Rasp Mine

Zinc – Lead – Silver Project
Project Approval No. 07-0018

Environment Assessment

Modification 4
Concrete Batching Plant
Blackwood Pit TSF2 Extension

April 2017

Broken Hill Operations Pty Ltd
BROKEN HILL

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SUBMISSION OF ENVIRONMENTAL ASSESSMENT (EA)

This EA is prepared under section 75W of the *Environmental Planning and Assessment Act 1979*

MODIFICATION EA PREPARED BY

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PROJECT APPROVAL MOD4

Applicant Name:	*Broken Hill Operations Pty Ltd*
Applicant Address:	*130 Eyre Street PO Box 5073* *Broken Hill Broken Hill* *NSW 2880 NSW 2880*
Proposed modification:	*Approval is sought to modify the Rasp Mine Project Approval 07_0018 to install a Concrete Batching Plant to manufacture shotcrete and other concrete products for use at the site and install infill embankments and a retaining wall of the Blackwood Pit Tailings Storage Facility (TSF2) to extend the life of facility, both located within Consolidated Mine Lease 7.*
ENVIRONMENTAL ASSESSMENT	*An EA for this Modification is attached.*
CERTIFICATION	*I certify that the contents of this EA have been prepared and to the best of my knowledge:* • *It is in accordance with Section 75W of the Environmental Planning and Assessment Act 1979;* • *Contains all available information that is relevant to the environmental assessment of the activities to which this Modification EA relates; and* • *The information contained in this Modification EA is neither false or misleading.*
Signature:	
Name:	*Gwendalynn Wilson* *Group Manager – Safety Health Environment Community* *CBH Resources Ltd*
Date:	*April 2017*

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EXECUTIVE SUMMARY

OVERVIEW

Broken Hill Operations Pty Ltd (BHOP) [a wholly owned subsidiary of CBH Resources Limited (CBH)] owns and operates the Rasp Mine (the Mine), which is located centrally within the City of Broken Hill on Consolidated Mine Lease 7 (CML7).

Mining has been undertaken within CML7 since 1885. The existing operations at the Mine Rasp Mine Project include underground mining operations, a processing plant producing zinc and lead concentrates and a rail siding for concentrate dispatch. These operations are undertaken in accordance with Project Approval (PA07_0018) granted from the then Minister for Planning on 31 January 2011, under Part3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Pursuant to section 75W of the EP&A Act, BHOP is seeking to modify its Project Approval to install a Concrete Batching Plant (CBP) and to extend the useful life of the Blackwood Pit Tailings Storage Facility (TSF2) via the installation of embankments and a retaining wall.

MODIFICATION DESCRIPTION

BHOP is seeking approval for a minor modification (MOD4) to the Project Approval to:

- install a CBP for the manufacture of fibrecrete and concrete for use at the Mine; and
- extend the life of the TSF2 by installing embankments and a retaining wall at low points along its perimeter.

The CBP is proposed to be located centrally within CML7 adjacent to the Backfill Plant. The Indian Pacific rail line and Broken Hill rail yards separate the proposed facility from its nearest neighbours, located 348 meters (m) to the north. The Mt Hebbard historic tailings storage facility separates the CBP from Broken Hill residents to the south.

BHOP currently sources concrete from a local supplier and trucks it to the site on the local road network. Construction and operation of the CBP at the Mine would allow BHOP to produce concrete on-site at a significant saving to the company (approximately $900,000 per annum). It would also result in a significant reduction in the number of heavy vehicles transporting concrete to the site on local roads.

TSF2 is an historic open cut last mined in the 1970's. TSF2 is located to the north east of CML7 and is surrounded by current mining and processing activities on three sides and by mining residences and employee club facilities owned by Perilya Operations Pty Ltd (Perilya) (CML4) to the north. A corridor for power and water services to these buildings runs along the boundary of CML7 and CML4. Two unoccupied buildings, named British Flats and Old Mine Residence No. 27, are located adjacent to and mid-way along the north-west side of the pit. The British Flats building is heritage listed.

In accordance with the existing Project Approval, TSF2 is currently being utilised for deposition of tailings from existing operations. At current mining rates, the existing capacity of TSF2 for tailings deposition will be reached by October 2019.

The proposed Modification would allow the extension of the life of the facility (at current production rates) to mid-2021. This would allow BHOP time to complete investigations into future options for on-site and/or off-site tailings storage facilities.

Construction of the CBP and the embankments and retaining wall proposed for TSF2 would be undertaken sequentially over approximately 15 months.

Without approval of the Modification the Mine will cease operation in October 2019.

The following table provides a summary of existing approved project components compared to the proposed modifications outlined in this Environmental Assessment (EA).

Comparison of Existing Approval and Proposed Modifications (MOD4)

Component	Approved Rasp Mine	Modified (MOD4) Rasp Mine
Mine Life	15 years (includes construction and closure) from 2011 to 2026.	No change, however operations will cease in October 2019 without approval for additional capacity for tailings deposition.
Tenement Status	CML7 – Incorporates the Rasp Mine.	No change
Mining Methods	Underground mining using various methods including long hole, benching, modified Avoca, room and pillar or uphole retreat. Within Western and Centenary Mineralisation and Blocks 7 to 12.	No change
Mining Rate and Total Production	750 000 tonnes per annum ore. Total production over life of Project: Approximately 8,450,000 t	No change
Waste Rock Disposal	Underground: Backfill. Surface: Inert material to be used for road repair and bunding and rehabilitation at closure	No change
Underground Ventilation	2 x 450 kW primary fans located 160 m below ground and exhausting centrally within CML7, Point 1. 2 x 110 kW fans located 160 m below ground and exhausting centrally within CML7 at Shaft 6.	No change
Processing Methods	Crushing, grinding, flotation, thickening and filtration at on-site processing facilities.	No change to ore processing. Installation of an on-site CBP for the manufacture of fibrecrete and concrete for use at the Mine site.
Processing Rates	250 tph in crushing plant and 93.8 tph in grinding plant.	No change
Concentrate Production	Lead: 44,000 tpa (concentrate 73% Pb and 985 g/t Ag) Zinc: 87,000 tpa (concentrate 50% Zn)	No change
Tailings Disposal	Course stream returned to mine void and finer stream to be directed to TSF1 (capacity of 960,000 t) and/or TSF2 (capacity 3.12 Mt).	No change to coarse tailings disposal (underground stope back fill). Fine tailings disposal to the extended TSF2, which as at 25 April 2016 has a capacity of 2 million dry tonnes. Requires embankments and retaining wall to be installed to increase capacity of TSF2 by 1 million dry tonnes. New capacity limit would be reached by mid-2021.
Services	Extensions to existing substations, water lines and phone lines. New 22kV overhead power lines to be constructed.	No change
Water supply / Extraction	Potable / treated water 9 ML/pa Raw untreated water 139 ML/pa Reclaimed / recycled water 300 ML/pa Extraction up to 390 ML per annum.	No change Increased water recycling has resulted in no additional requirement in the water supply.
External Roads	No changes to external road network.	No change.

Component	Approved Rasp Mine	Modified (MOD4) Rasp Mine
		Decrease in heavy vehicle movements along Eyre Street from 108 return trips/month (24 hours) to 50 return trips/month (day time only).
Employment Numbers	Full Production: 150	Current numbers are: Employees: 195 Contractors: 35 Additional 2 full time employees required for operation of the CBP.
Hours of Operation	Underground Operations: 7 days per week, 24 hours per day Shunting 7 days per week, 7am to 6pm. Activities not listed above – 7 days per week, 24 hours per day.	No change to operating hours. Construction hours 7am to 6pm Mon-Fri and 8am to 1pm Sat, no construction work on Sundays or Public holidays. CBP will operate 24 hours per day.
Disturbance Footprint	CML7 consists of 342.66 Ha Current land disturbance due to Rasp Mine activities is 28.4 Ha	Additional 0.2 hectares (ha) for the construction of TSF2 Embankment 1.

REGULATORY FRAMEWORK

The Rasp Mine was declared a Major Project under the *State Environment Planning Policy (SEPP) (Major Development) 2005* (now repealed) and was approved in January 2011 by the then NSW Minister for the Department of Planning and Infrastructure under Part 3A of the EP&A Act. Following repeal of Part 3A of the EP&A Act, the approved project is classified as a 'transitional Part 3A Project', under Schedule 6A of the Act. This Modification must therefore be considered under Section 75W of the EP&A Act, despite its repeal.

EXISTING ENVIRONMENT

The Mine is located centrally within the City of Broken Hill and is surrounded by transport infrastructure, areas of commercial and industrial development and some residential housing. The Mine is bound by Eyre Street and Holten Drive to the south and east, Perilya's Broken Hill North Mine to the east and South Mine to the west, and the commercial centre of Broken Hill to the north. The Mine site is dissected by two major State roads, including South Road (Silver City Highway SH22) to the southwest and Menindee Road (MR66) to the northeast. The Broken Hill Railway Station is located directly to the north of the Mine and lies on the main Sydney – Perth railway line. Residential and commercial areas surround the Mine with pasture land to the southeast.

The land within CML7 has several surface exclusion zones, which contain rail lines and stock yards to the north, along with commercial and some residential properties. The CBP is proposed to be located adjacent to the rail area. The area adjacent and north of TSF2 is also a surface exclusion zone with the surface rights held by Perilya. Perilya owned mining residences and other mining facilities such as a social club, bowling green and tennis court are located in this area.

IMPACTS, MANAGEMENT AND MITIGATION

The proposed Modification has the potential to result in additional impacts to those already approved, including impact to noise, air quality, community health, heritage, visual amenity and surface water. There is also a potential additional risk of embankment failure and seepage associated with the TSF2 extension. BHOP has engaged specialist consultants to provide assessments of potential significant impacts and advise on recommended measures to control any risks.

The following provides a summary of their findings.

Noise

EMM Consulting Pty Ltd (EMM) completed a noise impact assessment (NIA) (**Appendix H**) for the construction and operation of the CBP and construction of the embankments and spillway for TSF2[1]. The NIA was prepared in accordance with relevant guidelines and policies, and includes a cumulative assessment.

Construction Noise

Construction noise modeling results indicate that site noise during standard construction hours are predicted to satisfy the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) noise management levels at all assessment locations during the construction of the CBP and at the majority of assessment locations during the construction of the TSF2 embankments and spillway. The exceptions were at three (3) assessment locations - including a 1 dB(A) exceedance at A13, a 3dB(A) exceedance at A12 and exceedances of between 2-4 dB(A) at A14 - during the construction of the TSF embankments and the spillway. The major contributing noise sources were dozer operations and truck movements.

EMM noted that a 2dB(A) change in noise levels is generally not perceptible by the human ear and therefore that noise impact at A13 is unlikely. EMM highlighted that the modelled construction works represent worst-case scenarios for the duration of each activity, but that at times they would be lower than the predicted levels. EMM point out that excursions above criteria would be limited and only span a period of approximately three months for Embankment 2 and two months for Embankments 1 and 3.

EMM recommended feasible and reasonable construction noise management measures be implemented, including operational strategies, source noise control strategies and community consultation during the construction period of the embankments for TSF2. BHOP has committed to implementing these measures.

Operational Noise

Preliminary noise modeling results identified that the proposed CBP would require noise mitigation for the site to achieve the *Industrial Noise Policy* (INP) (EPA, 2000) derived criteria in the current Project Approval. BHOP has therefore committed to enclosing the batching process within a concrete structure and extending the current earthen bund perimeter in this area to create 6 m high noise barriers. These measures were included in EMM's operational noise modeling.

Operational noise modelling results indicate that site noise levels for existing approved operations and CBP operation combined are predicted to satisfy the criteria at all assessment locations, including during night-time F class temperature inversions. Similarly, EMM found that the predicted L_{Amax} noise level satisfy the World Health Organisation (WHO) *Guidelines for Community Noise* (1999) criteria at all assessment locations. Therefore, based on a conservative sound power levels, no sleep disturbance impact is expected during worst-case meteorological conditions.

Cumulative Noise

In February 2017, Perilya submitted an application[2] for approval to recommence underground mining operations at its Broken Hill North Mine, located to the north-east of the Rasp Mine. The construction works for the Perilya North Mine have the potential to occur at the same time as that of the Modification.

EMM's NIA concluded that cumulative noise from Perylia's proposed Broken Hill North Mine Recommencement Project and the modified Rasp Mine project combined is not anticipated to cause additional impact at any of the assessment locations.

[1] No additional noise impacts are expected during the operation of the extended TSF2.
[2] State Significant Development (SSD 7538)) Application for the Broken Hill North Mine Recommencement Project.

Air quality

Pacific Environment Limited (PEL) completed an *Air Quality Impact Assessment* (AQIA) (**Appendix I**) to assess the potential air quality impacts associated with the construction and operation of the CBP and TSF2 extension under both normal and upset conditions. The AQIS was prepared in accordance with relevant approved methods, and includes analysis of a worst-case cumulative operating scenario.

Cumulative air quality modelling results indicate that under worse-case cumulative operating conditions for the Modification (ie. during construction of TSF2 Embankments 2 and 3 and the CBP operating at full capability) the predicted dust levels would remain well below the relevant air quality assessment criteria specified in *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2016) and reflected in the Project Approval. This remains the case when potential air emissions from Perilya's proposed Broken Hill North Mine Recommencement Project are added to the cumulative modelling.

BHOP has committed to implementing a range of air quality mitigation, management and monitoring measures during the construction and operational phases of the modification. These include standard measures such as water sprays and chemical suppressants, as well as the installation of enclosed conveyor on the CBP. In addition, BHOP has committed to installing a fully automated sprinkler system at TSF2, which would be triggered by determined wind and air quality triggers, as well as a predictive meteorological forecasting system for the TSF2 extension, which would identify alerts and alarms to manage and / or cease dust generating activities.

Community Health

ToxConsult Toxicology Consulting Australasia (ToxConsult) completed an analysis based on PEL's AQIA results to determine whether a formal human health risk assessment (HHRA) was required for the modification (**Appendix L**).

ToxConsult noted that the predicted lead (Pb) levels in air and soil are small and would only occur during the 14 month construction period of the TSF2. ToxConsult confirmed that depending on the receptor location the Modification would potentially contribute 0.04 – 2% to the cumulative Pb in airborne total suspended particulates (TSP). ToxConsult note that this represents less than half the ambient air quality guideline at every receptor location. Results for Pb in soil are predicted to represent just 0.001 – 0.05 % of existing soil Pb concentration. ToxConsult considers these increases to be small and insignificant.

ToxConsult concluded that the incremental exposures to lead (Pb) due to the proposed Modification are so small that a formal HHRA for the proposal is not warranted.

Heritage

Two unoccupied heritage buildings, British Flats and the Old Mine Residence No. 27, are located adjacent to and mid-way along the north-west side of TSF2. The British Flats building is heritage listed in Broken Hill City Council *Local Environment Plan* (LEP, 2013). The buildings are owned by the Line of Lode Reserve Trust and currently managed by the Department of Primary Industry – Lands (DPI-Lands). The embankment design would have no impact on the heritage listed British Flats.

The original design for Embankment 1 required the demolition of the Old Mine Residence No. 27, however subsequently BHOP redesigned Embankment 1 of the TSF2 to avoid any impact to this structure. The current proposed design of embankments and the proposed installation of a retaining wall adjacent to the old mine residence would ensure that there are no impacts to these buildings.

Visual Amenity

Components of the new Modification infrastructure, including the CBP cement silo and Embankments 1 and 2 of the TSF2, would be visible from several surrounding local roadways. The CBP may also be visible from the Café located on a waste rock hill within CML7. However, these new elements in the landscape are consistent with the existing mine profile and viewshed and would not result in any significant additional visual amenity impacts.

Surface Water

The existing stormwater management and collection system in the vicinity of the CBP would continue to be utilised during the construction and operation of the CBP. This system includes a series of diversion drains and a rainfall runoff storage pond with sufficient capacity to hold a 1:100 ARI rainfall event.

Golder Associates (Golder) completed a *Design Report for the Blackwood Pit Tailing Storage Facility Extension* (Design Report) (**Appendix J**) for the proposed extension to the TSF2. The Design Report includes additional measures to collect runoff from the outer slopes of the perimeter embankments and surface water runoff from rainfall. The surface water designs incorporate an emergency spillway designed in accordance with NSW Dam Safety Committee (DSC) requirements. BHOP has adopted all the required additional stormwater management measures in the design of the TSF2 system.

Embankment Stability at TFS2

The Golder Design Report provides construction methodology, and civil and geotechnical engineering design for the TSF2 which are consistent with the relevant Australian National Committee on Large Dams (ANCOLD) and DSC guidelines.

Based on the location of the TSF2, the facility was assessed to be a “High A” hazard category facility by the DSC. This consequence category invoked the most conservative design criteria presented in the DSC and ANCOLD design guidance for a TSF. Accordingly, Golder has designed the extended TSF2 to the most stringent design criteria. BHOP has committed to construct and operate the TSF2 in-line with Golder’s recommended construction methodology and design criteria. In addition, BHOP has committed to implementing a dam safety surveillance monitoring program for the TSF2, which would be detailed in an updated BHOP Tailings Maintenance and Operating Manual (TMOM).

DSC is satisfied that the TSF2 design has an appropriate level of robustness that satisfies its guidance for such structures.

Seepage from TSF2

The TSF extension design prepared by Golder incorporates controls to minimise the potential risk of seepage from the facility. These include:

- compacted rockfill embankments;
- a filter sand layer on the upstream slope of each embankment;
- seepage collection drains installed in the filter sand along the upstream toe of each embankment;
- a 2 mm thick high density polyethylene (HDPE) geomembrane liner on the upstream slope of Embankment 2 and a 2 mm think linear low density polyethylene (LLDPE) liner on the upsteam slopes of Embankments 1 and 3; and
- upstream toe drains and seepage collection pits to collect any potential seepage

As part of the Design Report, Golder completed seepage modelling along representative cross sections of each TSF2 embankment to analyse potential seepage rates from future tailings. Golder concluded that seepage from Embankments 1 and 2 are expected to be negligible because water would not pond near them due to the shape of the tailing beach. Seepage from Embankment 2 is also expected to be very low and effectively negligible. Golder noted that any damage or defects in the geomembrane may result in some seepage, however this would be temporary and effectively contained and managed by the seepage collection system.

BENEFITS OF THE MODIFICATION

The proposed minor Modification would:

- allow BHOP to produce fibrecrete and concrete on-site and save approximately $900,000 per annum;
- significantly reduce the number of heavy vehicles transporting fibrecrete and concrete to site on local roads;
- allow the extension of the life of the TSF2 by approximately 2 years to mid-2021 and allow BHOP time to complete investigations into future options for on-site and/or off-site tailings storage;
- ensure continued employment of 195 full-time employees plus an additional 2 employees; and
- allow BHOP to continue to support the economic growth of Broken Hill.

It is considered that the proposed minor Modification could be implemented without any additional social or environment impacts above or beyond those already approved.

Without approval of the Modification the Rasp Mine will cease operation in October 2019.

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Appendix D – Letter to Mr R Williamson - Re: Rasp Mine Proposed Modification (MOD4), Mr C Preshaw Department of Planning and Environment, 15 September 2016

Appendix E – Letter to Mr V Sulicich – Re: Variation of Environment Protection Licence, Mr D Wallett, Environment Protection Agency, 9 September 2016, Ref: EF13/4102; DOC16/424128-01

Appendix F – Letter to Ms G Wilson – Re: Preliminary Paper – Project Approval 0018_07 for the Rasp Mine, Mr Z West Division of Resources & Energy, Ref: OUT16/32274

Appendix G – Preliminary Construction Schedule, BHOP December 2016

Appendix H – *Rasp Mine Modification 4, Concrete batching plant and TSF2 (Blackwood Pit) extension, Noise impact assessment,* EMM Consulting Pty Ltd, 29 March 2017

Appendix I –*Air Quality Assessment for the Rasp Mine MOD4*, Pacific Environment Limited, 27 March 2017

Appendix J(a) – *Design Report for the Blackwood Tailing Storage Facility Extension*, Golder Associates Pty Ltd, 15 March 2017

Appendix J(b) - *Independent Review of the Rasp Mine Blackwood Pit Tailings Storage Facility Extension,* Bruce Brown Consulting Pty Ltd, 11 November 2016

Appendix K – *Rasp Mine Project Approval Classification of Waste Rock,* Pacific Environment Limited, 20 March 2017

Appendix L – *Does Modification 4 of Rasp Mine Need a Health Risk Assessment*, ToxConsult – Toxicology Consulting Australasia, 3 April 2017

Appendix M - Letter to Mr R Williamson - Re: Blackwood Pit Tailings Storage Facility – Design Report, Mr S Knight, 9 December 2016

Appendix N – Community Consultation – MOD4 Presentation, 21December 2016

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1.0 BACKGROUND

This section provides an introduction to the Environmental Assessment (EA), details of the Proponent and summarises the report structure.

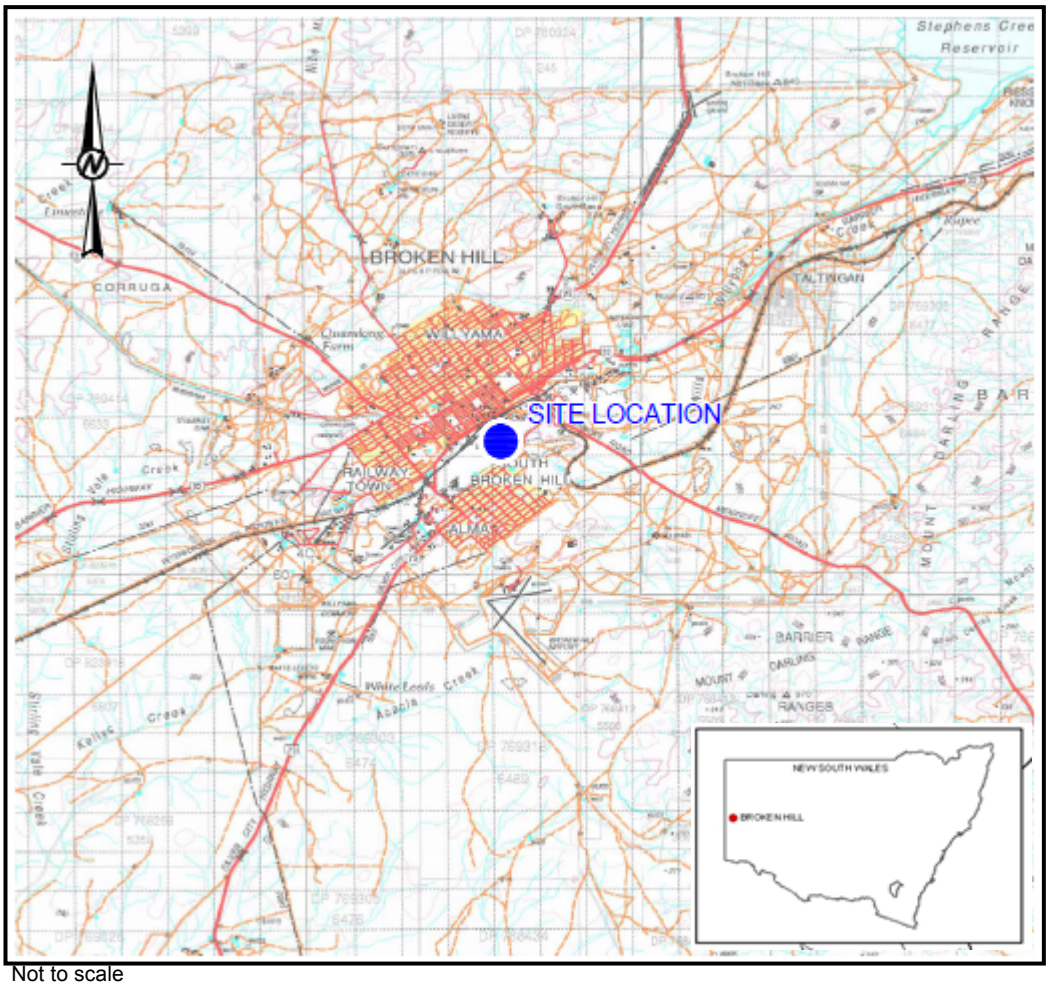
1.1 Introduction

Broken Hill Operations Pty Ltd (BHOP), a wholly owned subsidiary of CBH Resources Limited (CBH), purchased the Rasp Mine (the Mine) from Normandy Mining Investments (NMI) in 2001. The Mine occupies a central region in the historic Broken Hill Line of Lode orebody.

Mining has been undertaken in the Consolidated Mining Lease 7 (CML7) area since 1885. The Mine was the birthplace of Broken Hill Pty Ltd (BHP) and has subsequently been operated by several mining companies, including Broken Hill South and Minerals Mining and Metallurgy Ltd (MMM). Mining operations at the site have included both open pit and underground. The existing Mine site still contains historic mining infrastructure from various historical mining phases.

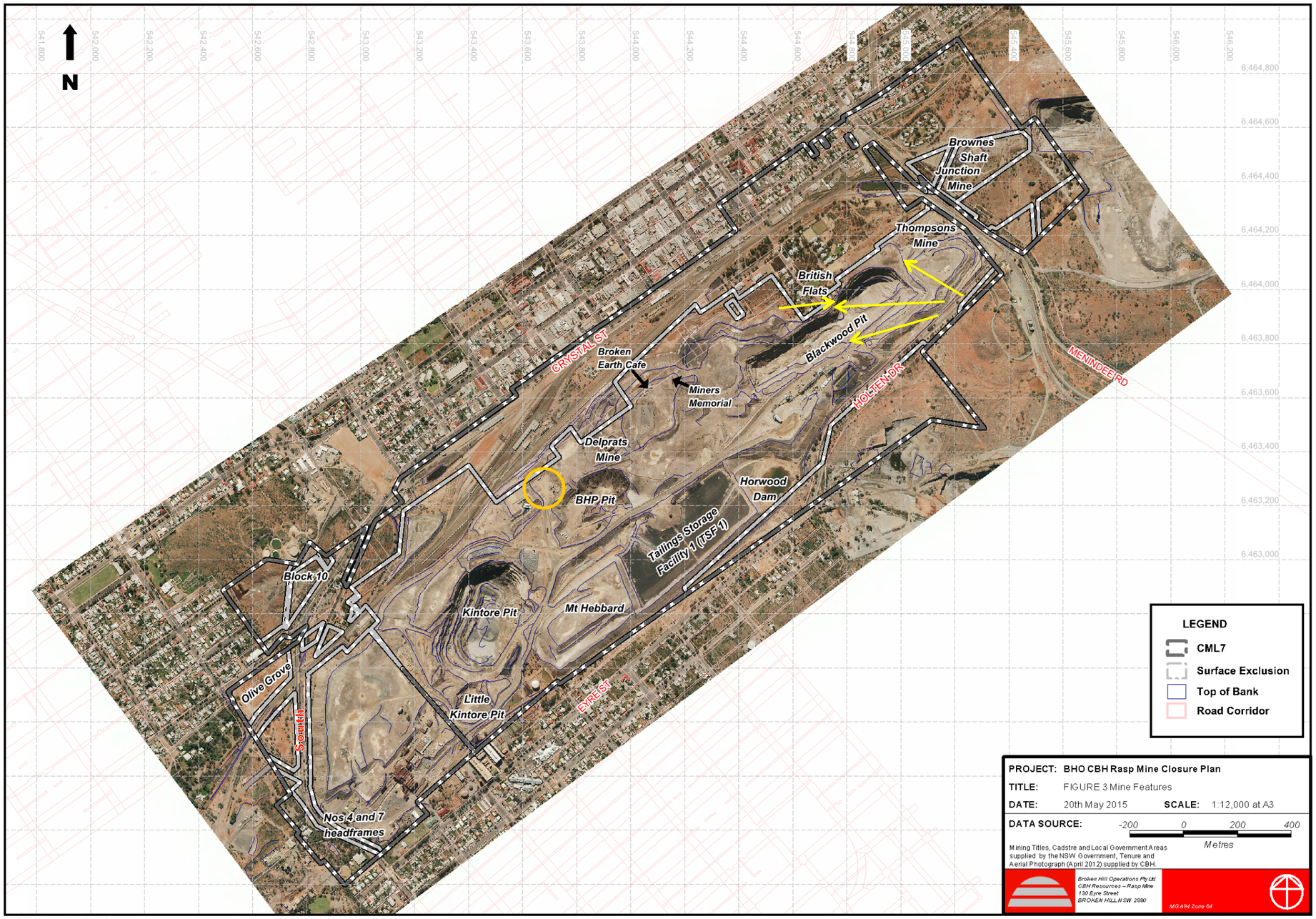
The Mine is located centrally within the City of Broken Hill (**Figure 1-1**) and is surrounded by transport infrastructure, areas of commercial and industrial development and some residential housing. The Mine is bounded by Eyre Street and Holten Drive to the south and east, Perilya Broken Hill Operations Pty Ltd (Perilya) North Mine to the east and Perilya's South Mine to the west, and the commercial centre of Broken Hill to the north. The Blue Metal Quarry lies to the east of the existing processing plant. An aerial view of CML7 is provided in **Figure 1-2.**

Figure 1-1 Locality Map



Not to scale

Figure 1-2 Aerial View of CML7



The Mine site is dissected by two major State roads, South Road (Silver City Highway SH22) to the southwest and Menindee Road (MR66) to the northeast. These roads form part of the existing road train and B-double routes through Broken Hill. The Broken Hill Railway Station is located directly to the north of the Mine and lies on the main Sydney – Perth railway line (the Indian Pacific).

The Rasp Underground Lead-Zinc-Silver Mine Project (07_0018) (the Project) was declared a Major Project under the State Environment Planning Policy (SEPP) *Major Development 2005* (now repealed) requiring the approval of the then NSW Minister for Planning under Part 3A of the EP&A Act. Approval was granted on 31 January 2011 for underground mining, the construction and operation of a processing plant to produce lead and zinc concentrates and a rail siding for concentrate dispatch. The Project Approval (PA) has subsequently been modified on three occasions, including:

- MOD1: to accommodate the relocation of the main ventilation shaft;
- MOD2: to allow crushing of ore to occur at any time; and
- MOD3: to allow mining of Block 7.

A copy of the consolidated Project Approval is provided at **Appendix A**. BHOP is now seeking approval from the Minister of Planning for a minor Modification (MOD4) to the Project under Section 75W of the EP&A Act to:

- install a Concrete Batching Plant (CBP) for the manufacture of fibrecrete and concrete for use at the Mine site, and
- extend the life of the Blackwood Pit Tailings Storage Facility (TSF2) by installing embankments and a retaining wall at low points along its perimeter.

The level of environmental assessment completed for this Modification is considered appropriate given that the Modification is minor and that:

- it does not change the current approved mining or production rates;
- it requires a minimum change to the Mine footprint (0.2 ha);
- it would result in potential impacts (predominantly from construction works) over a very short time span (15 months);
- the results of impact assessments, including those conducted by a range of specialist consultants, have found there are no significant impacts to the environment or community for health, noise, air quality, heritage, water seepage, surface water or visual amenity; and
- the changes to surface structures and landform would be consistent with the current mining landscape of Broken Hill.

1.2 Reason for Modification

The Modification would allow economic efficiencies in the use of fibrecrete and concrete at the Mine site, and would allow mining to progress past October 2019, when mining operations would cease without a facility for tailings deposition.

1.2.1 Concrete Batching Plant

BHOP operates an underground mine that uses fibrecrete to support the underground excavations and concrete for general civil work around site. Currently a monopoly exists in Broken Hill for the supply of batched concrete/fibrecrete and the company is currently paying high fees for the supply of fibrecrete.

Therefore, BHOP intends to construct its own batching facility to benefit the business. The construction and operation of the CBP would represent a cost effective alternative to the existing supply situation and is likely to save BHOP up to $900,000 annually.

1.2.2 TSF2 Extension

In the original EA it was planned for tailings to be placed both in above ground tailings storage facilities and underground, via the Backfill Plant, to fill mining voids. The tailings waste stream from ore processing has been approved to be deposited aboveground in the historic tailings facility (TSF1) and in the disused Blackwood Pit (TSF2).

BHOP has chosen to deposit tailings in TSF2 only and not use TSF1. This decision was made based on the greater capacity of TSF2 (3.1 Mt) compared to the capacity of TSF1 (970,000 t). In addition, the construction costs associated with the use of TSF1 were estimated to be significantly higher than those associated with extending TSF2 ($7.2 million verses $3.5 million).

In the initial PA BHOP underestimated the amount of mine development that was required to access the Main Lode and Western Mineralisation ore bodies. The need to undertake more underground mining development than anticipated has reduced the capacity of underground voids to accept both waste rock and tailings material from the Backfill Plant. In the original EA it was predicted that approximately 250,000 tonnes (t) of waste rock would be produced each year for a production rate of 750,000 t of ore. This has since increased to over 400,000 t averaged per year for an average production rate per year of 650,000 t of ore. BHOP has chosen to place the additional waste rock underground to fill voids and stopes, as it is more economic to dispose of waste rock underground rather than transporting waste to the surface. Therefore, there is no void space underground for the backfill of tailings.

Table 1-1 summarises tailings and waste rock placement as predicted in the original EA (at a production rate of 750,000 t) and what has actually been placed since commencement of operations.

Table 1-1 Summary of Proposed (EA) and Actual Placement of Waste Rock and Tailings

Year (to 30 June)	EA Tailings in Underground back fill per year (t)	EA Tailings deposited in TSF1 (t)	EA Tailings deposited in TSF2 (t)	EA Waste Rock U/G (t)	Actual[1]/ Predicted[2] Tailings in TSF2 (t)	Actual waste rock placed underground (t)	Actual waste rock stored Kintore Pit (t)	Actual Total waste rock (t)
2012	97,969	273,281	0	250,000	322,111[1]	47,527	150,000[3]	197,527
2013	195,938	195,138	0	250,000	574,833[1]	230,607	150,000[3]	380,607
2014	195,938	195,138	0	250,000	486,749[1]	223,473	163,304	386,777
2015	216,563	216,563	0	250,000	499,598[1]	223,611	228,942	452,553
2016[1]	247,500	88,281	159,219	250,000	555,837[1]	265,369	96,888	362,257
2017	278,438	0	278,438	250,000	570,000[2]	-	-	-
2018	309,375	0	309,375	250,000	570,000[2]	-	-	-
2019	309,375	0	309,375	250,000	570,000[2]	-	-	-
2020	309,375	0	309,375	250,000	570,000[2]	-	-	-
TOTALS	**2,160,471**	**968,401**	**1,365,782**	**2,250,000**	**4,719,128**	**990,587**	**789,134**	**2,057,855**

Note[1]: Actual tailings deposited.
Note[2]: Predicted tailings deposition.
Note[3]: Estimated

At current tailings deposition the life of TSF2 will be reached in October 2019. The construction of the proposed embankments and retaining wall will increase the life of this facility to mid-2021, providing time to seek alternative tailings deposition arrangements, either on or off site.

Without storage for tailings the Rasp Mine will cease operations in October 2019.

1.3 Document Purpose

This Environmental Assessment (EA) has been prepared to support the Major Project Development Modification Application, which will be lodged with the Department of Planning and Environment (DP&E) for determination by the Minister for Planning (or delegate). A comprehensive description of the activities proposed in this Modification Application (MOD4) is provided in **Sections 5** to **7** of this EA.

The Modification sought is otherwise consistent with the BHOP original EA, Preferred Project Report (PPR) and PA 07_0018 (as Modified). The schedule of land to which this EA applies is also consistent with the BHOP EA, PPR and PA 07_0018.

1.4 Agency Requirements for Environment Assessment

Several government agencies provided requirements to be addressed during the environment assessment for this Modification. These requirements, and the section in the EA where they are addressed, are summarised in **Table 1-2.** Copies of the correspondence are provided at **Appendices D** (DP&E), **E** (EPA) and **F** (DRE).

Table 1-2 Summary of Agency Requirements for the Environment Assessment

Government Agency	Issues Identified	Response in EA
Department of Planning & Environment	Consultation required to include: - NSW EPA to confirm that the proposal meets requirements of the relevant policies and guidelines, particularly in relation to noise and dust. - Department of Industry, Division of resources and Energy - NSW Dam Safety Committee - NSW Health - Department of Primary Industries - Broken Hill City Council	Section 4
	A strong justification will need to be provided, including consideration of alternatives, in relation to all aspects of the proposed modification, including the: - Need to undertake additional underground mining development; - Proposed design of the TSF2 embankments and retaining wall; - Reasons the approved TSF1 is an unviable option for tailings storage, and - Proposed location of the concrete batching plant.	 Section 8 Section 7 Section 8 Sections 6 & 8
	Include a revised materials balance accounting for the storage of additional waste rock underground and all tailings material within TSF2 (rather than as proposed in the original EA).	Sections 1.2 & 8
	Include detailed management measures that would be used to prevent tailings within the modified TSF2 from drying out and generating dust.	Sections 7 & 11.2
	The measures proposed and presented in the EA must be developed in consultation with the EPA.	Section 4
	The EA must demonstrate that the proposed modification would not increase the potential for lead exposure in the community.	Section 10.3
	Construction of the concrete batching plant and the TSF2 embankments and retaining wall are classified as construction activities. The EA should include an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline.*	Section 10.1
	Include details of changes to the surface management system and identification of the modifications required to the mine soil and water management plan (if applicable).	Sections 6.5 & 10.6
	Include details of raw water supply and use, including existing raw water consumption and proposed consumption associated with the modification. Provide details about the improvements in water use and consumption that have reduced raw water usage to date.	Sections 6.5 & 10.6

	Include details of the revised rehabilitation strategy and proposed final landform, specifically in relation to the modified TSF2. Ensure that project scheduling is clearly defined in the EA, providing details of proposed construction timeframes associated with the concrete batching plant and the TSF2 embankments and retaining wall. Potential cumulative impacts must be assessed if construction activities are expected to overlap. As the modification is a standalone document, rather that state that impacts were assessed in the original EA and reference this document, sufficient detail from the original project EA will need to be included in the modification EA to describe overall project impacts. Adequate justification will be required to justify the level of assessment undertaken for minor environmental impacts. Identify any proposed changes to the Environment Protection Licence requirements.	Section 10.1 Appendix G & Sections 6 & 7 Section 10 Section 3.2 Section 2.2
Environment Protection Authority	The proposed modification will require a licence variation prior to the commencement of any construction works associated with the modification. For the concrete batching plant:- - A detailed description of the physical operation of the plant; - A noise impact assessment identifying cumulative noise impacts associated with the mining operation; and - An air quality impact assessment identifying the cumulative dust impacts and proposed mitigation measures. For the extension of the Blackwood Pit as a tailings storage facility:- - A detailed geological impact assessment that defines any risk of failure of the TSF and the potential for pollution to surface waters or ground waters from the proposal, and - An air quality impact assessment identifying the potential impacts on air quality and proposed air monitoring and mitigation measures.	 Section 6 Appendix H & Section 10.1 Appendix I & Section 10.2 Appendix J & Sections 7 and 11 Appendix I & Section 10.2
Division of Resources & Energy	The Division does not have any concerns or comments regarding the installation of the concrete batching plant. The division requires the following matter to be addressed in the EA: - The impact of increasing the size/footprint of TSF2 (including its respective rock capping) on surface drainage post closure will need to be discussed/assessed, and - A revised Mining Operations Plan will be required	 Section 10.10 Section 10.10

1.5 Document Structure

The Executive Summary provides a brief overview of the Project and the major outcomes of this EA. The following sections of the EA include:

- **Section 1** - an introduction and details of the proponent;
- **Section 2** - details on the existing approved operations at BHOP;
- **Section 3** - discusses the regulatory framework relevant to the Modification;
- **Section 4 -** summarises the stakeholder engagement undertaken and any issues raised during that process;
- **Section 5** - summary of the Modification, its location and surrounding land users;
- **Section 6** - description of the various components of the Modification – Concrete Batching Plant, its installation, operation and closure;
- **Section 7** - description of the various components of the Modification –TSF2 Extension, its construction, operation and closure;
- **Section 8 -** discusses the alternative options assessed;
- **Section 9 -** describes the environmental risk assessment process and summarises the key potential environmental issues for the proposed Modification;

- **Section 10 -** outlines impacts identified in relation to the Modification and provides management and mitigation measures to be implemented by BHOP;
- **Section 11 -** lists management commitments to be implemented as a result of the Modification;
- **Section 12 -** outlines the conclusion and provides a justification for the Modification as sought;
- **Section 13 -** provides a list of abbreviations referenced in this EA.

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2.0 EXISTING OPERATIONS & ENVIRONMENT

This section provides detail on the existing approved operations at BHOP including land tenure, consents and licences, operations, environment management, environmental monitoring and details of the Environment Protection Licence.

2.1 Project Approval

2.1.1 Environment Assessment and Preferred Project Report

2.1.1.1 Environmental Assessment

An *Environmental Assessment* (EA) (BHOP, July 2010) supported the Project application for the original Rasp Underground Lead-Zinc-Silver Mine Project (07_0018) and described the following elements of the Project:

- mining of 8,450,000 t of ore until 31 December 2026;
- construction and/or extension of associated infrastructure, plant and equipment, including upgrade of internal roads and construction of an on-site noise abatement barrier;
- transport of ore to the surface in haul trucks;
- ore processing using crushing, milling and flotation;
- tailings management, to be deposited into Blackwood Pit (TSF2), and used as back fill for underground mining voids (this has yet to be implemented);
- works for surface water management; and
- construction of a rail siding and transport of concentrate in covered rail wagons to a smelter and/or port.

2.1.1.2 Preferred Project Report

BHOP subsequently amended the layout and design of the Project in order to further minimise environmental impacts and streamline operations. A Preferred Project Report (PPR) was submitted in September 2010 outlining the proposed changes to the Project and the subsequent reductions in environmental impacts. Updated environment assessments for air quality, noise and vibration, and storm water management were also submitted as part of the PPR.

These amendments involved:

- modifying the Project Area to include the new rail load-out area at the north-eastern end of the site;
- re-locating the processing plant to the north-eastern end of the lease (away from densely populated residential areas);
- removing secondary and tertiary crushers and screens from the crushing circuit; and
- loading concentrate into containers on trucks and transporting them to a newly constructed rail siding located towards the north-eastern end of the Lease.

2.1.2 Approved Project

On 31 January 2011 the Project Approval (07_0018) for the Rasp Underground Lead-Zinc-Silver Mine Project was granted under Part 3A of the EP&A Act. The key features of the Rasp Mine are provided in **Table 2-1**.

Table 2-1 Key Features of the Rasp Mine

Item	Description
Mine life	15 years to 31 December 2026
Tenement status	CML7 – Incorporates the Rasp Mine.
Mining methodology	Underground mining using various methods including long-hole, benching, modified Avoca, room and pillar or uphole retreat.
Mining Area	Western Mineralisation, Centenary Mineralisation, Main Lode Pillars (Blocks 8 to 12)
Mining rate and total production	750 000 tpa ore. Total production over life of Project: Approximately 8,450,000 t
Waste rock disposal	Underground: Backfill Surface: Inert material to be used for road repair and bunding and rehabilitation at closure
Processing methodology	Crushing, grinding, flotation, thickening and filtration at on-site processing facilities.
Processing rates	250 tph in crushing plant and 93.8 tph in grinding plant.
Concentrate production	Lead: 44,000 tpa (concentrate 73% Pb and 985 g/t Ag) Zinc: 87,000 tpa (concentrate 50% Zn)
Tailings disposal	Tailings disposal to TSF2 Blackwood Pit and to be used as backfill in underground stopes. Provision for some tailings to go underground as backfill over the next 4 to 5 years.
Services	Extensions to existing substations, water lines and phone lines. 22kV overhead power lines.

2.1.3 Project Approval Modifications

Since approval of the Project, three separate Modifications to the original Project Approval have been approved. The nature of these modifications is described in **Table 2-2**.

Table 2-2 Rasp Mine Project Summary of Approval Modifications

Modification	Purpose	Date Approved
MOD1	Relocation of the ventilation shaft and installation of the ventilation fans underground.	16 March 2012
MOD2	Allow crusher to be operated at any time (24 hours per day 7 days per week).	29 August 2014
MOD3	Extension of underground mining to include Block 7 (also included the Zinc Lodes).	17 March 2015

2.2 Current Consents, Authorisations and Licences

2.2.1 Consents

Table 2-3 presents the consents held by BHOP.

Table 2-3 Development Consents

Approval Number	Date Issued	Duration	Purpose
DA 125/2001	5 Sept 2002	Work completed	Surface drilling on CML7 in surface exclusion zone (near rail), supported by a Statement of Environmental Effects (SEE).
MOP 06/6463	26 Oct 2006 to 31 Aug 2008	Work completed	Construct exploration decline, conduct drilling and obtain bulk sample, supported by a Review of Environmental Factors (REF).
DA 101/2007	26 April 2007	Work completed	Undertake temporary mining in the Kintore Pit, supported by a SEE.
MOP Amendment 06/6436	5 May 2008 to 31 Oct 2008	Work completed	Extend the exploration decline.
MOP 06/6463	1 Sept 2009 31 Dec 2010 Extended to 31 March 2011	Works not undertaken	For underground mining and stockpiling 120,000 tpa, supported by a REF.
DA 264/2009	19 Jan 2010 to 2 Feb 2011	Work completed	For ancillary surface mining activities including crushing, stockpiling and transport of ore, supported by a SEE.
Part 3A PA 07_0018	31 Jan 2011	31 Dec 2026	Mining production of 750,000 tpa from Western Mineralisation, Centenary Mineralisation and Main Lode Pillars. Construction and operation of a minerals processing plant and rail loadout facility. Supported by an Environmental Assessment Report (EAR).
MOP 06/6483	1 April 2011 to 31 Mar 2014 Extended to 31 Oct 2014	Work completed	Mining production of 750,000 tpa from Western Mineralisation, Centenary Mineralisation and Main Lode Pillars. Construction and operation of a minerals processing plant and rail loadout facility. Supported by an EAR prepared for DPI Part 3A Project Approval.
PA 07_0018 MOD 1	16 March 2012	31 Dec 2026	Relocation of ventilation shaft.
MOP 06/6463	30 March 2012 to 31Mar 2014	Work completed	Relocation of ventilation shaft.
MOP 06/6463	March 2014 to 30 Jun 2014	Work completed	Extension of MOP requested and granted.
PA 07_0018 MOD 2	Feb 2014	31 Dec 2026	Allow 24 hour crusher operation.
MOP 06/6463	June 2014 to Aug 2014	Work completed	Extension of MOP requested and granted.
MOP 06/6463	August 2014 to Oct 2014	Work completed	Extension of MOP requested and granted

Approval Number	Date Issued	Duration	Purpose
MOP 06/6463	Oct 2014 to Oct 2015	Work completed	Allow 24 hour crusher operation.
MOP 06/6463	Nov 2014 to Oct 2015	Work completed	New MOP for underground mining, ore processing and dispatch of concentrates, including ancillary activities.
PA 07_0018 MOD3	17 March 2015	31 Dec 2026	Extension of underground mining to include all of Block 7 and the Zinc Lodes.
MOP 06/6463 Amendment	March 2015 to Oct 2015	Work completed	Extension of underground mining to include all of Block 7 and the Zinc Lodes.
MOP 06/6463	Nov 2015	30 Sept 2017	New MOP for underground mining, ore processing and dispatch of concentrates, including ancillary activities.
DSC advice	9 Dec 2017	-	Endorsement for Blackwood Pit TSF2 extension design (Embankments 1,2 & 3 and Retaining wall) which conforms to DSC requirements

2.2.2 Leases

Table 2-4 presents the mineral authorities held by BHOP for the Mine. For the purposes of this document, the area covered by CML7 (**Appendix B**) and MPLs 183, 184, 185 and 186 within the surface area rights of BHOP, is referred to as the Rasp Mine. Also listed is the exploration lease permitting these activities in and around Broken Hill.

Table 2-4 Mineral Authorities

Mineral Authority	Grant Date	Last Renewed	Renewal Date	Holder	Purpose
CML7	8 Oct 1987	17 Jan 2007	31 Dec 2026	BHOP	As per Schedule 2 of the Lease - Open cutting, shaft sinking, stoping, tunneling, building of dams, extraction and obtaining minerals, generation of electricity, erecting dwellings, storage of fuels, dumping of ore, treatment and dumping of tailing, development of roads.
MPL 183	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
MPL 184	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
MPL 185	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
MPL 186	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
EL 5818	8 Mar 2001	7 Mar 2009	7 Mar 2017	BHOP	Surface disturbing works such as drilling and soil sampling (renewal submitted awaiting confirmation)

This Modification applies only to CML7 and will have no impact on any of the other MPLs or EL listed.

2.2.3 Licences

Table 2-5 presents the licences held by BHOP in relation to the Mine.

Table 2-5 Licences Held

Licence / Permit	Issued By	Date of Expiry/ Renewal	Purpose
EPL 12559 (refer to Section 2.3.3.1 below)	EPA	Upon surrender, suspension or revocation.	Authorises the carrying out of scheduled activities: Crushing , grinding or separating >500,000 – 2,000,000T processed. Mining for minerals >500,000 – 2,000,000T produced.
Dangerous Goods Explosives	Work Cover	23 Feb 2017 24 Oct 2017	Store (renewal submitted awaiting confirmation) Manufacture
Water extraction 85WA752823	NOW	29 Mar 2017	To extract 390 ML for use on site or to send to Perilya Broken Hill Operations Pty Ltd (renewal submitted awaiting confirmation).
Radiation	EPA	26 Jul 2017	Sell and/or possess radiation apparatus. Sell and/or possess radioactive or items containing radioactive substances.

2.3 Current Mining Operations and Infrastructure

The current mining activities at the Mine extend between and include Blocks 7-12 in the old Main Lode Orebody (comprising 2 and 3 lens material). The Main Lode has been mined since the late 1800's and BHOP extract pillars and narrow remnants that have been left over the course of 100 years of mining. The Main Lode was the primary focus of mining operations on CML7 between 1884 and 1991 and BHOP currently focuses on mining the remaining material left in Blocks 7-12.

In addition, this Main Lode ore is supplemented by mining of the Zinc Lodes on the southern boundary of CML7 and bulk mining of the medium grade Western Mineralisation.

Production rates currently sit at approximately 700,000t per annum which is a combination of the above three separate mining lodes."

BHOP is currently serviced by surface facilities including administration offices, washhouse and change rooms, electrical and maintenance workshops, laboratory, stores facilities, core work and storage, crusher plant, processing plant and rail siding facilities.

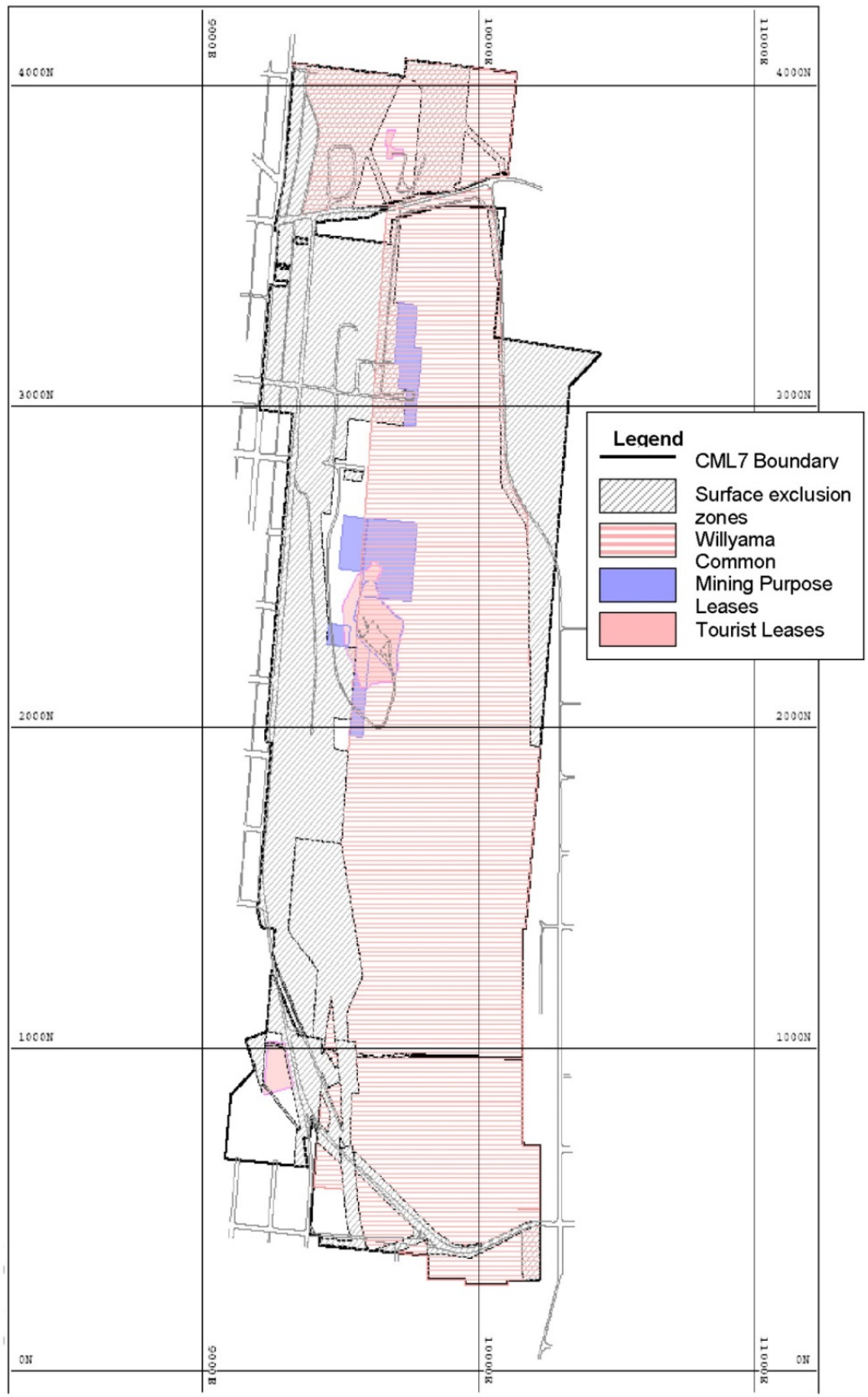
The site also includes historic mine buildings and structures across CML7 from previous mining, including original buildings and structures from the beginnings of BHP Pty Ltd's operations on site. These are listed as heritage items on the Broken Hill City Council Local Environment Plan (LEP) and some of which date from the 1890s.

2.4 Land Ownership

The majority of the land on which the CML7 and MPLs are located is designated as "WILLYAMA COMMON Reserve 2421" (refer to **Figure 2-1**). The Lease was originally gazetted on 4th September 1886. Only a small portion of the Lease area is freehold and this land is identified in Certificate of Title 4635/757298. The land within CML7 upon which BHOP has surface rights is leased from the Crown through a series of Mining and Western Land Leases, with the exception of one freehold block (Block 10) located towards the centre of CML7.

All activities associated with this Modification would be located on CML7 and within Willyama Common.

Figure 2-1 Consolidated Mining Lease 7



2.5 Environment Management System

BHOP currently operates under an Environment Management System (EMS) designed to assist BHOP to:

- effectively manage its environmental issues;
- ensure compliance with regulatory requirements;
- continually improve its environmental performance; and
- address the expectations of stakeholders.

In addition, in accordance with the existing PA, BHOP implements the following management plans to control potential environment impacts associated with its operations:

- Air Quality Management Plan (AQMP);
- Community Lead Management Plan (CLMP);
- Noise Management Plan (NMP);
- Technical Blast Management Plan (TBMP);
- Blasting Monitoring Program (BMP);
- Ground Control Management Plan (GCMP);
- Site Water Management Plan (SWMP);
- Traffic Management Plan (TMP);
- Waste Management Plan (WMP);
- Conservation Management Plan (on hold until final land use is agreed with DRE); and
- Mining Operations Plan, as required by the Department of Primary Industries – Resources and Energy (DRE).

The overall objectives for environmental management are outlined in the Environment Policy. **Table 2-6** provides a summary of objectives for a number of key environmental aspects relevant to this Modification.

Table 2-6 Environmental Objectives

Issue	Goal	Objectives
Air	To maintain current air quality standards.	To comply with air quality criteria as listed in the Project Approval and EP Licence, as verified by monitoring. To implement air quality control measures as outlined in the Air Quality Management Plan. To receive minimal community complaints, which are addressed promptly and satisfactorily, and reported as required. To report and address any non-compliances.
Lead	To have no adverse impact on blood lead levels of the community.	To assist the community in raising awareness about managing lead in the environment. To use measures to minimise dust emissions. To support community blood lead level monitoring programs.
Noise	To maintain an acceptable noise amenity for surrounding neighbours.	To use measures to minimise noise emissions. To monitor and meet noise emission criteria and EP Licence conditions. To promptly address any complaints relating to noise from the general public and report as required. To report and address any non-compliances.
Water	To prevent pollution and contamination to surrounding lands.	To use measures to prevent water discharge. To reduce the risk of oil or chemical contamination of surface / groundwater. To reduce sediment runoff.
Emergency response	To quickly and effectively minimise adverse impacts to the environment associated with an emergency situation.	To provide training and equipment to enable a quick and effective response to environmental emergencies including spillages.
Heritage	On hold until final end land use agreed with DRE.	On hold until final end land use agreed with DRE.

2.6 Existing Environment Monitoring

A key component of the EMS is the continued implementation of the existing comprehensive environment monitoring program at the Mine. **Table 2-7** summarises the BHOP environmental monitoring system, which includes comprehensive air quality, noise, blasting, water quality and meteorological programs to effectively monitor the environmental performance of BHOP operations. The monitoring programs have been developed in consultation with the relevant government agencies and in accordance with BHOP's Environment Protection Licence and conditions of the Project Approval.

Table 2-7 Existing Environmental Monitoring

Category	Parameter	Program
Air Quality	TSP	3 HVAS
	PM10	2 HVAS, 2 TEOM
	Dust Deposition	7 depositional dust gauges
	Lead	2 HVAS, 7 depositional dust gauges
	Gases and dust testing	2 ventilation outlets, 1 baghouse
Water Quality	Surface water	8 locations
	Groundwater	16 locations
Noise Monitoring	Attended noise monitoring	14 locations
Blast Monitoring	Fixed blast vibration and overpressure monitors	5 locations (2 roving monitors)
Meteorological monitoring	Weather station	1 location

3.0 REGULATORY FRAMEWORK

This section discusses the regulatory framework relevant under which the Rasp Mine is approved to operate relevant to the Modification.

3.1 Commonwealth Legislation - *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires actions which are likely to cause an impact on a matter of National Environmental Significance (NES) to undergo a rigorous assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance (NES)*" cannot be undertaken without prior approval from the Commonwealth Minister for the Environment, as provided under Part 9 of the EPBC Act.

Consistent with the original Project Approval, the proposed Modification is not considered a '*controlled action'*, is unlikely to impact matter of NES as listed in the EPBC Act and would not impact water resources. Therefore the proposed Modification does not require referral to the Commonwealth Department of Environment.

3.2 NSW Legislation - *Environment Planning and Assessment Act 1979* (EP&A Act)

The Project was declared a Major Project under the SEPP *Major Development 2005* (now repealed) and was approved in January 2011 by the then NSW Minister for the Department of Planning and Infrastructure under Part 3A of the EP&A Act. The Project is subject to the transitional requirements as outlined in Clause 12 of Schedule 6A of the Act which applies to facilitate modifications of approvals with the repeal of Part 3A of the Act.

This Modification application is made under section 75W of the EP&A Act. Section 75W of the EP&A Act provides for the modification of planning approvals issued under:

Part 3A of the Act as follows:

> *"(2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.*
>
> *(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*
>
> *(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification."*

The level of environmental assessment completed for this Modification is considered appropriate given that the Modification is minor and that:

- it does not change the current approved mining or production rates;
- it requires a minimum change to the Mine footprint (0.2 Ha);
- would result in potential impacts (predominantly from construction works) over a very short time span (15 months),
- the results of impact assessments, including those conducted by a range of specialist consultants, have found there are no significant impacts to the environment or community for health, noise, air quality, heritage, water seepage, surface water or visual amenity; and
- the changes to surface structures and landform would be consistent with the current mining landscape of Broken Hill.

3.3 Other Applicable Legislation

The existing approvals, licences and authorities relevant to the Project are described in **Section 2**.

Existing approvals, licences and/or authorities under various other pieces of NSW State legislation would continue to apply to the proposed Modification operations. **Table 3-1** lists the key relevant pieces of NSW State legislation and indicates the implications, if any, for the Modification and Project as a whole.

Table 3-1 Relevant NSW State Legislation

NSW State Legislative Act	Project Implications to Approvals, Licences and/or Authorities
Protection of the Environment Operations Act 1997 (POEO Act)	The proposed Modification will continue to operate under the approved limits within EPL 12559. BHOP will seek a variation to its EPL to accommodate the relocation of current air quality and noise monitoring equipment adjacent to Blackwood Pit as they are currently located where Embankment 2 will be constructed. BHOP will also seek advice from the EPA on any required changes to its current EPL for additional air quality monitoring and any other requirements.
Mining Act 1992	CML7 permits the extraction of zinc and lead (among others) ore within the Project Area, the Modification does not result in any changes to mining production totals or processing. Therefore there is no need for any amendments to authorities under this Act. Environmental protection and rehabilitation are also regulated under this Act by conditions of mining leases, including requirements for the submission of a Mining Operations Plan (MOP). The current MOP will require modification to include the activities outlined in the Modification.
Water Management Act 2000	No additional water licences under the *Water Management Act 2000* are required for the Modification. Water resources will not be affected by this Modification.
Work Health & Safety (Mines & Petroleum) Act 2013	BHOP will implement its Safety Management Plan in the area of the Modification and will utilise standards, plans and procedures in accordance with the *Work Health & Safety Act 2011*.
Heritage Act, 1977	There is one State Heritage listed item within CML7, the BHP Office Chimney located to the north-east of CML7 and 150 m from Embankment 1. This item will not be affected by the Modification.
Threatened Species and Conservation Act 1995	Not relevant to this Modification.
National Park and Wildlife Act 1974	Not relevant to this Modification.
Aboriginal Lands Rights Act 1983	Not relevant to this Modification.

3.4 SEPP - Mining, Petroleum Production and Extractive Industries

The State Environment Protection Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW. Part 3 of the Mining SEPP stipulates matters for consideration by the consent authority before determining an application for consent in respect of development for the purposes of mining. Specifically, Clauses 12 to 17 (inclusive) requires consideration to be given to the significance of the resource, the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

The information presented in this EA addresses each of the matters for consideration prescribed in the abovementioned clauses. Emphasis has been placed on anticipation and prevention of potential environmental and social impacts, with various mitigation measures, management strategies, and monitoring activities proposed to minimise adverse impacts.

Under Clauses 12 and 14 the consent authority is required to consider the compatibility of the Project with other nearby land uses and impacts on significant water resources, threatened species and greenhouse emissions.

Existing and approved land uses in the vicinity of the Modification consist of:

- current mining operations of BHOP and the adjacent Perilya mine;
- railway and rail yards.
- Perilya mining village and recreational facilities;
- unoccupied heritage structures;
- commercial properties; and
- residential housing.

The Modification would not change these existing uses and could operate without impacting these users beyond the impacts currently approved.

The Modification would optimise the economic viability of the Mine by allowing it to produce fibrecrete and concrete on-site. It would allow the extension of the life of the TSF2 by approximately 2 years to mid-2021, providing BHOP time to complete investigations into future options for on-site and/or off-site tailings storage, and ensuring on-going financial benefits and employment for Broken Hill.

BHOP has committed to implement a range of measures to avoid or minimise potential impacts of the Modification. The existing and additional mitigation and management measures would be documented in updated management plans and monitoring measures (refer to Sections 2.5 and 2.6 of this EA, respectively) and implemented during the construction and operation of the Modification. These measures are listed in **Sections 12** and **13** of this EA.

3.5 Local Council Environment Planning Instruments

3.5.1 Broken Hill Local Environment Plan 2013

The majority of the Mine, including the areas proposed for the CBP and TSF2 extensions are within Special Purpose Zone 1 (SP1) Special Activities – Mining [BHCC Local Environment Plan (LEP), 2013]. A section of this area from South Road to the boundary of Perilya's mining lease is zoned R1 General Residential. Mines are prohibited on land zoned R1.

Sub-clause 7(1)(a) of the Mining SEPP states that development for the purpose of underground mining may be carried out on any land with development consent. In relation to any inconsistency between the Mining SEPP and an LEP, sub-clause 5(3) provides that the Mining SEPP prevails to the extent of the inconsistency. Therefore mining is permissible in this location with development consent.

BHOP identified one BHCC LEP 2013 listed heritage item adjacent to the proposed Modification area(s) and has changed the design of the TSF2 embankments to ensure the protection of this item. The chosen

design also negates the need to demolish a significant structure, know as the Old Mine Residence No. 27, although not a heritage listed item. There are no indigenous items in the proposed Modification area.

3.5.2 Broken Hill Control Plan No 11 Management of Lead Contamination

Development Control Plan (DCP) 11 provides guidelines for the management of issues relating to lead contamination. Air quality studies have demonstrated that there will be no additional impacts above and beyond those already approved.

3.6 Summary of Required Approvals

The following approvals will be sought if the proposed Modification is approved:

- modification to the Project Approval 07_0018 by the Department of Planning & Environment;
- variation to EPL 12559 for additional air quality monitoring equipment and the requirement to relocated current air and noise monitoring equipment adjacent to TSF2;
- modification to the Mining Operations Plan from the Department of Primary Industry, Division of Resources and Energy; and
- endorsement from the NSW Dam Safety Committee for the construction and use of the extended TSF2.

3.7 List of BHOP Documents Requiring Amendment by this Modification

The following current environment management plans would be updated if the proposed Modification is approved:

- Environment Management Strategy;
- Noise Management Plan;
- Air Quality Management Plan;
- Air Quality Monitoring Protocol;
- Construction Environment Management Plan;
- Construction Traffic Management Plan;
- Tailings Maintenance and Operations Manual; and
- Mining Operations Plan (including Rehabilitation Management Plan).

4.0 STAKEHOLDER ENGAGEMENT

This section summarises the stakeholder engagement undertaken and any issues raised during that process, this includes consultation with government agencies, the adjacent mine, local business, local residents and the community.

4.1 Government Agencies

BHOP consults with relevant government agencies on a regular basis in relation to the approved mining operations. Additional consultation with key agencies was undertaken as part of this assessment process. A Preliminary Information Paper titled *Modification 4 Concrete Batching Plan and TSF2 (Blackwood Pit) Extension - Rasp Mine* was issued to relevant agencies in August 2016. A copy of the Information Paper is provided at **Appendix C**.

A series of additional meetings and site inspections to discuss the proposed Modification were also undertaken. A summary of the consultation undertaken in relation to this Modification, along with the key issues raised and where they have been addressed in the EA, is provided in **Table 4-1**.

Table 4-1 Summary of Consultation with Agencies

Government Agency	Issues Identified	Response in EA (Sections and Appendices)
Department of Primary Industry - Division of Resources and Energy - AEMR meeting and site inspection - 29 Apr 2016 - Meeting held at Mine - 18 Aug 2016 - Telephone discussions –various - Regulator meeting - 30 Nov 2016 - Site inspection - 22 Feb 2017	- Requirement for Mining Operations Plan to be amended once DP&E approval received. - Tailings encapsulation and rehabilitation cover, in particular thickness of cover - Long term dust management strategy - Life of mine tailings strategy	Sections 3.7 and 10.10 Section 7 Section 10.2 operations Section 10.10 closure Section 8.3
Department of Primary Industry – Lands - Meeting held at Dubbo – early Aug 2016 - Meeting on 17 Sept 2016	- Heritage impacts and impacts to old mining residence	Section 10.7
Broken Hill City Council - Meeting held – 4 Sept 2016 - Telephone discussions - various	- Noise for operation of concrete batching plant - Impacts on old mining residence and heritage impacts	Section 10.1 Section 10.7
Department of Planning and Environment - AEMR meeting and site inspection - 29 Apr 2016 - Telephone discussions – Aug 2016 - Regulator meeting - 30 Nov 2016 - Site inspection - 22 Feb 2017	- Noise during construction activities and from Concrete Batching Plant during operation - Dust management - Visual amenity for embankments and retaining wall	Section 10.1 Section 10.8
Environment Protection Authority - Telephone discussions – various Aug 2016 - Site visit – Oct 2016 - Regulator meeting - 30 Nov 2016 - Site visits – various - Site inspection - 22 Feb 2017	- Notification to EPA 30 days prior to embankment and retaining wall construction - Dust management of TSF2 during operations and decommissioning / rehabilitation activities - Justification for not conducting a new Health Risk Assessment - Evidence of effectiveness of water sprays for TSF dust control and use of an automated system. - Potential impacts on visual amenity from the TSF2 embankments. - Potential wind drift from water sprays. - Noise levels from production activities. - EA to include an alternatives study with	Section 7 Section 10.2 operations Section 10.10 closure Section 10.3 Section 10.2 Section 10.8 Section 10.10 Section 10.1 Section 8

	costings and justification. - Water management.	Sections 6-7 & 10.6
Dam Safety Committee - Meeting – 11 Aug 2016	- Dam break analysis - Peer review of design	Section 10.4 Section 5.3 and Appendix J(b)
NSW Health - Site inspection – 22 Feb 2017	- Dust management	Section 10.2 & 10.3

4.1.1 Division of Resources & Energy, Department of Primary Industry

Discussions were conducted with representatives of the Division of Resources & Energy (DRE) in August 2016 and a copy of the Preliminary Information Paper was provided. DRE Representative attended site on 18 August 2016 during which they were briefed on the proposed Modification. A DRE representative attended a presentation by consultants in Sydney on 30 November 2016, and a further inspection was held at site on 22 February 2017.

4.1.2 Lands, Department of Primary Industry

BHOP personnel attended a meeting with Lands at their Dubbo office in early August, 2016. A briefing was held with BHOP personnel and representatives from Lands (at their offices) on the 17 September 2016, where an overview of the proposed Modification was provided and the status of the Line of Lode Reserve Trust properties were discussed. A copy of the Preliminary Information Paper was also provided.

4.1.3 Broken Hill City Council

Discussions were conducted with representatives of the Broken Hill City Council (BHCC) in early September, 2016 and a copy of the Preliminary Paper – Zinc Lodes Project Approval Variation was provided. A briefing was held with representatives from the BHCC (at their offices) on the 4 September 2016 where an overview of the proposed Modification was provided and potential environmental impacts were discussed. Further consultation occurred via telephone discussions.

4.1.4 Department of Planning & Environment

Initial discussions were made with officers of the Department of Planning & Environment (DPE) on the Modification and the Preliminary Information Paper was provided in August 2016. Site inspections were held on 29 April 2016 as part of the AEMR / Annual Report review. DPE representatives attended a presentation by consultants in Sydney on 30 November 2016 and a further inspection was held at site on the 22 February 2017.

4.1.5 Environment Protection Authority

Discussions were conducted with representatives of the Environment Protection Authority (EPA) in early August 2016 with a copy of Preliminary Information Paper provided to the EPA on the 12 September, 2016. A site visit and inspection was undertaken in October 2016 with representatives of the EPA where several concerns were raised, these included; generation of dust by wind take up of tailings material during both operations and at closure of the facility prior to capping, height of the embankments, noise during construction. EPA representatives attended a presentation by consultants in Sydney on 30 November 2016 and a further inspection was held at site on the 22 February 2017.

4.1.6 Dam Safety Committee

A meeting was held between the NSW Dam Safety Committee, BHOP and its consultants on 11 August 2016 to discuss the proposed extensions and gain DSC requirements. BHOP consultants held various discussions with the DSC and submitted the proposed design for the embankments, which was endorsed in December 2016.

4.2 Local Community

Ongoing consultation with the local community in relation to this Modification has been undertaken since project inception in the last quarter of 2016. Consultation with local residents and community members culminated in a Public Meeting, which was held on the 17 December 2016. During the Public Meeting a presentation was provided by the:

- Rasp Mine General Manager - Rob Williamson;
- CBH Director & Chief Operations Officer - Visko Sulicich; and
- CBH Group Manager-Safety Health Environment Community - Gwen Wilson.

The presentation provided an overview of Modification, explaining the use and construction of both the CBP and the TSF2 extension. A copy of the presentation is provided at **Appendix N**. Preliminary modeling results for air quality and noise were presented and potential environmental risks associated with the modification and the proposed management was outlined.

Thirty-three members of the public attended (28 recorded) with media represented by the ABC. All were Broken Hill residents with some representatives from local businesses. Members from BHCC also attended.

The attendees at the Public Meting showed interest in the presentation and appeared positive towards the proposed Modification. Overall very few issues were raised, with the discussions predominantly related to heritage and in particular how current heritage facilities could be ustilised for tourism. Dust management in regards to the TSF2 extension was raised and BHOP provided the community members with an outline of the proposed automated water spray system.

In addition, BHOP undertook a site inspection and discussion in relation to the Modification with Perilya in November 2016. No issues or concerns were raised. Discussions were also held with a resident of the Proprietary Square, who requested that the Old Mine Residence No. 27 be demolished.

Table 4-2 provides a summary of issues identified during consultation with the local community, and where they are addressed in this EA.

Table 4-2 Summary of Consultation with the Local Community

Group	Issues Identified	Response in EA
Broken Hill Community: - Public meeting held – 17 December 2016 (33 people attended)	A presentation was provided outlining the proposals for the CBP and TSF2 extension. Discussion centred around heritage and ground water unrelated to the Modification. BHOP was asked whether dust would be managed by water sprays.	Heritage Section 10.7 Water Seepage Section 10.5 Air Quality Section 10.2
Perilya Broken Hill Operations Pty Ltd: - Site inspection with environment personnel in November 2016. - Various discussions and correspondence between senior managers.	No issues identified, requested notification prior to works commencing.	NA
Resident of Proprietary Square – discussions.	Requested the Old Mine Residence No. 27 to be demolished as it was considered to attracted vandals.	Heritage Section 10.7 Not being demolished.

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5.0 PROPOSED MODIFICATION

This section provides a summary of the proposed Modification, its location and surrounding land users.

5.1 Background

BHOP is seeking approval for a minor Modification to the PA for the Mine to:

- install a CBP for the manufacture of fibrecrete and concrete for use at the Mine; and
- extend the life of the TSF2 by installing embankments and a retaining wall at low points along its perimeter.

BHOP operates an underground mine that uses fibrecrete to support the underground excavations and concrete for general civil work around site. BHOP currently sources these materials from a local supplier and trucks it to the site on the local road network. However, BHOP is currently paying exorbitant fees for the supply of these materials because a monopoly exists in Broken Hill for batched concrete and fibrecrete.

Therefore, BHOP is proposing to construct and operate its own CBP at the Mine. This would allow BHOP to produce concrete and fibrecrete on-site at a significant saving to the company (approximately $900,000 per annum). It would also result in a significant reduction in the number of heavy vehicles transporting these products to the site on local roads (from 108 to 50 truck movements/month).

The tailings waste stream from ore processing is permitted to be deposited in the historic tailings facility known as TSF1 and in the disused Blackwood Pit known as TSF2. BHOP has chosen to deposit tailings in TSF2 only and not use TSF1. This decision was made based on the greater capacity of TSF2 (3.1 Mt) compared to the capacity of TSF1 (970,000 t). In addition, the construction costs associated with the use of TSF1 ($7.2 million) were estimated to be significantly higher than those associated with extending TSF2 ($3.5 million).

As discussed in Section 1.2.2, the need to undertake more underground mining development than anticipated has reduced the capacity of underground voids to accept both waste rock and tailings material from the Backfill Plant, as proposed in the original EA. BHOP has chosen to place the additional waste rock underground to fill voids and stopes, as it is more economic to dispose of waste rock underground rather than transporting waste to the surface. Therefore, there is no void space underground for the backfill of tailings.

At current tailings deposition the life of TSF2 will be reached in October 2019. The proposed Modification would allow the extension of the life of the facility (at current production rates) to mid-2021. This would allow BHOP time to complete investigations into future options for on-site and/or off-site tailings storage facilities.

Without approval of the Modification the Mine will cease operation in October 2019.

5.2 Description of Proposed Project Areas

The proposed CBP would be located centrally on the Mine site adjacent to the Backfill Plant (refer to **Figure 2-1)**. TSF2 is located to the north east of the Mine site adjacent to the Processing Plant. The proposed location for the CBP is approximately 1500 m from the nearest embankment proposed at TSF2.

5.2.1 Location of the Concrete Batching Plant

The proposed location of the CBP has already been disturbed by previous mining operations and is denuded of all vegetation. The area has existing services and sufficient space for turning heavy vehicles, with deliveries requiring minimal access on the Mine Haul Road.

The proposed CBP would cover an area of approximately 3,500 m^2 and be located approximately centrally on the Mine site adjacent to the Backfill Plant with the underground mine Primary Ventilation Shaft located to the west. To the southwest lies Kintore Pit, which provides access to the underground Mine Portal and to the southeast is Mt Hebbard, a historic tailings storage facility. The Indian Pacific railway line and rail yards are located immediately north, together with some commercial buildings and Crystal Street, a major arterial road in Broken Hill which acts as a trucking route from east to west and from Sydney to Adelaide. Commercial and residential buildings are also located along Crystal Street. The proposed location of the CBP and surrounding areas are shown in **Figures 5-1** to **5-2** and **Photographs 5-1** to **5-2**.

Figure 5-1 Proposed Area for CBP Showing Surrounds

Figure 5-2 Site for Proposed Concrete Batching Plant

Photograph 5-1 Proposed Location for CBP Looking North East Towards the Cafe

Photograph 5-2 Proposed Location of CBP Looking North West Towards Crystal Street

5.2.2 Land Users Adjacent Proposed Project Area – Concrete Batching Plant

The closest residents to the CBP are located on Crystal Street (**Photograph 5-3**) at a distance of approximately 348 m. The residences are separated from the CBP by the Indian Pacific rail-line and railway yards (refer to **Figure 3-2**).

Photograph 5-3 View of Crystal Street Opposite Rail Yards Looking East

The Broken Hill Mackenzie Business Centre, a previous railway yard facility before being fitted out with offices. is located within the rail yard area. It contains office suites and conference facilities for short and / or long term lease. A main tenant is at this Centre is Vertex Power & Process Pty Ltd, electrical contractors who run a main workshop. This is the closest commercial property to the proposed CBP and is the building to the left in **Photograph 3-4.**

Photograph 5-4 Rail Yards and Commercial Properties Looking East

Broken Hill Hire & Engineering Services Pty Ltd, who supplies and services industrial equipment, is located to the northwest of the proposed CBP. The site includes yards for the storage of industrial equipment, workshop and offices (refer to **Photograph 3-5**). A major shopping complex is located opposite this facility.

Photograph 5-5 Industrial Sales and Hire Looking to Proposed Concrete Batching Plant

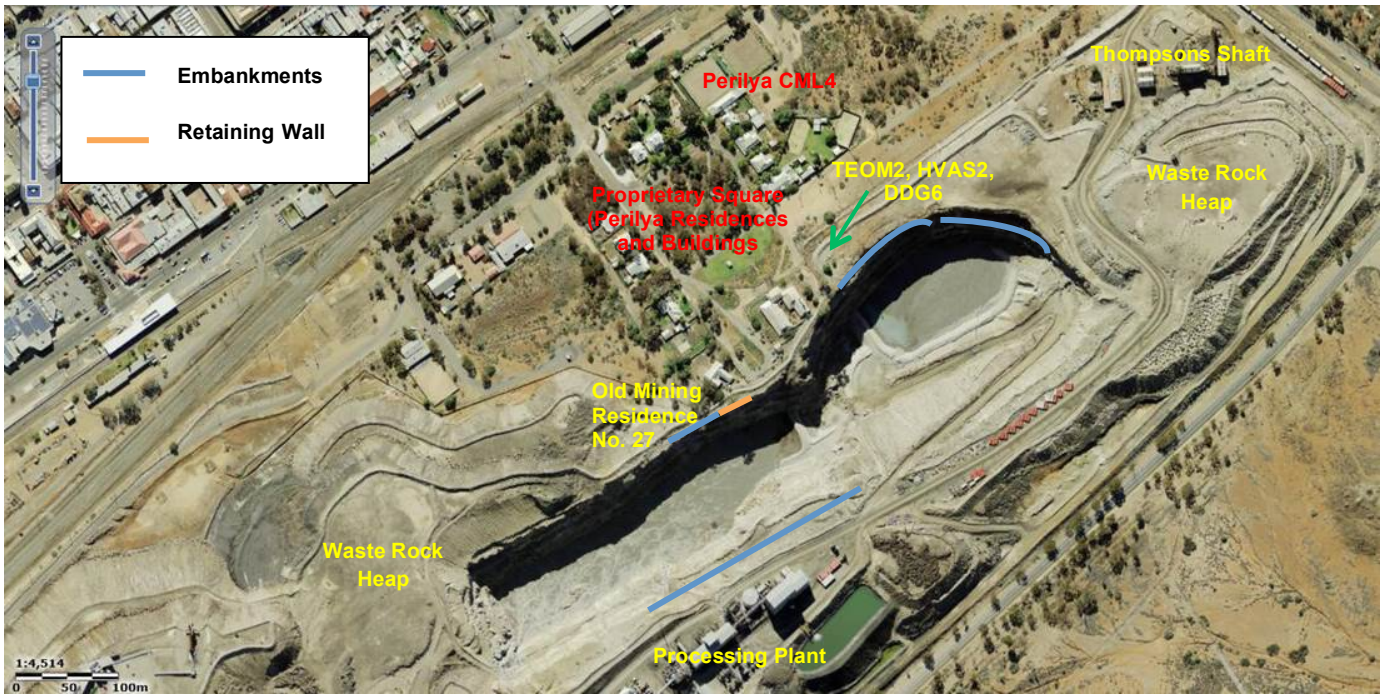
The proposed CBP would not be visible to South Broken Hill residents as Mt Hebbard provides a barrier to these residents, along with the safety bunding surrounding Kintore Pit and noise abatement bunds which lay south of the proposed area.

A summary of distances of these facilities to the proposed CBP is included in **Table 3-1**.

5.2.3 Location TSF2

TSF2 is located to the north of the current processing plant, with the historic Thompsons Shaft and mine buildings to the north-east, waste rock storage areas to the east and west, and Proprietary Square to the north (**Figures 1-2** and **5-3,** items highlighted in yellow are located within the surface rights areas of CML7).

Figure 5-3 Blackwood Pit TSF2 Showing Surrounds



5.2.4 Land Users Adjacent the Proposed TSF2 Project Area

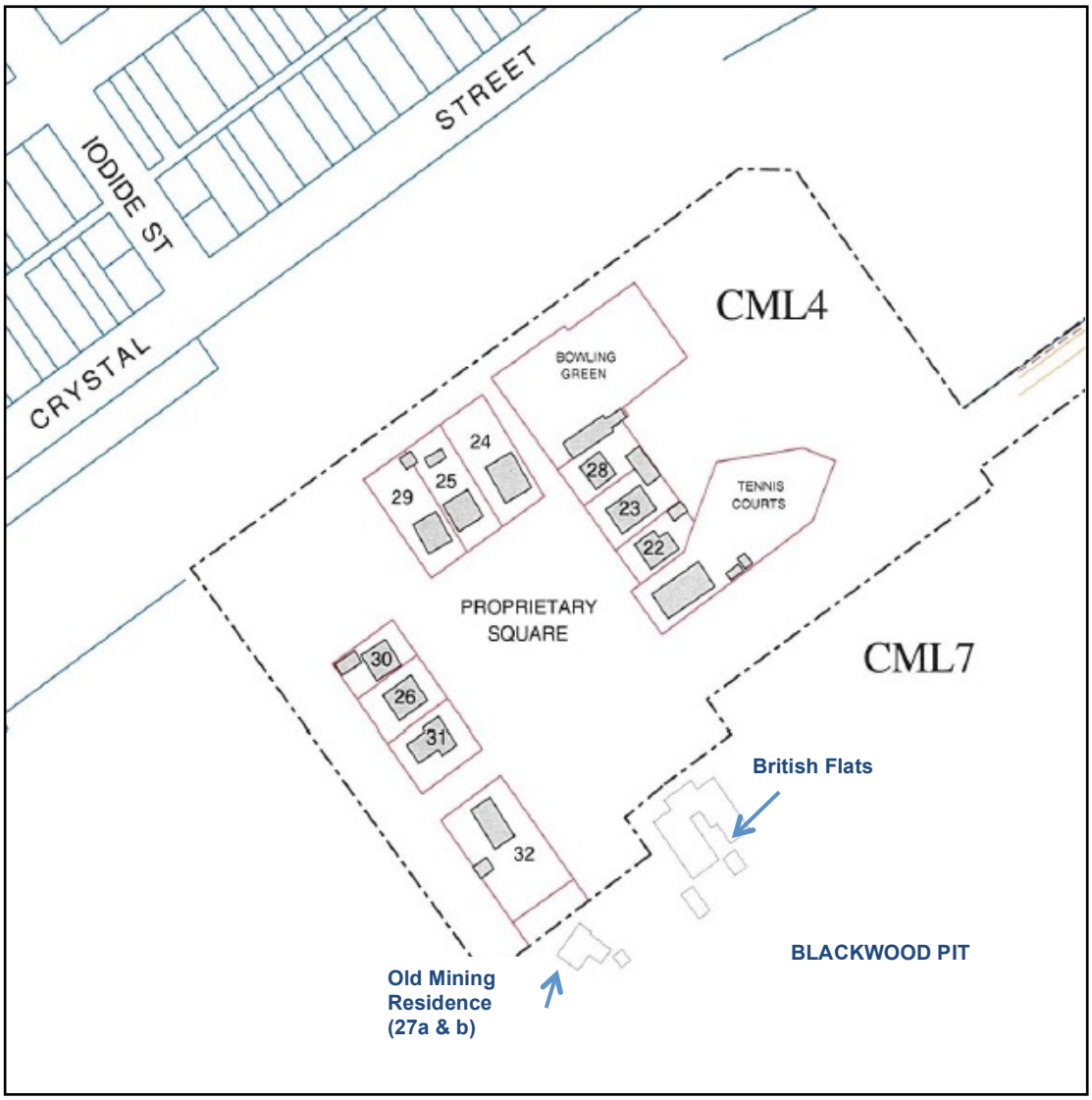
Located immediately to the north and adjacent to TSF2, and within the surface rights areas of CML7, are two historic buildings. These include British Flats which is a heritage listed building on the Broken Hill City Council Local Environment Plan 2013 (Item I21) and an Old Mine residence No. 27 (Block 14 Flats - also known as Residences 27a and 27b) which is unoccupied. This is not listed as a heritage item.

These structures would not be affected by the TSF2 extension and are discussed further in **Section 10.4**.

Located further north is Proprietary Square, which lies within a CML7 surface exclusion (15.24 m) on Consolidated Mine Lease 4 (CML4) held by Perilya. Perilya uses the area for some residential housing (9 residences not all occupied), a bowling green with club house and employee social club with tennis courts (refer to **Figure 3-4).**

A water / power easement delivering services to these houses from Perilya's North Mine also runs adjacent to the proposed Embankment 2. Perilya provides power and water from its North Mine located at the north east end of CML7 to Proprietary Square for their mining residences and structures. A surface exclusion zone (ML413 15.24 m) runs along the boundary of CML7 surface exclusion zone adjacent to Embankment 2 containing these facilities.

Figure 5-4 Proprietary Square (Perilya CML4)



Three buildings are located along Federation Way, to the west of Proprietary Square. Two of these are used by members of the public and the third as a commercial premise. They include:

- Cameron Pipe Band Hall located along Federation Way within CML7 on a surface exclusion Lot 21 Sec 58 (**Photograph 5-6**);
- St Johns training facility and offices located along Federation Way within CML7 on a surface exclusion Lot 22 Sec 59 (**Photograph 5-6**); and
- Jenmar Ground Control Products Pty Ltd operates from a building located along Federation Way within CML7 on a surface exclusion Lot 21 Sec 59. It is located to the west of St Johns and is a commercial business selling products to the mining industry (**Photograph 5-7**).

Photograph 5-6 Cameron Pipe Band to the Left and St Johns to the Right

Photograph 5-7 Jenmar Ground Control Products

5.2.5 Summary of Land Users and Distances to Proposed Modification Locations

Table 5-1 lists the land users in the general vicinity of the proposed Modification locations and distances between them measured at the closest points.

Table 5-1 Proposed Modification Distances to Land Users

Project Area	Item	Shortest direct distance (m)	Within CML7 surface rights area
Concrete Batching Plant	Railway Building	160	No
	Rail yards	128	No
	Mackenzie Business Centre	285	No
	Closest residential house in Crystal Street	348	No
	Café & Miners Memorial	512	Yes
TSF2	Heritage structure British Flats, unoccupied (EMB2)	25	Yes
	Old Mining Residence, unoccupied (EMB1)	10	.Yes
	Closest residence in Proprietary Square (house 32), occupied (EMB1)	90	No, surface exclusion 15.24 m
	Recreational services in Proprietary Square – Perilya Social Club tennis courts (EMB2)	106	No, surface exclusion 15.24 m.
	Recreational services in Proprietary Square – Perilya Bowling Club (EMB2)	216	No, surface exclusion 15.24 m.
	Perilya services corridor for power line and water pipes (EMB2)	42	No, surface exclusion
	Cameron Pipe Band Hall (EMB1)	246	No, surface exclusion 15.24 m
	St Johns (EMB1)	220	No, surface exclusion 15.24 m
	Jenmar Ground Control Products (EMB1)	227	No, surface exclusion 15.24 m

5.3 Preliminary Construction Schedule

The construction of the CBP and TSF2 extension would be undertaken sequentially. **Appendix G** outlines a preliminary schedule for construction. The estimated construction periods are listed in **Table 5-2** below. Although each element would be constructed separately, the order of construction would be determined by the contractor engaged to undertake the works, and therefore may change. The construction of the TSF2 embankments would be undertaken in two stages.

Table 5-2 Estimated Construction Times

Item	Construction Period (weeks)
Concrete Batching Plant	5
Embankment 1 (Stage 2)	15
Embankment 2 (Stage 1)	21
Embankment 3 (Stage 2)	16
Spillway (Stage 1)	4

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6.0 DESCRIPTION OF CONCRETE BATCHING PLANT

This section provides details of the proposed Modification – concrete batching plant, its components, installation, operation and closure.

6.1 Main Components

BHOP operates an underground mine that uses fibrecrete to support the underground excavations and concrete for general civil work around site. Fibrecrete is essentially a batched concrete that consists of the key components that are mixed together including aggregate, cement, steel fibres, water and various admixtures.

The CBP would consist of the following main components:

- Batch plant (silo, control room, loading hopper, leading belt, weightometer, cement auger);
- Enclosure for loading Agi-truck;
- Compressor / blower shed;
- Concrete bunkers for aggregate storage;
- Raw water tank (10,000L);
- Wash-out sump;
- Access roads; and
- Admixture storage.

Cement would be stored in a silo, which is the highest feature within the facility at approximately 10 m. Aggregate storage would be constructed concrete bunkers. **Photograph 6-1** provides an example of a similar concrete batching plant located at a mine in Ballarat, Victoria. **Figure 6-1** indicates the proposed layout for the CBP. **Figure 6-2** provides a drawing of the typical arrangements for a CBP.

6.2 General Operation

Cement would be transported in ISO tank containers by rail to the Mine and collected by truck from the Concentrate Rail Siding and transported internally to the CBP. The cement would be emptied into a silo using a blower where it would be stored.

Aggregates would be brought on site by suppliers and tipped into purpose made concrete bunkers. A small front-end loader would be used to handle the material. When batching, the aggregates would be loaded from the bunker and tipped into the batch-plant hopper before travelling up the conveyor belt and mixed with the cement which would be discharged from the silo using an auger. The cement and aggregates would be tipped into the Agi-truck where they would be mixed with water, admixtures and fibres.

Photograph 6-1 Proposed Concrete Batching Plant

Figure 6-1 Proposed Layout for the Concrete Batching Plant

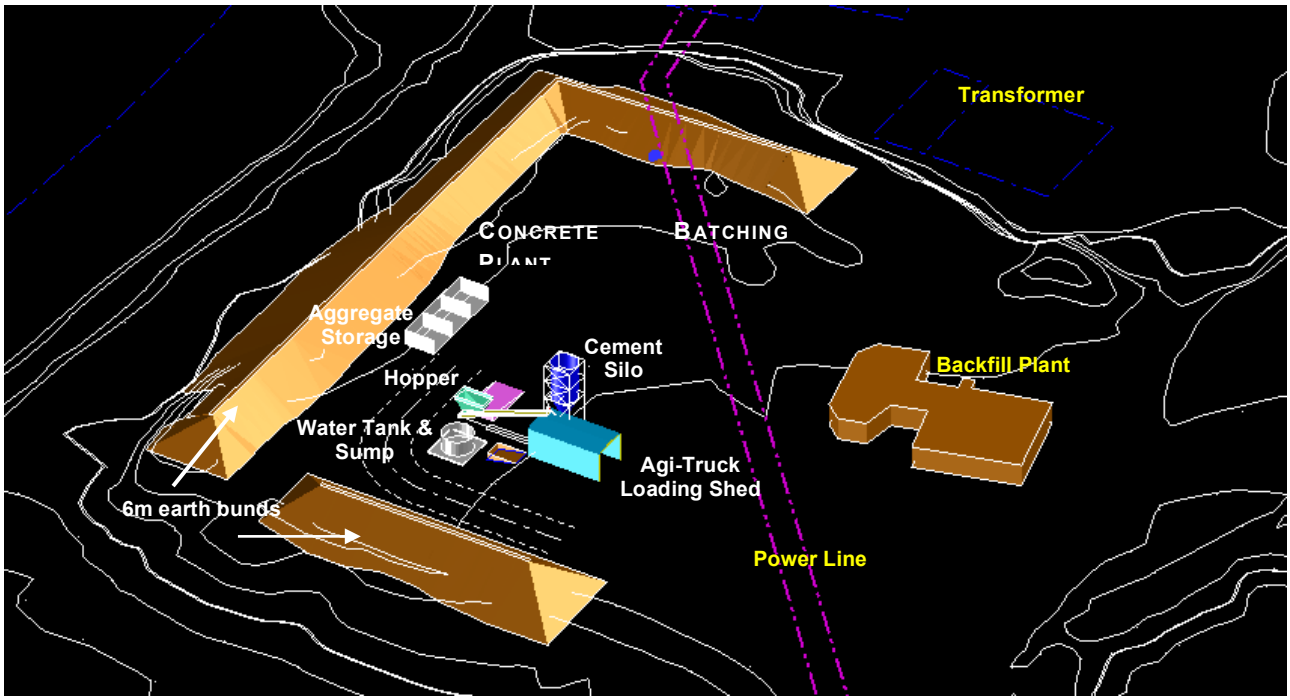
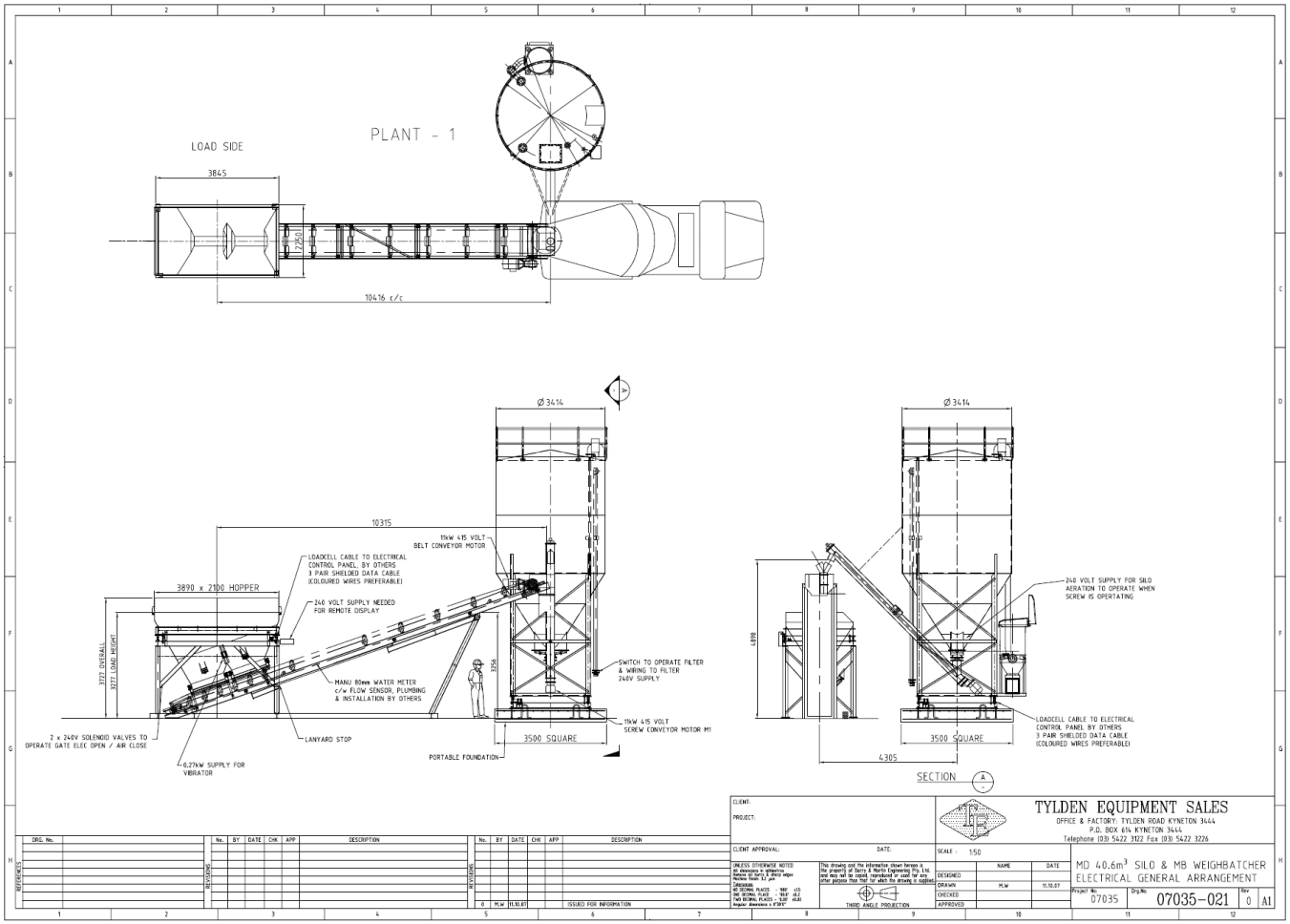


Figure 6-2 Typical Arrangements for a Concrete Batching Plant



6.3 Consumables

The estimated volume of materials that would be consumed at the design production rate of 15,000 m^3 of fibrecrete/concrete per annum is summarised in **Table 6-1**. Although current mining production requirements for fibrecrete (6,500m^3) are well below this design rate BHOP plan to ensure there is appropriate capacity for any future increase in demand.

Table 6-1 Estimated Annual Consumables

Material	Annual Consumption
Aggregate coarse	6,660 t
Aggregate fine	2,688 t
Sand	14,960 t
Cement	6,600 t
Steel fibres, - ReCo 65/35 (10 or 20 kg bags)	90 t
Admixtures – accelerator, SA 160 (1000 L pods)	345,000 L
Admixtures – stabiliser, Delvocrete MasterRoc HCA20 (1000 L pods)	45,000 L
Admixtures – plastiser, Master Glenium SKY 8703 103 (1000 L pods)	60,000 L

6.3.1 Aggregate

Aggregates would comply with *AS2758.1 Aggregates and Rock for Engineering Purposes – Concrete Aggregates*. The combined grading of coarse aggregate and fine aggregate or sand would be in accordance with the sizing outlined in **Table 6-2**.

Table 6-2 Grading of Aggregate

Sieve Aperture (mm)	Minimum (mm)	Maximum (mm)
13.2	100	100
9.5	93	100
4.75	78	100
2.36	60	93
1.18	42	78
0.6	28	58
0.3	17	32
0.15	6	17
0.075	0	2

Coarse aggregate would have a maximum nominal size of 10 mm with water absorption limited to a maximum of 2 per cent. Aggregate would be non-reactive for alkali-aggregate reaction (AAR). Coarse and fine aggregates would be stockpiled separately to prevent segregation and contamination with other materials. Aggregate would be sourced from Broken Hill and would be transported to site in trucks. It would be tipped directly into the fit-for-purpose concrete storage bunkers and pushed-up with a front end loader.

6.3.2 Cement

Cements used would be compliant to *AS3972-2010 General Purpose and Blended Cements* and comprise either general purpose (GP), or special purpose types (HES) (SR) or (SL).

Cement would be stored in a weather-tight silo protected from dampness and contamination.

6.3.3 Steel Fibres

Steel fibres would be delivered in 10 kg or 20 kg bags and stored, with other admixtures, in a designated shed or modified shipping container. Steel fibres would be loaded into the Agi bowl on the truck where the fibres would be mixed.

6.3.4 Admixtures

Admixtures consist of accelerators, stabilisers and plastisers, which would be stored in bunded areas and would include including:

- Accelerator, MasterRoc SA 160 (1000 L pods);
- Stabiliser, Delvocrete MasterRoc HCA20 (1000 L pods); and
- Plastisers, Master Glenium SKY 8703 103 (1000 L pods).

Admixtures would be delivered in ISO pods and loaded as required.

6.4 Truck movements

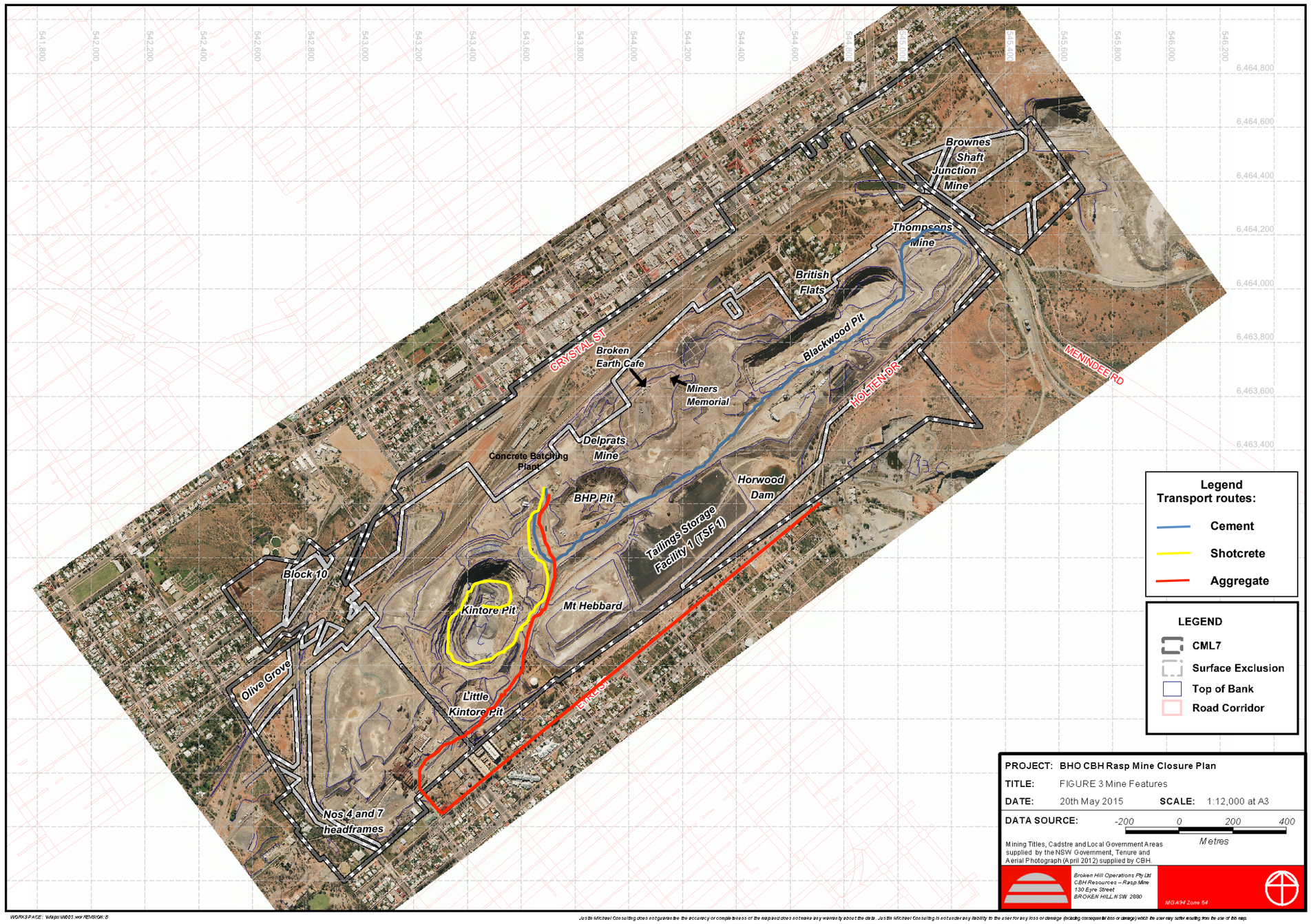
6.4.1 Off-Site

The main off-site truck routes are from the existing quarry located on Holten Drive, an extension to Eyre Street, and along the trucking route from Wentworth Road to the main Mine site gate access on Eyre Street (**Figure 6-3**). **Table 6-3** provides an estimation of the truck movements based on 15,000 m^3 per annum or 40 m^3 per day of fibrecrete/concrete production. The bulk of external deliveries would be aggregates (50 trucks per month), which would be sourced from the local quarry and transported by road using B-double or road train configurations (**Figure 6-3**, red highlight). Sand (approximately 30 trucks per month) would be transported via Wentworth Road and other raw materials used in the admixtures would be sourced both locally and interstate and would arrive at site via general freight deliveries (approximately an additional 11 trucks per year).

Aggregates, admixtures and steel fibres will be delivered to site as part of general freight deliveries and would equate to approximately 11 additional truck deliveries per year. It is anticipated that these additional deliveries will be absorbed into current traffic volumes and not would impact current vehicle movements on public roads.

Current Agi Trucks transporting concrete from the quarry (at any time during the 24 hour day) to the Mine will cease with the establishment of concrete batching on site reducing traffic volumes on Eyre Street by 108 trucks per month. In addition, there would be no concrete deliveries during the night-time period.

Figure 6-3 Rasp Mine Aerial Indicating Transport Routes



6.4.2 On-Site

Changes to on-site trucking routes will include cement supplies from the Concentrate Rail Siding to the CBP (**Figure 6-3**, blue highlight) along the Haul Road (a sealed road) and fibrecrete from the CBP to the Mine Portal (**Figure 6-3**, yellow highlight) located at the floor of Kintore Pit (also a sealed road until part-way down the Pit ramp).

Table 6-3 indicates the estimated truck movements based on 15,000 m^3 per annum or 40 m^3 per day of fibrecrete/concrete production. This is in excess of current batching requirements and is required to accommodate the maximum projected consumption, hence the difference in current and proposed Agi truck movements.

Table 6-3 Estimated Truck Movements Based on 15,000 m^3 Annual Production

Transport Type	Return Trips	
	Monthly	Annual
Current External Public Road: Agi movements from Quarry to site, return trips	108	1,296
Proposed External Public Road: Aggregate B-Double transport from Quarry to site, return trips	50	600
Proposed Internal Road CML7: ISO cement transport on mine site, return trips	21	252
Proposed Internal Road CML7: Agi movements on mine site, return trips	253	3,036
No additional rail movements. ISO's added to existing trains	Nil	Nil

All external transport deliveries to the Mine site would be conducted between 07:00-18:00 Monday to Saturday and 08:00-18:00 Sunday and public holidays. Internal Agi truck movements would occur 24 hours per day and internal deliveries of cement from the Concentrate Rail Siding to the CBP would occur during the daytime only.

6.5 Water Supply and Stormwater Management

6.5.1 Water Supply

Water aids in the mixing of materials and is pumped into the Agi truck where the admixtures and aggregates would be mixed with cement to form concrete or fibrecrete. It would also be used for washing the agitator and general cleaning.

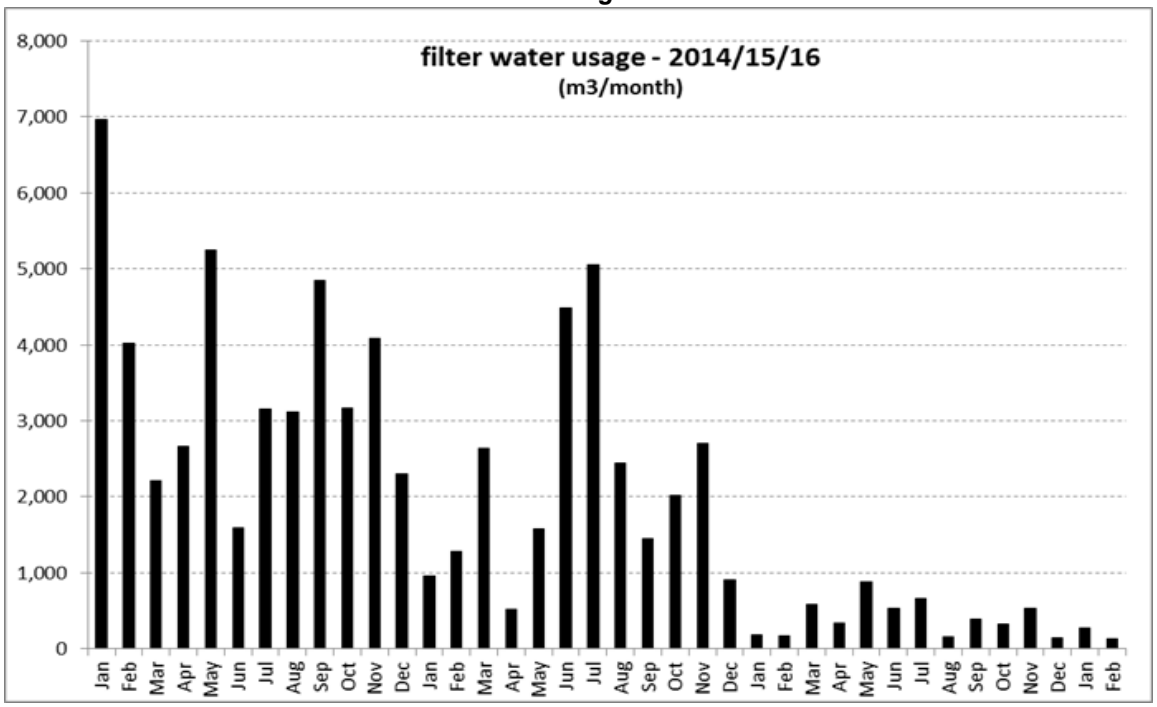
Water would be sourced from Essential Water via the existing raw water mains located at the Surface Fill Plant. At the estimated annual production rate of 15,000 m^3, approximately 3.6 ML of additional raw water would be consumed per annum. The original EA estimated a raw water use of 288 MLpa. Improvements in water use and consumption have reduced raw water usage. The current raw water usage is 260 MLpa, providing a current surplus of 28 MLpa. No increase in water usage from that estimated in the original EA is anticipated.

The installation of a lined water storage facility together with a system for water treatment has enabled:

- more water to be captured and stored;
- improved water recovery, and
- improved water quality.

These improvements have enabled the water to be used more widely within the Processing Plant and, in particular, the improved water quality has resulted in the ability to use this process water to clean filter cloths between cycles (a minimum of 100 cycles per day with equivalent consumption rate of 5 L/s over for the 24 hour production day), previously designed to only use raw water. **Figure 6-4** shows the water savings at the Mine since 2014.

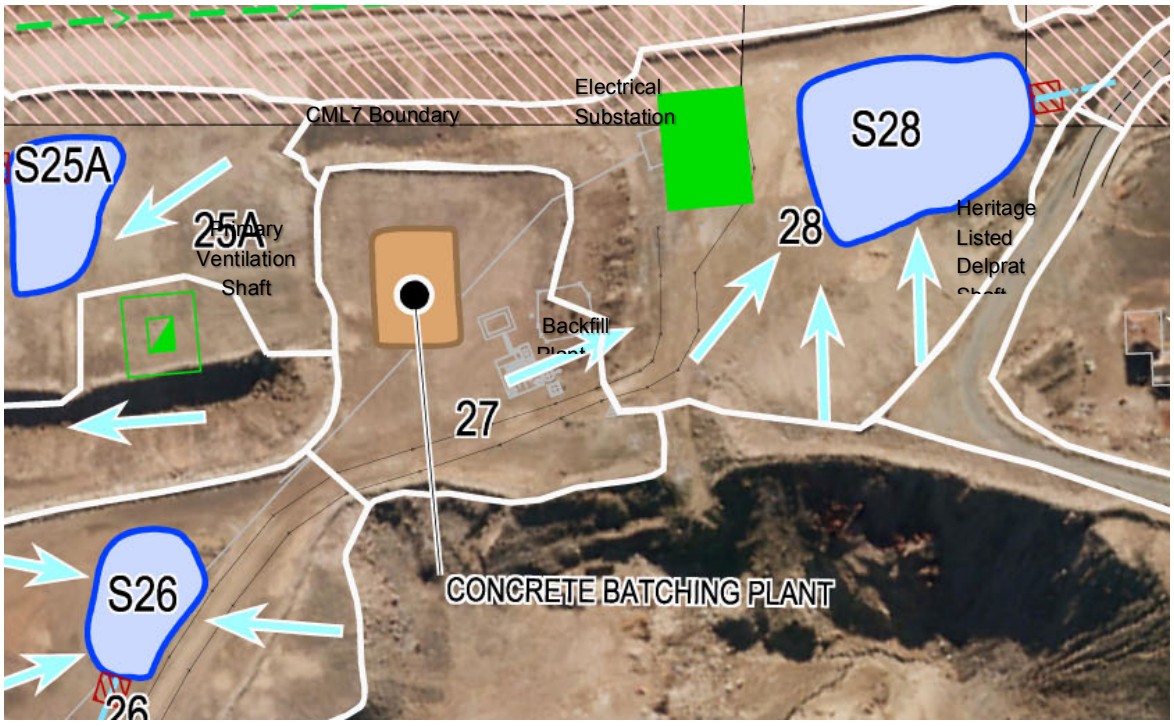
Figure 6-4 Reduction in Water Usage in the Processing Plant Water for Washing Filter Cloths



6.5.2 Stormwater Management

The CBP is located in the site sub-water catchment C27 which directs surface rainfall runoff to storage pond S28. As outlined in the existing BHOP Site Water Management Plan, this pond can hold a 1:100 ARI rainfall event (refer to **Figure 6-5**). The surface area would be formed to re-direct water around the newly installed noise abatement bunding to continue to this storage area. The unused Backfill Plant Sediment pond would be relocated to the north of the Backfill Plant.

Figure 6-5 Stormwater Management



6.6 Power Supply and Connections

Power would be fed from the current 300 kVA transformer located adjacent to the proposed CBP location. The feed would be located underground and the total power requirements would be less than 100 kW per hour. Current power usage at 125,000 kW per hour can easily accommodate the additional usage.

6.7 Wastes

Wastes that would be generated include during the operation of the CBP include:

- Wash-out from the Agi truck and general hose-down cleaning. The Agi trucks and general clean-outs would be washed out into a collection settling sump. The solids consist of aggregates, cement and water. The solids would be removed from the sump and disposed either to an underground stope or tailings storage facility;
- IBCs from Admixture materials. Empty IBCs would be washed out and returned to the manufacturer, and
- Steel fibre bags. Empty bags would be disposed of as part of general waste collection and removed from site.

6.8 Construction Preparation for Concrete Batching Plant

The area proposed for the location for the CBP was designated for plant infrastructure in the original EA. There is no vegetation or topsoil located in this area, which lies on consolidated waste rock. The installation and erection of the CBP would be undertaken separately to the construction of the Embankments at TSF2 (**Appendix G**).

Land preparation for the construction of the CBP would consist of leveling the area (minor works), installing concrete foundations and a noise abatement bund.

The surface area for the CBP, material storage, truck delivery and turnaround would be leveled using an excavator and grader. Waste rock from Kintore Pit would be used to form a base over the proposed area. It would be crushed at the floor of Kintore Pit (70 m depth) to a particle size 5 mm to 40 mm to provide gravel that would be moisture conditioned and compacted to form a firm base (approximately 1125 m^3 to provide a 300 mm cover). This would provide a surface finish that would minimise any dust take up from vehicle movements, including trucking and operation of the front end loader. A chemical suppressant would also be used to assist in dust mitigation.

Waste rock would be used as source material to increase the current earthen bund along the perimeter of the CBP area. The bund would be approximately 6 m in height and would extend along the north, east and western sides of the area. The bund would act to reduce noise levels and any visual amenity impacts to the township of Broken Hill. To minimise dust entrainment by wind the waste rock would not be crushed and would have rock sizes up to 500 mm a chemical dust suppressant would be applied to minimise ongoing dust generation during operation. Approximately 5,000 m^3 of this material may be required.

No additional roads are required to be constructed for the CBP. The existing roads from the Concentrate Rail Siding area to the CBP, and from the CBP to Kintore Pit, are sealed.

The main components of the CBP would be pre-fabricated off-site. Installation, including civil works, is expected to take five (5) weeks and be undertaken between 07.00 and 18.00 Monday to Friday and 08.00 to 13.00 Saturdays, no Sundays or public holidays.

During the construction phase of the CBP the following vehicles would be utilised:

- Excavator 8 hours per day for 4 weeks;
- Grader 8 hours per day for 2 days;
- Water truck 4 hours per day for 6 weeks;

- Dump trucks transporting waste rock 471 return trips (Kintore Pit); and
- Crane 8 hours per day for 2 days.

The proposed construction schedule in provided in **Appendix G**.

6.9 Personnel

The Mine currently employees 195 full time employees and 35 contractors. The Modification would result in a net increase of 2 full-time positions.

6.10 Operating Hours

Construction hours for the CBP would be Monday to Friday from 07:00-18:00 Saturdays from 08:00-13:00, and no work on Sundays or public holidays.

The CBP would operate 24 hours per day including deliveries to the Mine Portal. Other internal truck deliveries would occur during the daytime and external site deliveries would occur 07:00-18:00 Monday to Saturday and 08:00-18:00 Sunday and public holidays (where required).

7.0 DESCRITPTION OF TSF2 EXTENSION

This section provides a description of current operations of the TSF2, the proposed designs of the embankments and retaining wall, construction methodology and closure criteria and methods for the facility.

7.1 Current Operation

Flotation process tailings are currently pumped to and deposited at the south-western end of TSF2 via a duty/standby configuration of centrifugal pumps. Particle solids settle out of the slurry stream along the length of TSF2 in a north-easterly direction. Any excess water collects at the northeast end of the facility. From here the water is pumped back into the process water tank via a mobile diesel water pump. All tailings from the processing plant have been deposited in TSF2 with approximately 1,883,000 t of tailings deposited up to elevation RL 292 m at the north end (April 2016). **Photograph 7-1** shows the tailings deposition level as at July 2016.

Photograph 7-1 Blackwood Pit TSF July 2016 Looking North East

The existing deposition method ensures that the entire length of the tailings surface is constantly wetted by deposition of tailings slurry, minimising any potential for dust generation. Where the tailings do dry, a crust forms which is resistant to dusting (refer to **Section 10.2**). There are no visible signs of dust at the facility (the **Photograph 7-1** was taken during a severe wind storm in excess of 40 km per hour), however if dusting did occur water could be applied to the surface of the facility via the mechanism for tailings placement. **Section 10.2** outlines the existing dust management measures.

With a natural decant collection point to the north-east there is no requirement to disturb the surface crust or dried tailings from earthwork excavation activities which may have occurred with a constructed beach and decant pond (as was proposed in the original deposition method). Despite this, dust monitoring is continuous and ongoing and data collected from TEOM2 and HVAS3 located adjacent to the facility to the north, has shown no indication of an increase in total dust since the tailings have been deposited and rising within TSF2. **Figures 7-1** and **7-2** show monitoring results for PM_{10} from the monitors located adjacent to TSF2 for the last 4-5 years.

Figure 7-1 Results from Dust Monitor Adjacent Blackwood Pit (TSF2) – PM_{10}

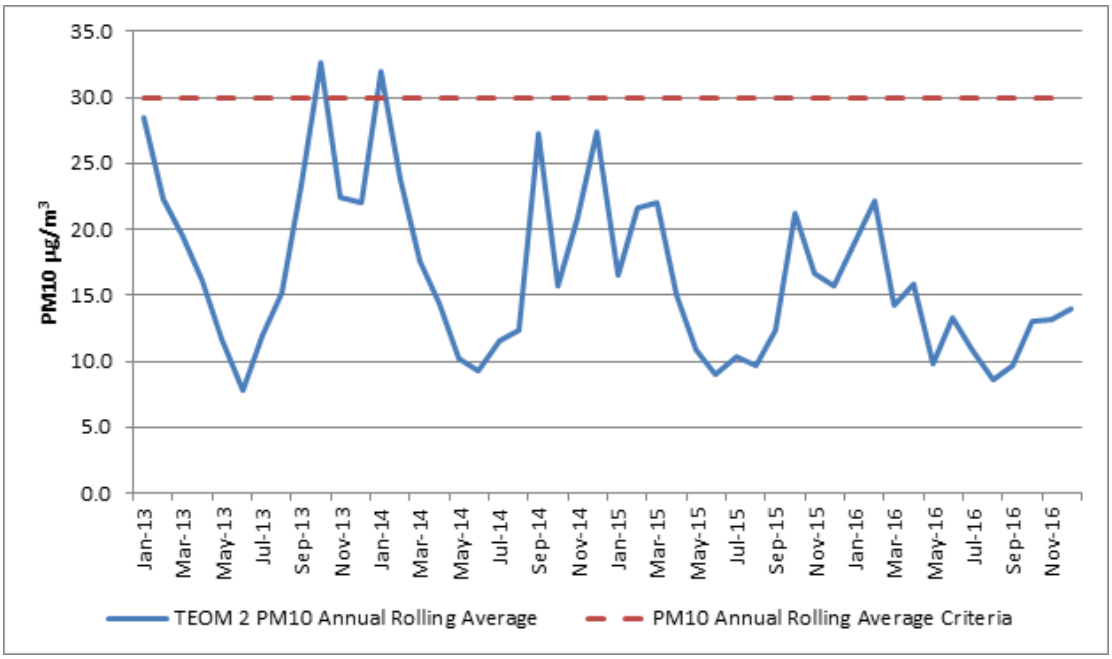
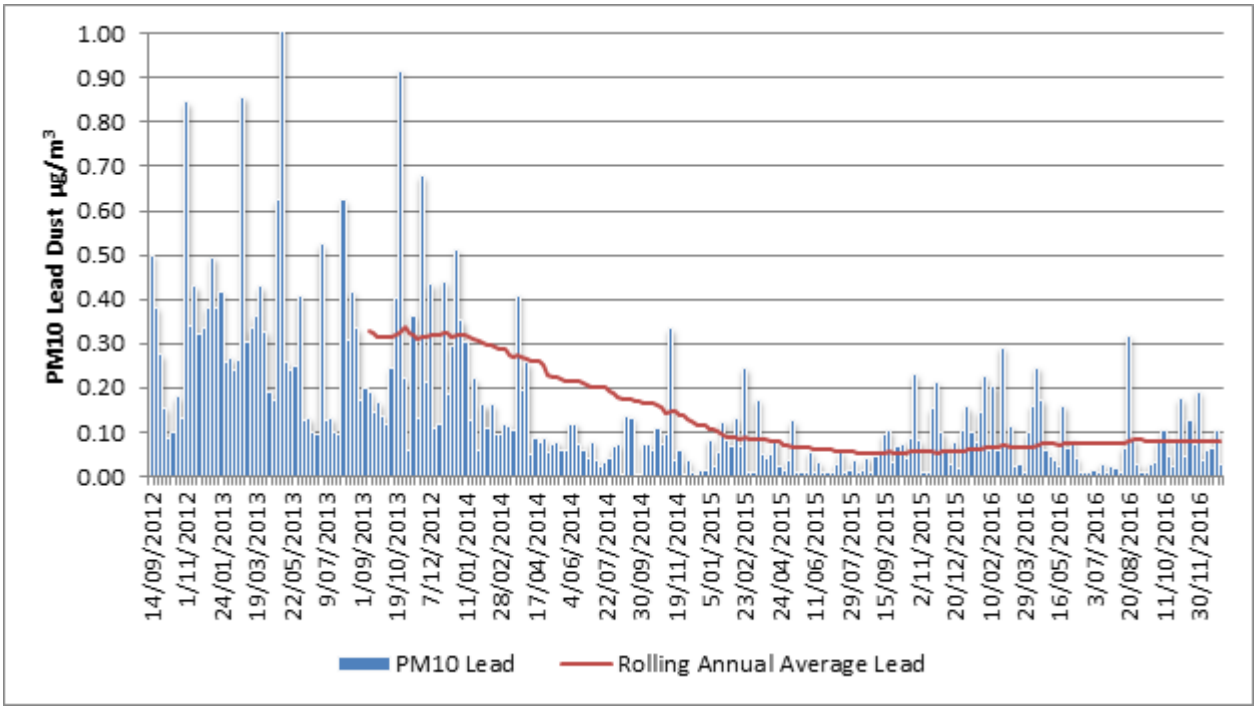


Figure 7-2 Results from Dust Monitor Adjacent Blackwood Pit (TSF2) - Lead



In accordance with the original EA, at the cessation of tailings disposition into TSF2, a final covering of waste rock will be placed over the top of the tailings to minimise the potential for dust generation as the tailings stabilise and consolidate. This will form a final cover to minimise the potential for wind entrainment of lead bearing dust from the Mine site. **Section 10.10** outlines proposed rehabilitation of the facility in accordance with the original EA.

7.2 Description of Embankments and Retaining Wall

The storage capacity in the existing TSF2, between the tailings beach surface on 25 April 2016 and a level 1 m below the lowest point of the pit rim (freeboard), is 1.29 Mm^3. At an expected tailings design dry density of approximately1.55 t/m^3, the current predicted capacity is 2.0 M t, or 3.5 years of tailings production at the indicated 570,000 t per year production rate. This indicates that TSF2 will reach its current design limit by approximately the end of October 2019.

The pit rim topography is variable from RL 335 m in the southwest to a low of RL 312 m in the northeast corner, with several dips below this level around its perimeter. There is therefore an opportunity to continue deposition of tailings from the southwest end of the pit and maintain the tailings beach sloping down to the northeast. There are three main areas where the rim of the pit dips and works are required, including the:

- northern corner of the Pit;
- area adjacent the Old Mine Residence No. 27; and
- pit rim adjacent to the Processing Plant.

Golder Associates Pty Ltd (Golder) was engaged to design the extension of the TSF2. The *Design Report for the Blackwood Pit Tailing Storage Facility Extension* (Golder, March 2017) is provided at **Appendix J**. Based on the above topographic considerations, the proposed design includes the construction of containment embankments and a retaining wall (to protect the Old Mine Residence No. 27). The alignment of the embankments has been selected to be near the existing topographic high areas; to maintain access along the existing road from the Processing Plant to the Concentrate Rail Siding; to retain tailings deposition adjacent to the Processing Plant, and to protect the Old Mine Residence No. 27. The alignments of the embankments were adjusted so that the footprints of the embankments were inside the BHOP surface rights boundary within CML7.

Due to space constraints at the Old Mine Residence No. 27 (**Photograph 10-4**) an embankment was not feasible between the residence and the pit. To enable Embankment 1 to extend over this area, the Old Mine Residence No. 27 would need to be demolished. To protect this building it is therefore proposed to construct a retaining wall consisting of rock filled gabion baskets along a portion of Embankment 1. The retaining wall would extent into Embankment 1 to the west, which is at a higher elevation. The retaining wall would be approximately 35 m in length and would reach a height of 2 m in the centre to 0.5 m at each end. The layout of Embankment 1 has been selected so that the final elevation does not extend over the gentle rise next to the Old Mine Residence No. 27 or encroache on the British Flats.

A conceptual layout of the embankments and retaining wall are presented in **Figure 7-3.**

The storage capacity of the facility after construction of the proposed embankments and retaining wall is estimated to be 1.9 Mm^3 or 2.95 Mt (from April 2016). The capacity has been estimated 1.5 m below the top of the embankment and retaining wall elevations (as potential for a freeboard and to accommodate any settlement). Construction of the embankments would be staged to suit the filling rate of the facility, with Embankment 2 required for tailings deposition by October 2019 and Embankments 1 and 3 by December 2020, extending the life of the facility to mid-2021.

Geometric and elevation information for the four components of the proposed embankments and retaining wall are presented in **Table 7-1**. Note the crest elevation of the embankments vary to reflect the grade of the tailings beach. The top of the retaining wall is indicated to be at a constant elevation to avoid construction complication, but could also be stepped or sloped.

Figure 7-3 Design Concept for Embankments and Retaining Wall at TSF2

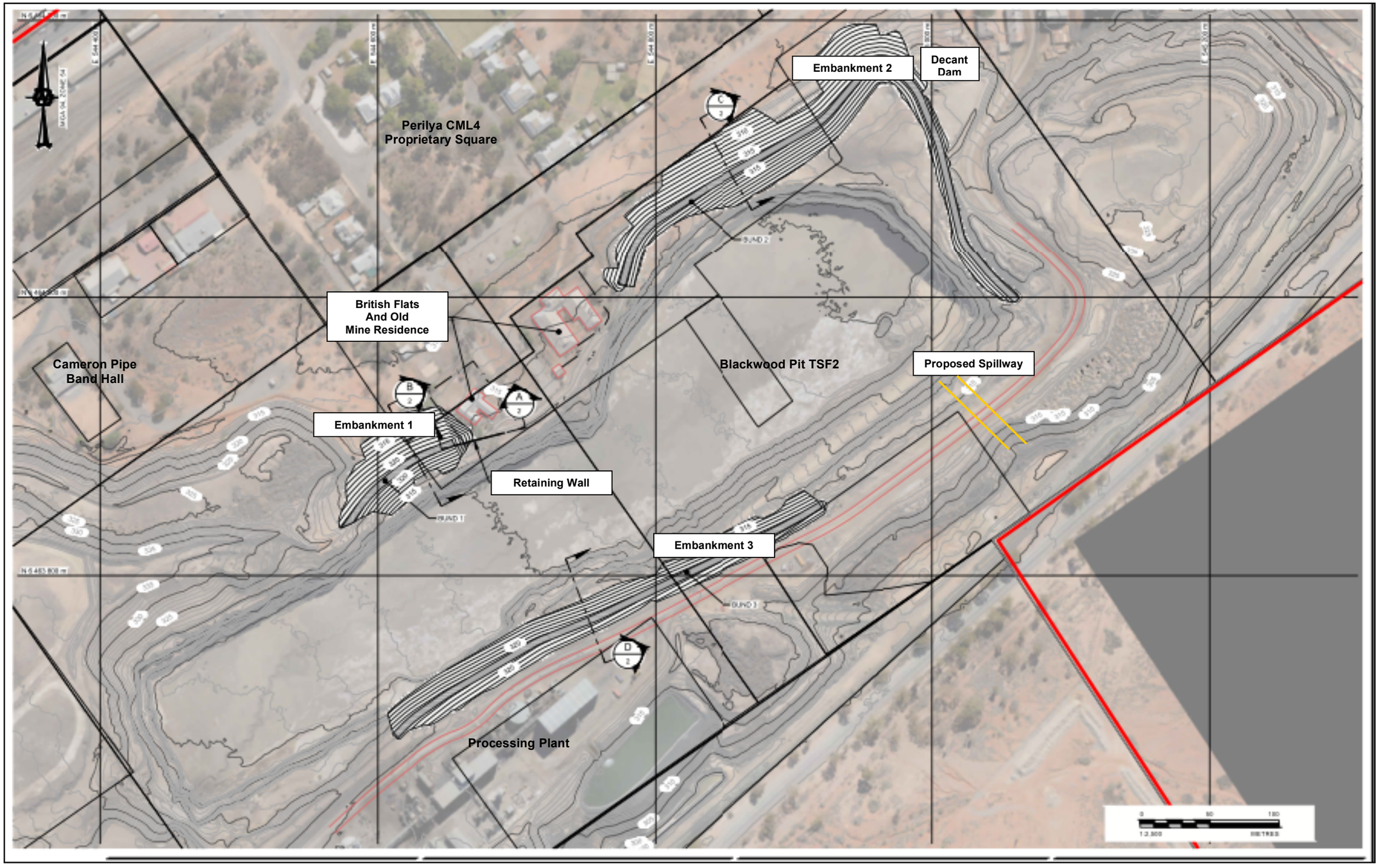


Table 7-1 Features of Embankments and Retaining Wall

TSF2 Extension Structures	Minimum Height (m)	Maximum Height (m)	Length (m)	Elevations (RL m)
Embankment 1 West of Old Mining Residence	0	6.4	160	322.2 m SW 320.1 m NE
Embankment 2 North-east Corner of the Pit	0	7	450	318.5 m W 315.0 m E
Embankment 3 Adjacent the Mill	0	5.2	350	323.0 m SW 318.0 m NE
Retaining Wall South of Old Mining Residence	0.5	2	35	319.8

Table 7-2 provides a summary of the differences in final tailings deposition levels with the original EA. Tailings deposition originates from the southwest, which is the highest end of the Pit and reduces in height as it travels to the northeast, the lowest point.

Table 7-2 Comparison of the Final Tailings Deposition Heights and Capacities

Report	Highest (SW)	Increase (m)	Lowest (NE)	Increase (m)	Total Capacity	Deposition Completion
Original EA 2010	316 RL	-	308 RL	-	5.1 Mt	Oct 2019
MOD4	324 RL	8	314 RL	6	6.1 Mt	July 2021

7.3 Consequence Category and Design Criteria

The changes to the pit would convert TSF2 into a structure that is subject to the review and endorsement of the NSW Dam Safety Committee (DSC). The DSC is the authority charged with the responsibility to oversee the safety of dams in NSW.

Both the DSC and the Australian National Committee on Large Dams (ANCOLD) guidelines require dams to be assessed against the consequence of failure. This determines the required parameters to be applied to the design. Based on these guidelines, Golder assessed the consequence category for the TSF extension to be a 'High A' hazard category facility. This is primarily due to the facility's location in the centre of a town invoking the most conservative design criteria presented in the DSC and ANCOLD design guidance.

Design criteria applied by Golder in the design of the TSF Extension is described in detail in **Appendix J**. In summary, the design includes:

- Flood management – spillway design for a probable maximum flood (generally considered to be 1 in a million probability);
- Environmental containment freeboard – designed to a 1:10,000 annual exceedence probability (AEP), 72 hour event;
- Earthquake loading – seismic parameters OBE: 0.12 g, MDE/MCE: 0.2 g;
- Factors of safety for slope stability in line with industry practice for permanent slopes;
- Assessment for potential liquefaction risk of tailings where embankments are over tailings. Embankments 1 and 3 which are partially located over tailings. The required foundations minimum un-drained shear strength of 35 kPa will be confirmed by vane shear and other geotechnical testing prior to construction;
- Installation of 0.5 m high safety bunds;
- Stormwater management on Embankments tied into the site stormwater management system;
- Spillway designed to pass a probable maximum flood and a concurrent wind event freeboard of 1 in 50 AEP events; and
- Tailings beach minimum freeboard of 0.5 m.

Bruce Brown Consulting Pty Ltd conducted an independent peer review of the TSF2 design. A copy of the peer review letter is also provided in **Appendix J(b)**. It should be noted that following this review, the dam break analysis was updated and a High A consequence category was adopted.

7.4 DSC Assessment

The proposed design was endorsed by the DSC in December 2016. A copy of the prescription notice dated 9 December 2016 is provided at **Appendix M.** The notice states that the overall design of the TSF2 extension conforms to the DSC requirements. The TSF2 will be subject to their ongoing inspection and review.

7.5 Construction of Embankments and Retaining Wall

7.5.1 Site Preparation

The majority of the perimeter surrounding the TSF2 consists of bedrock, waste rock and other unknown fill materials. There is some vegetation, which has been planted around the Old Mine Residence No. 27 at Embankment 1 and along the northeast boundary of Embankment 2. Some of this vegetation would be removed, including exotic tree species (6) and planted native trees (5). None of the trees contain hollows.

Embankment 2 and part of Embankment 1 are located on bedrock. The bedrock within the footprint of the embankments would be exposed by stripping the surface material which would be set aside for use later in the construction. The construction of these embankments would occur from the surface of the bedrock following grouting, if any large joints are exposed.

The existing safety bund located along the TSF2 rim edge between Embankment 1 and Embankment 2 may need to be re-constructed / repaired to ensure the 0.5 m freeboard above the tailing surface is maintained.

The existing tension cracks at the edge of the Pit at Embankment 1 would be filled with tailings prior to construction of this embankment. Drainage pipes would also be installed. These minor works would involve the use of a small excavator and roller with manual labour for the placement of the pipes and fill.

Embankments 1 and 3 would be constructed over some tailings as well as weathered bedrock and would require deposition of tailings within each embankment footprint to form a well-drained foundation.

7.5.1.1 Construction Method and Materials

Construction would be progressed in two stages with the construction of Embankment 2 and the spillway forming Stage1 and construction of Embankments 1 and 3 forming Stage 2.

The construction of the embankments would occur sequentially commencing with the construction of Embankment 2 which would also include the construction of a pump platform and an extraction pipe to manage decant water, a Stormwater Collection Pond and the spillway for flood protection.

The construction of Embankments 1 and 3 would follow up to a year later when the tailings reach the required level and strength for embankment placement. This would be confirmed prior to construction by hand operated vane sheer tests which measure the undrained sheer strength of the tailing. This will allow for review of foundation conditions and adjustment to embankment designs if required. This may involve the construction of a pioneering layer comprising compacted rockfill over a geotextile layer.

The retaining wall would be installed with the construction of Embankment 1 which would also include the development of a new unsealed road from the Haul Road around the rear of the Pit to access Embankment 1 from within the Mine site. This will be constructed using an excavator. A 5 m crest would be installed over each Embankment to serve vehicle access.

The embankments would be formed with compacted waste rock (rockfill) excavated during mining operations and currently stored in Kintore Pit. The rockfill would also be used to form a pioneering layer for

raise construction on potentially soft tailing.

There is currently in excess of 700,000 t of material stored in Kintore Pit. The waste rock would be tested prior to use to identify material suitable for use in the construction of the embankments that would minimise any increased risk to community health. The material will be selected to average no more than 0.5% lead.

7.5.1.2 Embankment 1 and Retaining Wall

Embankment 1 and the retaining wall would be constructed as part of Stage 2 of the Project, together with Embankment 3. Embankment 1 and the retaining wall would take approximately 15 weeks to complete. Access to Embankment 1 would be via the newly made unsealed road.

Embankment 1 is located partially over tailings, and can be constructed once the tailings reach an elevation of RL 320 m at the south-east end of the pit and the tailings are sufficiently consolidated and trafficable. A pioneering rockfill layer may be placed over the tailings if indicated by test work during foundation preparation works.

Since the embankment extends across the pit rim and onto tailings large differential settlements are expected to occur across the width and length of the embankment. The embankment is therefore proposed to be lined with a geomembrane liner on the upstream slope with a 250 mm high wrinkle to accommodate potential movement. The liner would be constructed over the upstream face with a sand filter curtain below and would be keyed into the tailing beach at the upstream toe of the slope.

The crest of the embankment would be formed with crushed waste rock (with a maximum particle size of 50 mm). The crest anchor trench for the embankment geomembrane would extend into the layer and would be backfilled with cement stabilized sand. All embankments would include a track-able surface over the crest to provide inspection access and to protect the top of the embankment crest. Safety bunds or bollards would be installed along the sides of the crest as appropriate.

An embankment displacement monitoring beacon would be installed at the crest to monitor deformation and settlement.

The construction of Embankment 1 also includes the installation of a retaining wall on the north-western side of the embankment. This wall would be formed using a basic structure of gabion baskets and is designed to restrict the embankment slope from the edge of an existing retaining wall next to the Old Mine Residence No. 27. The retaining wall would be constructed concurrently with the filling works for the embankment with access to the wall via the progressively filled area of the embankment.

7.5.1.3 Embankment 2, Stormwater Collection Pond and Spillway

Embankment 2

Embankment 2 would be constructed in Stage 1 of the Project and together with the construction of the spillway, would take approximately 25 weeks. Access to Embankments 2 would occur via the current Haul / Mill Road which is a sealed road.

Similarly with Embankment 1, the entire height of the embankment would be constructed followed by works on the upstream face and slope. The rockfill would be tipped at the embankment and spread by dozer. The material would be sprayed with water for moisture conditioning to facilitate compaction and manage dust. Compaction would be by a large (20 or 25 tonne) smooth drum vibrating roller. The rockfill would be compacted in layers of maximum loose thickness of 400 mm (or thinner depending on roller adopted).

The existing ground within the footprint of the embankment would be stripped and surface material, where present, would be removed to expose the bedrock. The construction of the embankment would commence from the surface of the bedrock. The bedrock below the upstream slope may require some treatment to seal defects or significant features or structure in the rock that may potentially be a significant seepage path. Treatment may involve removing loose rock blocks and joint gouge, and filling depressions and potential seepage paths with dental concrete or grout.

The upstream face of the embankment would be covered with a layer of filter sand which would provide a bedding layer for the geomembrane liner on the slope. The toe of the sand layer would include a gravel layer and slotted pipes, with solid walled outlet pipes extending to the downstream toe of the embankment.

The liner would be installed over the sand layer and would be keyed into the existing ground surface using the stripped surface material which has been moisture conditioned and compacted. An anchor trench would be excavated into this material and backfilled with compacted fill after the liner has been installed, or sealed with concrete if there is insufficient surface material available.

The crest of the embankment would be covered by a wearing course constructed from crushed rockfill. The crest anchor trench for the embankment geomembrane will extend into this layer, and be backfilled with cement stabilised sand. A nominal 100 mm thick layer of sand would extend over the upstream crest of the embankment to the edge of the anchor trench to provide a bedding layer over the rockfill for the geomembrane liner.

An embankment displacement monitoring beacon would be installed at the crest to monitor deformation and settlement.

The seepage collection system discharges to sumps fitted with a pump to return the water to the tailings surface. A surface toe drain would be constructed to collect stormwater runoff from the downstream embankment slope which would be directed to the Stormwater Collection Pond.

Stormwater Collection Pond

The Stormwater Collection Pond would be constructed to the north of Embankment 2 to store rainwater from runoff from the outer slope of Embankment 2.

The Stormwater Collection Pond would be excavated into *in situ* materials to form a 1.5 m deep pond for the collection and retention of rainwater runoff from Embankment 2. It is intended to be an evaporation pond similar to the other stormwater control ponds at the Mine. The approximate dimensions of the pond are 30 m × 15 m × 1.5 m deep. For an operating depth of 1 m, this provides capacity for approximately 500 m^3 of water sized to hold a 1 in 100 year 72 hour rainfall event

It would be constructed using an excavator, compactor, water truck and dozer for shaping the pond floor. The Pond would be constructed as part of the construction of Embankment 2 with excavated materials used in the floor of Embankment 2 and encapsulated.

Spillway

The spillway would be excavated into the existing materials at the eastern corner of the Pit and extend across the current Mill / Rail Loadout Road for 40 m. It is not known what materials exist in the area however the indication from aerial photography is that it contains mine waste rock and possibly some slag. The excavation would be formed using a combination of excavator, trucks and dozer operation. The excavated material (approximately 15,000 m^3) would be incorporated into Embankment 2 and encapsulated as the Embankment is constructed.

Once the excavation is completed rock would be placed over the area on each side of the road for erosion control. This material would be sourced from Kintore Pit and would be delivered to the spillway in haul trucks and dumped whre a layer would be formed using an excavator and dozer.

The spillway will include a concrete sill beam excavated into the weathered near-surface rock and would be formed at the same time as the rest of the spillway works.

The access road would be re-instated across the spillway, as part of the spillway construction. The spillway would include a concrete apron, which would be the access road surface, plus a concrete sill beam. The sill beam would be excavated into the ground to extend down to intact bedrock to form a seepage cut-off wall at the spillway.

The spillway chute would be lined with cobbles and boulders to provide erosion protection and the end of the chute includes an energy dissipation apron again formed with cobbles and boulders.

7.5.1.4 Embankment 3

Embankment 3 would be constructed along with Embankment 1 during Stage 2 of construction and would take approximately 16 weeks to complete. Embankment 1 and 3 would be constructed sequentially with the

sequence determined during Stage 1 construction. Access to Embankment 3 is via the sealed Haul / Mill Road.

Embankment 3 would be constructed similarly to Embankment 1 and can commence when the tailings have achieved the correct elevations and required strength. Most of the southern half of Embankment 3 would be constructed over future tailing beach while the northern half would generally be founded on the existing pit rim ground surface. The embankment height is generally 5.2 m high above the future tailing elevation.

The embankment would be lined with a geomembrane liner similar to the other embankments and would include a sand filter curtain below the geomembrane liner. Where the embankment is over tailing the geomembrane liner would be keyed into the tailing and similarly to Embankment 1 where the embankment abuts the Pit slope the liner would be joined to the Pit slope with a 250 mm high wrinkle to accommodate the potential differential settlement.

Where the embankment extends over existing ground, the ground conditions will be assessed during construction to decide whether the geomembrane liner is to be sealed against bedrock or whether the geomembrane liner should be anchored in an anchor trench excavated into the existing ground. The thickness of tailing to be stored against the northern length of the embankment is generally less than 2 m with no water ponding due to the tailing beach grading down to the north east. The hydraulic gradient at the geomembrane anchor trench is therefore minor.

The design also includes a seepage collection system at the toe of the filter curtain to further minimise potential seepage through the embankment. The seepage collection system discharges to a sump and is pumped back to the surface of the tailings or to the Processing Plant for reuse.

A surface drain would be constructed to collect stormwater runoff from the downstream embankment slope. The drain would discharge to the existing site stormwater management system and report to the Process Water Pond.

An embankment displacement monitoring beacon would be installed at the crest to monitor deformation and settlement.

7.5.2 Summary of Construction Materials

Table 7-3 provides a summary of the volume of materials to be used in the construction of the embankments and retaining wall.

Table 7-3 Estimated Construction Materials for Embankments, Retaining Wall and Spillway

Materials		EMB1	EMB2	EMB3	Retaining Wall	Spillway
Mine waste rock to 200 mm	m^3	14,300	29,000	20,500	-	-
Preparation of embankment footprint	m^3	2,500	2,000	-	-	15,000
Geotextile over tailings footprint	m^2	1,000	-	5,300	-	-
Placement of filter sand	m^3	1,200	2,200	2,100	-	-
Construction of sloping liner	m^2	2,300	4,500	4,100	-	-
Toe and sides anchorage of liner	m	180	450	400	-	-
Crest anchor trench	m	150	400	350	-	-
Crushed rock crest layer to 50 mm	m^3	750	2,000	2000	-	-
Concrete	m^3	308	308	119	-	70
Select rockfill to 100 mm	m^3	-	-	-	50	-
Select rockfill 300 - 500 mm	m^3	-	-	-	-	900

Liners would be sourced from either within Australia or overseas and would be transported to site via road as part of normal delivery supplies.

7.5.3 Summary of Construction Equipment

Construction of the embankments will require earth moving equipment such as an excavator, bull dozer and front end loader. The material placed on the inner side of the embankments would be compacted using smooth drum vibrating rollers. A forklift would be used to lift and place liner rolls. Two water trucks would also be used throughout the construction process. In summary, it is expected the following equipment would be utilised:

- Excavator;
- Dozer;
- Drum vibrating rollers;
- Forklift;
- Dump trucks for waste rock delivery;
- Water trucks;
- Agi trucks for concrete delivery; and
- Crusher and screen (located in Kintore Pit).

7.6 Truck Movements

There would be an increase in the number of internal truck movements on the Haul Road and Mill / Rail Loadout Road during construction occurring. This is a sealed road. Normal operations would continue during the construction period. A Construction Traffic Management Plan would be prepared to facilitate safe trucking movements during construction, while maintaining current mining operations.

Table 7-4 provides a summary of the number of truck movements for construction of the embankments, spillway and retaining wall at TSF2. These vehicle movements would occur over the approximate 14-month construction period, averaging an additional 15 to 20 return trips per day to normal site operating traffic.

Table 7-4 Summary of On-Site Truck Movements TSF2 Construction Period

Material	Vehicle	EMB1 Return Trips	EMB2 Return Trips	EMB3 Return Trips	Spillway
Waste rock max size 200m, 13m^3 per truck load	50 t truck	1100	2231	1577	
Waste rock max size 50 mm, 13m^3 per truck load	50 t truck	177	154	154	
Waste rock for chute size 300-500 mm 13m^3 per truck load	50 t truck	-	-	-	69
Filter sand, 8m^3 per truck load	35 t truck	150	275	263	
Concrete, 7m^3 per truck load	Agi truck	44	44	17	10
Excavated material15,000 m^3 per truck load	50 t truck	-	-	-	1000

Note – Refer **Figure 6-3** for transport routes.

7.7 Description of Operation

No changes are expected to the current general operations of the TSF2, which are described in the BHOP Tailings Maintenance and Operations Manual (TMOM). The TMOM would be reviewed and updated in line with this Modification, if approved.

As the TSF2 approaches completion, tailings deposition would be required from the Embankment 2 crest to manage the decant pond location and ensure the freeboard requirements are achieved. There would also be additional requirements for inspections and monitoring of the TSF2, and procedures for dust control management. These procedures will be incorporated into the updated TMOM.

In addition further inspections and engineering audits reportable to the DSC, will be conducted over the life of the facility and again these will be detailed in the updated TMOM.

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8.0 ALTERNATIVES CONSIDERED

This Section outlines the alternative locations for the CBP and the reasons for selection of the proposed location. It also discusses alternative strategies for tailings deposition.

8.1 Alternative Locations and Preferred Option for Concrete Batching Plant

Three locations within CML7 boundary were considered for the location of the CBP. The following identifies those locations, outlines their advantages and disadvantages, and provides justification for the preferred location.

8.1.1 Option 1 - BHP Pit

BHP Pit is centrally located with access via the Mine Haul Road. There is a level surface area and the CBP could be located 30 m below current surface. This would assist in mitigating potential noise impacts.

During investigation and inspection of this site it was found that:

- It does not provide sufficient room to turn around road trains delivering aggregate. To accommodate these vehicles the area in the northeast corner would require filling with approximately 30,000 m^3 of material and compaction. The filling of BHP Pit would result in the burying of several heritage items in the area, which are listed heritage items that are thought to be remnants from the BHP mining era (Items I305 building foundations and I306 concrete pillars listed on the BHCC LEP 2013).
- BHP Pit is currently used for other activities e.g. explosives magazine, a low grade ore stock pile. Further traffic operating in the area would result in congestion and possible safety risk.
- The BHP Pit is located directly on strike of Main Lode ore body and future underground mining may occur in the vicinity of this area. This may result in the need to relocated the CBP in the future, which is undesirable.

For these reasons locating the CBP at the BHP Pit was not considered viable.

8.1.2 Option 2 - Little Kintore Pit

Little Kintore Pit is located to the south-west of the site, adjacent to Kintore Pit and within 100 m of Broken Hill South residents. The pit is approximately 15 m in depth. This option was considered as the pit would provide noise buffering to the operations of the CBP and it is close to Kintore Pit access road.

During investigation and inspection it was found that:

- There is insufficient room at the base of the pit to turn around heavy vehicles delivering aggregate and cement.
- An access ramp would need to be constructed which would be costly to construct and would require a large proportion of the pit area.
- There were no services located in the vicinity of the pit.

For these reasons locating the CBP at Little Kintore Pit was not considered viable.

8.1.3 Option 3 – Adjacent Backfill Plant

The Backfill Plant is located in the central north of the site, and is abutted by a large level area (4,500 m^2) on already disturbed land. which would be sufficient space for delivery trucks to turn around. The Indian Pacific rail line and Broken Hill rail yards separate this area from the nearest neighbours, located 348 m to the north. The Mt Hebbard historic tailings storage facility separates the site from Broken Hill residents to the south.

The route of the delivery vehicles would require minimal crossover onto the main Haul Road and there is a short distance to the Mine Portal. The area would require minimal earthworks and services (power and water) are already in place at the site.

However, the area adjacent to Backfill Plant is situated in an elevated position and has the potential for exposure to residential and commercial areas of Broken Hill to the north. Citing of the CBP in this location would require additional noise control measures (as described in **Section 10.1**).

8.1.4 Concrete Batching Plant – Alternative Analysis

Table 8-1 provides a summary of the alternative options. The preferred option is Option 3 – Adjacent Backfill Plant.

Table 8-1 Alternative Analysis for Location of CBP

	Option 1 BHP Pit	Option 2 Little Kintore Pit	Option 3 Adjacent Backfill Plant
Available Area (m^2)	5,000	3,000	4,500
Earthworks required (m^3)	30,000	10,000	5,000
Available Services	Power, no water	No services	Power, water

Locating the CBP adjacent to the Backfill Plant was chosen as the preferred option. This site provides sufficient space, requires minimal earthworks and already has available services. It is also located several hundred meters away from residences to the north. It is therefore considered the most appropriate site from an economic, operational and environmental perspective.

8.2 Alternatives and Preferred Option for Tailings Deposition

A number of locations within CML7 boundary were considered for tailings deposition and storage. The following identifies the options, outlines their advantages and disadvantages, and provides a preferred location.

8.2.1 Option 1 - Utilising TSF1

Option 1 considers the possibility of utilising TSF1 for future tailings deposition. Golder considered this option in 2010 and designed and costed a two-stage lift to extend the life of the historic tailings storage facility (TSF1), which was a continuation of the Mt Hebbard TSF. The historic TSF1 was proposed to be raised from its current 322 mRL by 10 m to 332 mRL, with waste rock as the embankment material. The design included the construction of a 6 m high starter embankment followed by a subsequent 4 m high raise. The proposed capacity volume for this two-stage lift was 970,000 t, which would provide additional tailings storage life of 1.7 years. The construction costs of the TSF1 upgrade was estimated at $7.196M (2010 dollars).

This option would not achieve the desired tailings storage life at a reasonable cost.

8.2.2 Option 2 - Utilise BHP Pit

Option 2 considers the possibility of utilising the existing BHP Pit for future tailings deposition. During investigation of this option it was found that:

- The existing BHP Pit only has the capacity to hold approximately 560,000 m^3 of tailings, equating to a tailings storage life of less than 1 year.
- The filling of BHP Pit would result in the burying of several listed heritage items in the area, which are thought to be remnants from the BHP mining era (I304 stone wall, I305 building foundations, I306 concrete pillars, and 308 timber chute race listed in the BHCC LEP 2013).
- The explosives magazine, currently housed in BHP Pit, would require relocation.
- The BHP Pit is located directly on strike of Main Lode ore body and future underground mining may occur in the vicinity of this area. Utilising the BHP Pit for tailings deposition would result in sterilisation of ore in its vicinity.
- Safety issues in locating a tailings facility above underground workings.

Therefore, due to the limited storage capacity, existing activities within the pit and potential sterilization of ore resources, deposition of tailings in the BHP Pit was not considered the preferred option.

8.2.3 Option 3 - Utilise Kintore Pit

Option 3 considered the possibility of utilising Kintore Pit for future tailings deposition. Kintore Pit is a large pit approximately 75 m deep and 450 m long and 220 m wide. Kintore Pit would provide a capacity of approximately 5.2 Mm^3 and an estimated life of 10 years.

However, the portal to underground mine workings is located at the floor of the Kintore Pit and the haul road extends out of the pit to the run-of-mine pad. Utilising this facility would require a new portal to be established with an access decline. This pit is also used to store waste rock from underground workings and currently holds in excess of 700,000 t of this material. The waste rock would need to be relocated to provide the capacity to use this pit as a tailings storage facility.

In addition, a tailings facility located directly over an underground mining operation can pose a safety risk given the location of underground workings and the potential for a tailings run. The Kintore Pit contains numerous undefined openings connecting it to underground workings that would be difficult to manage from a safety point of view.

Therefore, due to the costs of relocating the portal and stored waste rock, and the safety concerns outline above, deposition of tailings in the BHP Pit was not considered the preferred option.

8.2.4 Option 4 - Store Tailings Underground

Option 4 considers the possibility of storing tailings underground as this would be less costly if sufficient large underground voids could be identified. An investigation was undertaken to place tailings in voids in old shafts (not current stopes) that would not compromise future mining or effect current mining. This investigation found that there are currently no opportunities for underground storage that would not result in some sterilisation of the resource.

As discussed in detail in **Section 1.2.2**, the need to undertake more underground mining development than anticipated has reduced the capacity of underground voids to accept both waste rock and tailings material from the Backfill Plant. In the original EA it was predicted that approximately 250,000 t of waste rock would be produced each year for a production rate of 750,000 t of ore. This has since increased to over 400,000 t averaged per year for an average production rate per year of 650,000 t of ore. BHOP has chosen to place the additional waste rock underground to fill voids and stopes, as it is more economic to dispose of waste rock underground if possible rather than transporting waste to the surface. This has meant that there is no void space underground for the backfill of tailings.

BHOP will continue to assess the possibility of underground placement of tailings (Option 4) at regular intervals during the life of the Mine.

8.2.5 Option 5 - Locate New Tailings Storage Facility

Option 5 considers the possibility of locating an off-site facility for tailings deposition that would provide storage for the life of mine. This would require locating a suitable site, obtaining rights to the land via a new mining lease, obtaining appropriate approvals and designing and constructing the facility and infrastructure for tailings transfer. This would involve consultation and negotiation with community stakeholders and government agencies.

It was concluded that these works could not be undertaken in time to place tailings prior to the existing TSF2 reaching capacity. This option will be assessed further in future.

8.2.6 Option 6 - Extension to TSF2

This option extends the capacity and life of the current tailings storage facility at TSF2 by filling in walls at three low points located around its perimeter. Details for this option are outlined in **Section 5**. This option was considered the most preferred option and is assessed as part of this EA.

8.2.7 Tailings Deposition Alternative Analysis

Table 8-2 provides a summary of the alternative options. The preferred option is Option 6 – Extension to Blackwood Pit (TSF2).

Table 8-2 Cost Benefit Analysis for Tailings Placement

	Option 1 Utilising TSF1	Option 2 BHP Pit	Option 3 Kintore Pit	Option 4 Under/ Ground Voids	Option 5 Off-site Storage	Option 6 Extension to TSF2
Cost ($M)	7.2	Not practical so not costed.	20	None available	Depending on capacity	3.5
Capacity (t)	970,000	560,000	5,200,000	None available	Capacity as required	1,000,000
Additional Life (years)	1.7	0.9	10	None available	Depending on capacity	1.75

Extending the capacity and life of the current tailings storage facility at Blackwood Pit (TSF2) was chosen as the preferred option. This option is the most cost effective and would result in sufficient additional tailings storage for almost 2 years. This would allow sufficient time for future storage arrangement to be made.

8.2.8 No MOD4 Project

Failure to install the CBP and commence on site concrete batching would result in an opportunity cost ($900Kpa) to the business reducing profits and impacting the viability of the Mine.

Failure to extend the tailings storage facility would result in the cessation of operations and the closure of the Mine in October 2019, as there would be nowhere to economically deposit tailings material.

8.3 Life of Mine Tailings Strategy

BHOP is in the process of preparing a future life of mine tailings storage strategy. The company is currently preparing tendering documentation to out-source this work. This strategy will consider both on and off site placement of tailings and will be completed by the end of 2017. This will allow sufficient time for project approval and construction of the new facility prior to the decommissioning of TSF2, which is forecast for mid-2021. This process will involve ongoing consultation with relevant regulators.

9.0 ENVIRONMENTAL ASSESSMENT

This Section describes the environmental risk assessment process and summarises the key potential environmental issues for the proposed Modification.

9.1 Environmental Risk Review

A number of reviews were undertaken internally by BHOP to identify the potential environmental impacts that could result from the proposed Modification. A summary of these was included in documentation distributed to government agencies for consultation. The information has now been updated during the development of the proposed Modification.

Participation in these reviews included relevant personnel to provide an appropriate mix of skills and experience to identify the potential scenarios / issues and the controls to be applied. **Table 9-1** details the team members[3] and their relevant qualifications and experience. The key focus was to identify hazards (underlying threats / causes) and the measures to control these hazards.

Table 9-1 Risk Review Team Members

Name	Organisation / Role	Experience & Qualifications
Rob Williamson	BHOP / General Manager	18 years, B Eng First Class Mine Manager Certificate
Costa Papadopoulos	BHOP / HSE Manager	27 years
Visko Sulicich	CBH / Chief Operations Officer	37 years, B Eng Mining Mine Manager Certificate
Brett Anderson	BHOP / Mining Manager	27 years, B Eng Mining Mine Manager Certificate
Ian Pattison	CBH / Group Manager - Metallurgy	30 years, BSc (Hons) 1st class, PhD (Mining), Member AusIMM
Andrew McCallum	BHOP / Metallurgy Superintendent	15 years, B App Science (Hon) - Metallurgy
Gwen Wilson	CBH / Group Manager - SHEC	32 years, BCom, Grad Dip Hazard Management
Len Sharp	BHOP / Environment & Community Liaison Officer	12 years, BEnv Sc
Rick Muller	BHOP / Environment & Community Liaison Officer	9 years, B Sc Biodiversity and Conservation

Table 9-2 provides a summary of the results of these reviews, including identification of the key environment issues relevant to the proposed Modification that require further assessment. Issues identified as requiring further assessment are addressed in more detail in **Section 10.0**.

[3] It should be noted that several risk reviews were undertaken over a period of time. Not all team members were present at every review.

Table 9-2 Review of Environment Issues

Environmental Issue	Relevance	Key Issue
Noise - construction	**CBP and TSF2 Extension:** Noise would be generated during construction from earthworks, installation of foundations, erection of plant and on-site road traffic.	Yes
Noise - operations	**CBP:** Noise would be generated during the operations of the CBP from the plant operation and from on-site road traffic. There would be additional on-site road traffic with concrete deliveries from the rail siding to the CBP, aggregate deliveries and fibrecrete from the CBP to the Mine Portal. There would be little change to public road traffic with a decrease in cement deliveries. **TSF2 Extension:** There would be no additional noise anticipated during operations of this facility.	Yes No
Embankment / Wall Failure	**TSF2 Extension:** An embankment or retaining wall failure may occur from a seismic event, flooding or from poor design and construction.	Yes
Air Quality - construction	**CBP:** Dust would be generated during construction from earthworks, installation of foundations and on-site road traffic, it is anticipated this would be minimal. (Assessment has been included in air quality modeling **TSF2 Extension:** Dust would be generated during construction from earthworks, materials loading/unloading and placement, and on-site road traffic.	No Yes
Air Quality - operations	**CBP:** Dust may be generated from vehicle traffic and aggregate loading/unloading to storage point, dumping aggregate into hopper, and mixing of materials. **TSF2 Extension:** Some drying of tailings may occur as the deposition heads towards decommissioning and the level of tailings rises closer to the surface, as per original EA and discussion.	Yes Yes
Community Health	**CBP:** No risks identified. **TSF2 Extension:** It is anticipated that construction works would take a maximum of 14 months and no additional health impacts related to construction are anticipated. There would be no additional health impacts anticipated during operation to the current operation of this facility. However given the significance of this issue a detailed review would be undertaken.	No Yes
Water - Supply	**CBP:** The operation of the CBP would utilise some raw water (1164 m^3) however as there has been a reduction in raw water use since the original EA (288 ML predicted per annum down to an average usage rate of 260 ML per annum) no additional raw water would be required to that outlined in the EA. **TSF2 Extension:** Construction would use some raw water for compaction and dust suppression. It is not anticipated that the level of raw water usage outlined in the original EA would be exceeded. The use of water sprays and the water truck for dust suppression was included in the original EA.	No No
Water - Seepage	**TSF2 Extension:** Seepage may occur from embankments and drainage.	Yes
Water –	**CBP:**	No

Environmental Issue	Relevance	Key Issue
Stormwater	Stormwater at the CBP would be collected and directed to the current stormwater management system. **TSF2 Extension:** Stormwater runoff would occur on embankments and post usage on the surface of TSF2.	Yes
Heritage	**CBP:** There are no heritage items in the vicinity of the proposed location of the CBP. **TSF2 Extension:** British Flats, located adjacent to the Pit, is a heritage listed building on the BHCC LEP, an Old Mine Residence No. 27 which is not heritage listed is also located adjacent to the pit.	No Yes
Ecology	**CBP:** No vegetation is required to be removed. **TSF2 Extension:** Isolated trees adjacent to the old mining residence and pit perimeter at Embankments 1 & 2 would require removal. This would include eleven trees, 5 native Western Red Box *Eucalyptus intertexta* and 6 exotic, Peppercorn *Schinus molle*. None of the trees were identified to contain hollows for fauna.	No No
Visual Amenity	**CBP:** There would be some impact on visual aspect from the surrounding City if Broken Hill and the café located on CML7. **TSF2 Extension:** There would be some impact on the visual aspect from the Crystal Street, Federation Way and Menindee Road. However this would be in keeping with the current mining profile of CML7.	Yes Yes
Traffic & Transport	**CBP:** There would be a number of changes to traffic and transport movements (increases on-site, decreases off-site). There would be some changes to surface activities with concrete deliveries from the rail siding to the CBP and fibrecrete to the Mine Portal. **TSF2 Extension:** There would be increased vehicle movements during construction, in particular to collect and deposit waste rock materials. There would be no additional vehicle movements for normal operations.	Yes Yes
Waste Management	**CBP:** Waste water would be generated by the batching process and collected in a sump for reuse. Sludge would be removed periodically and disposed in underground voids or in the tailing storage facility. There would be no significant wastes generated from the CBP, apart from packaging materials. These materials would be managed through the current Waste Management Plan. **TSF2 Extension:** There would be no change to wastes generated.	No No
Rehabilitation	**CBP:** The CBP would be located in an area that is already highly disturbed and has been included in the original EA. Rehabilitation would be consistent with the existing EA. **TSF2 Extension:** The surrounding area of the TSP2 is already highly disturbed. However individual trees vegetation may be required to be removed. Rehabilitation would need to consider long-term safety, stability, seepage management, erosion and sedimentation and aesthetics with the surrounding areas.	No Yes

9.2 Risk Assessment Process

BHOP conducted a risk assessment of the key environmental risks as identified and outlined in **Table 9-2**. Risk rankings were conducted for the most serious potential risks using the BHOP risk assessment tools (refer **Tables 9-3 to 9-5**).

Table 9-3 Rasp Mine Severity Consequence Table

	Safety	Environment	Community/Reputation	Operations
Catastrophic	• Fatality • Permanent disability • Serious injury, loss of limb • Prosecution or litigation	• Fatality of a person • Devastation to large area of land • Severely health effects or death or severe impact to protected flora and fauna or their habitat • Prosecution or litigation	• Community complaint impacts State/National level • Destruction of cultural items of significance • Complaint causes cessation of operations > 1 week	• Downtime of critical equipment > 1 week • Potential loss / property damage > $200,000
Major	• Lost time injury • Disabling injury > 4 days • Serious breach of safety regulations (breach of Golden Rules)	• Recorded health effect to people • Impact on protected fauna, flora • Emission/discharge exceeding legal guideline and requires government reporting • Loss of containment of substance (on site) >200L	• Community complaint impacts State level • Permanent damage to cultural items of significance • Prosecution/Litigation • Complaint causes cessation of operations < 1 week	• Downtime of critical equipment > 1 shift < 1 week • Potential loss / property damage > $50,000 < $200,000
Significant	• Requires government reporting • Medical treatment eg stitches, etc	• Any loss of containment off site to private or State property, road, waterway, etc • Loss of containment of substance (on site) 50 – 200L • Requires government reporting	• Community complaint impacts Council level • Damage to items of significance • Community relations affects ability to obtain environmental licence/approval	• Production loss > 4 hours < 12 hours • Potential loss / property damage > $10,000 < $50,000 • Theft on site requires police involvement
Moderate	• First aid treatment	• Loss of containment of substance (on site) 20 – 50L • Non-compliance with internal environmental target • Concern by local community re environmental matter	• Local complaint resolved and has future impact • Minor infringement of cultural heritage	• Production loss > 1 hour < 4 hours • Potential loss / property damage > $2,000 < $10,000
Minor	• Reported injury, no first aid required	• Loss of containment of substance (on site) <20L.	• Local complaint resolved	• Production loss < 1 hour • Potential loss / property damage < $2,000 • Theft on site no police involvement

Shaded areas are serious potential incidents (SPIs).

Table 9-4 Rasp Mine Likelihood Definitions

Likelihood	Definition
Almost Certain	Is expected to occur almost every time the task is completed. Occurs once per week.
Likely	Is likely to occur on a regular basis. Occurs once per month.
Possible	Would expect this to occur every now and then. Occurs once per year.
Unlikely	Would not expect this to occur too often. Occurs once every five years.
Rare	Not likely to occur unless under exceptional circumstances.

Table 9-5 Rasp Mine Risk Ranking Matrix

Likelihood	Consequence				
	Minor	Moderate	Significant	Major	Catastrophic
Almost Certain	11	16	20	23	25
Likely	7	12	17	21	24
Possible	4	8	13	18	22
Unlikely	2	5	9	14	19
Rare	1	3	6	10	15
	1-5 Low Risk		6-17 Medium		18-25 High Risk

9.3 Key Potential Environmental Risk Assessment Results

The key environmental issues identified during the risk review and consultation were assessed using the BHOP risk assessment tools and are summarized in **Table 9-6** below. Mitigation measures identified as a result of this risk assessment are discussed in detail in **Section 10** of this EA.

***Table 9-6* Key Potential Environment Issues**

Potential Key Environmental Issues	Risk Ranking	EA Reference
Noise, from earthworks, plant construction and on-site road traffic.	Medium - 12	Section 10.1
Noise, from operation of CBP.	Medium - 17	Section 10.1
Embankment and/or retaining wall failure at TSF2.	Medium - 15	Section 10.4
Air Quality, lead bearing dust generated during construction from earthworks and on-site road traffic.	Low - 5	Section 10.2
Air Quality, general dust during construction from earthworks and on-site road traffic.	Medium - 8	Section 10.2
Air Quality, dust generated from vehicle traffic, aggregate loading / unloading, dumping aggregate into hopper, and mixing of materials (CBP only).	Low -3	Section 10.2
Community Health, lead bearing dust generated from construction activities for the TSF extension.	Low -1	Section 10.3
Water – Seepage, Seepage may occur from TSF2 embankments and drainage.	Medium - 13	Section 10.5
Water – Stormwater runoff will occur on embankments and on the surface of the TSF both during operations and post usage.	Medium - 9	Section 10.6
Heritage, loss/damage to heritage structures.	Medium - 12	Section 10.7
Visual Amenity, impact on visual aspect from the CBP, TSF2 Embankments 1 &	Low - 4	Section 10.8

Potential Key Environmental Issues	Risk Ranking	EA Reference
2 and Retaining Wall.		
Traffic & Transport, changes to internal vehicle traffic - CBP.	Low - 2	Section 10.9
Traffic & Transport, changes to internal vehicle traffic TSF2 construction.	Medium - 8	Section 10.9
Rehabilitation, increase in the disturbance footprint (0.2 Ha), long term stability.	Medium - 7	Section 10.10

10.0 ENVIRONMENTAL RISKS AND MANAGEMENT

This section outlines impacts identified in relation to the Modification and provides management and mitigation measures to be implemented by BHOP.

10.1 Noise

EMM Consulting Pty Ltd (EMM) completed a noise impact assessment, *Rasp Mine Modification 4 Concrete Batching Plant and TSF2 (Blackwood Pit) Extension Noise impact assessment,* December 2016 (NIA) (**Appendix H**) for the construction and operation of a CBP and the construction of the embankments at TSF2. The NIA included a:

- cumulative assessment of all construction works with current operations;
- cumulative assessment of the operations of the CBP with current operations; and
- qualitative assessment of the potential cumulative impacts with Perilya's proposed Broken Hill North Mine Recommencement Project.

No additional noise impacts are expected from the operation of tailings deposition.

EMM compared the noise criteria (**Table 10-1**) as outlined in the Project Approval and EPL (adjusted for appropriate noise management levels) with the predicted levels for construction and future operations. The assessment also considered the potential impact of intermittent noise on sleep disturbance using the INP Application Notes level for suitable screening criteria and the World Health Organisation (WHO) *Guidelines for Community Noise* (1999). These criteria are also listed in **Table 10-1,** together with construction noise management levels (NMLs), which EMM derived in accordance with the *Interim Construction Noise Guideline* (ICNG).

Quantitative modelling was completed against acoustically significant plant and equipment items to determine noise impacts of construction works for the TSF2 extension and CBP operations. Both were assessed cumulatively with current operations as this was considered representative of the potential worst-case scenarios. Assessment locations were those identified in the PPR and are depicted on **Figure 10-1**.

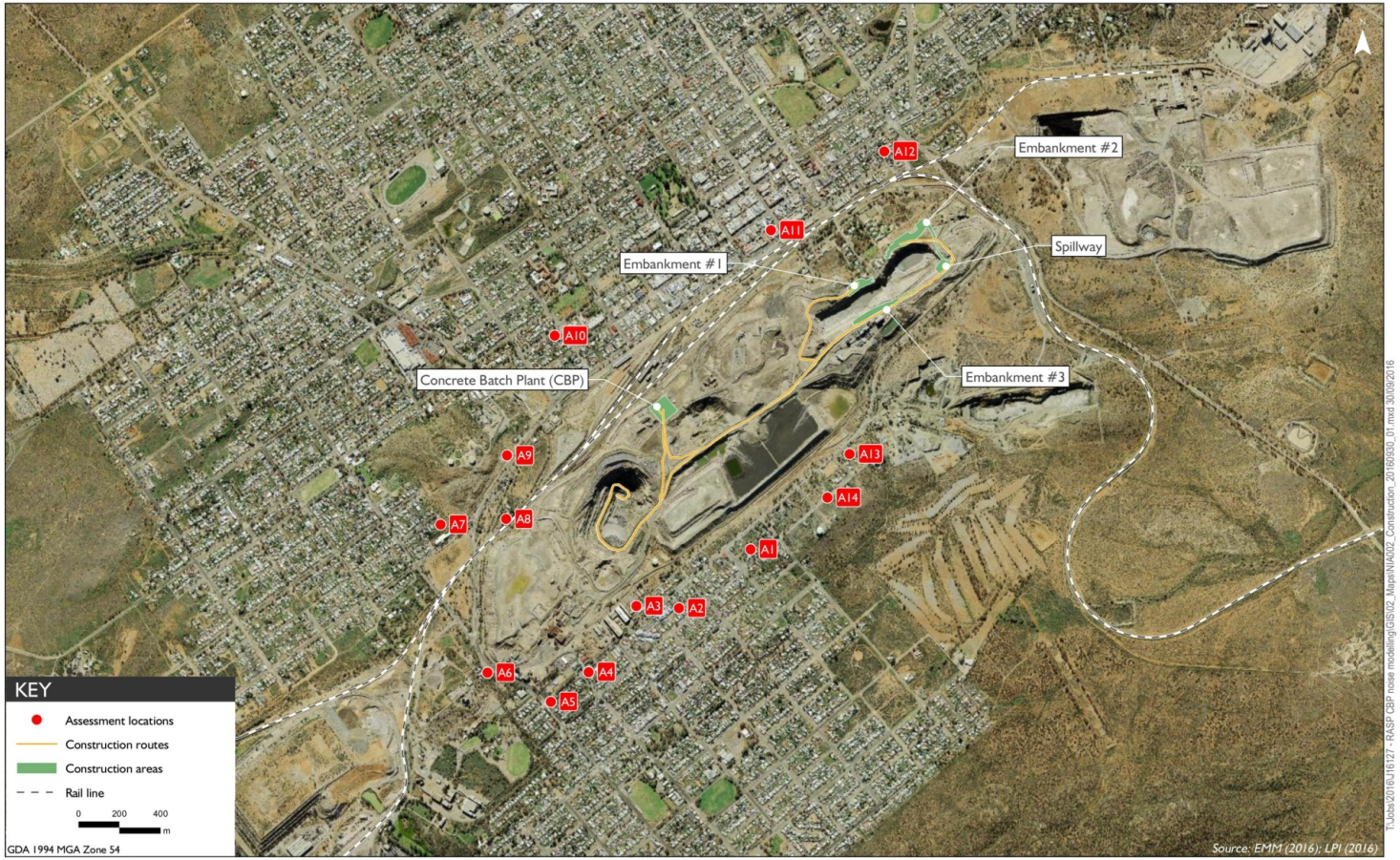
10.1.1 Impact Assessment - Noise – Construction

Noise would be generated during construction and installation of the CBP from earthworks, installation of foundations, erection of plant and on-site road traffic. Noise would be generated during construction of the TSF embankments from earthworks, mobile equipment, crushing activities and on-site road traffic. Details of modeled sound power levels for acoustically significant plant and equipment and construction activities can be found in the NIA.

A number of scenarios were assessed to identify construction works that would result in worst-case noise levels at off-site locations, incorporating noise sources from both construction activities as well as current operations. The operation of the CBP was included in background noise levels for the assessment of TSF2 construction noise impacts as this would be operational at the time.

Modelling results are provided in **Table 10-2** and show that site noise from standard hours construction works is predicted to satisfy the ICNG NMLs at most assessment locations. The exceptions were locations A12, A13 and A14 during construction of the TSF embankments and spillway. Noise predicted to be generated during construction activities associated the CBP would be lower than the applicable criteria.

Figure 10-1 Noise Assessment Locations



Location of proposed construction works

RASP Mine Modification 4
Noise Impact Assessment
Figure 2.1

Table 10-1 Rasp Mine Noise Criteria

ID	Location	Back Ground Levels dB(A)	Operational noise criteria $L_{Aeq(15\text{-}min)}$, dB			Sleep disturbance		Construction NML, $L_{Aeq(15\text{-}min)}$, dB RBL + 10 dB
						Screening criteria L_{Amax}, dB	WHO guideline L_{Amax}, dB	
			Day[1]	Evening[2]	Night[3]	Night[3]	Night[3]	Day[4]
A1	Piper St North	33	38	37	35	45	52	43
A2	Piper St Central	33	38	37	35	45	52	43
A3	Eyre St North	39	44	41	39	49	52	49
A4	Eyre St Central	39	44	41	39	49	52	49
A5	Eyre St South	39	44	41	39	49	52	49
A6	Bonanza and Gypsum Sts	43	48	41	39	49	52	53
A7	Carbon St	30	35	35	35	45	52	40
A8	South Rd	43	48	39	39	49	52	53
A9	Crystal St	41	46	39	39	49	52	51
A10	Garnet and Blende Sts	37	42	41	35	45	52	47
A11	Crystal St	41	46	39	39	49	52	51
A12	Crystal St	41	46	39	39	49	52	51
A13	419 Eyre St	33	38	35	35	45	52	43
A14	Piper St North	30	35	35	35	45	52	40

Notes:
1. Day period: Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
2. Evening period: Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
3. Night period: Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.
4. Construction hours: Monday – Friday: 7 am to 6 pm, on Saturdays: 8am to 1pm, on Sundays and Public Holidays no works.

The predicted increases above the ICNG NMLs were at three (3) assessment locations - including a 1 dB(A) exceedance at A13, a 3dB(A) exceedance at A12 and exceedances of between 2-4 dB(A) at A14 - during the construction of the TSF embankments and the spillway. The major contributing noise sources were dozer operations and truck movements.

EMM noted that a 2 dB change in noise levels is generally not perceptible by the human ear and therefore noise impacts at location A13 from the construction of Embankment 3, is unlikely. EMM also noted that previous attended noise monitoring completed for the Mine at location A12 has shown that daytime ambient noise levels at this location are generally elevated due to frequent traffic movements and industrial noise in the area which would mask some of the noise from the proposed construction works. Ambient noise of 54 dB to 57 dB $L_{Aeq,15min}$ are typical measured levels and are therefore similar to or higher than the worst case predicted construction noise levels presented in **Table 10-2**.

Location A14 is affected by the construction of each of the embankments and the spillway. It is in an elevated location with low background noise levels resulting in the lowest of the ICNG criteria (40 dB). This compares to 43 dB at location A13 and 51 dB at location A12. High intermittent noise levels can occur at locations A13 and A14 given their close proximity to the Quarry.

EMM noted that the modelled construction works represent worst-case scenarios for each relevant activity and therefore are considered worst-case for the duration of the relevant activity. It is anticipated that noise levels from the proposed construction works would be at times lower than the predicted levels shown in **Table 10-2**.

EMM recommended that feasible and reasonable mitigation measures be implemented during construction works associated with the extension of the TSF2.

Table 10-2 Cumulative Noise Results

Assessment location ID	Day ICNG Criteria $L_{Aeq(15\text{-}min)}$, dB	Predicted combined operational and construction noise levels, $L_{Aeq(15\text{-}min)}$, dB									
		CBP[1]		Embankment 2[2]		Spillway[2]		Embankment 3[2]		Embankment 1[2]	
		Predicted level	Level above NML, dB	Predicted level	Level above NML, dB	Predicted level	Level above NML, dB	Predicted level	Level above NML, dB	Predicted level	Level above NML, dB
A1	43	37	Nil	41	Nil	41	Nil	41	Nil	41	Nil
A2	43	36	Nil	39	Nil	39	Nil	40	Nil	40	Nil
A3	49	40	Nil	42	Nil	42	Nil	42	Nil	42	Nil
A4	49	37	Nil	42	Nil	42	Nil	42	Nil	42	Nil
A5	49	37	Nil	38	Nil	38	Nil	39	Nil	39	Nil
A6	53	35	Nil	36	Nil	36	Nil	36	Nil	36	Nil
A7	40	38	Nil	38	Nil	38	Nil	38	Nil	38	Nil
A8	53	39	Nil	40	Nil	39	Nil	40	Nil	40	Nil
A9	51	40	Nil	40	Nil	40	Nil	40	Nil	40	Nil
A10	47	38	Nil	40	Nil	39	Nil	39	Nil	39	Nil
A11	51	38	Nil	47	Nil	43	Nil	45	Nil	49	Nil
A12	51	39	Nil	**54**	3	46	Nil	46	Nil	49	Nil
A13	43	35	Nil	43	Nil	43	Nil	**44**	1	43	Nil
A14	40	36	Nil	**43**	3	**42**	2	**44**	4	**43**	3

Notes: *1. Predicted in combination with existing RASP Mine noise levels.*

2. Predicted in combination with existing RASP Mine noise levels and CBP operational noise levels.

10.1.2 Mitigation Measures and Management

EMM reviewed a number of management and mitigation measures for consideration by BHOP for construction noise, however none were deemed to be both feasible and reasonable and therefore could not be justified given the required economic outlay, the short duration of the project works and the benefit to be gained.

The noise abatement bund constructed along the Haul Road to the Rom Pad would provide some mitigation for truck noise levels to South Broken Hill residents.

Specific detailed noise management and mitigation measures would be reviewed with the contractor once the construction activities for each task are clearly defined. Management and mitigation measures may include some or all of the following:

- Adoption of ICNG recommended standard hours for normal construction work which are Monday to Friday from 7 am to 6 pm, Saturdays from 8 am to 1 pm, and no work on Sundays or public holidays;
- Regular reinforcement (such as at toolbox talks) of the need to minimise noise;
- Use of 'squawker' type reverse alarms on vehicles used on site;
- All plant will be driven in a conservative manner (no over-revving);
- Where possible, machinery will be located/orientated to direct noise away from the closest sensitive receivers;
- The quietest suitable machinery reasonably available will be selected for each work activity;
- Where possible machinery will have efficient low noise muffler design and be well-maintained;
- Where practicable, ensure the coincidence of noisy plant/machinery working simultaneously in close proximity to sensitive receivers is avoided;
- Scheduling activities to minimise impacts by avoiding conflicts with other scheduled events;
- Scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive; and / or
- Planning deliveries to occur during the hours of 7.00 am to 6.00 pm.

The construction noise mitigation and management measures which would be implemented for each key activity would be detailed in a Construction Environment Management Plan.

10.1.3 Impact Assessment - Noise – CBP Operations

Noise would be generated during the operations of the CBP from the plant operation and from on-site road traffic. Additional on-site road traffic would be generated by cement deliveries from the Concentrate Rail Siding to the CBP, as well as aggregate deliveries and fibrecrete from the CBP to the Mine Portal. It should be noted that the operation of the on-site CBP would result in a significant reduction in public road traffic (from 108 to 50 truck movements/month).

Preliminary noise modeling results identified that the proposed CBP would require noise mitigation for the site to achieve the derived criteria in the current Project Approval. BHOP has therefore committed to enclosing the batching process within a concrete structure and extending the current earthen bund perimeter in this area to create 6 m high noise barriers. These measures were included in EMM's operational noise modeling.

Modelling results summarized in **Table 10-3** indicated that site noise levels are predicted to satisfy the criteria at all assessment locations during future operations (existing approved operations and CBP operation combined).

Table 10-3 Future CBP Operational Noise Results

Assessment location ID	Predicted future $L_{Aeq(15\text{-}min)}$ noise levels, dB			Criteria, $L_{Aeq(15\text{-}min)}$, dB			Exceedance, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
A1	<38	<37	<35	38	37	35	Nil	Nil	Nil
A2	<38	<37	<35	38	37	35	Nil	Nil	Nil
A3	<44	<41	<39	44	41	39	Nil	Nil	Nil
A4	<44	<41	<39	44	41	39	Nil	Nil	Nil
A5	<44	<41	<39	44	41	39	Nil	Nil	Nil
A6	<48	<41	<39	48	41	39	Nil	Nil	Nil
A7	<35	<35	35	35	35	35	Nil	Nil	<1
A8	<48	<39	<39	48	39	39	Nil	Nil	Nil
A9	<46	<39	<39	46	39	39	Nil	Nil	Nil
A10	<42	<41	<35	42	41	35	Nil	Nil	Nil
A11	<46	<39	<39	46	39	39	Nil	Nil	Nil
A12	<46	<39	<39	46	39	39	Nil	Nil	Nil
A13	<38	<35	<35	38	35	35	Nil	Nil	Nil
A14	<35	<35	<35	35	35	35	Nil	Nil	Nil

EMM also assessed the potential noise impacts to sleep disturbance and found that the predicted L_{Amax} noise level satisfies the sleep disturbance screening criteria at all assessment locations. The predicted L_{Amax} noise level also satisfies the WHO guideline criteria at all assessment locations and therefore confirms that potential maximum noise levels from future site operations are unlikely to cause sleep disturbance at any of the assessment locations. Therefore, based on a conservative sound power level of 117 dB L_{Amax} or lower, no sleep disturbance impact is expected during worst case meteorological conditions.

10.1.4 Impact Assessment - Noise – Cumulative

In February 2017, Perilya submitted an application for Broken Hill North Mine Recommencement Project (SSD 7538). This application involves recommencement of underground mining operations at Perilya's Broken Hill North Mine, located to the north-east of the Rasp Mine. The construction works for the Perilya North Mine have the potential to occur at the same time as that of the Modification. Cumulative operational noise from Perilya North Mine and the Modification combined may also occur.

EMM completed a review of the noise assessment prepared by Muller Acoustic Consulting Pty Ltd (MAC) in January 2017 for the Perilya North Mine. The MAC assessment shows that $LA_{eq(15\text{-}min)}$ noise levels from Perilya North Mine during construction and operational stages are predicted to be well below the construction management level (NML) (by at least 10 dB) and operational criteria (by at least 8 dB) during worst case meteorological conditions at the potentially most affected representative assessment location (A12) for the Rasp Mine Modification.

A desktop analysis identified that predicted noise levels from Perilya North Mine would not influence construction or operational noise levels generated by the Rasp Mine Modification. Therefore, cumulative noise from Perilya North Mine and the Rasp Mine Modification combined is not anticipated to cause additional impact at any of the assessment locations.

10.1.5 Mitigation Measures and Monitoring

10.1.5.1 Mitigation Measures

As stated above, a preliminary noise modelling exercise identified that the proposed CBP would require noise mitigation to achieve the current PA criteria. A number of management and mitigation measures were considered in this assessment, however some were deemed not to be feasible and/or reasonable. These are provided in **Table 10-4** together with the justification for their implementation.

Table 10-4 Considered Feasible and Reasonable Noise Mitigation Measures – CBP Operation

Type of noise measure	Measure	Feasible	Reasonable	Justification
At source	CBP concrete[4] enclosure	Yes	Yes	Batching and slumping were identified as potentially high ranked contributors to offsite noise. This measure has been adopted in the model and will be implemented by BHOP.
At source	Use of a small size front-end loader	Yes	Yes	The front-end loader was identified as potentially a high ranked contributor to offsite noise and therefore a smaller size front-end loader (eg Volvo L50F) with a sound power level of the 102 dB(A) will be used. This measure has been adopted in the model and will be implemented by BHOP.
At source	Attenuation of front-end loader	Yes	No	A smaller front-end loader (eg Volvo L50F) with a sound power level of the 102 dB(A) will be used. It was identified as potentially a high ranked contributor to offsite noise. This measure is considered unreasonable given the infrequent occurrence of F class temperature inversion during the winter months in Broken Hill and hence the low probability of sustained noise exceedances. Further, the cost (eg $100,000s per plant) associated with sound attenuation kits versus the total dB reduction achievable (eg 3 to 4 dB) is unreasonable.
At path	6 m high noise barriers to the north-west and south-west of the CBP area	Yes	Yes	This measure has been adopted in the model and will be implemented by BHOP.
At receivers	Architectural treatment of affected dwellings (eg improved glazing, acoustic insulation and mechanical ventilation/ air-conditioning)	Yes	No	This measure is considered unreasonable given the low probability of sustained noise exceedances.

[4] Or an enclosure constructed of material that has the same or higher acoustic attenuation qualities.

These measures resulted in predicted site noise levels satisfying criteria at all offsite locations, including during night-time F class temperature inversions.

10.1.5.2 Monitoring

It is proposed to continue to conduct noise monitoring in accordance with the existing BHOP Noise Monitoring Program, which requires annual attended monitoring at each receptor. BHOP would also conduct random noise testing during the construction period and review noise generation activities, as required.

In addition, prior to construction of the CBP and TSF2 extension BHOP would prepare a Construction Environment Management Plan, which would include all, identified reasonable and feasible measures to minimise noise during construction.

10.2 Air Quality

10.2.1 Impact Assessment

Dust may be generated during construction of the CBP and TSF2 extension from earthworks, plant construction, rockfill material placement and on-site road traffic.

During operations of the CBP dust may be generated from vehicle traffic and aggregate loading/unloading to storage point, dumping aggregate into hopper, and mixing of materials. Operation of the TSF2 largely involves pumping tailings in slurry form into TSF2 and waste water from the decant pond located with TSF2 to the Processing Plant for reuse. Some drying of tailings may occur as the deposition heads towards decommissioning and the level of tailings rises closer to the surface.

Pacific Environment Ltd (PEL) was engaged to complete an *Air Quality Assessment for the Rasp Mine Rasp Mine Modification 4,* March 2017 (AQIA) (**Appendix I**) for the construction and operation of a CBP and of the TSF2 extension. The AQIA included:

- Review of current air quality modeling to determine current background and current mine works contribution (2016 was chosen as the model year), with a review of emissions inventories and meteorological data;
- Atmospheric dispersion modelling for the worst case emissions scenario (cumulative assessment of current operations, including TSF at both normal and upset conditions);
- Comparison of the current mine works (using 2016 as the base year of operations) with predicted incremental air quality predictions provided in the PPR;
- A cumulative assessment of all construction works with current operations;
- A cumulative assessment of the operations of the CBP with current operations;
- A qualitative assessment of the potential cumulative impacts with the Perilya's proposed Broken Hill North Mine Recommencement Project; and
- A Greenhouse Gas (GHG) assessment.

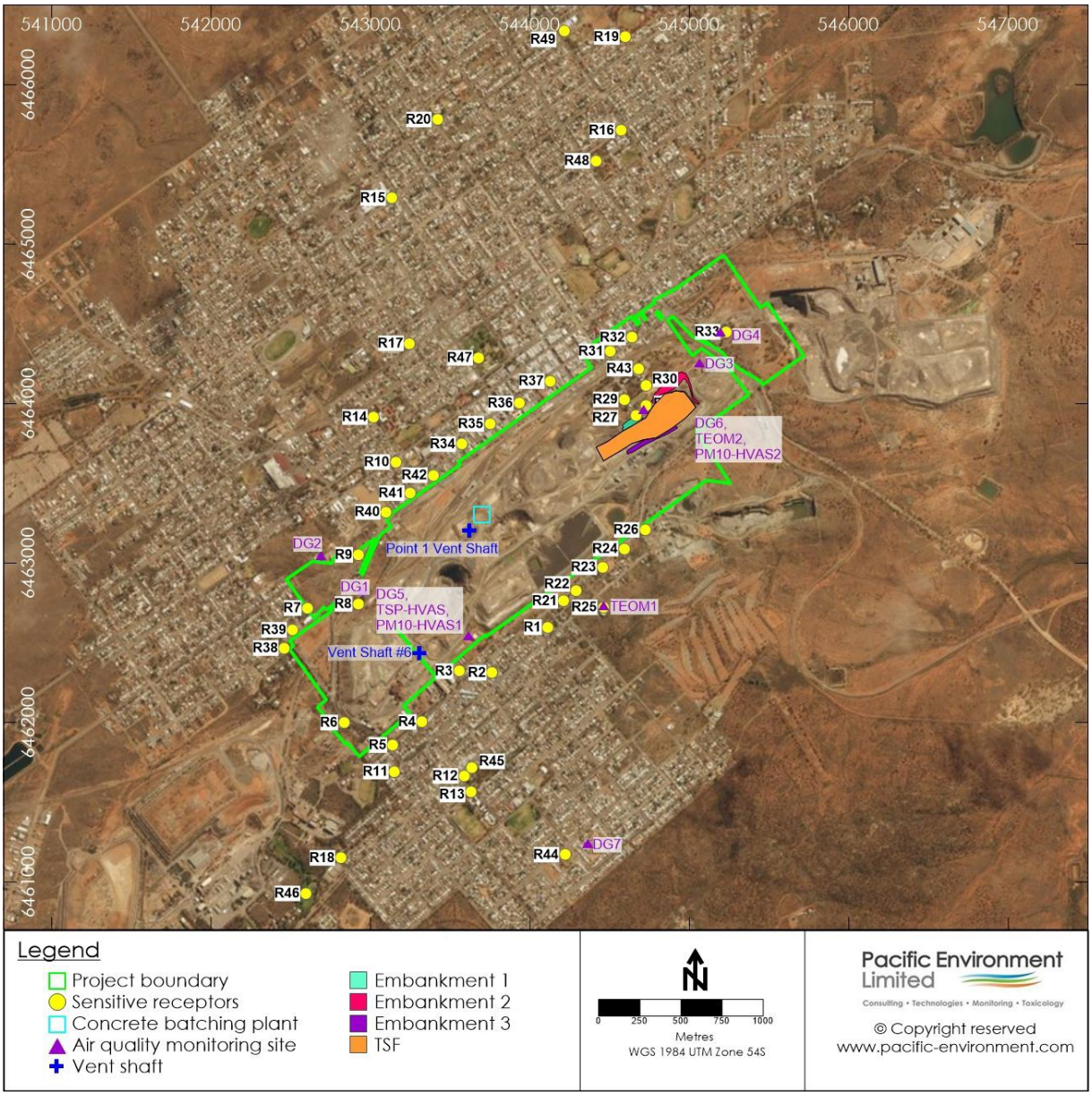
In addition PEL also completed field testing on the Mine site to identify the:

- control efficiency (expressed as a percentage of uncontrolled conditions) of moisture and crusting in restricting particulate emissions from wind erosion; and
- specific meteorological conditions under which wind erosion has the potential to occur.

Sensitive Receptors

The sensitive receptors (R1 to R42) from the original study (PPR) were supplemented with a further seven receptors, including the bowling green (R43) located in Proprietary Square and 6 additional playgrounds (R44 to 49). Receptor locations are depicted in **Figure 10-2** and are described in the AQIA.

Figure 10-2 Sensitive Receptor Locations with Location of CBP and TSF2 Extension, and Rasp Mine Air Quality Monitoring Network



Summary of Impact Assessment Results

The AQIA identified the construction of Embankment 2 as the worst-case scenario and conducted dispersion modeling for this case with current operations including the operations of the CBP and TSF under both normal and upset conditions. The impact assessment compared the results against the NSW EPA criterion listed below (and reflected in the PA), as well as the predictions provided in the PRP. As there is no criterion for deposited lead these results were only compared to the results provided in the PPR.

- Total suspended solids (TSP) (90 $\mu g/m^3$).
- Annual average lead (as part of TSP) (0.5 $\mu g/m^3$).
- Maximum 24 hour PM_{10} (50 $\mu g/m^3$).
- Annual average PM_{10} (25 $\mu g/m^3$) (PA criteria is 30 $\mu g/m^3$).
- Monthly average deposited dust (site increment 2 g/m^2/month, cumulative 4 g/m^2/month).
- Annual average lead dust deposition (compared to PPR predictions only).

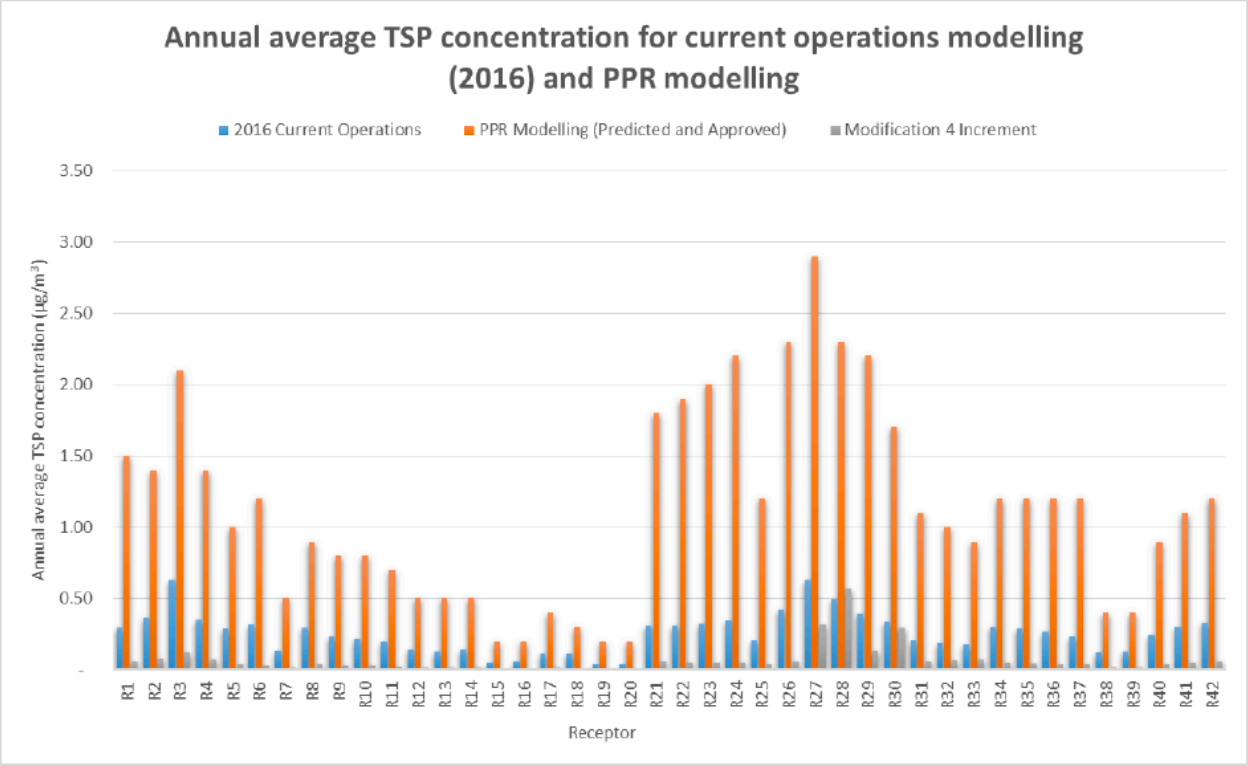
In summary, the vast majority of receptors were below the applicable criteria and the original predictions in the PPR. The air quality modelling results are discussed in details below.

Total Suspended Solids

The cumulative results for Total Suspended Solids (TSP) show that at all receptors, the predicted annual average TSP concentrations are well below the NSW impact assessment criterion of 90 µg/m^3 (refer to **Figure 10-3**). The highest predicted cumulative annual average TSP concentration is 36 µg/m^3, which was recorded from R28 and includes an incremental increase above current concentration levels of 0.53 µg/m^3. PEL concluded this would make negligible contributions to the PM exposure in the Broken Hill area.

As shown in **Figure 10-3**, the results also indicated that TSP incremental concentrations are all below the predicted incremental levels provided in the PPR.

Figure 10-3 TSP Comparison of Current (Modelled) Operations 2016 and PPR Predictions

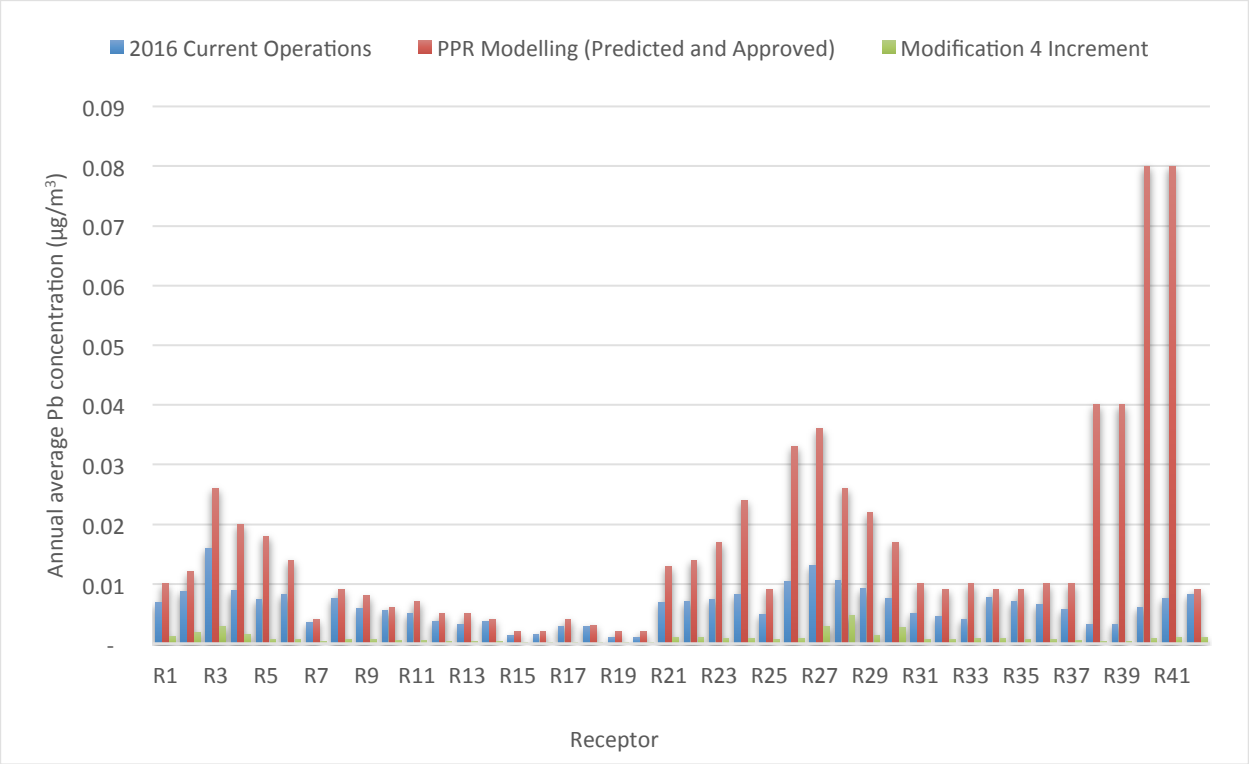


Annual Average Lead (as part of TSP)

The cumulative results for annual average lead (Pb dust) show that at all receptors, the predicted annual average Pb concentrations are well below the NSW impact assessment criterion of 0.5 µg/m^3 (refer to **Figure 10-4**). The highest predicted cumulative annual average Pb dust concentration is 0.24 µg/m^3, which was recorded from R2 and R3, and includes an incremental increase above current concentration levels of 0.0055 and 0.0080 µg/m^3, respectively.

As shown in **Figure 10-4**, the results also indicated that annual average lead incremental concentrations are all below the predicted incremental levels provided in the PPR.

Figure 10-4 Annual Average Lead Comparison of Current (Modelled) Operations 2016 and PPR Predictions



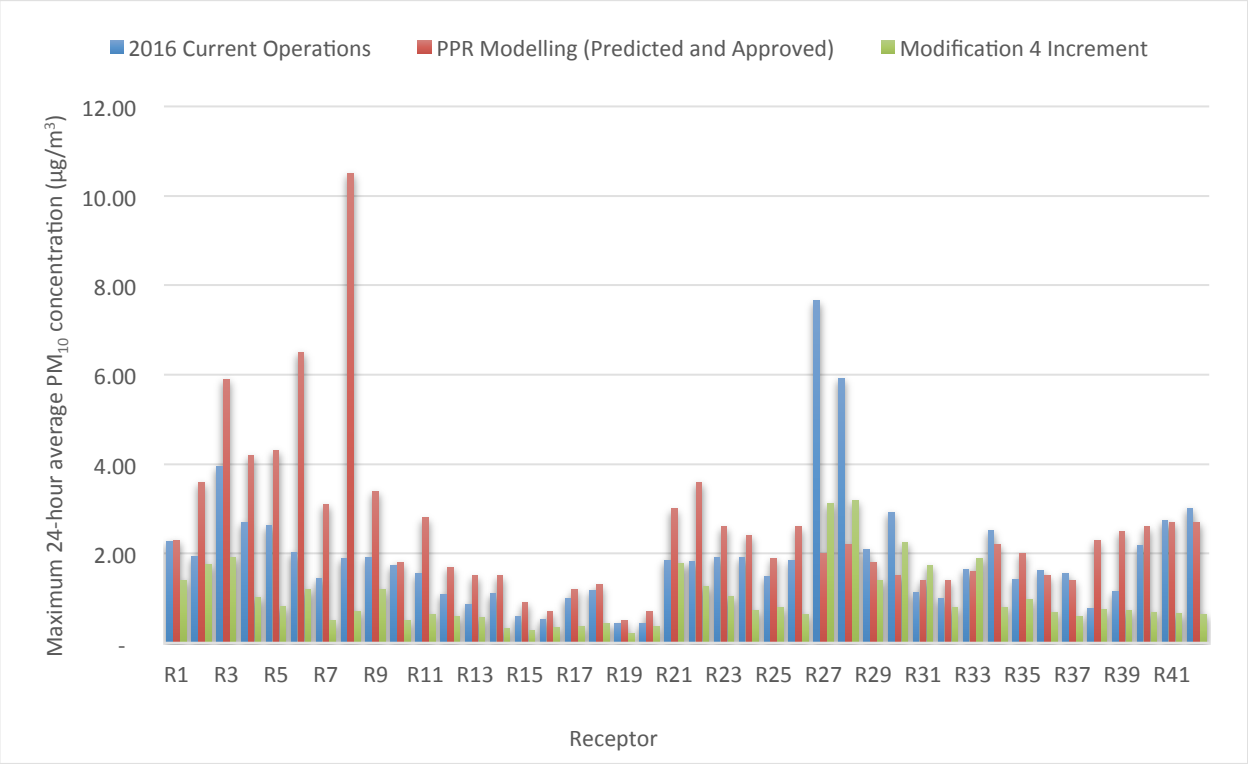
Maximum 24-hour PM_{10}

The cumulative results for maximum 24-hour PM_{10} show that at all receptors the predicted concentrations are well below the NSW impact assessment criterion of 50 µg/m^3 (refer to **Figure 10-5**). The highest predicted cumulative maximum 24-hour PM_{10} concentration is 46 µg/m^3, which includes incremental increases above current concentration levels ranging from 0.3 to 3.1 µg/m^3.

The comparison study of current operations 2016 with results predicted in the PPR found that in general, the maximum 24-hour average predictions are also below the PPR predicted increments. However there are several receptors where the predicted increment is marginally higher than the PPR predictions. These include a group of receptors close to the TSF Extension Embankments 1 and 2 (R27, R28, R29, R30 and R33) and a group of receptors located along Crystal Street (R34, R36, R37, R41 and R42).

PEL concluded that the major influence to these changes are anticipated to be as a result of different meteorological files being used, where the 2016 current operations modelling adopted calendar year 2016 observations, while the PPR adopted 2008/2009 and therefore the 24-hour predictions will not always align with the annual results. Other factors which may have influenced these results include the change in source configuration where the Primary Ventilation Shaft has been relocated and Ventilation Shaft No. 6 has been added. The 2016 current operations modelling also references site-specific data (e.g. empirically derived control factors and materials samples) in derivation of the emission inventory.

Figure 10-5 Maximum 24-hour PM_{10} Comparison of Current (Modelled) Operations 2016 and PPR Predictions



Annual Average PM_{10}

The cumulative results for annual average PM_{10} show that at all receptors, the predicted annual average concentrations are well below the NSW impact assessment criterion of 25 µg/m^3 (PEL compared results against the new EPA NSW criterion, the PA lists 30 µg/m^3 criteria) (refer to **Figure 10-6**). The highest predicted cumulative annual average PM_{10} concentration is 13 µg/m^3 recorded at all receptors. This includes incremental increases above current concentration levels ranging from <0.01 to 0.19 µg/m^3.

As shown in **Figure 10-6**, the results also indicated that annual average PM_{10} incremental concentrations are all below the predicted incremental levels provided in the PPR, with the exception of R17 which shows a negligible increase (0.011 µg/m^3).

Monthly Average Deposited Dust

The results for monthly average deposited dust (DD) show that at all receptors, the predicted dust deposition concentrations are well below both of the NSW impact assessment criterion of 2 g/m^2/month and cumulative 4 g/m^2/month (refer to **Figure 10-7**). The highest predicted cumulative monthly average deposited dust concentration is 2.8 µg/m^3 recorded from R27, R28 and R30 and R3, and includes incremental increases above current concentration levels of 0.08 and 0.15 g/m2/month.

As shown in **Figure 10-7**, monthly average dust deposition incremental concentrations are all below the predicted incremental levels provided in the PPR.

Annual Average Lead Dust Deposition

There is no NSW EPA criterion for lead deposition. The highest cumulative annual average Pb deposition level predicted for MOD4 is 0.053 g/m^2/year recorded at R3 which includes an incremental increase of 0.028 g/m^2/year (refer to **Figure 10-8**).

As shown in **Figure 10-8**, annual average lead deposition incremental concentrations are all below the predicted incremental levels provided in the PPR.

Figure 10-6 Annual Average PM_{10} Comparison of Current (Modelled) Operations 2016 and PPR Predictions

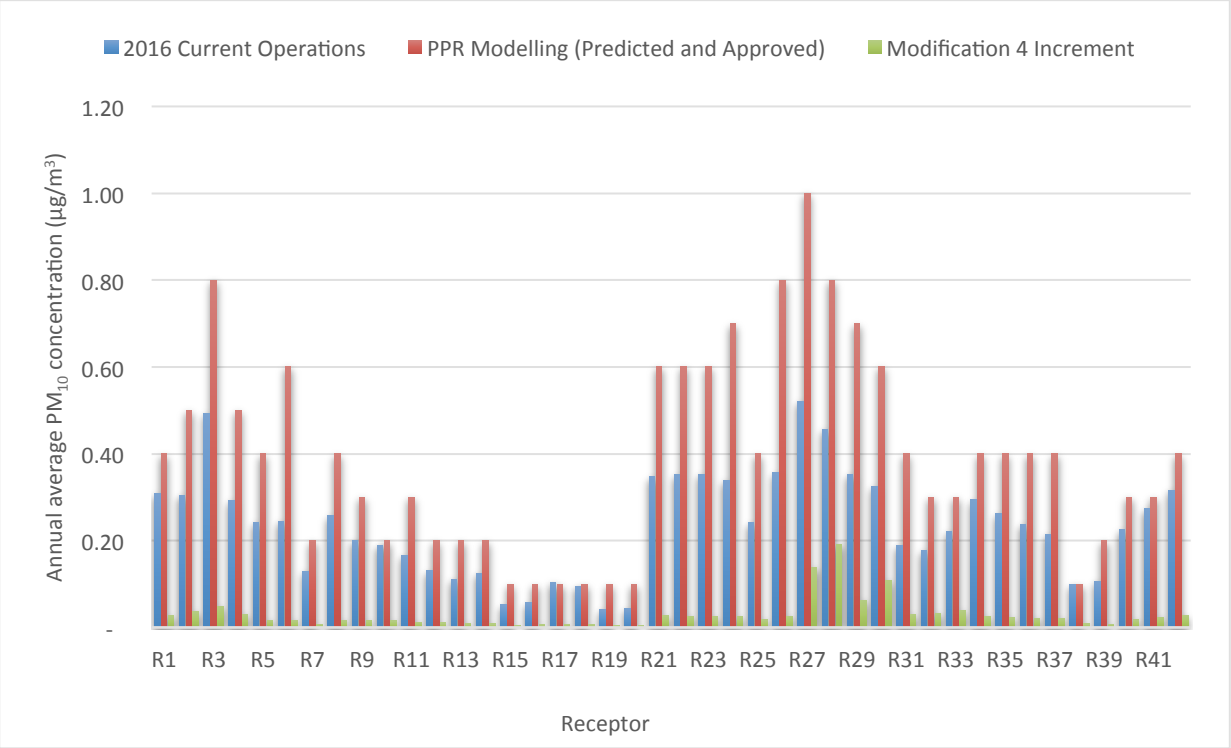


Figure 10-7 Monthly Average Dust Deposition Comparison of Current (Modelled) Operations 2016 and PPR Predictions

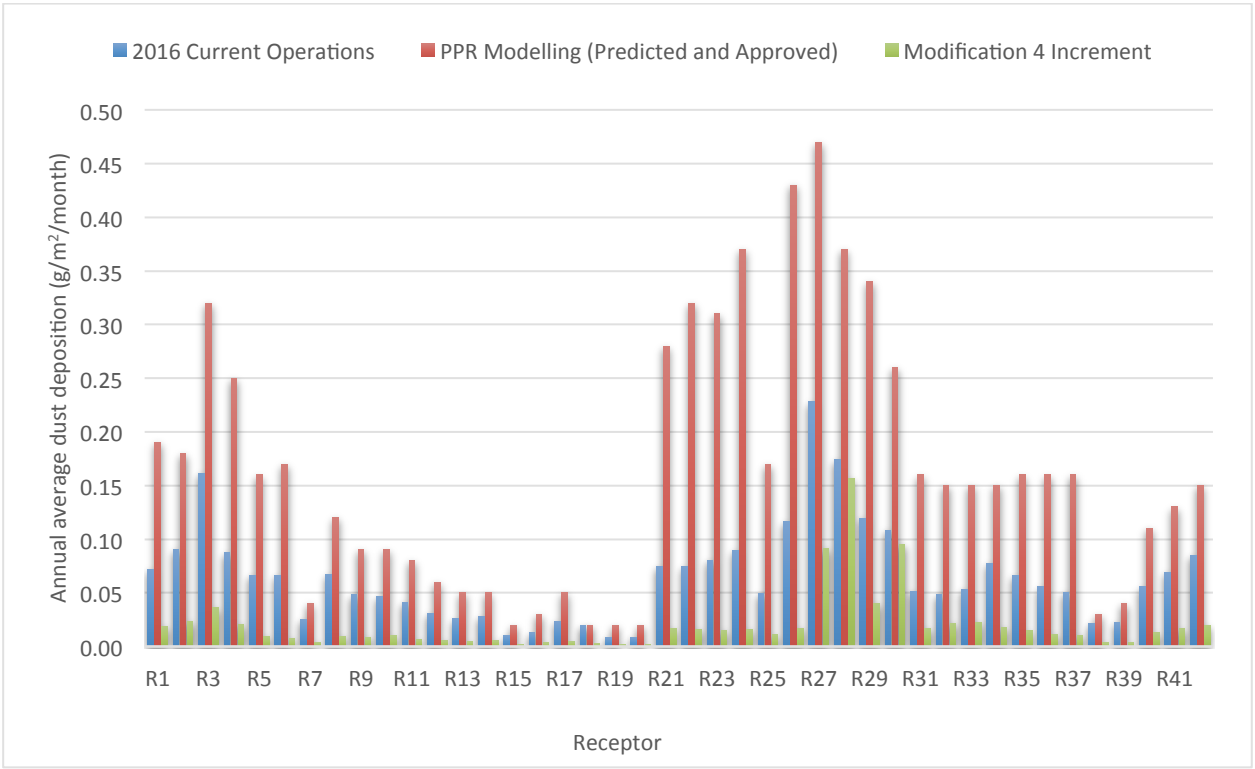
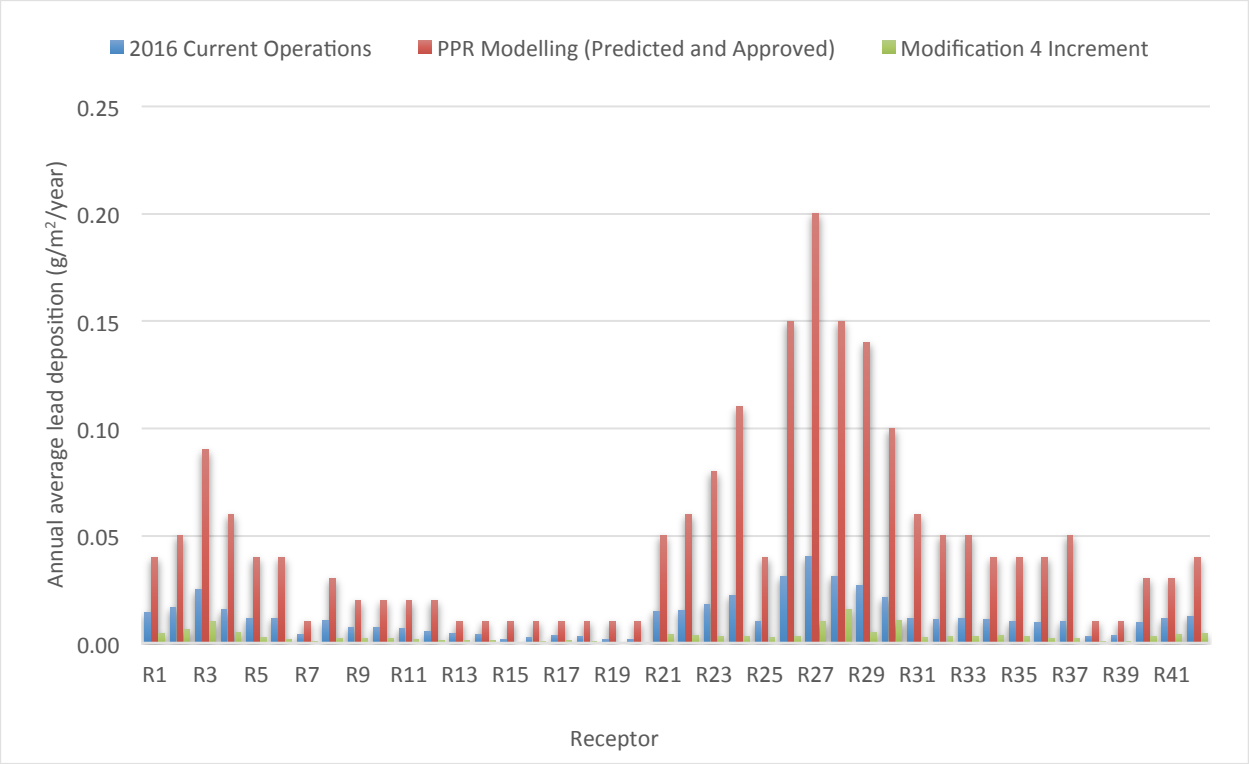


Figure 10-8 Annual Average Lead Dust Deposition Comparison of- Current (Modelled) Operations 2016 and PPR Predictions



Summary of Cumulative Impact Assessment Results

PEL completed a cumulative assessment of proposed construction and operation of the CBP and TSF2 extension with Perylia's proposed Broken Hill North Mine Recommencement Project (SSD 7538) (refer to **Appendix I**). The Broken Hill North Mine is located to the north east of Rasp Mine and therefore PM emissions from this source would have the potential to result in cumulative impacts when combined with predictions associated with the Rasp Mine Modifiction.

PEL noted that there are eight receptors that align with those used in Broken Hill North Mine air quality assessment such that impacts can be evaluated cumulatively. These receptors comprise R2, R11, R17, R18 R23, R24, R32 and R43 from the Rasp Mine (refer to **Figure 10-2**).

PEL conclude that for all of the air quality metrics assessed (including annual average and maximum 24-hour predictions for PM_{10} and $PM_{2.5}$, annual results for TSP, dust deposition and lead concentration) the cumulative results that combine emissions from Rasp Mine's existing operations, the proposed Modification, the proposed Broken Hill North Mine Recommencement Project and contributions from other background sources are all below the NSW impact assessment criteria at the nominated co-located receptors. PEL also highlighted that the Modification construction is only scheduled to occur over a short period (ie. 14 months).

Without additional knowledge as to the Broken Hill North Mine's proposed scheduling and development consent pathway, it should further be acknowledged that the two activities may or may not be undertaken at the same time, and as such the above discussion of cumulative impacts should be regarded as worst-case.

Greenhouse Gas (GHG) Assessment Results

PEL's AQIA also considered the potential increase in GHG emissions as a result of the Modification.

The World Resources Institute / World Business Council for Sustainable Development Greenhouse Gas Protocol (the GHG Protocol) originally documented the different scopes for GHG emission inventories. The GHG Protocol is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions. This corporate accounting and reporting

standard is endorsed by the Australian Department of Climate Change and Energy Efficiency.

The GHG Protocol defines three scopes for developing inventories leading to reporting of emissions. These scopes help to delineate direct and indirect emission sources, improve transparency, and provide a degree of flexibility for individual organisations to report based on their organisational structure, business activities and business goals.

Three scopes of emissions are defined in the GHG Protocol:

- 'Scope 1' emissions: direct GHG emissions occurring from sources owned or controlled by the company – for example vehicle fleet and direct fuel combustion. Any negative emissions (sequestration), for example from a plantation owned by the entity, would also be included in Scope 1.
- 'Scope 2' emissions: indirect GHG emissions from purchasing electricity or heat from other parties; and
- 'Scope 3' emissions: indirect emissions which occur due to the company's business activities, but from sources not owned or controlled by the company - for example emissions from employee business-related air travel.

Scope 1, 2 and 3 greenhouse gas emissions were quantified as part of the EA. The proposed Modification would be limited to Scope 1 emissions from diesel combustion. PEL estimated the diesel fuel consumption for the modification to be approximately 350,000L of diesel fuel which equates to 0.9 ktCO2-eq.[5]

For the Rasp Mine Project in its entirety annual emissions of GHG (Scope 1 and 2) are estimated at 40.21 ktCO2-e per year. This Modification would add an additional 2% loading, which is considered negligible.

10.2.2 Field Testing for Dust Control Efficiency

In addition to completing the AQIA, PEL completed field testing at the Mine site to identify the dust control efficiency and wind erosion / dust generating potential of various surface materials (refer to **Appendix K**). Two testing methods were used, inlcuding (1) The Confined Air Burst Chamber (CABC) for measuring relative control efficiency; and (2) The USEPA AP-42 sieving method for determination of threshold friction velocity.

The Confined Air Burst Chamber (CABC) testing method was used to estimate either the relative dust emission potential of different surface types, or the effectiveness of measures for controlling dust on a given surface type (% Control Efficiency). A total of 52 CABC tests were conducted on various surfaces at the Mine. Results are summarised in **Table 10-5**.

Table 10-5 Results from Field Testing November 2016

Material Type	Control (%)
Dry Tailings – Crusted	**99.7**
Wet Tailings	**100**
Waste Rock Trial	**99.7**
Uncontrolled Free Areas – Crusted	**96.6**
Controlled Free Areas – 5 month old dust suppressant	**98.9**
Unsealed Road Areas - Crusted	**90**
Unsealed Road Areas – Fresh dust suppressant	**99.2**

[5] The annual Scope 1 fuel consumption in the EA was reported as 1,604,400L resulting in an estimated 4.33 kt CO_2-eq. This is based on a 750,000 tpa ROM production rate. The total material to be moved for Modification 4 is approximately 79,000 m_3 or 165,000 tonnes.

The USEPA AP-42 sieving test method was used to for the determination of site-specific threshold friction velocities. A total of four sieve tests were conducted on tailings surfaces at TSF2. The results deriving the lift-off threshold wind speeds for tailings under various conditions are presented in **Table 10-6**.

Table 10-6 Results of USEPA Sieve Testing Rasp Mine November 2016

Sieve Test	Erosion Surface	Tyler Sieve Mode (opening – mm)	Lift-off Threshold Wind Speed (m/s)
1	Dry tailings	1	14.3
2	Dry fines in drainage gullies of the tailings	0.5	10.9
3	Wet tailings	>4	N/A
4	Dry tailings	1	14.3

Note wind speed 10 m above ground level.

PEL concluded that the results of the testing indicated that observed levels of moisture at TSF2 are adequate for operational dust control. For moist surfaces within TSF2, the CABC testing indicated 100% control efficiency, whilst the USEPA sieving method classified the material as being non-conducive to wind erosion. Dry, crusted areas were also observed to provide a high level of control (99.7%) relative to disturbed surfaces, equivalent to the proposed final waste rock cover.

The above conclusion assumes that crusted tailings remain undisturbed. On that basis, the use of waste rock cover is considered by PEL a more resilient and less readily disturbed surface for the long-term containment of TSF2 material after the point at which the TSF2 is no longer active.

The field testing results have been used by BHOP to inform future operational dust control measures for the TSF2, including:

- Determining the threshold wind velocity for TSF2 material for alerts / alarms when combined with local wind speed observations.
- Selective use of dust suppressant in TSF2 spray system, which will aid control of the TSF2 when used in the proposed TSF2 spray system, particularly at the end of the TSF's operational life.
- Setting up alerts / alarms on existing instrumentation to inform the use of TSF2 spray system
- Setting alerts both for critical PM concentrations and wind velocities recorded in proximity to the TSF2 surface.

These dust control measures would be considered in the revision of the BHOP Air Quality Management Plan and the TMOM (refer to discussion in Section 10.2.3 below).

10.2.3 Mitigation Measures and Monitoring

10.2.3.1 Mitigation Measures

Construction

Dust generated by earthworks and vehicle movements during construction would be managed through the use of the water truck and water sprays. Crushing and screening activities would be conducted on the floor of the Kintore Pit, 70 m below surface. Routine water sprays, the water truck and chemical dust suppressants would be used on unsealed haulage routes and the application of water during the placement of rockfill layers at the embankments (required for the structures strength and integrity) would minimise dust during embankment construction. Where any excavations occur the area would be moisture condition by application of water prior to the excavation and during the excavation. In addition, dust generating works would cease on high wind days (over 50 km/h).

Waste rock leaving Kintore Pit would be tested and selected so that waste rock used averages no more than 0.5% lead.

In addition, meteorological forecasting would be used to predict meteorological conditions for the coming day(s) to determine, at a minimum one day in advance, when an elevated risk of dust emissions may occur (e.g. based on wind speed, direction, rainfall and atmospheric stability). A system which activates an alert for potential dust generating activities when winds are 40 kph and an alarm to stop dust generating activities at when winds are 50 kph would be implemented.

A Construction Environmental Management Plan would be developed with the construction contractor to implement the above measures.

Operations

Minimal dust is expected to be generated from the CBP during operations, with the major dust sources being loading and unloading of aggregate materials and vehicle movements. Minimal dust is anticipated to be generated during the operations of TSF2.

In summary, the following dust mitigation measures would be implemented during operation of the CBP and TSP2:

- Enclosed building for batching and slumping activities at the CBP;
- Covered transport conveyor for aggregate to hopper;
- Chemical dust suppressant on roads;
- Water sprays on aggregate hopper;
- Water truck, as required;
- Installation of an automated water spray system covering the surface of TSF2;
- Minimising disturbance of the tailings surface crust which acts to reduce dust generation; and
- Implement a system which activities an alert for potential dust generating activities when winds are 40 kph and an alarm to stop dust generating activities at when winds are 50 kph.

The potential for dust during the placement of tailings into the TSF2 was included in the dust modeling of the original EA. Since that time the moisture content of the tailings has been successful at minimising the generation of dust during operations of the facility (refer to **Photograph 10-1**). Over the areas of the TSF2 where the tailings has dried, current experience on the TSF2 is that no dust is generated during windy days possibly due to the early formation of a surface crust due to evaporation of tailings liquor from the surface. This has proven to be 99.7% efficient in controlling dust (refer to the field testing results in **Table 10-5**).

Three levels for dust management are proposed during operation of the TSF2, including:

1. Water pumped through the current tailings placement system;
2. Installation of automatically activated sprinkler system with the application of water with a predictive meteorological forecasting system; and
3. Application of chemical dust suppressant through the water sprays.

The first management level for dust mitigation is the placement of water through the tailings distribution system. This would provide a spread of water over the tailings surface to suppress dust generation. This is the management strategy under current operating conditions.

The second level of dust management for the TSF was discussed in the original EA, which indicated that dust mitigation measures were to be introduced as the tailings level was raised closer to the surface. These measures consisted of the installation of a sprinkler system around the perimeter of the TSF2 with water applied through a number of strategically located high capacity sprayers.

In addition, meteorological forecasting would be used to predict meteorological conditions for the coming day(s) to determine, at a minimum one day in advance, when an elevated risk of dust emissions may occur (e.g. based on wind speed, direction, rainfall and atmospheric stability).

Photograph 10-1 View of Blackwood Pit TSF2, 9 November 2016

The predictive meteorological forecasting system would provide simple indicators of the following day's dust risk, based on meteorological conditions that are known to have adverse impacts, allowing measures to be put into place in advance. An example of such preparatory measures could include:

- Scheduling additional water cart operations / chemical dust suppressant application;
- Planning for modifying or relocating certain activities; and/or
- Scheduling maintenance on equipment.

BHOP currently monitors PM_{10} concentrations and wind speed/direction continuously at two locations (north and south of current mining operations). Monitoring will continue at these locations, and it is proposed to supplement this monitoring with an additional monitoring unit located in the TSF2 pit (along the ramp indicated in **Photograph 10-1**) which would be progressively moved as the tailings level rise. This would enable an automatic response system to be installed that would activate when certain triggers are applied. These triggers would include PM_{10} concentration level, wind speed and direction.

A short-term average (e.g. 1-hour average) PM_{10} performance indicator would be set at a concentration that allows proactive dust management to be implemented in the event that PM concentrations are increasing, and may potentially approach the 24-hour PM_{10} impact assessment criterion.

The field investigations (**Table 10-6**) indicate that a critical wind speed of 11 m/s (40 km/h measured at 10 m) should be used as an initial alert value to trigger further investigation and remedial action as required, as this is the threshold friction velocity where dust entrainment may occur.

Winds that reach 14 m/s (50 km/h) would be used as the critical wind speed alarm value when immediate action is required (i.e. implementation of TSF water sprays or chemical dust suppressant). A review of the onsite meteorological data, conducted by PEL, found that winds exceeding 11m/s may occur 1.3% of the time (or 112 hours per year) and exceeding 14m/s 0.02% of the time (or 2 hours per year).

Trigger values would be confirmed and the details of the automatic control and activation system for the sprinkler system would be included in the updated BHOP Air Quality Management Plan. Consideration would also be given to ensuring that they are sufficiently protective without generating excessive false alarms.

The spray system would apply water over the tailing surface from a number of strategically located sprayers. These locations are near the existing perimeter of the pit, along the embankment crests and some would be located on support structures on the tailings beach. Raw water would be used to prevent any potential issues in relation to spray drift to neighbouring areas. A raw water storage tank (the Silver Tank) with a capacity of 7.6 ML is connected to the raw water supply and has an automatic top-up system and would supply the sprays. The sprinkler system would allow activation of individual or a number of sprinklers as required.

The spray system would be installed during Stage 1 of the TSF2 extension works, following the completion of Embankment 2 and the Spillway. A few sprinklers would be relocated onto the top of the Embankments after their construction with approximately eight sprinklers located on the tailings beach. The selection of the sprinklers would be finalised during detailed design of the TSF2 extension, however it is proposed that the sprinklers would have a maximum throw distance of 60 m and would be placed as indicated in **Figure 10-9**. The operating pressure of the sprinker units would deliver equivalent to a rate of approximately 10 mm/h of rain with each sprinkler having the capacity to spray a minimum of 80 to 120 m^3/h. The spraying system would be able to activate one or more or all sprinklers to target the area where dust is being generated.

The design is based on the Sime Sprinkler Master supplied by Wet Earth Mining, Dust and Water Solutions and is widely used in the mining industry.

The spray system would be installed once the embankments have been completed and access to the pit rim becomes available and would be designed such that the piping and sprays can be activated at any time during operations.

The third level for dust control during the operations of the TSF2 is the application of a chemical dust suppressant through the water spray system. This chemical agent can be added to the water to extend the control of dust through wind entrainment. This would be particularly useful if there are longer delays or breaks in tailings deposition or where the application of water is not desirable. The use of chemical suppressant has proven successful on other surfaces with unsealed roads achieving an efficiency control of 99.2% and free-areas 99.2% (as measured by the CABC field tests outlined above **Table 10-5**).

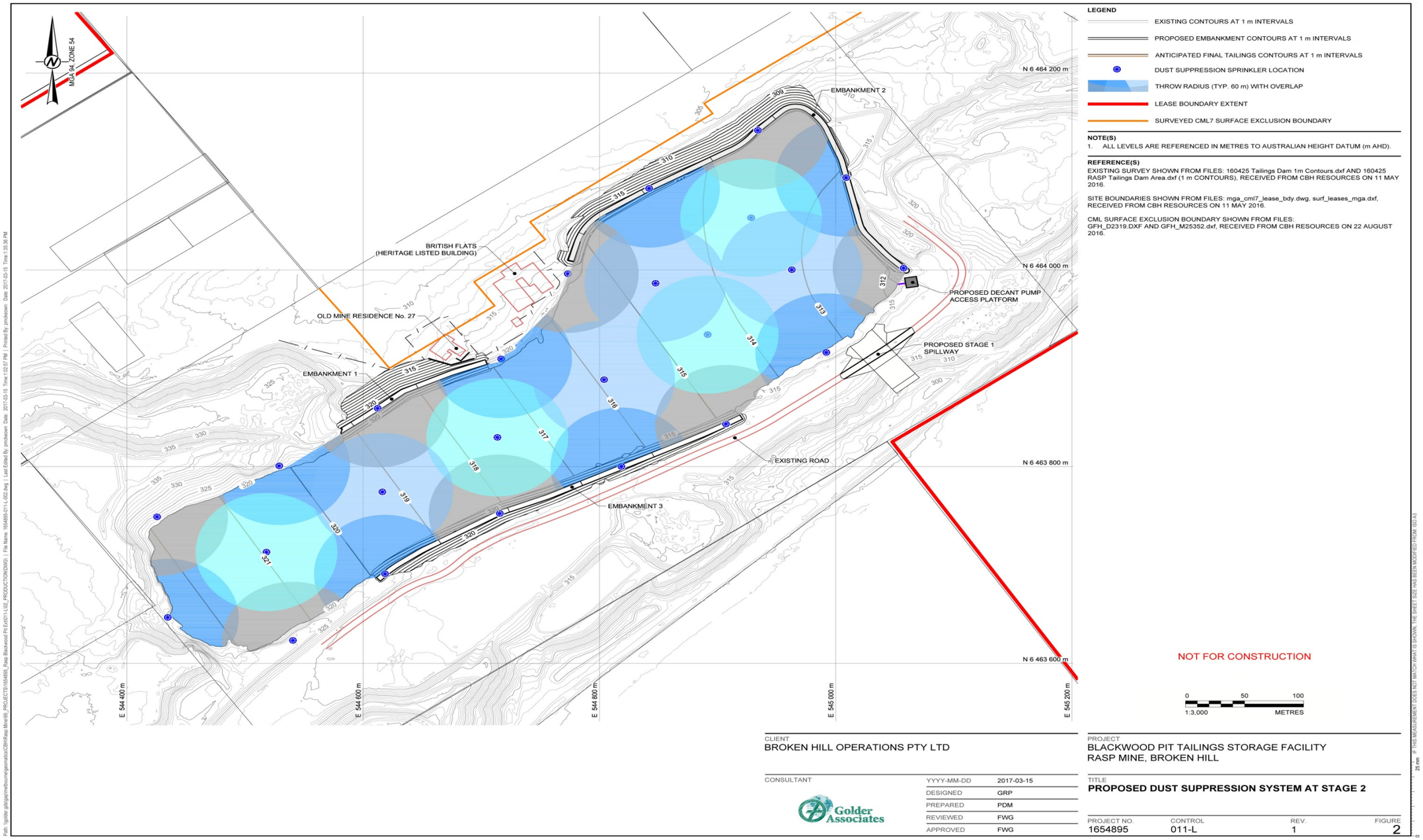
Dust mitigation at the cessation of tailings deposition is discussed in **Section 10.10.**

10.2.3.2 Monitoring

It is proposed to continue to implement the current air quality monitoring network as outlined in the BHOP Air Quality Monitoring Program. This would be supplemented with:

- meteorological forecasting to predict meteorological conditions for the coming day(s) to determine, at a minimum one day in advance, when an elevated risk of dust emissions may occur (e.g. based on wind speed, direction, rainfall and atmospheric stability); and
- an additional monitoring unit located in the TSP2 pit (along the ramp indicated in **Photograph 10-1**) which would be progressively moved as the tailings level rise. This would enable an automatic response system to be installed that would activate when certain triggers are applied. These triggers would include PM_{10} concentration level, wind speed and direction.

Figure 10-9 Proposed TSF Sprinkler Design System



10.3 Community Health

During the construction phases of the Modification vehicle movements and material handling of waste rock could result in lead bearing dust being entrained with wind and leaving the boundary of the site. The total concentrations for lead in air and deposited lead dust are very low and a discussion of their impact assessment is provided in Section 11.2.

In addition to this assessment, BHOP engaged ToxConsult Toxicology Consulting Australasia (ToxConsult) to complete an analysis based on PEL's AQIA results to determine whether a formal human health risk assessment (HHRA) was required for the modification. A copy of ToxConsult's letter report, *Does Modification 4 at Rasp Mine Need a Health Risk Assessment?* (March 2017) is included at **Appendix L**.

Toxconsult considered that the potential for exposures to Pb in Broken Hill occur predominantly from Pb in air and soil and if these concentrations were significantly increased then further assessment would be required.

For Pb in air, ToxConsult found that there were minimal increases relating from the TSF2 extension construction works. ToxConsult confirmed that depending on the receptor location the Modification would potentially contribute 0.04 – 2% to the cumulative Pb in airborne TSP. ToxConsult concluded that these increases are small and only occur during the 14 month construction period for the embankments and that at every location the predicted cumulative air Pb in TSP is less than half the ambient air quality guideline. This indicated there would be little potential for the incremental air Pb to cause harm.

For Pb in soil, ToxConsult identified that the largest contribution came from the TSF extension and thus calculated the concentration of Pb in soil from Pb dust deposition over the entire construction period of 14 months and compared these results to current (2013 data) levels of Pb in soils around Broken Hill. Results indicated that the predicted incremental increases of Pb in soil range from 0.03 – 0.3 mg/kg which represents just 0.002 – 0.15 % of existing soil Pb concentration. These increases were considered small and insignificant.

ToxConsult concluded that:

> *"It is our opinion that these incremental exposures to Pb, due to the proposed Modification, are so small that a formal HHRA for the proposal is not warranted. Indeed a HHRA will not inform on the potential impact to human health form the proposed Modification any more than is deduced form the analysis provided in this letter report."*

10.4 Embankment / Wall Failure

10.4.1 Impact Assessment – Embankment / Wall Failure – TSF2

An embankment or retaining wall failure may occur from a seismic event, flooding or from poor design and construction resulting in an overtopping event or a piping event, which may lead to loss of containment.

Golder Associates (Golder) completed a *Design Report for the Blackwood Pit Tailing Storage Facility Extension* (Design Report) (**Appendix J**) for the proposed extension to the TSF2. To adequately address the potential for wall failure in the TSF extension design, Golder completed a risk analysis, including mode failures, to identify the required measures for control. The results of this analysis and the mitigating conditions, design controls and critical operating criteria are summarised in **Table 10-7**. Golder confirms that the controls and criteria are inline with those required by the NSW DSC and ANCOLD guidelines.

Table 10-7 Golder - Risk Analysis and Design Controls - Embankment / Wall Failure

Description	Comments	Mitigating conditions, design controls and critical operating criteria
Embankment failure due to weak foundation conditions, loss of containment.	Applicable for all of the TSF embankments.	Embankment 2 will be constructed on strong in-situ material. Embankments 1 and 3 will be constructed on tailings which have been assessed and tested to confirm required strength. All Embankments construction require foundation inspection and approval as part of quality assurance during construction. Conclusion: Very low risk
Embankment failure due to earthquake shaking, loss of containment.	Applicable for all the TSF embankments.	The seismic risk of the region is low. Embankments formed using high strength rockfill and approved foundation conditions. The stability analyses show high factors of safety for MDE condition. Conclusion: Very low risk
A large pond due to excess liquor and/or rainfall overtops the embankment, resulting in erosion of the embankment and a loss of containment.	Applicable to Embankment 2 when the decant pond will be located adjacent to the embankment.	Compacted rockfill embankment is robust and has a high shear strength. A wide trapezoidal spillway will be excavated into natural ground during the construction of Embankment 2 with additional environmental containment freeboard below spillway level. Spillway is designed to manage the PMF. Conclusion: Very low risk
A very large pond forms at Embankment 2 and saturates the embankment fill. Sudden drawdown of the pond results in high pore-water pressures remaining in the embankment fill, leading to slope failure.	Only applicable to Embankment 2 should a large pond form against the embankment and saturate the Embankment fill.	Geosynthetic liner on upstream slope of embankment. Rockfill embankment and filter sand layer are relatively quick draining, so undrained conditions are not likely to occur. Conclusion: Very low risk
Static liquefaction occurs where the tailings strength is low and the rate of embankment construction does not sufficiently allow excess pore pressures to dissipate, resulting in a loss of shear strength, embankment failure and a loss of containment.	This mechanism is applicable for Embankments 1 and 3 where the embankment will be constructed onto the tailings beach.	Tailings deposition will occur locally along the footprint of Embankments 1 and 3 prior to Stage 2 construction to create conditions conducive to drying and strength gain f the tailings beach. Tailings are relatively coarse and drainage occurs over few weeks. Also, inspections and testing of the tailings will be undertaken prior to construction to ensure design parameters are achieved. Conclusion: Very low risk
An earthquake causes cyclic loading of the tailings and induces excess pore pressures, resulting in a loss of shear strength, embankment failure and a loss of containment.	Applicable for Embankments 1 and 3 where the Embankment will be upstream-raised onto the tailings beach.	Inspections and testing of the tailings will be undertaken prior to construction to ensure design parameters are achieved. Required tailing strength conditions result in conditions not susceptible to liquefaction. Conclusion: Very low risk
Tension cracks develop on the crest of the embankment as a result of interface between rigid pit wall / benches and the portion of embankment on tailing. Cracks allow inflow of runoff or wet tailings, resulting in slumping of the embankment slopes and a loss of containment.	Applicable for Embankments 1 and 3 where the embankment will be on the tailings beach.	Estimated differential settlement informed the selection of the deformable geomembrane liner for the upstream slope. Design includes a filter curtain as a backup to damage of the geosynthetic liner. Rockfill embankment provides a high resistance to internal erosion and remains high strength when wet. Conclusion: Very low risk

In summary, Golder concluded that with the mitigating conditions, design controls and critical operating criteria in place, the overall risk of embankment and/or wall failure is very low.

10.4.2 Mitigation Measures and Monitoring

10.4.2.1 Mitigation Measures

In accordance with the mitigating conditions, design controls and critical operating criteria summarised in **Table 10-7**, and those outlined in the NSW DSC and ANCOLD guidelines, BHOP would implement the following measures to ensure the stability of the TSF2:

- Embankment foundation inspection and approval process as part of quality assurance during construction;
- Water drainage system to prevent water pooling to be designed as part of embankment construction;
- Inclusion of geomembrane and filter curtain to cater for any differential settlement preventing erosion and slumping;
- Flood management – spillway design for a probable maximum flood (generally considered to be 1 in a million probability);
- Environmental containment freeboard – designed to a 1:10,000 annual exceedence probability (AEP), 72 hour event;
- Earthquake loading – seismic parameters OBE: 0.12 g, MDE/MCE: 0.2 g;
- Factors of safety for slope stability in line with industry practice for permanent slopes;
- Assessment for potential liquefaction risk of tailings where embankments are over tailings. Embankments 1 and 3 which are partially located over tailings. The required foundations minimum un-drained shear strength of 35 kPa and will be confirmed by vane shear and other geotechnical testing prior to construction; and
- Stormwater management on Embankments tied into the site stormwater management system.

10.4.2.2 Monitoring

The TMOM would be reviewed and updated to extend the surveillance monitoring program at the TSF2 to include the embankments, and to require:

- embankment integrity in weekly inspections; and
- inspections and monitoring for potential seepage from the embankments.

In accordance with the requirements of DSC, an annual TSF2 safety inspection and surveillance review would also be undertaken by an experienced tailing dam engineer independent of the company and would meet DSC requirements.

10.5 Water - Seepage

10.5.1 Impact Assessment - Seepage

Seepage may occur from TSF2 embankments. As part of the Design Report, Golder completed seepage modelling along representative cross sections of each TSF2 embankment to analyse potential seepage rates from future tailings.

Golder indicates that the tailings beach for the TSF2 would be operated with minimal water on the surface and any runoff or supernatant liquid would be collected at the decant pump located at the eastern edge of the pit. The current tailings beach at the current rate of rise is relatively dry with water generally ponded on the surface after rainfall events. The tailings is therefore in a desiccated state with a low permeability due to the unsaturated state of the tailings. Seepage through the tailings is therefore very slow given the low permeability.

Golder concluded that seepage from Embankments 1 and 2 are expected to be negligible because water would not pond near them due to the shape of the tailing beach and the only source of seepage is interstitial water from the tailings consolidation. At these locations the tailings is expected to be partially saturated due to the dry weather and relative low rate of rise of the tailings surface, as the surface reaches the base level of design embankments. Golder considered that adopting steady state saturated seepage conditions for these embankments was conservative and represented the upper bound of potential seepage rates.

Seepage from Embankment 2 was also expected to be very low and effectively negligible. Under general operating conditions no water is expected to pond next to Embankment 2, with only periodic short term ponding possibly next to Embankments 2 after rainfall events. Some wet tailings would also be placed next to the embankment periodically to shape the tailings beach. However the bulk mass of tailings next to the embankment is expected to be relatively dry and hence have a low permeability. Seepage from the tailing will primarily be retained by the geomembrane liner on the inside slope of the embankment. Any damage or defects in the geomembrane may result in some seepage flow past the geomembrane and into the sand layer and be collected in the seepage collection pipes. This seepage would occur if the location of the wet tailings or temporary ponded water coincides with the general location of the damage or defect. The seepage would effectively stop once the wet zone dries or temporary ponded water is removed. As tailings dries over any defect or damaged area, the tailings will effectively block the seepage path due to its low permeability.

Golder concluded that they did not expect seepage from Embankments 1 and 3 as there would be no water ponding adjacent to these embankments. At Embankment 2 Golder expected seepage rates from the drainage pipes in the embankment to be very low and effectively negligible.

Golder completed a risk review of potential seepage and provided mitigating conditions, design controls and critical operating criteria to minimmise risks. The results of this analysis are provided in **Table 10-8**.

Table 10-8 Golder - Risk Analysis and Design Controls - Seepage

Description	**Comments**	**Mitigating conditions, design controls and critical operating criteria**
Large water pond develops against the embankment causing hydraulic pressure resulting in seepage.	Only potentially applicable to Embankment 2 when decant pond forms against embankment during winter or following storm event.	Compacted rockfill embankment is robust and has a high shear strength. In addition a geosynthetic liner will be installed on the upstream slope of the embankment with an underlying seepage collection layer (Filter Sand) conveying seepage through defects in the geosynthetic liner to the seepage collection pipe. Conclusion: Very low risk
Seepage through an embankment results in progressive erosion of the embankment creating a “pipe” and inflow of sand/tailings resulting in a loss of containment.	Only applicable to Embankment 2 when decant pond forms against embankment during winter or following storm event.	The embankments will be constructed from non-dispersive material (Rockfill) with a geosynthetic liner installed on the upstream slope of the embankment with an underlying Filter Sand. The TMOM will include requirements to remove collected water on tailing beach to maximise tailings storage efficiency of the TSF. to manage piping failure. Conclusion: Very low risk
Seepage around a buried pipe results in progressive erosion of soil particles, with fine particles flowing through coarser particles and eventually creating a ‘pipe’ in the embankment that can result in a loss of containment.	Applicable for the Toe Drain Outlet pipes through embankments.	Toe Drain Outlet pipes include bentonite plugs to limit seepage pathways. Embankments are also constructed from free draining non-dispersive material (i.e. Rockfill) and the outlet pipe is a gravity flow pipe with no back pressure to develop high hydraulic gradient. Conclusion: Very low risk

In summary, Golder concluded that with the mitigating conditions, design controls and critical operating criteria in place, the overall risk of seepage is very low.

10.5.2 Mitigation Measures and Monitoring

10.5.2.1 Mitigation Measures

In accordance with the mitigating conditions, design controls and critical operating criteria summarised in **Table 10-8**, and those outlined in the NSW DSC and ANCOLD guidelines, BHOP would implement the following measures to minimise seepage risks associated with the TSF2:

- The base of each embankment would be compacted rockfill.
- A filter sand layer on the upstream slope of each embankment would be constructed for collection of potential seepage through any defects in the geomembrane, and to limit the potential of tailing migration through the embankment. The sand would also form a bedding layer for the geosynthetic liner over the rockfill.
- A seepage collection drain (perforated 150 mm diameter PVC or similar material pipe) would be installed in the filter sand along the upstream toe of each embankment. The pipe would be embedded in an aggregate layer to minimise migration of sand into the pipe perforations.
- A 2 mm thick high density polyethylene (HDPE) geomembrane liner would be installed on the upstream slope of embankment 2 and has been selected for this embankment as minimal settlement is expected as this embankment is to be founded on rock.
- Embankments 1 and 3 which are to be partially founded on tailing with an interface with the existing pit rock slopes may expect some differential settlement so a 2 mm thick linear low density polyethylene (LLDPE) would be installed on the upstream slopes of these embankments, which is more appropriate to conditions where deformation is expected. The LLDPE geomembrane would be installed with some slack to accommodate possible deformation and settlement of the embankment slope relative to the pit rock face.
- The geosynthetic liners would be anchored at the crest, along the toe and the ends of the embankments and ballast would be placed over the liner on the slopes to manage wind uplift and would be progressively buried by tailings.
- Upstream toe drains would be constructed to collect any potential seepage from the sand filter and convey collected seepage towards the seepage collection pits, located at the downstream toe of the embankments. The upstream toe drains are graded to low spots, from where the collected seepage is directed to the downstream (outer) edge of the embankment via gravity flow, into detention pits. The outlet pipe would include a seepage control plug around the pipe annulus. Collected seepage would minimal and would be pumped back onto the tailings and managed by evaporation.

10.5.2.2 Monitoring

Seepage collection outlet pipes would include inspection chambers, where appropriate to view flow rates from different portions of the embankment lengths. The BHOP Site Water Management Plan would be updated to include regular inspections and periodic monitoring from these locations.

10.6 Water - Stormwater

10.6.1 Impact Assessment

The existing stormwater management and collection system in the vicinity of the CBP would continue to be utilised during the construction and operation of the CBP. This system includes a series of diversion drains and a rainfall runoff storage pond (C28) with sufficient capacity to hold a 1:100 ARI rainfall event (refer to **Figure 6-5**). No additional risks have been identified to stormwater collection system as a result of the proposed installation of the CBP.

Golder's Design Report (**Appendix J**) for the proposed extension to the TSF2 includes additional measures to collect runoff from the outer slopes of the perimeter embankments and surface water runoff from rainfall. These design parameters are described in the following sections.

10.6.2 Mitigation Measures and Monitoring

10.6.2.1 Mitigation Measures

The TSF2 extension has been designed to manage stormwater flows and includes an emergency spillway with the required freeboard in accordance with DSC guidelines. Design considerations have also been provide for stormwater collection from the outer slopes of the embankments with rainfall to be contained within CML7 in a 1:100 AEP, 72 hour storm event. **Figure 10-10** indicates the predicted stormwater flows from the TSF2 embankments.

Figure 10-10 TSF2 Stormwater Catchment

Stormwater on the surface of the pit and supernatant water from the tailings would be directed to the northern end of the pit, using the current tailings deposition method, to a decant pond and would be pumped to the Processing Plant for use as process water. Should the ponded water exceed the environment freeboard containment, the emergency spillway would be activated. The environmental freeboard provides for a 1:10,000, 72 hour storm event or 334 mm of rain falling in the catchment area of the pit in 72 hours (48,800m^3). The average annual rainfall in Broken Hill is 260 mm which is fairly evenly distributed throughout the year, so the applied criteria provides for a very conservative design. The pit would have the capacity to retain 120,000 m^3 of water during Stage 1 and 50,000 m^3 of water during Stage 2.

Stormwater from Embankments 1 and 3 would be directed to the current stormwater management system and stormwater form Embankment 2 would be collected in a new Stormwater Collection Pond (designed to retain stormwater for a 1:100, 72 hour event) to be located to the north east of the embankment. The approximate dimensions of the pond are 30 m x 15 m x 1.5 m deep. The pond is intended to be an evaporation pond similar to the other stormwater control ponds at the site.

10.6.2.2 Monitoring

The BHOP Site Water Management Plan would be updated to include surface water monitoring of the new proposed TSF2 Stormwater Collection Pond.

10.7 Heritage

Two unoccupied heritage buildings, British Flats and the Old Mine Residence No. 27, are located adjacent to and mid-way along the north-west side of the proposed TSF2 extension.

The British Flats building is heritage listed in Broken Hill City Council *Local Environment Plan* (LEP, 2013) (Item I21) (refer to **Photograph 10-2**). The early British BHP general and assay offices were built at the British Flats location in 1888, as two separate buildings. In 1919 a new set of general and assay offices were built as one building and this is the building still standing. Part of the building was converted to flats in 1936 with the rest in 1946.

Photograph 10-2 British Flats

The Old Mine Residence No. 27 are also know as Block 14 Flats (Residences 27a and 27b) (**Photographs 10-3 and 10-4**). The building is not listed as a heritage item and there is no available information about its construction. From its appearance and architecture it would appear to have been built around 1900 as a mine manager's residence. In the early 2000's renovations were undertaken by the Broken Hill Skills Centre Incorporated as part of the Work for the Dole program funded by the commonwealth Government. Although there has been no on-going maintenance or repair the structure appears sound and is in reasonable condition.

Although these buildings are located on CML7, they are owned by the Line of Lode Reserve Trust and managed by Department of Primary Industry – Lands (DPI-Lands). Both buildings are unoccupied and there are no known plans for their use.

Photograph 10-3 Old Mine Residence

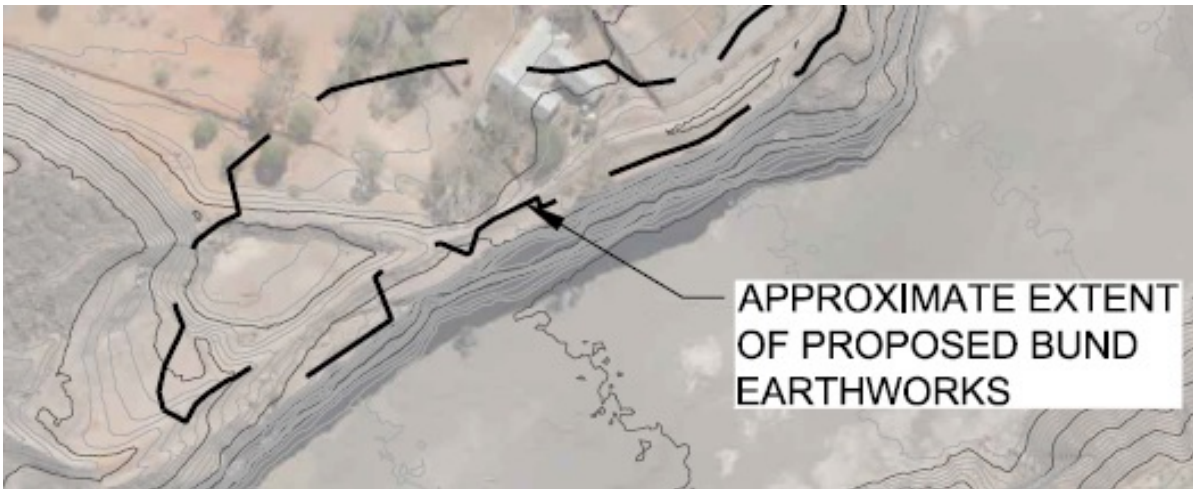
Photograph 10-4 Rear of Old Mining Residence Showing Proximity to Pit

10.7.1 Impact Assessment

The proposed location of Embankment 2 of TSF2 has been designed to avoid any impact to the British Flats. The pit safety bund adjacent to this building would undergo some repair to ensure its ongoing integrity.

The original design of Embankment 1 included a downward slope to the embankment, which would have engulfed the Old Mine Residence No. 27 and require the building to be demolished (refer to **Figure 10-11**).

Figure 10-11 Original Design Proposed for Embankment 1

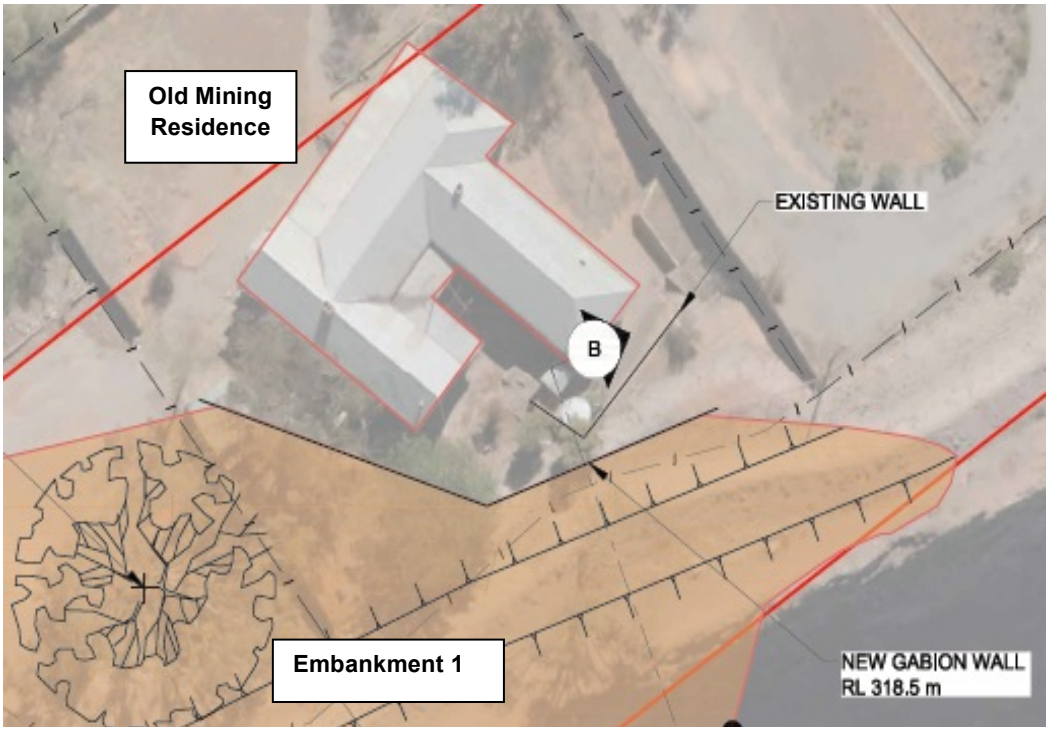


10.7.2 Mitigation Measures and Monitoring

10.7.2.1 Mitigation Measures

BHOP requested Golder to revisit the design with the view of retaining the building. This review resulted in the design of a retaining wall to restrict the embankment slope from the edge of an existing retaining wall next to the old mine residence. The retaining wall would maintain separation from the old mine residence and the existing retaining wall, protecting these structures (refer to **Figure 10-12**).

Figure 10-12 Revised Design for Embankment



10.7.2.2 Monitoring

Inspections of this area form part of the current site inspection program, and no change is considered necessary as a result of the Modification.

10.8 Visual Amenity

10.8.1 Impact Assessment – Visual Amenity

Concrete Batching Plant:

The CBP would cover an area of approximately 3,500 m^2, with the height of its tallest structure, the cement silo, being approximately 10 m. This height is similar to the existing Backfill Plant (8.8 m), which was constructed as part of the original PA. The top of the CBP (and the current Backfill Plant) would be visible from some areas of Crystal Street and potentially from the Café located on a waste rock hill within CML7 to the north.

TSF2:

The TSF2 embankments would result in minimal change to the visual aspect of the Line of Lode hill from Crystal Street, Federation Way and Menindee Road. However this will be in keeping with the current mining profile of CML7.

The Embankment 1 would be seen from Crystal Street, Federation Way, the road to the Café and Miners Memorial. The visual landscape is considered to be consistent with the waste rock dumps in the area. The embankment commences at a height of 322 m and would be keyed into the current waste rock bund which rises 345 m to the west. It would then be sloped downwards to the top of the current pit safety bund at 320 m, where it will adjoin the retaining wall. **Photograph 10-5** provides an impression of the embankment as viewed from Crystal Street.

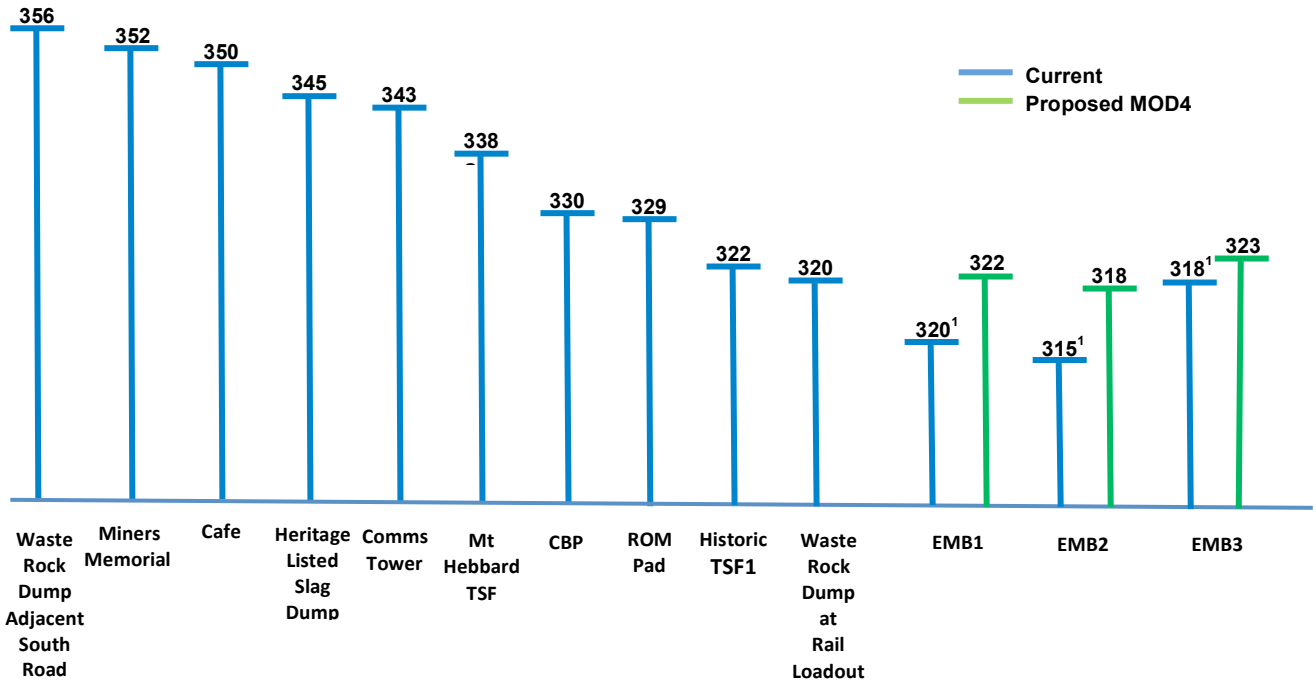
The retaining wall would only be visible from the Old Mine Residence No 27 and Proprietary Square directly adjacent the TSF2.

Photograph 10-5 Impression of Embankment 1 Looking from Crystal Street

Embankment 2 would be partly visible from Crystal Street and Menindee Road rising about up to 3 m above the current waste rock bund (refer to **Figures 10-13** and **10-14**). Embankment 3 would not be visible from residential areas. It may be seen from the Miners Memorial lookout but would appear consistent with the surrounding mining landscape.

Overall the TSF2 landform would be consistent with the surrounding area and mining aspects of the Line of Lode.

Figure 10-13 Height of Line of Lode Features / Structures (m)



Note 1 - Height taken from top of current bund.

Figure 10-14 Impression of Embankments

10.8.2 Mitigation Measures and Monitoring

10.8.2.1 Mitigation Measures

The CBP would be surrounded by a 6 m high noise abatement bund, which would restrict the view of most of the structure. Overall the TSF2 landform and CBP would be consistent with the surrounding area and mining aspects of the Line of Lode.

10.9 Traffic & Transport

10.9.1 Impact Assessment – Traffic and Transport

Concrete Batching Plant

There would be a number of changes to traffic and transport movements in relation to the construction and operation of the CBP. The construction of the CBP is anticipated to be completed in 5 weeks, and would involve laying foundations and erecting the plant which has been fabricated off-site. During this period current concrete/fibrecrete deliveries from off-site would continue, together with the operation of construction equipment and deliveries of required CBP inputs of cement, sand, admixtures and aggregate deliveries. The major impact during this period would be from on-site vehicle traffic, in particularly the construction of the 6 m noise abatement bund which will include up to 385 vehicle trips over the 5 week period (approximately 15 trips per day) from Kintore Pit to the CBP transporting waste rock.

Once in operation, on-site vehicle activities would increase with cement deliveries from the Rail Loadout to the CBP (21 per month) and fibrecrete to the Mine Portal (250 per month). Refer to **Figure 6-3** for the proposed transport routes.

Following completion of construction the normal operating conditions would result in a decrease in off-site road traffic through a decrease of approximately 50% of Agi-truck deliveries. Overall, the off-site traffic would reduce fro 108 to 50 vehicle movement per month.

TSF2

There would be an increase in vehicle movements during construction of the embankments, retaining wall and spillway, primarily transporting waste rock materials from Kintore Pit to each area. Other vehicle movements would include the water truck operating at all times during the construction works and Agi-truck deliveries of concrete from the CBP (approximately 115 deliveries over the total construction period). There would also be few off-site deliveries for these works and no impacts are anticipated to public roads.

Table 10-9 provides a summary of the major vehicle movements during the construction phase. Each structure would be constructed sequentially.

Table 10-9 Summary of Vehicle Movements - TSF Extension

Structure	Number of vehicle return trips	Construction Period (weeks)	Vehicle Movements working Days	
			Day	Hour
Embankment 1 and Retaining Wall	1503	15	18	1.6
Embankment 2 and Spillway	3660	25	27	2.4
Embankment 3	1997	16	23	2.1

There would be no additional vehicle movements for normal TSF2 operations.

10.9.2 Mitigation Measures and Monitoring

10.9.2.1 Mitigation Measures

Potential impacts of increased noise and dust from vehicle movements, as well as applicable mitigation and management measures, are addressed in **Sections 10.1** and **10.2** of this EA.

BHOP has committed to restricting construction activities to 7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturdays, with no work on Sundays or Public holidays.

10.10 Rehabilitation Strategy

The Mine rehabilitation strategy generally remains unchanged for this Modification.

The existing / approved rehabilitation principles and objectives for the Mine are to return the site to suitable commercial and / or educational uses, preserving the heritage value of the site and heritage buildings as agreed with regulators, the community and the Mine.

The following mine specific rehabilitation objectives were developed in response to regulatory and community requirements and identified risks. These objectives are consistent with those listed in the current Project Approval, Schedule 3 Conditions 34 and 35:

- Conserve heritage items, as agreed, and make them accessible;
- Undertake closure stormwater management initiatives to minimise erosion and restrict the potential for off-site pollution;
- Provide final landforms that are safe, stable, non-polluting and sympathetic to the mining heritage of Broken Hill;
- Install covers which enhance landform stability, minimise dust generation and adequately contain potentially hazardous material within the landform;
- Seal and/ or treat ‘free areas’ of the site and other potential sources of wind-blown dust to prevent the emission of dust following closure;
- Install barriers to restrict access to potentially hazardous locations (i.e. decline, shafts or open cut pits); and
- Meet the expectations and preferences, where possible, of the local community for post-mining land use for tourism.

These rehabilitation objectives have yet to be agreed with DRE.

The rehabilitation proposals provided below for the CBP and TSF2 are consistent with the DRE Rehabilitation Cost Estimate (RCE) required by the DRE in January 2015.

10.10.1 Concrete Batching Plant

The CBP would be erected in an area that is already highly disturbed and has been denuded of any vegetation. The area has been included in the current mine footprint. Along with all other non-heritage listed structures on CML7, the CBP would be demolished when the Mine ceases operation and waste rock would be placed over any areas that may have the capacity for dust entrainment by wind to reduce the potential for dust deposition over the township of Broken Hill. The noise abatement bund would be left in-situ as it is consistent with the current historic profile of the Hill and its removal would result in excessive unnecessary dust.

10.10.2 TSF2

The surrounding area of TSF2 is already highly disturbed and has been included in the original footprint disturbance. Embankment 1 would be placed partially over a small area close to the Old Mining Residence No. 27, which would result in an increase to the land disturbance footprint (0.2 Ha).

The primary objectives for closure of TSF2 are to manage the following:

- ***Safety*** – providing a final surface, which does not expose the public to chemical and physical hazards, particularly from the generation of dust.
- ***Stability*** – ability for the landform to remain stable over an extended period beyond closure, e.g. withstand large earthquakes and flood events, as well as continuous erosion forces from air and water.
- ***Seepage and groundwater*** – managing infiltration such that transportation of contaminants either to groundwater and/or surface water bodies will not impact receptors adversely.
- ***Erosion and sediment load*** – resistance to wind and water energy which may degrade the final surface and result in transportation of sediments to the external environment.
- ***Aesthetics*** – ability to blend into the natural environment and support intended end land uses.

In the final stages of tailings deposition the delivery system would be realigned to also discharge tailings from along the crest of Embankment 2 shaping the surface to direct runoff towards the spillway. The tailings beach surface near the spillway would be shaped by selective tailings placement from Embankment 2 to fill the environment containment freeboard to a point that the remaining depression below the spillway level would contain the 1:100 year 72 hour rainfall runoff event from the TSF2 catchment area.

Following deposition of the tailings to the designed level an application of chemical dust suppressant would be applied through the water spray system to minimise dust entrainment by wind while the tailings are allowed to settle and consolidate. Ponding water would be allowed to evaporate or be recirculated over the dryer part of the beach to remove the water from the low areas and promote drying of the tailings prior to the placement of cover material. It is expected that the tailings beach may be accessible for construction works within a few months after final placement of tailings.

The surface of the TSF2 would be covered progressively with waste rock sourced from Kintore Pit. Access over the tailing would be by end tipping the waste rock material on previously spread material with vehicles travelling on the previously placed material only. No vehicles would be permitted to travel directly on the tailings surface and disturb the dust control crust on the tailing surface. During these activities monitoring would continue from the monitoring station located adjacent to the Pit (and at other monitoring stations across the site).

A conceptual design of the cover layer has been prepared and comprises:

- A 200 mm thick capillary break layer formed of screened waste rock placed over the tailings surface.
- A 300 mm thick cover formed of compacted run of mine waste rock. The mine waste rock would contain sufficient fines to create a well graded rockfill after compaction. The rockfill would be watered and compacted using heavy smooth drum compaction equipment. The cover would be robust and resistant to wind and water erosion. Studies would be conducted to determine if a further in-fill layer is required and the thickness of this additional layer (the current rehabilitation cover thickness allows for 1 m).

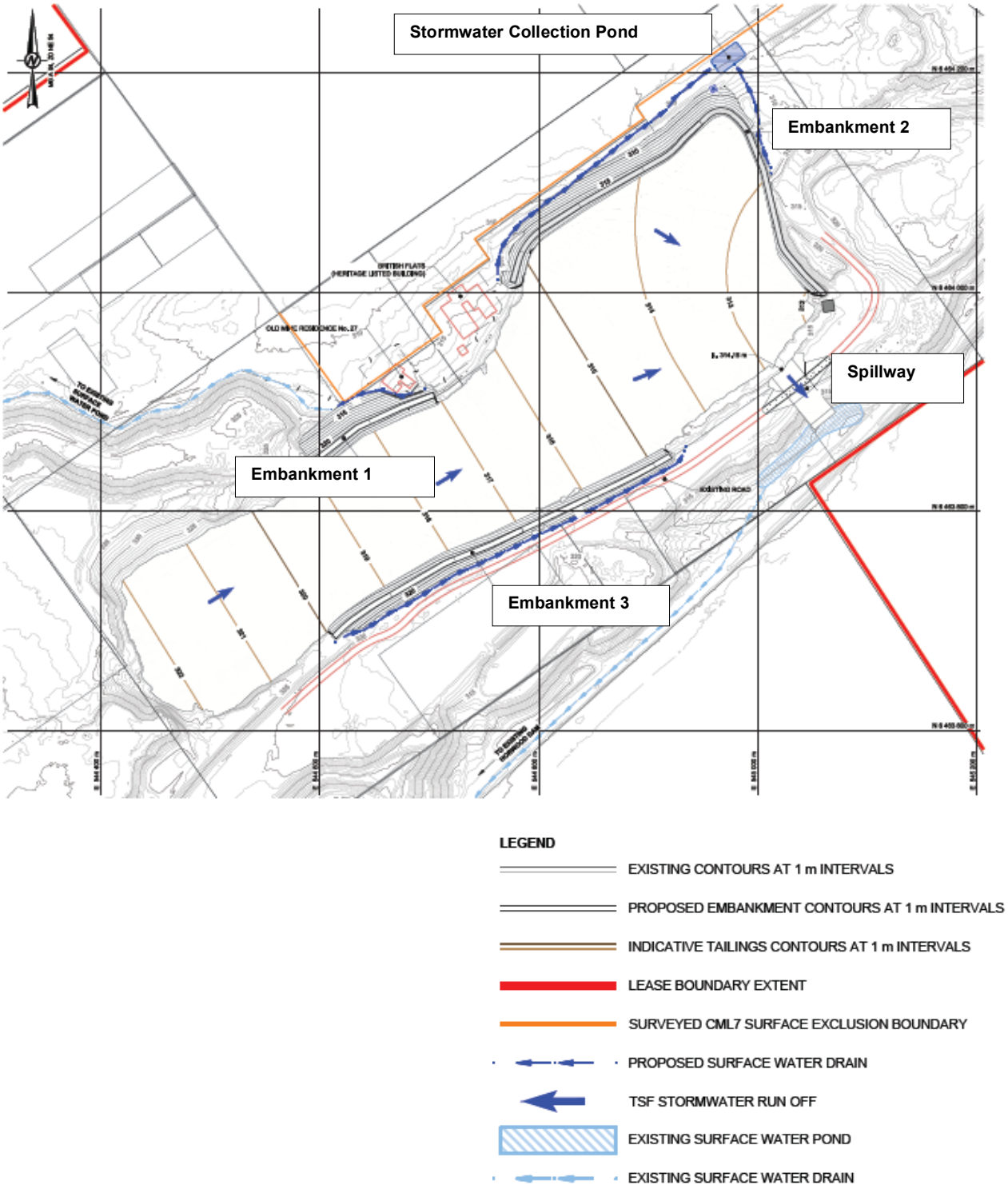
The cover layer would be constructed over the entire tailings surface and be integrated into the in-situ rock on the Pit rim and the embankment rockfill. The surface would be shaped to shed water towards the low area near the spillway, with runoff in excess of 1 in 100 year events discharging through the spillway.

The embankments are designed with 2.5H:1V downstream slopes which are appropriate for closure and long term stability of the rockfill embankments. The embankments would be constructed from durable compacted rockfill. Wind and rain erosion of the embankments is expected to be minimal. No further rehabilitation of the downstream embankment slopes is envisaged.

Seepage flow rate from the collection system within the embankments will be monitored periodically. Where the seepage rate has stopped the sumps may be decommissioned and removed. Removed sumps and any other removed materials would be disposed as part of the mine rehabilitation procedure to underground voids or other tailings storage facility.

The proposed stormwater management of TSF2 at closure is presented in **Figure 10-15** below.

Figure 10-15 TSF2 Stormwater Management at Closure



If this Modification is approved, the existing site Mining Operations Plan (MOP) would be updated to include the agreed rehabilitation strategies applicable to the CBP area and the TSF2.

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11.0 PROPOSED STATEMENT OF COMMITMENTS

*This Section lists management commitments to be implemented as a result of the Modification, these are **in addition** to the current Statement of Commitments.*

11.1 Noise

The following additional mitigation measures will be implemented:

- Batching and slumping to occur in a concrete[6] enclosure;
- Cover the conveyor at the CBP used for transport of aggregate to the hopper;
- A small size front-end loader will be used at the CBP (SPL 102 dB(A));
- A 6 m high noise abatement bund will be constructed at the perimeter of the CBP to the north-west and south-west (dual purpose for noise and visual amenity);
- Prior to construction of the CBP and TSF2 extension incorporate into the Construction Environment Management Plan all identified reasonable and feasible measures to minimise noise during construction; and
- Construction work will only be undertaken during Monday to Friday from 7 am to 6 pm, Saturdays from 8 am to 1 pm, and no work on Sundays or public holidays.

11.2 Embankment / Wall Failure

The following additional mitigation measures will be implemented:

- All NSW DSC requirements in relation the TSF2 design, inspection and monitoring; and
- Review and update the existing TMOM to include additional inspection and monitoring requirements for the TSF2.

11.3 Air Quality

The following mitigation measures will be implemented:

- Install and operate an automated water spray system covering the surface of TSF2 connected to both the current TEOM located adjacent TSF2 and the new monitoring PM_{10} unit to be installed on a ramp within TSF2;
- Develop and implement a procedure for triggering the activation of the TSF2 water spray system based on monitoring air quality data, wind speed and direction;
- Minimising disturbance of the tailings surface crust which acts to reduce dust generation;
- Test and select waste rock from Kintore Pit so that waste rock used averages no more than 0.5% lead;
- Implement a meteorological forecasting system which activates dust management initiatives including an alert system for potential dust generating activities when winds are 40 kph, and an alarm system for when winds are 50 kph or greater to indicate dust generating activities are to cease; and
- Prior to construction of the CBP and TSF2 extension incorporate into the Construction Environment Management Plan specific mitigation and management measures to be implemented to control dust during construction.

[6] Or an enclosure constructed of material that has the same or higher acoustic attenuation qualities.

11.4 Water - Seepage

The following mitigation measures will be implemented:

- Incorporate TSF2 seepage controls recommended by Golder and as required by the DSC;
- Line each embankment of the TSF with a geomembrane liner;
- Collect seepage in a filter sand layer on the upstream slope of each embankment of the TSF extension where collection drains will be installed; and
- Periodically monitor seepage at the TSF extension via inspection chambers installed on the drainage pipes.

11.5 Water – Stormwater

The following mitigation measures will be implemented:

- Review and update the BHOP Site Water Management Plan to address stormwater management at the CBP and TSF2 embankments to collect and retain a 1:100 year, 72 hour rainfall event; and
- Construct a spillway at TSF2 to meet the NSW DSC requirements.

11.6 Heritage

The following mitigation measures will be implemented:

- Construct a retaining wall to protect the Old Mining Residence No. 27 adjacent to the TSF2.

11.7 Visual Amenity

The following mitigation measures will be implemented:

- A 6 m high noise abatement bund will be constructed at the perimeter of the CBP to the north-west and south-west (dual purpose for noise and visual amenity).

11.8 Traffic and Transport

The following mitigation measures will be implemented:

- Construction work to only be undertaken during Monday to Friday from 7 am to 6 pm, Saturdays from 8 am to 1 pm, and no work on Sundays or public holidays; and
- Deliveries to be restricted to 7 am to 6 pm Monday to Friday without prior authorisation.

11.9 Waste

Wastes will be managed in accordance with the BHOP Waste Management Plan. There are no additional mitigation measure resulting from MOD4.

11.10 Rehabilitation

The following mitigation measures will be implemented:

- Conduct investigation and/or studies to confirm cover layer design and thickness, details to be outlined in the amendment to the MOP;
- Address stormwater management by directing TSF2 surface water to the spillway;
- Monitor seepage flows and decommission pipework and pumps when confirmed has stopped and will not continue.

12.0 CONCLUSION

This section provides a justification for the Modification as sought and concluding comments.

BHOP is seeking approval for a minor Modification (MOD4) to the Project Approval to:

- install a CBP for the manufacture of fibrecrete and concrete for use at the Mine; and
- extend the life of the TSF2 by installing embankments and a retaining wall at low points along its perimeter.

BHOP has committed to continue implementing existing mitigation and management measures and, where required, implement additional measures to minimise potential impacts as a result of this Modification. This EA has demonstrated that, with these measures in place, the proposed Modification can be undertaken within acceptable standards and with no significant impacts to the environment or the community.

The proposed minor Modification would result in a range of benefits, including:

- allow BHOP to produce fibrecrete and concrete on-site and save approximately $900,000 per annum;
- significantly reduce the number of heavy vehicles transporting fibrecrete and concrete to site on local roads;
- allow the extension of the life of the TSF2 by approximately 2 years to mid-2021 and allow BHOP time to complete investigations into future options for on-site and/or off-site tailings storage;
- ensure continued employment of 195 full-time employees plus an additional 2 employees; and
- Allow BHOP to continue to support the economic growth of Broken Hill.

Without approval of the Modification the Rasp Mine will cease operation in October 2019 and the benefits of the project listed above would not be realised.

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13.0 ACRYNOMS

Ag	Silver
AQIA	Air Quality Impact Assessment
AQMP	Air Quality Management Plan
BHCC	Broken Hill City Council
BHOP	Broken Hill Operations Pty Ltd
CBH	CBH Resources Ltd
CBP	Concrete Batching Plant
CLMP	Community Lead Management Plan
CML7	Consolidated Mining Lease 7
CMP	Conservation Management Plan
DCP	Development Control Plan
DP&E	Department of Planning & Environment
DP&I	Department of Planning & Infrastructure
DRE	Department of Trade & Investment, Division of Resources & Energy
EA	Environment Assessment
EL	Exploration Lease
EMS	Environment Management Strategy
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environment Protection Licence 12559
GHG	Greenhouse Gas
g/t	Grams per tonne
Ha	Hectares
HVAS	High Volume Air Sampler
km	Kilometres
LEP	Local Environment Plan 2013
LOLA	Line of Lode Association
LOLRT	Ling of Lode Reserve Trust
m	Metres
MMM	Minerals Mining & Metallurgy Ltd
NML	Construction Noise Management Levels
MOP	Mining Operations Plan
MPL	Mining Purpose Lease
NIA	Noise Impact Assessment
Normandy	Normandy Mining Investments
NSW	New South Wales
PA	Project Approval

Pb	Lead
Perilya	Perilya Broken Hill Operations Pty Ltd
PM_{10}	Particulate matter with equivalent aerodynamic diameter of 10
PPR	Preferred Project Report
REF	Review of Environmental Factors
SEE	Statement of Environment Effects
SEPP	State Environment Planning Policy
SWMP	Site Water Management Plan
t	Tonnes
TARP	Trigger and Action Response Plan
TEOM	Tapered Element Oscillating Microbalance
tpa	Tonnes per annum
tph	Tonnes per hour
TMP	Traffic Management Plan
TSF2	Blackwood Pit – Tailings Storage Facility
TSP	Total Suspended Particulates
µg/m3	microgram/cubic metre
WMP	Waste Management Plan
Zn	Zinc

Appendix A

Project Approval 07_0018 MOD3

Department of Planning and Environment

March 2015

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Appendix B

Consolidated Mining Lease 7

Mining Lease Conditions

2004

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Appendix C

Preliminary Information Paper

Modification 4

Concrete Batching Plant and TSF2 (Blackwood Pit) Extension

Rasp Mine

Broken Hill Operations Pty Ltd

August 2016

Appendix D

Letter to Mr R Williamson

Re: Rasp Mine Proposed Modification (MOD4)

Mr C Preshaw

Department of Planning and Environment

15 September 2016

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Appendix E

Letter to Mr V Sulicich

Re: Variation of Environment Protection Licence

Mr D Wallett, Environment Protection Agency

9 September 2016, Ref: EF13/4102; DOC16/424128-01

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Appendix F

Letter to Ms G Wilson

Re: Preliminary Paper – Project Approval 0018_07 for the Rasp Mine

Mr Z West

Division of Resources & Energy

Ref: OUT16/32274

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Appendix G

Preliminary Construction Schedule

Broken Hill Operations Pty Ltd

December 2016

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Appendix H

Rasp Mine Modification 4

Concrete batching plant and TSF2 (Blackwood Pit) extension

Noise Impact Assessment

EMM Consulting Pty Ltd

March 2017

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Appendix I

Air Quality Assessment for the Rasp Mine MOD4

Pacific Environment Limited

March 2017

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Appendix J(a)

Design Report for the Blackwood Pit Tailing Storage Facility Extension

Golder Associates Pty Ltd

March 2017

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Appendix J(b)

Independent Review of the Rasp Mine Blackwood Pit Tailings Storage Facility Extension

Bruce Brown Consulting Pty Ltd

11 November 2016

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Appendix K

Rasp Mine Project Approval Classification of Waste Rock

Pacific Environment Limited

March 2017

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Appendix L

Does Modification 4 at Rasp Mine Need a Health Risk Assessment?

Toxicology Consulting Australasia

March 2017

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Appendix M

Dam Safety Committee (DSC) Blackwood Pit TSF2

Prescription Letter

9 December 2016

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Appendix N

Community Presentation

17 December 2016