



BENGALLA MINE

Development Consent Modification 4
Statement of Environmental Effects

for

Bengalla Mining Company Pty Limited

December 2017

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

BENGALLA MINE

DEVELOPMENT CONSENT SSD-5170
MODIFICATION 4
STATEMENT OF ENVIRONMENTAL EFFECTS

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December 2017

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1 OVERVIEW

This section provides an overview of Bengalla Mine, introduces the proponent and outlines the purpose and structure of this Statement of Environmental Effects (SEE).

1.1 BACKGROUND

Bengalla Mining Company Pty Limited (BMC) operates the Bengalla Mine (Bengalla) in the Upper Hunter Valley of NSW. Bengalla is situated approximately 130 km north-west of Newcastle and 4 km west of the township of Muswellbrook.

BMC holds Development Consent SSD-5170 (as modified) (SSD-5170) under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to enable continued open cut coal mining operations and associated activities at Bengalla to 2039.

Figure 1 is the approved conceptual development layout.

SSD-5170 is supported by the '*Continuation of Bengalla Mine Environmental Impact Statement'* (Bengalla EIS) (Hansen Bailey, 2013) as modified by the *'Continuation of Bengalla Mine Response to Submissions'* (RTS) (Hansen Bailey, 2014).

SSD-5170 has been modified three times. Modification 1 (MOD 1) was granted under Section 96(2) of the EP&A Act on 16 December 2015 enabling the alteration to various water management infrastructure and relocation of an explosives storage facility. MOD 1 is supported by the *'Bengalla Mine Development Consent Modification Statement of Environmental Effects'* (MOD 1 SEE) (Hansen Bailey, 2015) and *'Bengalla Mine Response to Submissions Development Consent Modification 1'* (Hansen Bailey, 2015b).

Modification 2 (MOD 2) granted under Section 96(2) of the EP&A Act on 1 July 2016 authorises the alteration of the approved Main Overburden Emplacement Area (OEA) to improve visual amenity and establish a new access road. This application was supported by the '*Bengalla Mine Development Consent Modification Statement of Environmental Effects'* (MOD 2 SEE) (Hansen Bailey, 2016a) and *'Bengalla Mine Response to Submissions Development Consent Modification 2'* (Hansen Bailey, 2016b).

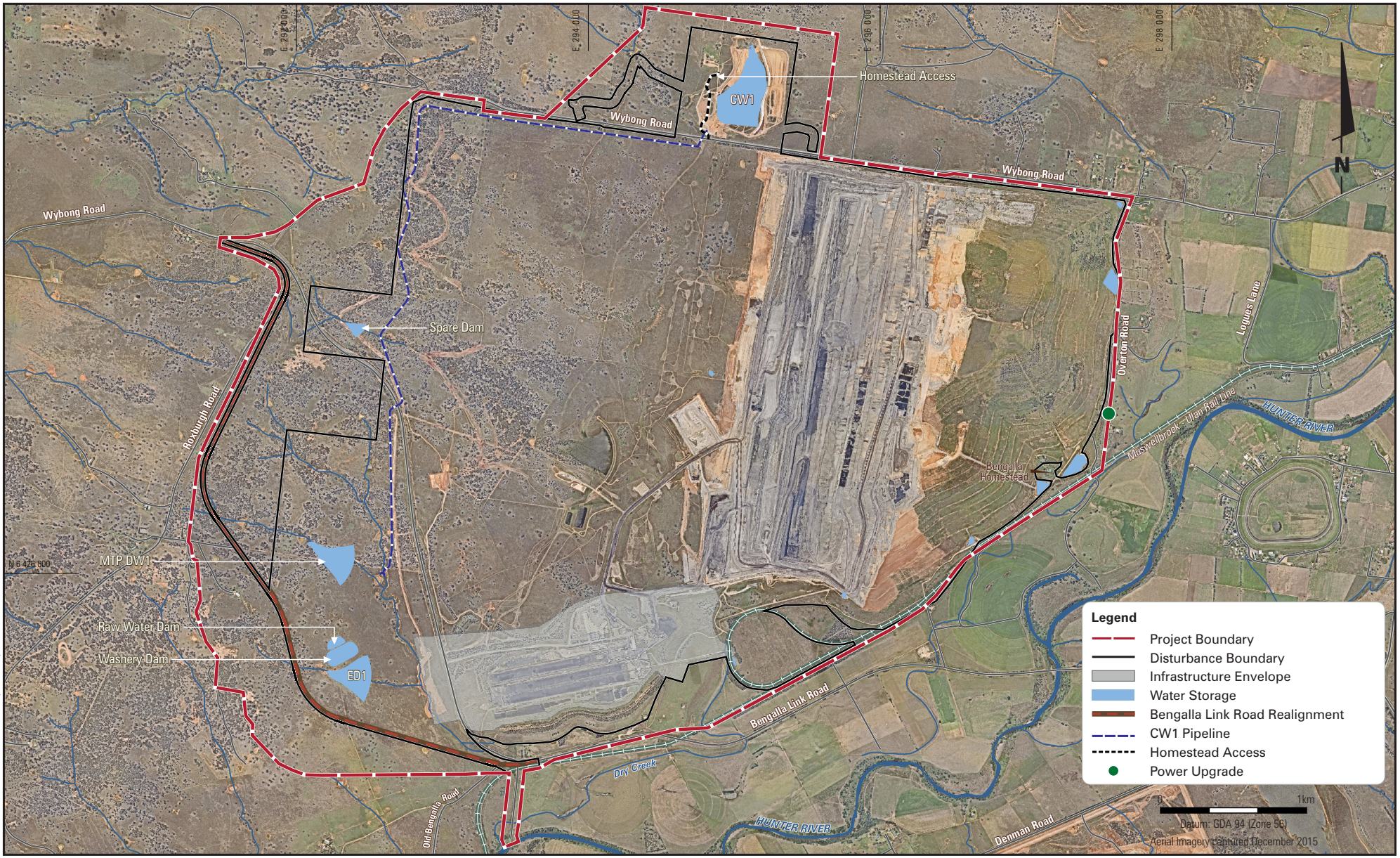
Modification 3 (MOD 3) granted under Section 96(2) of the EP&A Act on 23 December 2016 authorises minor changes to facilitate adjustments to the positioning and operation of an explosives facility and reload facility; Hunter River pipeline and emplacement and use of temporary topsoil stockpiles during the mining process. This application was supported by the '*Bengalla Mine Development Consent Modification Statement of Environmental Effects'* (MOD 3 SEE) (Hansen Bailey, 2016c) and *'Bengalla Mine Response to Submissions Development Consent Modification 3'* (Hansen Bailey, 2016d).

1.2 DOCUMENT PURPOSE

This Statement of Environmental Effects (SEE) has been prepared to support an application for Modification 4 under Section 96(2) of the EP&A Act (MOD 4).

MOD 4 generally seeks:

- Amendments to the approved water management system;
- To temporarily store earthen materials associated with dam construction and other identified suitable clay material required for the future Dry Creek reinstatement;
- Increase the capacity of (and an additional locations for) Run of Mine (ROM) coal stockpiles; and
- Additional storage locations for temporary emplacement of coal processing reject material.



HB BENGALLA MOD 4 1655 F1 Development Layout 04 12 2017

BENGALLA MINE

Conceptual Development Layout

FIGURE 1

1.3 PROPONENT

The proponent is BMC which is owned by the Bengalla Joint Venture (BJV).

The BJV comprises:

- New Hope Bengalla Pty Limited 40%;
- Wesfarmers Bengalla Limited (a wholly owned subsidiary of Wesfarmers Limited) 40%;
- Taipower Bengalla Pty Limited (a wholly owned subsidiary of Taiwan Power Company) 10%; and
- Mitsui Bengalla Investment Pty Limited (a wholly owned subsidiary of Mitsui Coal Holdings Pty Limited) 10%.

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Website: http://www.bengalla.com.au/

1.4 ENVIRONMENTAL MANAGEMENT SYSTEM

Environmental management is an integral part of BMC's business. BMC manage any activities that have potential to impact on the environment. This includes coal mining operations, coal handling and processing operations, construction and all the support services associated with the business.

The prevention and management of the potential and actual environmental impacts from BMC's mining activities is achieved through:

- Taking a systematic approach;
- Taking preventive action in preference to reactive correction; and
- BMC working to improve environmental performance.

BMC has an approved Environmental Management Strategy and operates under a series of Environmental Management Plans (EMPs) as required by SSD-5170. A list of the currently approved EMPs is provided in **Table 1**.

1.5 DOCUMENT STRUCTURE

Section 2 provides a description of MOD 4 activities compared to that which are approved;

Section 3 includes a brief discussion on the applicable regulatory framework;

Section 4 outlines the stakeholder consultation conducted;

Section 5 presents an environmental risk assessment;

Section 6 provides a discussion on the environmental impacts from MOD 4 and identifies any required additional mitigation requirements;

Section 7 provides a conclusion; and

Section 8 and **Section 9** each define the abbreviations used throughout this SEE and a list of relevant reference materials.

Table 1
BMC SSD-5170 Management Plans

Environmental Management Plans	
Visual Impact Mitigation Plan	Environmental Management Strategy
Historic Heritage Management Plan	Air Quality Management Plan
Rehabilitation Management Plan	Blast Management Plan
Water Management Plan	Aboriginal Cultural Heritage Management Plan
Noise Management Plan	Biodiversity Management Plan
Pollution Incident Response Management Plan	Biodiversity Offset Management Plan

2 MODIFICATION DESCRIPTION

This section provides an overview and description of MOD 4. It includes a discussion on the need for MOD 4.

BMC is seeking approval from the NSW Minister for Planning for a modification to SSD-5170 under Section 96(2) of the EP&A Act to facilitate the following:

- Changes to the approved water management system to reflect operations at Bengalla including proposed enlargement of the approved Staged Discharge Dam (ED1), and construction and use of the Dry Creek East Dam;
- Temporary storage of approximately 2,500 m^3 of excess materials from the construction of ED1;
- Increase in the capacity and additional locations of ROM coal stockpiles;
- Additional storage locations for temporary emplacement of coal processing reject material, prior to permanent emplacement; and
- Temporary clay emplacement within the Main OEA or to the west of this for later use in the reinstatement of Dry Creek.

MOD 4 interactions with the approved conceptual mine plans for each of Year 4 and Year 24 are presented on **Figure 2** and **Figure 3**.

All of MOD 4 activities are within the already approved Project Boundary and Disturbance Boundary. No changes are being sought to the extent or intensity of mining, the approved mining method or mine equipment fleet.

The following sections provide a more detailed description of MOD 4.

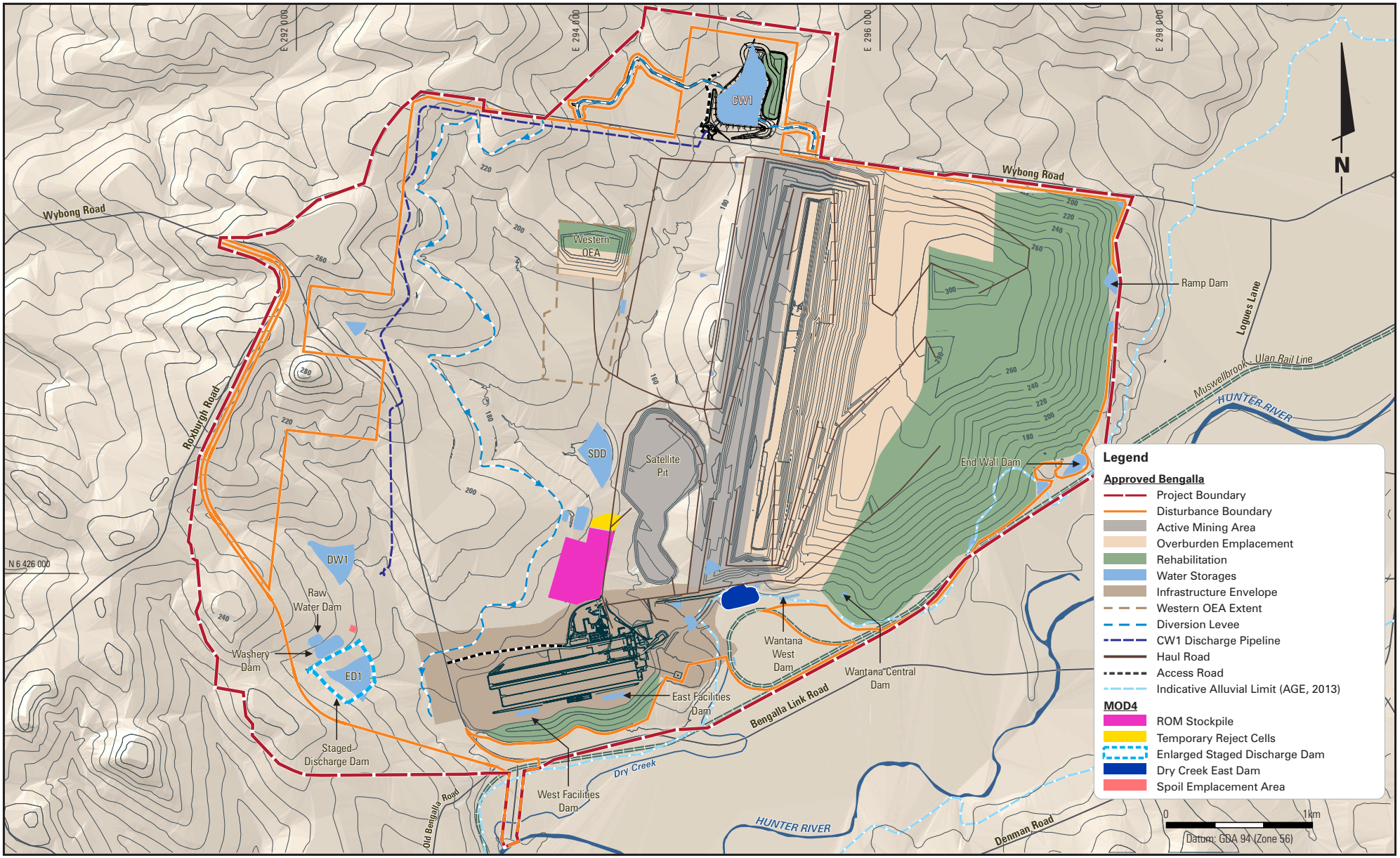
2.1 WATER MANAGEMENT SYSTEM

2.1.1 Approved Activity

Bengalla EIS

Section 4.1 of the Bengalla EIS described the continued use and upgrade of existing water management infrastructure and construction of new water management infrastructure. Section 8.6.2 describes the "…*relocation of water storage infrastructure as mining progresses through existing dams (including the Staged Discharge Dam and raw water dam)*…" and "…*The Project will require the relocation of the Staged Discharge Dam and the discharge point to the location shown on Figure 50*."

Table 47 of the Bengalla EIS describes indicative water management system storage capacities and indicates that the relocated ED1 will have a nominal operating capacity of 300 ML, which was largely to replicate the existing Staged Discharge Dam (SDD) (constructed in 1997).



HB BENGALLA MOD 4 1655 F2 Modification Overview - Year 4 Mine Plan 04 12 2017 Rev E

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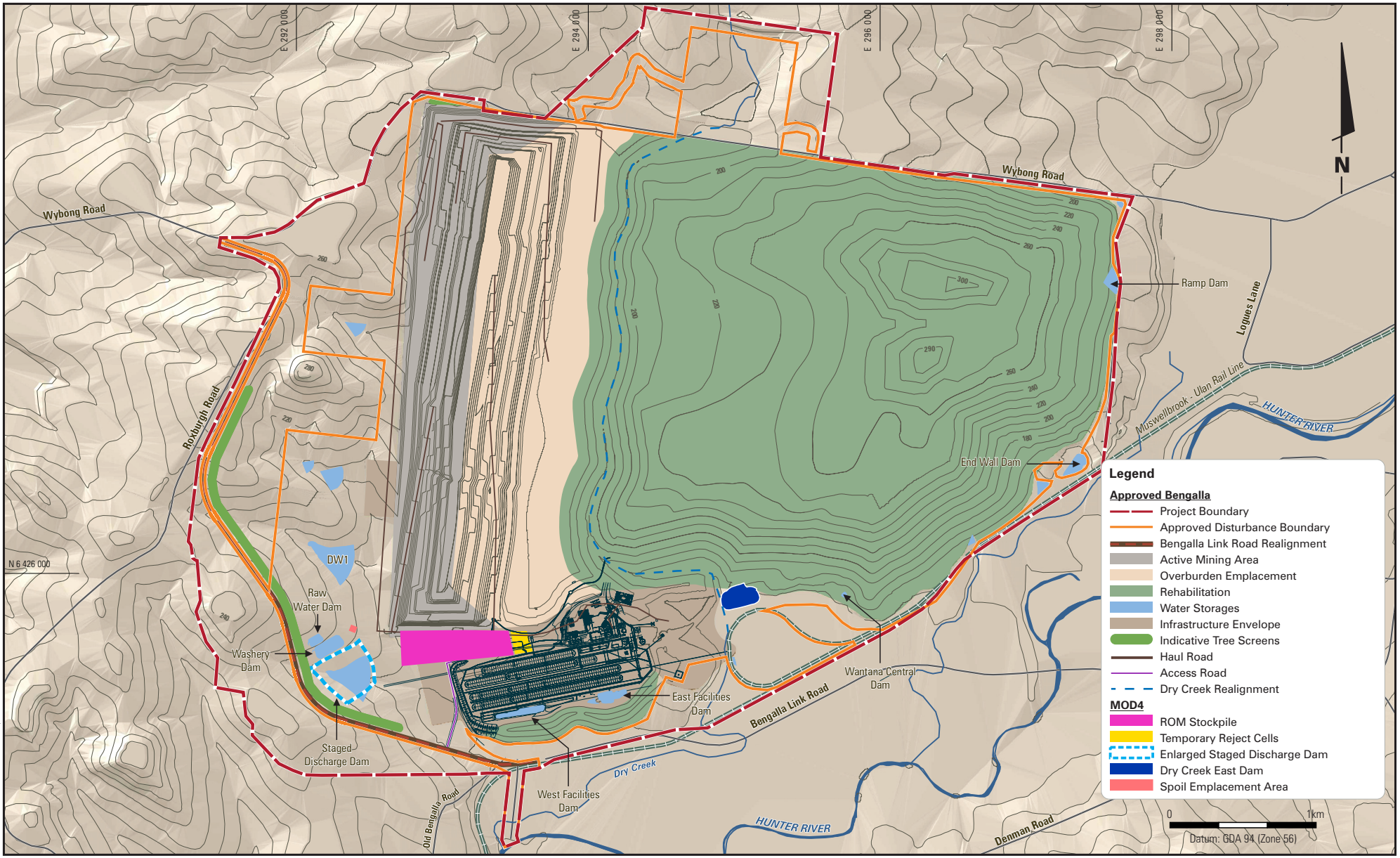
MOD4 Conceptual Year 4 Mine Plan

FIGURE 2



HB BENGALLA MOD4 F3 Conceptual Year 24 Mine Plan from MOD2 04 12 2017 Rev G

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MOD4 Conceptual Year 24 Mine Plan

FIGURE 3

MOD 1

MOD1 sought at Section 3.1 "*Alterations to various water management infrastructure components including: … Relocation of the Staged Discharge Dam Hunter River Salinity Trading Scheme (HRSTS) staged discharge release point*…"

Section 3.2.1 noted "*Prior to the closing of the culvert under the Southern Haul Road, BMC's existing Environment Protection Licence (EPL) 6538 HRSTS discharge location will be relocated. An indicative location has been identified where discharge water will be pumped from the existing Staged Discharge Dam via a pipeline to a release point within the Western Diversion Levee…*" Section 3.2.3 states "*This Modification seeks to revise the relocated positions for the Hunter River and Washery Dam to an appropriate location within the Disturbance Boundary near the approved future relocated Staged Discharge Dam*."

The MOD 1 surface water assessment states "*The overall health of the water management system is reflected in the modelled stored inventory in the open cut pits. The median (50th percentile) inventories of Main Pit and Satellite Pit show that the pits are generally maintained dry with no long term build up. The 90th percentile inventory in Main Pit and the Satellite Pit reaches 240 ML and 450 ML respectively. The Satellite Pit will be used to store excess water when wet conditions prevail. The excess water can generally be managed in Pit when the Satellite Pit has been consumed.*"

Figure 2 indicates the locations of the existing SDD and the relocated SDD (ED1) approved in MOD1.

No changes to the surface water management infrastructure were proposed for MOD 2 and MOD 3.

2.1.2 Modification Sought

To reduce the likelihood of water storage in mining areas following wet conditions, BMC is seeking a greater out-of-pit storage capacity.

It is proposed to enlarge the capacity of the relocated SDD (ED1) to avoid prolonged inundation of mining areas during wet conditions as more water reporting from the various mining areas would be stored onsite in ED1.

Feasibility studies have concluded that a 700 ML capacity ED1 will be required to achieve this goal. This is 400 ML greater that the currently approved ED1.

Other than the increased capacity, there are no changes proposed to the location or general operating parameters of ED1.

During the construction of ED1 (which may occur over two stages), excavated material will be used for the construction of the dam. However, approximately 2,500 m^3 of excess material may not be required, and will be stored in the vicinity of ED1 (see **Figure 2**).

Following the completion of construction, any discharge of water from Bengalla to the Hunter River will occur from ED1 through existing drainage structures.

BMC is also seeking to construct a new dam, named the Dry Creek East Dam, located to the south of the current mining area (see **Figure 2**). The dam has a nominal capacity of 93 ML and is required for additional mine water storage. Dry Creek East Dam is proposed to be located in an area bounded by the south haul road, Dry Creek and the West Wantana Dam.

Figure 6.1 of the '*Bengalla Continuation of Mining Project Groundwater Impact Assessment*' (AGE, 2013) includes the estimated extent of quaternary alluvium on the Hunter River floodplain. Part of the footprint of the Dry Creek East dam extends slightly onto the area estimated to include quaternary alluvium. A test pit has indicated that approximately 200 mm of alluvial material is present below the topsoil. Neighbouring test pits that were part of the same investigation did not encounter alluvial material.

The impoundment area of the proposed dam comprises excavated storage below the existing surface level and volume above ground contained by an earthfill embankment. To prevent potential interaction between mine water and the alluvium, the excavated storage area will be lined with approximately 600 mm of compacted clay liner, formed either of approximately 300 mm of material treated insitu and overlain by another approximately 300 mm of clay or approximately 600 mm of material placed in two layers.

Following feasibility work, BMC is also seeking minor changes to the final landform drainage network, by relocation of the approved (but yet to be constructed) Temporary OEA Sediment Dam located within the Main OEA. The approved Temporary OEA Sediment Dam was located to the east of the Main OEA ridgeline and overflowed to Bengalla East Sediment OEA Dam. The approved strategy also directed runoff from overburden areas west of the ridgeline to Ramp Dam and into Endwall Dam.

The proposed Temporary OEA Sediment Dam is located to capture runoff from areas west of the ridgeline. The proposed Temporary OEA Sediment Dam overflows to the open cut mining area and pumps to the proposed Dry Creek East Dam.

2.2 EXPANDED ROM STOCKPILE

2.2.1 Approved Activity

Section 4.4.1 and Table 9 of the Bengalla EIS summarise the approved ROM stockpiles at Bengalla as follows:

> "*… An increase in the size of coal CHPP stockpiles to approximately 1,215,000*".
>
> "*Emergency ROM coal stockpile upgrade of 40,000 t (and relocation with the ROM hopper) …*
>
> *An extension to the existing emergency ROM coal stockpile will be required to be used in the event that there is a failure, delay in the offsite coal chain to the Port of Newcastle or other operational reasons;*
>
> *ROM coal may also be temporarily stockpiled within the confines of the mining area from time to time where operational efficiencies so require; and*
>
> *The maximum ROM coal stockpile capacity on site will be up to 350,000 t …*

The Project coal handling system is shown on Figure 20 of SSD-5170."

2.2.2 Modification Sought

BMC is seeking approval for an increase in the capacity of total ROM coal stockpiled at Bengalla from 350,000 t to 1,250,000 t.

Up to 350,000 t of ROM coal will continue to be temporarily stockpiled in the mining area or at the CHPP. Of this, up to 40,000 t may be stored at the existing approved ROM hopper and at the approved (but yet to be constructed) relocated ROM hopper.

The increase of 900,000 t sought is based on an operational requirement for greater flexibility.

It is proposed that new ROM coal stockpiles with a capacity of up to 900,000t will be initially located generally adjacent to the west of the open cut as illustrated on **Figure 2**. Dust management techniques will continue to be utilised.

As mining progresses it is proposed to periodically relocate the ROM coal stockpiles further to the west in advance of mining, remaining within the Disturbance Boundary, and generally adjacent to existing infrastructure. **Figure 3** shows the indicative location at Year 24.

The stockpile area will consist of several stockpiles located as generally outlined in the conceptual layout (see **Figure 4**). The actual configuration and number of stockpiles will be influenced by operational constraints at each location. The new ROM coal stockpiles will be approximately 10 m in height to enable a loader to reach any point within the stockpiled area.

Coal flow in and out of the ROM stockpile will be undertaken utilising Bengalla's approved fleet. No additional fleet to that approved under SSD-5170 will be required.

2.3 PLACEMENT OF REJECT MATERIAL

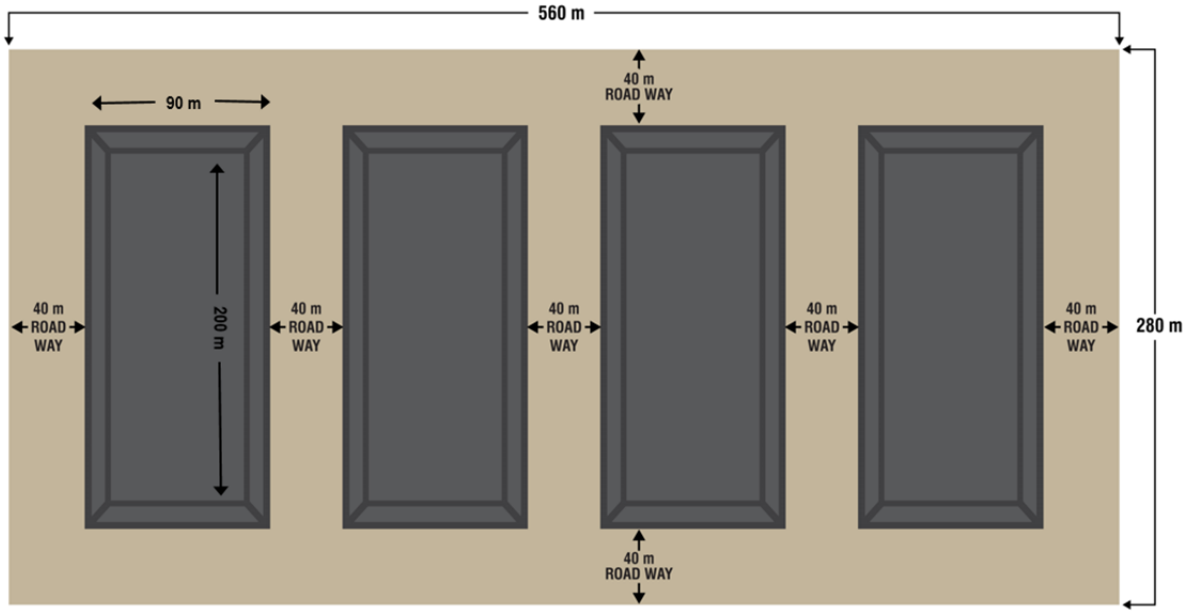
2.3.1 Approved Activity

Section 4.1 of the Bengalla EIS includes in the project description "… *continued rejects and tailings co-disposal in the Main OEA and in the temporary in-mining area reject emplacement* …"

Table 9 of the Bengalla EIS states "*Reject material is stored in a 700 t reject bin before being dried in cells and in temporary emplacements in the mining area and buried within the overburden area and capped with a minimum of 5 m of inert overburden material*".

See Figures 14 to 18 of the Bengalla EIS.

Figure 4
Conceptual ROM Stockpile Layout



2.3.2 Modification Sought

BMC is seeking approval for additional flexibility in the location for temporary emplacement of reject material, prior to permanent emplacement in the OEA. This will reduce handling limitations during wet weather periods or when reject cell availability is limited.

Reject material which is not emplaced into the Main OEA is temporarily stored in reject cells on the highwall side at Bengalla. The temporary cells are then emptied as soon as it is practical and safe to do so.

Historically, the temporary reject storage area has been within the open cut. The Dry Creek catchment south of Wybong Road and east of the Western Diversion Levee is now contained within the current mining area.

Temporary reject cells will be generally adjacent to the operational mining area, west of the open cut, but within the Disturbance Boundary. Reject material may also continue to be temporarily stockpiled in the mining area. Reject cells are nominally up to 100 m x 100 m in size and have a capacity of approximately 40,000 tonnes, with their design dependant on the environmental and safety parameters relevant to the emplacement location. The cells will move as required within the Disturbance Boundary.

Indicative locations proposed for the construction of reject cells in advance of the mining area are presented for Year 4 and Year 24 in **Figure 2** and **Figure 3**.

2.4 LONG-TERM MATERIAL EMPLACEMENT FOR DRY CREEK REINSTATEMENT

2.4.1 Approved Activity

Section 4.9.3 of the Bengalla EIS states: "*After Year 15 and prior to Year 24, a permanent realignment of Dry Creek will be constructed using best practice initiatives to ensure its successful stabilisation*."

Table 88 of the Bengalla EIS indicates that approximately 990,000 m^3 of Class 3, 6 and 6V topsoil is available to meet the required 152,000 m^3 needed to rehabilitate 38 ha of the Dry Creek Reinstatement.

Section 10.4 states "*A permanent reinstatement of Dry Creek will be constructed using best practice engineering design to ensure its successful stabilisation following mining*."

2.4.2 Modification Sought

BMC has commenced preliminary design works so that sufficient quantities and qualities of clay and topsoil materials are identified and stockpiled as mining progresses for the reinstatement of Dry Creek which is currently estimated to commence after Year 15 (2029).

This work has identified that approximately 450,000 m^3 of clay material in the proximity of the existing Dry Creek will be required for lining the reinstated Dry Creek. It is proposed that this material will be emplaced (in either or both) depending upon operational requirements from time to time:

- To the west of the active mining area within the Disturbance Boundary for a total area of approximately 70,000 m^2 in one or more locations; or
- Within the Main OEA approved final landform if access issues with Mount Pleasant Mine (MTP) preclude emplacement in the west.

Whichever area is utilised, the stockpiled clay material will be managed to minimise dust generation.

2.5 COMPARISON OF THE APPROVED DEVELOPMENT AND MOD 1 TO MOD 4

Surface Water, Air Quality, Acoustic and Visual assessments were completed to understand the possible impacts of MOD 4. The results of these assessments indicate that there will be no significant change to the environmental impacts associated with SSD 5170. Further information on these assessments is provided in **Section 6**.

Table 2 provides a summary of key MOD 4 components and comparison with the approved Bengalla (including MODS 1 to 3). SSD-5170 will remain substantially the same if MOD 4 is approved.

Table 2
Key Modification Components and Comparison with Approved Bengalla

Component	Bengalla Existing (Approved)	MOD 1	MOD 2	MOD 3	MOD 4
Planning Approval & Supporting Documents	SSD-5170, Bengalla EIS and RTS	MOD 1, SEE 1 and RTS	MOD 1, SEE 2 and RTS	MOD 2, SEE 3 and RTS	This SEE
Disturbance Boundary	SSD-5170 Appendix 2	MOD 1 SEE Figure 5	No change	No change	No change
Life of Mine	2039	No change	No change	No change	No change
Deposit	Additional 316 Mt ROM coal within the mining areas shown on Bengalla EIS Figure 14 to Figure 18	No change	No change	No change	No change
Mining Method	Open cut – dragline, truck and excavator	No change	No change	No change	No change
Production	Up to 15.0 Mtpa ROM coal	No change	No change	No change	No change
Operational Hours	Mining operations and coal processing 24 hours per day, seven days per week	No change	No change	No change	No change
Workforce	Up to 900 full time personnel (plus contractors)	No change	No change	No change	No change
Blasting	Maximum of 12 blast events per week during the hours of 7:00 am to 5:00 pm, Monday to Saturday;	Additional locations for the siting of the Explosives Storage Facility	No change	Explosive Storage Facility and reload facility to be constructed and operated within the Disturbance Boundary	No change
Equipment	Various as listed in the Bengalla EIS	No change	No change	No change	No change

Component	Bengalla Existing (Approved)	MOD 1	MOD 2	MOD 3	MOD 4
Coal Transport	Product coal transported by rail, up to 16 laden train movements per day	No change	No change	No change	No change
Final Landform	Final landform engineered to ensure a sustainable final landform, including stable highwalls and the final void	No change	Visual amenity changes to OEA: • Northern Relief Area up to Reduced Level (RL) 300 • Southern Relief Area to RL 290	No change	No change
Water Management	• Mine water dams and clean water dams (including relocations as required) • CW1 north of Wybong Road and associated Infrastructure • Diversion of Dry Creek (temporary via pipeline, longer term reinstated) • HRSTS Staged Discharge Dam and release point • Hunter River intake • Minor disturbance associated with ancillary works including the Dry Creek pipeline and associated power supply, water diversion structures, minor contour banks, tracks along pipelines and sediment control structures	• Utilisation of the Satellite Pit as a water catch dam • Relocation of the HRSTS Staged Discharge Dam release point • Construction of northern clean water diversion levees in an alternate location • Relocation of future Hunter River Dam and Washery Dam	No change	Hunter River pipeline to be aligned and operated within the Disturbance Boundary	Increase in capacity of Staged Discharge Dam to 700 ML and Construction of the Dry Creek East Dam for additional mine water storage Relocation of approved Temporary OEA Sediment Dam on the Main OEA

Component	Bengalla Existing (Approved)	MOD 1	MOD 2	MOD 3	MOD 4
Temporary ROM Stockpile	350,000 t capacity (at CHPP, 40,000 t adjacent relocated ROM or temporarily inpit)	No change	No change	No change	Increase ROM capacity by 900,000 t to 1,250,000 t (and total stockpile capacity from 1,215,000 t to 2,115,000 t)
Rejects Management	• Rejects and tailings co-disposal in the Main OEA and in the temporary in-mining area reject emplacement • Relocation of ROM bin after Year 2	No change	No change	No change	Flexibility in the location for temporary emplacement of reject material
Reinstatement of Dry Creek	Reinstatement in OEA after Year 15	No change	No change	No change	Temporary clay emplacement within the main OEA or to the west for later use in the reinstatement of Dry Creek
Relocation of Bengalla Link Road	Relocation of a 6 km section around Year 15	No change	No change	No change	No change

Component	Bengalla Existing (Approved)	MOD 1	MOD 2	MOD 3	MOD 4
Ecological Offsets	To offset the ecological impact of mining, BMC have developed a Biodiversity Offset Strategy, and prepared a Biodiversity Management Plan which describes how the Strategy will be implemented. Condition 30 states: "*Within 6 months of the approval of the Biodiversity Management Plan, the Applicant must lodge a conservation bond with the Department to ensure that the biodiversity offset strategy is implemented in accordance with the performance and completion criteria of the Biodiversity Management Plan."*	No change	No change	No change	No change

3 REGULATORY FRAMEWORK

This section briefly describes the regulatory framework under which Bengalla is approved to operate as relevant to MOD 4. It discusses the ability of the Minister for Planning and Infrastructure to modify SSD-5170 under Section 96(2) of the EP&A Act.

3.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

3.1.1 Existing Development Consent

On 3 March 2015, the Secretary of the Department of Planning and the Environment (DP&E) as delegate of the Minister for Planning granted SSD-5170 for the Bengalla Continuation Project under Section 89E of the EP&A Act. The supporting document for SSD-5170 is the Bengalla EIS (Hansen Bailey, 2013) and as modified by the RTS (Hansen Bailey, 2014).

3.1.2 Power to Modify

Section 96 of the EP&A Act allows for a Development Consent to be modified by the consent authority to which the original application was made. Section 96(2) of the EP&A Act states:

> *"A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*
>
> *(a) It is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all)."*

Under Section 96(2), the consent authority must be satisfied that what is proposed is no more than to "*modify*" (i.e. alter without radical transformation) the proposed development (including MOD 4 and any previous modifications) such that it remains "*substantially the same development*" as the originally approved development.

The MOD 4 Application has been prepared in line with the draft guidelines for *Modifying an Approved Project* (DP&E, 2017).

Bengalla as Originally Approved

Bengalla as originally approved in SSD-5170 includes the following features:

- Continued open cut mining west of the then operations at a rate of up to 15 Million tonnes per annum (Mtpa) ROM coal for 24 years to a total of not more than 316 million tonnes;
- Continued use, extension or relocation of existing infrastructure, including administration and parking facilities, in-mining area facilities (including dragline shut down and erection pad), helipad, tyre laydown area, explosives and reload storage facility, core shed, workshop, roads, reject bin, ROM hopper, stockpiles, conveyors,

water management infrastructure, bioremediation area, supporting power infrastructure, rail and rail loading infrastructure and ancillary infrastructure;

- Continued use of the existing dragline, truck fleet and excavator fleet (with progressive replacement or substitution with equivalent);
- An out of mining area OEA to the west of Dry Creek, which may be utilised to store excess overburden material until it is intercepted by mining;
- Construction and use of various items of new infrastructure (including radio tower, extensions to the Mining Infrastructure Area, additional raw coal stockpile and upgrade to the ROM coal stockpile (along with associated conveyor network) generally as shown on the infrastructure plans and construction of the Mount Pleasant Staged Discharge Dam and associated water reticulation infrastructure;
- Processing, handling and transportation of coal via the (upgraded) CHPP and rail loop for export and domestic sale;
- Continued rejects and tailings co-disposal in the Main OEA and in a temporary in-mine reject emplacement area;
- Relocation of a 6 km section of Bengalla Link Road at approximately Year 15 near the existing mine access road to facilitate coal extraction;
- The diversion of Dry Creek via dams and pipe work with a later permanent realignment of Dry Creek through rehabilitated areas when emplacement areas are suitably advanced;
- Relocation of water storage infrastructure as mining progresses through existing dams (including the Staged Discharge Dam and raw water dam); and
- A workforce of up to 900 full time equivalent personnel (plus contractors) at peak production.

Substantially the Same Development

A detailed description of MOD 4 is provided in **Section 2.**

The changes proposed in MOD 4 will if approved, authorise a development which will be *"substantially the same development"* as that originally approved under SSD-5170. Assessment of MOD 4 (discussed further in **Section 6**) has shown that it will not result in additional environmental impacts.

The proposed MOD 4 works will be wholly contained within the Approved Disturbance Boundary (impacts from activities within which have already been the subject of a comprehensive biodiversity offsets package). As a result, the alterations to the development will not impact on areas containing listed species or communities of flora or fauna under the *Threatened Species Conservation Act 1995* (TSC Act) or *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) beyond the areas already approved for disturbance and subject to an agreed and in place biodiversity offsets package.

MOD 4 will not result in any change to the core elements of SSD-5170 (as modified) such as, but not limited to:

- Total coal production quantities and rates, overburden generation or duration of mining;
- Existing method of mining or destination of ROM and product coal;
- The character and location of the currently approved infrastructure components; and
- Existing manning levels.

Additional discussion comparing the approved operations with MOD 4 is provided in **Section 2.5**. The proposed modified development is substantially the same development for which SSD-5170 was originally granted.

3.1.3 Need for a Statement of Environmental Effects

Clause 115 of the *Environmental Planning and Assessment Regulation 2000* NSW (EP&A Regulations) sets out the information which is required to accompany any application for modification of a development consent. That information is set out in **Table 3**, with reference made to where each requirement is addressed in this SEE.

Table 3
SEE Requirements

Clause	Information Required	Where it is provided in this SEE
115(1) An application for modification of a development consent under section 96 (1), (1A) or (2) or 96AA (1) of the Act must contain the following information:		
(a)	the name and address of the applicant,	**Section 1.3**
(b)	a description of the development to be carried out under the consent (as previously modified),	**Section 2**
(c)	the address, and formal particulars of title, of the land on which the development is to be carried out,	No change to the land set out in the existing development consent (see SSD-5170, Appendix 1)
(d)	a description of the proposed modification to the development consent,	**Section 2**
(e)	a statement that indicates either: (i) that the modification is merely intended to correct a minor error, mis-description or miscalculation, or	N/A
	(ii) that the modification is intended to have some other effect, as specified in the statement	**Section 2**
(f)	a description of the expected impacts of the modification,	**Section 6**
(g)	an undertaking to the effect that the development (as to be modified) will remain substantially the same as the development that was originally approved,	**Section 3.1.2**
(h)	if the applicant is not the owner of the land, a statement signed by the owner of the land to the effect that the	Under clauses 49 and 115 of the EP&A Regulation landowner

Clause	Information Required	Where it is provided in this SEE
	owner consents to the making of the application (except where the application for the consent the subject of the modification was made, or could have been made, without the consent of the owner),	consent is not required if the applicant gives notice of or advertises the application in accordance with those clauses. No land affected by the application is owned by an Aboriginal Land Council.
(i)	a statement as to whether the application is being made to the Court (under section 96) or to the consent authority (under section 96AA),	Not applicable: application is being made to the consent authority as described in **Section 3.1.2**
and, if the consent authority so requires, must be in the form approved by that authority.		

3.1.4 Matters for Consideration in Determining Modification Applications

Section 96(3) of the EP&A Act provides:

> *(b) "In determining an application for modification of a consent under this section, the consent authority must take into consideration such of the matters referred to in section 79C (1) as are of relevance to the development the subject of the application."*

The matters referred to in section 79C (1) relevant to the application for MOD 4 include:

- The provisions of any environmental planning instrument that applies to the land the subject of the Modification, including:
  - *Muswellbrook Local Environmental Plan 2009* (Muswellbrook LEP); and
  - *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*.
- Any Development Control Plan;
- Any planning agreement that has been entered into under Section 93F, or any draft planning agreement that a developer has offered to enter into under Section 93F (BMC entered into a planning agreement in respect of the development reproduced as Appendix 2 of SSD-5170);
- The regulations that apply to the land to which the development application relates;
- The likely impacts of the development including environmental impacts on both the natural and built environments, and social environmental impacts on the locality (these are assessed in this SEE);
- The suitability of the site for the development (this has been determined with the approval of SSD-5170 and MOD 4 results in substantially the same development);
- Any submissions made in accordance with the EP&A Act or the regulations; and

- The public interest.

3.2 RELEVANT PLANNING INSTRUMENTS

The components of MOD 4 will remain substantially consistent with the approved activities and will be located entirely within the Approved Disturbance Boundary of SSD-5170. No additional approval processes or planning instruments are required to be considered.

3.3 APPROVALS UNDER OTHER NSW LEGISLATION

3.3.1 Water Management Act 2000

The licensing and approvals provisions of the *Water Management Act 2000* (WM Act) apply (in general terms) to water sources that are subject to a Water Sharing Plan (WSP). With all relevant WSPs in place, Parts 2 and 5 of the *Water Act 1912* no longer apply to Bengalla and are not discussed further.

No additional water sources regulated under the Water Act will be affected by the proposed activities and therefore no additional water access licences will be required.

BMC will continue to hold all relevant licences, share component and allocation required to comply with the WM Act at all times water is taken.

3.3.2 Dams Safety Act 2015

The *Dams Safety Act 2015* (Dams Safety Act) requires Dams Safety NSW to "*formulate measures (including the development of guidelines) to ensure the safety of dams*". Under the Dams Safety Act, dams can be declared by order under Section 5, and owners of declared dams "*must comply with the requirements of the dams safety standards that apply to the dam*."

BMC's existing SSD and CW1 are each listed as a Prescribed Dam under the *Dams Safety Act 1978*. Under Schedule 2 Part 2 (6) of the Dams Safety Act, "*A dam that was, immediately before the repeal of the former Act, a prescribed dam under that Act is, until such time as an order is made under section 5, taken to be a declared dam for the purposes of this Act*". All prescribed dams at Bengalla will be operated under a safety management system which complies with the requirements of Dams Safety NSW.

MOD 4 will not result in the construction of or changes to any additional dams that are subject to regulation under the Dams Safety Act by the Dams Safety Committee.

3.4 COMMONWEALTH LEGISLATION – ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 CTH

The existing development is approved under EPBC 2012/6378 under the EPBC Act.

The components of MOD 4 will remain substantially the same as the approved Project, and will be located entirely within the Disturbance Boundary. MOD 4 will not result in the disturbance of additional vegetation located outside of the Disturbance Boundary approved under SSD-5170 (as Modified). As such, MOD 4 will not result in significant impacts to EPBC listed species and vegetation communities.

Further, the area to be cleared in association with MOD 4 activities will not result in additional impacts to MNES as assessed and approved under EPBC 2012/6378. MOD 4 will not constitute a 'controlled action' for any impacts to MNES and there is no requirement to refer the Action under Section 68 of the EPBC Act to the Federal Minister for the Environment for an approval under Part 9 of the EPBC Act.

MOD 4 is not seeking approval for any additional disturbance to that currently approved and will not result in any additional environmental impact to Matters of National Environmental Significance (MNES).

3.5 GATEWAY

Clause 119A of the EP&A Regulations provides for when Gateway Certificates are required for modification applications under Section 96(2) of the EP&A Act. The clause applies to an application "... *that relates to mining or petroleum development* ..."

"Mining or petroleum development" is defined for the purposes of the gateway requirements in clause 17A of SEPP Mining. That definition excludes areas where a mining lease is not required to be issued to enable the development to be carried out because there is a current mining lease.

MOD 4 is not seeking approval for any additional disturbance to that currently approved or for disturbance outside the current mining leases and will not result in any additional environmental impact. Accordingly, there is no requirement for a Gateway Certificate to be sought or issued in order to make this application.

4 STAKEHOLDER ENGAGEMENT

This section provides a summary of the stakeholder engagement undertaken for MOD 4 by BMC.

Table 4 outlines the relevant level of consultation activities undertaken for MOD 4. Outcomes from discussions have been incorporated into this SEE.

Various communication and engagement mechanisms will continue to be implemented to ensure the effective ongoing engagement with key stakeholders.

Key stakeholder consultation avenues that are maintained by BMC include:

- Consultation with the Muswellbrook community as required;
- Updates to the BMC Community Consultative Committee;
- Community Open Day (as required by BMC management); and
- Preparation and distribution of the Bengalla Annual Review.

Table 4
Stakeholder Engagement and Consultation

Stakeholder	Consultation
Department of Planning and Environment (DP&E)	• Meetings on 13 September 2017 and 8 December 2017.
Muswellbrook Shire Council (MSC)	• Meeting on 14 August 2017.
MACH Energy	• Provision of draft SEE document on 13 December 2017.
Community Consultative Committee	• 24 May 2017 presentation.

5 RISK ASSESSMENT

A risk assessment was completed to identify potential environmental and socio-economic issues associated with MOD 4. The purpose of the risk assessment process was to prioritise the required environmental and socio-economic impact studies required for the SEE.

Each of the potential environmental issues was ranked in accordance with the BMC Risk Classification Matrix (see **Appendix A**) as being of low, moderate, high or critical risk. The risk rating allocated to an impact is dependent upon the probability of the impact occurring and the potential consequences should the impact materialise.

Each of the environmental and socio-economic issues has been assessed and where appropriate, management and mitigation options developed.

Due to the nature of MOD 4, no environmental aspects provided a critical, high or moderate risk. Surface water, air quality, acoustics, visual, ecology and heritage impacts were determined to be of low risk primarily due to MOD 4 components being generally consistent with approved activities and being located entirely within the Approved Disturbance Boundary.

Table 5 summarises findings from the risk assessment.

Table 5
Environmental Risk Rating

Critical	High	Moderate	Low
None	None	None	Surface Water
			Air Quality
			Acoustics
			Visual Impacts
			Ecology
			Aboriginal Archaeology
			Non-Aboriginal Heritage

6 IMPACTS, MANAGEMENT AND MITIGATION

The potential environmental impacts of MOD 4 have been assessed as part of this SEE. The findings of this assessment as well as a description of the measures that will be implemented to manage and mitigate potential impacts are presented below.

6.1 SURFACE WATER

6.1.1 Impact Assessment

A '*Surface Water Impact Assessment*' (SWIA) (WSP, 2017) for MOD 4 was completed by WSP and is presented in **Appendix B**. Specifically, the SWIA identified the impacts as a result of MOD 4 on the Bengalla water management system and in particular the potential impacts to local surface hydrology.

Surface water management at Bengalla is based on the following key principles where reasonable and feasible:

- Minimise use of fresh water from external sources (Bengalla has a current allocation from the Hunter River);
- Diversion of clean surface water runoff away from areas disturbed by mining activities where possible;
- Collection of surface water runoff from areas disturbed by mining activities in catch drains and direction of this to sediment traps;
- Collection of runoff from industrial areas in catch drains and containment within the Bengalla water management system. Processing of waste water through the Bengalla Waste Water Treatment Plant for treatment and reuse as mine water supply;
- Transfer of open cut water to storage dams for reuse as mine water supply; and
- Minimal discharge of surplus mine water off-site (i.e. promote recycling of captured water).

Modelling

The water balance modelling completed for the '*Bengalla EIS Surface Water Impact Assessment*' (WRM, 2013) and the Bengalla MOD1 SEE 'Surface Water Impact Assessment' (WRM, 2015) was the basis adopted for MOD 4 assessment. The computer based OPSIM model has been used to simulate and assess the dynamics of the site water balance at Bengalla (incorporating MOD 4) under varying climatic sequences across four representative mine stages previously utilised for the Bengalla EIS. The model simulates the operations of all major components of the proposed water management system on a daily basis using different historical sequences of recorded rainfall data. The inflows and outflows for the water management system are outlined in **Table 6**.

Table 6
Simulated Inflows and Outflows for the Water Management System

Inflows	Outflows
Direct rainfall onto water surface of storage	Evaporation from water surface of storages
Catchment Runoff	Water demands (CHPP, dust suppression, vehicle wash down)
Groundwater Inflows	Overflows from storages (in accordance with Blue Book design criteria).
Raw water extracted from the Hunter River	Controlled releases under the HRSTS

The revised water balance modelling provides an assessment of surface water impacts under the full range of wet and dry conditions that have historically been experienced in the region. The model results are presented as a statistical summary of the results from different realisations, represented as percentiles. For example, the 50th percentile value represents the median of all realisations. The 1st percentile represents the value which has been exceeded by only 1% of realisations and the 99th percentile represents the value which has been exceeded in 99% of realisations.

Four different stages of Bengalla were considered in the modelling (Years 4, 8, 15 and 24). Although the catchment areas will continually change as mining progresses, these modelled years will provide a good representation of conditions over Bengalla's life. The surface water runoff volumes used in the water balance model were estimated using the '*Australian Water Balance Model'* (Boughton, 1993).

Uncontrolled Offsite Releases

The results of the revised site water balance modelling show that the mine water management system can be operated in accordance with the conditions of BMC's existing Environment Protection Licence (EPL) 6538. The revised model results indicate that there is:

- No uncontrolled release of mine affected water from Dry Creek East Dam prior to its conversion to a sediment dam;
- No uncontrolled releases of mine affected water from ED1; and
- No uncontrolled releases from the East and West Facilities Dam.

MOD 1 indicated that there was a <1% annual risk of overflow from the East and West Facilities Dam. The reduction in overflow risk can be attributed to the additional out-of-pit storage capacity provided in the enlarged ED1 which allows additional water to be pumped out of the East and West Facilities dams during extremely wet periods, to the Washery Dam.

Controlled offsite releases

Controlled offsite discharges refer to water discharged under the HRSTS from the existing SDD and yet to be constructed ED1 to Dry Creek. The results from the assessment indicate the following:

- The 50th percentile annual discharge shows that no discharges are required apart from one year where approximately 42 ML/a is modelled to be discharged under the HRSTS;
- The 10th percentile annual discharge shows that up to approximately 662 ML/a are discharged under the HRSTS, a reduction from 750 ML/a predicted in MOD 1; and
- The 1st percentile annual discharge shows that up to approximately 1,747 ML/a are discharged under the HRSTS, a slight increase from the 1,550 ML/a predicted in MOD 1.

Controlled releases of mine water to the Hunter River will continue to be undertaken in accordance with the conditions of the HRSTS and EPL 6538, with a maximum daily release limit of 200 ML/day.

External Water Supply Requirements

BMC holds licences to draw raw water from the *Hunter Regulated River Water Source* to meet site demands. The water is pumped to the Raw Water Dam for use when required. Raw water is used as a last priority to meet site demands, with the exception of the vehicle wash demand which ranges between 97 ML/a and 132 ML/a.

BMC hold Water Access Licences (WALs) with sufficient share component totalling 6,017 units (comprising 1,455 high security units and 4,562 general security units) to account for the maximum predicted take for the life of Bengalla based on predicted demands from the Hunter Regulated River Water Source (Management Zone 1A). BMC maintains exclusive rights for the dedicated use of at least 3,310 units (comprising 1,449 high security units and 1,860 general security units) under these WALs. The remaining units of the WALs (comprising five high security units and 2,702 general security units) are currently subject to use by licensees of BMC owned land for agricultural purposes.

The SWIA (**Appendix B**) presents the total annual modelled demand for water from an external source over the life of Bengalla. A summary of these results indicates the following:

- Compared with the results of MOD 1, the median (50th percentile) raw water requirement from an external source increases slightly from 1,530 ML/a to 1,575 ML/a; and
- Compared with the results of MOD 1, the 1st percentile (very dry) raw water requirement from an external source drops slightly from 1,920 ML/a, to 1,833 ML/a.

No additional water access licences for water take from water sources regulated under the WM Act will be required for MOD 4.

Mining Area availability

The median (50th percentile) inventories of Main Pit and Satellite Pit show that the mining areas are generally maintained dry with no long term build up for both MOD 1 and MOD 4. The 10th percentile inventory in Main Pit and the Satellite Pit reduces from 240 ML to 60 ML, and 450 ML to 35 ML, respectively.

Other impacts

The revised modelling indicates that MOD 4 will have no significant changes to:

- The Bengalla catchment area;
- Water quality in the Hunter River and Dry Creek;
- The Hunter River floodplain; and
- The geomorphology of the Hunter River or Dry Creek.

MOD 4 does not propose any changes to the assumptions utilised in the previously completed surface water or groundwater modelling completed for the Bengalla EIS and Bengalla SEEs. The results of the previous site water balance modelling show that the mine water management system can be operated in accordance with BMC's existing EPL 6538 conditions.

MOD 4 will not result in any significant changes to the currently approved water management regime at Bengalla. It is noted that the water management system will continue to evolve as the mine develops. Sediment dams and mine water dams will continue to be designed, constructed and operated in accordance with the requirements of SSD-5170 (as modified).

6.1.2 Mitigation and Management

As discussed in **Section 2.1.2**, the footprint of the Dry Creek East Dam extends onto the area estimated to include quaternary alluvium. Test pit investigations found that one pit indicated approximately 200 mm of alluvial material was present below the topsoil, with no others encountering alluvium. As a conservative measure to prevent potential interaction between mine water and alluvium, the excavated storage area will be lined with approximately 600 mm of compacted clay liner.

Erosion and sediment control devices will be designed and constructed according to the guidelines *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004), as well as recommendations from the *Draft Guidelines for Establishing Stable Drainage Lines on Rehabilitated Minesites* (Department of Land and Water Conservation, 1999).

BMC will hold or have applied for relevant licences, share component and allocation required to comply with the WM Act when water is taken.

6.2 AIR QUALITY

6.2.1 Impact Assessment

An '*Air Quality Assessment*' (TAS, 2017) was completed by Todoroski Air Sciences for MOD 4 and is presented in **Appendix C**. The Air Quality Assessment provided a qualitative assessment of the potential change in air quality associated with MOD 4.

The proposed temporary clay emplacement is expected to generate a small quantity of dust for a short period. Relative to the total quantity of dust generated from Bengalla, any potential dust impacts from this activity would be negligible.

The proposed ROM coal stockpiles and reject emplacement area are located generally along approved haul routes and thus there would be no significant deviation to existing approved haul distances as a result. No additional ROM coal or reject material would be moved in any one year as a result of MOD 4, the materials would only be redirected. The majority of dust emissions associated with the proposed operation of the ROM coal stockpiles and reject emplacement would arise from the handling of the material at the stockpiles and from wind erosion of the stockpiles.

Air Quality Modelling was conducted for Years 4 and 24 of the approved mining operation and including the proposed modifications, using the air dispersion model developed for the Bengalla EIS, and updated to reflect the proposed features of MOD 4. A comparison of the estimated total annual dust emissions for the approved mining operation and the proposed modifications were made.

It is calculated that the total annual dust emissions associated with MOD 4 would increase by approximately 0.56 – 0.91% relative to the approved Bengalla EIS.

The predicted incremental maximum 24-hour average and annual average PM_{10}, annual average TSP and annual average dust deposition levels for Years 4 and 24 of MOD 4 were calculated and compared to those of the approved Bengalla EIS.

The MOD 4 results indicated that the predicted dust levels are unlikely to change materially at any privately-owned receptor locations identified in SSD-5170. Further it is predicted that the dust emissions resulting from the activities to be conducted as part of MOD 4 will remain within air quality emissions criteria presented in SSD-5170.

The results of the modelling are presented in Figure 3 to Figure 20 of the report attached in **Appendix C**.

6.2.2 Mitigation and Management

Existing BMC dust management techniques consistent with '*Bengalla Air Quality Management Plan*' (BMC, 2016b) will be applied to MOD 4.

6.3 ACOUSTICS

6.3.1 Impact Assessment

An Acoustic Assessment was completed by Bridges Acoustics for MOD 4 and is presented in **Appendix D**. The Acoustic Assessment provided a qualitative assessment of the potential change in construction and operational noise associated with MOD 4 in comparison to those presented in the '*Bengalla EIS Acoustic Impact Assessment*' (Bridges Acoustics, 2013) and '*Bengalla MOD2 Acoustic Impact Assessment*' (Bridges Acoustics, 2016).

Noise levels were determined by modifying the most recent noise model for Bengalla, developed for the Bengalla EIS and varied for MOD 2, to include mining equipment accessing and operating on the proposed coal stockpiles. The assessment considered Years 4 and 24.

This assessment indicates MOD 4 would have no material effect on noise levels at any receptor. Minor changes of less than 1 dBA to predicted noise levels would not be discerned by residents and no additional receptors are likely to be affected by project related noise over relevant criteria.

Construction work associated with MOD 4 would either be imperceptible compared to adjacent mining activity or would remain within currently approved levels. MOD 4 would have no appreciable effect on other acoustic issues including sleep disturbance, low frequency noise, road and rail traffic noise and blasting impacts.

Based on the results of this assessment, MOD 4 is unlikely to have a material effect on noise levels and impacts are anticipated to remain within criteria in SSD-5170.

6.3.2 Mitigation and Management

Existing BMC noise management techniques consistent with *'Bengalla Noise Management Plan'* (BMC, 2016d) will be applied to MOD 4.

6.4 VISUAL ASSESSMENT

6.4.1 Impact Assessment

The '*Visual Impact Assessment*' (JVP Planning and Design, 2013) undertaken for the Bengalla EIS characterised the local visual landscape within the vicinity of Bengalla as being that of a rural setting dominated by mining activities along with agricultural activities associated with the Hunter River Floodplain. The visual character varies as a result of topography, vegetation cover, and land use types. This can create screening or visual buffers, or alternatively provide a viewing corridor to specific areas within the Project Boundary.

The visual impacts associated with the expanded ROM stockpiles have been considered. The expanded ROM stockpiles are generally located north of the existing CHPP and west of the main OEA.

To assess worst case views of the ROM stockpiles, a desktop assessment was conducted and representative viewing locations were selected consistent with visual assessment locations utilised for the Bengalla EIS. The ROM stockpiles (up to 10m in height) would be screened by the OEA, or topography and vegetation cover from most of the locations considered in the Bengalla EIS. Views may be possible from locations PM5 (Denman Road) and PM6 (Roxburgh Road). **Figure 5** to **Figure 8** present cross sections associated with these locations.

These figures indicate that the stockpile is screened from PM5 by intervening topography and the location of existing infrastructure for Years 4 and 24.

Figure 7 and **Figure 8** show that views from Roxburgh Road will initially be screened by topography, with further reduction in visual effect as the tree screens along the relocated Bengalla Link Road develop. Views of the temporary ROM stockpiles from Bengalla Link Road may be possible, however will only be experienced for a limited time and in the context of an existing mine and Mine Infrastructure Area.

6.4.2 Mitigation and Management

As outlined in Section 8.5.4 of the Bengalla EIS, BMC will, where appropriate, establish tree screens and plantings to minimise visual impacts.

Visual impacts to sensitive receivers will be considered during the future development of the Bengalla Link Road realignment proposed around Year 13. By Year 24 the proposed tree screens will likely be established along the realigned Bengalla Link Road.

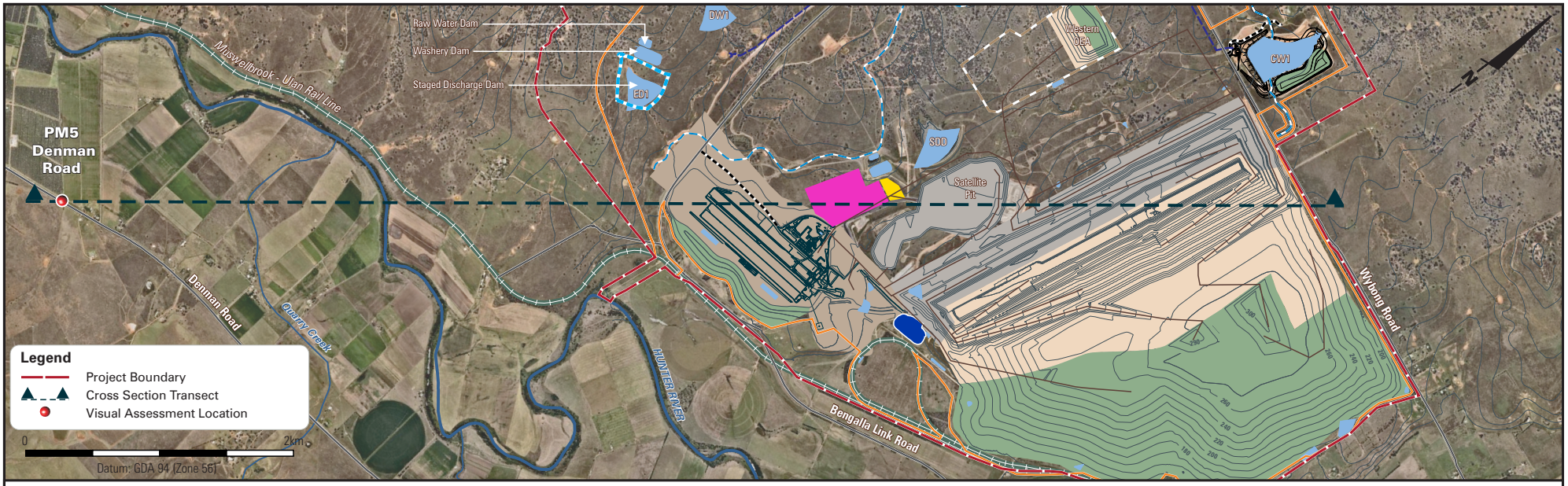
6.5 ECOLOGY

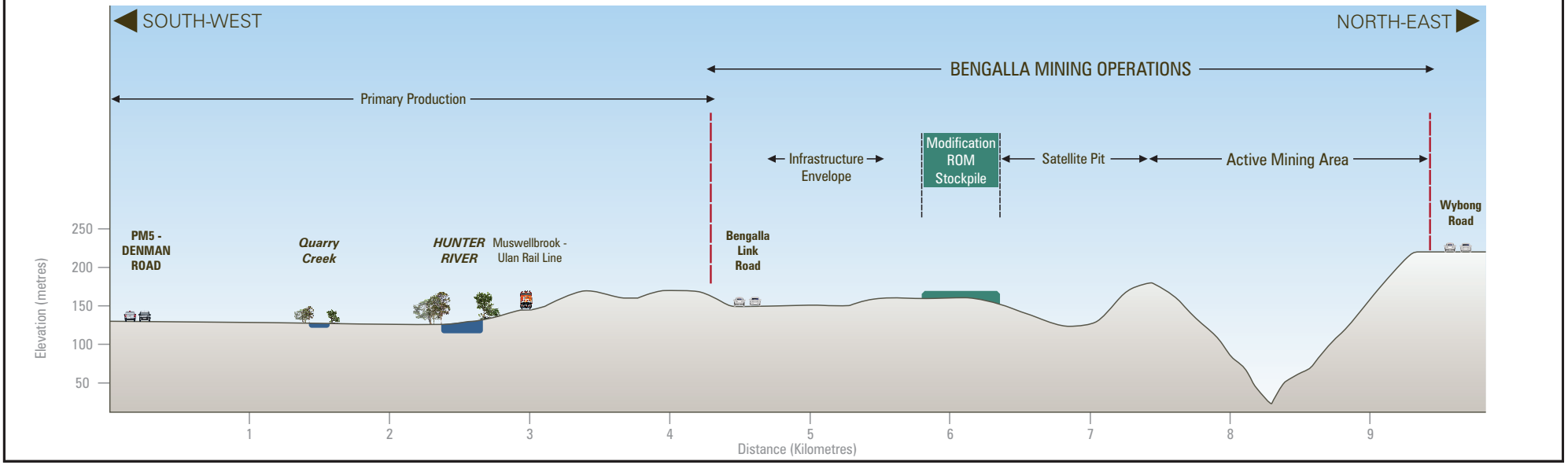
A desktop review of the previously completed Bengalla EIS '*Ecological Impact Assessment'* (Cumberland Ecology, 2013) and Bengalla SEE '*Ecological Impact Assessment'* (Cumberland Ecology, 2015) was completed for MOD 4.

All components of MOD 4 are located entirely within the existing Approved Disturbance Boundary. Therefore, no additional disturbance to any flora or fauna species, including any listed under the TSC Act and/or EPBC Act will occur.

The existing Ground Disturbance Permit (GDP) process will continue to be implemented prior to clearing or disturbing vegetation and applies to all land owned or managed by BMC that have not previously been disturbed by mining or associated activities.

BMC will continue to manage all ecological matters on-site in accordance with the *Bengalla Biodiversity Management Plan* (BMC, 2016c).





HB BENGALLA MOD 4 1655 F5 PM5 Denman Road Cross Section - Year 4 04 12 2017

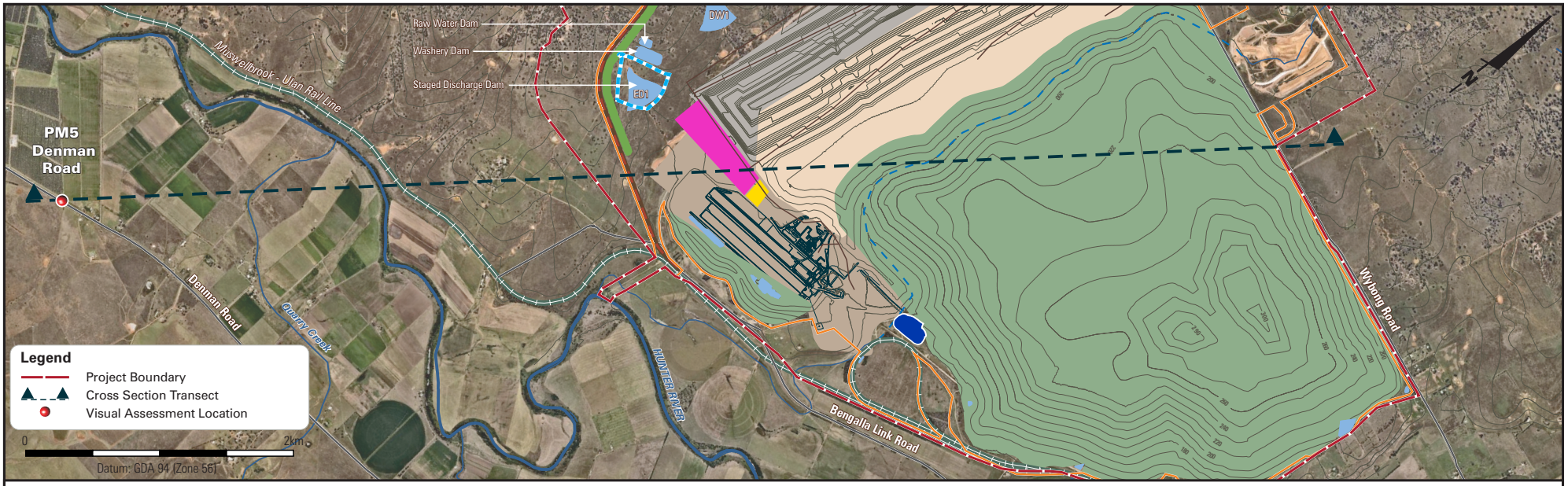
BENGALLA MINE

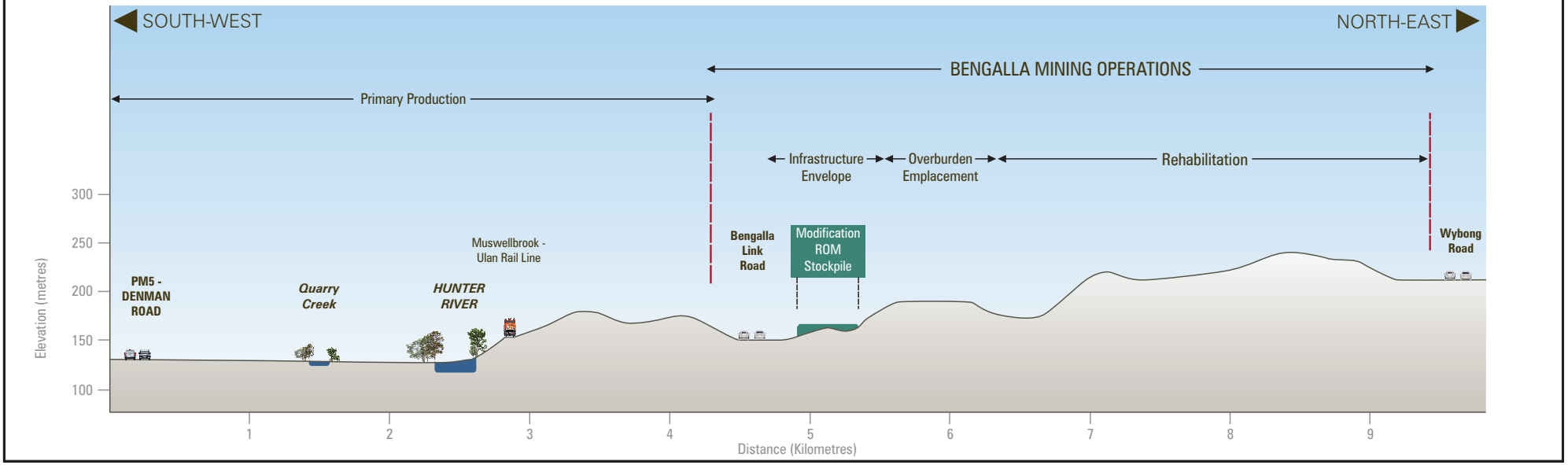
BENGALLA

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

MOD4 PM5 Denman Road Cross Section - Year 4

FIGURE 5





HB BENGALLA MOD 4 1655 F6 PM5 Denman Road Cross Section - Year 04 12 2017

BENGALLA MINE

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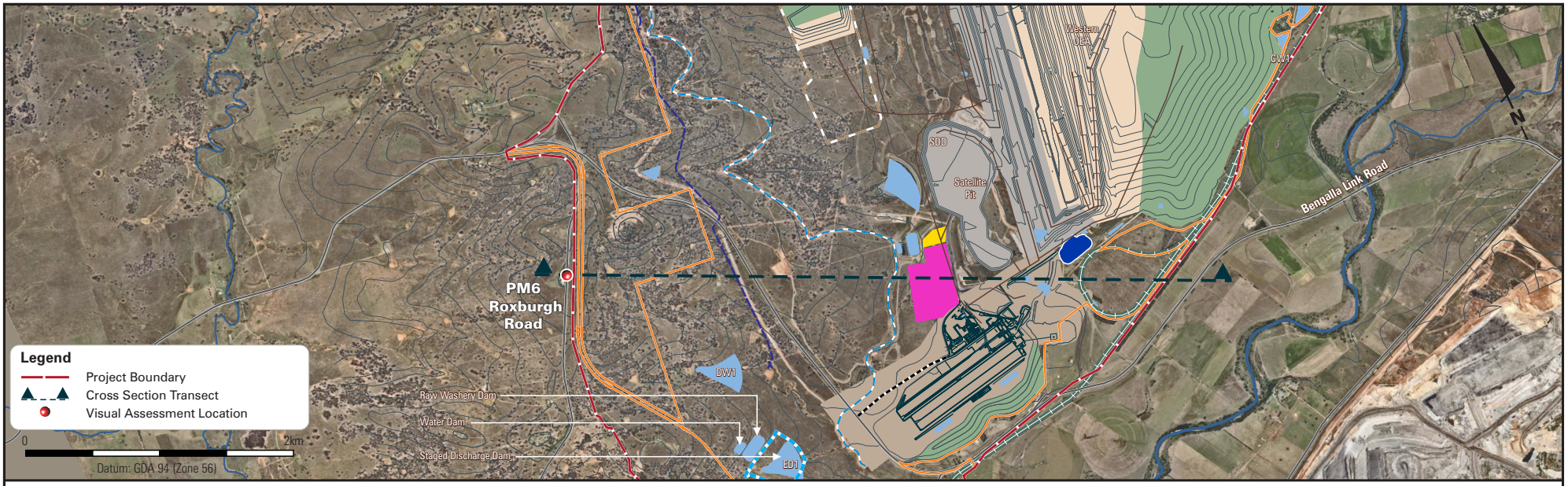
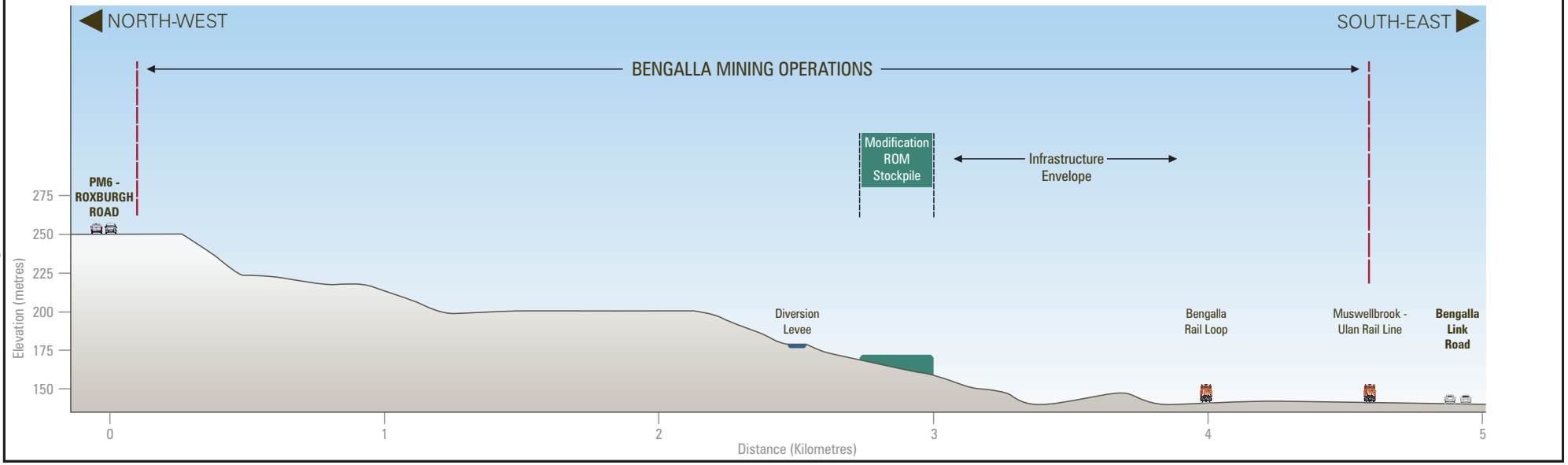
MOD4 PM5 Denman Road Cross Section - Year 24

FIGURE 6





HB BENGALLA MOD 4 1655 F7 PM6 Roxburgh Road Cross Section - Year 4 04 12 2017

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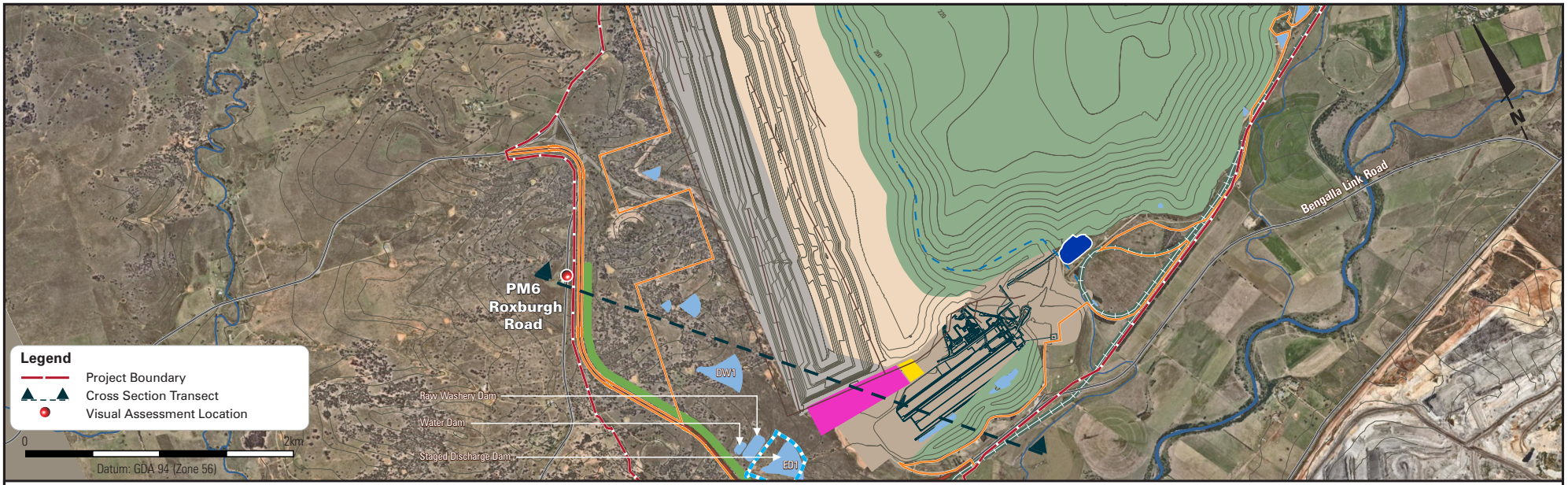
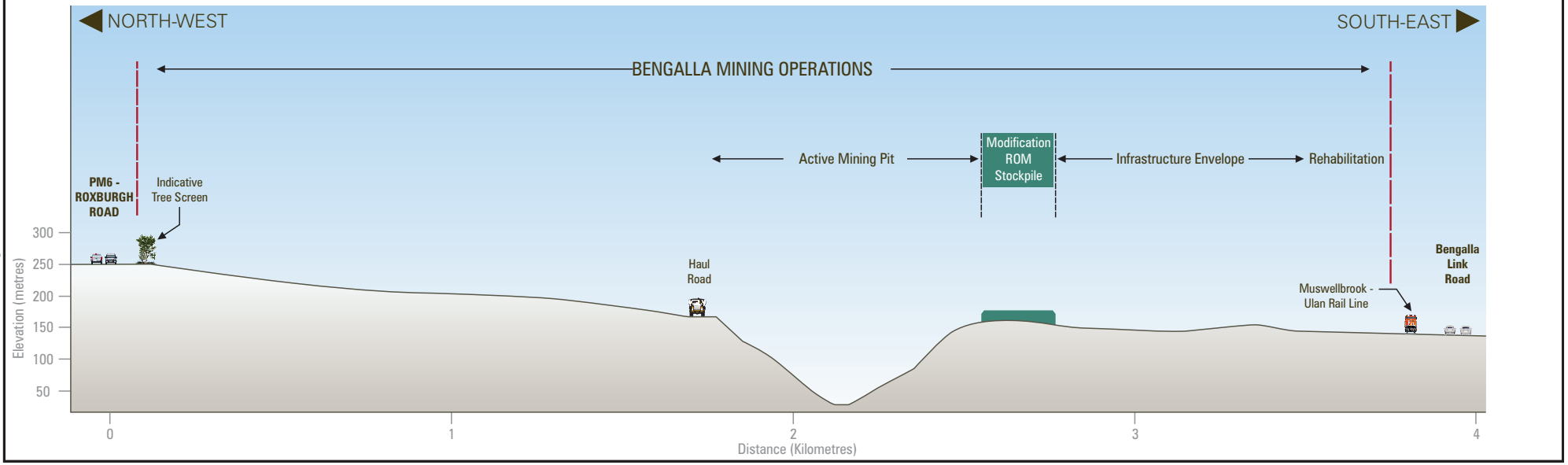
MOD4 PM6 Roxburgh Road Cross Section- Year 4

FIGURE 7





HB BENGALLA MOD 4 1655 F8 PM6 Roxburgh Road Cross Section - Year 24 04 12 2017

BENGALLA MINE

BENGALLA

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MOD4 PM6 Roxburgh Road Cross Section - Year 24

FIGURE 8

6.6 ABORIGINAL ARCHAEOLOGY

A desktop review of the previously completed Bengalla EIS *Aboriginal Archaeological and Cultural Heritage Impact Assessment* (AECOM 2013a), Bengalla SEE *Aboriginal Archaeology Due Diligence Assessment* (AECOM 2015), the Bengalla *Aboriginal Archaeology and Cultural Heritage Management Plan* (BMC, 2015) and the *Bengalla Continuation of Mining Project: Aboriginal Archaeological Salvage Program* (AECOM, 2016) was completed for MOD3.

All previously identified Aboriginal artefacts located within the Approved Disturbance Boundary have been salvaged in accordance with relevant approvals.

As elements relating to MOD 4 are wholly located within the Approved Disturbance Boundary, no impacts to any Aboriginal artefacts will occur.

6.7 NON-ABORIGINAL HERITAGE

A review of the Non-Aboriginal Heritage items previously identified in the Bengalla EIS *Historic Heritage Impact Assessment* (AECOM, 2013b) was completed for MOD 4. There are no remaining Historic Heritage Sites in proximity to MOD 4.

As MOD 4 is entirely situated within the Approved Disturbance Boundary, no additional mitigation measures are proposed.

BMC will continue to manage items relating to historic cultural heritage in accordance with the approved *Historic Heritage Management Plan* (BMC, 2016f) (as modified).

7 CONCLUSION

The activities presented in MOD 4 will result in the development remaining substantially the same as that already approved at Bengalla and will have minimal environmental impact.

MOD 4 is required to provide BMC with additional water storage, increase the capacity and provide flexibility in the location of ROM coal stockpiles and reject emplacement areas and additional locations for the storage of clay materials for later re-use.

Assessments on air quality, water balance and noise were completed to identify any changes in impacts that MOD 4 may have. These assessments concluded that MOD 4:

- Provides improved operational efficiency by increasing the volume of out of pit water storage, and will not result in any material change to the currently approved water management regime at Bengalla;
- Total annual dust emissions are predicted to be within 1% of the approved Bengalla EIS, and the predicted dust levels are unlikely to change materially at any privately-owned receptor locations; and
- Total noise emissions will result in minor changes of less than 1 dBA to Bengalla EIS predicted noise levels at privately-owned receptor locations. This will not be discerned by residents and no additional receptors are likely to be affected by Bengalla related noise over relevant criteria.

The approval of MOD 4 would provide BMC with the flexibility to better manage its open cut mining operation with minimum environmental impact.

* * *

For

HANSEN BAILEY

Dianne Munro
Principal Environmental Scientist

8 ABBREVIATIONS

Abbreviation	Description
Bengalla EIS	Continuation of Bengalla Mine Environmental Impact Statement (Hansen Bailey, 2013)
Blue Book	Landcom (2004), *Managing Urban Stormwater: Soils & Construction.*
BMC	Bengalla Mining Company Pty Limited
BJV	Bengalla Joint Venture
DP&E	NSW Department of Planning and Environment
DRE	Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulations	*Environmental Planning and Assessment Regulation 2000*
GDP	Ground Disturbance Permit Process
LGA	Local Government Area
MACH	Mach Energy Australia Pty Limited
Mining Act	*Mining Act 1992*
MOD 1 SEE	Bengalla Mine Development Consent Modification Statement of Environmental Effects (SSD-5170 MOD1) (Hansen Bailey, 2015)
MOD 2 SEE	Bengalla Mine Development Consent Modification Statement of Environmental Effects (SSD-5170 MOD2) (Hansen Bailey, 2016a)
MOD 3 SEE	Bengalla Mine Development Consent Modification Statement of Environmental Effects (SSD-5170 MOD3) (Hansen Bailey, 2016b)
MOD 4 SEE	This document
MOD 1 RTS	Bengalla Mine Response to Submissions Development Consent Modification 1 (Hansen Bailey, 2015b)
MOD 2 RTS	Bengalla Mine Response to Submissions Development Consent Modification 2 (Hansen Bailey, 2016c)
MOD 3 RTS	Bengalla Mine Response to Submissions Development Consent Modification 3 (Hansen Bailey, 2016d)
MOP	Mining Operations Plan
MTP	Mount Pleasant Mine
Mtpa	Million tonnes per annum
MSC	Muswellbrook Shire Council
Muswellbrook LEP	*Muswellbrook Local Environment Plan 2009*
OEA	Overburden Emplacement Area
ROM	Run of Mine
RL	Reduced Level
RTS	Continuation of Bengalla Mine Response to Submissions
SEE	Statement of Environmental Effects

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Appendix A

BMC Risk Classification Matrix

RISK ASSESSMENT MATRIX

Likelihood	Consequence				
	1 – Minor	2 – Medium	3 – Serious	4 – Major	5 – Catastrophic
A – Almost Certain	Moderate	High	Critical	Critical	Critical
B – Likely	Moderate	High	High	Critical	Critical
C – Possible	Low	Moderate	High	Critical	Critical
D – Unlikely	Low	Low	Moderate	High	Critical
E – Rare	Low	Low	Moderate	High	High

LIKELIHOOD CLASSIFICATION

LIKELIHOOD	DESCRIPTION	FREQUENCY
Almost Certain	Recurring event during the life-time of an operation / project	Occurs more than twice per year
Likely	Event that may occur frequently during the life-time of an operation / project	Typically occurs once or twice per year
Possible	Event that may occur during the life-time of an operation / project	Typically occurs in 1-10 years
Unlikely	Event that is unlikely to occur during the life-time of an operation / project	Typically occurs in 10-100 years
Rare	Event that is very unlikely to occur during the life-time of an operation / project	Greater than 100 year event

Appendix B

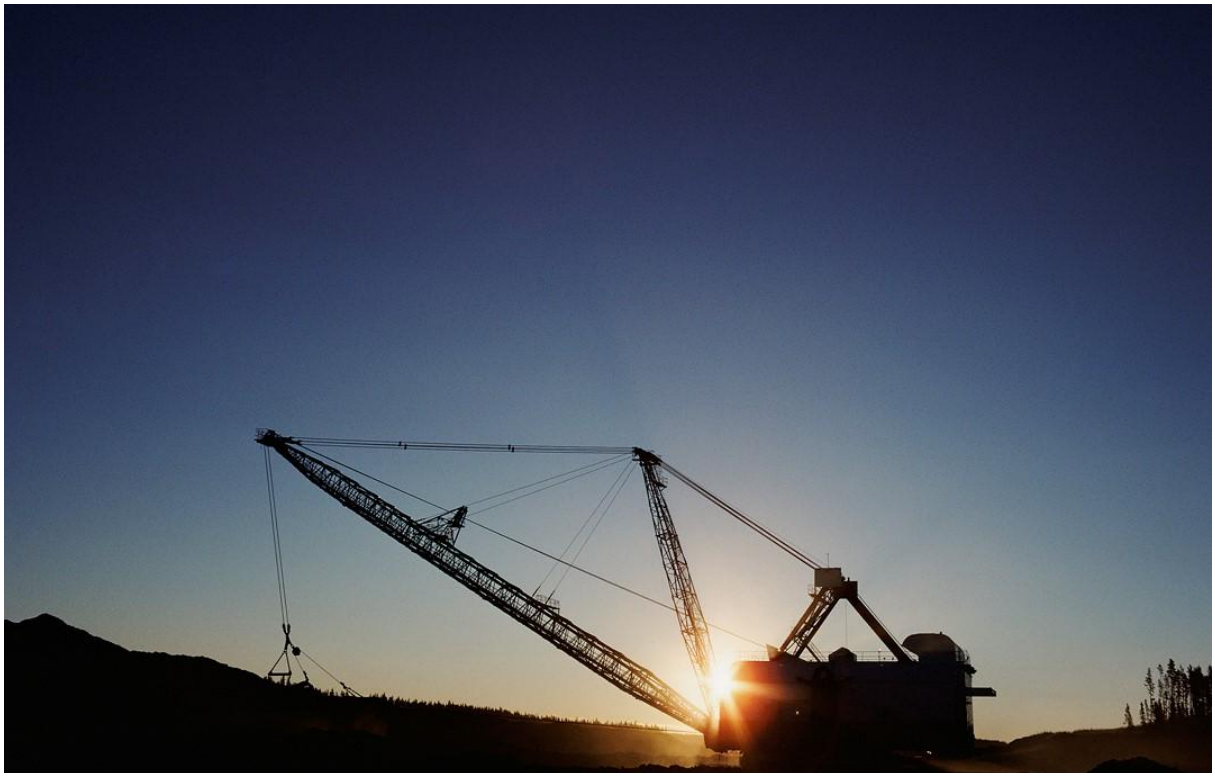
Surface Water Impact Assessment

HANSEN BAILEY

BENGALLA MINE MODIFICATION 4

SURFACE WATER IMPACT ASSESSMENT

DECEMBER 2017



Question today
Imagine tomorrow
Create for the future

Bengalla Mine Modification 4
Surface Water Impact Assessment

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REV	DATE	DETAILS
E	6/12/2017	Revised dam names
F	7/12/2017	Clarifications
G	11/12/2017	Table formatting

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Appendix A Catchment and landuse breakdown

1 INTRODUCTION

Bengalla Mining Company Pty Limited (BMC) operates the Bengalla Mine (Bengalla) in the Upper Hunter Valley of NSW. Bengalla is situated approximately 130 km north-west of Newcastle and 4 km west of the township of Muswellbrook.

BMC holds Development Consent SSD-5170 (as modified) under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) for the Continuation of Bengalla Mine. SSD-5170 enables BMC to continue open cut coal mining at a production rate of up to 15 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 2039.

SSD-5170 has been modified three times. Modification 1 (MOD 1) granted under Section 96(2) of the EP&A Act on 16 December 2015 authorises the alteration to various water management infrastructure and relocation of an explosives storage facility. Modification 2 (MOD 2) granted under Section 96(2) of the EP&A Act on 1 July 2016 authorises the alteration of the approved Main Overburden Emplacement Area (OEA) to improve visual amenity and establish a new access road. Modification 3 (MOD 3) granted under Section 96(2) of the EP&A Act on 23 December 2016 authorises minor changes to the approved location of an explosives facility, reload facility, Hunter River pipeline and topsoil stockpiles.

BMC is now seeking approval from the NSW Minister for Planning for Modification 4 (MOD 4) to SSD-5170 under Section 96(2) of the EP&A Act to facilitate the following:

— Changes to the approved water management system to reflect operations at Bengalla Mine (Bengalla) including the proposed Dry Creek East Dam (mine water storage dam) and proposed enlargement of the approved Future Staged Discharge Dam (ED1) to approximately 700 ML capacity;

— Temporary storage of approximately 2,500m^3 of excess material from the construction of ED1;

— Increase in the capacity and additional locations of temporary Run Of Mine (ROM) coal stockpiles:

— Increase the capacity of temporary ROM coal stockpiles to 1,215,000 t from the approved 350,000 t;

— Additional storage locations for temporary emplacement of coal processing reject material, prior to permanent emplacement

— Temporary clay emplacement within the Main OEA or to the west of this for later use in the reinstatement of Dry Creek

All of MOD 4 activities are within the approved Project Disturbance Boundary. No changes are being sought to the method, extent or intensity of mining or mining equipment fleet.

WSP Australia Pty Limited has been engaged by Hansen Bailey Pty Limited to prepare a revised Surface Water Impact Assessment (SWIA) to support the Statement of Environmental Effects (SEE) for MOD 4. This report presents the assessment methodology, assumptions and findings, and is structured as follows:

— Section 1 provides background information on Bengalla.

— Section 2 provides a brief overview of the national and state regulatory framework relating to surface water resources.

— Section 3 describes the existing surface water environment.

— Section 4 describes the existing, approved and proposed water management systems for Bengalla.

— Section 5 provides details of the site water balance for MOD 4, including modelling methodology, assumptions, results and relevant water licencing.

— Section 6 provides an assessment of potential surface water impacts of MOD 4.

— Section 7 outlines mitigation and management measures for MOD 4.

— Section 8 summarises the findings of the assessment.

2 REGULATORY FRAMEWORK

2.1 REGULATORY DOCUMENTS

Key regulatory documents and guidelines relevant to this assessment include:

— Protection of the Environment Operations Act 1997.

— Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002 and Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Amendment Regulation 2016.

— Water Management Act 2000 (and associated Water Sharing Plans).

— *Managing Urban Stormwater: Soils and Construction - Volume 1* (Landcom, 2004) ('Blue Book') and *Managing Urban Stormwater: Soils and Construction - Volume 2E Mines and Quarries* (Department of Environment and Climate Change (DECC), 2008).

2.1.1 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

Bengalla holds Environment Protection Licence (EPL) 6538 under the Protection of the Environment Operations Act 1997 (POEO Act). EPL 6538 includes a licensed discharge point to allow for release of water from the Existing Staged Discharge Dam (SDD) to the Hunter River. The discharge volume and concentration limits are provided in Table 2.1.

Table 2.1 EPL 6538 discharge conditions

PARAMETER	LIMIT
pH	6.5 - 9.5
TSS	120 mg/L
Volume	200 ML/day

EPL 6538 was recently varied in December 2016 to change the location of the licensed discharge point, and associated surface water monitoring points, following completion of the Dry Creek diversion works. The old discharge point to Dry Creek was located at the Existing SDD. The new discharge point is located within the Western Diversion Levee, with discharge water now being pumped from the Existing SDD to the discharge point via a pipeline. This location may be amended again in the future as operations move westward via an EPL 6538 amendments.

2.1.2 WATER MANAGEMENT ACT 2000

Under the Water Management Act 2000, BMC must hold Water Access Licences (WAL) with sufficient water allocation to account for the water Bengalla takes from a water source. A summary of surface water entitlements held by BMC for exclusive use by Bengalla is provided in Table 2.2.

Table 2.2 Surface water entitlements held by BMC for Bengalla

WATER SOURCE	ENTITLEMENT
Hunter Regulated River Water Source (Management Zone 1A)	1,449 high security units 1,376 general security units
Hunter Unregulated and Alluvial Water Source - Muswellbrook Water Source	109 ML (harvestable right)

HUNTER REGULATED RIVER WATER SOURCE

BMC holds WALs with sufficient share component totalling 6,017 units, comprising 1,455 high security units and 4,562 general security units from the Hunter Regulated River Water Source under the Water Sharing Plan (WSP) for the Hunter Regulated River Water Source 2016. Bengalla currently has exclusive rights for the use of at least 2,826 units (comprising 1,449 high security units and 1,376 general security units) under these WALs. The remaining units of the WALs (comprising 5 high security units and 3,186 general security units) are currently subject to temporary use by licensees of BMC owned land for agricultural purposes (BMC, 2017).

HUNTER UNREGULATED AND ALLUVIAL WATER SOURCE

The WSP for the Hunter Unregulated and Alluvial Water Sources 2009 applies to the Muswellbrook Water Source, including Dry Creek and its tributaries. A WAL is not required to take and use water by means of harvestable rights dams in accordance with the applicable harvestable rights order under the Water Management Act 2000. Harvestable rights may be available to account (wholly or partially) for the take of water from a water source.

2.1.3 PROTECTION OF THE ENVIRONMENT OPERATIONS (HUNTER RIVER SALINITY TRADING SCHEME) REGULATION 2002 AND AMENDMENT REGULATION 2016

The Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002 (the HRSTS) operates in the Hunter River catchment.

The central idea of the HRSTS is to only discharge salty water when there is lots of low salt, fresh water in the river (NSW DEC, 2016). The Hunter River is broken into three sectors for the purposes of the HRSTS: the upper, middle and lower sectors. Bengalla is located within the upper sector. Monitoring points along the Hunter River are used to measure whether the river is in 'low', 'high' or 'flood' flow. When the river is in 'low' flow, no discharge is allowed. When the river is in 'high' flow, limited discharge is allowed controlled by a system of salt discharge credits. The amount of discharge allowed depends on the ambient salinity in the river, so it can change daily. The total allowable discharge (TAD) is calculated so that the salt concentration does not exceed 900 µS/cm in the middle and lower sectors of the river or exceed 600 µS/cm in the upper sector. When the river is in 'flood', unlimited discharge is allowed as long as the salt concentration does not exceed 900 µS/cm. Members of the HRSTS coordinate their discharges so that this goal is achieved (NSW DEC, 2016).

There is a total of 1000 salt discharge credits in the HRSTS, with different licence holders having different numbers of credits. Licence holders can only discharge salt into the river in proportion to the credits they hold: 1 credit allows a discharge of 0.1% of the TAD (NSW DEC, 2016).

The NSW Environment Protection Authority (EPA) has recently completed a review of the HRSTS. The Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Amendment Regulation 2016 implements the recommendations of the review and commenced on 16 March 2017. The primary change contained in the Amendment Regulation is an increase to the flood flow thresholds to significantly lower the risk that salinity targets could be exceeded by simultaneous, full capacity discharges by all participants during 'flood' flows. The new 'flood' flow thresholds will not impact the total amount of salt that can be discharged by participants or the frequency, size and duration of discharge opportunities under the Scheme. However, the new thresholds will change the number of discharge opportunities that are classified as 'high flow' versus 'flood flow' and there may be slightly more discharges being classified as 'high flow'. Participants will need to ensure that they hold sufficient credits in order to discharge their desired quantity of saline water into these 'high flow' discharge opportunities (NSW EPA, 2016).

The amended HRSTS flow thresholds are summarised in Table 2.3. The 'flood' flow threshold increased from >4,000 to >6,500 ML/day in the upper sector, from >6,000 to >16,500 ML/day in the middle sector, and from >10,000 to >28,500 ML/day in the lower sector.

Table 2.3 Amended flow thresholds for HRSTS

FLOW CATEGORY	FLOW RATE (ML/DAY)		
	UPPER SECTOR	MIDDLE SECTOR	LOWER SECTOR
Low flow (no discharge)	0 to 1,000	0 to 1,800	0 to 2,000
High flow (discharge with credits)	1,000 to 6,500	1,800 to 16,500	2,000 to 28,500
Flood flow (discharge unrestricted by credits)	> 6,500	> 16,500	> 28,500

Bengalla participates in the HRSTS. BMC's EPL 6538 stipulates the concentration and volume limits at the licensed discharge point applicable to HRSTS releases (refer to Section 2.1.1 Table 2.1).

2.1.4 MANAGING URBAN STORMWATER: SOILS AND CONSTRUCTION

The *Managing Urban Stormwater: Soils and Construction* publications provide guidelines for erosion and sediment control during construction and other land disturbance activities.

Managing Urban Stormwater: Soils and Construction - Volume 1 (Landcom, 2004) ('Blue Book') provides general guidelines for the design, construction and implementation of measures to improve stormwater management, primarily erosion and sediment control, during the construction-phase of urban development. *Managing Urban Stormwater: Soils and Construction - Volume 2E Mines and Quarries* (DECC, 2008) provides supplementary guidelines, principles and recommended minimum design standards for erosion and sediment control at mines and quarries.

Erosion and sediment controls for Bengalla will be designed, installed and maintained in accordance with the guidelines *Managing Urban Stormwater: Soils and Construction - Volume 1* (Landcom, 2004) ('Blue Book') and *Managing Urban Stormwater: Soils and Construction - Volume 2E Mines and Quarries* (DECC, 2008).

3 EXISTING SURFACE WATER ENVIRONMENT

3.1 REGIONAL AND LOCAL DRAINAGE NETWORKS

Bengalla is located adjacent to the Hunter River floodplain and is entirely encompassed by the Hunter River catchment. Upstream of Muswellbrook the Hunter River has a catchment area of approximately 4,200 km². From Muswellbrook, the Hunter River continues to meander for approximately 35 km in a generally south-west direction before turning easterly after it is joined by the Goulburn River near Denman and then continuing toward Newcastle.

The western parts of the Bengalla mining area drain to Dry Creek, which is an ephemeral tributary of the Hunter River that runs through the mine site capturing runoff from an area of about 18 km². The Dry Creek catchment has mostly been cleared for agriculture and is dominated by grasslands, although some areas of scattered woodland remain. Dry Creek has been temporally diverted to allow mining operations as per the development consent SSD-5170 (as modified). The Dry Creek Diversion works were completed in December 2016.

3.2 CLIMATE DATA

Daily rainfall and evaporation data for the site for the 114-year period between 1893 and 2006 was obtained from the Bureau of Meteorology (BOM) Data Drill service. This is the period that rainfall data overlaps with the available streamflow data (refer Section 3.4). The Data Drill accesses grids of data derived by interpolating the BOM's station records. The data in the Data Drill are all synthetic and there are no original meteorological station data left in the calculated grid fields (BOM, 2006).

The Data Drill is considered superior to individual BOM station records and site meteorological station data for long-term water balance modelling purposes because it draws on a greater dataset, both spatially and in time. The Data Drill is also considered superior for modelling purposes as it does not contain gaps.

The rainfall records from the two rainfall stations closest to Bengalla with the longest period of record (Muswellbrook (BOM Station No. 61053) and Aberdeen (BOM Station No. 61000)) were obtained and average monthly rainfall compared to that from the Data Drill. The evaporation record from Scone SCS (BoM Station No 61089) was also obtained as this is the closest station where evaporation is recorded and a similar comparison made with the Data Drill. This comparison is shown below in

Table 3.1.

Summary statistics for the Data Drill rainfall data are provided in Table 3.2.

Table 3.1 Mean monthly rainfall and evaporation

MONTH	MEAN MONTHLY RAINFALL (mm)			MEAN MONTHLY EVAPORATION (mm)	
	MUSWELLBROOK (61053) (125 YEARS DATA)	ABERDEEN (61000) (113 YEARS DATA)	DATA DRILL * (114 YEARS DATA)	SCONE SCS (61089) (66 YEARS DATA)	DATA DRILL (128 YEARS DATA)
January	69.6	73.5	71.4	220	214
February	66.9	62.2	62.6	174	169
March	52.8	51.6	53.8	155	150
April	43.5	40.2	42.3	105	106
May	41.5	41.5	40.4	68	72
June	51.3	44.5	44.6	48	53
July	44.2	40.6	39.9	59	61
August	38.6	36.5	36.3	84	88
September	40.7	39.1	38.0	117	118
October	48.6	49.3	49.3	158	157
November	56.1	50.9	49.7	183	184
December	67.0	66.1	61.7	223	217
Total	620.7	596.0	589.8	1,594	1,583

*Notes: * Data Drill for coordinates -32.25S, 150.85E (decimal degrees)*

Table 3.2 Summary statistics for modelled rainfall data (Data Drill – 1893 to 2006)

STATISTIC	ANNUAL RAINFALL (mm/YR)
Minimum	285
5th percentile (dry)	348
10th percentile	373
50th percentile (median)	591
90th percentile	766
95th percentile (wet)	815
99th percentile	940
Maximum	1225
Standard deviation	154

3.3 RAINFALL RUNOFF

The volume of surface water runoff from mine site catchments has been estimated using the Australian Water Balance Model (AWBM) rainfall-runoff model (Boughton, 1993) that is incorporated in the OPSIM water balance model.

The AWBM is a partial area saturation overland flow model. The use of partial areas divides the catchment into regions (contributing areas) that produce runoff during a rainfall-runoff event and those that do not. These contributing areas vary within a catchment according to antecedent catchment conditions and allow for the spatial variability of surface storage in a catchment. The use of the partial area saturation overland flow approach is simple and provides a good representation of the physical processes occurring in most Australian catchments (Boughton, 1993). This is because daily infiltration capacity is rarely exceeded, and the major source of runoff is from saturated areas. Figure 3.1 shows a schematic layout of the AWBM.

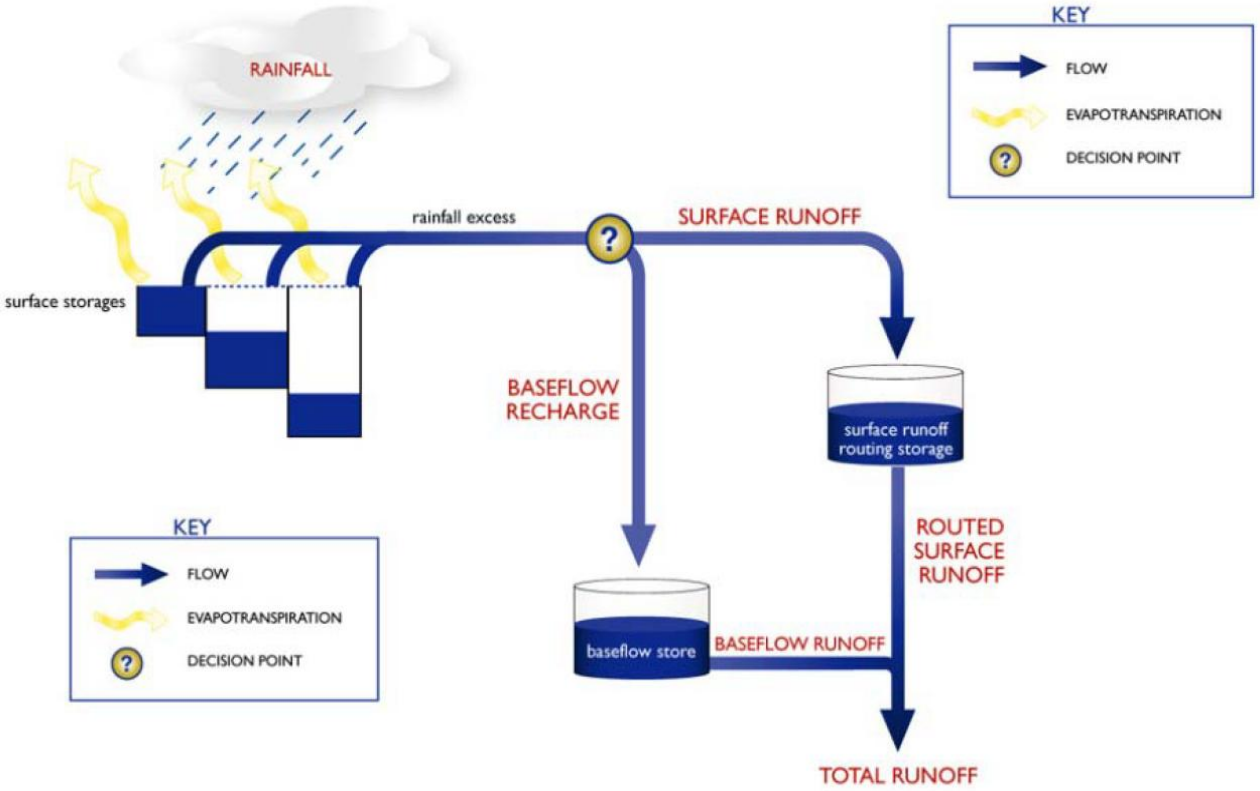

Figure 3.1 Schematic layout of the AWBM rainfall-runoff model (CRC for Catchment Hydrology Australia, 2004)

To implement the AWBM in a given catchment, a set of nine parameters must be defined as summarised in

Table 3.3. These parameters define the generalised model for a particular catchment. The parameters are usually derived for a gauged catchment by a process of calibration where the recorded streamflows are compared with calculated streamflows. The parameters are adjusted to produce the best match between the means and standard deviations of the daily streamflows, to match the difference in peak flow discharges.

Table 3.3 Description of AWBM parameters

PARAMETER	DESCRIPTION
A1, A2, A3	Partial areas represented by surface storages
C1, C2, C3	Surface storage capacities
Ks	Daily surface flow recession constant
BFI	Baseflow index
Kbase	Daily baseflow recession constant

AWBM parameters for Bengalla have been obtained from the Bengalla Continuation of Mining Project Environmental Impact Statement (EIS) SWIA (WRM, 2013) and are summarised in Table 3.4. Verification of the water balance model and adopted AWBM parameters was undertaken for the period January 2010 to December 2011 as part of the EIS SWIA. No further calibration or verification has been undertaken of the adopted AWBM parameters. Average long term volumetric runoff coefficients estimated from the AWBM are also summarised in Table 3.4. The volumetric runoff coefficient is the ratio of the volume of runoff to the volume of rainfall. Rainfall losses include interception by vegetation, evaporation from the land surface, depression storage on the land surface and infiltration into the soil.

Table 3.4 Adopted AWBM parameters for mine site catchments

LAND USE	AWBM PARAMETERS								
	BFI	K_{BASE}	A1	A2	A3	C1 (mm)	C2 (mm)	C3 (mm)	VOLUMETRIC RUNOFF COEFFICIENT
Undisturbed area	0.134	0.433	0.433	5.7	57.8	115.7	0.933	0.39	12.4%
Rehabilitated spoil	0.134	0.433	0.433	5.7	57.8	115.7	0.933	0.39	12.4%
Industrial	0.134	0.433	0.433	2.6	26.7	53.3	0	0	21.8%
Open cut pit	0.2	0.6	0.2	5	70	90	0	0	15.7%
Active spoil	0.136	0.27	0.594	50	100	500	0	0.103	2.7%

Source: EIS SWIA (WRM, 2013)

3.4 STREAMFLOW

The streamflow record for the Hunter River at Muswellbrook Bridge (Station No 210002) was obtained from the NSW Government Department of Primary Industries Water (DPI Water) 'real-time data' website. The Muswellbrook Bridge gauge has been in operation since 1913 and is still operating, however, there is more than 30 years of missing data over this period of record. The catchment area for the Hunter River at Muswellbrook Bridge is approximately 4,220 km^2.

Historical streamflow timeseries for the Hunter River at Muswellbrook Bridge (Station No 210002) for the full period of record from 1913 to 2017 is provided in Figure 3.2 and a low flow frequency analysis is provided in Figure 3.3. A flow duration curve for the full period of record from 1913 to 2017 is provided in Figure 3.4. The flow duration curve shows the percentage of time that flow in the Hunter River equals or exceeds a specific value based on the historical record. The Hunter River catchment was modified in 1988 with completion of upgrade works to Glenbawn Dam, and the daily flow duration curve for the period 1988 to 2017 is also provided in Figure 3.4 as this curve is more representative of the catchment in its current developed condition.

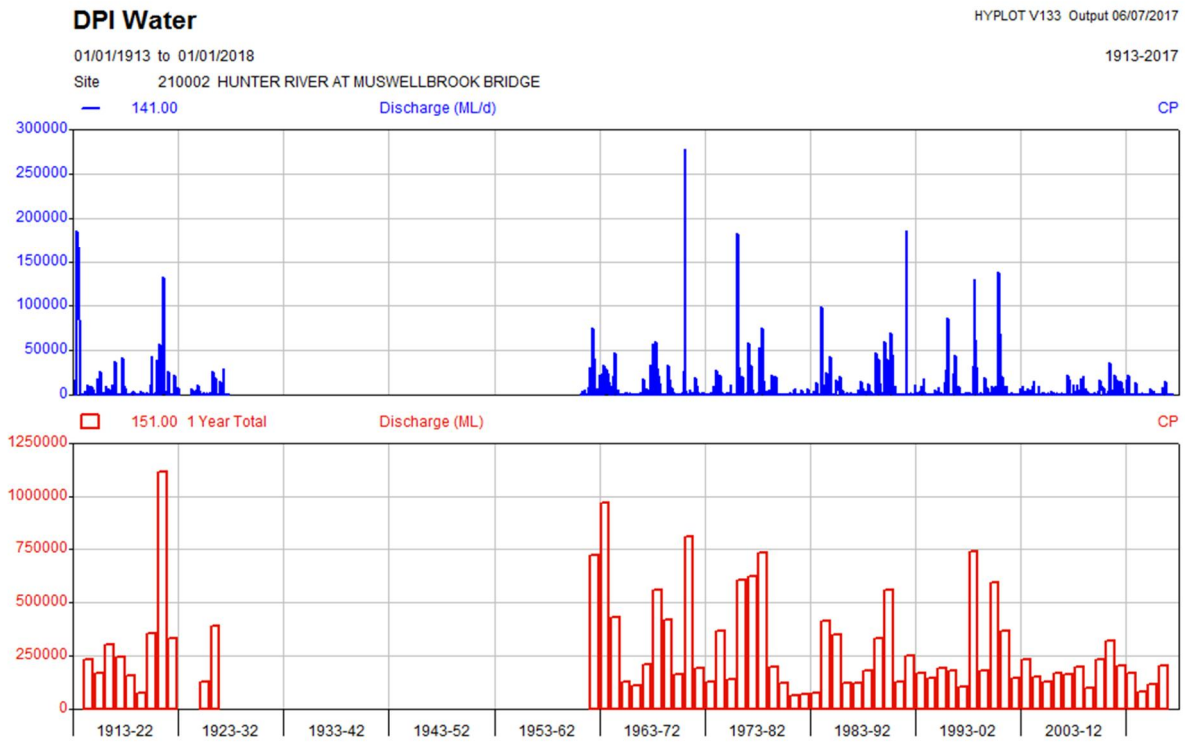

Figure 3.2 Streamflow timeseries for Hunter River at Muswellbrook Bridge (Station No 210002) for 1913 to 2017 (Source: DPI Water 'real-time data' website)

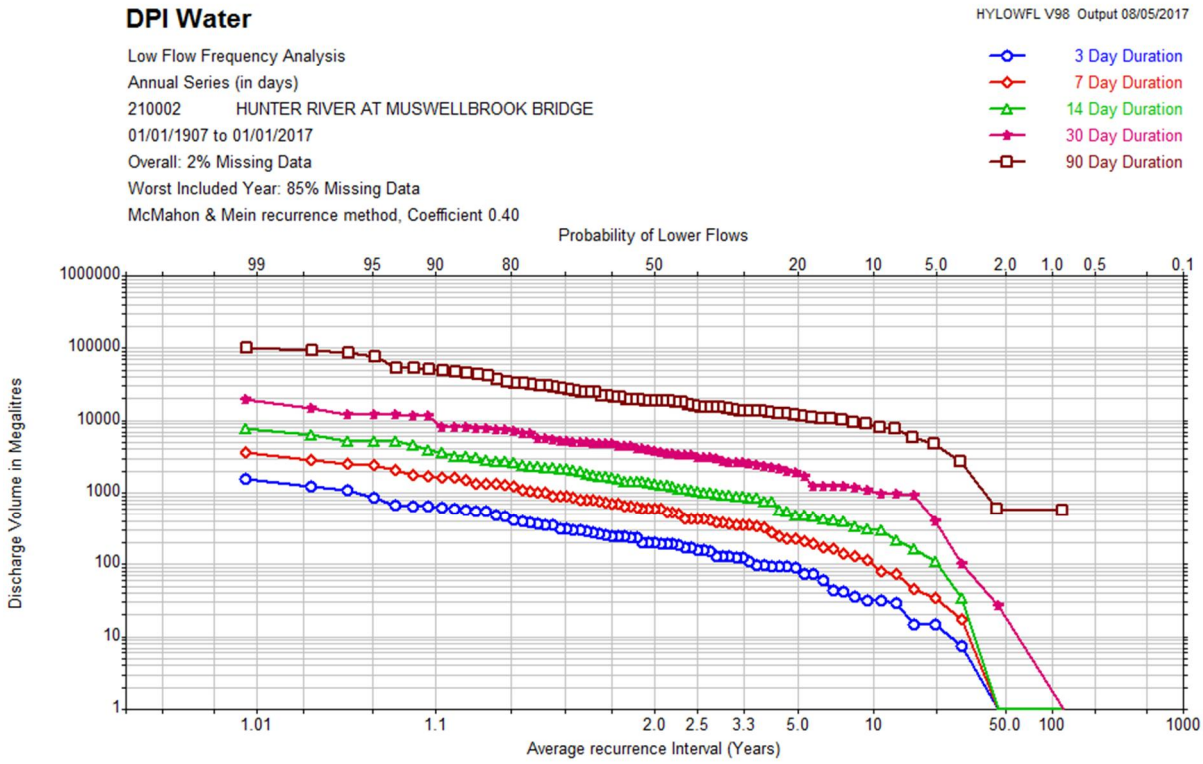

Figure 3.3 Low flow frequency analysis for Hunter River at Muswellbrook Bridge (Station No 210002) for 1913 to 2017 (Source: DPI Water 'real-time data' website)

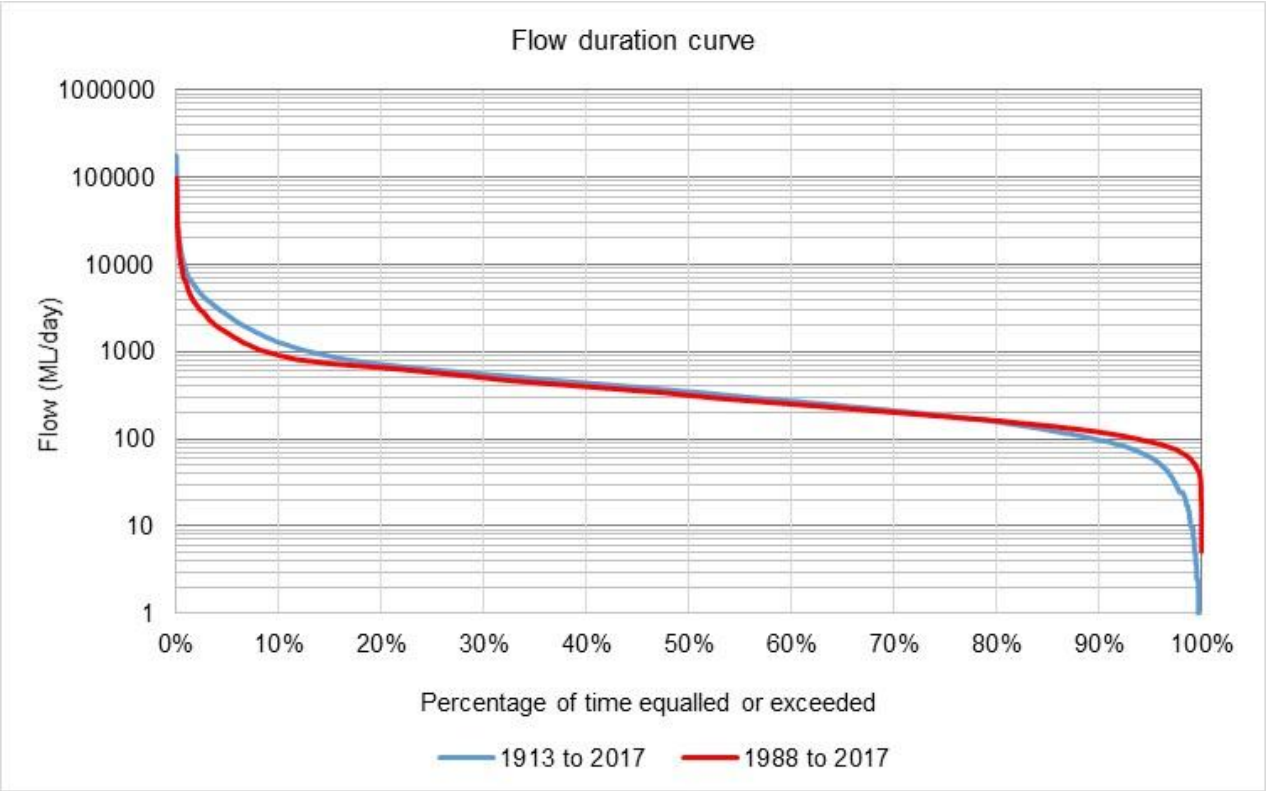

Figure 3.4 Flow duration curve for Hunter River at Muswellbrook Bridge (Station No 210002)

The flow duration analysis for the period 1988 to 2017 shows that flows less than 10 ML/day can be expected 0.01% of time. The minimum flow recorded from 1988 to 2017 was 5.1 ML/day. The flow duration curve for the full period of record from 1913 to 2017 shows that flows less than 10 ML/day can be expected 1.1% of time. Comparison of the two flow duration curves indicates that Glenbawn Dam has increased the frequency of low flows and decreased the frequency of high flows.

For the purposes of water balance modelling, simulated streamflow data for the Hunter River was obtained from DPI Water's Integrated Quantity and Quality Model (IQQM) for the period 1/1/1900 to 30/6/2007 for use in the EIS SWIA (WRM, 2013). The IQQM simulated streamflow data is based on the catchment in its developed condition (with assumed demands for power generation and irrigated crop areas etc) and does not contain data gaps. As such the IQQM simulated data was considered superior to historical streamflow data for the purposes of water balance modelling. Simulated data is not available beyond 30/6/2007.

4 WATER MANAGEMENT

4.1 EXISTING WATER MANAGEMENT STRATEGY

Bengalla's existing water management strategy is described in the Bengalla WMP (BMC, 2017). The following definitions are used for the various water types:

— Clean water - Water pumped from the Hunter River into the Existing Raw Water Dam or runoff from a catchment that is undisturbed by mining and associated activities. Includes runoff from fully rehabilitated mined out areas where the rehabilitation area has been relinquished.

— Mine water - Water that accumulates within, or drains from, active mining and infrastructure areas and any other areas where runoff may have or has come into contact with coal or carbonaceous material.

— Sediment water - Runoff from areas disturbed by mining and associated activities that has not come into contact with coal or carbonaceous material. Includes water from non-relinquished rehabilitation areas.

— Contaminated water - Associated with water used by the vehicle washbay and bathhouse that is captured and processed in the hydrocarbon separation system and waste water treatment plant (WWTP) respectively to enable its transfer and reuse in the mine water system.

Water management at Bengalla is based on the following key principles:

— Minimise the use of clean water from external sources.

— Where possible, divert clean water away from areas disturbed by mining and associated activities.

— Collect sediment water in catch drains and direct to sediment traps and settling dams, and where required reuse as Bengalla water supply.

— Collect runoff from industrial areas (mine water) in catch drains.

— Transfer of open cut pit water (mine water) to storage dams for reuse as Bengalla water supply.

— Minimal offsite discharge of surplus mine water.

4.1.1 CLEAN WATER MANAGEMENT

Dams, pipelines and associated drainage structures redirect clean water away from disturbed areas. A series of temporary drains divert clean water around the disturbance area to the downstream waterway.

4.1.2 MINE WATER MANAGEMENT

Mine water is used onsite or discharged to the Hunter River in accordance with EPL 6538 and the HRSTS. Water stored in the Existing Washery Dam is used for mine site demands, excluding the vehicle wash down, fire suppression and drinking and shower purposes, as a priority over raw water. The pit is utilised for mine water storage, as required. The EPL 6538 licensed discharge point for mine water is located on the Western Diversion Levee, with discharge water being pumped from the Existing SDD to the discharge point via a pipeline.

4.1.3 SEDIMENT WATER MANAGEMENT

Sediment water is detained within the Bengalla water management system. Sediment dams transfer water to the mine water management system, with overflows from sediment dams to natural watercourses only occurring during large rain events or prolonged wet periods.

New sediment dams are designed in accordance with the guidelines *Managing Urban Stormwater: Soils and Construction - Volume 1* (Landcom, 2004) ('Blue Book') and *Managing Urban Stormwater: Soils and Construction - Volume 2E Mines and Quarries* (Department of Environment and Climate Change, 2008). Sediment dams are generally 'wet basins' designed for 'Type D/F' soils.

Following the relinquishment of established rehabilitation areas it is anticipated that relevant sediment dams will be removed from the mine water management system and clean runoff from rehabilitated areas will be released to the environment.

4.1.4 CONTAMINATED WATER MANAGEMENT

Contaminated water at Bengalla is generated by the bathhouse and vehicle wash bay. Contaminated water from the bathhouse is processed through the WWTP which then directs the water into the process water circuit for reuse in the mine water system. Contaminated water from the vehicle wash bay is processed through a hydrocarbon separation system which directs waste oil into a waste oil tank and the water component into the facilities sump. The water from the facilities sump overflows into the East & West Facilities dams for reuse in the Bengalla water management system.

4.2 EXISTING WATER MANAGEMENT SYSTEM

Bengalla's existing water management system is described in the Bengalla WMP (BMC, 2017). The main components of the existing Bengalla water management system (as at June 2017) include:

- The Existing Washery Dam supplies process water to the coal handling and preparation plant (CHPP) and truck fill stations. The Existing Washery Dam is also used as a transfer dam, receiving excess mine water which then overflows to the Existing SDD.
- Water supply infrastructure includes the Hunter River intake and pipeline and the Existing Raw Water Dam which acts as a storage dam for raw water pumped to site.
- The Bengalla WWTP treats effluent and directs it into the Bengalla mine water management system for reuse.
- The East & West Facilities dams capture CHPP return water, contaminated water from the WWTP and vehicle wash, mine water runoff and mine water transferred from the Wantana West Dam and ROM North Dam. Water from the East & West Facilities Dams is transferred to the Existing Washery Dam.
- The South Loop Road Dam and Endwall Dam receive mine water from the pit.
- CW1 (located north of Wybong Road) intercepts runoff from the Dry Creek catchment upstream of Bengalla.
- The Northern Diversion Levees divert clean water from the upper Dry Creek catchment into CW1.
- The Western Diversion Levee, constructed west of Dry Creek and south of Wybong Road, diverts clean water around active mining and into Dry Creek south of the existing Mine Access Road.
- The EPL 6538 licensed discharge point for mine water is located on the Western Diversion Levee, with discharge water being pumped from the Existing SDD to the discharge point via a pipeline. Discharges are undertaken in accordance with conditions of the HRSTS and EPL 6538.
- Sediment traps, drainage channels and sediment dams collect and treat sediment water runoff from overburden, non-relinquished rehabilitation and hardstand areas.
- Various other minor sediment and mine water dams.

A schematic of the existing Bengalla water management system is provided in Figure 4-1.

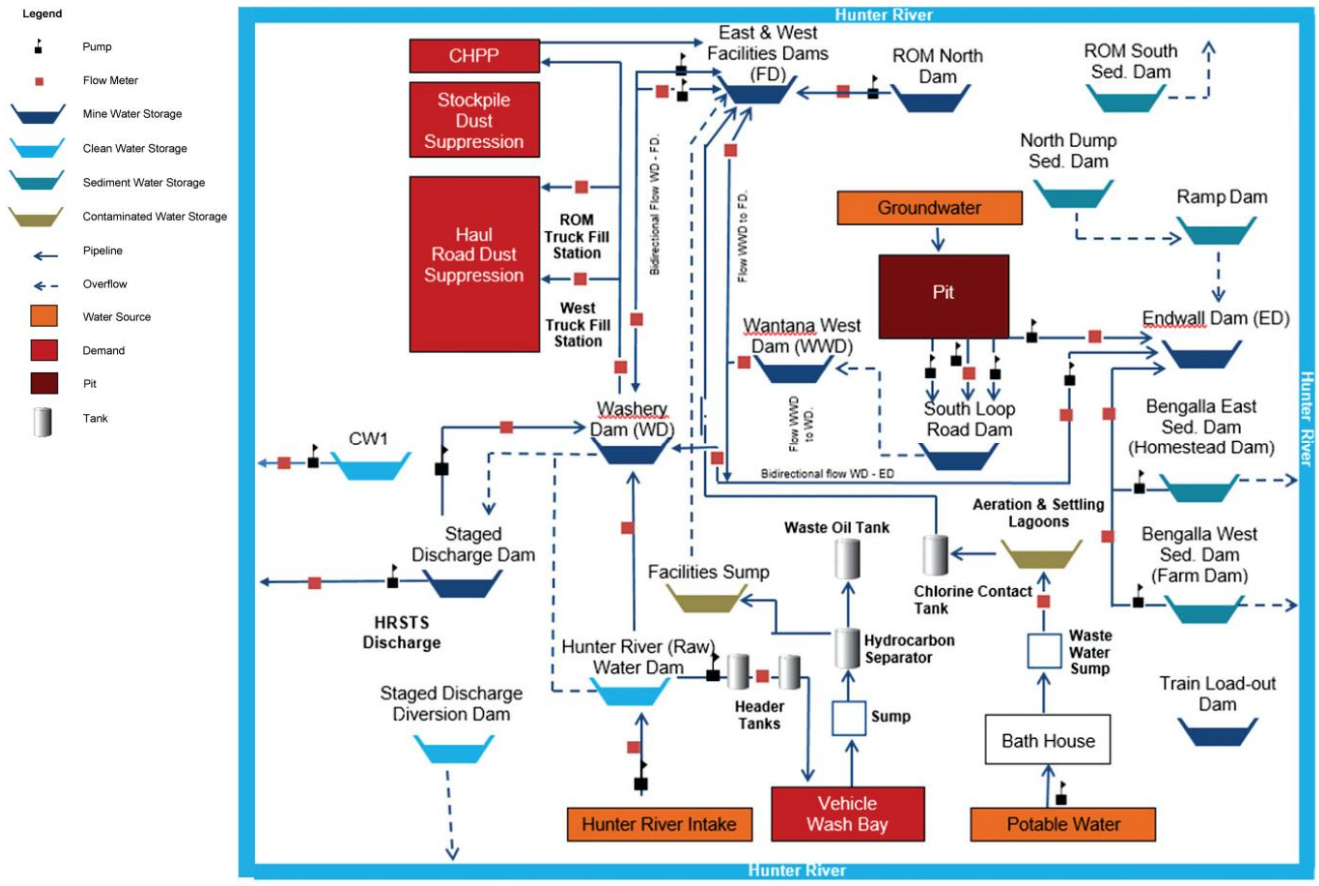

Figure 4-1 Bengalla existing water management system schematic (March 2017) (Source: BMC, 2017)

4.3 APPROVED OPERATIONS

To facilitate ongoing mining operations at Bengalla, a number of changes to the original Bengalla water management system have been approved as part of the Bengalla Continuation of Mining Project (as modified). Key changes include:

BENGALLA CONTINUATION OF MINING PROJECT

— Increased water demands associated with increased production rates, including CHPP water use, stockpile and haul road dust suppression and vehicle wash down.

— Mining operations continuing west through some existing facilities. Some storages will be relocated as this occurs. The Existing Raw Water Dam, Existing Washery Dam and Existing SDD will be relocated. The approved capacity of Future SDD (ED1) is 300 ML.

— The diversion of Dry Creek via dams and pipe work with a later permanent alignment of Dry Creek through rehabilitation areas when overburden areas are suitably advanced.

— Construction of various mine water dams, diversion drains, levees, sediment dams and associated drainage works, as required.

MOD 1

— Utilisation of the Satellite Pit as a temporary mine water catchment dam.

— Relocation of the SDD and HRSTS release point.

— Construction of clean water diversion levees in locations other than those already approved.

— Revised locations for the Future Raw Water Dam and Future Washery Dam.

The performance of the approved Bengalla water management system is described in the Bengalla MOD 1 SEE SWIA (WRM, 2015). The overall health of the water management system is reflected in the modelled stored inventory in the open cut pits. The median (50th percentile) inventories of the Main Pit and Satellite Pit show that the pits are generally maintained dry with no long term build up. The 90th percentile inventory in the Main Pit and Satellite Pit reaches 240 ML and 450 ML respectively. The 99th percentile inventory in the Satellite Pit reaches approximately 1,250 ML (WRM, 2015).

MOD 2

MOD 2 did not include significant changes to the Bengalla water management system. Water balance modelling was not undertaken for MOD 2.

MOD 3

MOD 3 did not include significant changes to the Bengalla water management system. Water balance modelling was not undertaken for MOD 3.

4.4 PROPOSED WATER MANAGEMENT SYSTEM

The proposed MOD 4 water management system includes:

— Enlargement of the Future ED1 to approximately 700 ML in order to provide additional out-of-pit mine water storage onsite and to reduce the volume stored in-pit during wet conditions. This is 400 ML above the approved capacity of 300 ML. There are no changes proposed to the approved location or general operating philosophy of ED1.

— Provision of the proposed approximately 93 ML capacity Dry Creek East Dam.

  — Dry Creek East Dam will initially be a mine water dam (Year 4) and will operate as a midway point between the open cut pit and ED1. Dry Creek East Dam will replace the existing function of Wantana West Dam as a staging point for pit dewatering. Pumped flows from the Main Pit and Satellite Pit will be received via the South Loop Road Dam which will overflow into the Dry Creek East Dam. From the Dry Creek East Dam mine water will be pumped onto the Future Washery Dam for reuse onsite or release from ED1 under the HRSTS. Pumped flows from the Endwall Dam and Wantana West Dam sediment dams will also report to Dry Creek East Dam.

  — Dry Creek East Dam will be converted to a sediment dam (by Year 8) and will capture and treat runoff from a local overburden catchment as well as continuing to receive pumped inflows from other sediment dams. As a sediment dam, Dry Creek East Dam will pump to the Future Washery Dam and Dry Creek East Dam will overflow to the natural watercourse only during large rain events or prolonged wet conditions. When Dry Creek East Dam no longer operates as a mine water dam, pit dewatering will be to the Future Washery Dam. The dewatering pipeline route may include a small staging dam to facilitate efficient pumping.

  — Dry Creek East Dam will be considered a clean water dam when the overburden catchments reporting to it are fully rehabilitated and relinquished and will release to natural watercourses.

— Relocation of the approved Temporary OEA Sediment Dam within the Main OEA. The approved Temporary OEA Sediment Dam was located to the east of the Main OEA ridgeline and overflowed to Bengalla East Sediment Dam. The approved strategy also directed runoff from overburden areas west of the ridgeline to Ramp Dam (and onto Endwall Dam). The proposed approximately 58 ML Temporary OEA Sediment Dam is located to the west of the ridgeline and captures runoff from areas west of the ridgeline. The proposed Temporary OEA Sediment Dam overflows to the open cut pit and pumps to the proposed Dry Creek East Dam.

— Runoff from the proposed ROM stockpile and Temporary Rejects Cells will be captured in the mine water management system. In Year 4, these areas drain to the Satellite Pit and the East & West Facilities dams. In Year 24, these areas drain to the Main Pit and the East & West Facilities dams.

The proposed water management system layouts for the Year 4, 8, 15 and 24 mine stage 'snapshots' are shown in Figure 4-2 to Figure 4-5. The proposed water management system schematics, showing the connectivity between water storages, sources and demands, for the Year 4, 8, 15 and 24 mine stage 'snapshots' are shown in Figure 4-6 to Figure 4-9.

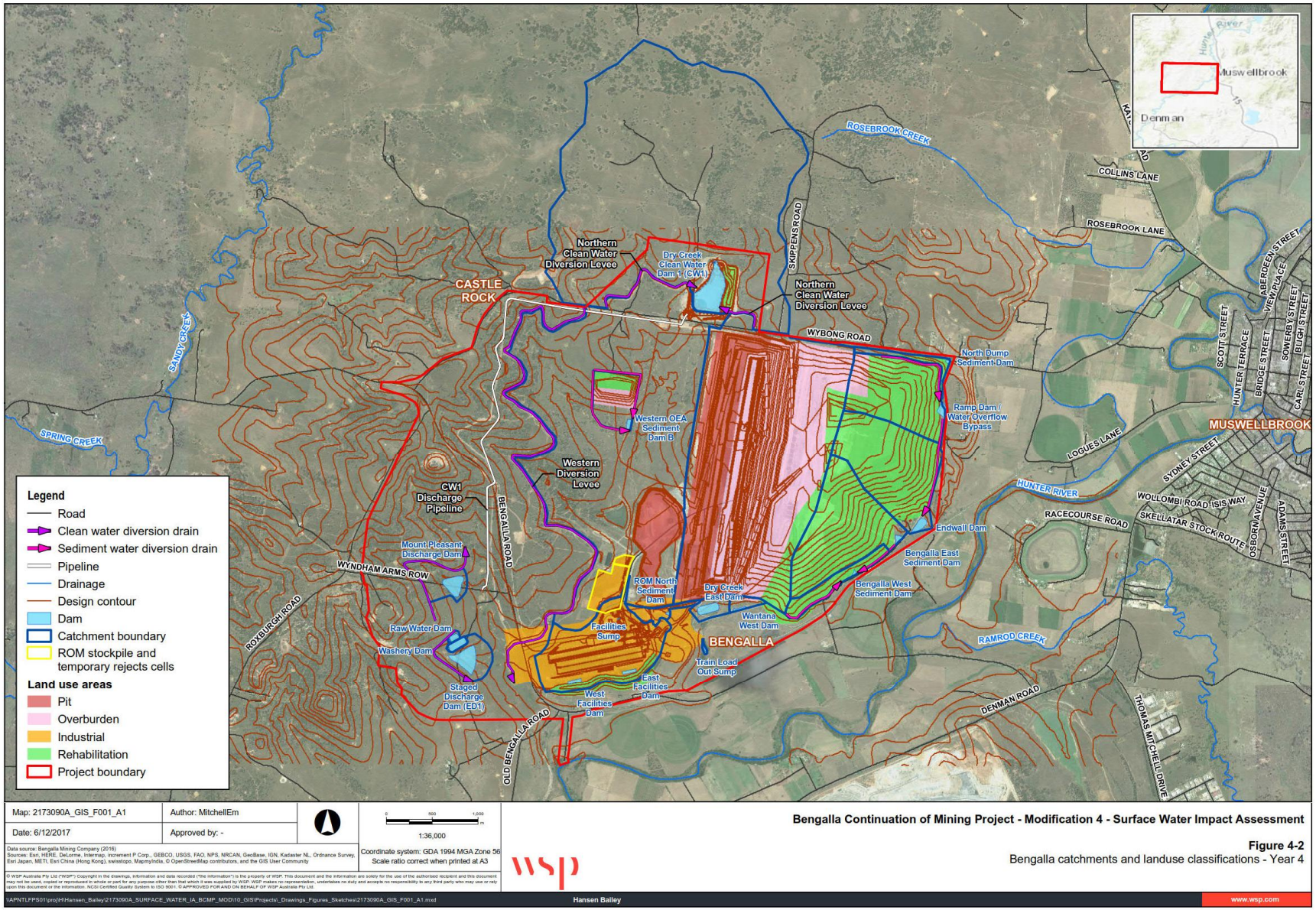

Figure 4-2 Bengalla catchments and landuse classifications – Year 4

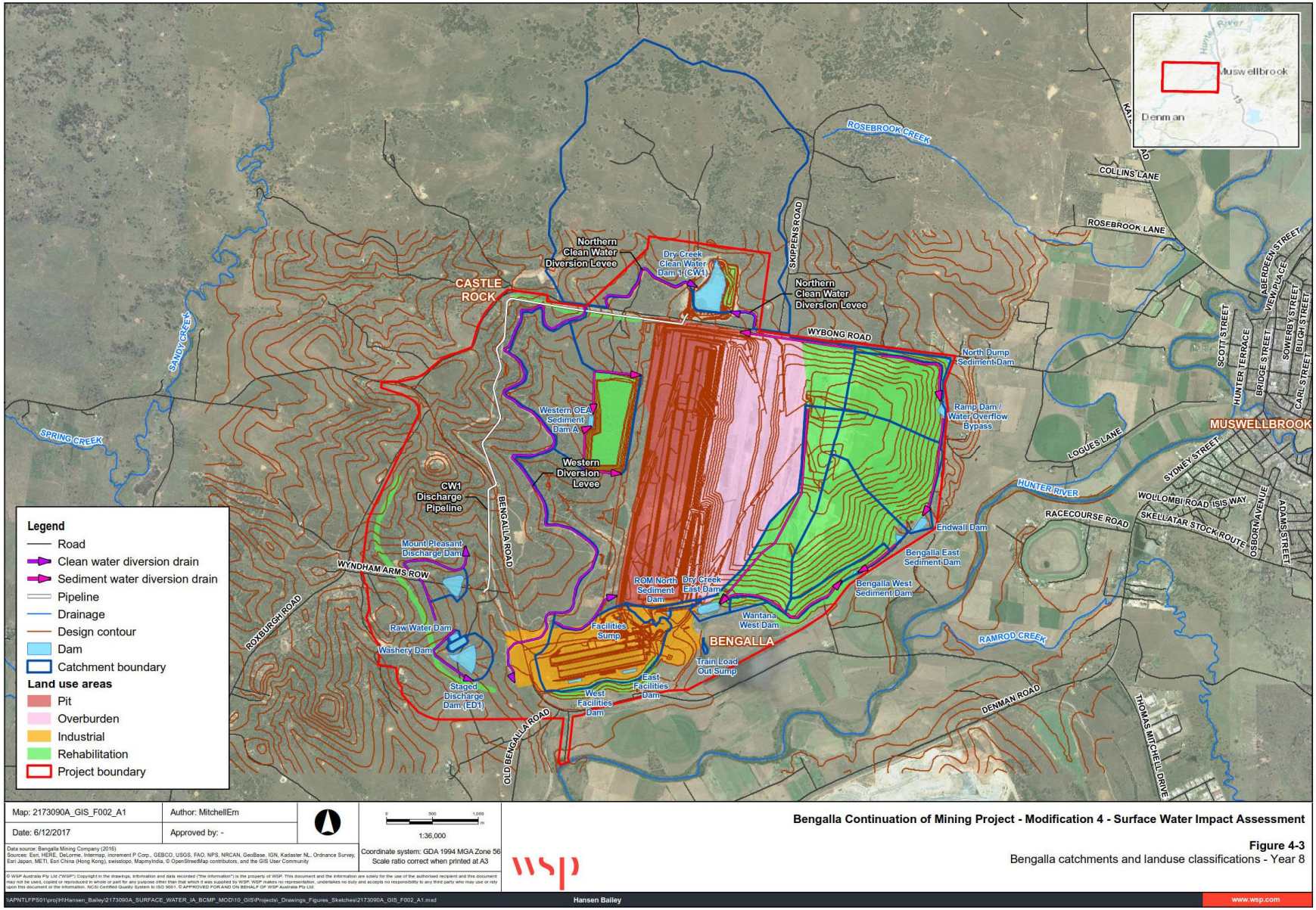

Figure 4-3 Bengalla catchments and landuse classifications – Year 8

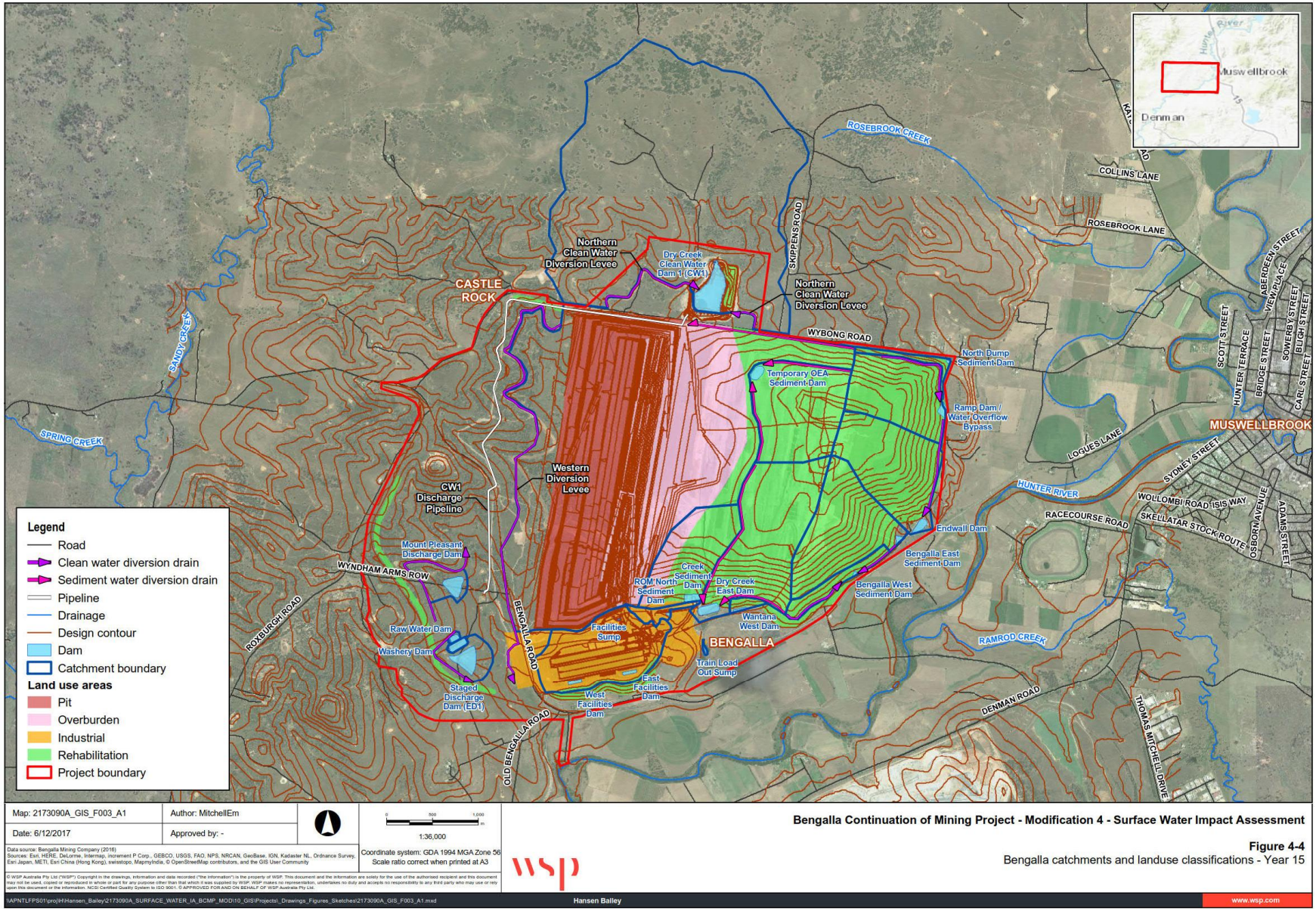

Figure 4-4 Bengalla catchments and landuse classifications – Year 15

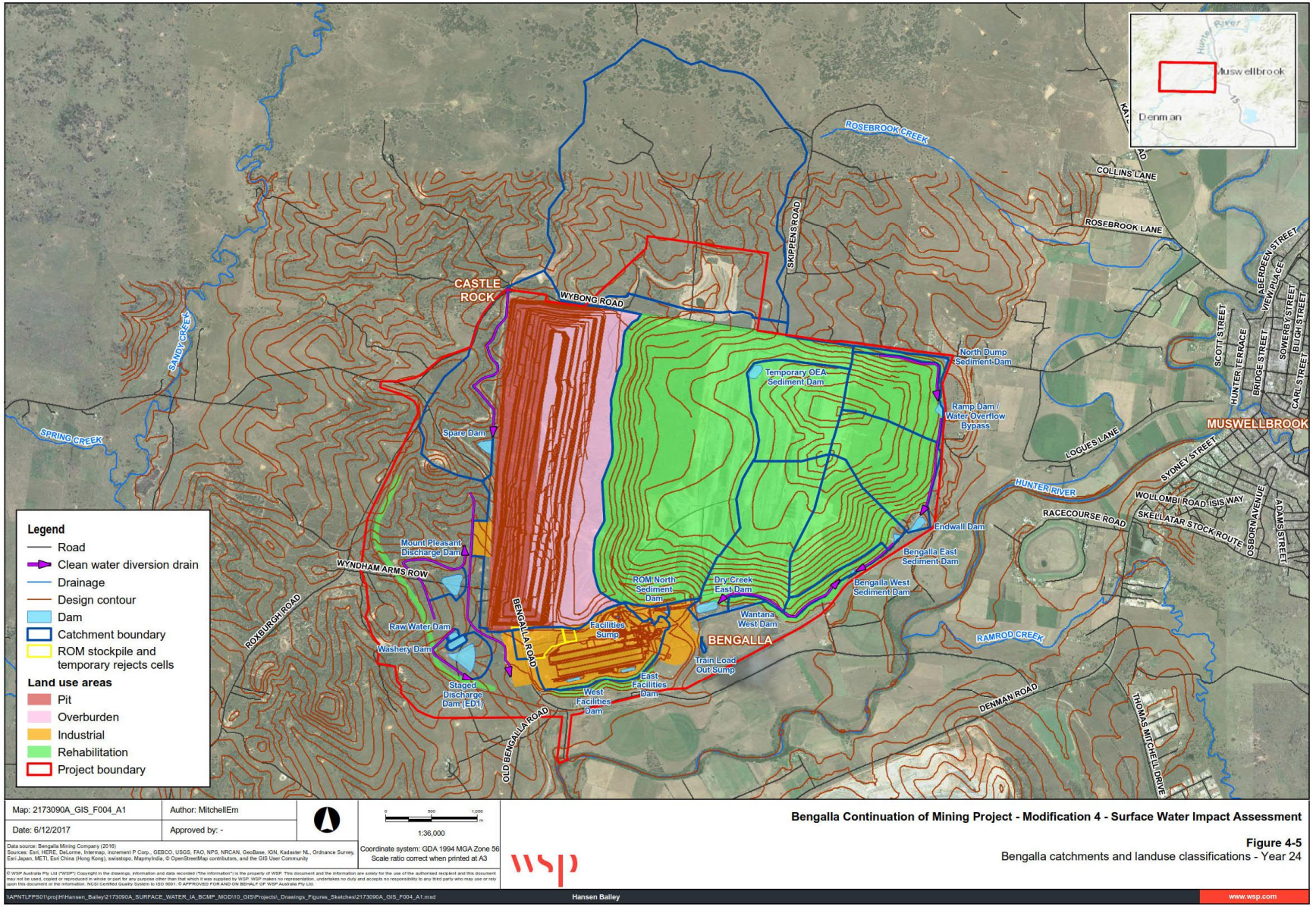

Figure 4-5 Bengalla catchments and landuse classifications – Year 24

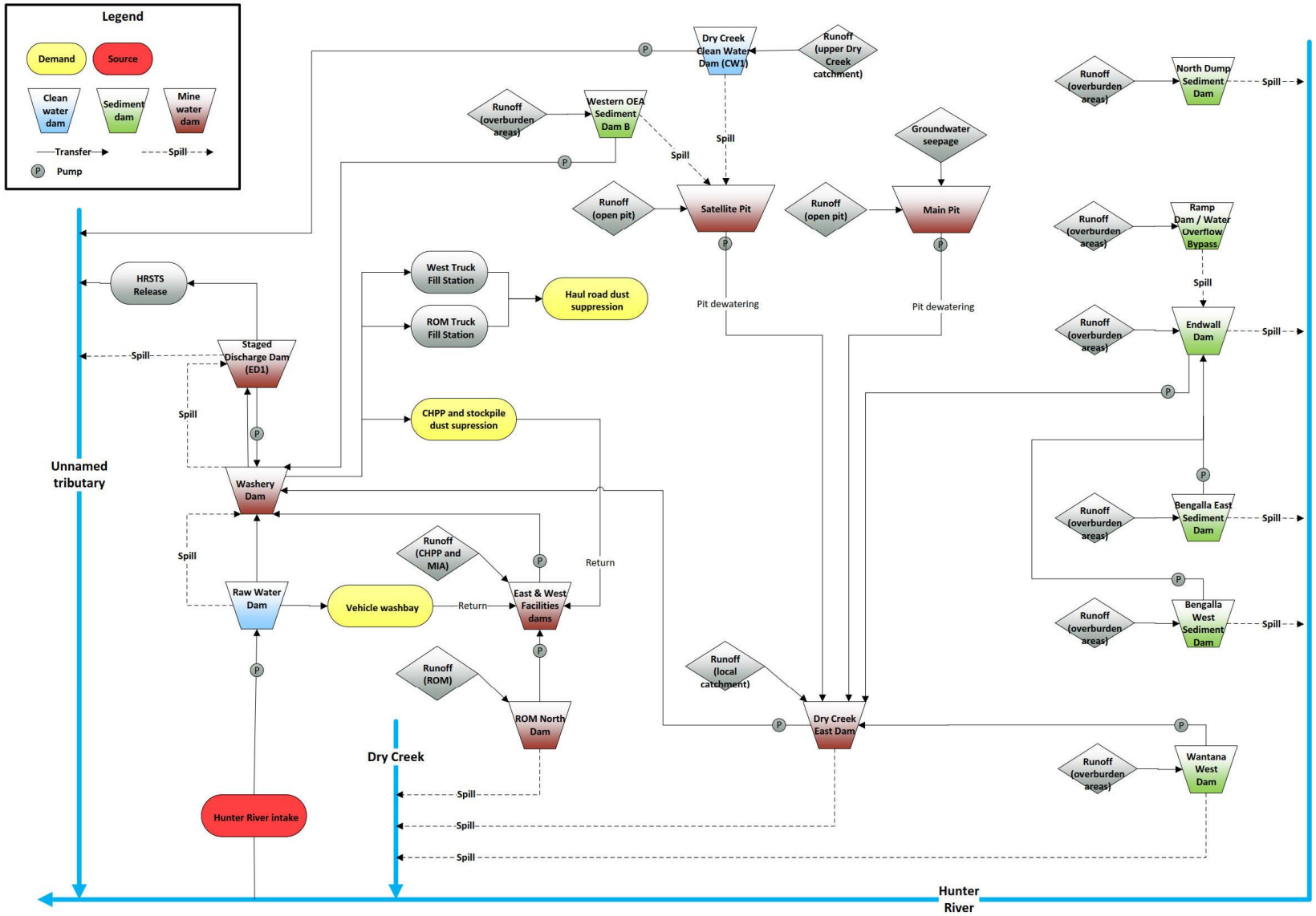

Figure 4-6 Bengalla proposed water management system schematic – Year 4

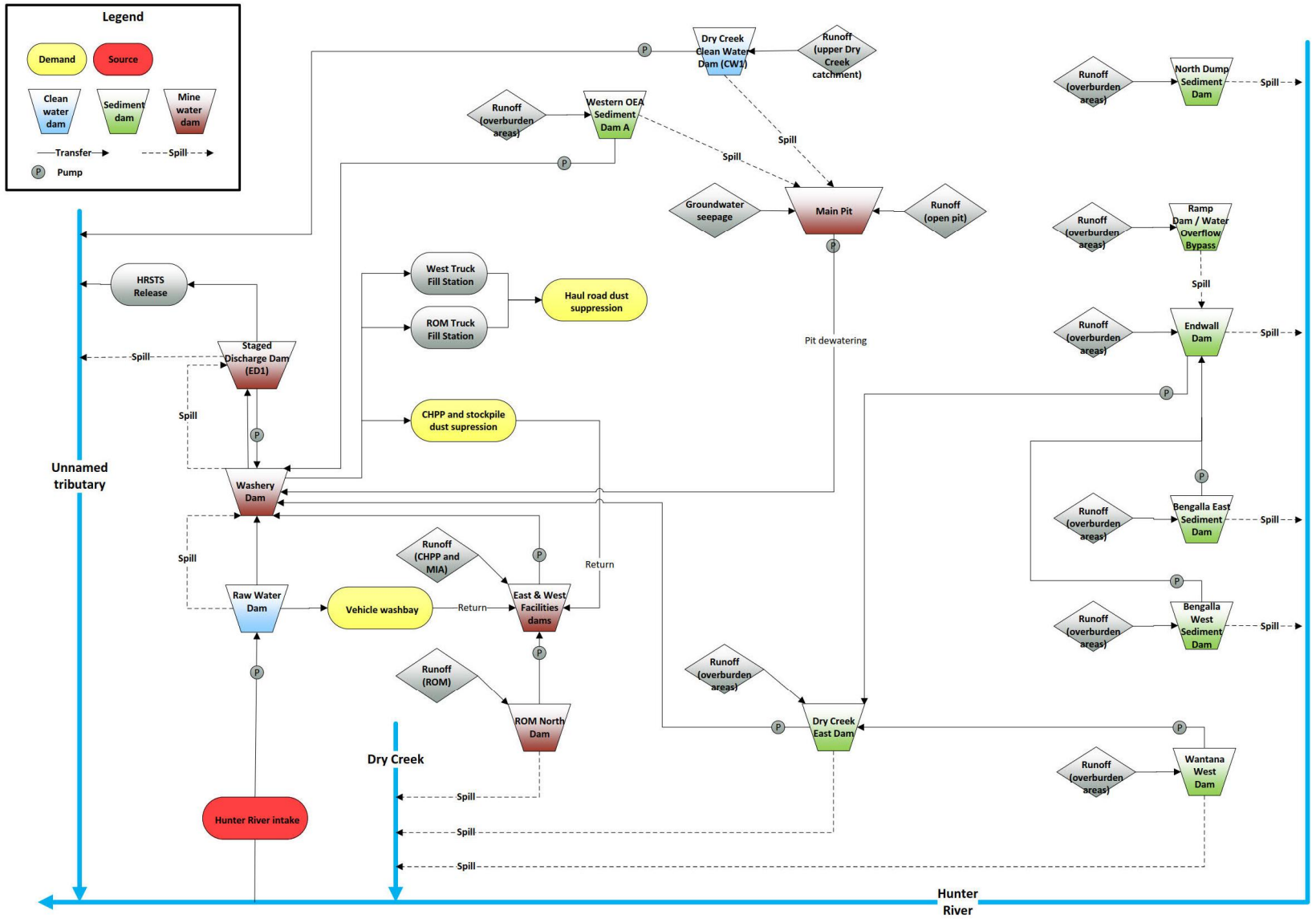

Figure 4-7 Bengalla proposed water management system schematic – Year 8

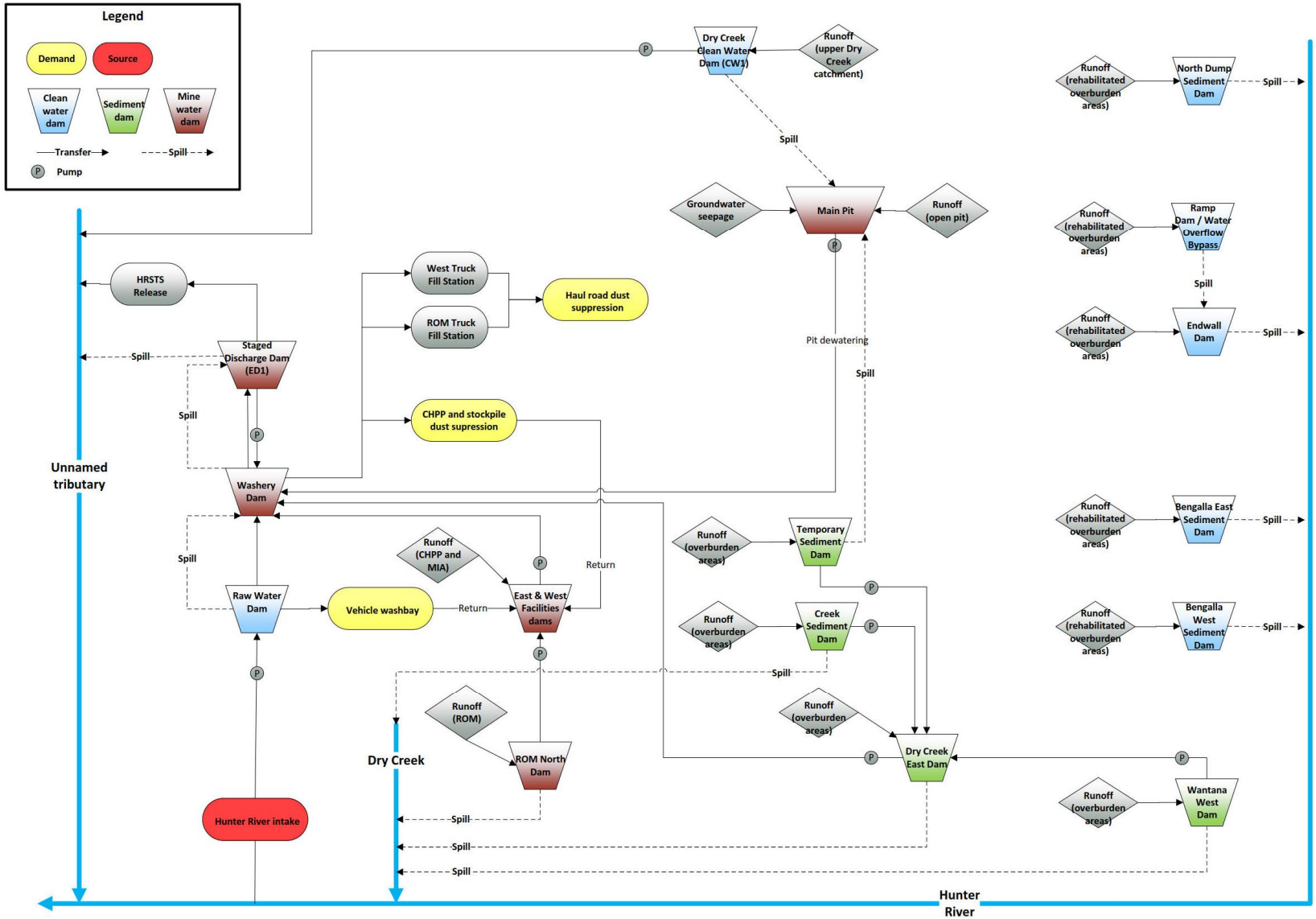

Figure 4-8 Bengalla proposed water management system schematic – Year 15

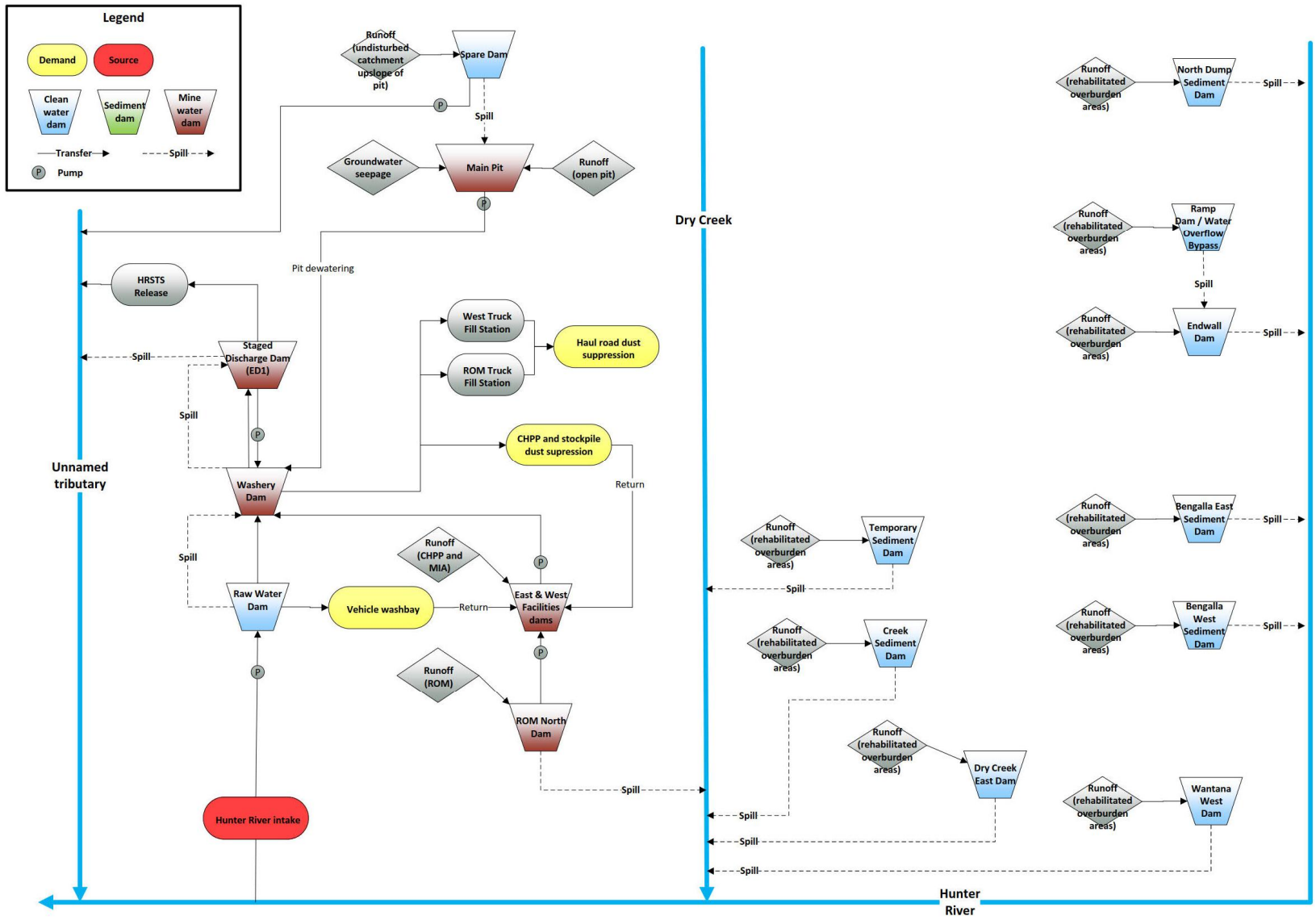

Figure 4-9 Bengalla proposed water management system schematic – Year 24

4.5 WATER MANAGEMENT STRUCTURES

Existing, approved and proposed water storages are summarised in Table 4.1. The timing of proposed water structures is provided in Table 4.2. By Year 4, the Existing Raw Water Dam, Existing Washery Dam and Existing SDD will all be relocated, and Endwall Dam and Wantana West Dam will be converted from mine water dams to sediment dams.

Table 4.1 Bengalla existing, approved and proposed water management structures – description

DAM	EXISTING CAPACITY (ML)	APPROVED CAPACITY (ML)	MOD 4 PROPOSED CAPACITY (ML)	PURPOSE	COMMENTS
Existing Staged Discharge Dam (SDD)	280	280	NA (to be replaced by ED1)	Mine water	Staging capacity for wet weather conditions. Licensed release point for mine water under the HRSTS. Accepts water from the Bengalla water management system.
Future ED1	NA	300	700	Mine water	
Existing Washery Dam	25	25	NA (to be replaced by Future Washery Dam)	Mine water	Supply dam for the CHPP and dust suppression water for the water truck fill points. The Existing Washery Dam overflows to the SDD.
Future Washery Dam	NA	25	25	Mine water	The Future Washery Dam will overflow to the Future ED1.
Existing Raw Water Dam	5	5	NA (to be replaced by Future Raw Water Dam)	Clean water	Storage dam for clean water extracted from the Hunter River, supplies the Existing Washery Dam, vehicle wash and fire suppression system. Overflows to the Washery Dam.
Future Raw Water Dam	NA	5	5	Clean water	
East & West Facilities dams	158 with short term capacity up to 208	158 (comprises 24 ML + 24 ML and nominal 110 ML for 'Additional Facilities Dam' if required)	158 with short term capacity up to 208	Mine water	Accepts mine water runoff from the CHPP stockpile and main infrastructure area and process water from dewatering of coal reject material. Accepts pumped mine water inflow from North ROM dam and contaminated water from the WWTP and vehicle wash.
ROM North Dam	13.6	51 (includes nominal 50 ML for 'Additional ROM Dam' if required)	51 (modelled as 13.6 as this is existing)	Mine water	Captures mine water runoff from the ROM and ROM haul road.
ROM South Dam	0.5		0.5	Sediment water	Captures sediment water runoff from the ROM visual bund.

DAM	EXISTING CAPACITY (ML)	APPROVED CAPACITY (ML)	MOD 4 PROPOSED CAPACITY (ML)	PURPOSE	COMMENTS
Endwall Dam	80	80	80	To be converted to sediment dam by approximately Year 4 (currently mine water dam)	Currently accepts mine water pumped from the pit. Also receives sediment water from rehabilitation area, Bengalla East and Bengalla West Sediment Dams.
West Wantana Dam	16	16	16	To be converted to sediment dam by approximately Year 4 (currently mine water dam, pit dewatering function to be replaced by Dry Creek East Dam)	Captures sediment water runoff from disturbed areas associated with Wantana Extension.
Bengalla East Sediment Dam (Homestead Dam)	23.7	43 (nominal)	43 (modelled as 23.7 as this is existing)	Sediment water	Captures sediment water runoff from the OEA un-relinquished rehabilitation area.
Bengalla West Sediment Dam (Farm Dam)	5	5 (assigned to East Wantana Sediment Dam)	5	Sediment water	Captures sediment water runoff from the OEA un-relinquished rehabilitation area.
Ramp Dam (bypassed by open drain)	16	16	16	Sediment water	Previously accepted sediment water runoff from the OEA rehabilitation area and overflow from the North Dump Sediment Dam. Now bypassed.
Dry Creek Clean Water Dam 1 (CW1)	900	900	900	Clean water	Captures runoff from the Dry Creek catchment upstream of Bengalla.
Train Load Out Sump	0.5	0.5	0.5	Mine water	Accepts mine water runoff from the train load out facility.
Facilities Sump	0.5	0.5	0.5	Contaminated water	Accepts contaminated water from the truck and light vehicle wash bay.

DAM	EXISTING CAPACITY (ML)	APPROVED CAPACITY (ML)	MOD 4 PROPOSED CAPACITY (ML)	PURPOSE	COMMENTS
North Dump Sediment Dam	0.5	0.5	0.5	Sediment water	Accepts sediment water runoff from the rehabilitation on the northern emplacement area.
Dry Creek East Dam	NA	NA	93	Mine water	Replaces the function of West Wantana Dam - accepts mine water overflow from the South Loop Road Dam -
Western OEA Sediment Dam A	NA	26 (nominal)	83 (nominal*, sized using 'Blue Book' for Year 8 catchment)	Sediment water	Captures runoff from Western OEA.
Western OEA Sediment Dam B	NA	17 (nominal)	16 (nominal*, sized using 'Blue Book' for Year 4 catchment)	Sediment water	Captures runoff from Western OEA.
Creek Sediment Dam	NA	36 (nominal)	270 (nominal*, sized using 'Blue Book' for Year 24 Dry Creek reinstatement catchment)	Sediment water	Captures runoff from disturbed areas during rehabilitation of Dry Creek.
Spare Dam	NA	100 (nominal)	100 (nominal**)	Clean water	Captures clean surface water from upstream catchment.
South Loop Road Dam	0.5	0.5	NA (to be replaced by proposed new Dry Creek East Dam)	Mine water	Currently accepts mine water pumped from the pit. Overflows to the Wantana West Dam. Will overflow to the proposed new Dry Creek East Dam.
Temporary OEA Sediment Dam	NA	Shown in EIS and MOD 1 but not sized	58* (sized using 'Blue Book' for Year 15 catchment)	Sediment water	Capture sediment water runoff from overburden areas.
Main pit	NA	NA	NA	Mine water	Open cut pit
Satellite pit	NA	NA	NA	Mine water	Open cut pit

*Notes: * Dam sizing is nominal. To be confirmed during detailed design. To be sized using 'Blue Book'. Storage capacity may be provided in more than one sediment dam located within the OEA.*

*** Spare Dam sizing is nominal. To be confirmed during detailed design.*

Table 4.2 Bengalla proposed water management structures - period of operation

STORAGE	TYPE OF WATER STORAGE	REPRESENTATIVE MINE STAGE			
		YEAR 4	YEAR 8	YEAR 15	YEAR 24
Future ED1	Mine water	X	X	X	X
Future Washery Dam	Mine water	X	X	X	X
Future Raw Water Dam	Clean water	X	X	X	X
East & West Facilities dams	Mine water	X	X	X	X
ROM North Dam	Mine water	X	X	X	X
ROM South Dam	Sediment water	X	X	X	X
Endwall Dam	Sediment dam	X	X	-	-
	Clean water	-	-	X	X
West Wantana Dam	Sediment dam	X	X	X	-
	Clean water	-	-	-	X
Bengalla East Sediment Dam (Homestead Dam)	Sediment Dam	X	X	-	-
	Clean water	-	-	X	X
Bengalla West Sediment Dam (Farm Dam)	Sediment Dam	X	X	-	-
	Clean water	-	-	X	X
Ramp Dam	Sediment dam	X	X	-	-
	Clean water	-	-	X	X
Dry Creek Clean Water Dam 1 (CW1)	Clean water	X	X	X	-
Train Load Out Sump	Mine water	X	X	X	X
Facilities Sump	Contaminated water	X	X	X	X
North Dump Sediment Dam	Sediment Dam	X	X	-	-
	Clean water	-	-	X	X
Dry Creek East Dam	Mine water	X	-	-	-
	Sediment water	-	X	X	-
	Clean water	-	-	-	X
Western OEA Sediment Dam A	Sediment water	-	X	-	-
Western OEA Sediment Dam B	Sediment water	X	-	-	-
Creek Sediment Dam	Sediment water	-	-	X	-
Spare Dam	Clean water	-	-	-	X
Temporary OEA Sediment Dam	Sediment water	-	-	X	-
	Clean water	-	-	-	X
Main pit	Mine water	X	X	X	X
Satellite pit	Mine water	X	-	-	-

Legend: Shading 'x' – storage active for 'snapshot' mine stage, No shading – storage not active for 'snapshot' mine stage

5 MINE WATER BALANCE

5.1 MODELLING APPROACH

Water balance models for the Bengalla water management system were developed for the EIS SWIA (WRM, 2013) and MOD 1 SEE SWIA (WRM, 2015) using OPSIM software, a widely used platform for mine site water balance studies. The MOD 1 model has been used as the basis of water balance modelling for MOD 4 and has been revised to include MOD 4.

The OPSIM model was used to calculate the volume of water in storages at the end of each day by taking into account daily rainfall-runoff inflow, groundwater inflow, evaporation from the storage, water usage, pumping between storages in the form of a pumping policy, controlled releases and storage overflow. The OPSIM model also included a high-level salt balance to calculate the concentration of salt in storages at the end of each day in order to simulate controlled releases to the Hunter River under the HRSTS.

The OPSIM model was run at a daily time step using the 'forecast period simulation' mode. The 'forecast period simulation' runs the model over the 22 year mine life considered (i.e. 1 January 2018 to 31 December 2039) for multiple climate sequences (or realizations) developed by stepping through the available climate and streamflow data from 1893 to 2006. This is the period that concurrent streamflow and climate data are available. The first realization starts on 1 January 1893, the second realization on 1 January 1894 etc. The model was simulated for 93 realizations. The model parameters (catchment areas, storage facilities, demands, groundwater inflows and operating rules etc.) are varied in the model between the Year 4, 8, 14 and 24 mine stage 'snapshots'. This takes into account the dynamic nature of the mine plan and water management system. The results for all of the realisations are retained and are analysed using percentile analysis. The assumed timing for the mine stage 'snapshots' in the model is summarised Table 5.1.

Table 5.1 Assumed timing for mine stage 'snapshots' in OPSIM model

MINE STAGE 'SNAPSHOT'	PERIOD APPLIED IN OPSIM MODEL	PERIOD (YEARS)
Year 4	Year 3 to Year 7 (1 January 2018 to 31 December 2022)	5
Year 8	Year 8 to Year 14 (1 January 2023 to 31 December 2029)	7
Year 15	Year 15 to Year 23 (1 January 2030 to 31 December 2038)	9
Year 24	Year 24 (1 January 2039 to 31 December 2039)	1

The water balance model operating rules have been refined to reflect recent changes to the HRSTS flow thresholds made under the HRSTS Amendment Regulation 2016. The onsite operating rules generally prioritise pumping of mine water and sediment dam water to the Future Washery Dam (and onto ED1) over pit dewatering, to better reflect the existing operational Bengalla water management system.

5.2 MODEL ASSUMPTIONS

The following key assumptions were made in the water balance analysis:

— The mine conditions (catchment areas, storage facilities, demands, groundwater inflows and operating rules etc) will change continuously over the life of the mine. The changes to mine conditions occurring between snapshots have not been considered. However, the Year 4, 8, 15 and 24 mine stage 'snapshots' are considered to reasonably represent the conditions over the approved life of the mine.

- A pumping policy based on the existing and proposed infrastructure has been included in the water balance model. Pump rates modelled are average daily rates, assuming operation of the pumps at an average rate for 24 hours per day. Pump rates have been provided by BMC and have been updated since the EIS.
- Annual estimates of demands have been distributed uniformly to obtain daily average demands for the water balance model. The exception is dust suppression demands which are estimated in the model on a daily basis based on rainfall.
- It is assumed that water cannot be pumped out of sediment dams below the 'sediment zone' volume. Sediment has not been modelled.
- It is assumed that the overburden emplacement areas will be progressively rehabilitated. Once the entire catchment of any overburden sediment dam is rehabilitated and relinquished, pumping to the mine water management system will cease and runoff from relinquished areas will be released directly to the natural watercourse via a sediment dam. The assumed timing of the release of sediment dams is provided in Table 4.2.
- Annual estimates of groundwater inflows to the pit have been distributed uniformly to obtain daily inflow rates for the water balance model. All groundwater inflows are assumed to inflow to the Main Pit.
- The Hunter River and Dry Creek watercourses have not been modelled in detail. Modelling of the Hunter River is limited to the flow and salinity time series provided by the DPI Water IQQM model for the duration 1893 to 2006.
- While the model assesses the performance of the system under historical climatic events assuming they will reoccur in the future at the same magnitude and in the same sequence, it neither takes into account changes in climate conditions, nor incorporates the potential impacts of global climate change.
- AWBM rainfall-runoff model parameters for mine site catchments have been sourced from the EIS SWIA (WRM, 2013). Verification of the water balance model and adopted AWBM parameters was undertaken for the period January 2010 to December 2011 as part of the EIS SWIA (WRM, 2013). No further calibration or verification of the AWBM parameters has been undertaken.
- Salinity concentrations for runoff from mine site catchments have been sourced from the EIS SWIA (WRM, 2013). No calibration or verification of the salinity parameters has been undertaken.
- It is assumed that raw water will be available from the Hunter River as required to meet demands. It has been assumed that adequate water allocations or alternative water sources are available to makeup the external water requirement (the model essentially assumes an infinite source of external water).
- It is assumed that controlled releases from ED1 will be made in accordance with the conditions of the HRSTS. Release rates were determined in the water balance model based on the salinity of water stored in SDD along with salinity and streamflow rates in the Hunter River. It was assumed that 3.5% of the TAD could be used by BMC based on the number of credits held by BMC at the commencement of the HRSTS (35 credits). It was assumed that TAD opportunities could be 100% utilised. Refer to Section 5.3.5.3 for details of the HRSTS.
- It is assumed that all runoff within the water management system drains to a storage, and that the diversion drains capture all runoff from their local catchments with no bypass.
- The ROM South Dam, Train Load Out Sump and Facilities Sump have not been included in the model.
- Starting volumes at the commencement of the water balance model simulation have been assumed based on recorded site data on 11 November 2016.

5.3 MODEL DATA

5.3.1 STORAGE CHARACTERISTICS

A summary of existing, approved and proposed water storages capacities is provided in Table 4.1. The assumed period of operation of the proposed water management structures for the mine stage 'snapshots' is summarised in Table 4.2. The assumed period of operation in Table 4.2 indicates if a dam will be present for a specified 'snapshot' in time. The actual timing for commissioning / decommissioning of dams will depend on the mine progression and may occur in between mine stage 'snapshots'.

Stage-storage relationships have been used in the water balance model to calculate the volume of evaporation from dams and the volume of direct rainfall on dams. The stage-storage relationships for existing dams were assumed based on data provided by BMC based on bathymetry and survey undertaken in 2016. Stage-storage relationships for proposed dams were assumed based on data from the EIS model (WRM, 2013) or from assumed storage characteristics. Stage-storage relationships for proposed sediment dams were based on 1V:3H side slopes and a storage depth of 3 m.

Storage volumes for the commencement of the water balance model simulation were based on recorded site data for 11 November 2016 as summarised in Table 5.2. Storages not listed in Table 5.2 are assumed empty.

Table 5.2 Assumed initial model storage volumes (as recorded 11 November 2016)

DAM	STARTING VOLUME (ML)	COMMENTS
Existing Raw Water Dam	5.0	Assigned to Future Raw Water Dam
Existing SDD	143.8	Assigned to ED1
Existing Washery Dam	22.8	Assigned to Future Washery Dam
East & West Facilities dams	114.4	
Endwall Dam	20.5	
West Wantana Dam	5.6	

5.3.2 CATCHMENT AND LANDUSE BREAKDOWN

Catchment boundaries for the water management system were generally delineated using the mine plans and reasonable assumptions about the likely destination of runoff. Catchment boundaries are shown on the conceptual water management system plans provided in Figure 4-2 to Figure 4-5.

The catchment boundaries for the East & West Facilities dams have been based on the existing footprint of the MIA and CHPP areas, with the exception of Year 24 where the catchment has been extended to the west to include the proposed ROM stockpile and Temporary Rejects Cells.

A summary of modelled catchment areas is provided in Table 5.3 and a more detailed breakdown of catchment area land uses is provided in Appendix A.

Table 5.3 Modelled catchment areas

DAM	CATCHMENT AREA (HA)			
	YEAR 4	YEAR 8	YEAR 15	YEAR 24
Bengalla East Sediment Dam (Homestead Dam)	94.1	94.1	94.1	94.1
Bengalla West Sediment Dam (Farm Dam)	17.3	17.3	17.3	17.3
CW1	631.0	631.0	631.0	-
Dry Creek East Dam	9.0	98.1	135.4	135.4
East & West Facility dams	95.3	91.5	91.0	102.2
Endwall Dam	96.9	96.9	96.9	96.9
North Dump Sediment Dam	7.8	7.8	7.8	7.8
Pit	432.0	744.6	797.8	487.4
Ramp Dam (bypassed)	75.3	75.3	75.3	75.3
ED1	19.5	19.5	19.5	19.5
Future Raw Water Dam	1.2	1.2	1.2	1.2
Future Washery Dam	2.0	2.0	2.0	2.0
ROM North Dam	7.6	7.6	7.6	6.1
Train Load Out Sump	0.4	0.4	0.4	0.4
Wantana West Dam	4.4	4.4	4.4	4.4
Satellite Pit	515.9	-	-	-
Western OEA Sediment Dam B	27.8	-	-	-
Western OEA Sediment Dam A	-	145.8	-	-
Temporary OEA Sediment Dam	-	-	101.4	101.4
Creek Sediment Dam	-	-	72.8	-
Spare Dam	-	-	-	96.4
Future Dry Creek (includes former CW1 catchment and rehabilitated areas)	-	-	-	1,147.1
Total	2,037.4	2,037.4	2,155.6	2,394.6

Legend: Shading – catchment not active for 'snapshot' mine stage, No shading – catchment not active for 'snapshot' mine stage

5.3.3 WATER QUALITY

Salt generation rates for water inputs have been sourced from the EIS SWIA (WRM, 2013) and are summarised in Table 5.4. These rates are based on analysis of the site monitoring data.

Table 5.4 Water quality salt generation rates adopted in model

MINE STAGE 'SNAPSHOT'	SALT GENERATION RATE (µS/CM)
Natural / dirty water	240
Rehabilitated spoil	500
Industrial	1,700
Open cut mine	5,000
Active spoil	1,000
Groundwater	1,300
Hunter River intake	550

Source: EIS SWIA (WRM, 2013)

5.3.4 WATER INPUTS

5.3.4.1 SURFACE WATER RUNOFF

The AWBM rainfall-runoff model (using the historical daily rainfall and monthly evapotranspiration data) is incorporated in the OPSIM model to generate a daily time series of runoff from mine site catchments. The AWBM rainfall-runoff model and parameters are described in Section 3.3.

5.3.4.2 DIRECT RAINFALL

Direct rainfall on dams were determined based on assumed dam stage-storage relationships. Stage-storage relationships are discussed in Section 5.3.1.

5.3.4.3 GROUNDWATER SEEPAGE

Groundwater inflow estimates for the mining pits were sourced from Figure 11.6 of the Bengalla Continuation of Mining Project Groundwater Impact Assessment (AGE, 2013). Pumpable pit seepage estimates for the 'snapshot' mine stages considered are summarised in Table 5.5 and are defined as the total volume of groundwater seepage minus losses due to evaporation. The AGE (2013) report indicates that groundwater ingress is from the Permian coal measures.

Table 5.5 Groundwater seepage estimates

MINE STAGE 'SNAPSHOT'	PUMPABLE PIT SEEPAGE (ML/DAY)
Year 4	0.07
Year 8	0
Year 15	0.04
Year 24	0

Source: Bengalla Continuation of Mining Project Groundwater Impact Assessment (AGE, 2013)

5.3.4.4 EXTERNALLY SOURCED WATER

Raw water will be imported from external sources to meet demands during a water deficit and to provide a source of high-quality water. Fire suppression and vehicle wash down demands will be sourced from the Future Raw Water Dam. The Future Raw Water Dam will supply makeup water to the Future Washery Dam for use in the CHPP and for dust suppression (when there is an onsite water deficit). When there is a mine water deficit onsite, a minimum stored volume will be maintained in the Future Washery Dam by pumping water from the Future Raw Water Dam (Hunter River water).

BMC hold Water Access Licences (WALs) with sufficient share component totalling 6,017 units (comprising 1,455 high security units and 4,562 general security units) to account for the maximum predicted take for the life of Bengalla based on predicted demands from the Hunter Regulated River Water Source (Management Zone 1A). BMC maintains exclusive rights for the dedicated use of at least 3,309 units (comprising 1,449 high security units and 1,860 general security units) under the WALs. The remaining units of the WALs (comprising 5 high security units and 2,702 general security units) are currently subject to use by licensees of BMC owned land for agricultural purposes.The 1,449 units of high security water entitlements are equivalent to a maximum total of 1,449 ML/year assuming 100% allocation of high security water entitlements. Note that lower allocations of high security entitlements can be expected during dry periods, with little or no allocation of general security entitlements possible during drought periods.

5.3.5 WATER OUTPUTS

5.3.5.1 DEMANDS

CHPP DEMANDS

CHPP demands have been sourced from the EIS SWIA (WRM, 2013). A net CHPP demand of 1,164 ML/yr was assumed based on a ROM throughput of 15 Mtpa modelled for all 'snapshot' mine stages considered. The net CHPP demand is based on the average plant usage of 77.6 L/ROM tonne (wet) which is based on recorded net water usage at Bengalla during the 2011 calendar year.

STOCKPILE DUST SUPPRESSION DEMANDS

Stockpile dust suppression demands have been sourced from the EIS SWIA (WRM, 2013). A demand of 150 ML/yr has been assumed for all 'snapshot' mine stages considered. The dust suppression demand is based on usage rates provided by BMC. One hundred percent evaporative loss of stockpile dust suppression demands has been assumed.

Stockpile dust suppression demands will be sourced from the Future Washery Dam.

HAUL ROAD DUST SUPPRESSION

Haul road dust suppression demands have been sourced from the EIS SWIA (WRM, 2013). Dust suppression rates are based on a dry day haul road watering rate of 3.1 mm/day. The rate has been reduced on rain days. The haul road areas are based on haul road lengths calculated from the mine plans and an assumed width of 25 m.

Haul road dust suppression demand estimates are summarised in Table 5.6. One hundred percent evaporative loss of haul road dust suppression demands has been assumed.

Table 5.6 Haul road dust suppression demand estimates

MINE STAGE 'SNAPSHOT'	HAUL ROAD WATERING AREA (HA)	MAXIMUM DAILY DUST SUPPRESSION (KL/DAY)*	AVERAGE YEARLY DUST SUPPRESSION (ML/YR)**
Year 4	47.1	1,478	457
Year 8	45.0	1,414	437
Year 15	54.3	1,706	527
Year 24	52.5	1,648	509

Notes:

** For a non-rain day.*

*** Based on long term average including rain days*

Source: EIS SWIA (WRM, 2013)

VEHICLE WASH DOWN

Vehicle wash down demands have been sourced from the EIS SWIA (WRM, 2013) and is 132 ML/year.

Vehicle wash down demands will be sourced from the Future Raw Water Dam.

DEMAND SUMMARY

Assumed demands are summarised in Table 5.7. Dust suppression demands in Table 5.7 are based on average climate conditions and are therefore likely to be higher during dry conditions.

Table 5.7 Average demand summary

YEAR	ROM COAL (Mtpa)	DEMAND (ML/YR)				
		CHPP DEMAND (NET)	STOCKPILE DUST SUPPRESSION	HAUL ROAD DUST SUPPRESSION (AVERAGE CLIMATE)	VEHICLE WASH DOWN (NET)	TOTAL
Year 4	15.0	1,164	150	457	132	1,903
Year 8	15.0	1,164	150	437	132	1,883
Year 15	15.0	1,164	150	527	132	1,973
Year 24	15.0	1,164	150	509	132	1,955

Demand sources are summarised in Table 5.8. Where demands are listed as being sourced from the Future Washery Dam in Table 5.8 they will be sourced from mine water as a priority. When there is a mine water deficit onsite, a minimum stored volume will be maintained in Washery Dam by pumping water from the Future Raw Water Dam (Hunter River water).

Table 5.8 Demand sources

DEMAND	SOURCE	WATER CLASSIFICATION
CHPP	Future Washery Dam	Mine water (as a priority over raw water)
Stockpile dust suppression	Future Washery Dam	Mine water (as a priority over raw water)
Haul road dust suppression	Future Washery Dam	Mine water (as a priority over raw water)
Vehicle wash down	Future Raw Water Dam	Raw water (Hunter River water)

5.3.5.2 OTHER LOSSES

EVAPORATION

Average monthly evaporation estimates were based on historical climate data sourced from the BOM station Scone SCS (BOM station No. 61089). A reduction factor of 0.7 has been applied to the open cut pit to account for reduced evaporation rates.

Evaporative surface area for dams has been determined based on assumed dam stage-storage relationships. Stage-storage relationships are discussed in Section 5.3.1.

SEEPAGE

Water balance modelling has assumed no seepage loss. This assumption is intended to be conservative from the perspective of containment performance but may not be conservative for other outcomes of operational simulation modelling (such as water supply reliability).

5.3.5.3 HRSTS CONTROLLED RELEASES

Controlled releases of mine water stored in ED1 will be made in accordance with the conditions of the HRSTS and EPL 6538. Release rates will depend on stored water quality in ED1 along with streamflow and salinity conditions in the Hunter River.

Release rules (Rule 1 and Rule 2) for inclusion in the OPSIM water balance model are generally based on the rules adopted for the EIS SWIA (WRM, 2013). A maximum daily release of 200 ML has been assumed in accordance with EPL 6538 and the HRSTS conditions. The release rules have been updated to reflect recent changes to the flood flow thresholds made under the HRSTS Amendment Regulation 2016. The 'flood' threshold for the upper sector was increased from 4,000 ML/day to 6,500 ML/day.

The release rules have also been updated to more accurately reflect credit limitations during 'high' flow periods. The EIS SWIA (WRM, 2013) and MOD 1 SEE SWIA (WRM, 2015) models assumed that 100% of the TAD could be used by Bengalla, and no salt discharge credit limit was applied during 'high' flow periods. In reality, during 'high' flow periods the TAD would be proportioned amongst the different license holders participating in the HRSTS based on the number of credits held. A limit of 35 credits has now been assumed for Bengalla based on the number of credits held by Bengalla at the commencement of the HRSTS (i.e. 3.5% of the available 1000 credits).

Modelled release rules are summarised in Table 5.9 and Table 5.10.

Table 5.9 Modelled controlled release rules from ED1 to Hunter River under HRSTS – Rule 1

RULE 1 – VOLUME LIMIT RATING			
HUNTER RIVER FLOW CLASSIFICATION (FOR UPPER SECTOR)	HUNTER RIVER STREAMFLOW (ML/DAY)	MAXIMUM RELEASE RATE (ML/DAY)	APPLY RULE 2?
Low	< 1,000 ML/day	0	No
High	1,000 to 6,500 ML/day *	200	Yes
Flood	> 6,500 ML/day *	200	No

*Notes: * Flood flow threshold changed from 4,000 to 6,500 ML/day under The Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Amendment Regulation 2016*

Table 5.10 Modelled controlled release rules from ED1 to Hunter River under HRSTS – Rule 2

Rule 2 – Salinity limit rating			
METHOD	CR (µS/CM)	K VALUE	COMMENT
Absolute Increase (K + Cr)	0	600	If the EC of Hunter River is zero, the concentration in the Hunter River can increase by up to 600 µS/cm as a result of discharge from all HRSTS license holders. Bengalla is allocated 3.5% of total discharges (i.e. 35 credits at 0.1% per credit)
Absolute Increase (K + Cr)	600	0	If the EC of Hunter River is 600 µS/cm, the concentration in the Hunter River can increase by zero mg/L as a result of discharge from all HRSTS license holders. Bengalla is allocated 3.5% of total discharges (i.e. 35 credits at 0.1% per credit)

Where Cr = concentration at the reference node (i.e. the Hunter River) and K = concentration increase (linearly interpolated). Setting K = 600 for Cr = 0 µS/cm, and K = 0 for Cr = 600 µS/cm allows transfer so long as receiving water quality does not increase by more than 600 µS/cm for an initial receiving water concentration of 0 µS/cm, pro-rating to an increase of no more than 0 µS/cm for an initial receiving water concentration of 600 µS/cm. OPSIM linearly interpolates data between adjacent rows.

Source: Modified from EIS SWIA (WRM, 2013).

The estimated TAD under the HRSTS was calculated at a daily time step as the mass of salt that could be added to the Hunter River to achieve the target salinity (i.e. the same target salinity set by 'Rule 2' in OPSIM). The Hunter River salinity time series referenced by 'Rule 2' in the model was artificially modified so that during high flow periods other license holders were responsible for a salinity increase equivalent to 96.5% of the TAD and only 3.5% of the TAD was available for use by Bengalla.

The OPSIM water balance model operating rules assumed that water would not be discharged from ED1 if the stored water inventory in ED1 was less than 200 ML. This operating rule was applied to retain some water for reuse onsite.

5.3.6 WATER TRANSFER RATES

Modelled transfer rates are summarised in Table 5.11.

Table 5.11 Modelled transfer rates

PUMP, CHANNEL OR PIPELINE CONNECTION			DESIGN PEAK FLOW RATE (L/s)	COMMENT
TO	FROM	MINE STAGE 'SNAPSHOT'		
East & West Facilities dams	Rom North Dam	Years 4, 8, 15, 24	110	
Endwall Dam	Bengalla East Sediment Dam	Years 4 and 8	100	
	Bengalla West Sediment Dam	Years 4 and 8	100	
Dry Creek East Dam	Endwall Dam	Years 4 and 8	105	
	Wantana West Dam	Years 4, 8 and 15	105	
	Main Pit	Year 4	300	3 x 100 L/s pumps
	Satellite Pit	Year 4	200	2 x 100 L/s pumps
	Creek Sediment Dam	Year 15	105	
	Temporary OEA Sediment Dam	Year 15	40	
Future Washery Dam	East & West Facilities dams	Years 4, 8, 15, 24	300	
	Dry Creek East Dam	Years 4, 8, 15	400	
	Main Pit	Year 8, 15 and 24	300	3 x 100 L/s pumps
	ED1	Years 4, 8, 15, 24	120	
	Future Raw Water Dam	Years 4, 8, 15, 24	200	
	Western OEA Sediment Dam B	Year 4	40	
	Western OEA Sediment Dam A	Year 8	40	
Future Raw Water Dam	Hunter River	Years 4, 8, 15, 24	110	Sourced from Hunter River as required
ED1	Future Washery Dam	Years 4, 8, 15, 24	200	Gravity fed
Dry Creek	Spare Dam	Year 24	125	

5.3.7 OPERATIONAL RULES

Modelled operating rules are summarised in Table 5.12.

Table 5.12 Modelled operating rules

FUNCTION	ITEM	OPERATIONAL CONTROL RULES
Raw water input	Hunter River raw water supply	Annual allocation of water up to 1,449 ML/yr supplied to Future Raw Water Dam from Hunter River. Maximum daily intake of 9.5 ML/d from Hunter River.
Groundwater seepage input	Groundwater seepage	Incoming groundwater seepage into Main Pit varies per year of mine life. Refer to Section 5.3.4.3 and Table 5.5 for further details.
Site demands	CHPP	Supplied from Future Washery Dam. Refer to Section 5.3.5.1 for demand rates. Net demand modelled. 100% loss from demand.
	Stockpile dust suppression	Supplied from Future Washery Dam. Refer to Section 5.3.5.1 for demand rates. 100% loss from demand.
	Haul road dust suppression	Supplied from Future Washery Dam (via truck fill stations). Refer to Section 5.3.5.1 for demand rates. 100% loss from demand.
	Vehicle wash and fire suppression	Supplied from Future Raw Water Dam. Refer to Section 5.3.5.1 for demand rates. Net demand modelled. 100% loss from demand.
Operational pits	Main Pit (open cut pit)	Receives groundwater inflow. Refer Table 5.5 for inflow rates. Dewaters using a three-staged pumping system at the following rates: — Pit Water Volume > 0 ML: 100 L/s — Pit Water Volume > 80 ML: 200 L/s — Pit Water Volume > 200 ML: 300 L/s Dewaters to Dry Creek East Dam in Year 4. Dewaters to Future Washery Dam in Years 8, 15 and 24.
	Satellite Pit	Dewaters using a two-staged pumping system at the following rates: — Pit Water Volume > 0 ML: 100 L/s — Pit Water Volume > 4 ML: 200 L/s Dewaters to Dry Creek East Dam in Year 4. Satellite Pit not active in Years 8, 15 and 24.

FUNCTION	ITEM	OPERATIONAL CONTROL RULES
Storage dams	Future Raw Water Dam	Draws water from Hunter River up to raw water annual allocation limit as required. Supplies water to Future Washery Dam when required. Supplies vehicle wash and fire suppression.
	Future Washery Dam	Supplies water to CHPP, Stockpile Dust Suppression and Haul Road Dust Suppression when required. Transfers water to ED1 at 200 L/s when water volume is above 8 ML. Maintains minimum 7.5 ML of water from the following sources in order of priority: Year 4: — East & West Facilities dams — Dry Creek East Dam (receives pit dewatering), Western OEA Sediment Dam B — ED1 — Future Raw Water Dam Year 8, 15 and 24: — East & West Facilities dams — Dry Creek East Dam, Western OEA Sediment Dam A — Main Pit — ED1 — Future Raw Water Dam Water sourced from Future Raw Water in the event of a mine water deficit onsite. Overland transfer to ED1.
	ED1	Licenced release location for mine water discharge to Hunter River under HRSTS guidelines. Releases water to Hunter River when stored volume exceeds 200 ML and conditions of HRSTS discharge are met. Cannot be pumped-out below 70 ML to account for nominal 35 ML 'sediment zone' volume and nominal 35 ML emergency supply. Receives transfers from Future Washery Dam. Pumping to ED1 ceases when stored volume exceeds 660 ML. Spillway to Dry Creek / Hunter River.
	East & West Facilities dams	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to Future Washery Dam. Spillway to Hunter River.

FUNCTION	ITEM	OPERATIONAL CONTROL RULES
	ROM North Dam	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to East & West Facilities dams. Spillway to Hunter River.
	West Wantana Dam	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to Dry Creek East Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Dry Creek.
	Ramp Dam	Spillway to Endwall Dam.
	Endwall Dam	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to Dry Creek East Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Dry Creek.
	Dry Creek East Dam	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to Future Washery Dam. Cannot be pumped-out below 'sediment zone' volume. Pumping to Dry Creek East Dam in Year 4 ceases when stored volume exceeds 82 ML. Spillway to Dry Creek.
	Western OEA Sediment Dam B	Operated to keep water levels at a minimum to prevent spills. Pumped to Future Washery Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Satellite Pit.
	Western OEA Sediment Dam A	Operated to keep water levels at a minimum to prevent spills. Pumped to Future Washery Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Main Pit.
	Bengalla East Sedimentation Dam	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to Endwall Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Hunter River.
	Bengalla West Sedimentation Dam	Operated to keep water levels at a minimum to prevent spills to Hunter River. Pumped to Endwall Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Hunter River.
	Temporary OEA Sediment Dam	Operated to keep water levels at a minimum to prevent spills to Main Pit. Pumped to Dry Creek East Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Main Pit.

FUNCTION	ITEM	OPERATIONAL CONTROL RULES
	Creek Sediment Dam	Operated to keep water levels at a minimum to prevent spills to Dry Creek. Pumped to Dry Creek East Dam. Cannot be pumped-out below 'sediment zone' volume. Spillway to Dry Creek.
	CW1	Pumps to Dry Creek to maintain empty. Spillway to Main Pit.
	Spare Dam	Pumps to Dry Creek to maintain empty. Spillway to Main Pit.
Site discharges	Hunter River Salinity Trading Scheme controlled discharge (HRSTS)	Controlled discharge from ED1 to meet the requirements of the HRSTS. Maximum daily discharge 200 ML/day. Discharge only to occur if stored volume in ED1 > 200 ML. Refer to Section 5.3.5.3 for further details.

5.4 MODEL RESULTS

The water balance model simulates the performance of the proposed mine water management system against a range of historical climate conditions. Results have been provided as a statistical predictive tool on potential performance over the mine lifetime. This forecast is based on 93 realisations of different climate data applied over the 22-year modelled life of the mine from 1 January 2018 to 31st December 2039. A range of percentile values have been provided as part of the results. The 50th percentile results reflect the median results for the site. The 1st percentile represents the value which has been exceeded by only 1% of realisations and the 99th percentile represents the value which has been exceeded in 99% of realisations.

5.4.1 EXTERNAL WATER SUPPLY REQUIREMENTS

The predicted annual volume of raw water sourced from external supplies is summarised in Table 5.13 and Figure 5.1. Demands are also provided in Table 5.13.

Table 5.13 Annual external raw water requirement based on water balance simulation

MINE STAGE 'SNAPSHOT'	DEMAND (NET) (ML/YR)	RAW WATER REQUIREMENT (ML/YR)				
		1ST %ILE RESULT	5TH %ILE RESULT	10TH %ILE RESULT	50TH %ILE RESULT	90TH %ILE RESULT
Year 4	1,903	1,726	1,688	1,658	**1,293**	847
Year 8	1,883	1,731	1,715	1,664	**1,252**	880
Year 15	1,973	1,814	1,794	1,761	**1,411**	1,033
Year 24	1,955	1,833	1,819	1,806	**1,589**	1,354
Maximum result over life of project	1,955	1,833	1,819	1,806	**1,589**	1,354

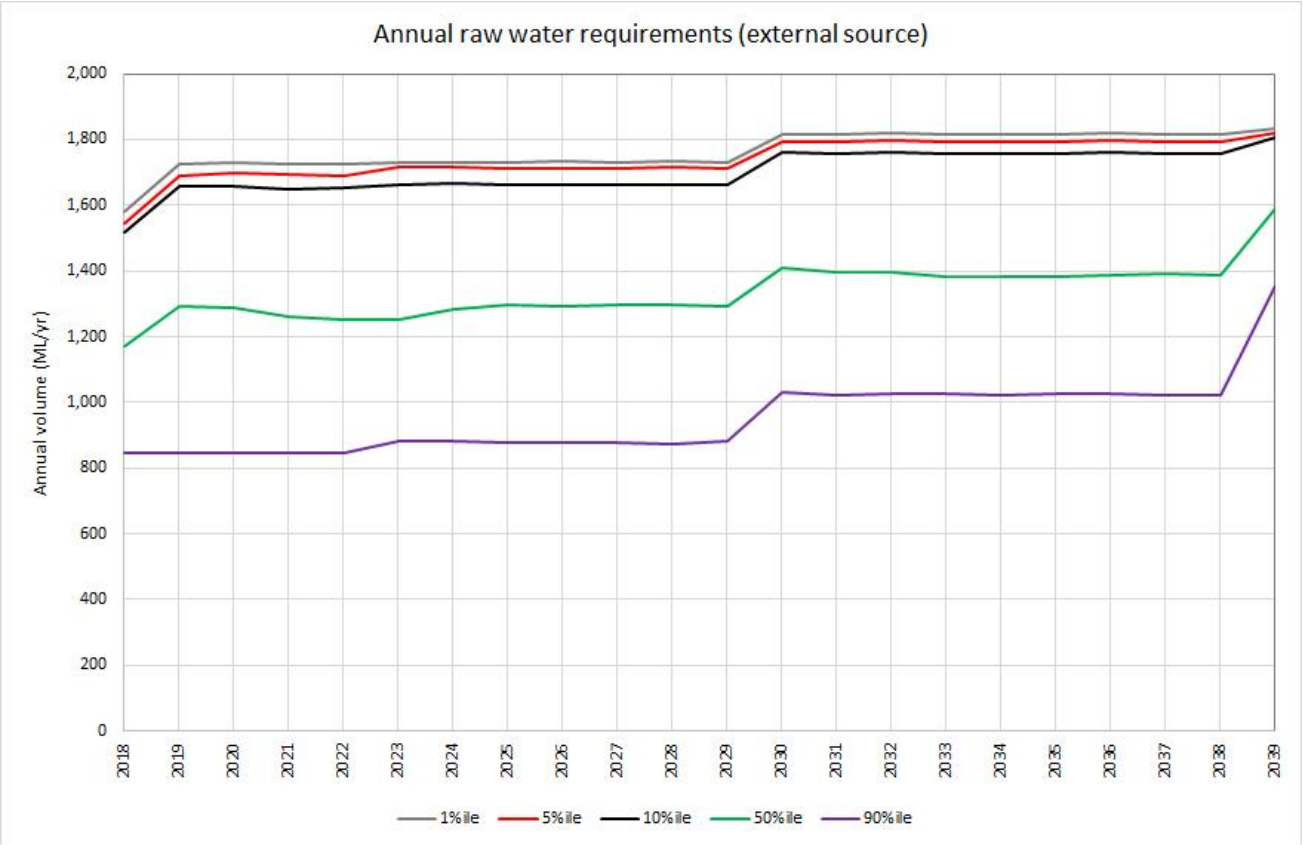

Figure 5.1 Annual timeseries of predicted annual requirement for raw water based on water balance simulation

The predicted raw water requirement from external sources varies significantly depending on the stage of mining and climate conditions. The 50th percentile (representative of average climatic conditions) annual requirement for raw water from external sources ranges from 1,252 ML/yr in Year 8 to 1,589 ML/yr in Year 24. The 1st percentile result (representative of very dry conditions) annual requirement from external sources ranges from 1,726 ML/yr in Year 4 to 1,833 ML/yr in Year 24. There is always a requirement of at least 132 ML/yr from external sources to meet vehicle wash down demands as high quality water is required. The demand from external sources is higher in the later years of the project as less water is available from mine site catchments in these years as runoff from relinquished rehabilitated areas is released to the creek system.

The requirement for raw water is below the available High Security entitlement for the 90th percentile (wet climatic conditions) for all snapshot years and the 50th percentile (average climatic conditions) for snapshot years 4, 8 and 15. For snapshot year 24, the 50th percentile raw water requirement is 1,589 ML/yr. This is 140 ML higher than the available High Security entitlement supply of 1,449 ML/yr under the Hunter Regulated River Water Source WSP (assuming 100% allocation of high security water entitlements). The 1st, 5th and 10th percentile requirements for raw water are also above the available High Security entitlement across all mine stage snapshots. However, BMC also hold general security water entitlements under the Hunter Regulated River WSP.

BMC hold Water Access Licences (WALs) with sufficient share component totalling 6,017 units (comprising 1,455 high security units and 4,562 general security units) to account for the maximum predicted take for the life of Bengalla based on predicted demands from the Hunter Regulated River Water Source (Management Zone 1A). This is based on a conservative assessment of 90% of the allocation of the high security units being available plus a minimum 35% allocation of the general security units held for exclusive use by BMC. BMC maintains exclusive rights for the dedicated use of at least 3,309 units (comprising 1,449 high security units and 1,860 general security units) under the

WALs. The remaining units of the WALs (comprising 5 high security units and 2,702 general security units) are currently subject to use by licensees of BMC owned land for agricultural purposes.

5.4.2 PERFORMANCE OF WATER STORAGE FACILITIES

OPEN CUT PITS

Predicted maximum stored volumes in the open cut pits are summarised in Table 5.14. Daily time series plots of stored volumes in the Main Pit and Satellite Pit are provided in Figure 5.2 and Figure 5.3 respectively. The pits are maintained dry for the 90th percentile and 50th percentile result (very dry to average climatic conditions) however, water may be stored in-pit for the 10th to 1st percentile result (relatively wet to very wet conditions).

The predicted 10th percentile result maximum volume stored in the Main Pit and Satellite Pit over the life of the project are 60 ML and 35 ML respectively. The predicted 1st percentile result maximum volume stored in the Main Pit and Satellite Pit over the life of the project are 727 ML and 554 ML respectively. Stored volumes in-pit are greatest in Year 4 when pit catchment areas are greatest. Stored volumes in-pit decrease in Year 24 when runoff from relinquished rehabilitated areas is released to natural watercourses.

Table 5.14 Maximum stored volume in-pit based on water balance simulation

MINE STAGE 'SNAPSHOT'	STORED VOLUME (ML)				
	1ST %ILE RESULT	5TH %ILE RESULT	10TH %ILE RESULT	50TH %ILE RESULT	90TH %ILE RESULT
MAIN PIT					
Year 4	264	91	0	**0**	0
Year 8	674	209	43	**0**	0
Year 15	716	135	49	**0**	0
Year 24	312	49	7	**0**	0
Maximum result over life of project	727	209	60	**0**	0
SATELLITE PIT					
Year 4	468	133	34	**0**	0
Maximum result over life of project	554	134	35	**0**	0

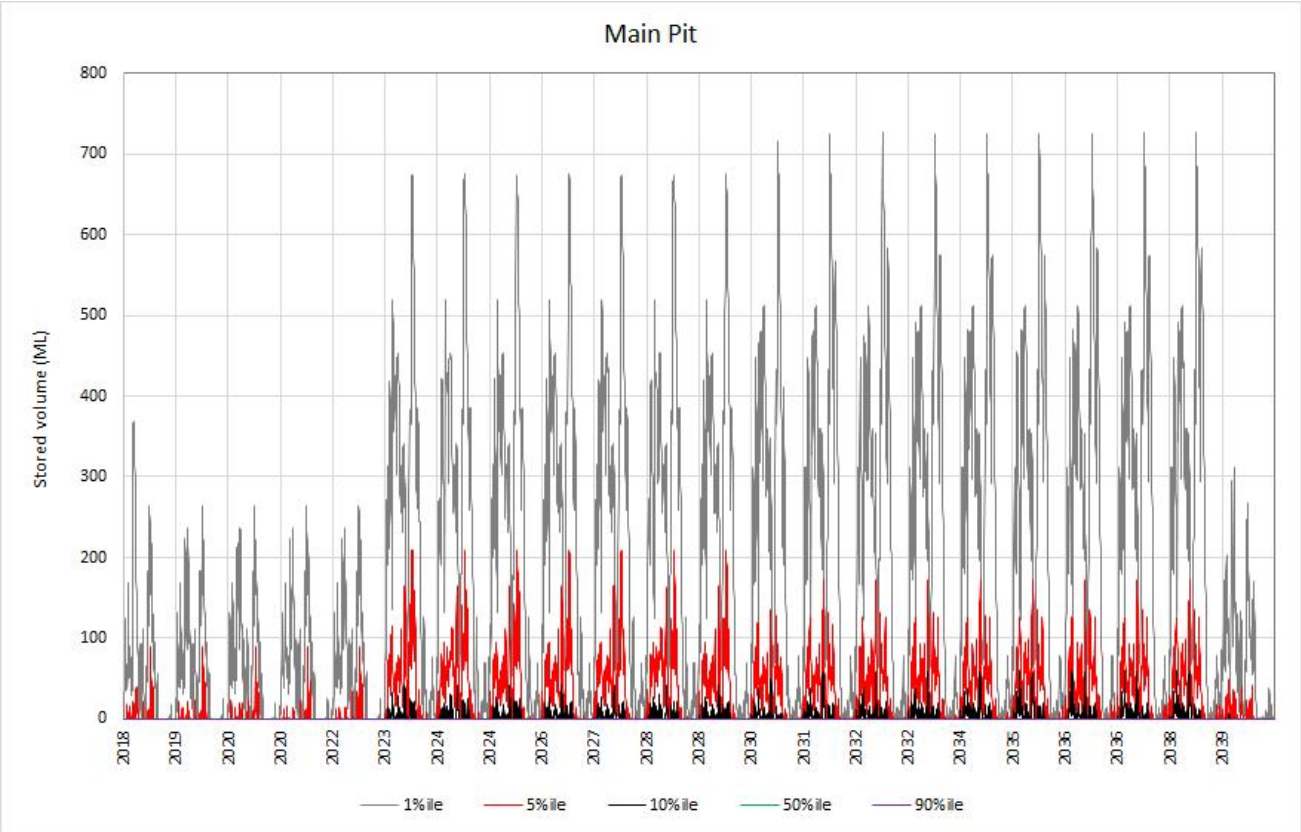

Figure 5.2 Daily timeseries of predicted stored volume in Main Pit based on water balance simulation

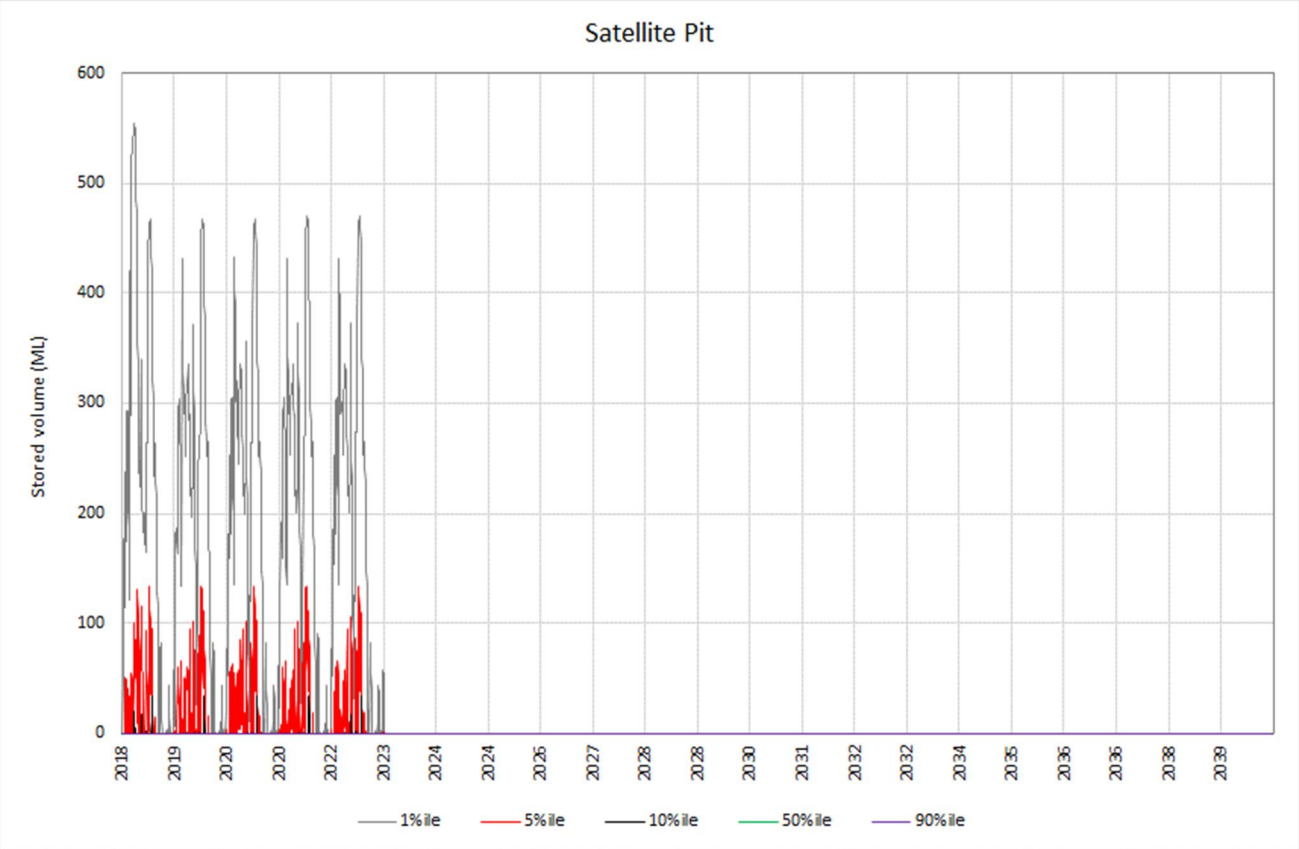

Figure 5.3 Daily timeseries of predicted stored volume in Satellite Pit based on water balance simulation

5.4.3 UNCONTROLLED OFFSITE RELEASES

MINE WATER DAMS

Water balance modelling for the simulated water balance realizations predict that there are no uncontrolled overflows from mine water dams. Modelling predicts:

— There are no uncontrolled overflows of mine water from ED1.

— There are no uncontrolled overflows of mine water from Dry Creek East Dam in Year 4 prior to its conversion to a sediment dam.

— There are no uncontrolled overflows of mine water offsite from the East & West Facilities dams. Spills are contained within the CHPP and MIA bunded area.

— There are no uncontrolled overflows of mine water from the ROM North Dam.

SEDIMENT DAMS

Water balance modelling for the simulated water balance realizations predict that uncontrolled overflows occur from sediment dams. Sediment dams typically have up to a 10% annual risk of overflow to natural watercourses a result of large rainfall events or prolonged wet conditions.

5.4.4 CONTROLLED OFFSITE RELEASES UNDER HRSTS

The predicted annual volume of controlled releases to the Hunter River from Bengalla under the HRSTS is summarised in Table 5.15 and Figure 5.4. Annual HRSTS releases of up to 1,747 ML/yr are predicted for the 1st percentile results. However, the model predicts no release for the 50th percentile except in 2018 with a release of 42 ML/yr. HRSTS releases are lower in Years 15 and 24 when runoff from relinquished rehabilitated areas is released to natural watercourses.

Table 5.15 Annual HRSTS controlled release based on water balance simulation

MINE STAGE 'SNAPSHOT'	HRSTS RELEASE (ML/YR)				
	1ST %ILE RESULT	5TH %ILE RESULT	10TH %ILE RESULT	50TH %ILE RESULT	90TH %ILE RESULT
Year 4	1,742	828	644	0	0
Year 8	1,612	772	632	0	0
Year 15	1,467	687	479	0	0
Year 24	701	259	166	0	0
Maximum result over life of project	1,747	921	662	42	0

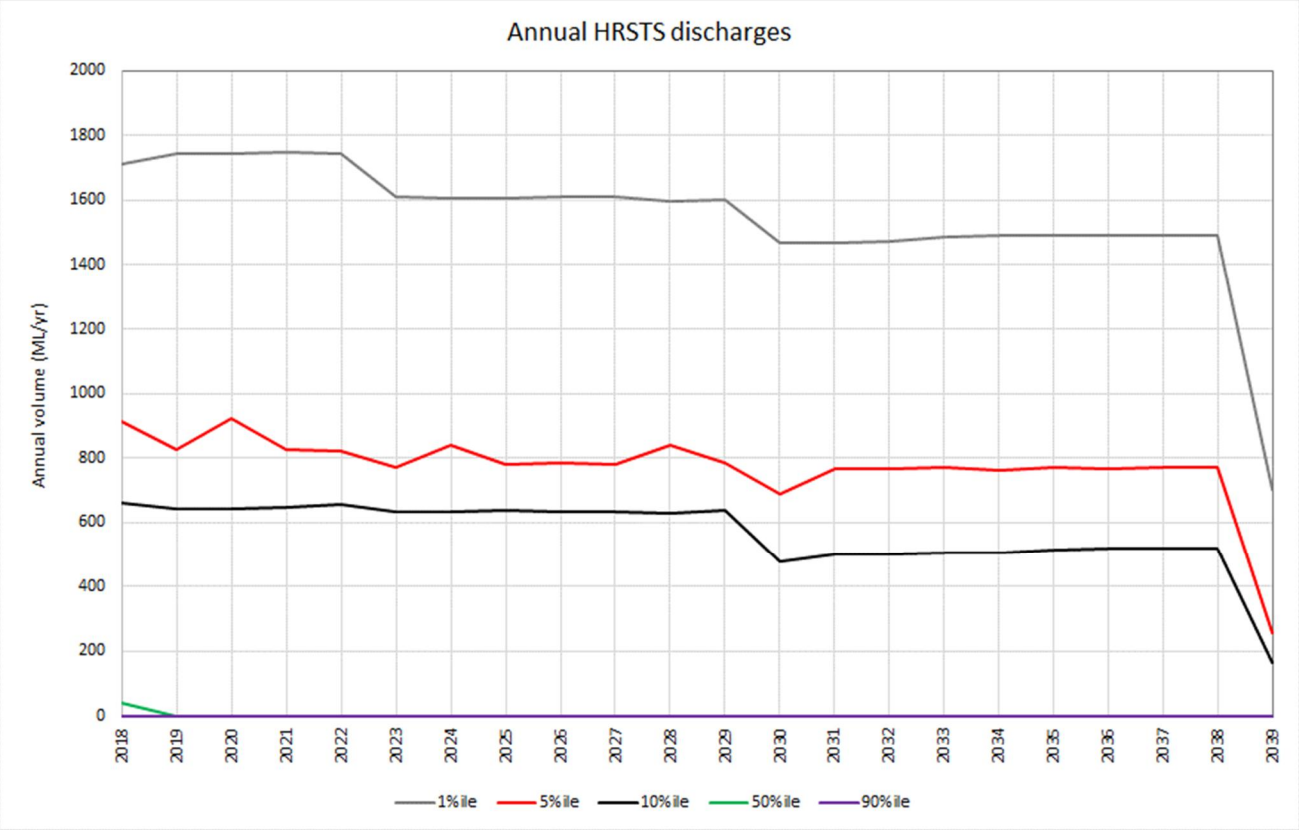

Figure 5.4 Annual timeseries of predicted annual HRSTS controlled releases based on water balance simulation

6 IMPACT ASSESSMENT

6.1 POTENTIAL IMPACTS

Potential impacts of MOD 4 on surface water resources are discussed in the following sections and include:

— Reduction to the volume of water stored in-pit during prolonged wet periods because of an increase in the out-of-pit mine water storage capacity onsite.

— Marginal changes to the volume of water released under the HRSTS resulting from the provision of additional out-of-pit mine water storage onsite and increase in the volume of sediment dam water retained onsite for reuse.

— Marginal changes to the volume of Hunter River raw water required to meet site demands because of an increase in the out-of-pit mine water storage onsite and increase in the volume of sediment dam water retained onsite for reuse.

— Marginal reduction of catchment area draining to the Hunter River due to increase of footprint of ED1 and addition of the proposed new Dry Creek East dam.

— Erosion and sedimentation impacts associated with construction of the enlarged ED1 and new Dry Creek East dam.

6.2 PIT AVAILABILITY

MOD 4 will increase the out-of-pit mine water storage capacity onsite and will result in a reduction in the volume of mine water stored in-pit during wet periods. The MOD 4 storage capacity of the enlarged ED1 is 700 ML, which is 400 ML greater than the approved capacity of 300 ML.

A comparison of the predicted maximum volume of water stored in-pit over the life of the project for the approved and MOD 4 scenarios is provided in Table 6.1. The 50th percentile result shows that the pits are generally maintained dry under average climatic conditions for both the approved and MOD 4 scenarios. The 10th percentile result, representative of relatively wet conditions, for the Satellite Pit reduces from 450 ML for the approved scenario to 35 ML for the MOD 4 scenario. The 10th percentile result for the Main Pit reduces from 240 ML for the approved scenario to 60 ML for the MOD 4 scenario.

Table 6.1 Comparison of predicted maximum in-pit storage volumes over life of project – approved versus MOD 4 scenarios

	MAXIMUM IN-PIT STORED VOLUME (ML)			
	SATELLITE PIT		MAIN PIT	
	APPROVED (MOD 1)	PROPOSED (MOD 4)	APPROVED (MOD 1)	PROPOSED (MOD 4)
50th percentile result (average climatic conditions)	0	0	0	0
10th percentile result (wet conditions)	450	35	240	60

6.3 CONTROLLED OFFSITE RELEASES UNDER HRSTS

MOD 4, along with recent amendments to the HRSTS flow thresholds, will result in minor changes to controlled offsite releases from Bengalla under the HRSTS. The additional out-of-pit storage capacity provided in the enlarged ED1 will allow Bengalla to store additional mine water, including sediment water, onsite for reuse. The recent amendments to the HRSTS flow thresholds will increase the number of release opportunities that are classified as 'high' flow (discharge with credits) versus 'flood' flow (discharge unrestricted by credits).

A comparison of the predicted HRSTS controlled releases for the approved and MOD 4 scenarios is provided in Table 6.2. The 50th percentile result, representative of average climatic conditions, increases from 0 ML/yr for the approved scenario to 42 ML/yr for the MOD 4 scenario. The 10th percentile result, representative of relatively wet conditions, reduces from 750 ML/yr for the approved scenario to 662 ML/yr for the MOD 4 scenario. The 1st percentile result, representative of very wet conditions, increases from 1,550 ML/yr for the approved scenario to 1,747 ML/yr for the MOD 4 scenario.

Table 6.2 Comparison of predicted maximum annual HRSTS controlled releases over the life of project – approved versus MOD 4 scenarios

	MAXIMUM ANNUAL HRSTS CONTROLLED RELEASE (ML/YR)	
	APPROVED (MOD 1)	PROPOSED (MOD 4)
50th percentile result (average climatic conditions)	0	42
10th percentile result (wet conditions)	750	662
1st percentile result (very wet conditions)	1,550	1,747

6.4 UNCONTROLLED OFFSITE RELEASES

For the currently approved scenario, no uncontrolled overflows were predicted from mine water dams except for the East & West Facilities dams which were predicted to have less than a 1% annual risk of overflow. For the MOD 4 scenario, no uncontrolled overflows are predicted from mine water dams. The reduction in overflow risk from the East & West Facilities dams can be attributed to the additional out-of-pit storage capacity provided in the enlarged ED1. This allows additional water to be pumped out of the East & West Facilities dams during wet periods. The reduction in overflow risk can also be attributed to an increase in the proposed pump rate from the East & West Facilities dams to the Washery Dam and an emergency short term storage capacity within excavated drains leading to the dams.

Uncontrolled overflows are predicted from sediment dams for both the approved and MOD 4 scenarios. For the MOD 4 scenario sediment dams have up to a 10% annual risk of overflow to natural watercourses as a result of large rain events or prolonged wet conditions.

6.5 EXTERNAL WATER SUPPLY REQUIREMENTS

MOD 4, along with recent amendments to the HRSTS flow thresholds, will not result in a change to the mine site water demands but will result in minor changes to the volume of mine water, including sediment dam water, that is stored onsite for reuse.

A comparison of the predicted Hunter River raw water requirement over the life of Bengalla for the approved and MOD 4 scenarios is provided in Table 6.3. The 50th percentile result, representative of average climatic conditions, shows that the raw water requirement increases from 1,530 ML/yr for the approved scenario to 1,589 ML/yr for the MOD 4 scenario. The 1st percentile result, representative of very dry conditions, decreases from 1,920 ML/yr for the approved scenario to 1,833 ML/yr for the MOD 4 scenario. This decrease may be attributed to the additional out-of-pit storage capacity, provided in the enlarged ED1, which will allow Bengalla to store additional water onsite for reuse.

Table 6.3 Comparison of predicted maximum annual external water requirements over life of project – approved versus MOD 4 scenarios

	MAXIMUM ANNUAL EXTERNAL WATER REQUIREMENT (ML/YR)	
	APPROVED (MOD 1)	PROPOSED (MOD 4)
50th percentile result (average climatic conditions)	1,530	1,589
1st percentile result (very dry conditions)	1,920	1,833

6.6 LOSS OF CATCHMENT AREA

MOD 4 will not result in significant changes to the Bengalla water management system catchment area. There are no changes proposed to the approved mine landforms. There will be a negligible increase in catchment area associated with the increased dam footprints for the enlarged ED1 and the proposed Dry Creek East Dam.

6.7 WATER QUALITY

MOD 4 will not result in significant changes to water quality in the Hunter River and Dry Creek. For the MOD 4 scenario, water balance modelling predicts that there will be no uncontrolled mine water dam overflows. Controlled releases of mine water to the Hunter River will continue to be undertaken in accordance with the conditions of the HRSTS and EPL 6538. Uncontrolled overflows will occur from sediment dams during large rainfall events or prolonged wet periods. Sediment dams typically have a 10% annual risk of overflow.

Runoff from the proposed ROM stockpile and Temporary Rejects Cells will be captured in the mine water management system.

6.8 FLOODING

MOD 4 will not result in changes to the Hunter River floodplain. The enlarged ED1 and the proposed Dry Creek East Dam are both located outside of the 100 year average recurrence interval (ARI) flood envelopes for the Hunter River and Dry Creek.

6.9 CONSTRUCTION ACTIVITIES

Erosion and sediment controls will be implemented during the construction of the proposed enlarged ED1 and proposed Dry Creek East Dam generally as stipulated in the Bengalla WMP (BMC, 2017). With the implementation of these temporary controls, construction activities are not expected to significantly impact surface water quality.

7 MITIGATION AND MANAGEMENT

7.1 WATER MANAGEMENT PLAN

The approved Bengalla WMP (BMC, 2017) has been prepared in accordance with the requirements of SSD-5170 (as modified). The WMP describes the existing approved water management infrastructure and procedures in place at Bengalla, including:

— Water managed being clean water, sediment water, mine water and contaminated water management.

— Site water balance.

— Water monitoring program.

— Water impact trigger levels and management actions.

— Erosion and sediment controls.

The existing Bengalla WMP (BMC, 2017) will be reviewed and revised to reflect MOD 4, to the satisfaction of the relevant regulatory agencies.

The proposed water management system for MOD 4 is in line with the existing key principles for water management at Bengalla. The proposed water management system, including layout plans and schematics showing the connectivity between water supplies, demands and storages for the Year 4, 15, 8 and 24 mine stage 'snapshots', is described in Section 4. The proposed site water balance is described in Section 5.

7.2 EROSION AND SEDIMENT CONTROLS

Erosion and sediment controls are outlined in the existing Bengalla WMP (BMC, 2017). Erosion and sediment controls will be implemented during the construction, operation and rehabilitation phases of the project, including construction of the proposed enlarged ED1 and the proposed Dry Creek East Dam.

Erosion and sediment controls will be designed, installed and maintained in accordance with the guidelines *Managing Urban Stormwater: Soils and Construction - Volume 1* (Landcom, 2004) ('Blue Book') and *Managing Urban Stormwater: Soils and Construction - Volume 2E Mines and Quarries* (Department of Environment and Climate Change, 2008).

7.3 DRY CREEK EAST DAM ENGINEERING DESIGN

Dry Creek East Dam is proposed to be located in an area bounded by the south haul road, an embankment that was constructed by BMC for an overland conveyor, Dry Creek and the West Wantana Dam. The overland conveyor was removed from the embankment when the ROM dump hopper was relocated from the east end of the site to a location adjacent to the CHPP. The dam design takes into account the internal powerlines present in the vicinity of the Dry Creek East Dam.

Figure 6.1 of the Bengalla Continuation of Mining Project Groundwater Impact Assessment (AGE, 2013) includes the estimated extent of quaternary alluvium on the Hunter River floodplain. Part of the footprint of the Dry Creek East Dam extends onto the area estimated to include quaternary alluvium. One test pit that was part of geotechnical engineering investigations at the proposed dam site indicated 200 mm of alluvial material present below the topsoil. Neighbouring testpits that were part of the same investigation did not encounter alluvial material.

The impoundment area of the proposed Dry Creek East Dam comprises excavated storage below the existing surface level and volume above ground contained by an earthfill embankment. To prevent potential interaction between mine

water and the alluvium the excavated storage area will be lined with approximately 600 mm of compacted clay liner, formed either of approximately 300 mm or material treated in situ and overlain by another approximately 300 mm of clay or approximately 600 mm of material placed in two layers.

8 SUMMARY OF FINDINGS

Water balance modelling has been undertaken to assess the potential surface water impacts of MOD 4. Modelling has been undertaken for the life of mine using long-term historical daily climate data and is based on the Year 4, 8, 15 and 24 mine stage 'snapshots'. The results of the mine water balance for the simulated water balance realizations indicate the following:

— MOD 4 will result in a reduction in the volume of mine water stored in-pit during prolonged wet periods. The 50th percentile result, representative of average climatic conditions, shows that the pits are generally maintained dry with no long term build up. The 10th percentile volume stored in the Satellite Pit and Main Pit reaches 35 ML and 60 ML, respectively.

— Raw water from the Hunter River is required to meet site demands, with the requirement for raw water varying depending on the stage of mining and climate conditions. The 50th percentile, representative of median climatic conditions, external water requirement ranges from 1,252 ML/yr in Year 8 to 1,589 ML/yr in Year 24. BMC hold WALs for the Hunter Regulated River Water Source under the Hunter Regulated River WSP. Bengalla currently has exclusive rights for the use of 1,449 high security units and 1,860 general security units under these WALs. Demand from the Hunter River Regulated Water Source is predicted to slightly decrease as a consequence of MOD 4.

— No uncontrolled offsite overflows from mine water dams are predicted.

— Uncontrolled offsite overflows are predicted to occur from sediment dams (up to a 10% annual risk of overflow) as a result of large rainfall events or prolonged wet conditions.

— Controlled releases under the HRSTS will need to occur during wet climatic conditions. Controlled releases of mine water from ED1 will be undertaken in accordance with the conditions of the HRSTS and EPL 6538. The 50th percentile release, representative of average climatic conditions, is 42 ML/yr.

REFERENCES

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— Hansen Bailey (2015), Bengalla Mine Development Consent Modification Statement of Environmental Effects (SSD-5170 Modification 1).

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— Macintosh, J. C. (2012), OPSIM Version 7 Reference Manual, Water Solutions Pty Ltd.

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— WRM Water & Environment (2013), Bengalla Continuation of Mining Project, Surface Water Impact Assessment, Appendix J.

— WRM Water & Environment (2015), Bengalla Modification, Surface Water Impact Assessment, Appendix D.

APPENDIX A

CATCHMENT AND LANDUSE BREAKDOWN

Table A1 Catchment areas and landuse breakdown – Year 4

CATCHMENT	CATCHMENT AREA (HA)					
	REHABILITATION	INDUSTRIAL	ACTIVE SPOIL	OPEN CUT PIT	UNDISTURBED	TOTAL
Bengalla East Sediment Dam	91.5	0.0	0.0	0.0	2.6	94.1
Bengalla West Sediment Dam	16.2	0.0	0.0	0.0	1.1	17.3
CW1	4.9	0.0	0.0	0.0	626.0	631.0
Dry Creek East Dam	0.0	0.2	0.4	0.6	7.8	9.0
East & West Facility dams	11.0	82.9	0.0	0.0	1.4	95.3
Endwall Dam	90.9	0.0	0.0	0.0	6.0	96.9
North Dump Sediment Dam	5.5	0.0	0.2	0.0	2.1	7.8
Pit	36.7	0.8	252.8	115.8	25.8	432.0
Ramp Dam (bypassed)	64.9	0.0	8.6	0.0	1.8	75.3
ED1	0.0	0.0	0.0	0.0	19.5	19.5
Future Raw Water Dam	0.0	0.0	0.0	0.0	1.2	1.2
Future Washery Dam	0.0	0.0	0.0	0.0	2.0	2.0
ROM North Dam	0.0	7.4	0.0	0.0	0.2	7.6
Train Load Out Sump	0.0	0.0	0.0	0.0	0.4	0.4
Wantana West Dam	0.3	0.0	0.8	0.0	3.2	4.4
Satellite Pit	0.0	21.5	0.0	41.2	453.1	515.9
Western OEA Sediment Dam B	8.9	0.0	8.8	0.0	10.1	27.8
Western OEA Sediment Dam A	0.0	0.0	0.0	0.0	0.0	0.0
Temporary OEA Sediment Dam	0.0	0.0	0.0	0.0	0.0	0.0
Creek Sediment Dam	0.0	0.0	0.0	0.0	0.0	0.0
Spare Dam	0.0	0.0	0.0	0.0	0.0	0.0
Total	330.9	112.9	271.6	157.6	1,164.4	2,037.4

Table A2 Catchment areas and landuse breakdown – Year 8

CATCHMENT	CATCHMENT AREA (HA)					
	REHABILITATION	INDUSTRIAL	ACTIVE SPOIL	OPEN CUT PIT	UNDISTURBED	TOTAL
Bengalla East Sediment Dam	91.9	0.0	0.0	0.0	2.2	94.1

Bengalla West Sediment Dam	17.3	0.0	0.0	0.0	0.0	17.3
CW1	4.9	0.0	0.0	0.0	626.0	631.0
Dry Creek East Dam	95.3	0.4	0.8	0.0	1.6	98.1
East & West Facility dams	5.8	85.3	0.0	0.0	0.3	91.5
Endwall Dam	91.7	0.0	0.0	0.0	5.2	96.9
North Dump Sediment Dam	7.7	0.0	0.0	0.0	0.1	7.8
Pit	36.1	3.4	294.8	184.0	226.3	744.6
Ramp Dam (bypassed)	73.5	0.0	0.0	0.0	1.7	75.3
ED1	0.3	0.0	0.0	0.0	19.2	19.5
Future Raw Water Dam	0.0	0.0	0.0	0.0	1.2	1.2
Future Washery Dam	0.0	0.0	0.0	0.0	2.0	2.0
ROM North Dam	0.0	7.3	0.3	0.0	0.0	7.6
Train Load Out Sump	0.0	0.1	0.0	0.0	0.3	0.4
Wantana West Dam	3.3	0.0	0.0	0.0	1.0	4.4
Satellite Pit	0.0	0.0	0.0	0.0	0.0	0.0
Western OEA Sediment Dam B	0.0	0.0	0.0	0.0	0.0	0.0
Western OEA Sediment Dam A	51.5	0.0	0.0	0.0	94.4	145.8
Temporary OEA Sediment Dam	0.0	0.0	0.0	0.0	0.0	0.0
Creek Sediment Dam	0.0	0.0	0.0	0.0	0.0	0.0
Spare Dam	0.0	0.0	0.0	0.0	0.0	0.0
Total	479.2	96.5	295.9	184.0	981.7	2,037.4

Table A3 Catchment areas and landuse breakdown – Year 15

CATCHMENT	CATCHMENT AREA (HA)					
	REHABILITATION	INDUSTRIAL	ACTIVE SPOIL	OPEN CUT PIT	UNDISTURBED	TOTAL
Bengalla East Sediment Dam	91.9	0.0	0.0	0.0	2.2	94.1
Bengalla West Sediment Dam	17.3	0.0	0.0	0.0	0.0	17.3
CW1	4.9	0.0	0.0	0.0	626.0	631.0

Dry Creek East Dam	129.5	0.5	0.0	0.0	5.4	135.4
East & West Facility dams	5.7	85.4	0.0	0.0	0.0	91.0
Endwall Dam	91.7	0.0	0.0	0.0	5.2	96.9
North Dump Sediment Dam	7.6	0.0	0.0	0.0	0.1	7.8
Pit	60.0	1.6	301.7	251.3	183.1	797.8
Ramp Dam (bypassed)	75.3	0.0	0.0	0.0	0.0	75.3
ED1	0.2	0.0	0.0	0.0	19.2	19.5
Future Raw Water Dam	0.0	0.0	0.0	0.0	1.2	1.2
Future Washery Dam	0.0	0.0	0.0	0.0	2.0	2.0
ROM North Dam	0.0	7.4	0.0	0.0	0.2	7.6
Train Load Out Sump	0.0	0.1	0.0	0.0	0.3	0.4
Wantana West Dam	3.3	0.0	0.0	0.0	1.0	4.4
Satellite Pit	0.0	0.0	0.0	0.0	0.0	0.0
Western OEA Sediment Dam B	0.0	0.0	0.0	0.0	0.0	0.0
Western OEA Sediment Dam A	0.0	0.0	0.0	0.0	0.0	0.0
Temporary OEA Sediment Dam	101.4	0.0	0.0	0.0	0.0	101.4
Creek Sediment Dam	49.0	2.7	21.2	0.0	0.0	72.8
Spare Dam	0.0	0.0	0.0	0.0	0.0	0.0
Total	638.0	97.7	322.8	251.3	845.9	2,155.6

Table A4 Catchment areas and landuse breakdown – Year 24

CATCHMENT	CATCHMENT AREA (HA)					
	REHABILITATION	INDUSTRIAL	ACTIVE SPOIL	OPEN CUT PIT	UNDISTURBED	TOTAL
Bengalla East Sediment Dam	91.4	0.0	0.0	0.0	2.6	94.1
Bengalla West Sediment Dam	16.8	0.0	0.0	0.0	0.5	17.3
Dry Creek East Dam	129.5	0.5	0.0	0.0	5.4	135.4
East & West Facility dams	6.5	95.7	0.0	0.0	0.0	102.2
Endwall Dam	89.7	0.0	0.0	0.0	7.2	96.9
North Dump Sediment Dam	7.6	0.0	0.0	0.0	0.1	7.8
Pit	0.6	9.2	259.1	181.2	37.3	487.4
Ramp Dam (bypassed)	75.1	0.0	0.0	0.0	0.2	75.3
ED1	0.3	0.0	0.0	0.0	19.1	19.5

Future Raw Water Dam	0.0	0.0	0.0	0.0	1.2	1.2
Future Washery Dam	0.0	0.0	0.0	0.0	2.0	2.0
ROM North Dam	0.0	6.1	0.0	0.0	0.0	6.1
Train Load Out Sump	0.0	0.1	0.0	0.0	0.3	0.4
Wantana West Dam	3.1	0.0	0.0	0.0	1.3	4.4
Satellite Pit	0.0	0.0	0.0	0.0	0.0	0.0
Western OEA Sediment Dam B	0.0	0.0	0.0	0.0	0.0	0.0
Western OEA Sediment Dam A	0.0	0.0	0.0	0.0	0.0	0.0
Temporary OEA Sediment Dam	101.4	0.0	0.0	0.0	0.0	101.4
Creek Sediment Dam	0.0	0.0	0.0	0.0	0.0	0.0
Spare Dam	0.0	0.0	0.0	0.0	96.4	96.4
Subtotal	522.0	100.6	259.1	181.2	173.6	1,247.6
Former CW1 (to reinstated Dry Creek)	0.0	0.0	0.0	0.0	642.7	642.7
Dry Creek (reinstated)	474.3	1.9	0.7	0.0	27.5	504.4
Total	996.4	102.5	259.8	181.2	843.6	2,394.6

Appendix C

Air Quality Impact Assessment

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5 December 2017

Dianne Munro
Principal
Hansen Bailey
Via email: DMunro@hansenbailey.com.au

RE: Air Quality Assessment – Bengalla Mine Development Consent Modification 4

Dear Dianne,
Todoroski Air Sciences has assessed the potential for air quality impacts to arise due to the proposed modifications at Bengalla Mine (Bengalla) and investigated the likely change in dust emissions associated with modifications relative to the approved operations.

Modification description
Bengalla is an open cut coal mine located approximately 4 kilometres (km) west of Muswellbrook in the Upper Hunter Valley of New South Wales. Bengalla Mining Company Pty Limited (BMC) was granted approval on 3 March 2015 for the continuation of mining under State Significant Development Consent SSD-5170.

BMC is seeking approval from the NSW Minister for Planning or their delegate for a modification to SSD-5170 under section 96(2) of the *Environmental Planning and Assessment Act* (EP&A Act). The key features associated with the proposed modifications include:

- Changes to the approved water management system to reflect operations at Bengalla including a proposed enlargement of the approved Staged Discharge Dam (ED1), and construction and use of the Dry Creek East Dam;
- Temporary storage of approximately 2,500m^3 of excess material from the construction of ED1;
- Increase in the capacity and additional locations of Run Of Mine (ROM) coal stockpiles;
- Additional storage locations for temporary emplacement of coal processing reject material, prior to permanent emplacement; and,
- Temporary clay emplacement within the Main OEA or to the west of this for later use in the reinstatement of Dry Creek.

It is important to note that all of the proposed activities are within the existing approved project boundary and disturbance boundary and there are no changes being sought to the extent or intensity of mining, mining equipment fleet or mining method.

This assessment focuses on the key air emissions, arising from activity associated with the change in capacity and location of the temporary ROM coal stockpiles and temporary emplacement of coal processing reject material. The conceptual locations of the temporary ROM coal stockpiles and reject emplacement are shown in **Figure 1** and **Figure 2** for the approved mine plans for Year 4 and Year 24, respectively.

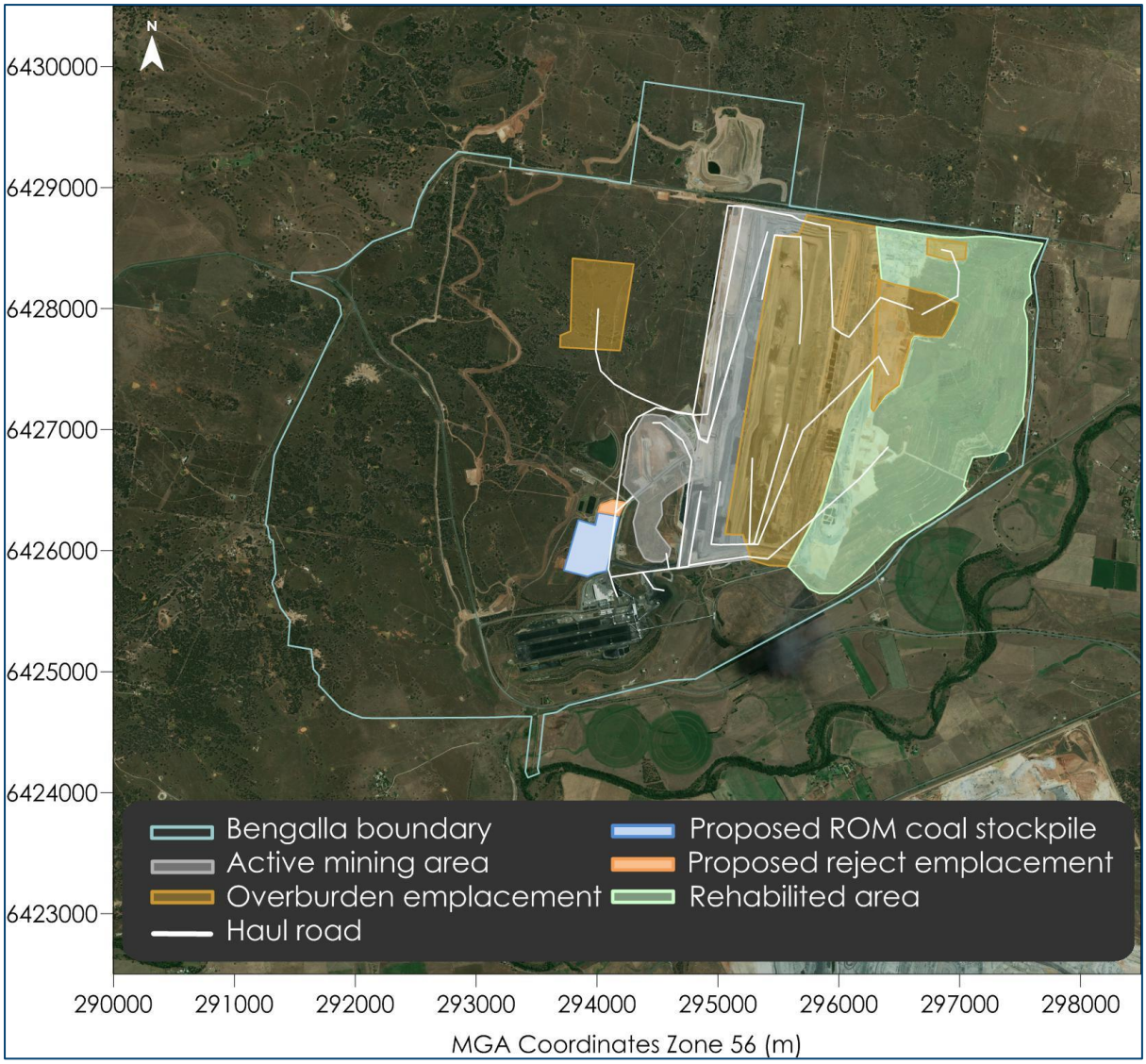

Figure 1: Modification overview – Year 4 Mine Plan

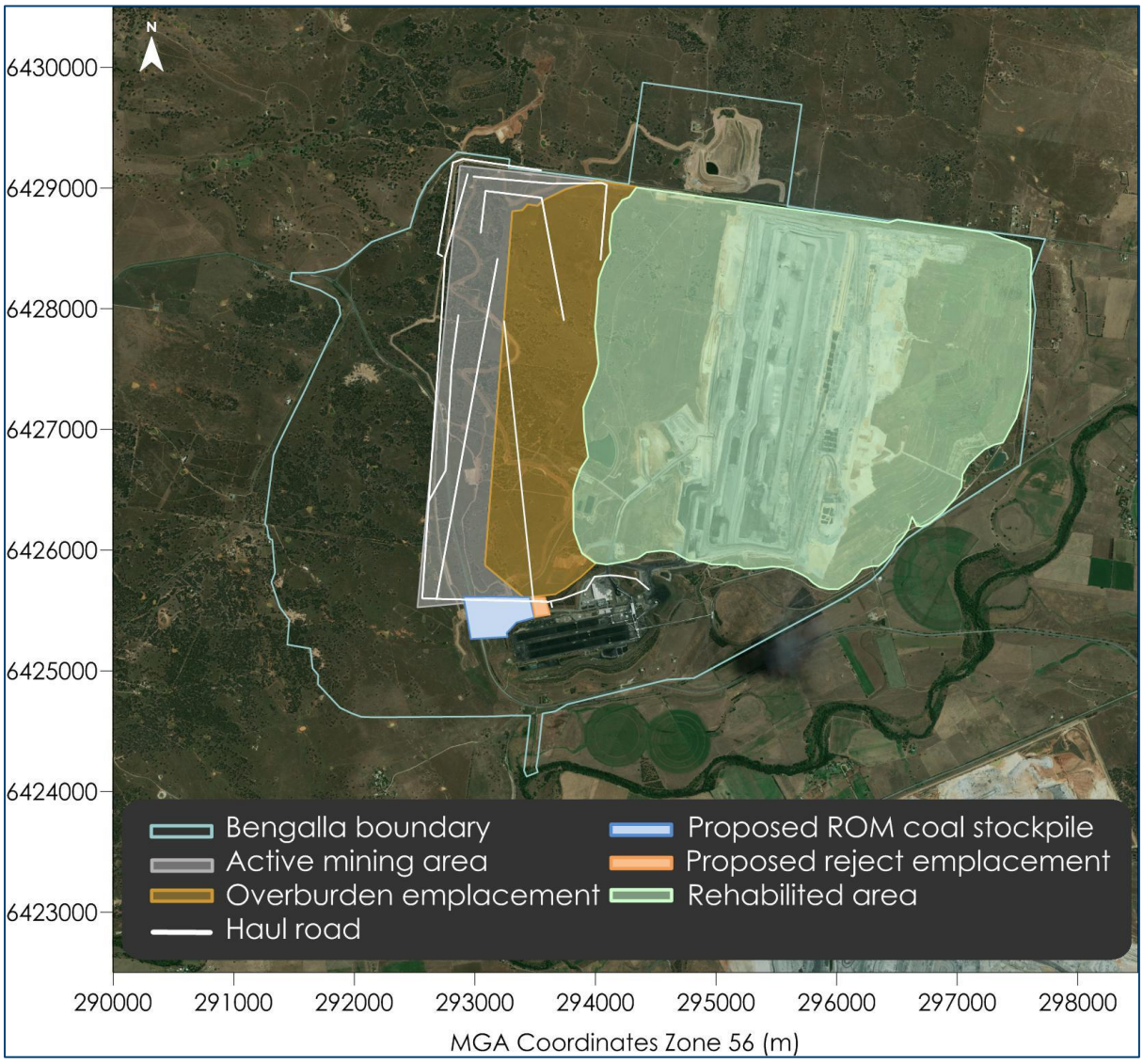

Figure 2: Modification overview – Year 24 Mine Plan

The proposed Modification seeks to increase the capacity of ROM coal stockpiled at Bengalla from 350,000 tonnes to 1,250,000 tonnes (within a total stockpiling capacity of 2,115,000). It is proposed that new ROM coal stockpiles with capacity of up to 900,000 tonnes are constructed generally adjacent to the operational mining area immediately to the west of the open cut, indicatively shown in **Figure 1**. As mining progresses it is proposed to relocate the ROM coal stockpiles further west in advance of active mining as indicatively shown in **Figure 2**. The proposed ROM coal stockpiles will be up to 10 metres (m) in height.

Flexibility in the temporary emplacement of rejects is required to assist with drying the material prior to the permanent emplacement in the OEA. This material would be temporarily emplaced (for approximately three years before being mined out) adjacent to the proposed ROM coal stockpiles (see **Figure 1** and **Figure 2**).

To investigate what effect the alteration to the temporary ROM coal stockpiles and temporary emplacement rejects may have on dust levels in the wider environment, air dispersion modelling was performed to predict the potential change associated with this aspect of the Modification.

The proposed temporary clay emplacement is expected to only generate a small quantity of dust for a short period. Relative to the total quantity of dust generated from the adjacent mine operations, any potential dust effects from this activity would be negligible, and hence it has not been considered in further detail. Appropriate dust mitigation and management measures would apply.

Assessment of potential air quality impacts

The proposed ROM coal stockpiles and reject emplacement area are located generally along approved haul routes and thus there would be no significant deviation to the existing approved haul distances. The majority of dust emissions associated with the proposed operation of the ROM coal stockpiles and reject emplacement would arise from the handling of the material at the stockpiles and from wind erosion of the stockpiles. It is important to note that no additional ROM coal or reject material would be moved in any one year as a result of this Modification, material would instead only be redirected to the piles.

To investigate the extent of the effects on air quality due to the proposed modifications, air dispersion modelling was performed using the detailed air dispersion model previously developed for the Continuation of Bengalla Mine Environmental Impact Statement (EIS) (**Hansen Bailey, 2013**). The model was updated to reflect the proposed features of the Modification.

The air dispersion model was setup identically (apart from adding in the activities associated with the Modification) to allow for a direct comparison with the previous assessment. Full details regarding the air dispersion model setup can be found in the Air Quality Impact Assessment (AQIA) (**Todoroski Air Sciences, 2013**).

The influence of the Modification has been investigated for Years 4 and 24 of the AQIA. A comparison of the estimated total annual dust emissions in Year 4 and Year 24 for the approved mining operation and the proposed modifications is presented in **Table 1**. The cells highlighted in orange shading indicate the activities associated with the Modification. It is noted in Year 4, the activity associated with the approved Bengalla Continuation Project Modification 2 (MOD 2) (**Todoroski Air Sciences, 2016**) has been included in the emission estimation. It can be seen that for some activities, emissions decrease (e.g. less transport of coal to an existing pile) and there are also new sources of dust arising from new activities.

It is calculated that the net total annual dust emissions associated with the Modification would increase dust emissions by approximately 0.56 – 0.91% relative to the approved Bengalla Continuation Project.

The small increase in total annual dust emissions due to the proposed Modification primarily arises from the additional handling of ROM at the new stockpiles and from wind erosion at the stockpiles. The overall haulage distance for transporting ROM coal would be similar as the proposed stockpile area is located along the existing haul route, hence there is no additional dust estimated for this activity.

Table 1: Comparison of estimated TSP emission rate for the proposed Modification (kg/year)

Activity	Year 4 – Approved operations	Year 4 – Proposed Modification	Year 24 – Approved operations	Year 24 – Proposed Modification
OB - Topsoil Removal	4,184	4,184	4,184	4,184
OB - Drilling	12,469	12,469	16,920	16,920
OB - Blasting	53,589	53,589	72,541	72,541
OB - Loading OB to haul truck	128,650	128,650	187,665	187,665
OB - Loading OB to haul truck Sat-Pit	10,675	10,675	-	-
OB - Loading OB to haul truck at Wybong Dump	1,770	1,770	-	-
OB - Hauling to Emplacement	2,542,873	2,542,873	4,986,527	4,986,527
OB - Hauling to Emplacement WOEA	60,058	60,058	-	-
OB - Hauling to Emplacement Sat-Pit	150,162	150,162	-	-
OB - Hauling to Emplacement Relief from Main Pit	108,789	108,789	-	-
OB - Hauling to Emplacement Relief from Wybong Dump	6,392	6,392	-	-
OB - Emplacing at Dump	126,342	126,342	187,665	187,665
OB - Emplacing at Dump WOEA	5,901	5,901	-	-
OB - Emplacing at Dump Relief	8,852	8,852	-	-
OB - Rehandle Overburden	6,175	6,175	9,008	9,008
OB - Dozers on various OB Activities	677,876	677,876	677,876	677,876
OB - Dozers on various OB Relief	67,788	67,788	-	-
OB - Dragline	362,222	362,222	362,222	362,222
CL - Drilling	1,233	1,233	1,673	1,673
CL - Blasting	5,954	5,954	8,060	8,060
CL - Dozers ripping/pushing/clean-up	246,855	246,855	246,855	246,855
CL - Loading ROM coal to haul truck	570,899	570,899	622,914	622,914
CL - Loading ROM coal to haul truck Sat-Pit	52,015	52,015	-	-
CL - Hauling to ROM hopper	282,226	265,293	511,623	480,926
CL - Hauling to ROM hopper Sat-Pit	16,347	15,366	-	-
CL - Hauling to New ROM Stockpile	-	16,934	-	21,592
CL - Hauling to New ROM Stockpile Sat-Pit	-	981	-	-
CL - Unloading ROM coal at New ROM stockpile	-	37,375	-	37,375
CL - Rehandle ROM coal at New ROM stockpile	-	7,475	-	7,475
CL - Loading ROM coal to haul truck	-	37,375	-	37,375
CL - Hauling from New ROM stockpile to ROM hopper	-	11,746	-	9,254
CHPP - Unloading ROM to hopper	93,437	93,437	93,437	93,437
CHPP - Rehandle ROM at hopper	93,437	56,062	93,437	56,062
CHPP - Dozers at ROM hopper	706	706	706	706
CHPP - Unloading to product coal stockpile	548	548	548	548
CHPP - Loading Rejects	514	514	514	514
CHPP - Hauling Rejects	70,864	70864.31973	80,732	80,732
CHPP - Dumping Rejects	514	514.4201566	514	514
PC - Loading coal to train at Bengalla Rail loop	438	438.3659192	438	438
WE - Overburden emplacement areas	745,689	745,689	582,837	582,837
WE - Overburden emplacement areas Relief	107,303	107303.1146	-	-
WE – Wybong Dump area	13,853	13852.83624	-	-
WE - Open pit	557,901	557,901	891,955	891,955
WE - ROM stockpiles	1,247	1,247	1,247	1,247
WE - New ROM stockpiles	-	7,807	-	7,858
WE - Reject stockpiles	-	1,848	-	1,816

Activity	Year 4 – Approved operations	Year 4 – Proposed Modification	Year 24 – Approved operations	Year 24 – Proposed Modification
WE - Product stockpiles	7,156	7,156	7,156	7,156
Grading roads	62,778	62,778	62,778	62,778
Total TSP emissions (kg/yr)	**7,266,683**	**7,332,934**	**9,712,032**	**9,766,705**
% Change of Total TSP emissions		0.91%		0.56%

OB – Overburden, CL – Coal, CHPP – Coal Handling and Preparation Plant and WE – Wind erosion
Cells highlighted in orange indicate the activities associated with the proposed Modification.

Dispersion modelling predictions

The predicted air quality levels due to the proposed Modification are overlaid with the predictions for the indicative Year 4 of MOD2 (**Todoroski Air Sciences, 2016**) and Year 24 of the AQIA (**Todoroski Air Sciences, 2013**) and as amended in a letter report (**Todoroski Air Sciences, 2014**).

The amended letter report (**Todoroski Air Sciences, 2014**) demonstrates the dust mitigation strategy for short-term dust impacts outlined in the existing air quality management plan (as modified) for Bengalla (**Hansen Bailey, 2016**). Overlaying these contours allows for a direct comparison of the potential change associated with the proposed Modification to be clearly seen.

Year 4

The dispersion modelling results comparing the predicted 24-hour average PM_{10} with and without the dust mitigation strategy, annual average PM_{10}, 24-hour average and annual average $PM_{2.5}$, annual average TSP and annual average dust deposition levels for Year 4 are presented as isopleth diagrams in **Figure 3** to **Figure 9** in **Appendix A**.

The results indicate that the proposed Modification has a negligible effect at the privately-owned receptor locations and only a minor increase immediately adjacent the area where the Modification is taking place (i.e. close to the CHPP).

The figures show that the predicted dust levels are unlikely to change significantly at any privately-owned receptor as a result of the proposed Modification in comparison with the results presented in **Todoroski Air Sciences (2014)** and **Todoroski Air Sciences (2016)**. No additional privately-owned receptor locations are predicted to exceed any of the SSD5170 development consent relevant air quality criteria as a result of the Modification during Year 4.

Year 24

The dispersion modelling results comparing the predicted 24-hour average PM_{10} with and without the dust mitigation strategy, annual average PM_{10}, 24-hour average and annual average $PM_{2.5}$, annual average TSP and annual average dust deposition levels for Year 24 are presented as isopleth diagrams in **Figure 10** to **Figure 16** in **Appendix A**.

The results indicate that the proposed Modification has a negligible effect at the privately-owned receptor locations and only a minor increase immediately adjacent to the area where the Modification is taking place.

Overall, the results also show that there is negligible change in the predicted impacts for areas in the far-field and in particular at any privately-owned receptor location. The figures show that the predicted dust levels are

unlikely to change significantly at any privately-owned receptor as a result of the proposed Modification in comparison with the results presented in **Todoroski Air Sciences (2013)** and **Todoroski Air Sciences (2014)**. No additional privately-owned receptor locations are predicted to exceed any of the relevant air quality criteria in the SSD5170 development consent as a result of the Modification during Year 24.

Comparison of short-term predictions

The predicted maximum 24-hour average impacts for the proposed Modification (Year 4 and 24 combined) are compared with the predicted maximum envelope for Bengalla (**Todoroski Air Sciences, 2013**) (i.e. maximum zone of influence for all years) in **Figure 17** (see **Appendix A**).

The figure shows the extent of short-term dust impacts for the Modification would largely remain within the existing approved maximum envelope.

Figure 18 in **Appendix A** presents a comparison of the predicted maximum 24-hour average impacts for the proposed Modification (Year 4 and 24 combined) with the predicted maximum envelope for Bengalla including consideration of the dust mitigation strategy for short-term dust impacts (**Todoroski Air Sciences, 2014**).

Figure 17 and **Figure 18** in **Appendix A** show that the predicted impacts due to the Modification would largely remain within the existing approved envelope. The figures also illustrate that the application of the dust mitigation strategy for short-term dust impacts can further minimise and prevent the potential for adverse dust levels occurring due to the Modification, as can be seen in several places where the Modification impact is significantly less (due to such measures taking effect on a single day). Note that in practice the actual weather, position of monitors etc. will be different, however the figures still illustrate the general scale of effect such measures can have.

Cumulative total effects

A comparison of the cumulative annual average PM_{10} impacts for the proposed Modification with the approved impacts in Year 4 and Year 24 is presented in **Figure 19** and **Figure 20** respectively in **Appendix A**. The figures indicate that the proposed modifications would have no detectable influence on the existing approved situation in regard to the total cumulative level of impact.

Overall, the proposed Modification would result in a negligible change to the approved operations and would not result in any materially significant additional impacts at the surrounding receptor locations and no additional acquisition or management requirements would be triggered.

It should also be noted that the small changes that may arise would be within the modelling accuracy, and the natural variation in the background dust levels that occur day to day or year to year.

The Mount Pleasant Coal Mine exhibited a project modification (MOD3) in June 2017. MOD3 includes an extension of the life of the open cut mine by six years and an extension of existing overburden and waste rock emplacement.

The dust emissions set out in the MOD3 air assessment (**Todoroski Air Sciences, 2017**) were compared with the modelled dust emissions for the Mount Pleasant Coal Mine in the Bengalla mine AQIA (**Todoroski Air Sciences, 2013**). Due to the proposed changes in the rate of activity and application of

additional dust control measures at the Mount Pleasant Project, the MOD3 emissions are significantly lower than those modelled (for Mount Pleasant) in the Bengalla AQIA. Therefore, the modelling for the Mount Pleasant Coal Mine and assessment of cumulative impacts included in the AQIA would be conservative. It is noted that the Mount Arthur and Mangoola coal mines have not submitted any modifications since the assessment of the AQIA and hence their contribution to the cumulative assessment is unchanged.

Revised Approved Methods

A revised version of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (**NSW EPA, 2017**) was gazetted on 20 January 2017 and supersedes the previous version. The key update to the Approved Methods document is the inclusion of particle assessment criteria consistent with revised National Environmental Protection (Ambient Air Quality) Measure (AAQ NEPM) particle standards for $PM_{2.5}$ and annual average PM_{10}.

To demonstrate the outcomes of the revised Approved Methods criteria for annual average PM_{10}, modelling predictions at each of the privately-owned receptor locations which exceed 25µg/m^3 are indicated by the orange shaded cells in **Table 2** in **Appendix B** for Year 4 and Year 24 incorporating the proposed Modification, respectively. Those receptor locations previously predicted to exceed the SSD5170 criterion of 30µg/m^3 in the AQIA are indicated by the green shaded cells.

Please note that receptors 108, 120 and 156 are predicted to already exceed the revised Approved Methods criteria for cumulative annual average PM_{10}, and this would not change due to the Modification. The dust effects at receptors due to the Modification would not lead to any new exceedance of the new Approved Methods criteria.

The assessment also shows that no additional privately-owned receptor locations are predicted to exceed the SSD5170 development consent air quality criterion as a result of the proposed Modification.

Summary and Conclusions

The activities associated with the proposed Modification are predicted to generate less than one per cent more dust relative to the approved SSD-5170 (as Modified) Project. This change is within the modelling accuracy and the normal variation that naturally occurs in background dust levels daily or between years.

Direct modelling of all mining activities including the proposed Modification during mine plan Year 4 and Year 24 was conducted and compared with the approved levels (**Todoroski Air Sciences, 2013** and **Todoroski Air Sciences, 2016**).

The comparison shows that the proposed Modification would only influence dust levels in the close vicinity to the site of the activity and that no significant change in dust level at any off-site receptor would occur from the mine as a result of the proposed Modification. The cumulative levels, including background levels and the emissions from all other mines show no discernible change. No additional impacts at any privately-owned receptor locations due to the Modification are predicted to lead to any new exceedance of any of the relevant air quality criterion.

It is concluded that the proposed operation of the additional ROM stockpiles and reject emplacement area will not result in any discernible additional impact above that presented in the **Todoroski Air Sciences (2013)** and **Todoroski Air Sciences (2016)** assessment at any receptor locations.

Please feel free to contact us if you need to discuss (or require clarification on) any aspect of this report.

Yours faithfully,
Todoroski Air Sciences

Philip Henschke
Atmospheric Physicist

Aleks Todoroski
Director

References

Hansen Bailey (2013)

"Continuation of Bengalla Mine Environmental Impact Statement", prepared by Hansen Bailey, September 2013.

Hansen Bailey (2016)

"Bengalla Mine Air Quality Management Plan", prepared by Hansen Bailey, January 2016.

NSW EPA (2017)

"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW EPA, January 2017.

Todoroski Air Sciences (2013)

"Air Quality and Greenhouse Gas Impact Assessment Continuation of Bengalla Mine", prepared for Hansen Bailey by Todoroski Air Sciences, July 2013.

Todoroski Air Sciences (2014)

"Bengalla Continuation – Dust mitigation strategy for short-term dust impacts", prepared for Hansen Bailey by Todoroski Air Sciences, December 2014.

Todoroski Air Sciences (2016)

"Air Quality Assessment – Bengalla Mine Development Consent Modification 2", prepared for Hansen Bailey by Todoroski Air Sciences, April 2016.

Todoroski Air Sciences (2017)

"Mount Pleasant Operation Mine Optimisation Modification Air Quality and Greenhouse Gas Assessment", prepared for MACH Energy Australia by Todoroski Air Sciences, May 2017.

Appendix A

Isopleth Diagrams

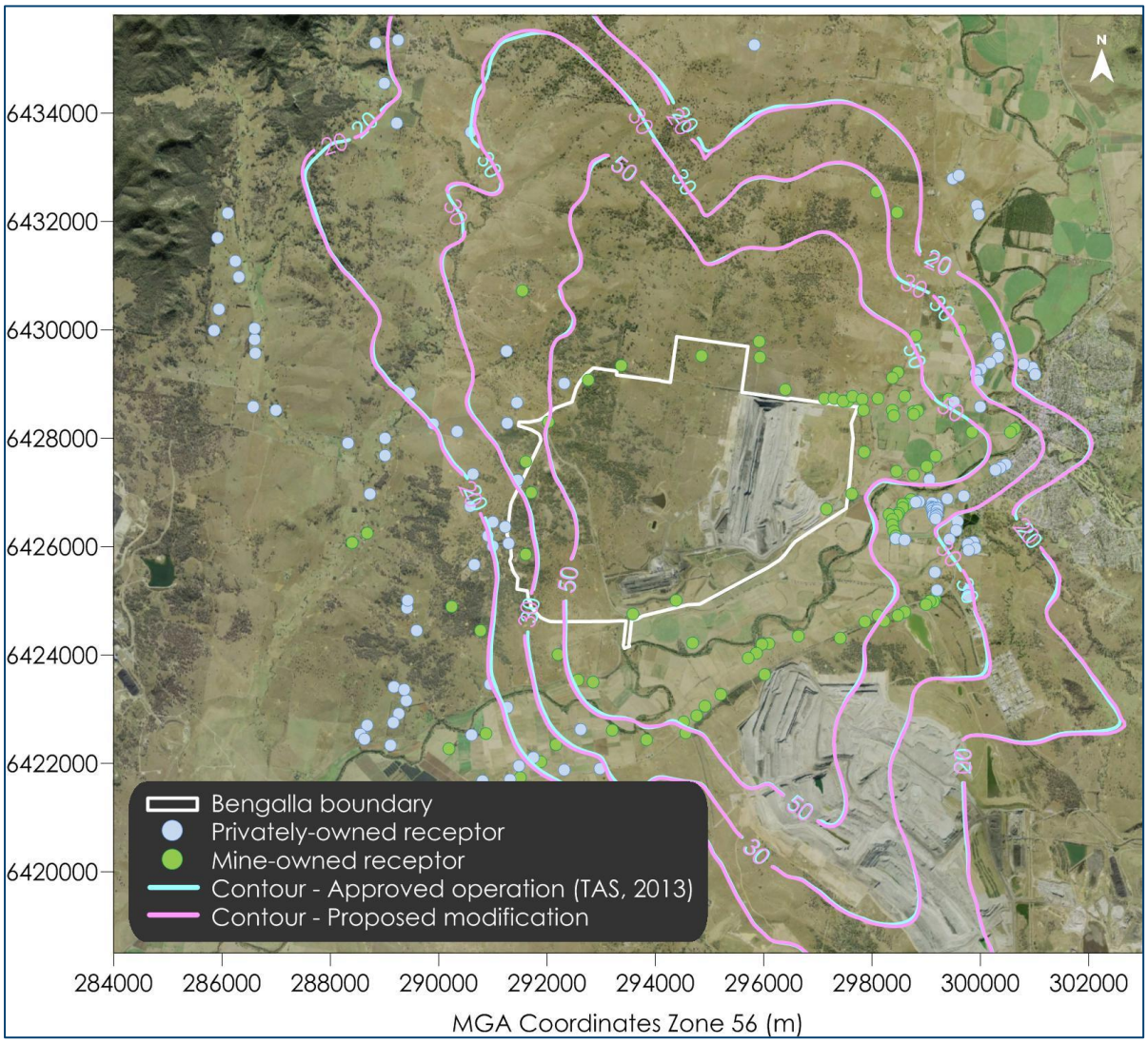

Figure 3: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed Modification as per MOD2 (TAS, 2016) –Year 4 (µg/m^3)

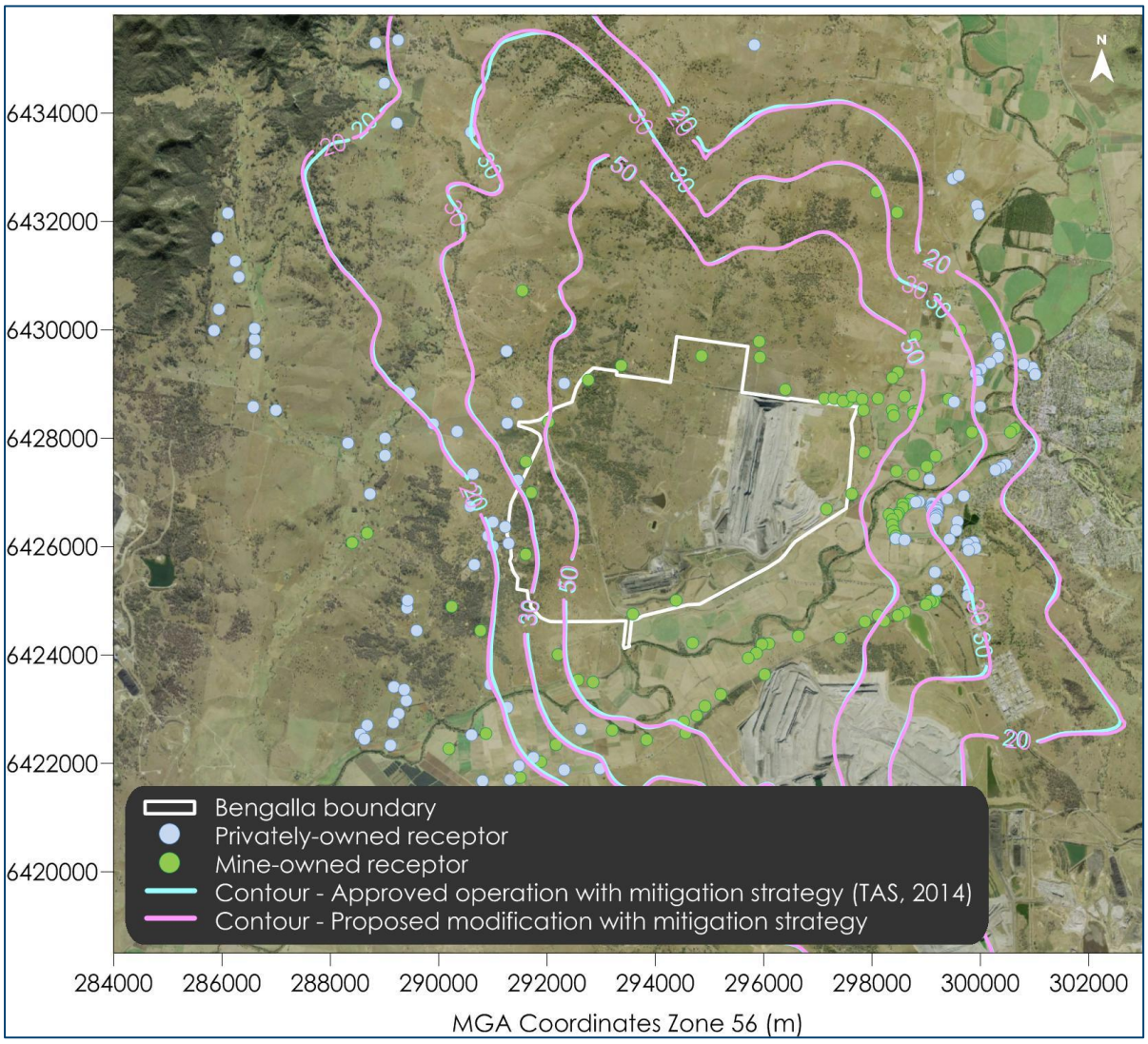

Figure 4: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed Modification including consideration of mitigation strategy (TAS, 2014) –Year 4 (µg/m^3)

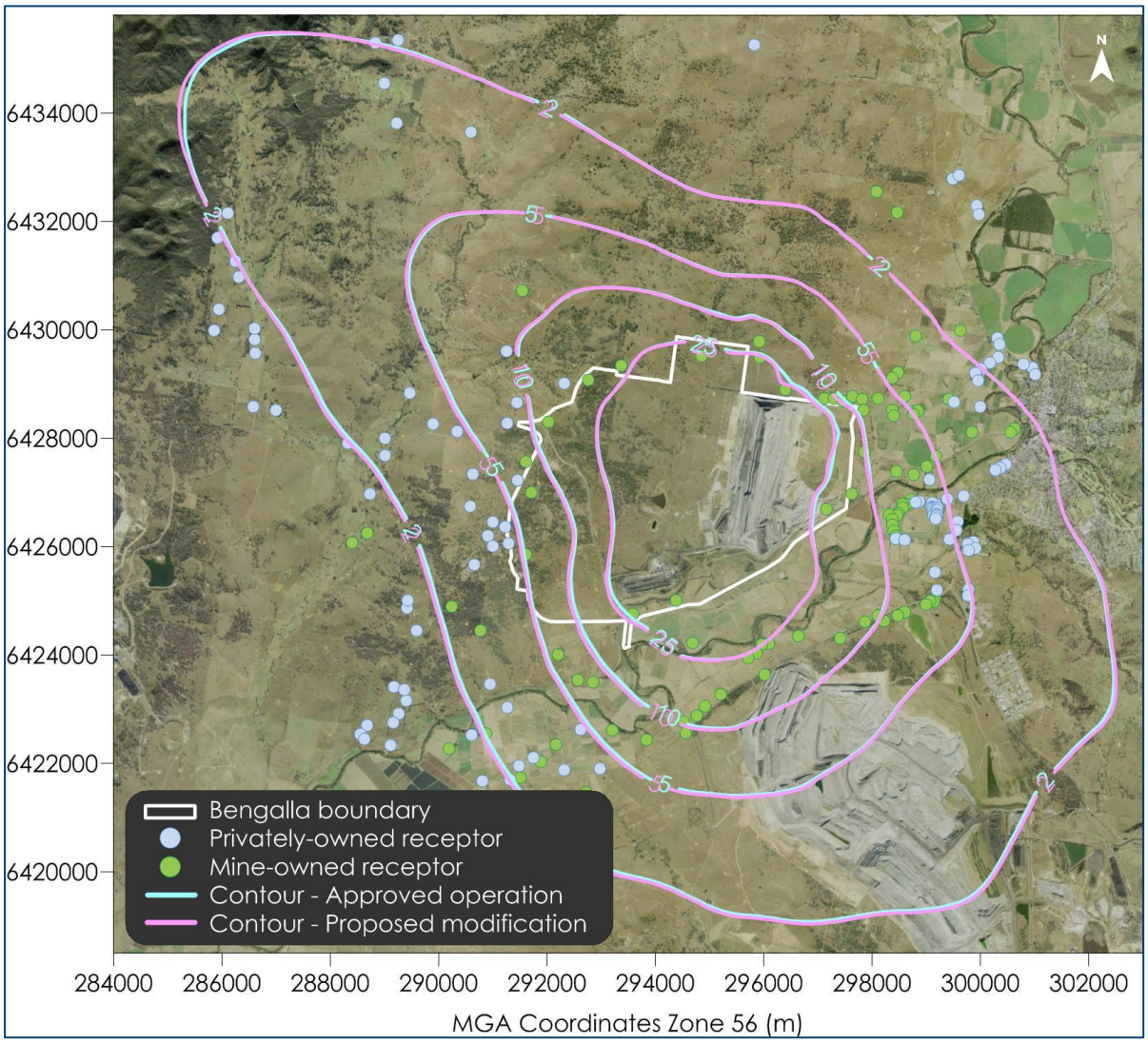

Figure 5: Comparison of predicted incremental annual average PM_{10} concentrations –Year 4 (µg/m^3)

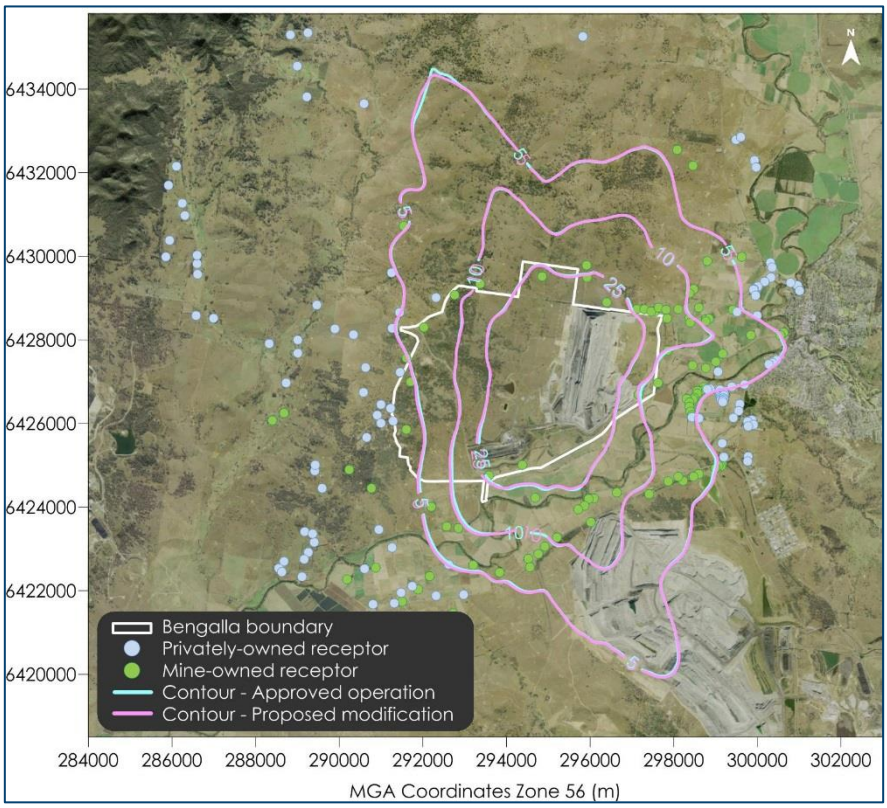

Figure 6: Comparison of predicted maximum incremental 24-hour average $PM_{2.5}$ concentrations – Year 4 (µg/m^3)

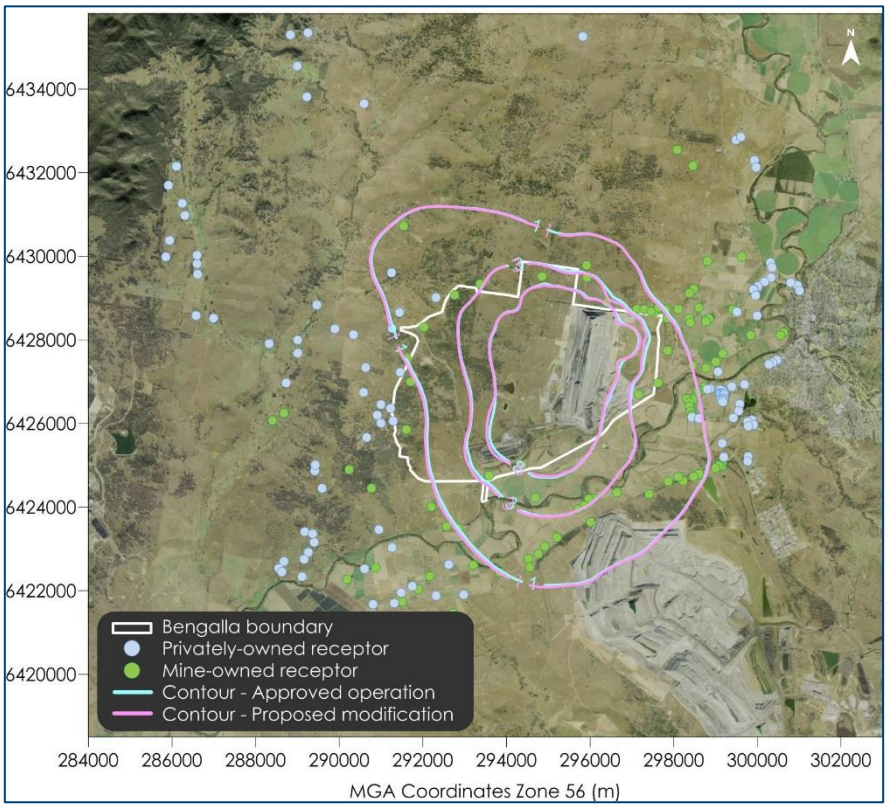

Figure 7: Comparison of predicted incremental annual average $PM_{2.5}$ concentrations –Year 4 (µg/m^3)

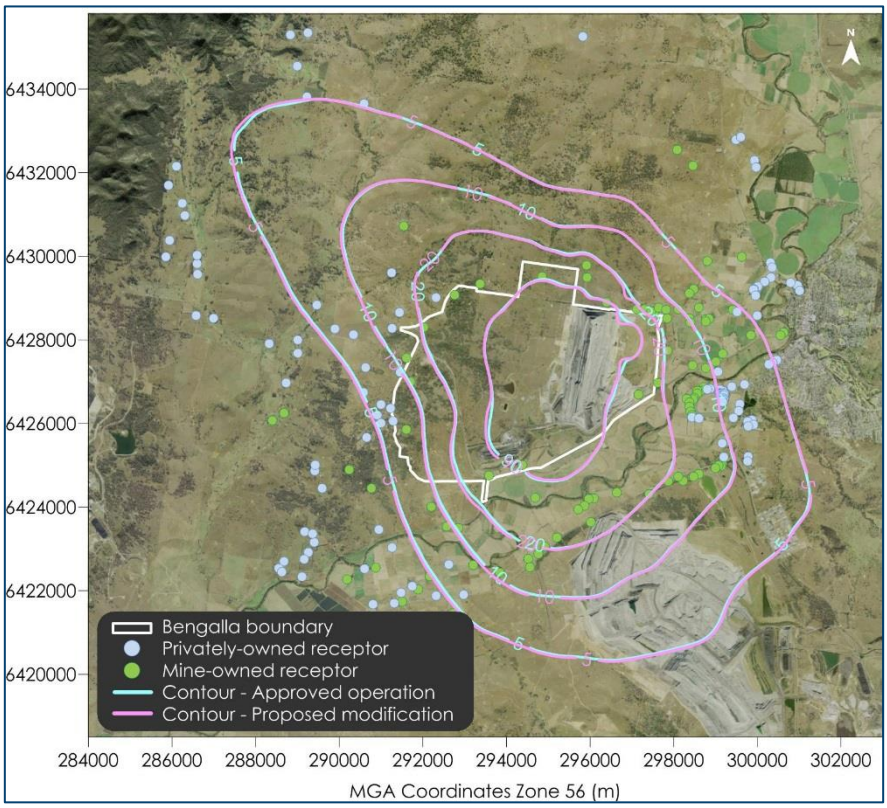

Figure 8: Comparison of predicted incremental annual average TSP concentrations –Year 4 (µg/m^3)

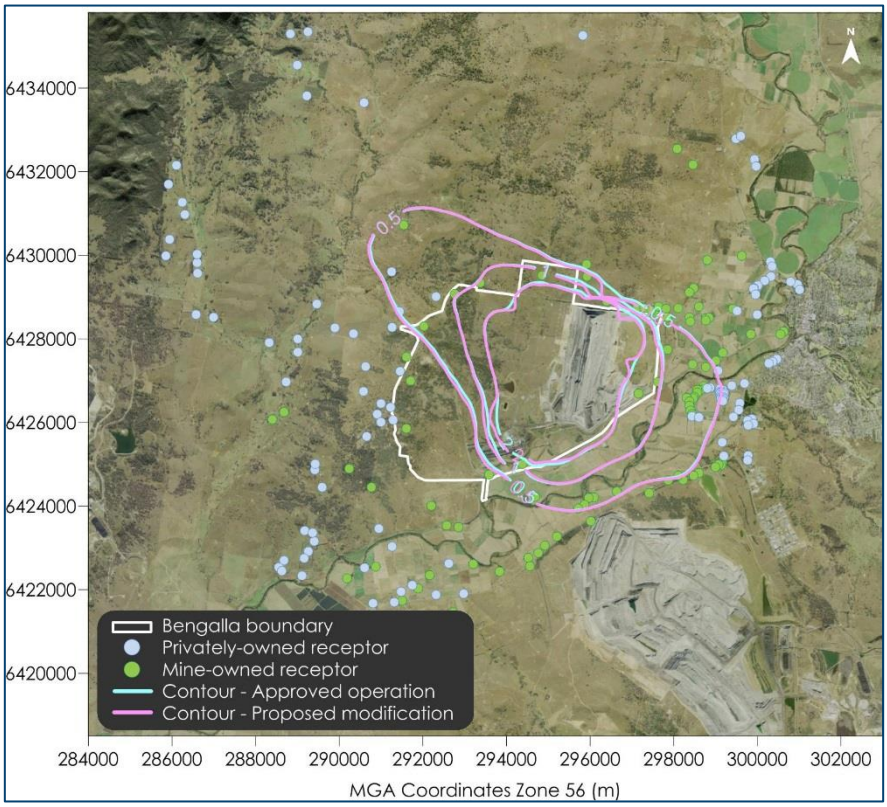

Figure 9: Comparison of predicted incremental annual average dust deposition levels –Year 4 (g/m^2/month)

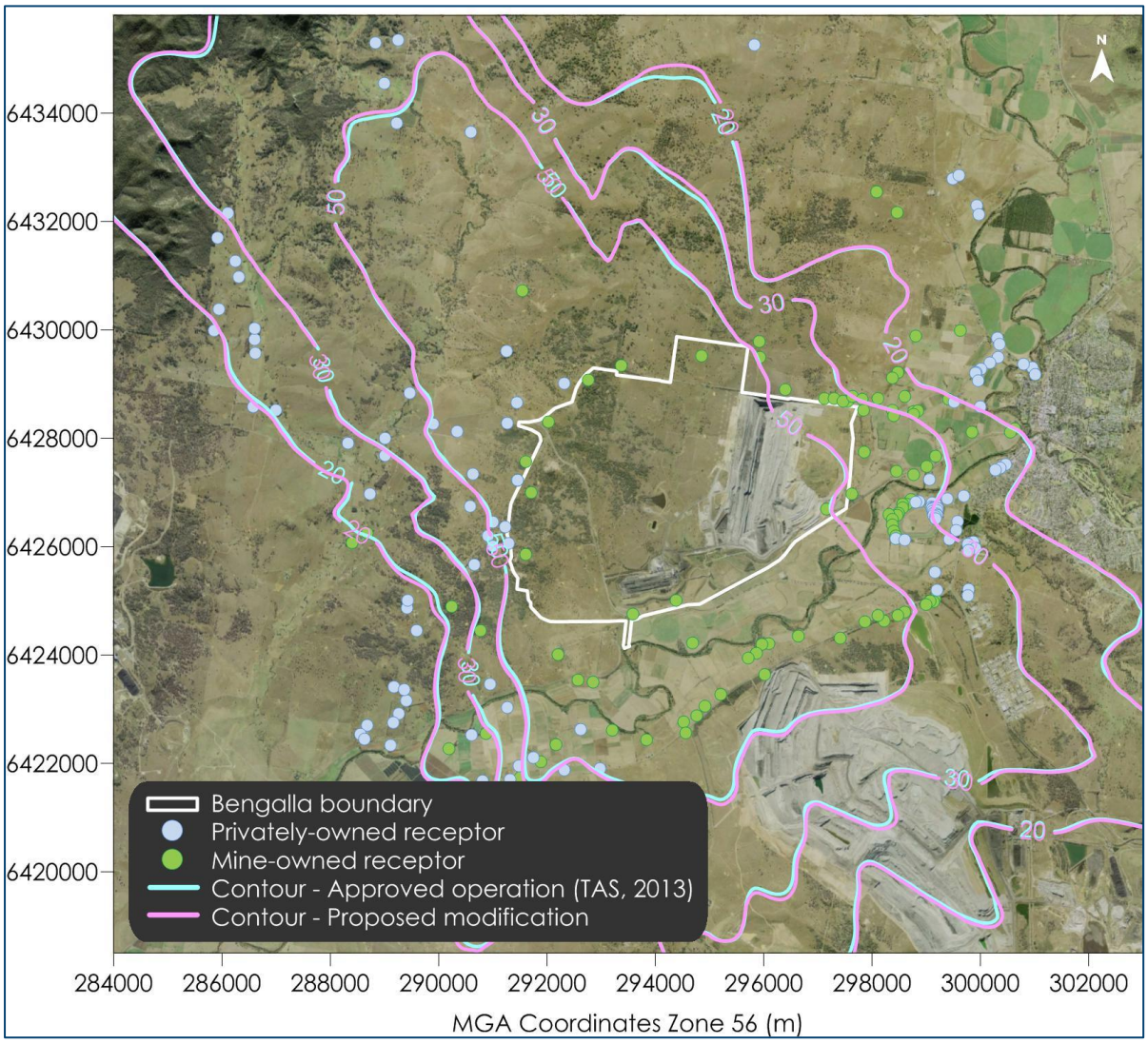

Figure 10: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed Modification as per AQIA (TAS, 2013) –Year 24 (µg/m^3)

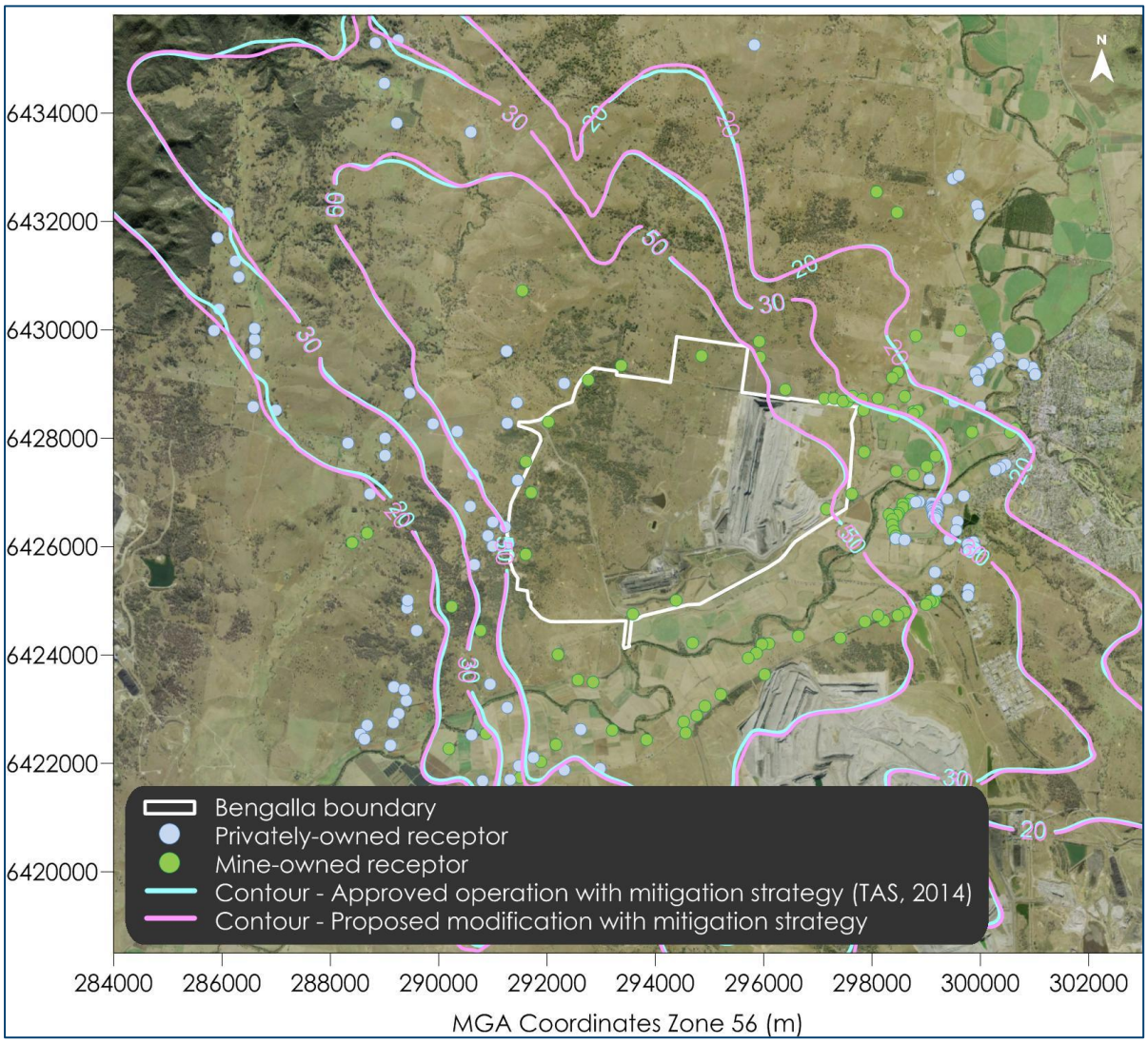

Figure 11: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed Modification including consideration of mitigation strategy (TAS, 2014) –Year 24 (µg/m^3)

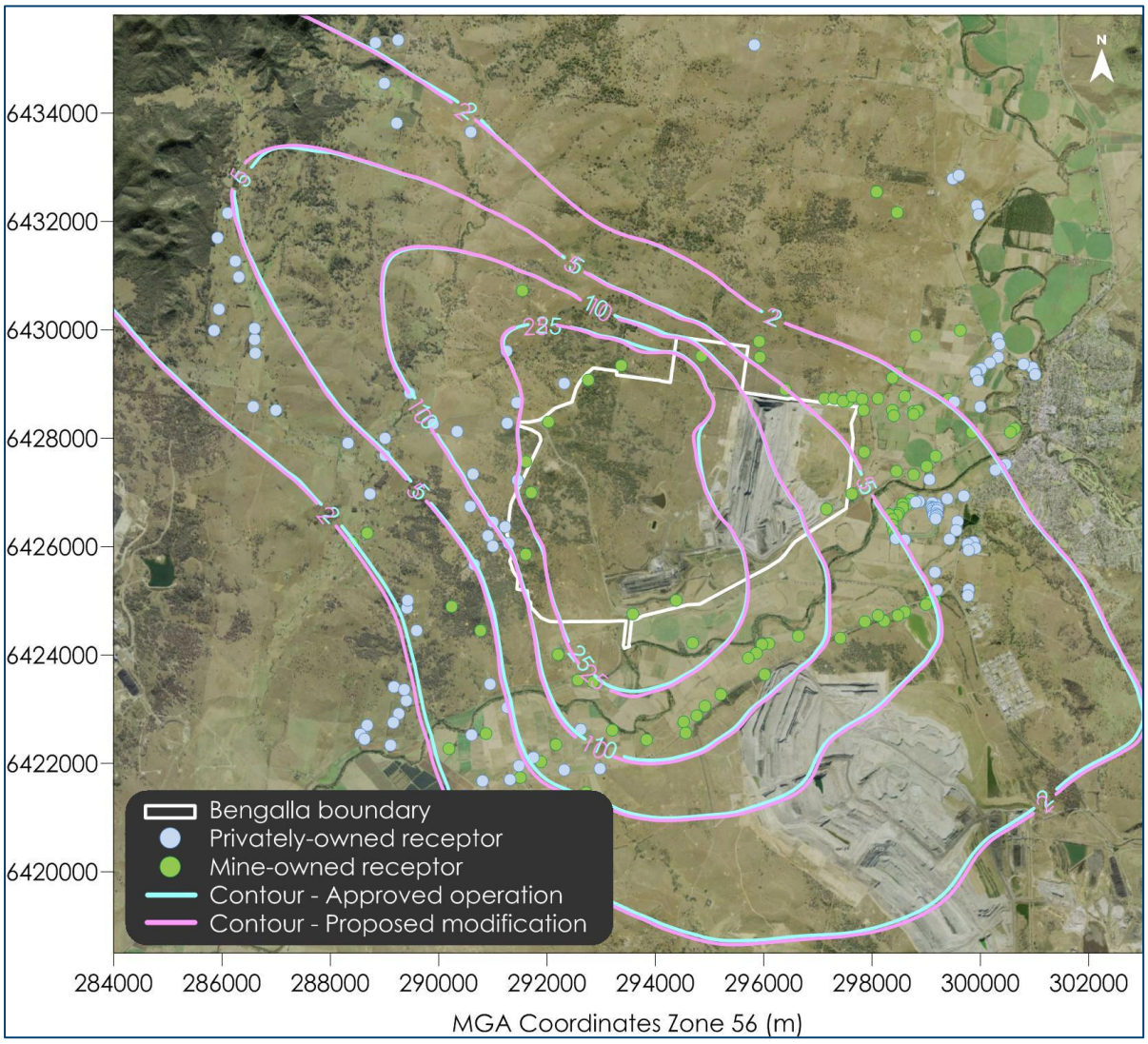

Figure 12: Comparison of predicted incremental annual average PM_{10} concentrations –Year 24 ($\mu g/m^3$)

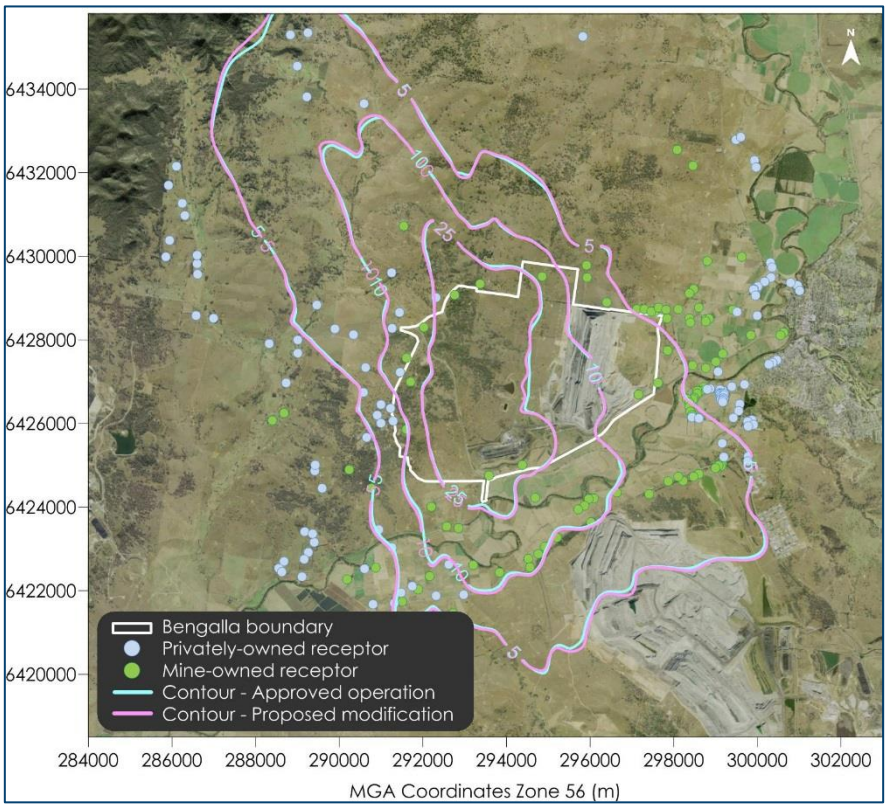

Figure 13: Comparison of predicted maximum 24-hour average $PM_{2.5}$ concentrations –Year 24 ($\mu g/m^3$)

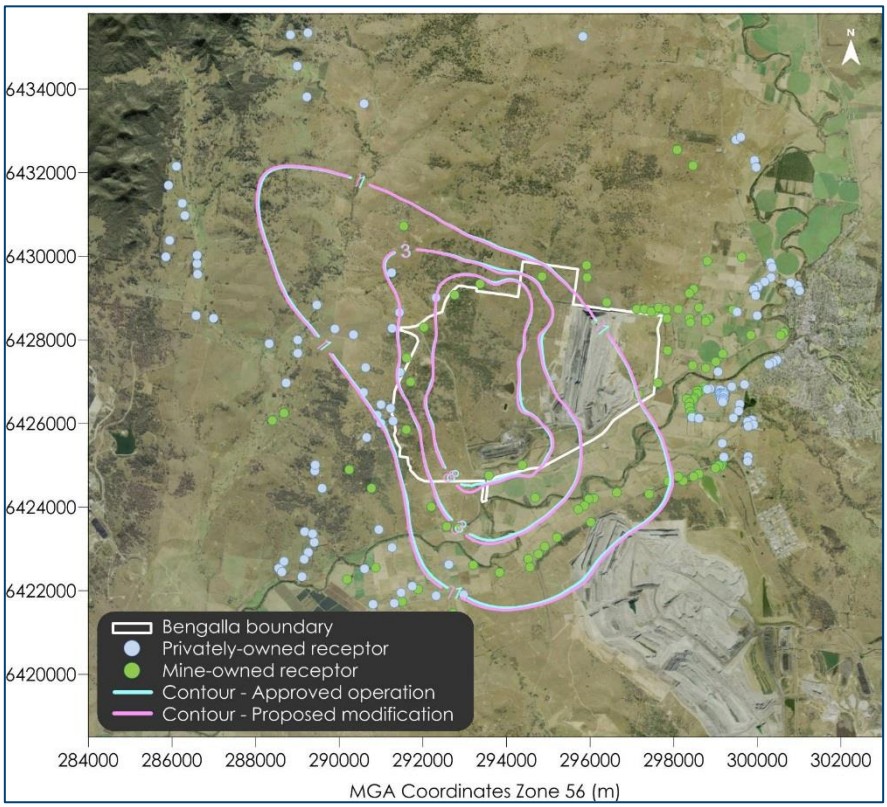

Figure 14: Comparison of predicted annual average $PM_{2.5}$ concentrations –Year 24 ($\mu g/m^3$)

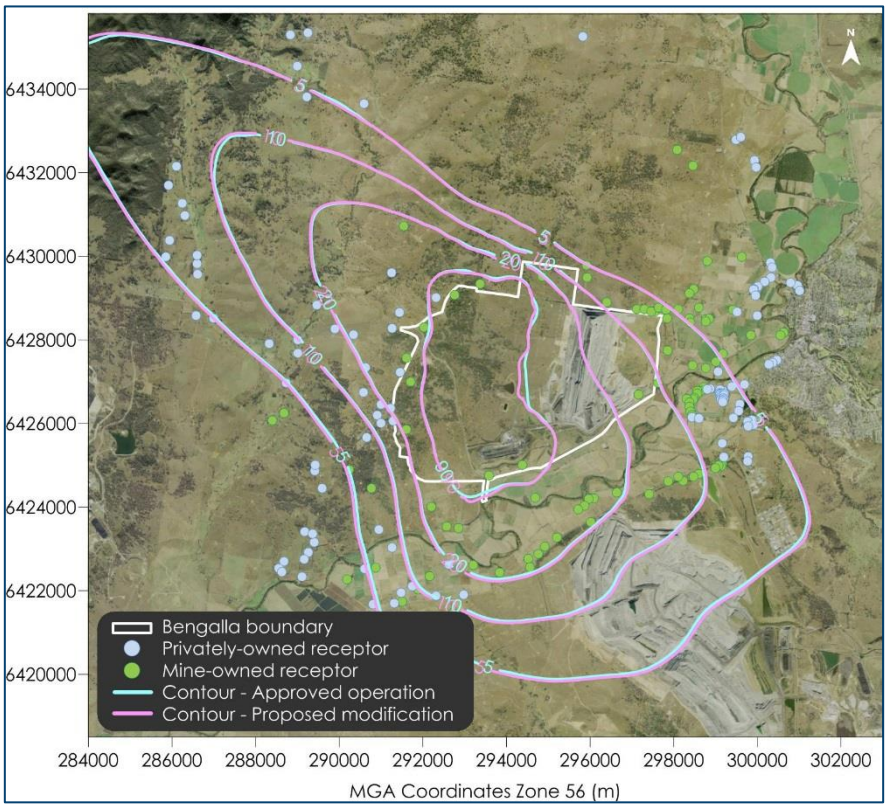

Figure 15: Comparison of predicted annual average TSP concentrations –Year 24 (µg/m^3)

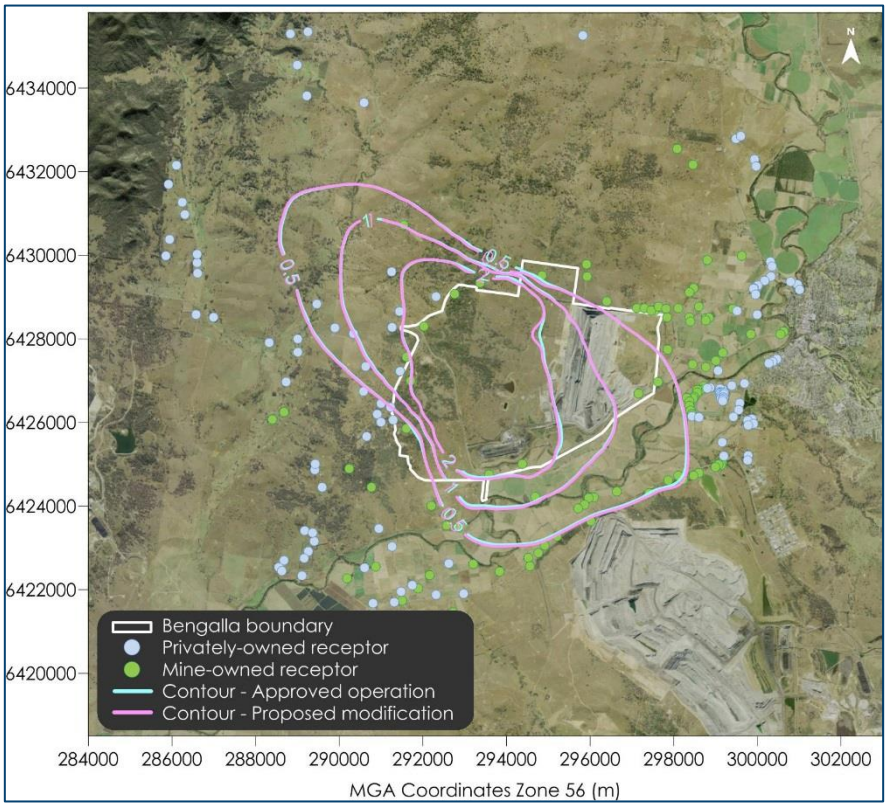

Figure 16: Comparison of predicted annual average dust deposition levels –Year 24 (g/m^2/month)

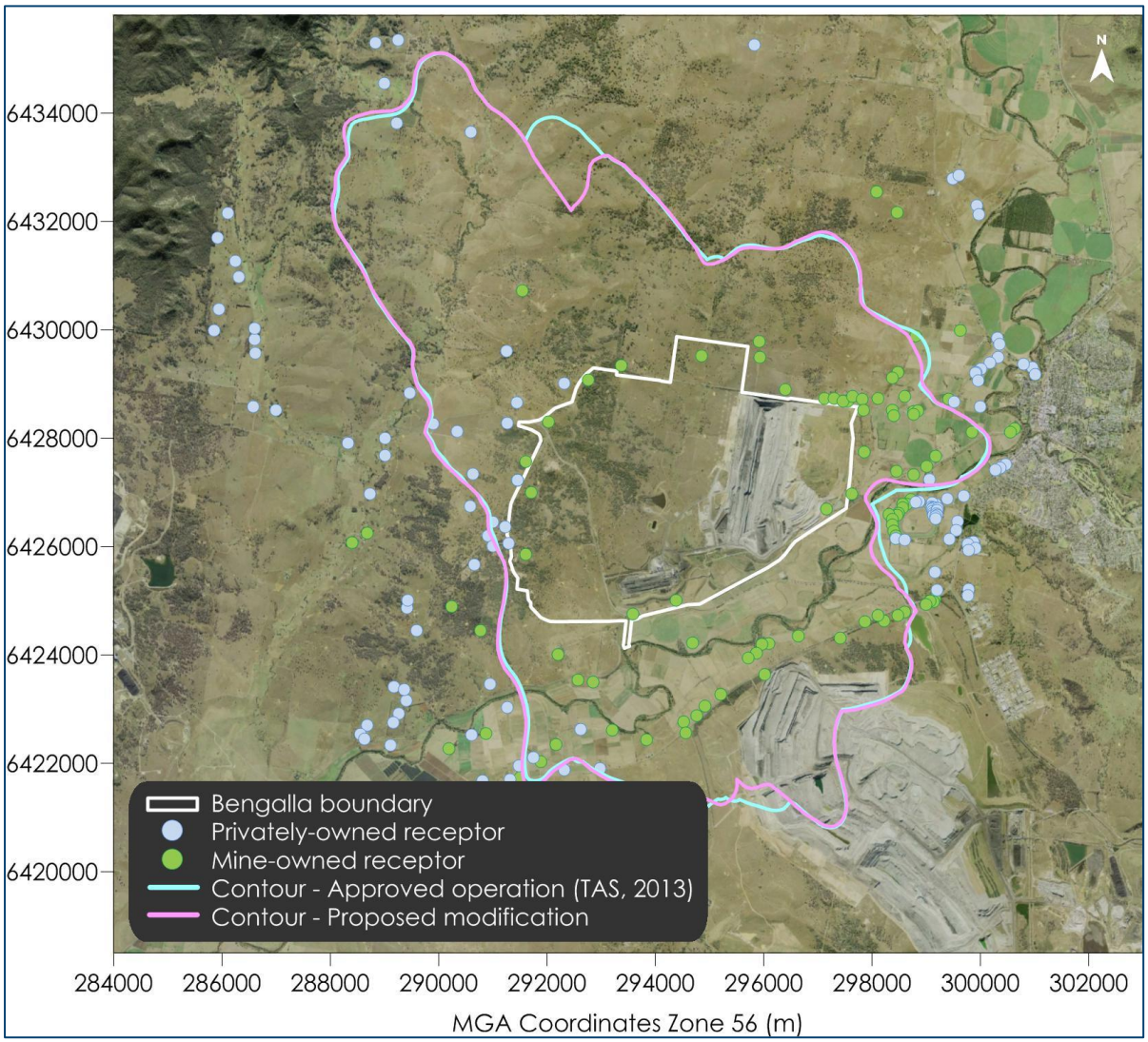

Figure 17: Comparison of maximum incremental 24-hour PM_{10} concentrations for all years, as per AQIA (TAS, 2013) with proposed Modification (Year 4 and Year 24).

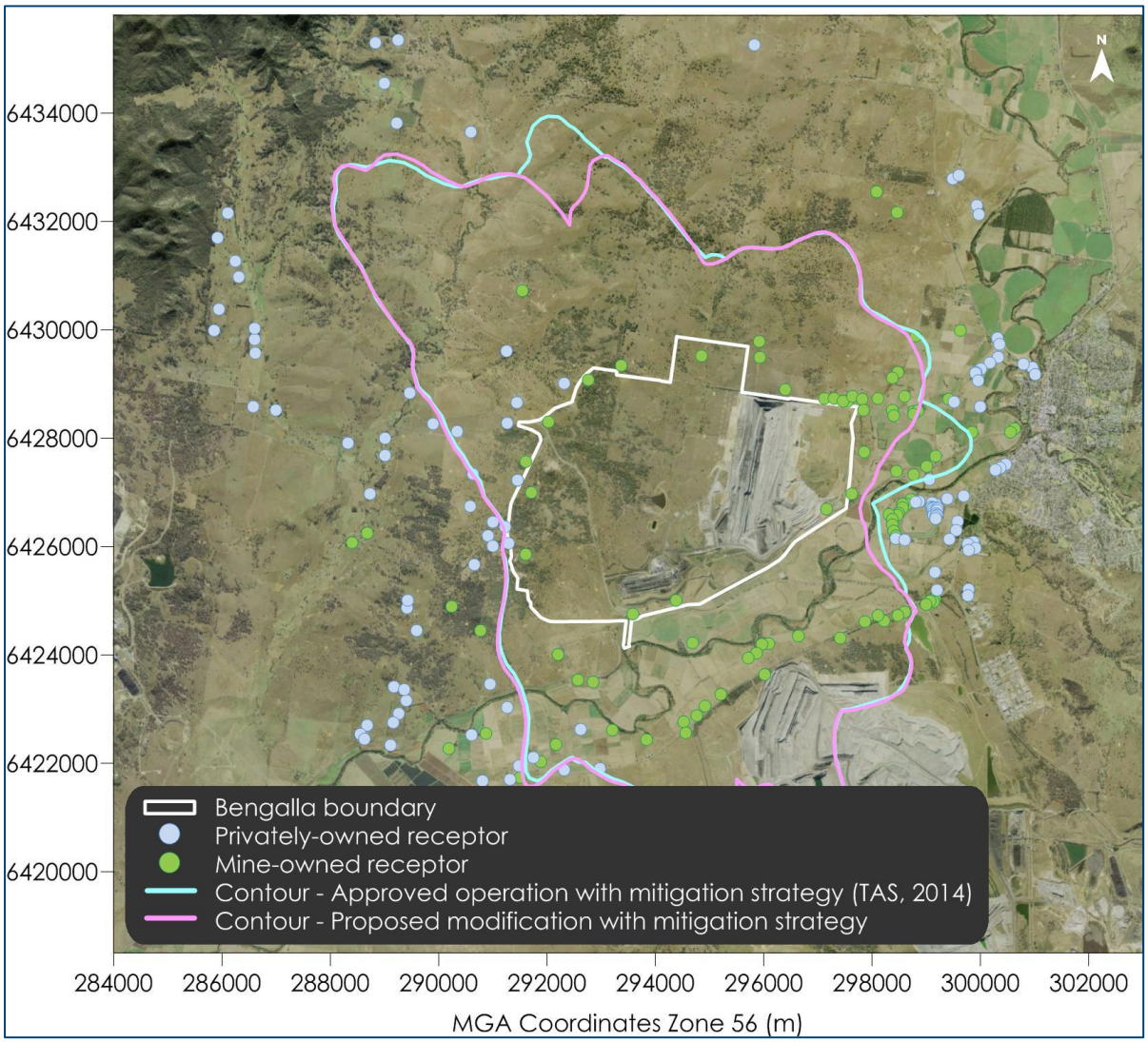

Figure 18: Comparison of maximum incremental 24-hour PM_{10} concentrations for all years with proposed Modification (Year 4 and Year 24) including consideration of mitigation strategy (TAS, 2014)

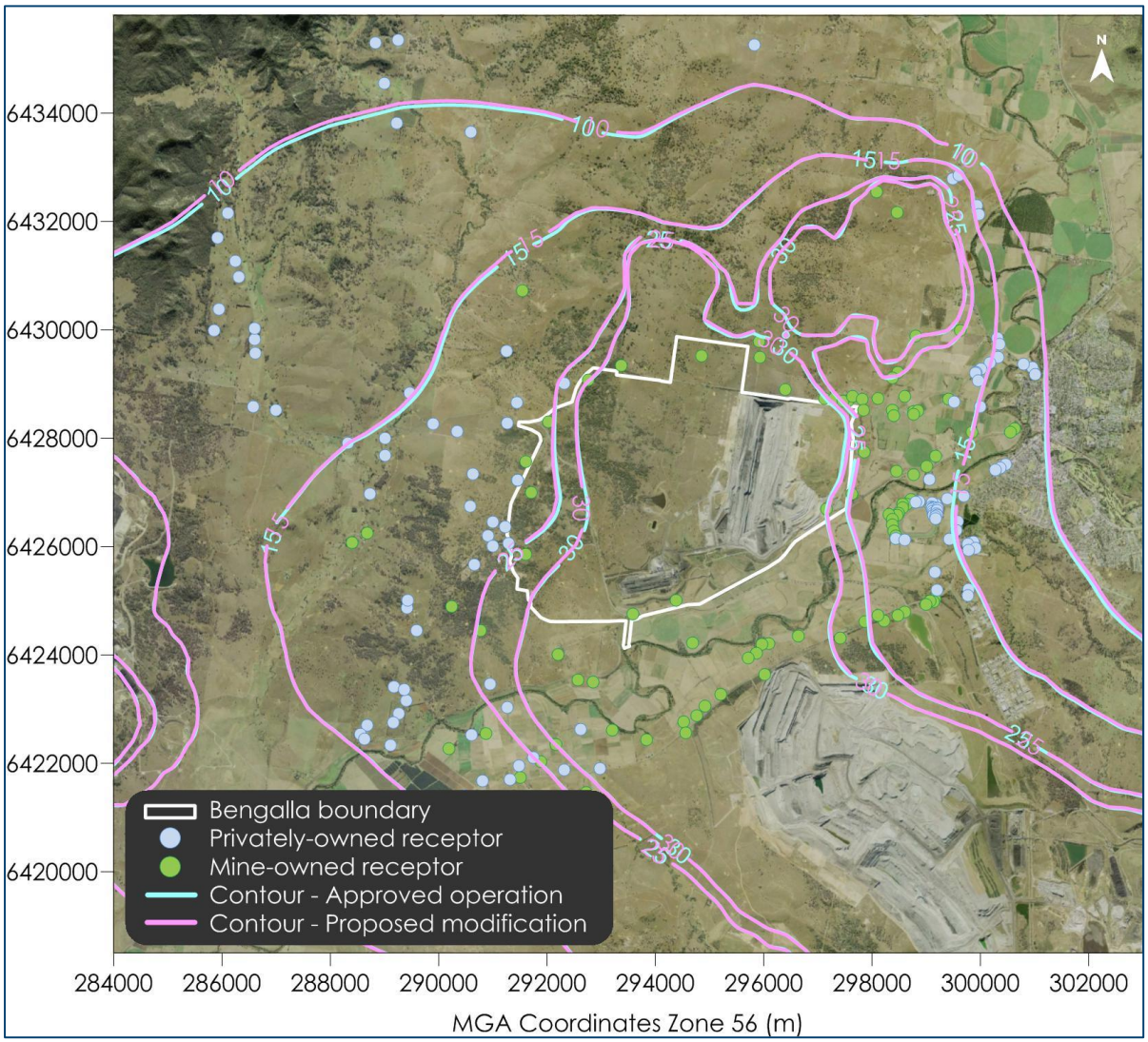

Figure 19: Comparison of cumulative predicted annual average PM_{10} concentrations (Bengalla and other sources) – Year 4 (µg/m^3)

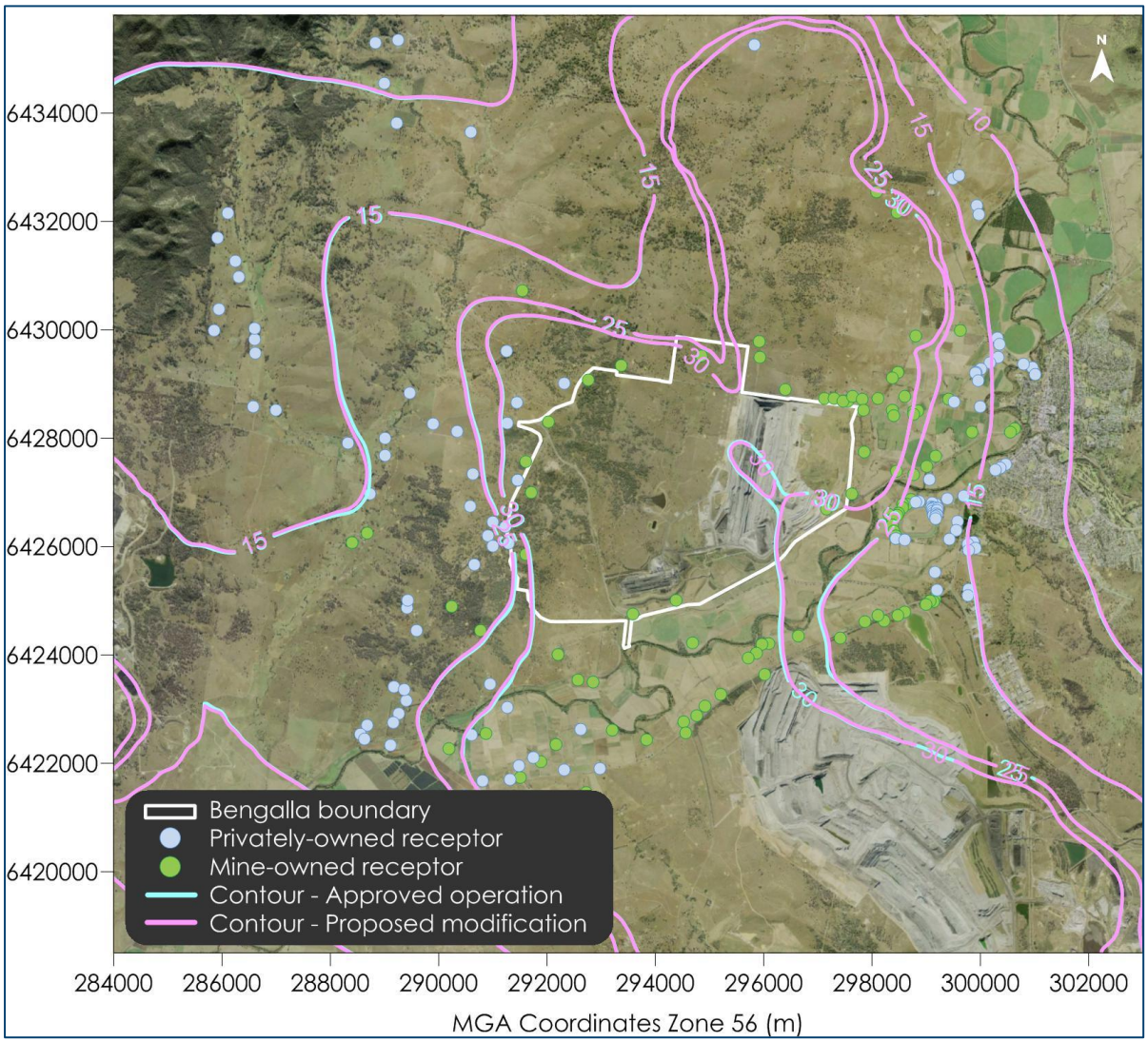

Figure 20: Comparison of cumulative predicted annual average PM_{10} concentrations (Bengalla and other sources) – Year 24 (µg/m^3)

Appendix B

Modelling Predictions

Table 2: Modelling predictions for cumulative annual average PM_{10} – privately-owned receptors

Receptor ID	Year 4	Year 24	Receptor ID	Year 4	Year 24
	SSD-5170 criterion 30µg/m³ Approved Methods criterion 25µg/m³			SSD-5170 criterion 30µg/m³ Approved Methods criterion 25µg/m³	
2	15	14	108	17	**26**
3	14	14	110S	19	**32**
7	11	12	110N	21	**31**
8	11	12	112N	**27**	**32**
12	11	12	112S	21	**39**
17	14	14	113	23	**40**
19	15	15	114	25	**41**
22	16	16	117	**27**	**45**
23	17	17	118	**39**	**44**
24	17	17	119	**34**	**44**
25	16	17	120	**27**	**29**
27W	18	21	126N	19	24
27E	15	16	126W	18	24
29	17	20	126S	17	23
30	12	13	130	16	22
31	12	14	133N	16	21
33	13	14	133W	16	20
39	15	16	133S	16	20
40	16	17	145	19	23
41	16	19	146	19	23
42	17	19	149S	21	21
43	18	21	149W	20	20
44	18	22	149N	20	19
45	20	23	152	23	22
46	19	22	153	23	21
47	17	19	154	24	22
48	17	19	155	24	25
49	17	19	156S	23	**26**
50	17	19	156E	22	24
51	17	19	156W	20	21
52	17	19	158	21	**37**
53	17	19	161	19	23
54	16	18	166	19	**32**
55	16	18	168	**26**	**68**
57	16	18	169	20	**33**
58	16	18	171	19	**34**
59	16	18	180	15	19
60	16	18	184(1)	16	20

Receptor ID	Year 4	Year 24	Receptor ID	Year 4	Year 24
	SSD-5170 criterion 30µg/m³ Approved Methods criterion 25µg/m³			SSD-5170 criterion 30µg/m³ Approved Methods criterion 25µg/m³	
61	15	16	186N	15	16
62	15	16	186S	16	16
63	15	16	189	15	15
64	17	18	192	17	15
66	18	17	194	13	13
81	14	15	195	13	13
83	14	15	198	12	13
84	14	14	199	12	13
85	14	15	200	11	12
87N	16	15	201	11	12
87S	16	16	203	12	13
88W	10	11	209S	11	12
88N	10	11	209E	11	12
88S	10	10	209W	10	12
90	12	13	209N	10	12
92	12	14	222	10	11
93	12	13	230	11	10
96	11	11	252	9	**36**
97	12	12	286	9	9
98	12	14	287	9	9
102	14	18	288	10	10
103	15	21	289N	14	13
105	15	21	289S	14	13
106	18	**31**	292W	19	14
107	16	22	292E	16	14

Appendix D

Acoustic Impact Assessment

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BENGALLA MINING COMPANY PTY LTD

ACOUSTIC IMPACT ASSESSMENT

MODIFICATION TO DEVELOPMENT CONSENT

REPORT J0130-115-R1
5 DECEMBER 2017

Prepared for:
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GLOSSARY

The following acoustical terms are used in this report:

Sound Pressure	Small air pressure variations above and below normal atmospheric pressure that are perceived by human ears as sound.
Sound Power	Sound energy emitted by a source, measured in watts (W) or expressed on a decibel scale with 0 dB representing 1 picowatt (1 pW) of sound power. While both sound pressure (in pascals) and sound power (in watts) can be expressed on a decibel scale, they are not interchangeable or directly comparable. Sound power levels are most commonly expressed as unweighted decibels (dBL), particularly when referring to sound power levels in frequency bands, but can be expressed as A-weighted decibels (dBA).
Frequency	The rate of sound pressure or sound power fluctuations per second, expressed as cycles per second or hertz (Hz). Human ears in good condition can typically detect sound pressure in the frequency range 20 Hz to 20,000 Hz (20 kHz), depending on the sound level.
Decibels, dB	A noise level unit based on a logarithmic scale of Pascals of sound pressure above and below atmospheric pressure, or watts of sound power. Expressing a sound level in decibels implies root-mean-squared (RMS) unless explicitly stated otherwise. Human ears in good condition can typically detect sound pressures from the threshold of perception at 0 dB (20 uPa) to the approximate threshold of pain at 140 dB (200 Pa). An increase of 10 dB is perceived as an approximate doubling of sound level by an average human ear.
dBL	Linear decibels, the same as dB but used to explicitly define a decibel scale in the absence of any weighting within the audible range.
dBA	A-weighted decibels, where the A weighting means frequencies below 500Hz and above 10kHz are artificially reduced to approximate the frequency response of an average human ear. Most sound monitoring instruments include an A-weighting option, enabling direct measurement of noise levels in dBA.
LA90	The A-weighted noise level exceeded 90% of the time (which can be thought of as the quietest 10% of the time) over a defined measurement period, usually 15 minutes or one hour, and widely accepted as the background noise level.
LAeq	The A-weighted equivalent continuous, or logarithmic average, noise level over a defined time period either measured or predicted at a specific location.

1 INTRODUCTION

Bengalla Mining Company Pty Limited (BMC) is seeking approval from the NSW Minister for Planning or their delegate for a modification to SSD-5170. The modification is sought under section 96(2) of the *Environmental Planning and Assessment Act* (EP&A Act) for the following:

- Changes to the approved water management system to reflect operations at Bengalla Mine (Bengalla) including a proposed enlargement of the approved Staged Discharge Dam (ED1), and construction and use of the Dry Creek East Dam;
- Temporary storage of approximately 2,500 m3 of excess materials from the construction of ED1;
- Increase in the capacity and additional locations of ROM coal stockpiles;
- Additional storage locations for temporary emplacement of coal processing reject material, prior to permanent emplacement; and
- Temporary clay emplacement within the Main OEA or to the west of this for later use in the reinstatement of Dry Creek.

1.1 Receptors

Bengalla adjoins rural and residential receptors on all sides, with other operating and approved coal mines located south east and north of Bengalla. Some of the closest rural properties have previously been purchased by BMC to provide land for the mine or a noise and/or air quality buffer around the mine.

A number of properties not owned by BMC have been purchased by owners of the approved and currently being constructed Mt Pleasant Mine located to the north or the operating Mt Arthur Coal Mine located to the south east. Properties and residences owned by BMC or other mining companies are not considered to be noise-sensitive receptors and are not specifically assessed in this report.

Figures 1 and 2 present an overview of the Modification for representative Years 4 and 24 respectively.

Figure 1: Modification Overview – Year 4 Mine Plan

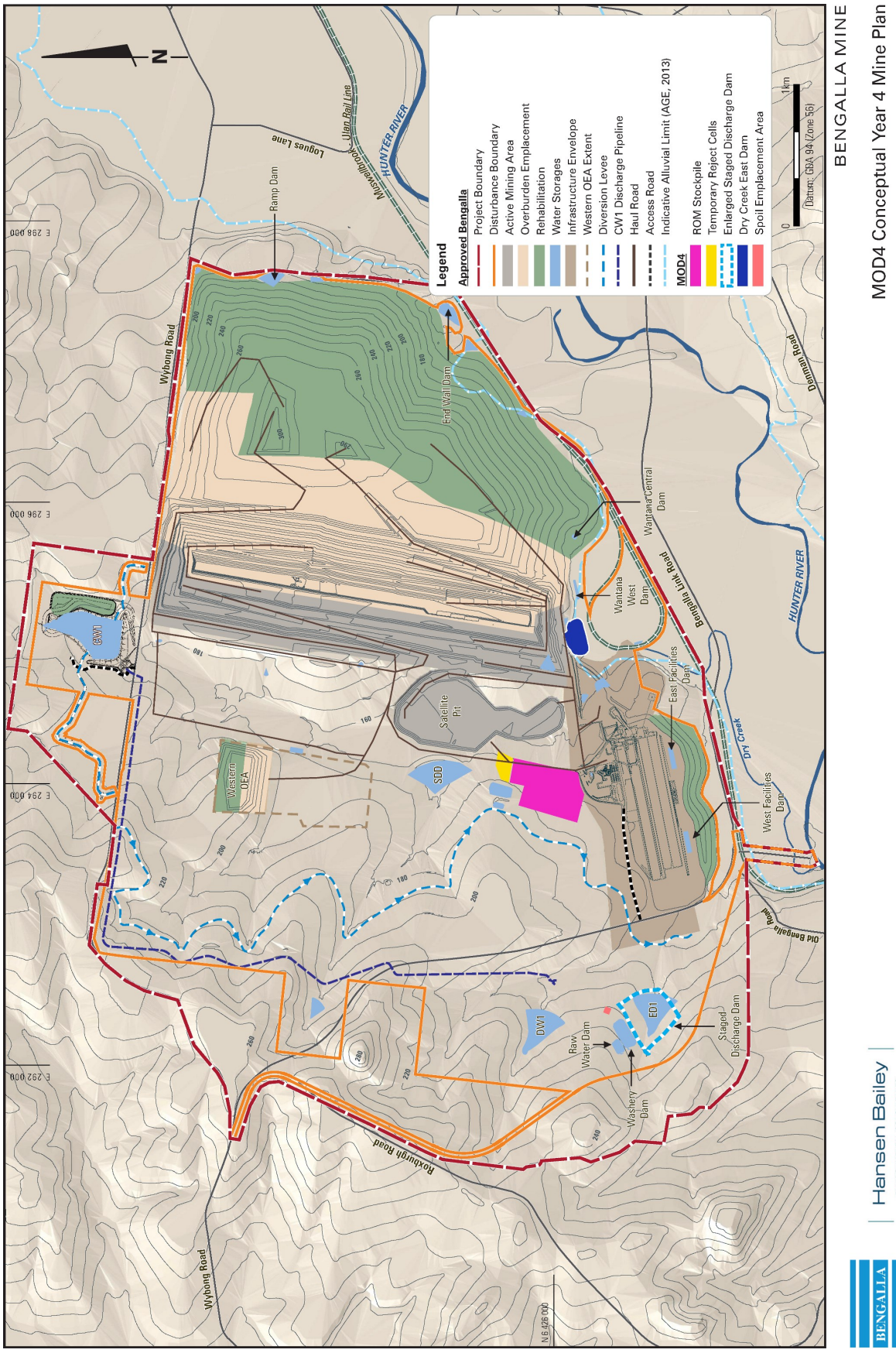
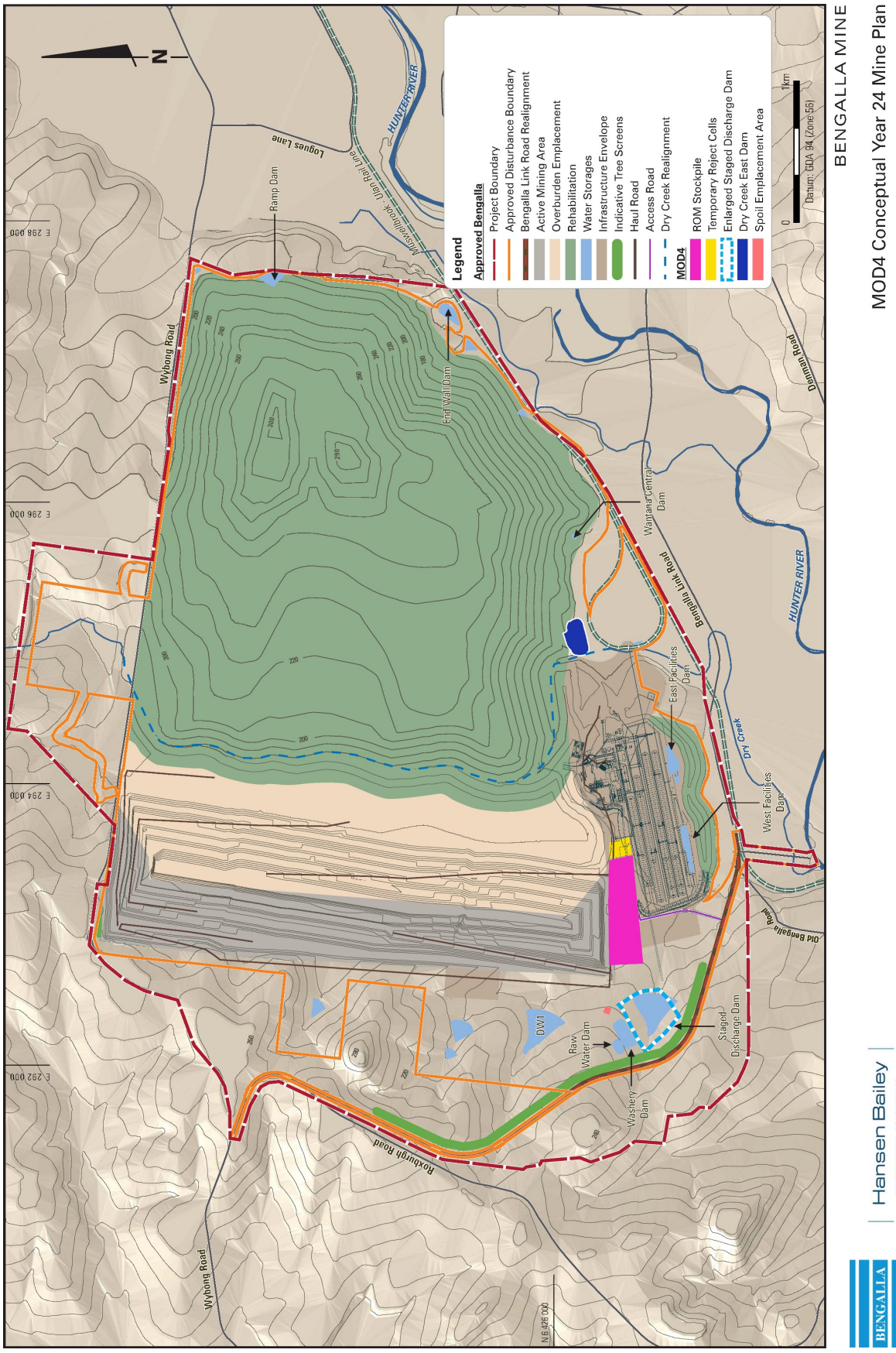


Figure 2: Modification Overview – Year 24 Mine Plan



2 NOISE CRITERIA

Bengalla Mine operates under Development Consent SSD-5170 (as modified) issued by the Minister for Planning on 3 March 2015. The Development Consent includes a number of conditions to minimise environmental impacts based on current NSW government guidelines and policies, including the following relevant conditions.

ACQUISITION UPON REQUEST

1. *Upon receiving a written request for acquisition from the owner of the land listed in Table 1, the Applicant must acquire the land in accordance with the procedures in conditions 5 and 6 of schedule 4.*

Table 1: Land subject to acquisition upon request

Acquisition Basis	*Receiver No*
Noise	*152, 153, 154, 156*

Note: To interpret the land referred to in Table 1, see the applicable figure in Appendix 4.

2. *If the Applicant receives a written request for acquisition from the owner of the land listed in Table 2 and if that land is no longer subject to acquisition upon request under the relevant development consent or project approval shown in Table 2, then the Applicant must acquire the land in accordance with the procedures in conditions 5 and 6 of schedule 4.*

Table 2: Land subject to acquisition upon request

Acquisition Basis	*Receiver No*	*Mine*
Noise	*112, 113, 114, 120*	*Mt Arthur*
Noise & Air	*117, 118, 119, 155*	
Noise & Air	*166, 168, 171*	*Mt Pleasant*
Air	*169*	

Note: To interpret the land referred to in Table 2, see the applicable figure in Appendix 4.

NOISE

Noise Criteria

4. *Except for the noise-affected land in Tables 1 and 2, the Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 4 at any residence on privately owned land.*

Table 4: Noise Criteria dBA

Location	*Day*	*Evening*	*Night*	
	LAeq,15min	*LAeq,15min*	*LAeq,15min*	*LA1,1min*
109, 110, 156, 161	*40*	*40*	*40*	*45*
106, 108	*39*	*39*	*39*	*45*
27, 169	*39*	*39*	*36*	*45*
105, 126	*38*	*38*	*38*	*45*
22, 23, 24, 25, 29, 43, 44	*38*	*38*	*36*	*45*
167	*38*	*38*	*35*	*45*
19, 64, 66	*38*	*37*	*36*	*45*
180, 184, 186	*37*	*37*	*35*	*45*
146	*37*	*37*	*37*	*45*
102, 130, 145, 189	*36*	*36*	*36*	*45*
All other privately owned residences	*35*	*35*	*35*	*45*

Note: To interpret the land referred to in Table 4, see the applicable figure in Appendix 4.

However, these criteria do not apply if the Applicant has a written agreement with the relevant landowner to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Noise generated by the development is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy. Appendix 5 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

2.1 Low Frequency Noise

Previous assessments of low frequency noise have been based on the recommendations in the *NSW Industrial Noise Policy* (INP). However, the *Noise Policy for Industry* (NPI) (EPA, 2017) includes alternative recommendations for the assessment of low frequency noise which have been adopted for this assessment.

The NPI requires a 1/3 octave spectrum in the frequency range 10 Hz to 160 Hz to be calculated or measured at the receptor and compared to defined threshold levels. Measured or predicted levels over the threshold in one or more frequency bands require a penalty of:

- 2 dBA to be applied to the measured or calculated dBA level at the receptor for a threshold exceedance of up to 5 dB in one or more 1/3 octave bands; or
- 5 dBA to be applied to the measured or calculated dBA level at the receptor for a threshold exceedance of more than 5 dB in one or more 1/3 octave bands.

2.2 Construction Noise

Construction noise levels produced during establishment of most industrial developments are normally assessed to the *Interim Construction Noise Guideline* (ICNG). Section 1.2 of the ICNG states it does not apply to construction associated with quarrying and mining and suggests this activity should be assessed under the *NSW Industrial Noise Policy* (INP). Section 1.3 of the INP, however, specifically excludes construction noise. The NPI similarly excludes construction noise.

The Dry Creek East Dam and Staged Discharge Dam are not directly related to mining and are therefore assessed to noise criteria in the ICNG which recommends:

- A ‘noise affected’ level of 10 dBA above the background noise level which represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq,15min level is greater than the ‘noise affected’ level, all feasible and reasonable noise control measures should be applied in an effort to meet the ‘noise affected’ level; and
- A ‘highly noise affected’ level which represents the point above which there may be a strong community reaction to noise. Additional mitigation measures such as reduced working hours or respite periods should be considered in consultation with the relevant authority and the community.

3 OPERATIONAL NOISE

3.1 Noise Assessment Method

Noise levels from the Modification to potentially affected receptors were determined by modifying the most recent noise model of Bengalla Mine which was developed during preparation of the Continuation of Bengalla Mine Environmental Impact Statement (Bengalla EIS) and more recently Modification 2 to SSD-5170 , to include mining equipment accessing and operating on the proposed ROM coal stockpiles.

The noise model is based on RTA Technology's Environmental Noise Model (ENM) software. ENM is a general purpose noise modelling package that combines terrain and noise source information with other input parameters such as weather conditions to predict noise levels at specific receiver locations or as contours over a receiver area. It is recognised in NSW as one of the most appropriate choices for situations involving complex topography and a large number of individual noise sources and where a detailed assessment of the effects of atmospheric conditions on noise propagation is required.

The terrain files were originally supplied by Hansen Bailey and BMC for inclusion in the noise model for Modification 2, while the modelled equipment locations were adjusted to suit the terrain and the location of the proposed ROM coal stockpiles. As the terrain remained largely unaffected by the Modification, the majority of equipment locations were not changed from the EIS and Modification 2 noise models. All other noise model parameters including CHPP equipment, mobile equipment fleet, source noise levels and prevailing weather conditions have remained unchanged from the Bengalla EIS and Modification 2 noise models and comply with relevant recommendations in the INP and Draft ING.

The Bengalla EIS reported predicted noise levels for project years 1, 4, 8, 15 and 24, while the Modification 2 assessment primarily considered Years 4 and 8 as those years were most affected by that Modification. This assessment initially considered representative Years 4 and 24, with other years not requiring detailed assessment given the insignificant change in noise levels predicted for these two representative years.

3.2 Weather Conditions

A summary of prevailing weather conditions is presented below. A more detailed analysis of prevailing weather conditions was presented in the Bengalla EIS and remains relevant to this assessment.

Table 1: Modelled Weather Conditions.

Atmospheric Parameter	Day Neutral	Day and Evening Prevailing		Night Prevailing	
Temperature, °C	20			10	
Relative Humidity, %	70			90	
Wind Speed, m/s	0	3		0	2
Wind Direction	-	SE	SSW	-	ENE
Temp Gradient, °C/100m	-1			3	
Equivalent Inversion	-1	6.5	6.5	3	8

Modelled weather conditions comply with relevant recommendations in the INP and Draft ING, specifically including Fact Sheet D attached to the Draft ING which recommends appropriate weather

related noise model parameters. The F stability class is represented in the noise model by a 3°C/100m temperature inversion which is near the upper end of the F class temperature gradient range.

3.3 Noise Control Strategies

Since operations commenced at Bengalla in 1998, BMC has invested significant resources into achieving all reasonable and feasible noise mitigation measures in an effort to minimise operational noise levels. BMC has a long history of working with equipment manufacturers to achieve the lowest possible equipment sound levels, particularly with regard to CHPP equipment and the haul truck fleet. All existing noise control options assessed in the Bengalla EIS are also assumed in this assessment.

3.4 Operational Noise Sources

BMC currently utilises a number of items of fixed and mobile equipment to uncover, extract, process and transport coal. Average sound power levels for existing equipment are listed in Table 2 and are identical to those adopted in the Bengalla EIS. Figures showing the location modelled sources are shown in Appendix B, with each source placed at the height above ground listed in Table 2.

Table 2: Existing Noise Sources and Sound Power Levels.

Noise Source,		Sound Power Level, dBL re 1pW *									Total	
Height Above Ground, m		31.5	63	125	250	500	1000	2000	4000	8000	Lin	A
Mobile Equipment												
Dragline 9020	15	124	121	119	109	111	108	104	99	90	127	113
Excavator EX3600	6	117	118	121	115	112	109	107	102	94	125	115
Excavator EX5500	6	117	118	121	115	112	109	107	102	94	125	115
Loader L1800	3	106	109	114	111	109	108	106	104	101	119	113
Truck 830E	3	116	121	120	115	113	109	106	102	97	125	115
Tracked Dozer D11	2	108	106	116	107	111	109	107	99	93	119	114
Wheel Dozer 854	3	106	109	114	111	109	108	106	104	101	119	113
Water Cart R90	3	107	108	117	116	111	110	108	103	96	121	115
Drill SK50	2	110	115	120	117	112	107	102	95	95	123	114
Grader 16M, 24M	2	97	99	109	105	103	104	102	96	88	113	108
Coal Processing and Transportation Equipment												
Sizing station ST103	15	112	108	108	104	101	100	95	84	73	115	104
Transfer ST104	10	101	103	108	105	102	99	97	94	86	112	105
Transfer ST105	8	101	103	108	105	102	99	97	94	86	112	105
Yard conveyor /200m	1	105	100	101	101	97	93	91	88	81	109	100
Raw stacker SK101	8	96	98	103	100	97	94	92	89	81	107	100
Raw reclaimer RC301	3	115	111	109	106	101	96	94	90	80	118	104
Transfer ST301	8	98	102	104	102	100	97	95	91	84	109	103
Surge bin BN301	20	89	94	92	93	94	96	95	93	87	103	101
CPP ST401	15	126	122	120	117	112	107	105	101	91	129	115
CPP Second Stage	15	120	116	114	111	106	101	99	95	85	123	109
Reject transfer ST701	8	117	109	105	102	107	106	105	99	89	119	111
Reject bin BN701	20	111	107	105	102	97	92	90	86	76	114	100
Transfer ST801	12	104	106	111	108	105	102	100	97	89	115	108
Sampling station ST802	12	96	98	103	100	97	94	92	89	81	107	100

Noise Source, Height Above Ground, m		Sound Power Level, dBL re 1pW *									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	Lin	A
Stackers SK801, 802	8	96	98	103	100	97	94	92	89	81	107	100
Reclaimer RC801, 802	3	115	111	109	106	101	96	94	90	80	118	104
Transfers ST803, 804	8	96	98	103	100	97	94	92	89	81	107	100
Train conveyor /200m	1	107	102	103	103	99	95	93	90	83	111	102
Train bin BN801	15	96	98	103	100	97	94	92	89	81	107	100
Locomotive (on loop)	3	109	109	102	101	105	104	100	94	88	114	108

* dBL means unweighted, as opposed to A-weighted, noise levels. Total dBL and dBA sound power levels are shown in the last two columns.

3.5 Predicted Mining Noise Levels

Noise levels were reported in the Bengalla EIS for all receptors predicted to receive a noise level over 35 LAeq,15min. As the Modification has the potential to affect noise levels at receptors located generally east of Bengalla, only those receptors are included in Table 3. Other receptors included in the equivalent results table in the Bengalla EIS are located generally west of Bengalla and noise levels at these receptors are not significantly affected by the Modification.

Tables 3 and 4 show predicted noise levels rounded to the nearest 1 dBA in project years 4 and 24 respectively, for comparison with currently approved noise levels. The following receptors have been excluded from the tables:

- Receptors in Consent Schedule 3 Conditions 1 and 2, subject to acquisition upon request;
- Receptors owned by a mining company; and
- Receptors predicted to receive less than 35 LAeq,15min in both years 4 and 24.

Noise contour figures showing predicted noise levels under calm and prevailing weather conditions have been produced for years 4 and 24 and are attached in Appendix A.

Table 3: Approved and Predicted Noise Levels at Residences, Year 4, LAeq,15min

Owner ID	Block ID	Previous (Bengalla EIS)			Approved (Mod 2)			Proposed		
		Day	Day/ Evening	Night	Day	Day/ Evening	Night	Day	Day/ Evening	Night
		Neutral	Prevailing		Neutral	Prevailing		Neutral	Prevailing	
Eastern receivers subject to 38 day / 37 evening / 36 night LAeq,15min INP noise criteria										
10	19	21	36	32	25	36	32	25	35	32
	25	21	36	31	25	36	32	25	35	32
11	22	21	37	32	26	37	32	26	35	32
12	23	21	37	31	26	37	32	26	35	33
13	24	21	37	31	26	37	32	26	36	33
14	27E	22	36	31	25	36	31	25	34	32
	27W	22	37	31	26	37	31	26	35	32
15	29	28	36	31	28	36	31	28	34	33
25	43	29	36	32	29	36	32	29	34	34
26	44	30	36	32	30	36	32	29	34	34
44	64	29	31	34	29	31	34	29	31	35

Owner ID	Block ID	Previous (Bengalla EIS)			Approved (Mod 2)			Proposed		
		Day	Day/ Evening	Night	Day	Day/ Evening	Night	Day	Day/ Evening	Night
		Neutral	Prevailing		Neutral	Prevailing		Neutral	Prevailing	
46	66	29	30	34	29	30	35	29	31	35
Other receivers subject to 35 day / 35 evening / 35 night LAeq,15min noise criteria										
72	102	21	21	33	21	21	33	21	21	34
74	105	22	22	34	22	22	34	23	23	35
75	106	24	24	36	24	24	36	25	25	37
	108	23	23	35	23	23	36	24	24	37
76	109	24	24	36	24	24	36	25	25	37
77	110	22	22	36	22	22	36	22	23	37
86	126N	21	25	32	21	25	32	21	26	33
	126C	20	24	31	20	24	31	20	25	33
	126S	19	23	31	19	23	31	20	23	32
87	130	18	21	31	19	21	31	19	22	32
91	145	20	26	31	20	26	31	21	27	32
92	146	21	26	32	21	26	32	21	26	33
101	186N	16	33	28	16	33	29	17	34	31
	186S	16	32	27	16	32	28	17	33	29
103	167	19	35	29	19	35	30	20	36	32
106	180	17	34	28	17	34	28	17	35	30
107	184	16	33	29	17	33	30	17	34	31
108	189	16	32	28	17	32	29	17	33	31
Contour Figure		-	-	-	-	-	-	A1	A2	A3

Blue shading – a moderate noise impact of 2 to 5 dBA above the INP criteria.
Green shading – a mild noise impact of up to 2 dBA above the INP criteria.

Table 4: Approved and Predicted Noise Levels at Residences, Year 24, LAeq,15min

Owner ID	Block ID	Previous (Bengalla EIS)			Approved (Mod 2) [1]			Proposed		
		Day	Day/ Evening	Night	Day	Day/ Evening	Night	Day	Day/ Evening	Night
		Neutral	Prevailing		Neutral	Prevailing		Neutral	Prevailing	
Eastern receivers subject to 38 day / 37 evening / 36 night LAeq,15min INP noise criteria										
10	19	18	33	33	18	33	33	18	32	33
	25	18	33	33	18	33	33	19	32	33
11	22	18	33	33	18	33	33	19	32	33
12	23	18	33	33	18	33	33	19	32	33
13	24	18	33	33	18	33	33	19	32	33
14	27E	18	32	34	18	32	34	18	32	34
	27W	18	33	34	18	33	34	18	32	34
15	29	18	30	35	18	30	35	19	32	35

Owner ID	Block ID	Previous (Bengalla EIS)			Approved (Mod 2) [1]			Proposed		
		Day	Day/ Evening	Night	Day	Day/ Evening	Night	Day	Day/ Evening	Night
		Neutral	Prevailing		Neutral	Prevailing		Neutral	Prevailing	
25	43	20	30	35	20	30	35	21	32	36
26	44	20	30	35	20	30	35	21	32	36
44	64	23	28	36	23	28	36	25	29	35
46	66	23	28	36	23	28	36	25	29	35
Other receivers subject to 35 day / 35 evening / 35 night LAeq,15min noise criteria										
72	102	21	21	36	21	21	36	22	22	37
74	105	23	23	38	23	23	38	23	23	38
75	106	25	25	39	25	25	39	26	26	39
	108	23	23	39	23	23	39	25	25	40
76	109	24	24	40	24	24	40	25	25	40
77	110	23	23	40	23	23	40	24	24	40
86	126N	21	23	38	21	23	38	22	25	38
	126C	21	22	37	21	22	37	21	24	37
	126S	20	21	36	20	21	36	21	23	36
87	130	19	20	36	19	20	36	20	21	36
91	145	21	25	36	21	25	36	23	26	36
92	146	22	24	37	22	24	37	23	26	37
101	186N	21	37	35	21	37	35	21	37	34
	186S	21	36	34	21	36	34	21	36	33
103	167	24	38	35	24	38	35	25	38	33
106	180	21	37	34	21	37	34	22	38	35
107	184	21	38	36	21	38	36	22	38	35
108	189	21	36	35	21	36	35	21	36	35
Contour Figure		-	-	-	-	-	-	A4	A5	A6

Blue shading – a moderate noise impact of 2 to 5 dBA above the INP criteria.

Green shading – a mild noise impact of up to 2 dBA above the INP criteria.

1 The Mod 2 noise levels are identical to the EIS levels as the Mod 2 assessment did not recalculate noise levels for Year 24.

Tables 3 and 4 show predicted noise levels are within 1 dBA of the currently approved levels for all potentially significant noise levels over 35 LAeq,15min, with a maximum change of 2 dBA for all calculated noise levels, due to only minor changes in the mine plan and noise model from recent similar assessments. For many receptors the predicted change in noise level is less than 1 dBA.

The Modification is therefore expected to have a very minor effect on noise levels from the project to all receptors. Only minor changes to Table 4 in SSD-5170 (as modified) are required or recommended to reflect the predicted noise levels in Tables 3 and 4.

3.6 Low Frequency Noise

Predicted noise levels based on noise model results cannot, by default, be determined over the entire frequency range defined in the NPI as noise model software calculates levels over the audible frequency range 20 Hz to 20 kHz. In addition, available mining machine sound power data are generally not available below the 20 Hz frequency band and, in a few cases, are only available in octave bands.

Low frequency noise levels have therefore been assessed using the following procedure:

- Convert octave sound power data to 1/3 octave data where required, generally by evenly apportioning sound energy in each octave band over the corresponding 1/3 octave bands;
- Where sound power data are available for frequency bands below 20 Hz, such as for the Bengalla Coal Preparation Plant building, add all sound energy in the range 10 Hz to 20 Hz to the 20 Hz 1/3 octave band to allow this energy to be considered by the noise model. This step is valid as sound attenuation due to distance, atmospheric absorption, topographic shielding and ground reflection is very similar for the range 10 Hz to 20 Hz as calculated for the 20 Hz band;
- Calculate noise levels to receptors and compare the calculated 1/3 octave spectrum from all sources to the threshold values to identify the potential for low frequency impacts; and
- In the event that predicted noise levels in the 20 Hz band exceed the relevant threshold value, the additional sound energy from the lower frequency bands that was previously added to the 20 Hz band is separated and compared to the relevant thresholds in the lower bands.

Results from this procedure have indicated:

- The dBC noise levels calculated at receptors are generally in the range 14 to 18 dB above the dBA levels, with the lower differences generally associated with the higher predicted dBA results for receptors closer to Bengalla Mine. dBC – dBA differences in the range 18 to 20 dB are noted at some receptors located generally to the south west, primarily due to their proximity to the CHPP;
- Exceedances of the 1/3 octave threshold values recommended in the NPI occur at the closest receptors that in all cases are predicted to receive over 40 LAeq,15min. Exceedances of the low frequency thresholds therefore only occur at receptors that are already acknowledged to be affected by mining noise; and
- Calculated 1/3 octave levels remain below the threshold levels at all privately owned receptors that are not subject to acquisition upon request.

The low frequency noise assessment therefore does not affect the predicted noise levels reported in Tables 3 and 4.

3.7 Sleep Disturbance

The EIS and Mod 2 assessments concluded maximum noise levels with the potential to disturb sleep would remain below relevant criteria. Minor changes to the mine plan would result in a maximum changer of 1 dBA in predicted maximum noise levels. The project would continue to comply with relevant sleep disturbance limits at all privately owned residences that are not subject to acquisition upon request, and a detailed assessment of this issue is not required.

3.8 Cumulative Noise

Drayton Mine has ceased operations since the EIS assessment while no additional project changes at Mt Arthur Coal or Mangoola Mine have been approved since the EIS assessment. The Mt Pleasant Project is currently seeking a 6 year extension to its operations. The cumulative noise assessment in the EIS considered Mt Pleasant operating and as such, no significant changes to the assessment in the EIS are required.

4 CONSTRUCTION NOISE

The proposed ROM and reject stockpiles would be placed on areas of natural ground cleared of vegetation and topsoil within the existing Disturbance Boundary. Construction of the stockpiles would therefore be limited to minor earthworks similar to that required to clear ground ahead of mining. With the stockpiles adjacent to or within proposed mining areas, noise levels produced during construction of the stockpiles would be similar to approved noise levels produced by clearing and topsoil stripping and do not require specific assessment.

Construction of the proposed extended DW1 would produce similar noise levels as those currently approved, although for a corresponding longer period of time. Construction of the proposed Dry Creek East Dam, within the previous mining area, would produce minor noise levels compared to approved mining noise and again does not require specific assessment.

5 BLASTING

The Modification does not affect mining activity, apart from a minor change to the handling of ROM coal and CHPP reject material, therefore has no effect on currently approved blasting impacts at any private receptor.

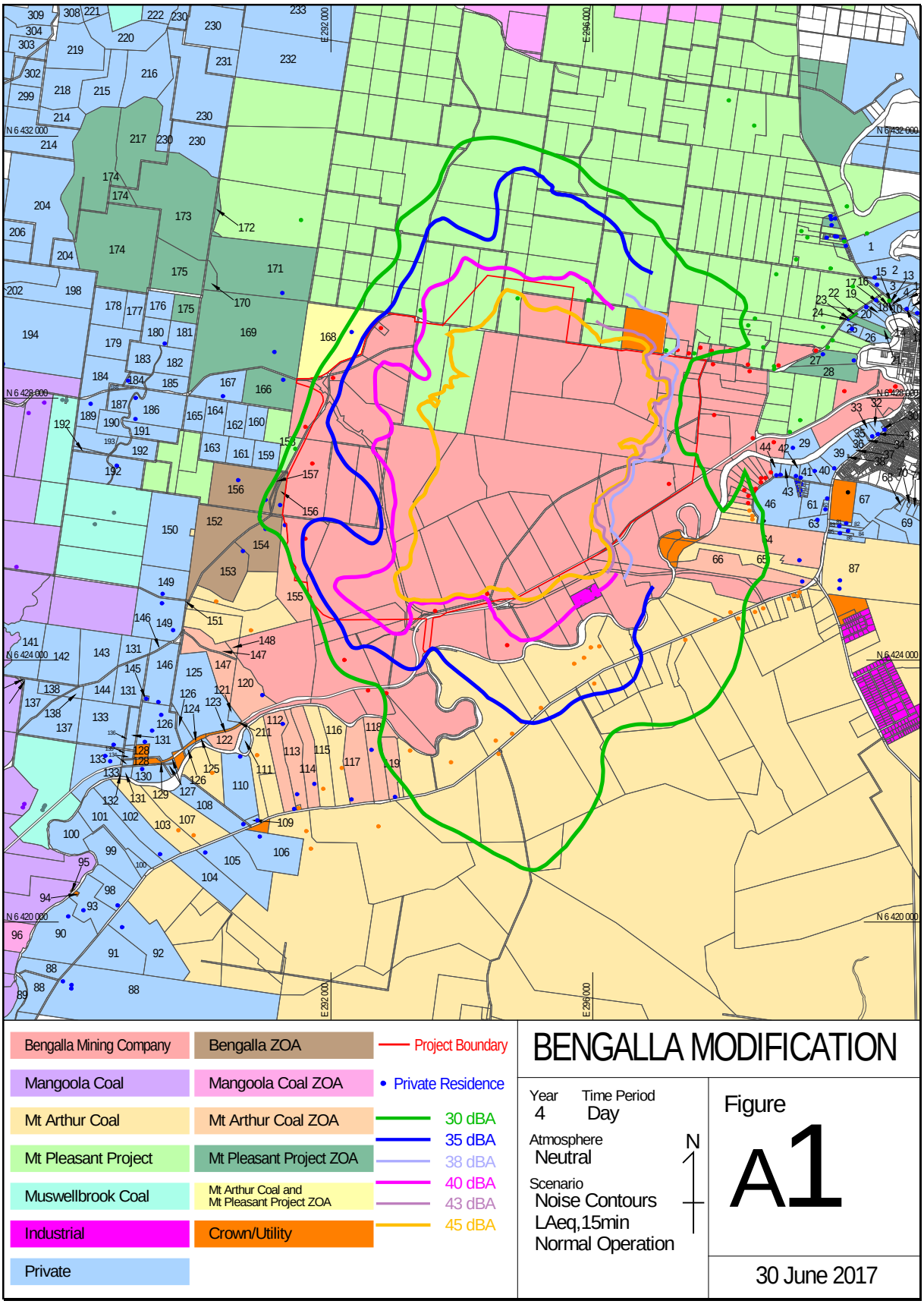
6 CONCLUSION

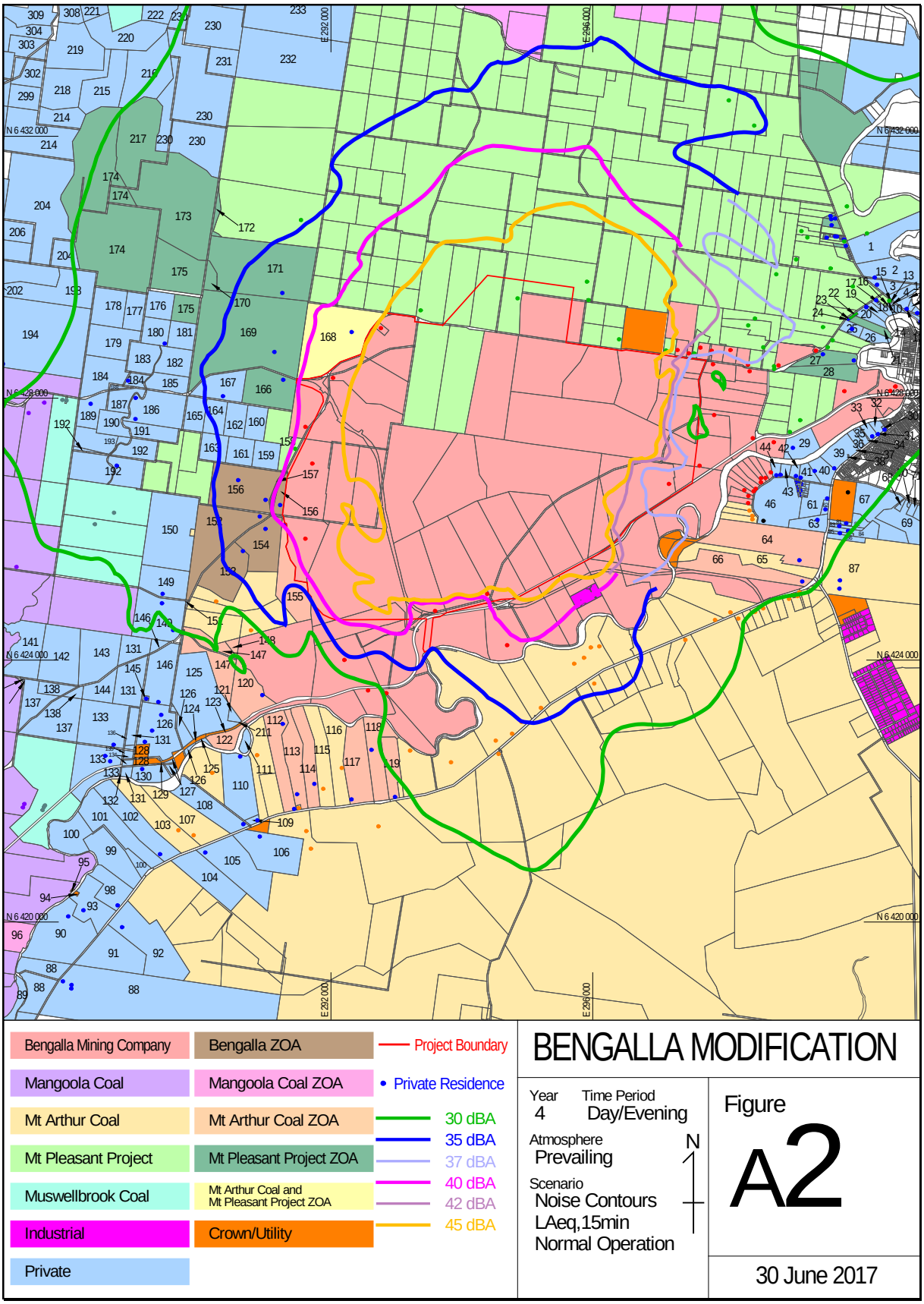
This assessment indicates the Modification would have no significant effect on noise levels at any receptor. Minor changes of less than 1 dBA to predicted noise levels would not be discerned by residents and no additional receptors are likely to be affected by project related noise over relevant criteria.

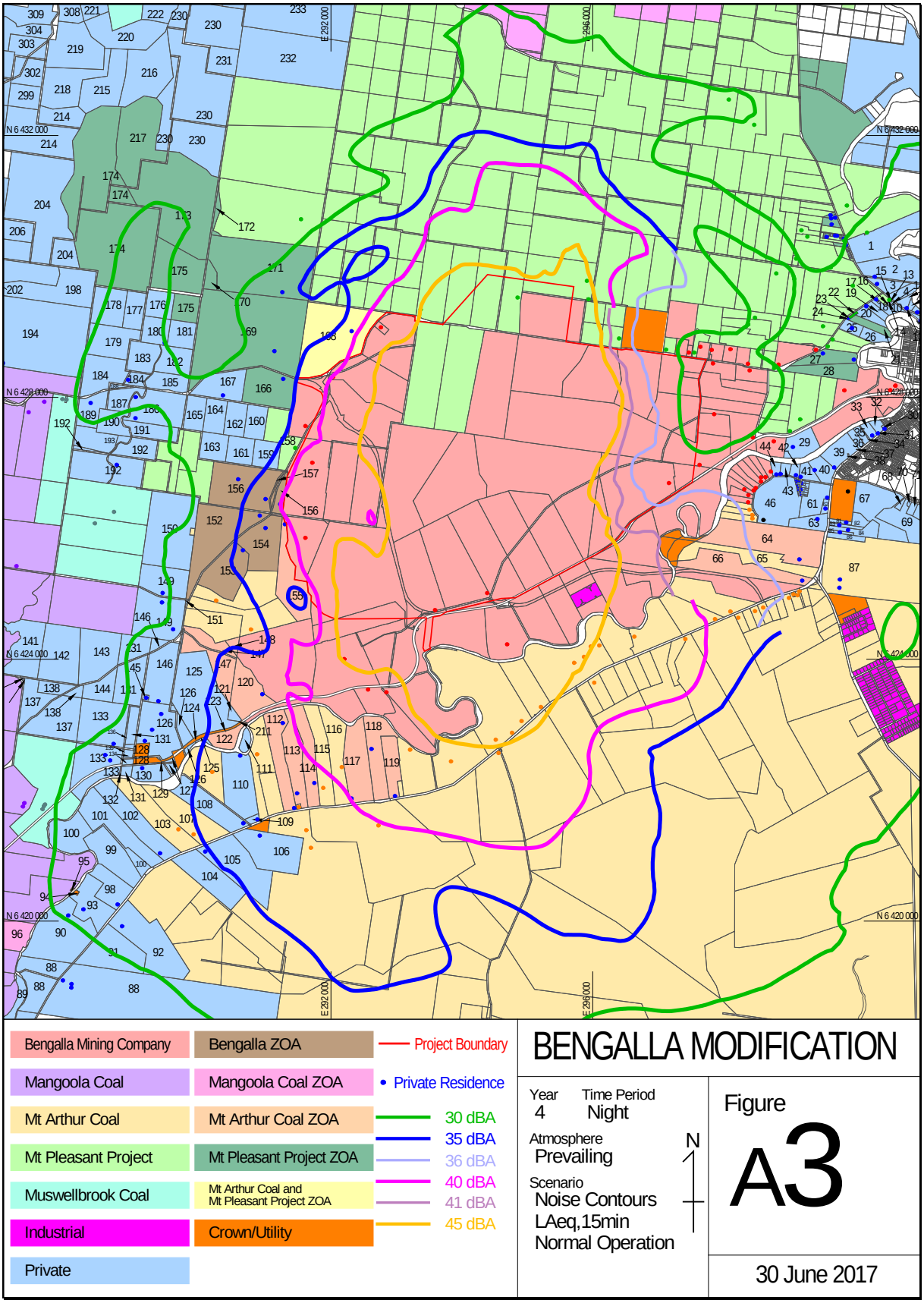
Construction work associated with the Modification would either be imperceptible compared to adjacent mining activity or would remain within currently approved levels. The Modification would have no appreciable effect on other acoustic issues including sleep disturbance, low frequency noise, road and rail traffic noise and blasting impacts.

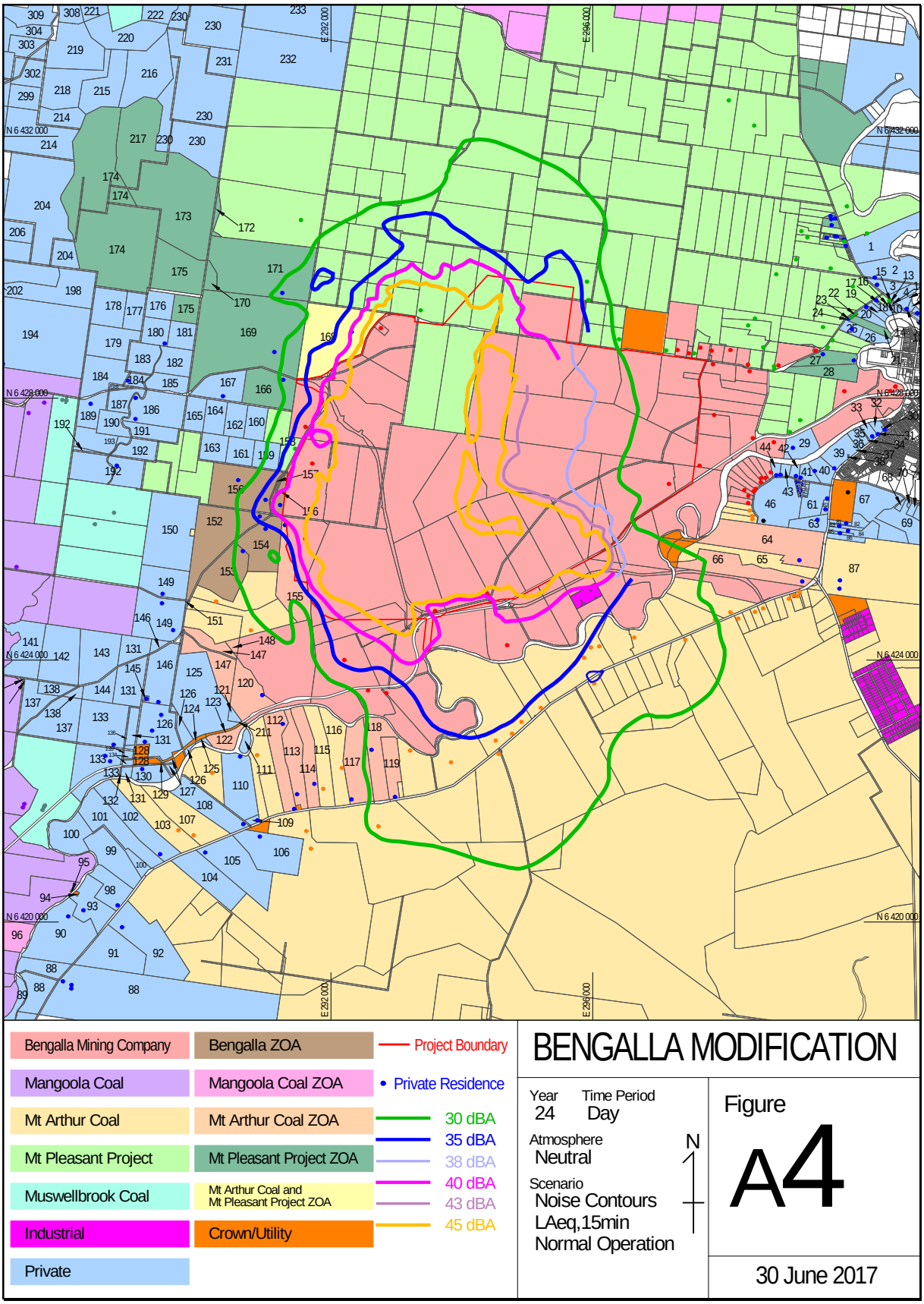
APPENDIX A – NOISE CONTOUR FIGURES

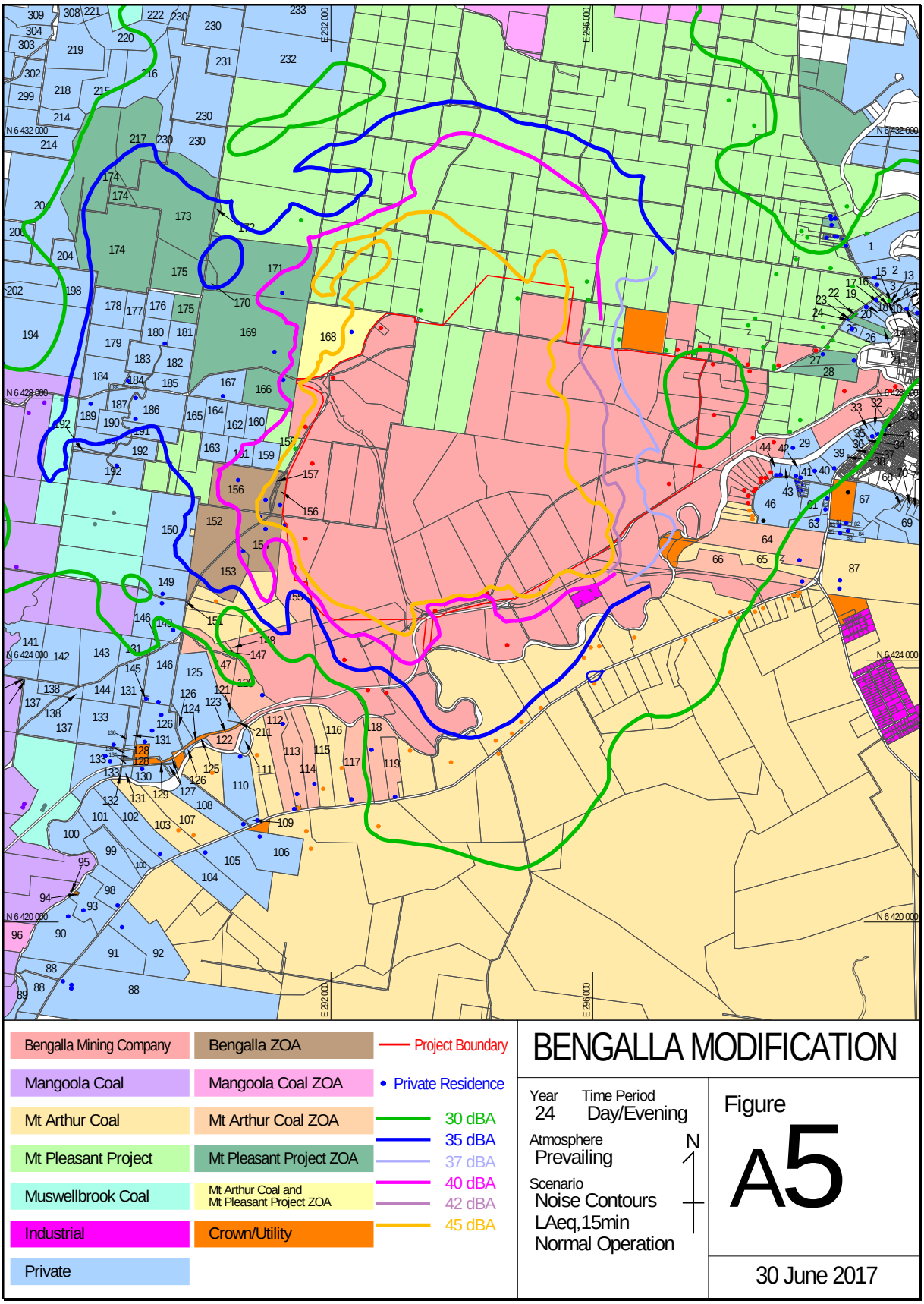
FIGURE	NOISE CONTOURS – NORMAL OPERATION		
A1	Year 4	Day	Neutral weather conditions
A2	Year 4	Day/Evening	Prevailing weather conditions
A3	Year 4	Night	Prevailing weather conditions
A4	Year 24	Day	Neutral weather conditions
A5	Year 24	Day/Evening	Prevailing weather conditions
A6	Year 24	Night	Prevailing weather conditions

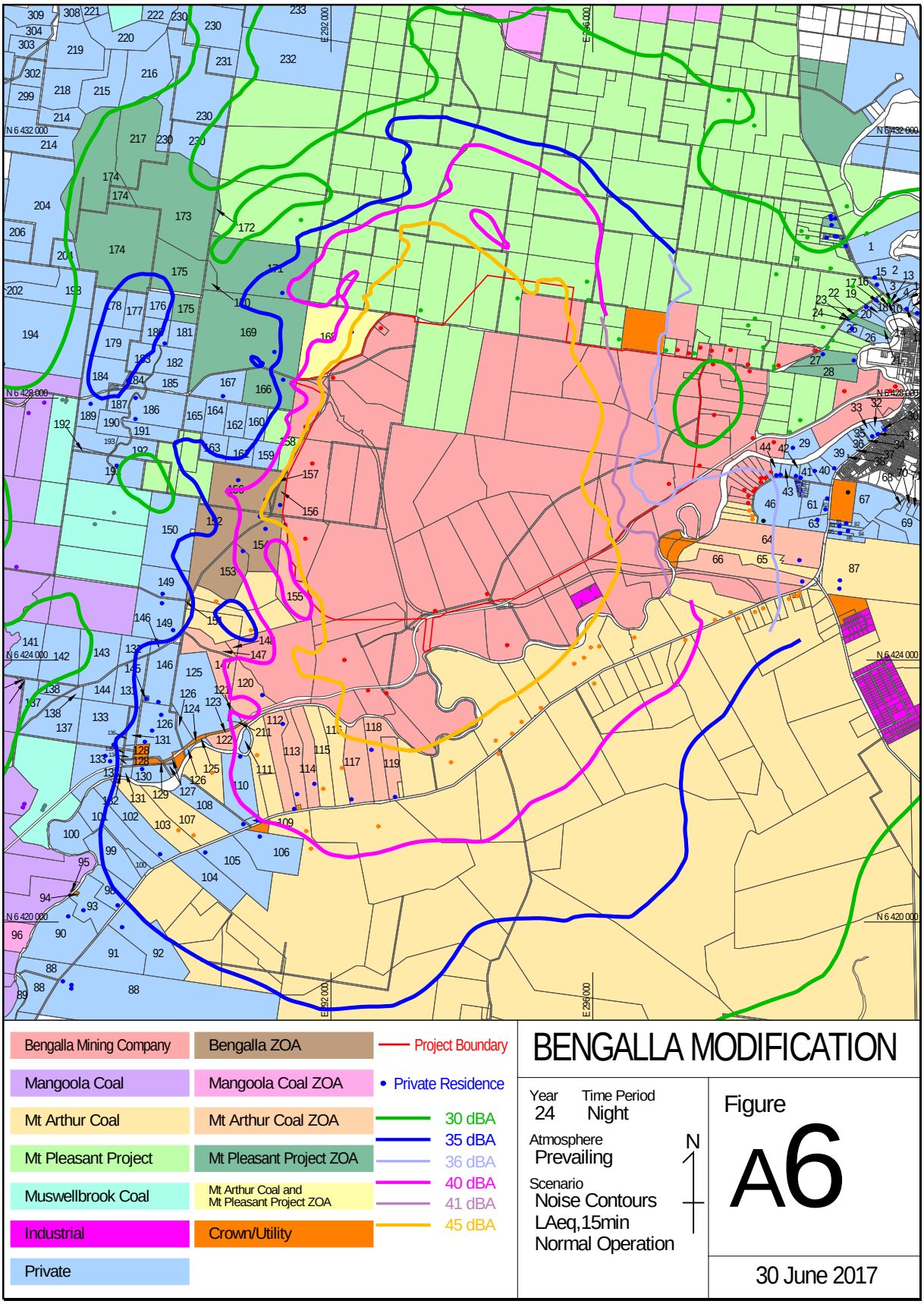

Bengalla Mining Company
Mangoola Coal
Mt Arthur Coal
Mt Pleasant Project
Muswellbrook Coal
Industrial
Private
Bengalla ZOA
Mangoola Coal ZOA
Mt Arthur Coal ZOA
Mt Pleasant Project ZOA
Mt Arthur Coal and Mt Pleasant Project ZOA
Crown/Utility
Project Boundary
Private Residence
30 dBA
35 dBA
38 dBA
40 dBA
43 dBA
45 dBA
BENGALLA MODIFICATION
Year 4
Time Period Day
Atmosphere Neutral
Scenario Noise Contours LAeq,15min Normal Operation
N
Figure A1
30 June 2017


Bengalla Mining Company
Mangoola Coal
Mt Arthur Coal
Mt Pleasant Project
Muswellbrook Coal
Industrial
Private
Bengalla ZOA
Mangoola Coal ZOA
Mt Arthur Coal ZOA
Mt Pleasant Project ZOA
Mt Arthur Coal and Mt Pleasant Project ZOA
Crown/Utility
Project Boundary
Private Residence
30 dBA
35 dBA
37 dBA
40 dBA
42 dBA
45 dBA
BENGALLA MODIFICATION
Year 4
Time Period Day/Evening
Atmosphere Prevailing
Scenario Noise Contours LAeq,15min Normal Operation
N
Figure A2
30 June 2017


Bengalla Mining Company
Mangoola Coal
Mt Arthur Coal
Mt Pleasant Project
Muswellbrook Coal
Industrial
Private
Bengalla ZOA
Mangoola Coal ZOA
Mt Arthur Coal ZOA
Mt Pleasant Project ZOA
Mt Arthur Coal and Mt Pleasant Project ZOA
Crown/Utility
Project Boundary
Private Residence
30 dBA
35 dBA
36 dBA
40 dBA
41 dBA
45 dBA
BENGALLA MODIFICATION
Year 4
Time Period Night
Atmosphere Prevailing
Scenario Noise Contours LAeq,15min Normal Operation
N
Figure A3
30 June 2017


Bengalla Mining Company
Mangoola Coal
Mt Arthur Coal
Mt Pleasant Project
Muswellbrook Coal
Industrial
Private
Bengalla ZOA
Mangoola Coal ZOA
Mt Arthur Coal ZOA
Mt Pleasant Project ZOA
Mt Arthur Coal and Mt Pleasant Project ZOA
Crown/Utility
Project Boundary
Private Residence
30 dBA
35 dBA
38 dBA
40 dBA
43 dBA
45 dBA
BENGALLA MODIFICATION
Year 24
Time Period Day
Atmosphere Neutral
Scenario Noise Contours LAeq,15min Normal Operation
N
Figure A4
30 June 2017


Bengalla Mining Company
Mangoola Coal
Mt Arthur Coal
Mt Pleasant Project
Muswellbrook Coal
Industrial
Private
Bengalla ZOA
Mangoola Coal ZOA
Mt Arthur Coal ZOA
Mt Pleasant Project ZOA
Mt Arthur Coal and Mt Pleasant Project ZOA
Crown/Utility
Project Boundary
Private Residence
30 dBA
35 dBA
37 dBA
40 dBA
42 dBA
45 dBA
BENGALLA MODIFICATION
Year 24
Time Period Day/Evening
Atmosphere Prevailing
Scenario Noise Contours LAeq,15min Normal Operation
N
Figure A5
30 June 2017

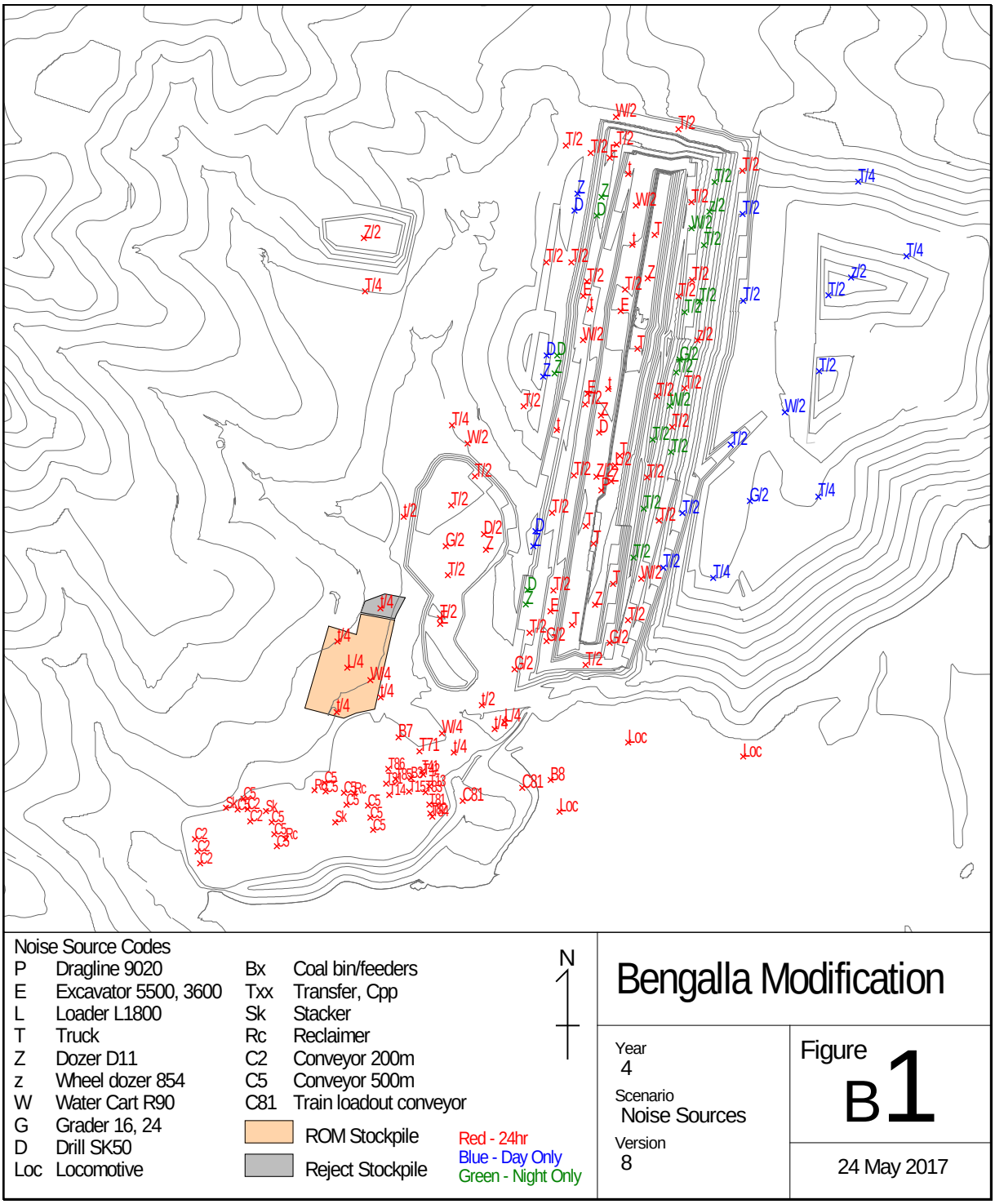

Bengalla Mining Company
Mangoola Coal
Mt Arthur Coal
Mt Pleasant Project
Muswellbrook Coal
Industrial
Private
Bengalla ZOA
Mangoola Coal ZOA
Mt Arthur Coal ZOA
Mt Pleasant Project ZOA
Mt Arthur Coal and Mt Pleasant Project ZOA
Crown/Utility
Project Boundary
Private Residence
30 dBA
35 dBA
36 dBA
40 dBA
41 dBA
45 dBA
BENGALLA MODIFICATION
Year 24
Time Period Night
Atmosphere Prevailing
Scenario Noise Contours LAeq,15min Normal Operation
N
Figure A6
30 June 2017

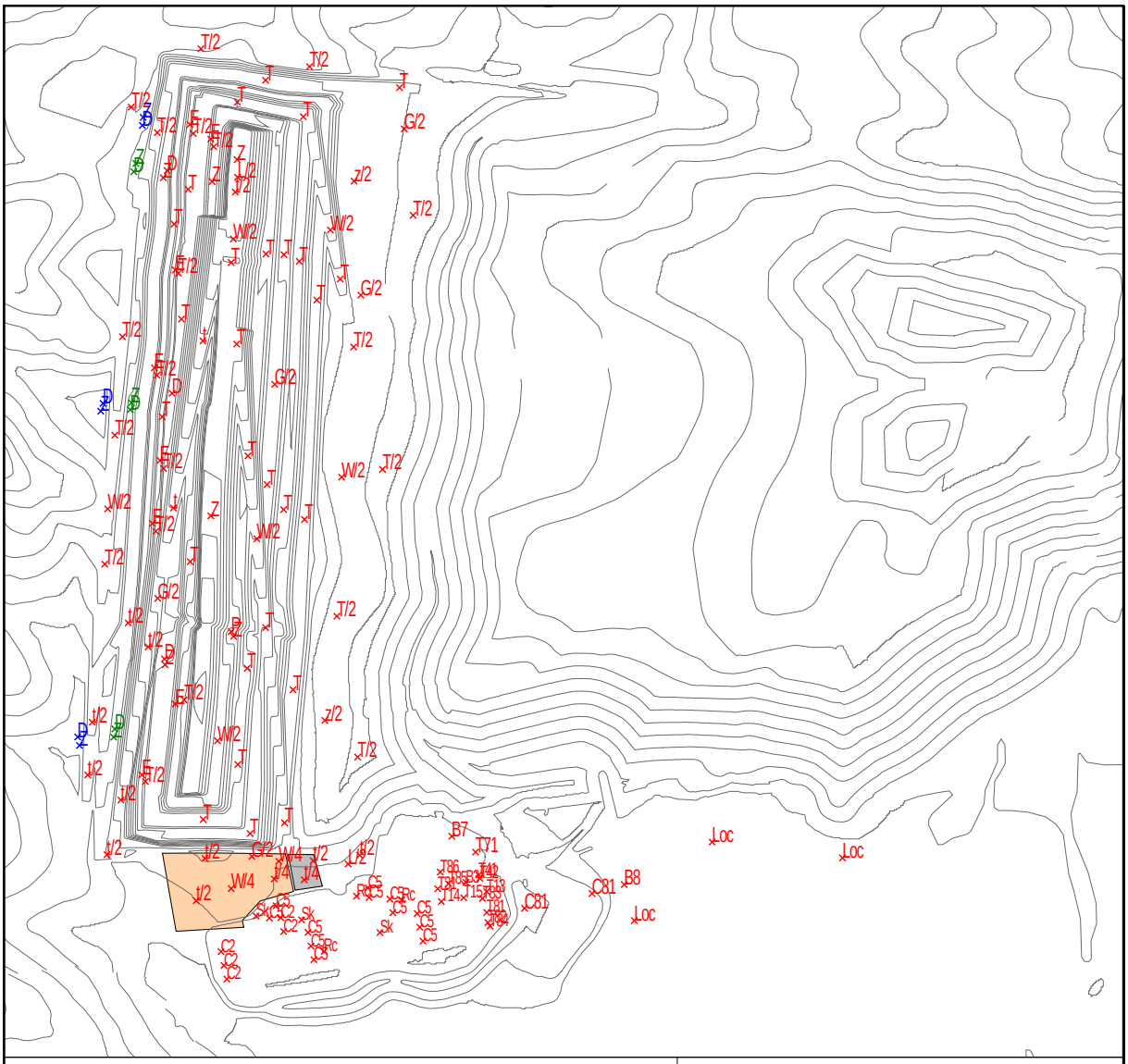
APPENDIX B – NOISE SOURCE LOCATION FIGURES

FIGURE NOISE SOURCE LOCATIONS – NORMAL OPERATION

B1 Year 4

B2 Year 24




Noise Source Codes
P Dragline 9020
E Excavator 5500, 3600
L Loader L1800
T Truck
Z Dozer D11
z Wheel dozer 854
W Water Cart R90
G Grader 16, 24
D Drill SK50
Loc Locomotive
Bx Coal bin/feeders
Txx Transfer, Cpp
Sk Stacker
Rc Reclaimer
C2 Conveyor 200m
C5 Conveyor 500m
C81 Train loadout conveyor
ROM Stockpile
Reject Stockpile
Red - 24hr
Blue - Day Only
Green - Night Only
N
Bengalla Modification
Year 24
Scenario Noise Sources
Version 8
Figure B2
23 May 2017