecasted slurry deposited tailings surface (refer pink lines in Figure 1 and Figure 2). The forecasted slurry deposited tailings surface considered a 2.5% grade towards east based on recent tailings beach survey data. The adopted top surface of the stockpile was modelled at the same grade of the base, i.e., at 2.5 % towards the east.

Case 2: Similar geometry to Case 1 but with a flat top dry tailings stockpile with a maximum slope of 15m height.

The parameters adopted for the slope stability assessment has considered the following:

- The dry stack tailings will be tracked rolled resulting in a bulk density of 20 kN/m^3. Based on our knowledge of the dried tailings from the construction of Embankments 1 and 3, an effective cohesion strength of 5 kPa and a friction angle of 33º was adopted.

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- From CPT investigation in the past and recent excavations in the tailings surface it is evident that the upper zone of tailings is unsaturated and well consolidated from sun drying of the deposited layers. The upper zone of slurry deposited tailings under the proposed dry stack stockpile for a depth of 10 m considers an effective strength friction angle of 30° with no cohesion.
- Tailings below upper slurry deposited tailings layer is assessed using an undrained strength ratio of 0.20. The undrained peak shear strength ratio was selected from previous critical state laboratory testing conducted on tailings samples, ref Golder report 1896230-004-R-Rev0, dated August 2018.
- Rapid construction of the stockpile was considered, i.e., the analysis assumes that the strength gain of the lower layers of tailings does not occur over the period of the stockpile construction (B-bar of 1.0 was adopted).
- Various batter angles were considered for the stockpile slope with an adopted steepness limit of 2 H in 1 V, to manage surface ravelling and limit the extent of potential erosion. This batter limit also enables the possibility to include some benches in the batter to further limit erosion and enable construction. The limit of 2H in 1V relates to the overall slope batter.

The outcome of slope stability assessment is presented in Attachment A. The stability assessment indicates a factor of safety of about 1.4 for Case 1 and about 1.3 for Case 2 based on the adopted parameters and a slope batter of 2 H in 1 V.

Given that the stockpile is intended to be a temporary stockpile for up to two years (i.e., assumed time period over which capacity TSF 3 may not be ready to receive tailings), the adopted target factor of safety is 1.3. We consider the undrained strength of the deeper tailings is expected to increase with time as the pore water pressure dissipates from the existing tailings. The factor of safety of the slope will therefore increase over time as the underlying tailings continue to consolidate, but that timeline has not been considered further in this analysis.

3.0 GEOMETRY OF TAILINGS STOCKPILE AND VOLUME ANALYSIS

We proposed the stockpile geometry and estimated stockpile volume for two options. The footprint for the concept for Option 1 was provided by BHOP and Option 2 was selected to estimate the maximum potential volume of tailings BHOP can dry stack at the south west end of TSF 2 if required.

Option 1: A layout of Option 1 is presented in Figure 1. The top of stockpile is proposed to merge with the existing level at the western and southern sides of the existing overburden slopes at the edge of the pit. The crest of the stockpile slope at the west side is proposed to be up to RL 336 m and the north eastern slope crest of stockpile is proposed to be up to RL 338. The eastern side of the stockpile outer slope will grade down to the existing edge bund along the pit edge. The outer slopes of the stockpile must not be steeper than 2H:1V.

A summary of the stockpile capacity assessment for Option 1 is presented in Table 1. The stockpile is estimated to have a capacity of 265,000 m^3 for dry tailings storage. Considering a dry density of 1.6 t/m^3 for dry stack tailings, the Option 1 stockpile is expected to have a storage capacity for 424,000 tonnes of tailings. Based on a forecast deposition rate of 400,000 tonnes per year (ref. BHOP Memorandum titled '*Blackwood Pit TSF2- Tailings harvesting setup and dry stacking discussion*', dated 16 December 2021), the tailing storage capacity of Option 1 stockpile is predicated to provide capacity for approximately 12 months.

Table 1: Option 1 Stockpile Capacity Assessment Summary

Item	Unit	Estimate
Stockpile surface area	m^2	28,000
Stockpile Volume	m^3	265,000
Forecast tailings deposition rate	t/year	400,000
Assumed dry stack tailings density	t/m^3	1.6

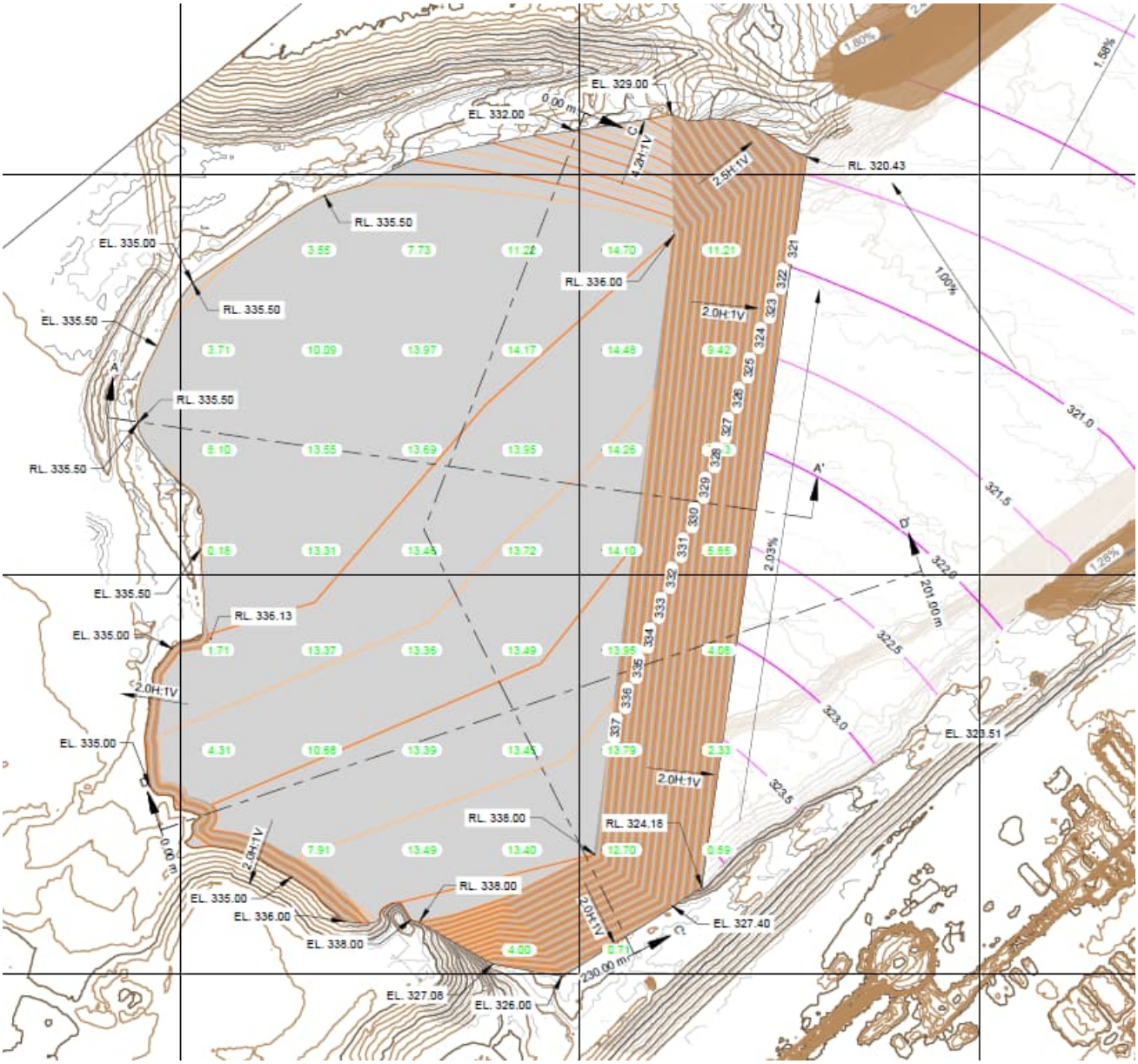


Figure 1: Option 1 Stockpile Layout

Option 2: A layout of Option 2 is presented in Figure 2. The top of stockpile is proposed to merge with the existing level at the western and southern sides of the existing overburden slopes at the edge of the pit. The crest of the stockpile slope at the west side is proposed to be up to RL 336 m and the north eastern slope crest of stockpile is proposed to be up to RL 338. The eastern side of the stockpile outer slope will grade down to the existing edge bund along the pit edge. The outer slopes of the stockpile must not be steeper than 2H:1V.

A summary of the stockpile capacity assessment for Option 2 is presented in Table 2. The stockpile is estimated to have a capacity of 332,000 m^3 for dry tailings storage. Considering a dry density of 1.6 t/m^3 for dry stack tailings, the Option 2 stockpile is expected to have a storage capacity for 531,000 tonnes of tailings. Based on a forecast deposition rate of 400,000 tonne per year (ref. BHOP Memorandum titled '*Blackwood Pit TSF2- Tailings harvesting setup and dry stacking discussion*', dated 16 December 2021), the tailing storage capacity of Option 2 stockpile is predicated to provide capacity for approximately 16 months.

Table 2: Option 2 Stockpile Capacity Assessment Summary

Item	Unit	Estimate
Stockpile surface area	m^2	33,000
Stockpile Volume	m^3	332,000
Forecast tailings deposition rate	t/year	400,000
Assumed dry stack tailings density	t/m^3	1.6

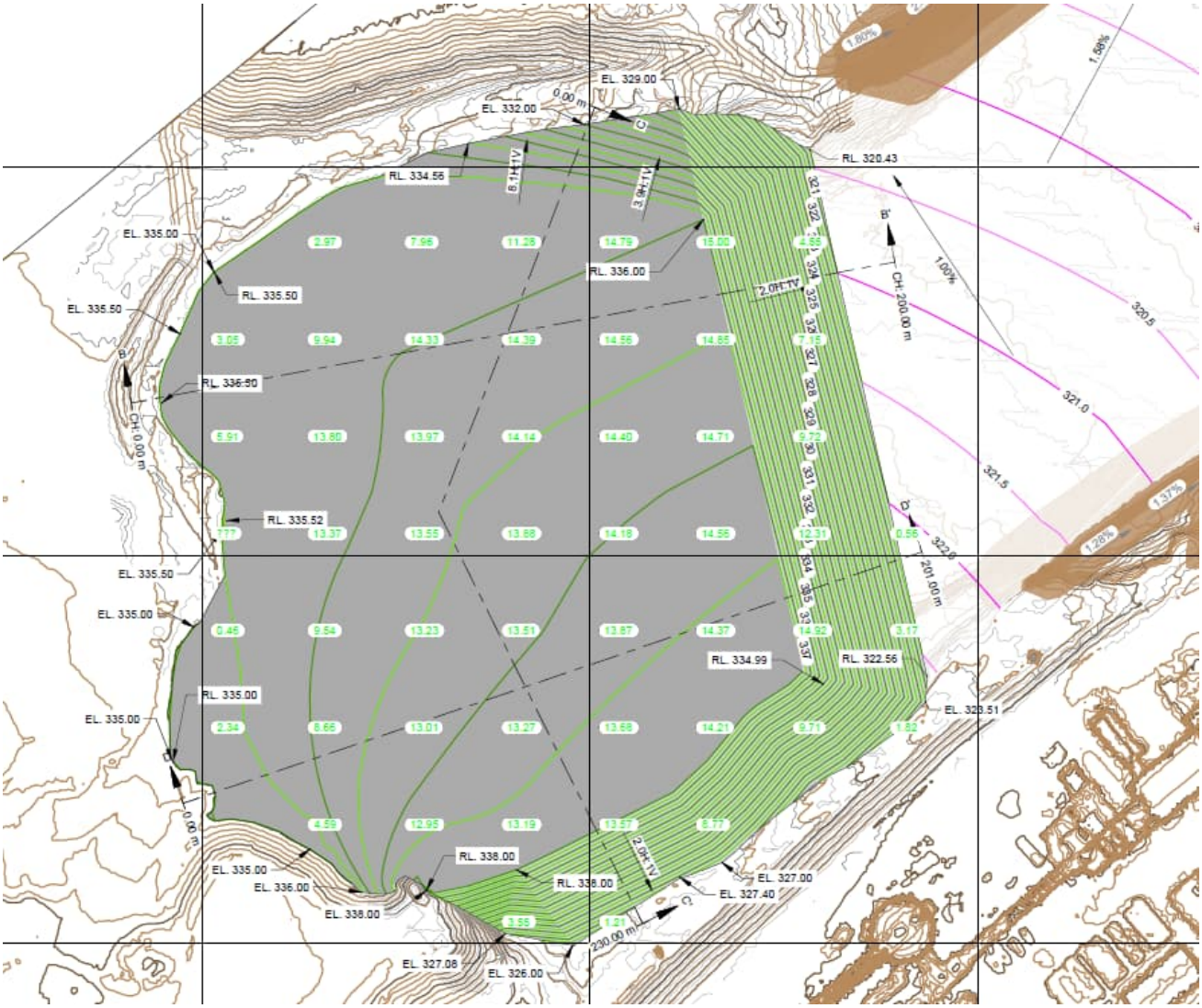


Figure 2: Option 2 Stockpile Layout

4.0 RECOMMENDATION RELATED TO TAILINGS EXCAVATION, PLACEMENT AND STOCKPILE MONITORING

The tailings deposited in Blackwood Pit is to be dried for a period of up to 20 days (ref. 1896230-R-054-Rev1, dated June 2021) prior to excavation and transporting to the dry stack stockpile located at the south western end of Blackwood pit. The dry tailings from Blackwood pit will be excavated using excavators and transported to dry stack stockpile site by dump trucks. The dry tailings should be spread in nominal 300 mm thick horizontal layers and track rolled using dozers or other similar equipment. The shapes presented in Figure 1 and Figure 2 are to be constructed progressively over the entire footprint of the stockpile. The northern and eastern edge of the stockpiled tailings should be compacted to a dry density ratio of 95 % Standard to limit the extent of erosion of the face from periodic rainfall events. It is expected this will require compaction with a roller, with the usual width of the roller drum being approximately 2.5 m.

A spoon drain should be included along the eastern toe of the stockpile on the west side of the existing bund of the pit to direct runoff and sediment from the stockpile slope into the TSF to the north. Some additional stormwater measures may be required along the southern and western edges of the top of the stockpile as the top of the stockpile elevation extends above the existing crest elevations of the overburden slopes.

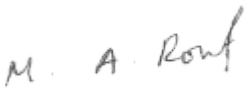
The stockpile slopes, in particular the north eastern face of stockpile should be monitored for erosion after rainfall runoff events. If significant erosion is observed, further erosion protection measures could be implemented in consultation with the Design Engineer. Benches may be considered on the eastern slope of the stockpile to reduce erosion.

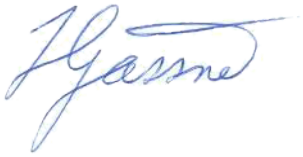
We suggest that dust suppression measures are also implemented on the stockpile to suppress dust emanating from stockpile site.

5.0 CLOSING

We trust the information provided in this Technical Memorandum is clear, should you have any queries please contact the undersigned.

GOLDER ASSOCIATES PTY LTD





Md Abdur Rouf
Civil Engineer

Fred Gassner
Senior Principal

MAR/FWG/sje

Attachments
A- Slope Stability Assessment
B- Important Information

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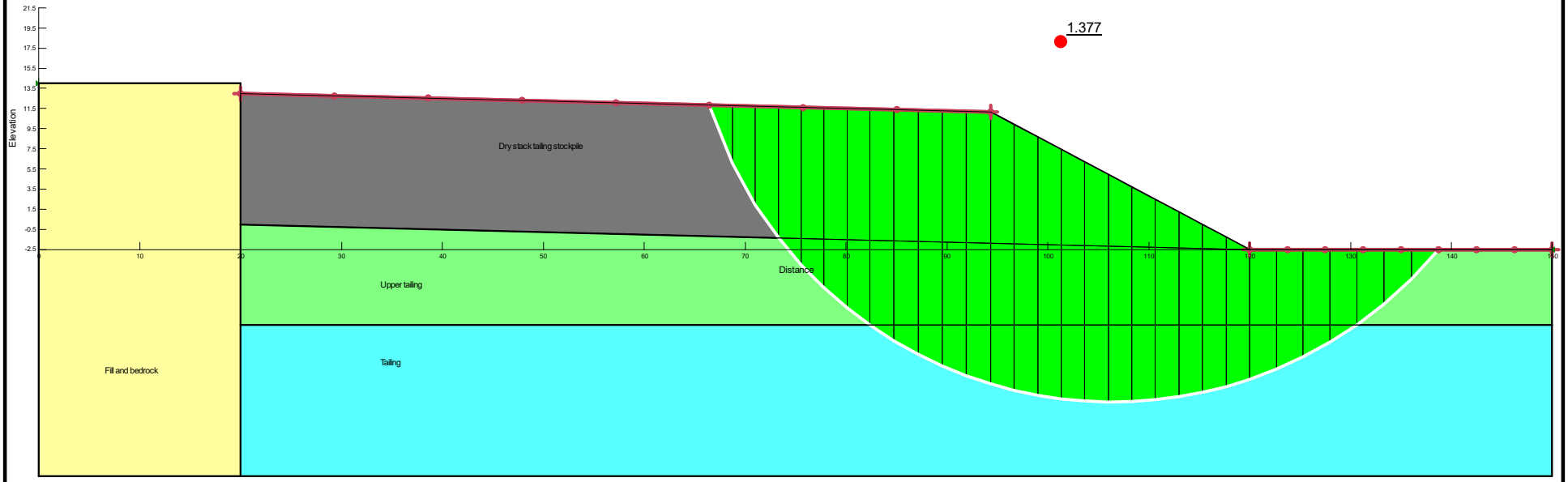
ATTACHMENT A

Slope Stability Assessment

Case 1

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	B-bar	Add Weight
	Dry stack tailing stockpile	Mohr-Coulomb	20			5	33	0	0	Yes
	Fill and bedrock	Bedrock (Impenetrable)							0	No
	Tailing	SHANSEP	19	0	0.2				1	No
	Upper tailing	Mohr-Coulomb	20			0	30	0	0	No



Slope Stability

Dry stack tailing stockpile 2H 1V - short term strength condition.gsz

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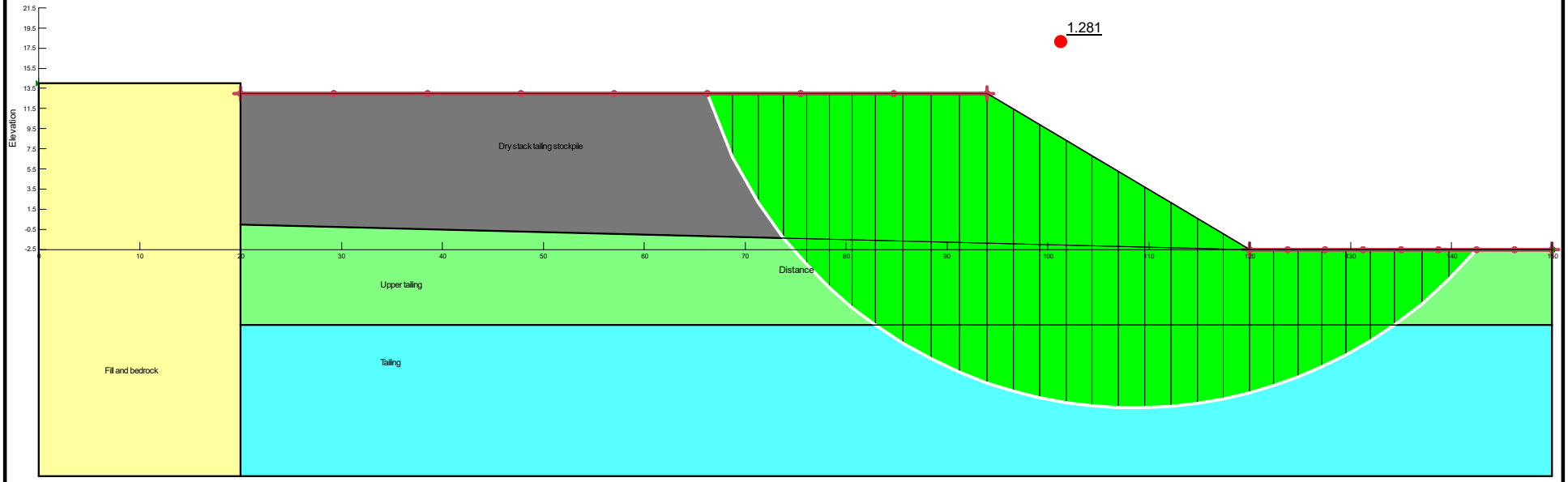
Case 2

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	B-bar	Add Weight
	Dry stack tailing stockpile	Mohr-Coulomb	20			5	33	0	0	Yes
	Fill and bedrock	Bedrock (Impenetrable)							0	No
	Tailing	SHANSEP	19	0	0.2				1	No
	Upper tailing	Mohr-Coulomb	20			0	30	0	0	No



Slope Stability	
Dry stack tailing stockpile 2H 1V straight horizontal line.gsz	
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ATTACHMENT B

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification

Appendix B
Noise assessment

EMM
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7 November 2022

Joel Sulicich
Health Safety Environment and Training Manager
Broken Hill Operations Pty Ltd
130 Eyre Street
Broken Hill NSW 2880

Re: Rasp Mine TSF2 Dry Stacking - Noise

Dear Joel,

1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Broken Hill Operations Pty Ltd (BHOP) to complete a review of potential noise impacts for the proposed temporary dry stacking activities at the Rasp Mine in Broken Hill, NSW. The site currently operates under Project Approval 07_0018.

In March 2022 approval was granted to allow tailings to be co-placed with excess waste rock from underground mining development into the former Kintore Pit, which will extend the site's tailings storage capacity beyond 2022.

Under the tailings placement methodology currently used onsite, there is insufficient storage space in the current tailings storage facility Blackwoods TSF2 until TSF3 (Kintore Pit) is ready. BHOP is proposing to create a temporary harvested tailings stockpile within the footprint of TSF2 as a temporary measure until TSF3 is ready. The proposed TSF2 dry tailings activities would occur before the TSF2 tailings harvesting activities commence and hence they would not occur concurrently. No other approved activities are proposed to change.

The purpose of this letter is to provide the findings of our qualitative review of potential noise emissions from dry stacking and compare these to the relevant site noise limits.

2 Noise impact

Dry stacking is proposed to occur at the southern end of TSF2. Dried tailings would be placed using two tractor scoops. A review has been completed of the noise model established for the MOD6 noise impact assessment and associated reports *Rasp Mine Modification 6 – Kintore Pit TSF3 – Noise impact assessment* and *Addendum to MOD 6 noise impact assessment – TSF2 tailings harvesting haul road update* prepared by EMM in 2021.

Based on data in Table 4 of the Department of Environment, Food and Rural Affairs (UK) (DEFRA) noise database (ref: *Update on noise database for prediction of noise on construction and open sites*, 2005), the maximum sound pressure level (L_{Amax}) for a tractor towing equipment (reference number 74) is 80 dB(A). This would equate to a maximum sound power level of 108 dB(A) for a tractor towing equipment. Assuming two tractor scoops operating, the total sound power level for dry stacking could be up to 111 dB(A).

A review of the noise model identified that the total sound power level adopted in the MOD6 impact assessment for the TSF2 tailings harvesting activities (approved under MOD6), which include the operation of an excavator, two dozers and one grader, would be 116 dB(A). Site noise levels generated during the TSF2 tailings harvesting activities (day period only) were predicted in the MOD6 impact assessment to satisfy the relevant noise limits at all residential assessment locations.

Based on the noise model review, which included a comparison of sound power levels for the relevant sources (as mentioned above) and their locations within the site, noise levels likely to be generated by dry stacking would be lower than those from the TSF2 tailings harvesting. Therefore, no increase in total site noise as predicted in the MOD6 noise assessment reports (EMM 2021) is anticipated at any of the residential assessment locations. Therefore, total noise levels from daytime site operations, including during dry stacking, are predicted to be consistent with those from MOD6 approved operations and satisfy the relevant noise limits at all residential assessment locations.

3 Conclusion

The proposed dry stacking is unlikely to increase total site noise predictions above the relevant noise limits at all residential assessment locations. Therefore, additional noise impacts at surrounding sensitive receivers from the proposed dry stacking are unlikely. The conditions of approval and the current Noise Management Plan for the site remain appropriate to manage noise from the proposed activity.

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

Yours sincerely

Teanuanua Villierme
Senior Acoustic Consultant
tvillierme@emmconsulting.com.au

Reviewed by Najah Ishac on 13/4/2022

Appendix C

Air quality assessment and Human health risk assessment

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CBH Resources Rasp Mine Dray Stacking

Air Quality Assessment

Project Number.: 0042

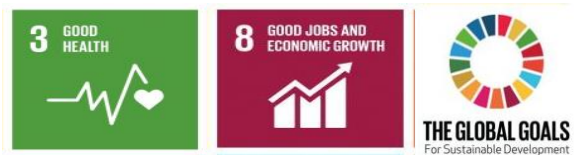
Date: 13 May 2022

Document details	
Document title	CBH Resources Rasp Mine Dray Stacking
Document subtitle	Air Quality Assessment
Project No.	0042
Date	13 May 2022
Version	Final
Author	Jane Barnett
Client Name	Broken Hill Operations Pty Ltd

Document history

Version	Date	Author	Reviewed by	Comments
D01	29.04.2022	Jane Barnett	Damon Roddis	Draft for client review
F01	13.05.2022	Jane Barnett	Damon Roddis	Final

The following Sustainable Development Goals are applicable to this work:



Jane Barnett
Principal – Air Quality

Zephyr Environmental Pty Ltd
PO Box 41
Rozelle NSW 2039

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List of Figures

1 INTRODUCTION

Broken Hill Operations Pty Ltd (BHOP) operates the Rasp Mine, an underground silver/zinc/lead operation located within the city limits of Broken Hill in the far west of NSW. Mining has been undertaken within CML7 since 1885. The existing operations at the Rasp Mine include underground mining operations, a processing plant producing zinc and lead concentrates, a rail siding for concentrate dispatch and other associated infrastructure. These operations are undertaken in accordance with Project Approval PA07_0018, granted from the then Minister for Planning on 31 January 2011, under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The latest air quality assessment was completed in 2021, to determine the potential impacts of the proposed Modification 6 (MOD6). Part of the MOD6 proposal included the harvesting of a thin layer of dry tailings from the surface of Blackwood Pit (TSF2) and transfer to Kintore Pit (TSF3).

Even though MOD6 is approved and will provide long term tailings storage options, TSF2 will reach capacity before TSF3 is ready for tailing deposition. BHOP is therefore proposing to 'dry stack' tailings at the southern end of TSF2 against the high wall for a period of 9 – 16 months before TSF3 is available. The purpose of this assessment is therefore to determine whether there are likely to be any air quality impacts associated with this change.

2 PROJECT DESCRIPTION

Two of the scenarios considered in the MOD6 assessment included:

- a construction scenario – representing the construction of the box cut and the new portal; and
- an operational scenario – representing a reasonable worst-case future year of operations, with progressive rehabilitation and 100% of operations from the new mine portal

Under the proposed dry stacking, the construction scenario will now include the harvesting of tailings and stockpiling them at the southern end of TSF2.

The site layout is shown in Figure 2-1, which indicates the locations of the area to be harvested, as well as the area designated for dry stacking (stockpiling).

Two dry stacking options have been investigated, to evaluate different stockpile sizes.

- Option 1, refers to a 28,000 m^2 stockpile, incorporating 400,000 tonnes of dry tailings over a period of 12 months.
- Option 2 will involve the same tailing deposition rate of 400,000 t/y, but assumes dry stacking occurs over a 16 month period, resulting in a larger stockpile of 33,000 m^2.

Emissions calculations have been carried out for both Option 1 and Option 2. It has been assumed that whichever option is selected going forward, this will occur concurrently with the construction scenario described above and modelled within the MOD6 air quality assessment.

Figure 2-1: Indicative locations of stockpiling and dry stacking

3 AIR QUALITY ASSESSMENT CRITERIA

The *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) specifies air quality assessment criteria relevant for assessing impacts from air pollution (NSW EPA, 2016). These criteria are consistent with the revised National Environment Protection Measure for Ambient Air Quality (referred to as the Ambient Air-NEPM) and are listed in the conditions for Project Approval 07_0018. Table 3-1 presents the air quality criteria that are relevant to this study.

Table 3-1: NSW EPA impact assessment criteria

Pollutant	Averaging period	Criterion
TSP	Annual	90 µg/m^3
PM_{10}	Annual	25 µg/m^3
	24-hour	50 µg/m^3
$PM_{2.5}$	Annual	8 µg/m^3
	24-hour	25 µg/m^3
Lead (TSP fraction)	Annual	0.5 µg/m^3
Deposited Dust	Annual	2 g/m^2/month (incremental)
		4 g/m^2/month (cumulative)

4 EXISTING ENVIRONMENT

The monitoring at the site is described in the MOD6 air quality assessment. The same estimates of background concentrations and deposition rates have been assumed for this assessment.

To maintain consistency with the MOD6 assessment, the model year 2016 has been used for this assessment.

5 EMISSIONS TO AIR

This assessment focusses on the additional particulate emissions resulting from the dry stacking activities, occurring in conjunction with the construction scenario modelled in the MOD6 assessment. The same emission estimation techniques have been applied here, that is, emission factors developed by the US EPA and routinely applied in NSW.

The additional activities for which emissions have been calculated include:

- Material being harvested from TSF2 / transferred to the stockpile
- Wind erosion from the stockpile
- Wind erosion from the disturbed tailings area

It is understood that tailings are proposed to be harvested / transported for dry stacking using rubber-tyred tractor scoops, such as shown in Figure 5-1.

Figure 5-1: Example of rubber tyred tractor scoops proposed for tails harvesting

There are no particulate matter emission factors available for the equipment proposed for the dry stacking. Accordingly, a combination of dozers and excavators pushing, dumping and shaping has been assumed. This emission estimation is considered to be conservative, given scooping action (pulling) is anticipated to cause less disturbance of the TSF surface compared to a dozer push or excavator movement.

As noted in Section 2, there are two harvesting options being considered:

- Option 1; a 28,000 m^2 stockpile completed in 12 months
- Option 2; a 33,000 m^2 stockpile completed over 16 months

The only difference with regard to particulate emissions between these two options, will be the area subject to wind erosion from the different size stockpiles. The tailings deposition rate will be the same for both options, at 400,000 t/y, but Option 2 will continue for an additional 4 months resulting in a larger stockpile.

Table 5-1 presents the total emissions for the construction scenario and the additional emissions from dry stacking, as well as the increase this represents to total emissions.

Table 5-1: Change in total annual emissions for each dry stacking option

Air Quality Metric	MOD6 emissions (kg)	Dry stacking emissions (kg)	Percentage increase in total emissions (%)
Option 1 – 12 months of stockpiling			
TSP	44,027	582	1.3
PM_{10}	14,006	193	1.4
$PM_{2.5}$	2,714	52	1.9
Lead	519	1.2	0.2
Option 2 – 16 months of stockpiling			
TSP	44,027	585	1.3
PM_{10}	14,006	195	1.4
$PM_{2.5}$	2,714	52	1.9
Lead	519	1.2	0.2

As shown in Table 5-1, the increase in annual emissions is less than 2% across all air quality metrics and thus unlikely to result in any material change to the estimated impacts presented in the MOD6 construction assessment. It is also shown that there is almost no difference between Option 1 and Option 2.

6 IMPACT ASSESSMENT

In addition to evaluating the change to site emissions inventory, it is also important to consider the change in off-site air quality impacts.

Predictions for each air quality metric and averaging period were made for all 70 discrete receptors referenced within the MOD6 assessment. These predictions were added to the cumulative results presented for the MOD6 construction scenario to determine the potential increase.

The largest changes for all pollutants and for all averaging periods, were predicted at receptor R27. As shown in Figure 6-1, R27, Proprietary Square, is situated immediately to the north of TSF2 and adjacent to the proposed dry stacking activities.

Figure 6-1: Location of most impacted receptor (R27) in relation to the proposed dry stacking activities

The predictions for receptor R27 and the percentage increase they represent are shown in Table 6-1. These results are for Option 2, as these annual emissions are higher and so present a reasonable worst case.

With the exception of deposition, all increases are estimated to be less than 1%. This would not result in any material / measurable change to the MOD6 construction predictions. All metrics remain well below their relevant EPA criteria.

The increase in lead deposition is predicted to be 1.7%. It was noted in the MOD6 assessment that the model likely over-predicts lead deposition, particularly close to the mine. To account for this over-prediction, the background was therefore assumed to be zero and so the MOD6 increment is essentially also the cumulative value. Therefore, the dry stacking increment may appear to be proportionally higher, even though the absolute value is still very low at 0.001 g/m^2/annum.

The total dust deposition rate is predicted to increase by approximately 1.3%, but again, this is likely to be an over-prediction due to the close proximity to emission sources. The predicted rate also remains well below both the incremental and cumulative EPA criteria.

Table 6-1: Predictions at most impacted sensitive receptor (R27) for Option 2

Metric	MOD6 construction (cumulative)[1]	Dry stacking increment	MOD6 with dry stacking (cumulative)[2]	Percentage increase over MOD6	EPA impact assessment criterion	Units
Annual average lead concentration	0.24	0.0004	0.24	0.2%	0.5	µg/m^3
Annual average lead deposition	0.06	0.001	0.06	1.7%	N/A	g/m^2/annum
Annual average TSP concentration	36.6	0.198	36.8	0.5%	90	µg/m^3
Annual average PM_{10} concentration	13.5	0.067	13.5	0.5%	25	µg/m^3
Annual average $PM_{2.5}$ concentration	5.5	0.018	5.5	0.3%	8	µg/m^3
Maximum 24-hour average PM_{10} concentration	46.6	0.414	47.0	0.9%	50	µg/m^3
Maximum 24-hour average $PM_{2.5}$ concentration	19.0	0.085	19.0	0.5%	25	µg/m^3
Annual average dust deposition	3.4	0.043	3.4	1.3%	2 (incremental) 4 (cumulative)	g/m^2/month

Notes
[1]: Includes the MOD6 increment plus the existing background value as noted in Section 5.2 the MOD6 air quality assessment
[2]: Includes background, MOD6 increment and the new dry stacking increment. Sometimes these values are presented as equal to the MOD6 cumulative value, even though there is an additional dry stacking contribution. This due to rounding when this contribution is very small. The small change can be seen in the % increase value.

7 MITIGATION MEASURES

The current mitigation measures include both proactive and reactive processes. The extensive monitoring network informs the Trigger Action Response Plans (TARPs), providing alerts to staff when conditions are such that measures such as additional watering of TSFs or haul routes is required.

There is a proposal to install an extensive sprinkler system (extension of the TSF2 sprinkler system) along the southern edge of TSF2 which would further reduce emissions. It is noted that the tailings material is inherently moist, with a moisture content of 10 – 2% when harvested.

Finally, the location of the proposed dry stacking, at the southern end of TSF2, against the high wall provides significant shelter from higher wind speeds and will thus mitigate wind erosion from this source.

It is anticipated that the above, in conjunction with current mitigation measures will be sufficient to control emissions and adequately reduce off-site air quality impacts.

A proactive measure to consider may be to focus harvesting efforts in the months when winds are not blowing from the south. As shown in Figure A3, southerlies dominate during the warmer months, mainly in February, and so particular caution should be taken at these times. The real time monitoring network will assist with this management.

8 CONCLUSION

BHOP proposes to 'dry stack' tailings at the southern end of TSF2 against the high wall for a period of 9 – 16 months before TSF3 is available. An evaluation of the anticipated increase in particulate, at both the emissions inventory and off-site impact level (using dispersion modelling) has been completed. This concludes that, under the sites current and proposed dust mitigation methods, dry stacking, over a 9 – 16 month period will result in a minimal change to the predicted impacts approved under MOD6.

Appendix A

Analysis of 2016 wind speed and direction data

Figure A1 shows that 2016 is a representative year with regard to wind speed and direction, the parameters most relevant for the dispersion of ground-based particulate sources. All years display very similar distribution patterns, with the highest frequency of winds originating from the southern quadrant.

Figure A2 and Figure A3 show the seasonal and monthly variation, respectively for 2016. The winds from the southern quadrant occur predominantly in summer and winds are also generally stronger at this time. These southerlies are less prevalent during the winter months.

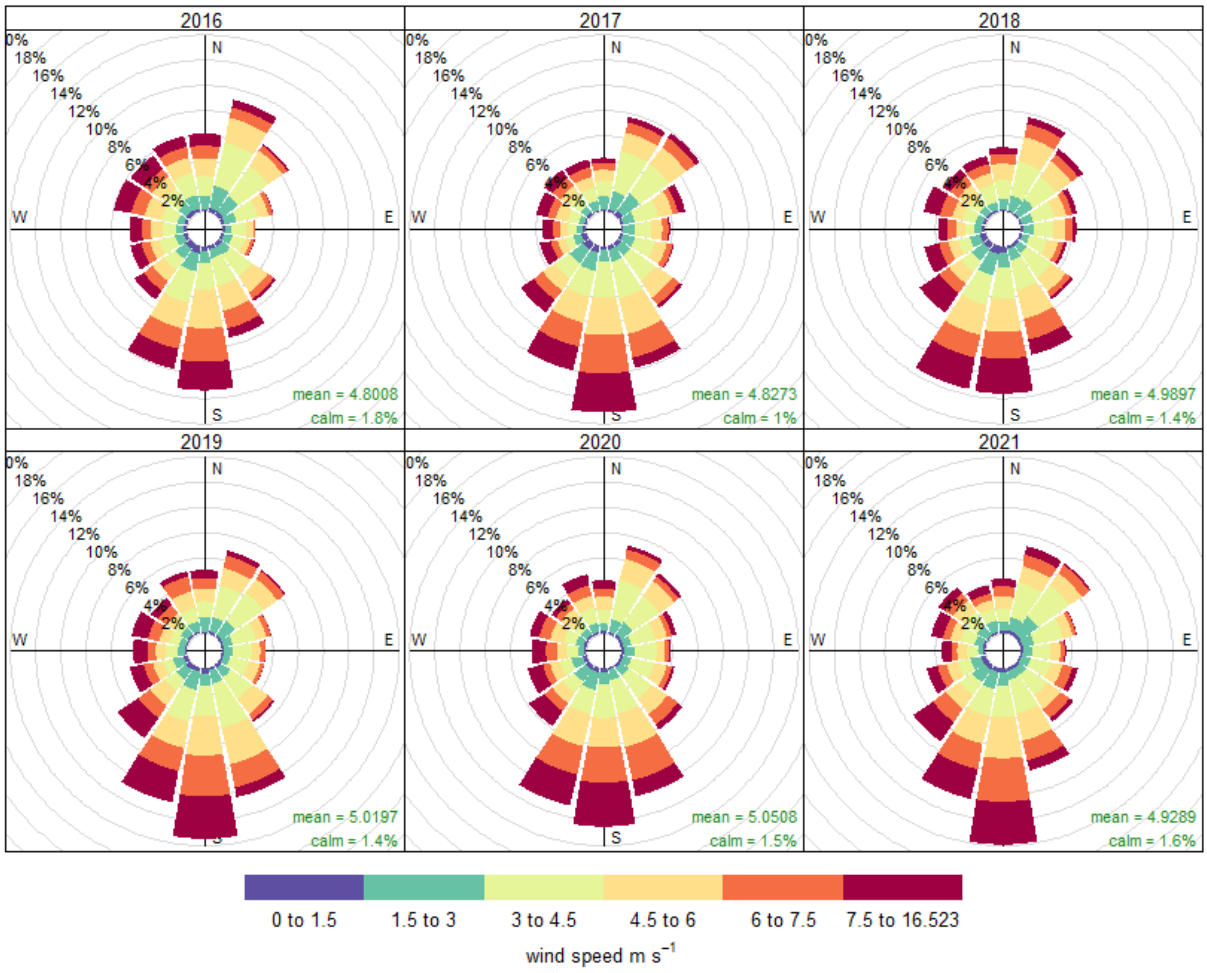


Figure A1: Annual windroses for Broken Hill (2016 – 2021)

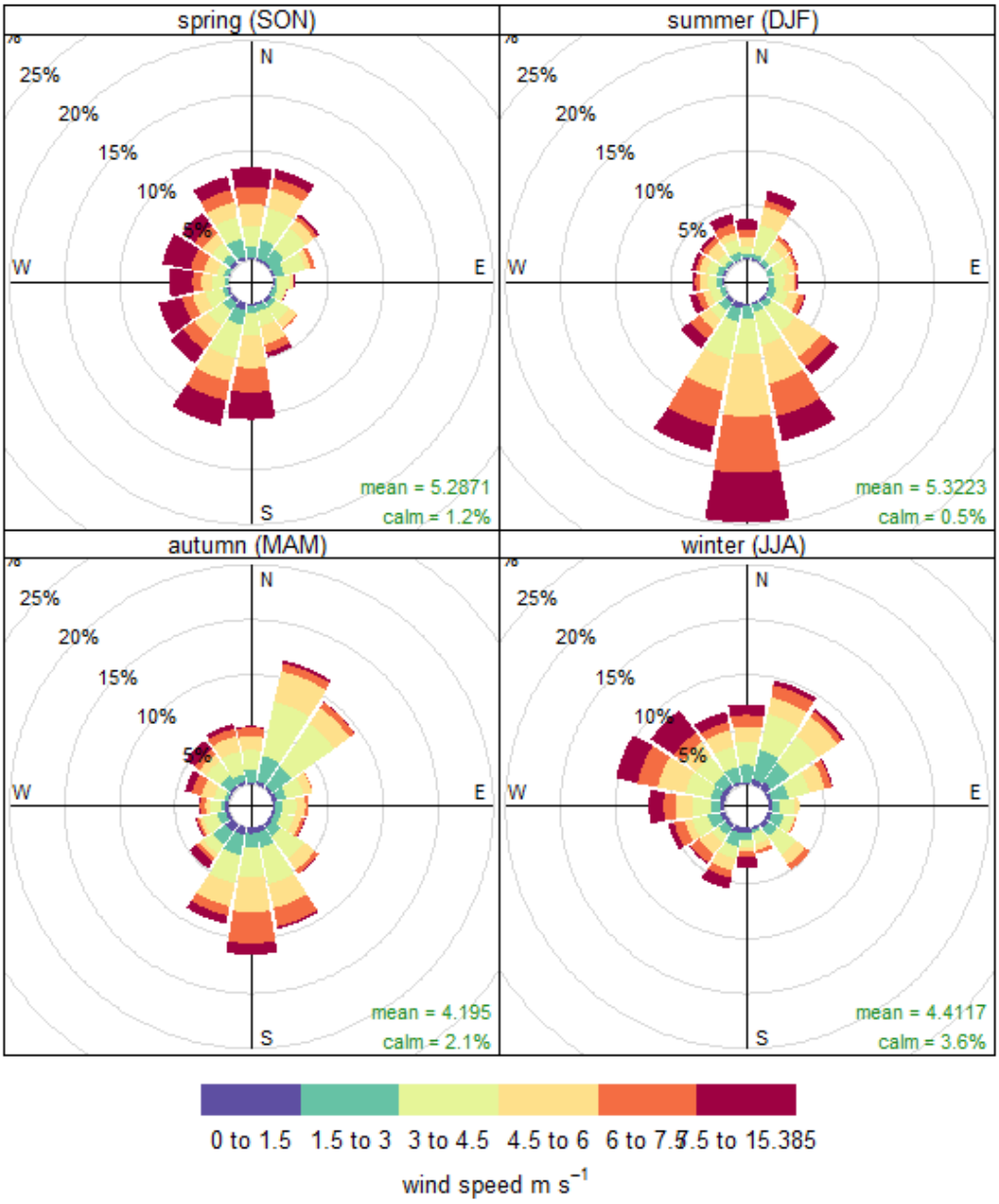


Figure A2: Seasonal windroses for Broken Hill (2016)

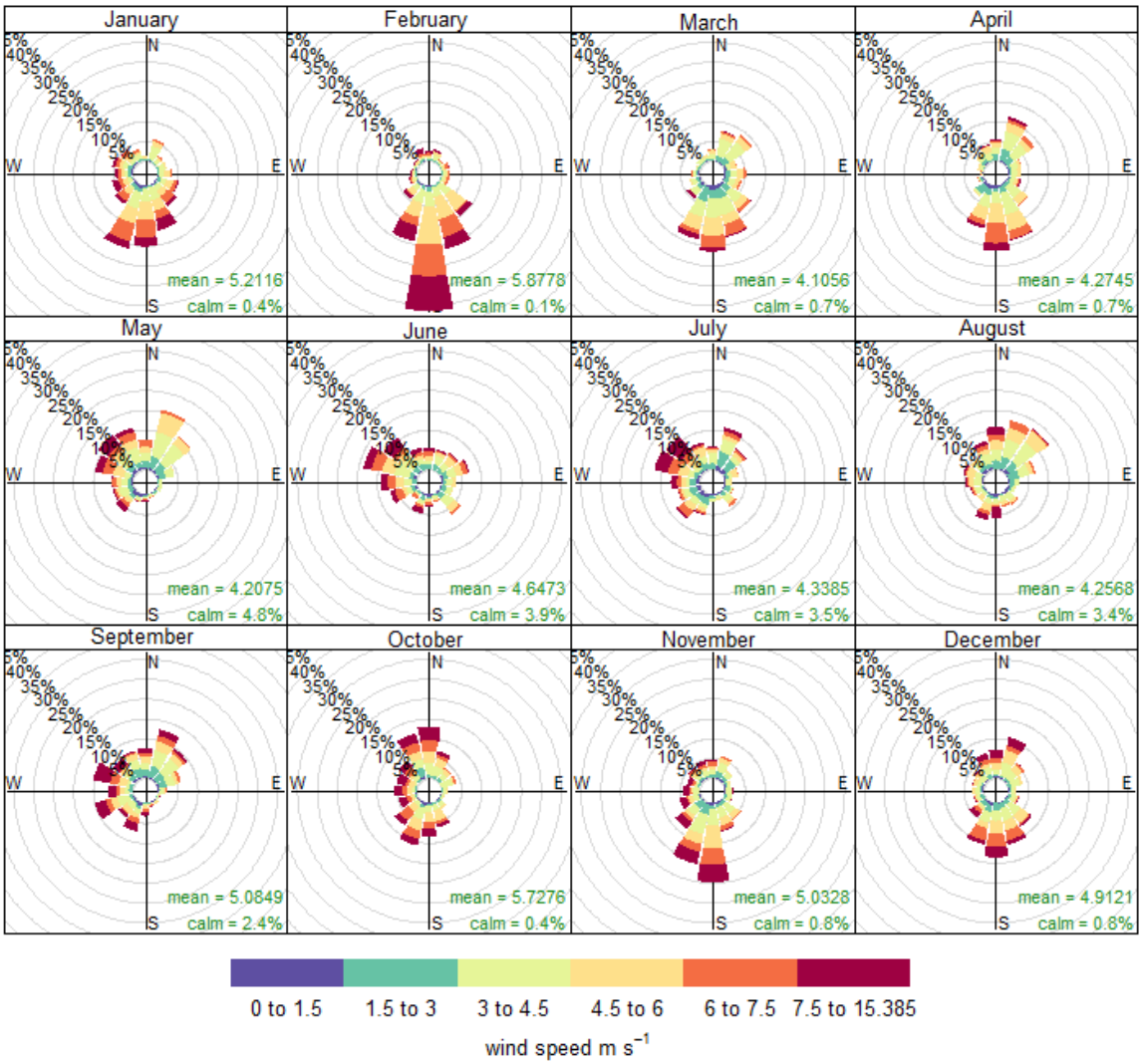


Figure A3: Monthly windroses for Broken Hill (2016)

29 September 2022

640.30547-L01-v1.0-20220929 (MOD10 letter).docx

Broken Hill Operations Pty Ltd
130 Eyre Street
Broken Hill, NSW 2880

Attention: Joel Sulicich

Dear Joel

Potential impact of MOD10 on MOD6 HHRA conclusions

1 Background

SLR has previously conducted a human health risk assessment for the RASP Mine in Broken Hill entitled "*Human Health Risk Assessment for RASP Mine, Modification 6*" (SLR Report Reference 640.12028-R01-v3.0, dated 14 December 2020) (termed 'the HHRA' or SLR 2020 in this letter). An addendum to the HHRA (termed 'HHRA addendum' or SLR 2021 in this letter) was also issued to consider minor changes to the project description which relate to the location and alignment of the Tails Harvesting Haul Road.

Part of the Modification 6 (MOD6) proposal included the harvesting of a thin layer of dry tailings from the surface of Blackwood Pit (TSF2) and its transfer to Kintore Pit (TSF3). Even though MOD6 is approved and will provide long term tailings storage options, TSF2 will reach capacity before TSF3 is ready for tailings deposition. Broken Hill Operations Pty Ltd (BHOP) is therefore proposing to temporarily 'dry stack' tailings at the western end of TSF2 against the high wall for a period of 9-16 months before TSF3 is available. This proposed modification forms part of MOD10[1].

Zephyr Environmental (2022a) conducted an Air Quality Assessment to determine whether the proposed temporary 'dry stacking' method is likely to impact the air quality predictions made which underpinned the data also used in the HHRA. In their assessment two 'dry stacking' options were investigated to evaluate different stockpile sizes:

- Option 1: 28,000 m^2 stockpile, incorporating 400,000 tonnes of dry tailings over a period of 12 months.
- Option 2: Same tailing deposition rate of 400,000 tonnes/annum but assumes 'dry stacking' occurs over a 16-month period, resulting in a larger stockpile of 33,000 m^2.

Since the 'dry stacking' activity will take place over a relatively short timeframe, Zephyr Environmental (2022) undertook predictions for each air quality metric and averaging period for all 70 receptors referenced within the MOD6 assessment and added the predictions to the cumulative results for the MOD6 construction scenario. The largest changes were predicted at receptor R27 (i.e. a residential location in Proprietary Square close to District 5), situated immediately north of TSF2 and adjacent to the proposed 'dry stacking' activities.

[1] MOD10 also includes installation of a new fresh air ventilation intake to provide suitable ventilation to workers in the northern underground areas of the mine.

Zephyr Environmental (2022) predicted that the 'dry stacking' part of MOD10 may result in the following increases to annual emission rates for the construction scenario from those originally predicted and used in the HHRA:

- Option 1: 0.2% for lead (Pb), 1.3% for TSP, 1.4% for PM_{10} and 1.9% for $PM_{2.5}$.
- Option 2: Same predicted percentage increases to Option 1.

BHOP have requested SLR to consider whether the changes to the air quality predictions impact on the conclusions made in the HHRA Report, and the associated addendum (SLR 2021) for the MOD6 construction phase. SLR was provided with a spreadsheet from Zephyr Environmental (2022b) which presents the modelled incremental increases from 'dry stacking' for Option 2 at each receptor location for lead deposition and annual PM_{10}.

2 Results for Construction Phase

In the SLR (2021) HHRA Report Addendum, it was estimated that the predicted incremental increases in soil Pb potentially arising from the approximately 12-month MOD6 construction phase range from 0.03 – 2 mg/kg (rounded) which represent only 0.005 – 0.43% of existing soil Pb concentrations. Taking into consideration the potential modelled increase in annual Pb deposition rate at each receptor location as a result of 'dry stacking' for Mod10 (as provided in Zephyr Environmental 2022b), this would result in negligible change to the soil Pb concentration attributable to the construction phase of the project, i.e. the incremental soil Pb from construction would not change[2], still range from 0.03 to 2 mg/kg, and still equate to 0.005 – 0.43% of existing soil Pb concentrations (see **Appendix A**).

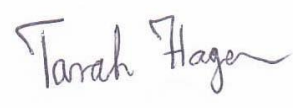
Similarly, the modelled incremental increase in annual average Pb in PM_{10} in air from 'dry stacking' is negligible, resulting in an unchanged range of annual average Pb in PM_{10} (from MOD6) of 0.0005 to 0.014 µg/m^3, depending on receptor location (see **Appendix B**).

Thus, the 'dry stacking' activities forming part of proposed MOD10 do not change the HHRA conclusions with respect to the construction scenario.

3 Overall Conclusion

The 'dry stacking' activity forming part of proposed MOD10 does not change the conclusions of the HHRA (SLR 2020) nor the conclusions in the HHRA addendum (SLR 2021).

Yours sincerely



TARAH HAGEN, MSC, DABT, FACTRA
Technical Director - Toxicology & Risk Assessment

Checked/
Authorised by: GDN

[2] There is no discernible change in lead concentration for MOD6 with SLR 2021 addendum increase (0.330 mg/kg) compared to MOD6 construction with MOD10 and addendum increase (0.331 mg/kg) using Location R11 in District D1 as an example.

References

SLR (2020). Human Health Risk Assessment for RASP Mine, Modification 6. SLR Report Reference 640.12028-R01-v3.0, dated 14 December 2020.

SLR (2021). HHRA for RASP Mine, Mod6 Addendum. SLR Letter 640.30198.00000-L01-v1.1-20210524. Dated 24 May 2021.

Zephyr Environmental (2022a). CBH Resources Rasp Mine Dray Stacking Air Quality Assessment. Project Number: 0042. Date: 13 May 2022.

Zephyr Environmental (2022b). Excel Spreadsheet entitled 'Scenario 2 – Lead and PM10'. Received via e-mail correspondence by SLR on 28/09/2022.

Appendix A: Change in construction Pb deposition and estimated soil Pb concentration due to MOD10 'dry stacking' activity

District	ID	Annual metal deposition		Additional soil metal concentration after 12 months construction		% of existing soil Pb concentration		
		MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	Existing soil metal concentration	MOD6 construction as % of existing soil Pb	MOD6 construction as % of existing soil Pb (with MOD10 & addendum increase)
		$M_{ann\ dep}$ ($g/m^2/yr$)	$M_{ann\ dep}$ ($g/m^2/yr$)	C_s (mg/kg)	C_s (mg/kg)	$C_{s\_existing}$ (mg/kg)	%	%
D1	R6	0.013289	0.013293	0.442	0.442	370	0.12%	0.12%
D1	R11	0.009936	0.009941	0.330	0.331	370	0.09%	0.09%
D1	R18	0.005161	0.005164	0.172	0.172	370	0.05%	0.05%
D1	R46	0.003922	0.003924	0.130	0.131	2450	0.005%	0.005%
D1	R53	0.004846	0.004849	0.161	0.161	370	0.04%	0.04%
D2	R43	0.026274	0.026482	0.874	0.881	735	0.12%	0.12%
D2	R44	0.003495	0.003498	0.116	0.116	700	0.02%	0.02%
D2	R68	0.007376	0.007382	0.245	0.246	735	0.03%	0.03%
D2	R69	0.006005	0.006010	0.200	0.200	735	0.03%	0.03%
D2	R70	0.004948	0.004952	0.165	0.165	735	0.02%	0.02%
Other (D2)	R59	0.001016	0.001017	0.034	0.034	735	0.005%	0.005%
D3	R3	0.045649	0.045659	1.518	1.518	370	0.41%	0.41%
D3	R4	0.018440	0.018447	0.613	0.613	370	0.17%	0.17%
D3	R5	0.014275	0.014280	0.475	0.475	370	0.13%	0.13%
D3	R12	0.008240	0.008245	0.274	0.274	370	0.07%	0.07%

District	ID	Annual metal deposition		Additional soil metal concentration after 12 months construction		% of existing soil Pb concentration		
		MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	Existing soil metal concentration	MOD6 construction as % of existing soil Pb	MOD6 construction as % of existing soil Pb (with MOD10 & addendum increase)
		$M_{ann\ dep}$ (g/m²/yr)	$M_{ann\ dep}$ (g/m²/yr)	C_s (mg/kg)	C_s (mg/kg)	$C_{s\_existing}$ (mg/kg)	%	%
D3	R13	0.007061	0.007066	0.235	0.235	370	0.06%	0.06%
D3	R45	0.008250	0.008256	0.274	0.275	370	0.07%	0.07%
D4	R1	0.021854	0.021874	0.727	0.727	370	0.20%	0.20%
D4	R2	0.024008	0.024020	0.798	0.799	370	0.22%	0.22%
Other (D4)	R21	0.025512	0.025538	0.848	0.849	370	0.23%	0.23%
Other (D4)	R22	0.027087	0.027116	0.901	0.902	370	0.24%	0.24%
Other (D4)	R23	0.031913	0.031948	1.061	1.062	370	0.29%	0.29%
Other (D4)	R24	0.036220	0.036266	1.205	1.206	370	0.33%	0.33%
Other (D4)	R25	0.018095	0.018114	0.602	0.602	370	0.16%	0.16%
Other (D4)	R26	0.048199	0.048262	1.603	1.605	370	0.43%	0.43%
D5	R31	0.019355	0.019450	0.644	0.647	604	0.11%	0.11%
D5	R32	0.017699	0.017792	0.589	0.592	604	0.10%	0.10%
D5	R33	0.019893	0.019921	0.662	0.663	604	0.11%	0.11%
D5	R64	0.004867	0.004880	0.162	0.162	604	0.03%	0.03%
D5	R65	0.013442	0.013498	0.447	0.449	604	0.07%	0.07%
D5	R66	0.008758	0.008778	0.291	0.292	604	0.05%	0.05%
D5	R67	0.009174	0.009198	0.305	0.306	604	0.05%	0.05%

District	ID	Annual metal deposition		Additional soil metal concentration after 12 months construction		% of existing soil Pb concentration		
		MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	Existing soil metal concentration	MOD6 construction as % of existing soil Pb	MOD6 construction as % of existing soil Pb (with MOD10 & addendum increase)
		$M_{ann\ dep}$ (g/m²/yr)	$M_{ann\ dep}$ (g/m²/yr)	C_s (mg/kg)	C_s (mg/kg)	$C_{s\_existing}$ (mg/kg)	%	%
D6	R10	0.012670	0.013697	0.421	0.456	1125	0.04%	0.04%
D6	R34	0.024140	0.024713	0.803	0.822	1125	0.07%	0.07%
D6	R35	0.021895	0.022318	0.728	0.742	1125	0.06%	0.07%
D6	R36	0.019995	0.020312	0.665	0.676	1125	0.06%	0.06%
D6	R37	0.019040	0.019045	0.633	0.633	1125	0.06%	0.06%
D6	R41	0.017841	0.017851	0.593	0.594	1125	0.05%	0.05%
D6	R42	0.024201	0.024216	0.805	0.805	1125	0.07%	0.07%
D6	R47	0.011491	0.011517	0.382	0.383	300	0.13%	0.13%
D6	R50	0.014722	0.014769	0.490	0.491	1125	0.04%	0.04%
Other (D6)	R27	0.060533	0.060540	2.013	2.013	1125	0.18%	0.18%
Other (D6)	R28	0.049093	0.049101	1.633	1.633	1125	0.15%	0.15%
Other (D6)	R29	0.040833	0.040846	1.358	1.358	1125	0.12%	0.12%
Other (D6)	R30	0.034066	0.034082	1.133	1.133	1125	0.10%	0.10%
D7	R7	0.006858	0.006861	0.228	0.228	1125	0.02%	0.02%
D7	R9	0.012405	0.012410	0.413	0.413	1125	0.04%	0.04%
D7	R38	0.005751	0.005753	0.191	0.191	1125	0.02%	0.02%
D7	R39	0.006086	0.006089	0.202	0.202	1125	0.02%	0.02%

District	ID	Annual metal deposition		Additional soil metal concentration after 12 months construction		% of existing soil Pb concentration		
		MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	Existing soil metal concentration	MOD6 construction as % of existing soil Pb	MOD6 construction as % of existing soil Pb (with MOD10 & addendum increase)
		$M_{ann\ dep}$ (g/m²/yr)	$M_{ann\ dep}$ (g/m²/yr)	C_s (mg/kg)	C_s (mg/kg)	$C_{s\_existing}$ (mg/kg)	%	%
D7	R40	0.013594	0.013599	0.452	0.452	1125	0.04%	0.04%
D7	R51	0.007396	0.007400	0.246	0.246	1125	0.02%	0.02%
D7	R52	0.008026	0.008030	0.267	0.267	1125	0.02%	0.02%
D7	R57	0.004084	0.004087	0.136	0.136	1125	0.01%	0.01%
D7	R62	0.004216	0.004218	0.140	0.140	1125	0.01%	0.01%
Other (D7)	R8	0.015992	0.015996	0.532	0.532	1125	0.05%	0.05%
D8	R55	0.001991	0.001993	0.066	0.066	251	0.03%	0.03%
D8	R56	0.002113	0.002115	0.070	0.070	251	0.03%	0.03%
D8	R61	0.002144	0.002145	0.071	0.071	251	0.03%	0.03%
D9	R16	0.004196	0.004206	0.140	0.140	275	0.05%	0.05%
D9	R19	0.002764	0.002770	0.092	0.092	275	0.03%	0.03%
D9	R20	0.002672	0.002676	0.089	0.089	275	0.03%	0.03%
D9	R48	0.004938	0.004949	0.164	0.165	250	0.07%	0.07%
D9	R49	0.002469	0.002474	0.082	0.082	80	0.10%	0.10%
D9	R60	0.006665	0.006681	0.222	0.222	275	0.08%	0.08%
D10	R14	0.008067	0.008071	0.268	0.268	343	0.08%	0.08%
D10	R15	0.003200	0.003204	0.106	0.107	343	0.03%	0.03%

District	ID	Annual metal deposition		Additional soil metal concentration after 12 months construction		% of existing soil Pb concentration		
		MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	MOD6 construction (as per SLR 2021 addendum to HHRA)	Mod6 construction (with MOD10 & addendum increase)	Existing soil metal concentration	MOD6 construction as % of existing soil Pb	MOD6 construction as % of existing soil Pb (with MOD10 & addendum increase)
		$M_{ann\ dep}$ (g/m²/yr)	$M_{ann\ dep}$ (g/m²/yr)	C_s (mg/kg)	C_s (mg/kg)	$C_{s\_existing}$ (mg/kg)	%	%
D10	R17	0.007071	0.007076	0.235	0.235	343	0.07%	0.07%
D10	R54	0.005852	0.005858	0.195	0.195	343	0.06%	0.06%
D10	R58	0.002073	0.002074	0.069	0.069	343	0.02%	0.02%
D10	R63	0.002997	0.002999	0.100	0.100	343	0.03%	0.03%

Appendix B: Change in construction Pb in PM_{10} due to MOD10 'dry stacking' activity

District	ID	Annual average Pb in PM_{10}		
		MOD6 construction	% increase in PM_{10} due to MOD10	MOD6 + MOD10
		µg/m³	%	µg/m³
D1	R6	0.0045	0.007%	0.0045
D1	R11	0.0037	0.009%	0.0037
D1	R18	0.0021	0.006%	0.0021
D1	R46	0.0017	0.005%	0.0017
D1	R53	0.0020	0.006%	0.0020
D2	R43	0.0062	0.140%	0.0062
D2	R44	0.0013	0.004%	0.0013
D2	R68	0.0023	0.009%	0.0023
D2	R69	0.0018	0.009%	0.0018
D2	R70	0.0018	0.007%	0.0018
Other (D2)	R59	0.0005	0.002%	0.0005
D3	R3	0.0120	0.016%	0.0120
D3	R4	0.0062	0.012%	0.0062
D3	R5	0.0052	0.010%	0.0052
D3	R12	0.0030	0.010%	0.0030
D3	R13	0.0026	0.009%	0.0026
D3	R45	0.0030	0.010%	0.0030
D4	R1	0.0063	0.024%	0.0063
D4	R2	0.0075	0.018%	0.0075
Other (D4)	R21	0.0071	0.031%	0.0071
Other (D4)	R22	0.0073	0.032%	0.0073
Other (D4)	R23	0.0077	0.036%	0.0077
Other (D4)	R24	0.0081	0.048%	0.0081
Other (D4)	R25	0.0048	0.016%	0.0048
Other (D4)	R26	0.0097	0.061%	0.0097
D5	R31	0.0047	0.076%	0.0047
D5	R32	0.0043	0.076%	0.0043
D5	R33	0.0052	0.029%	0.0052
D5	R64	0.0015	0.015%	0.0015
D5	R65	0.0034	0.048%	0.0034
D5	R66	0.0024	0.022%	0.0024
D5	R67	0.0025	0.024%	0.0025
D6	R10	0.0040	0.500%	0.0040

District	ID	Annual average Pb in PM_{10}		
		MOD6 construction	% increase in PM_{10} due to MOD10	MOD6 + MOD10
		µg/m³	%	µg/m³
D6	R34	0.0062	0.294%	0.0062
D6	R35	0.0059	0.228%	0.0060
D6	R36	0.0056	0.184%	0.0056
D6	R37	0.0052	0.009%	0.0052
D6	R41	0.0057	0.015%	0.0057
D6	R42	0.0066	0.020%	0.0066
D6	R47	0.0032	0.030%	0.0032
D6	R50	0.0039	0.046%	0.0039
Other (D6)	R27	0.0136	0.010%	0.0136
Other (D6)	R28	0.0120	0.014%	0.0120
Other (D6)	R29	0.0093	0.019%	0.0093
Other (D6)	R30	0.0084	0.022%	0.0084
D7	R7	0.0025	0.006%	0.0025
D7	R9	0.0042	0.008%	0.0042
D7	R38	0.0023	0.006%	0.0023
D7	R39	0.0024	0.006%	0.0024
D7	R40	0.0047	0.009%	0.0047
D7	R51	0.0026	0.006%	0.0026
D7	R52	0.0028	0.007%	0.0028
D7	R57	0.0017	0.005%	0.0017
D7	R62	0.0017	0.005%	0.0017
Other (D7)	R8	0.0051	0.008%	0.0051
D8	R55	0.0009	0.004%	0.0009
D8	R56	0.0010	0.003%	0.0010
D8	R61	0.0009	0.003%	0.0009
D9	R16	0.0013	0.011%	0.0013
D9	R19	0.0009	0.007%	0.0009
D9	R20	0.0010	0.005%	0.0010
D9	R48	0.0015	0.012%	0.0015
D9	R49	0.0008	0.006%	0.0008
D9	R60	0.0019	0.017%	0.0019
D10	R14	0.0026	0.006%	0.0026
D10	R15	0.0011	0.007%	0.0011
D10	R17	0.0022	0.008%	0.0022

District	ID	Annual average Pb in PM_{10}		
		MOD6 construction	% increase in PM_{10} due to MOD10	MOD6 + MOD10
		µg/m³	%	µg/m³
D10	R54	0.0018	0.007%	0.0018
D10	R58	0.0009	0.004%	0.0009
D10	R63	0.0012	0.003%	0.0012

Appendix D
Surface water assessment

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8 November 2022

Joel Sulicich
Health Safety Environment and Training Manager
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CBH Resources - Rasp Mine
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Broken Hill NSW 2880

Re: TSF2 Temporary Stockpile of Harvested Tailings

Dear Joel,

This letter provides a review of surface water management at Tailings Storage Facility 2 (TSF2) at the Rasp Mine, to support a modification application to undertake temporary storage of harvested tails.

1 Introduction

Due to the timing constraints associated with the preparation of Tailings Storage Facility (TSF) 3, to be located in Kintore Pit, temporary stockpiling of tailings is proposed in TSF2. An area within the TSF2 has been identified in the southern western portion where material will be stockpiled to a height of (up to) approximately 10 metres (m) above the current planned finish level for the TSF against existing contours at the southern end of the pit.

2 Existing activities and water management

2.1 Tailing storage facility details

The emplacement of tailings within TSF2 was assessed in Golders (2017) and Golders (2021), which provided a summary of the TSF design elements. The current design and operating assumptions for TSF2 are provided in Table 2.1.

Table 2.1 TSF 2 design elements

Element	Parameter
Deposition shape	1.5% grade from south-west to north-east
Environmental Containment Freeboard – required flood storage between the tailings beach and the spillway elevation	1 in 10,000 (0.01%) Average exceedance probability (AEP) in a 72 hour event

Table 2.1 TSF 2 design elements

Element	Parameter
Operational freeboard – distance between tailings beach on the embankment crest	Min depth: 600 millimetres (mm)
Total freeboard – storage capacity between the tailings beach and the crest of the containment embankments including an operational water pond	1 in 10,000 (0.01%) AEP in a critical duration event
Volume assumptions for Environmental Containment Freeboard (Golders 2017)	Area: 15.9 hectares (ha) (12 ha of TSF with 3.9 ha of external catchment) 0.01% AEP Rainfall depth: 334 mm Runoff coefficient: 0.9 Volume estimated: 48,000 m^3
Invert of spillway	314.15 mAHD
TSF Spillway capacity	Probable Maximum Flood (PMF) event
Moisture content at discharge	35%
Moisture content following deposition – dried tailings	10 to 13%
Final tailings deposition levels in proposed temporary stockpile area	321-322 metres Australian Height Datum (m AHD)
Dewatering TSF following rainfall event	Maximum Period: 7 days Volume: based on 1% AEP 72 hour event
Water management off tailings	Stormwater and supernatant water is expected to periodically pond on the tailings beach at the north-east end of the tailing beach. Water is removed from the TSF through use of a portable pump.
Liner on embankment walls (Embankment 1, 2 and 3)	2 mm thick high density polyethylene (HDPE) geomembrane liner.
TSF closure assumptions	No water storage on TSF once tailings has reached the final deposition levels. As the final levels are approached, the volume of the Environmental Containment Freeboard will progressively reduce. This will be over the period of a year.

The following relevant commitments have been previously made in relation to the management of TSF2:

- Post operations and capping of the TSF a 1:100 year, 72 hour rainfall event will be retained on the surface of the TSF any additional rainfall event will flow over the spillway, some may be captured within Horwood Dam and some may be released from site, depending on the size of the rainfall event.
- Decant requirements from the TSF will be serviced through the use of a portable pump to mitigate prolonged ponding in specific areas of the facility that may not necessarily be at the designed lowest point (north-east corner).

Based on the reporting from BHOP Annual Environmental Report, in 2021 tailings deposited in TSF2 totalled 378,150 t, with much of that material being emplaced in the south-west portion of TSF2.

2.2 Existing water management

The site water management plan for Rasp considers the following management aspects related to the active TSF:

- Open channel drains have been implemented around parts of Embankments 1 and 3 of the TSF2 to direct any potential seepage or stormwater away from the toe of the facility to a nominated stormwater collection pond.
- The plan nominates groundwater and surface quality criteria, which is consistent with the operations Environment Protection Licence (EPL). The criteria supports an adverse water quality trigger of 30% for further investigations.
- The plan provides a series of contingency strategies in the event that contaminated seepage occurs from TSF2.
- The plan outlines the operational water cycle which indicates that the TSF2 has some external catchment contributing to storage area, and a connection via seepage to historical underground workings.
- Generally sediment captured within the surface water storages is being temporarily stockpiled on-site. Following the preparation of TSF3, material will be relocated and disposed of in TSF3.

Monitoring activities on TSF2 include the following:

- Visual inspection and supernatant level monitoring occurs daily.
- Monitoring of potential water levels and groundwater quality changes due to the TSF2 activities occur via groundwater bores GW11 and GW12 which are both located to the south of TSF2.
- Surface water quality is monitored from the TSF2 through monthly sampling of supernatant.
- Wet weather visual monitoring thresholds in addition to the regular inspections.

3 Risk identification

The following surface water risks have been identified for the temporary dry tails stacking proposed:

- Development of a preferential surface to groundwater pathway in the TSF due to the stockpiling of material. This has been considered a risk due to the areas of external catchment contributing to the TSF2 from catchments south-west of the facility's edge. There is a potential for low points to develop where water cannot drain that may lead to ongoing saturation.
- Loss of storage capacity within the TSF for Environmental Containment Freeboard and total freeboard due to the temporary emplacement of material within the storage zone.
- Changes in water quality within TSF2 and downstream water management system due to the harvesting of emplaced material leading to a potential geochemical change.

4 Assessment of proposed activities

4.1 Drainage patterns surrounding and within TSF2

The temporary stockpile of harvested tailings from TSF2 is proposed to build up one area of the TSF2 with tailings for relocation to Kintore Pit once it has been prepared as TSF3 (as approved under MOD6). The temporary stockpile has a conceptual design that is within the far south western portion of TSF2, abutting against the previous Blackwoods pit walls. The height of the stockpile is proposed to be (up to) approximately 10 m which will theoretically be above the crest of the pit wall.

Existing drainage patterns surrounding the TSF2 have been developed on as needed basis with the focus being on management of seepage through fill embankments and offsite discharge risks. Given the infrequent rainfall internal interfaces between catchments contributing to the TSF2 have been focused on safety bunding rather than water management.

As the temporary stockpile proceeds up and above the existing pit crest, there is a potential for drainage capture points to form. Safety bunding has been constructed around the crest of the pit wall terminating flow paths towards the temporary stockpile area. Modifications to the bunding, external to the TSF2 is expected to be undertaken on as needed basis as the proposed activities progress.

The potential risks of potential poor surface drainage patterns around TSF2 specifically in association with proposed temporary stockpile are expected to be managed operationally and not result in an increase in any offsite environmental risk.

4.2 Environmental Containment Freeboard

TSF2 has been designed to function with a water storage above the tailings layer, below the spillway level. This water storage volume is required to store the 0.01% AEP 72 hour event due to TSF2 being classified as High Risk A consequence category structure, as per the ANCOLD guidelines. The storage of water above the tailings layer assists in detaining poorer quality water following rainfall events. The criteria for this volume is elevated beyond the standard water management system which is commensurate with the risks of the tailings management system.

As part of MOD6, TSF2 is to be subdivided into three separate cells using intermediate bunding to assist in provided an access way for trucks to undertake tailings harvesting activities. The three cells are to be constructed with internal spillways between cells, such that surface drainage patterns remain from south-west to north-east, towards the existing TSF2 emergency spillway.

The proposed stockpile of harvested tailings within TSF2 is expected to temporarily reduce the available Environmental Containment Freeboard by 25 % (contained within one cell space). However, as tailings are harvested from TSF2 additional storage volume would be achieved as depths within the TSF are increased. The balance of these cut and stockpile activities should be undertaken such that the risks of a reduced Environmental Containment Freeboard volume are mitigated as far as practicable. Factors in the consideration of storage volumes have considered some conservatism in a minimal loss rate of 10%, when in reality losses to dry tailings is higher, but no testing has been done to understand what an alternative loss rate could be.

To further mitigate the loss of volume, the construction of a stormwater pond of approximately 10,000 m^3 within the cell nearest to the TSF2 spillway will be completed as part of construction works associated with the MOD6 approval. The construction of the stormwater pond is expected to offset any potential loss in the environmental containment freeboard volume caused by the harvesting activities. Water captured within the pond would be pumped out and reused within the ore processing plant.

The Rasp Water Management Plan requires updating to account for the function of the Stormwater Pond within the TSF2 and within the sites operational water cycle.

MOD6 also provided an updated closure concept which included considerations for TSF2 following the completion of tailings harvesting activities which include infilling of the three cells with production tailings, and the stabilisation of the area using a cover of waste rock (<0.5% lead).

4.3 Water quality

Water quality data captured between 2012 and 2022 for groundwater, and 2021 to 2022 for surface water, has been reviewed for monitoring sites specific to the TSF2 area. This includes level and quality sampling from GW11 and GW12, and supernatant sampling from water collected on the TSF2 surface.

The results of the data review are summarised in Table 4.1 compared with the current Water Management Plan (BHOP 2019) quality criteria. The results indicate water collected from the surface of the TSF is not suitable for discharge and must be collected and reused as part on site or as part of the mineral processing system as per current practices. Surface water tends to be slightly acidic, saline and high in major ions and dissolved metals.

Groundwater quality data collected indicated varying groundwater levels over time not necessarily connected to rainfall variability. Site observations documented within the Mining Operations Plan (MOP) and Annual Environmental Management Report indicate that perched groundwater environments can indicate some variability both in level and quality due to the emplacement of tailings. This is due to the gradual filling of past mine workings that occur extensively across the site but in many cases are discontinuous.

Table 4.1 Median water quality monitoring for surface and groundwater specific to TSF2

		Groundwater monitoring program		Surface water monitoring program
Analyte	**units**	**GW11**	**GW12**	**TSF2 supernatant**
pH (field testing)	pH units	6.6	6.3	6.1
Electrical conductivity	µS/cm	4,810	13,300	7,905
Total dissolved solids (TDS)	mg/L	3,810	11,950	6,915
Total alkalinity	mg/L	76	75	2
Sulphate as SO4	mg/L	2,140	5,270	3,745
Chloride	mg/L	500	1,735	897
Calcium	mg/L	297.0	456.0	566.5
Magnesium	mg/L	149.5	558.0	146.0
Sodium	mg/L	614.5	2,075.0	1,035.0
Dissolved cadmium	mg/L	0.0838	1.385	0.332
Dissolved lead	mg/L	0.037	0.009	1.855
Dissolved manganese	mg/L	32.45	70.90	115.50
Dissolved zinc	mg/L	39.8	176.5	49.8
Dissolved iron	mg/L	0.05	0.05	0.65

GW12 when compared to GW11 and the criteria in the Water Management Plan indicate elevated median concentrations of Total Dissolved Solids and a number of major ions. GW12 is often dry becoming active for short periods of time.

Metal concentrations across the two sites were below the criteria defined by the water management plan but many exceed the various receptor guidelines. There has been no seepage events of perched groundwater, from the TSF2 into surface waters downstream.

Geology and geochemistry is summarised within the MOP, last revised by BHOP in 2021 (now replaced by a Rehabilitation Management Plan). The MOP indicates that typically mining ore within the Broken Hill area lacks pyrite, a key element in the generation of acid in surface and groundwater, created through the oxidation process of ore and tailings.

Also, the Broken Hill area has a high proportion of calcite within the geology sequence which acts as a buffer to any acid that does tend to form over time. Based on the monitoring results and the history of mining in the area, it is unlikely that specific changes in surface or groundwater quality will result from the temporary storage of harvested tailings within TSF2.

5 Mitigation measures

The following are summary of water management mitigation measures identified in the assessment of the proposed activities.

- Commitment to progressively modify surface water management requirements for the area through the construction of water diversions or perimeter bunding around the top-of-bank edge of the TSF2, upslope of where the temporary stockpiles will be placed (north-west to south-west perimeter) where necessary.
- As part of MOD6 the Stormwater Pond was constructed with a storage of approximately 10 megalitres (ML) to assist in the management of stormwater runoff within the TSF2 and offset any loss in the Environmental Containment Freeboard volume. Areas of harvested and temporary stockpile of tailings should be undertaken such that it does not impact on the ability to store the Environmental Containment Freeboard volume, of at least 48 ML, below the invert of the spillway. Required flood storage capacity for the Environmental Containment Freeboard is conservatively considered based on a minimal loss assumption.
- Update the water management plan to account for activity specific monitoring and management measures. Continue existing surface and groundwater monitoring programs.

5.1 Aspects not considered in assessment

It is expected that the management of dust remains unchanged with the movement of infrastructure to occur, where required, to facilitate the proposed stockpile (BHOP 2022). It is assumed that the stockpile activities will not change the reliability of water for the dust suppression systems associated with the TSF2.

6 Closing

EMM trusts that this assessment meets your expectations. If any further information or clarification is required, do not hesitate to email me on lhammersley@emmconsulting.com.au or by phone on 02 4907 4861.

References

Golder (2017) *Design Report for the Blackwood Pit Tailing Storage Facility Extension*, prepared for Modification 4(MP07_0018-Mod-4), Golder Associates, Sydney

Golder (2021) *Rasp Mine, Tailings and Waste Rock Management for MOD 6*, prepared for Modification 6 (MP07_0018-Mod-4), Golder Associates, Sydney

BHOP (2021) *Rasp Mine, Mining Operation Plan, 1 October 2021 -30 September 2023*, Broken Hill Operations Pty Ltd, Broken Hill

BHOP (2022) *Annual Environmental Management Report 2021*, Broken Hill Operations Pty Ltd, Broken Hill

Yours sincerely

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Appendix D.1
Figures

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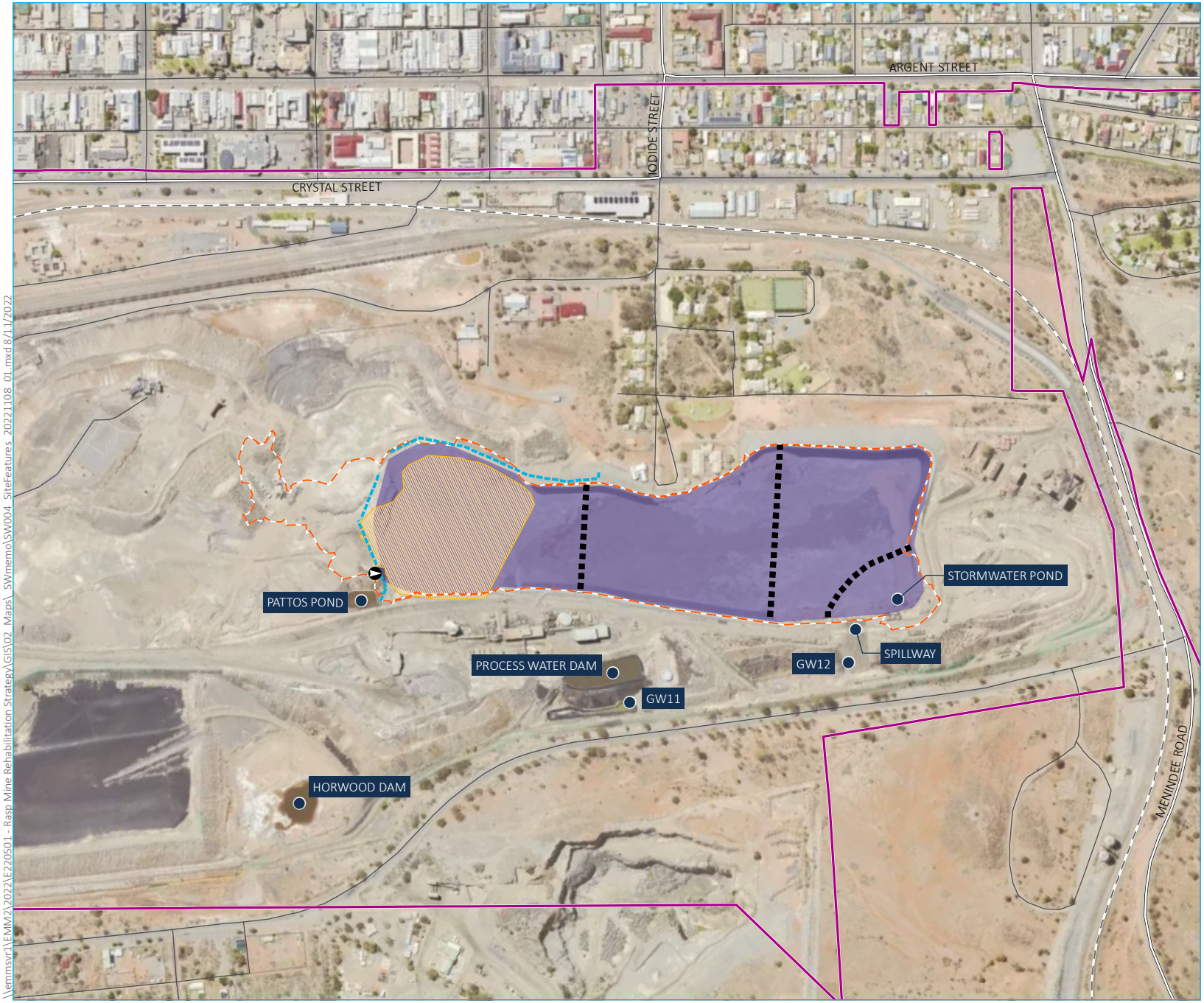

KEY

- Broken Hill Operations mining lease
- Temporary stockpile location
- TSF2 footprint
- Existing catchment extent
- Photo point
- Site feature
- Safety berm
- Approximate cell embankment

Existing environment

- Rail line
- Major road
- Minor road

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Source: EMM (2022); DPE (2021); DFSI (2020); Metromap (2022)

0 250 500 m

GDA2020 MGA Zone 54

TSF2 site features and temporary stockpile location

Rasp Mine
TSF2 Temporary Stockpiling of Harvested Tailings
Figure A.1

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Figure A.2 TSF2 – view north – proposed temporary stockpile location

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