RED HILL
MINING LEASE

ENVIRONMENTAL IMPACT STATEMENT

Appendix T
Addendum to the EIS – Environmental Assessment

DECEMBER 2014

Table of Contents

Tables

Figures

Section 1 Introduction

1.1 Project Background

BHP Billiton Mitsubishi Alliance (BMA), through its joint venture manager, BM Alliance Coal Operations Pty Ltd, proposes to convert the existing Red Hill Mining Lease Application (MLA) 70421 to enable the continuation of existing mining operations associated with the Goonyella Riverside Broadmeadow (GRB) mine complex. Specifically, the mining lease conversion will allow for:

- An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine (BRM).
- A future incremental expansion option of the existing Goonyella Riverside Mine (GRM).
- A future Red Hill Mine (RHM) underground expansion option located to the east of the GRM complex.

The three project elements described above are collectively referred to as the Red Hill Mining Lease Project (the project).

The Red Hill Mining Lease Project is a coordinated project under section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) which required BMA to prepare an environmental impact statement (EIS). The impact assessment process, under which this EIS has been prepared, is managed by the Office of the Coordinator-General on behalf of the Queensland Coordinator-General.

The project is also a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It will, therefore, also require approval from the Commonwealth Minister for the Department of the Environment (DOTE).

BMA prepared an EIS for the project. The purpose of the EIS was to satisfy the requirements of both the SDPWO Act and the EPBC Act and to inform a decision on whether the project should proceed, and if so, under what conditions. The EIS was submitted to the Office of the Coordinator-General in December 2013 and released for public review and comment from 14 December 2013 to 13 February 2014. The Office of the Coordinator-General received 56 submissions relating to the EIS from local, state and federal government, and private submitters.

1.2 Purpose of this Document

Following evaluation of the project and the receipt of submissions from the public, the Coordinator-General has requested additional information to the EIS to address a number of issues. The Addendum to the EIS provides the corrections, clarification and further information as required by the Coordinator-General. This document, Appendix T, addresses submissions related to the environmental assessment of the project. Submissions relating to social and economic matters are addressed in a separate addendum, Appendix U.

No additional studies were required by the Coordinator-General. Since the publication of the EIS, there have been no material changes or refinements to the project that require further assessment.

Section 2 Public Review

2.1 Public Review Process

The Red Hill Mining Lease EIS was released for public consultation between 14 December 2013 and 13 February 2014. The EIS was distributed to Queensland and Commonwealth government agencies, and was available to the public by the following methods:

- download from the Department of State Development, Infrastructure and Planning website;
- download from the BHP Billiton website;
- order a free copy of the DVD or purchase a printed copy through BMA; and
- view a printed copy at four libraries (Mackay, Moranbah, Canberra, Brisbane).

During the public consultation period, interested parties were invited to make comment on the EIS through a properly made submission to the Queensland Office of the Coordinator-General. The deadline for receipt of these submissions was 13 February 2014.

During the consultation period further information and opportunity to comment on the project were available through the project email address (metcoalinfo@bhpbilliton.com), reply-paid mail address (BHP Billiton Mitsubishi Alliance, Reply Paid 1430, Brisbane QLD 4001) and free-call number (1800 078 797).

These contact details enabled stakeholders to contact the project team with queries relating to the project or to provide feedback regarding its planning and development. The contact details were advertised on project communication materials including newspaper advertisements and the project overview fact sheet.

BMA provides 24-hour coverage of the free-call number; during office hours it is staffed by project team members and after hours by a message centre. Any after-hours calls are promptly followed-up by the project team to ensure a timely response to all contacts received.

2.2 Submitters

During the public review period, 56 submissions on the EIS were received. The submitters are identified in **Table 2-1** and include:

- federal government – 1 submitter;
- state government – 16 submitters;
- local government – 2 submitters;
- public organisation – 3 submitters;
- private submitter (landholder) – 1 submitter; and
- private submitter (other) – 33 submitters.

Table 2-1 EIS Submitters

Submitter Number	Submitter Types	Department / Organisation	Division
1	State Government	Department of National Parks, Recreation, Sport and Racing	Strategy and Policy Services - Queensland Parks and Wildlife Service
2	State Government	Department of State Development, Infrastructure and Planning	Planning Group, Regional Planning Team
3	State Government	Department of State Development, Infrastructure and Planning	Planning Group
4	Private Submitter - Other Individual		
5	Private Submitter - Other Individual		
6	Private Submitter - Other Individual		
7	Private Submitter - Other Individual		
8	Private Submitter - Other Individual		
9	Private Submitter - Other Individual		
10	Private Submitter - Other Individual		
11	State Government	Queensland Ambulance Service	
12	State Government	Department of Tourism, Major Events, Small Business and the Commonwealth Games	Office of the Director-General
13	State Government	Department of State Development, Infrastructure and Planning	Strategic Policy
14	State Government	Department of Aboriginal and Torres Strait Islander and Multicultural Affairs	
15	State Government	Department of Agriculture, Fisheries and Forestry	Strategic Policy and Planning
16	Private Submitter - Other Individual		
17	Public Organisation	Asia Pacific Strategy	
18	Private Submitter - Other Individual		
19	State Government	Department of Transport and Main Roads	
20	Private Submitter - Other Individual		
21	Public Organisation	Danricson Pty Ltd ATF Danricson Trust	
22	Federal Government	Department of the Environment	

Submitter Number	Submitter Types	Department / Organisation	Division
23	Private Submitter - Other Individual		
24	Private Submitter - Other Individual		
25	Private Submitter - Other Individual		
26	Private Submitter - Other Individual		
27	Public Organisation		
28	Private Submitter - Other Individual		
29	Private Submitter - Other Individual		
30	Private Submitter - Other Individual		
31	Private Submitter - Other Individual		
32	State Government	Department of Housing and Public Works	
33	Private Submitter - Landholder		
34	Private Submitter - Other Individual		
35	Private Submitter - Other Individual		
36	Private Submitter - Other Individual	Opera Consulting Pty Ltd ATF Opera consulting Investment Trust	
37	Private Submitter - Other Individual	Real Wealth Australia Pty Ltd	
38	Private Submitter - Other Individual		
39	Private Submitter - Other Individual	Wegener Wheel Pty Ltd	
40	Private Submitter - Other Individual		
41	Private Submitter - Other Individual		
42	State Government	Department of Natural Resources and Mines	
43	Private Submitter - Other Individual		
44	State Government	Department of Education, Training and Employment	Strategic Engagement, Employment, Skills and Training and Employment
45	Local Government	Isaac Regional Council	
46	Private Submitter - Other Individual		

Submitter Number	Submitter Types	Department / Organisation	Division
47	State Government	Department of State Development, Infrastructure and Planning	Regional Services Group
48	Private Submitter - Other Individual		
49	State Government	Department of Environment and Heritage	
50	Private Submitter - Other Individual		
51	Private Submitter - Other Individual		
52	State Government	Department of Health	
53	Private Submitter - Other Individual		
54	Private Submitter - Other Individual		
55	Local Government	Mackay Regional Council	Development Services
56	State Government	Department of Treasury	

Section 3 Project Description

3.1 Submissions

This section responds to submissions from the following:

- Department of Agriculture, Fisheries and Forestry
- Department of Natural Resources and Mines
- Isaac Regional Council
- Department of the Environment

3.2 Thick Seam Mining

Introduced and improved over the last 20 years, the Longwall Top Coal Caving (LTCC) method is used for extracting thick seams (greater than 4.5 m). This method offers increased efficiency of resource recovery in thick seams. Experience at BRM has been that there is no significant increase in subsidence where this technique has been used.

The LTCC method cuts the lower portion of the coal seam and is accompanied by caving and reclaiming the 'top' coal. The initial first cut of coal from the longwall face is undertaken using a conventional shearer and conveyor with heights generally in the range of 2.8 to 3.0 m. As the hydraulic support advances, the rear conveyor remains in place to capture coal that is caved into the goaf. The flow of coal onto the rear conveyor is controlled by retracting the rear cantilevers of selected supports exposing the rear conveyor to the goaf coal which 'caves' into the free space.

Once an area has been caved the rear cantilever is extended back out into the goaf stopping any further influx of goaf material. The caving process may be repeated at the same position (secondary caving) if further coal is present before the rear conveyor is finally advanced forward under the rear of the support ready for the next shearer cycle. Depending on the conditions in the mine various caving sequences are employed to maximise the top coal recovery. In many cases the top coal caving is the primary production mechanism from the face rather than coal cutting, and overall face cycle times depend entirely on caving rates rather than shearing rates.

As a result of employing LTCC technology in the thicker seam environments, the extent of surface expression can be increased. The increased subsidence depths will vary depending on a range of factors including the depth of surface cover and the overlying geology.

Subsidence predictions undertaken for the EIS assume a worst-case subsidence depth of approximately 6 m and potential impacts and mitigations have been provided on that basis. BMA confirms that the project should be assessed on the basis of these worst-case predictions.

However, recent experience at the existing BRM shows subsidence depths in the range of 3.0 to 3.6 m where LTCC technology is used. LW108 was the first panel to be mined at BRM using LTCC but this did not extend to under the Isaac River. The maximum subsidence predicted for LW108 was approximately -4 m. The maximum subsidence surveyed was -3.637 m. This subsidence is similar to that experienced where traditional longwall technology (i.e. no caving) has been used.

Stabilisation of the bank of the Isaac River and protection measures in the form of pile fields were implemented in 2007 over the pillar zones of LW102/103 to LW105/106, prior to the subsidence occurring. These have mitigated the risk of bank erosion of the pillar zones while the panels have been infilling with sand.

Given the success of these subsidence management approaches at existing operations, BMA is no longer considering other mining methods, such as pillar and board, under the Isaac River. LTCC will be used across all areas, including under the Isaac River and other waterways.

3.3 Central Queensland Coal Associates Agreement Act 1968

Theproject's targeted coal resources form part of the assets owned by the entities comprising the Central Queensland Coal Associates Joint Venture (CQCA JV). The CQCA JV and the State of Queensland are parties to the *Central Queensland Coal Associates (CQCA) Agreement Act 1968* (CQCA Agreement). The CQCA Agreement provides the CQCA JV with certain rights and imposes certain obligations in respect of the development and operation of coal mines in Central Queensland. The CQCA Agreement also commits the State of Queensland to ensuring that CQCA JV's rights are not impaired or prejudicially affected through any act of the State.

The CQCA Agreement provides the CQCA JV with the right to have certain Special Coal Mining Leases granted and renewed pursuant to the CQCA Agreement (among other things). MLA70421 (Red Hill Mining Lease) is not a special coal mining lease for the purposes of the CQCA Agreement, and therefore the CQCA Agreement does not apply to the grant of MLA70421.

Whilst the CQCA Agreement grants CQCA JV various general rights, BMA does not currently contemplate any specific requirements arising under the CQCA Agreement that need to be considered during the Red Hill Mining Lease Project EIS process.

3.4 Supply of Construction Materials

As the project has not reached the detailed design stage, estimates of construction materials are not available. Prior to construction, the project will enter into a detailed study phase that will identify the quantity and the rate at which quarry material will be needed to construct the mine. A detailed assessment of demand and supply will be undertaken by BMA prior to execution of the expansion options and will be based on the rate and scale of development determined by the project owners.

BMA's approach will be to first use on site resource material for mine construction and then obtain resources from existing local quarries. Based on BMA's recent project development experience, it is not anticipated that a significant quanitity of quarry material would be required from off site.

BMA understands that local quarries operate on a flexible basis to respond to construction demand. Availability of local materials will, therefore, depend on the level of local demand at the time of construction.

3.5 Water Supply

The project's water supply will be linked to the existing GRB mine complex water management system. This system has adequate capacity to manage the water demand of the project and this is not expected to be affected by climate change over the lifetime of the project. There is also sufficient capacity to supply existing groundwater users affected by the project. BMA is committed to implementing compensation agreements with landholders affected by groundwater drawdown (see **Section 6.14.3**).

An important aspect of the operational strategy for the GRB mine complex's water management system is to reuse mine water wherever possible as a priority over external pipeline raw water supply. This has sustainability benefits in making the mine as self-sufficient as possible and minimising the mine's reliance on external water supplies. It is also important to manage the storage inventory (total mine water volumes) in the mine water management system so that adequate storage can be made available for the containment of wet and very wet seasonal conditions.

Not all of the mine operational water requirements can be supplied with reused mine water. Some of the water requirements for the operations require high quality water sourced from external pipeline raw water supply. This raw water demand forms a very small portion of the overall site water use and includes:

- water treated for potable uses (drinking, washrooms) – 180 megalitres (ML)/year;
- water used in the existing BRM – 365 ML/year; and
- a small quantity of water required for the coal handling and preparation plant (CHPP). While most of the water demand for the CHPP is met through recycled water, a minor component (typically 3 per cent) of the CHPP water use requires raw water. For GRM this equates to 180 ML/year.

BMA holds substantial allocations of water from the Fitzroy and Burdekin water catchments and numerous licences to interfere with and take water across BMA's mine sites. BMA operates a substantial water pipeline network in Central Queensland servicing its mines, landholders and towns.

For example, BMA holds contractual rights to approximately 10,000 ML/year of water from the Burdekin Pipeline (owned by SunWater) that is a supply source for BMA operations in the vicinity of Moranbah. In addition, BMA has a water allocation of 6,200 ML/year from the Eungella Dam that is also available for use in BMA operations in the Moranbah vicinity. In securing its water rights, BMA has allowed for the current and potential future use of water from these sources at the GRB mine complex and for growth options associated with MLA70421.

In relation to future activities on MLA70421, BMA expects that it will be required under the Environmental Authority (EA), being sought in relation to the *Environmental Protection Act 1994*, to prepare, update and maintain a Water Management Plan. For example, in the case of BMA's most recently developed new mine (Caval Ridge Mine), the required Water Management Plan must be reviewed annually, prior to the wet season (i.e. by 1 November) in accordance with the requirements of the relevant EA.

The Plan will recognise that water to be used for project operations will be sourced via an off-take from the existing water pipelines developed to support BMA's current and future mining operations, along with various other purposes. Further, this Plan will recognise that water will be sourced from the Eungella Dam and/or the Burdekin Pipeline. The project will have an internal BMA allocation to draw water as part of the BMA-related water allocations. These allocations are held by BMA directly or indirectly via contractual arrangements with SunWater in accordance with the Burdekin Water Resource Plan and the *Water Act 2000*.

Section 4 Approvals/Legislative Framework

4.1 Submissions

This section responds to submissions from the following:

- Department of State Development, Infrastructure and Planning
- Department of Agriculture, Fisheries and Forestry
- Department of the Environment
- Department of Natural Resources and Mines

4.2 Environment Protection andBiodiversity Conservation Act

4.2.1 Ecology

For the purposes of clarification, BMA confirms that it is seeking approval on the basis of potential for worst-case impacts on matters of national environmental significance (MNES) relevant to the EPBC Act, particularly in relation to land clearance associated with gas drainage activities and subsidence.

BMA requests that the project be assessed on the basis of 100 per cent clearance of the mine footprint for incidental mine gas (IMG) drainage and infrastructure development. In practice, BMA will implement a range of measures to avoid or minimise the actual disturbance. Further discussion of this can be found in **Sections 8.6** and **8.7** and the Offset Strategy (**Appendix B**). Commitments to these measures are described in EIS Appendix S and include:

- Seek to avoid and/or minimise placement of IMG extraction wells and infrastructure within RE11.8.11/TEC (Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin) where practical.
- If clearing in the area of RE11.8.11/TEC (Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin) is required, conduct pre-clearing surveys for *Dichanthium setosum*, *Dichanthium queenslandicum* and *Digitaria porrecta*.

- If these grasses are identified, clearing will be avoided in these areas wherever possible, with slashing preferred to gain access.
- If clearing is required, where practical, individual plants will be collected and relocated, and topsoil removed and set aside to protect seed banks. Topsoil will be replaced over pipelines as quickly as possible.
- When selecting locations for wells, tracks and other infrastructure during the detailed design, already disturbed areas will be used wherever practicable, particularly in riparian and woodland vegetation.
- Placement of IMG extraction wells and other infrastructure will seek to avoid the following areas wherever practicable:
  - endangered REs 11.4.7, 11.4.8 and 11.4.9; and
  - riparian zones along Isaac River and 12 Mile Gully, particularly native vegetation within 100 m of the bank.
- River and creek crossings will be selected where breaks in vegetation occur wherever possible, recognising that crossing locations must align with the pillars between each longwall panel.

The project requirements for construction of incidental mine gas infrastructure will be determined prior to the commencement of each stage of development. Flexibility is required to adapt the gas drainage layout in response to the effectiveness of gas drainage activities. As a result, the project has assumed the worst-case to assess the ultimate area of disturbance.

Further details of specific impacts on ecological MNES are described in **Section 8**. A staged offset strategy will be provided to address the federal and state governments' offset requirements for unavoidable impacts. This is described in **Section 10**.

Subsidence predictions are provided in the EIS, with a maximum predicted subsidence of up to 6 m. Although BMA's experience with existing underground mining at Broadmeadow Mine suggests that actual impacts may be less than this, the project has been assessed on the basis of this worst-case prediction. Subsidence voids and their impacts are discussed in more detail in **Section 5**.

4.2.2 Water

A detailed discussion of MNES in relation to water resources is given in Appendix Q3 to the EIS. Further discussion of water resources can be found in **Section 5** and **Section 6**. However, this section addresses the specific issue of whether the project is likely to have a significant impact on a water resource.

The Significant Impact Guideline 1.3: Coal seam gas and large coal mining developments – impacts on water resources states that *an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to:*

- *the hydrology of a water resource,*
- *the water quality of a water resource,*

that is of sufficient scale or intensity as to reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes, or to create a material risk of such reduction in utility occurring.

4.2.2.1 Surface Water

There are five registered water licensees located within 100 km downstream of the study area, along the Isaac River. Four of these water licenses are for stock and domestic purposes and the fifth licence is in relation to a diversion. There are no licensed water users identified within the study area.

Hydrological analysis, as shown in more detail in the EIS Appendix I7, indicates that without mitigation, the potential loss of flow from 12 Mile Gully catchment due to ponding of waters in subsidence voids (worst case) could be in the order of 2,300 ML/year, or approximately 52 per cent of the mean annual flow. There are no known human users of water relying on water directly from 12 Mile Gully and the potential loss is not considered significant in that context. Nonetheless, the reduction of mean annual flow in 12 Mile Gully is potentially significant for aquatic ecology and, hence, on this basis, mitigation has been considered to reduce ponding in the 12 Mile Gully catchment (Section 7 of EIS Appendix I7). With implementation of the proposed mitigation, the maximum total potential subsidence ponding of all voids in the 12 Mile Gully catchment would reduce to approximately 1,900 ML.

When considered in terms of 'whole-of-project' hydrological impacts, the loss of flow in the Isaac River due to potential worst case subsidence void ponding in the 12 Mile Gully catchment (with no mitigation) will be partially offset by the increase in mean annual flow from Eureka Creek through the GRB mine complex). It will reduce to approximately 1,600 ML/year. The total Isaac River catchment mean annual flow is estimated to be approximately 50,000 ML/year. The 1600 ML/year reduction of mean annual flow in the Isaac River represents approximately three per cent loss of the Isaac River mean annual flow at Goonyella gauge. The potential loss of mean annual flow in the Isaac River will be practically immeasurable in the Water Resource (Fitzroy Basin) Plan 2011 context, representing less than 0.07 per cent of the mean annual flow in the Isaac River at Yatton guage. Hence, the project impact on Isaac River flow volumes will not materially impact on the State's ability to meet the water resource plan environmental flow objectives. Mitigation of ponding in the 12 Mile Gully catchment need only address local hydrological impacts within the 12 Mile Gully watercourse.

The Broadmeadow extension will be integrated with the existing BRM operations, including all aspects of water management. The future RHM will operate separately from the existing GRB mine complex; however, there will be an interaction between the two operations including in relation to mine water management. Mine waters generated by the project will be transferred to GRB mine complex and water demands that can be met from reuse of mine water such as the Red Hill CHPP will be supplied from the GRB mine water inventory. This type of mine water exchange arrangement also occurs between other coal mining operations in Queensland.

The project will not adversely impact on the capability of the GRB mine water management system to comply with the current EA conditions for salinity and compliance limits in the Isaac River downstream of the mine releases. EA conditions are set based upon EHP scientific modelling to meet local and regional water quality objectives. No environmental harm is predicted as these objectives consider the receiving environment and the cumulative effects of other releases and impacts.

It is considered that there will be no significant impacts on the hydrology or quality of surface water as a result of the project.

4.2.2.2 Groundwater

Predictions of groundwater drawdown have been made. Drawdown in bores of 5 m or more is generally considered, in fractured rock aquifers, to have a material impact on bore yield. There are no identified groundwater supply bores within the predicted 5 m drawdown zone. Thus, no 'at risk' bores have been identified. Two production bores (Skeleton Bore (NRM Registration 81696), and Cleanskin Gully Bore), on the 'Broadmeadow' property are located outside the predicted 5 m drawdown contours. Monitoring will be carried out to validate the model predictions and BMA will enter into make good agreements where necessary.

During mining operations, groundwater quality within aquifers surrounding the site is not expected to change from pre-mining conditions. RHM water and waste storage facilities infrastructure will be designed, constructed, and managed to ensure little or no potential of seepage. During degassing and mining operations, groundwater will be continually extracted from bores or sumps in the underground workings to ensure a safe working environment. This extraction of groundwater will create a depression in the potentiometric surface around the workings such that the net movement of groundwater is towards the workings during mine operation. This drawdown and alteration in groundwater flow effectively limits the potential for contaminant plumes to migrate off site via groundwater.

A rise in the groundwater salinity within the RHM workings may occur as a result of atmospheric weathering of the exposure of wall, roof and floor rock during mining. However, any increase in groundwater salinity is expected to be minor compared to the natural salinity of the groundwater in the Permian formations.

The creeks and the reach of Isaac River within the study area are ephemeral and there are no perennial water holes. There are nogroundwater dependant ecosystems present. It is considered that there will be no significant impacts on the hydrology or quality of groundwater as a result of the project.

Comprehensive monitoring programs are proposed to ensure that any impacts that do arise from the proposed project are identified so that appropriate mitigation measures can be adopted.

4.3 Regional Planning Interests Act 2014

The *Regional Planning Interests Act 2014* (QLD) (RPI Act) and *Regional Planning Interests Regulation 2014* (RPI Regulation) commenced on 13 June 2014.

The RPI Act identifies and protects areas of Queensland that are of regional interest. In doing this, the RPI Act seeks to manage the impact and support coexistence of resource activities and other regulated activities in areas of regional interest. The Act aims to ensure that land use planning protects:

- living areas (termed Priority Living Areas);
- high quality agricultural areas (termed Priority Agricultural Areas);
- strategic cropping land (termed Strategic Cropping Areas (SCA)); and
- important environmental areas (termed Strategic Environmental Areas).

The RPI Act repealed the *Strategic Cropping Land Act 2011* (SCL Act) but integrates the SCL Act policy framework for 'on-tenure' resource activities. The RPI Act has various implications for resource projects proposed within an area of regional interest and is dependent on the status of tenure and environmental approvals at various prescribed dates, the location and the type of proposed development. If a resource activity is proposed within an area of regional interest and an exemption under the RPI Act does not apply to the project, a Regional Interests Development Approval will be required.

Areas of land which may contain potential SCA have been mapped in the north-eastern portion of the EIS study area (**Figure 4-1**). This portion of the EIS study area containing mapped areas of SCA is not expected to be disturbed by any project activities. Should the Project's level of impact on SCA change it will be addressed under the RPI Act.

The study area is not affected by any Priority Living Areas, Priority Agricultural Areas or Strategic Environmental Areas under the RPI Act.

4.4 Other Approvals

BMA acknowledges the clarification provided by the Department of Natural Resources and Mines (NRM) with regards to applicable legislation, which includes:

- A development permit under the *Sustainable Planning Act 2009* is no longer required if the proposed works are located on a mining lease and if the proposed works are considered to be an authorised activity under the *Minerals Resources Act 1989*.
- Recent changes to the *Water Act 2000* have changed the timeframes for submitting bore information. Records about each water bore are to be submitted within 60 days after the day drilling commences.

BMA recognises, as detailed by NRM, that:

- Should there be the need to include a diversion or construction that may interfere with the flow of water, BMA would be required to meet the provisions of both the *Water Act 2000* and the Water Resource (Fitzroy Basin) Plan 2011.
- Should there be a need to undertake riverine activities or the taking of water then BMA is required to meet the provisions of both the *Water Act 2000* and the Water Resource (Fitzroy Basin) Plan 2011 to obtain approvals required for the project.

A riverine protection permit will be required if it is necessary to excavate or place fill within a watercourse, lake or spring. Other authorities may also be required before starting works, including owner's consent, quarry material allocations and vegetation clearing permits.

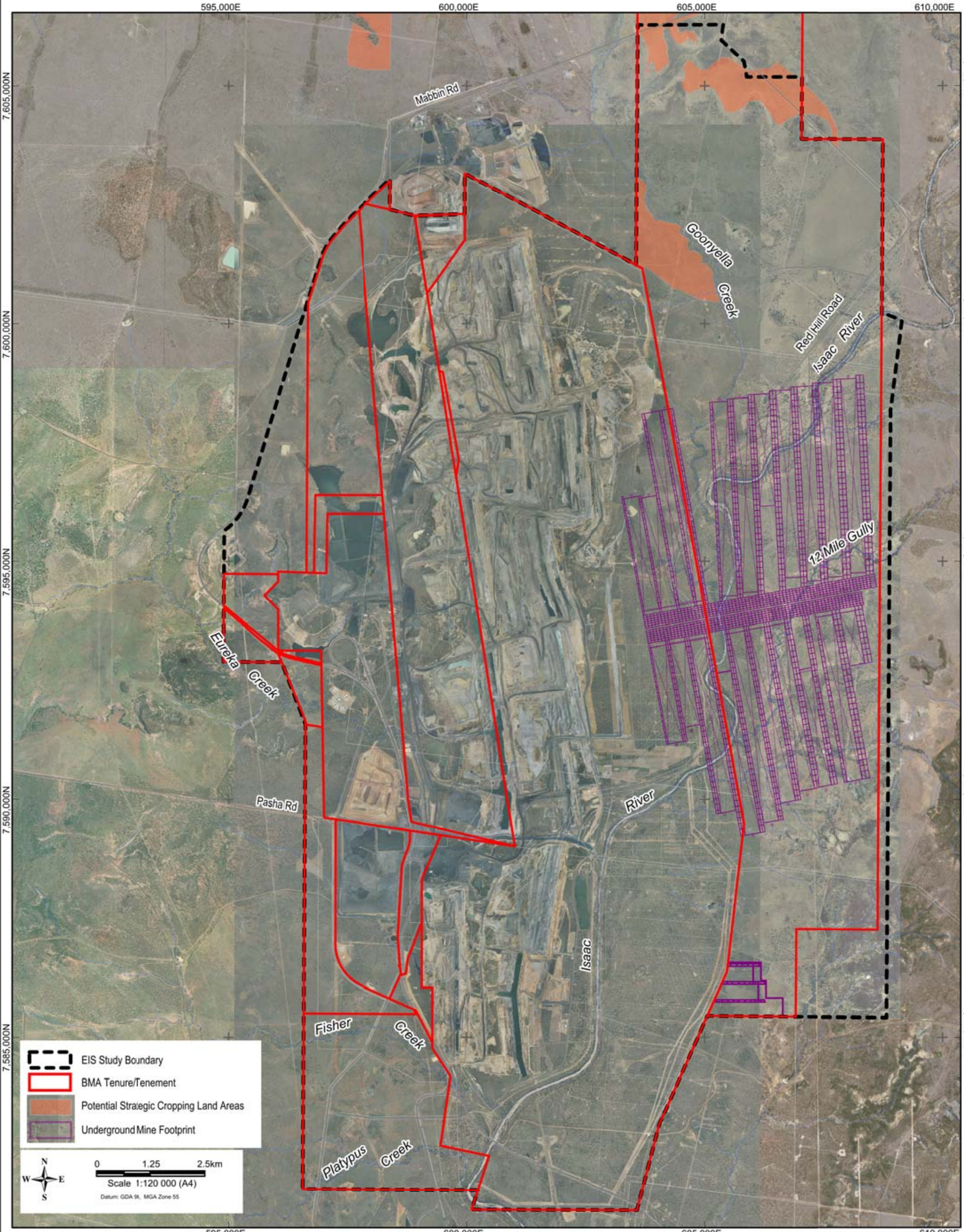
BMA will not do not require a riverine protection permit if excavation or placement of fill is:

- exempt under section 814 of the *Water Act 2000*; or
- permitted under section 50 of the *Water Regulation 2002*; or
- undertaken in accordance with the Riverine protection permit exemption requirements.

Specifically, a riverine protection permit will not be required to undertake remedial activities in a watercourse, lakes or spring provide that the placement of fill or excavation within the watercourse is included in the Subsidence Management Plan approved under the conditions of the EA. Where necessary, BMA will contact NRM prior to undertaking riverine activities and/or the taking of water prior to the construction of any works that may interfere with the flow of water.

BMA acknowledges that it is a requirement of the *Water Act 2000* that a licensed water bore driller must submit the records of the drilling and installation of a water well to NRM within 60 days after commencement of the well. All details of the monitoring bores to be constructed on site will be provided to NRM within the required time frames.

BMA may need approval under the *Forestry Act 1959* for the taking or disturbance of state owned land if not authorised under the *Mineral Resouces Act 1989*. Where required, the Department of Agriculture, Fisheries and Forestry (DAFF) will be contacted if timber or quarry material from state forest is reused on site.



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BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

STRATEGIC CROPPING AREAS

URS | APPROVALS | Figure: 4-1

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Section 5 Surface Water

5.1 Submissions

This section responds to submissions from the following:

- Department of Agriculture, Fisheries and Forestry
- Department of the Environment
- Department of Natural Resources and Mines
- Department of Environment and Heritage Protection
- Isaac Regional Council

5.2 Mine Plan and Sequence

The flood hydrology, hydraulics and surface water quality assessments in the EIS were based on the October 2011 mine plan. However, a minor modification has been made to the mining plan since then. The revised mine plan includes an extension of Panel 15, but the RHM footprint remains unchanged. The panel extension is outside of the 1 in 1,000 annual exceedance probability (AEP) area of flood inundation as shown in Figure 7-6 in Appendix I5 of the EIS. A minor increase in Panel 15 will have negligible impact on flood hydrology and water quality, and no impact to the flood hydraulics.

5.3 Subsidence Predictions

5.3.1 Predicted versus Measured Subsidence

Predictions of subsidence were made using surface deformation prediction software. Outputs from the modelling, such as subsidence depth contours or a digital elevation model, were used to create post subsidence terrain for use in geomorphic impact assessments.

Based on available BRM data (Alluvium (2014)), the amount of subsidence experienced at the surface is largely dependent on:

- geological strata;
- depth below surface of mining; and
- thickness of seam mined.

At BRM, eight longwall panels have been mined. LW101 to LW107 have been mined using conventional longwall mining and LW108 by LTCC or thick seam mining in areas outside of the Isaac River channel. LTCC recovers more coal from the seam where the seam is thicker than can be mined by conventional longwall mining (**Section 3.2**). This extra extraction thickness creates the potential for greater subsidence at the surface.

Alluvium (2014) prepared a report summarising the analyses of the predicted versus actual subsidence. The actual data were gathered from aerial and manual surveys across the BRM longwall panels LW101 to LW107. The results of the manual survey are provided in **Table 5-1**.

Table 5-1 Manual survey versus predicted maximum subsidence

Longwall Panel ID	Predicted Maximum (m)	Surveyed Maximum (m)	Difference (m)
LW101	-2.5	-3.1	-0.6*
LW102	-2.5	-3.6	-1.1*
LW103	-2.5	-2.8	-0.3
LW104	-2.5	-3.0	-0.5
LW105	-2.5	-2.9	-0.3
LW106	-2.5	-3.1	-0.6
LW107	-2.5	-2.7	-0.2

* influenced by changes to mine infrastructure

Generally, the survey showed that 2 m of subsidence is typically reached 50 m from the pillar zone with full subsidence on the centreline ranging from 2.25 to 3.0 m for the majority of the longwall panels mined using conventional techniques. The maximum subsidence observed was within 0.2 to 0.6 m of that predicted with the exceptions of LW101 and LW102, which were also influenced by changes to mine infrastructure during the period between pre and post subsidence surveys.

A comparison of 2006 and 2011 aerial survey data was undertaken in addition to the manual survey analyses. Comparison of the two datasets shows that the majority of the subsided area is within 0 to 0.5 m of predictions. This is similar to the findings of the manual survey.

A manual survey of LW107 was undertaken in April 2013. The maximum surveyed subsidence increased to -2.852 m, which is 0.35 m deeper than predicted.

Maximum subsidence predictions for LTCC panel LW108 were approximately 4 m. The maximum subsidence surveyed was -3.637 m, which is 0.363 m less than predicted.

The subsidence modelling for BRM indicated that an extraction thickness of 5.6 m of coal occurred or was planned. Subsidence at the surface was predicted at approximately 2.5 m, where coal extraction occurs at depths of 150 to 250 m below surface. The predicted subsidence is approximately 45 per cent of the extracted thickness.

Measured results indicate that for the shallow longwall mining, 150 to 250 m below surface, the measured subsidence is closer to 50 per cent of the extracted thickness.

The RHM target seam (Goonyella Middle Seam (GMS)) thickness is typically between 7.5 m to 9.6 m. For the purposes of mine planning, BMA has assumed a recovered coal total extraction thickness of 7.5 m. In areas of maximum coal extraction of 9.6 m, subsidence of 6.1 m is predicted (64 per cent), and this subsidence reduces to 5.5 m to the east (57 per cent).

Based on measured subsidence at shallow depth, the high percentage of subsidence depth to seam thickness is considered less likely as mining at RHM will occur at greater depths (200 to 450 m below surface). Thus the use of the deep subsidence predictions allows for the adequate assessment of potential impacts associated with mine induced subsidence at the deeper RHM.

5.3.2 Subsidence Impacts

One submitter requested a discussion of subsidence impacts other than vertical displacement. To provide this additional information the following reports were reviewed:

- geotechnical assessment of LTCC application at Broadmeadow Mine (SCT 2010);
- surface subsidence prediction for the Goonyella Coal Extension (GCE) Mine Plan (IMC 2011); and
- surface subsidence prediction for the RHM (Appendix I1 of the EIS).

5.3.2.1 Potential chain pillar compaction

Longwall mining involves the extraction of "panels" of coal which are separated by narrow "chain pillars" of coal which are left in place for support. When coal has been extracted from panel areas each mined-out panel area is described as a "goaf". Creation of this goaf area results in fracturing and settlement of the overlying strata.

Chain pillar strength in the GMS was considered by SCT at BRM (SCT 2010). Longwall extraction was modelled to assess the height of the chain pillar, which can vary as some of the strata above the pillar can include overburden material after goaf, and modify the strength of the pillar. The caving, stress redistribution, fracture distribution and subsidence were simulated by modelling. The modelling indicated that fracturing over the chain pillars does not occur in the shallower areas (150 m depth) and the pillars remain stable. Chain pillars, 35 m thick, are anticipated to yield at depths greater than approximately 200 m and induce subsidence over the chain pillars. At 250 m, the subsidence over the pillars is anticipated to range from approximately 0.5 to 0.7 m.

Chain pillars at BRM are planned at approximately 35 m thickness. It was found that in areas where mining will occur at depths of 300 m or greater, subsidence impacts can be improved with the use of pillar thicknesses of 40 to 45 m of coal.

5.3.2.2 Subsurface fracturing height above the mined longwall panels

The nature of the mining-induced fractures is typically bedding plane shear and subsidence (bending) related fractures along the panel edges. Fracture modelling for the BRM LTCC indicated that the mining-induced fractures are predicted to extend to the base of the Tertiary sediments for mining at 150 m and 250 m depth. The Tertiary sediments are composed of an intercalation of sands, gravels, and soft clays of medium to high plasticity; they are not predicted to display any significant shear strain other than tensile fractures adjacent to the pillar edges at surface.

The modelling conducted for the shallow mining at BRM indicates that the sands and clays in the Tertiary sediments can readily deflect over the fractured rock below and maintain their overall integrity. This has been noted in the Bowen Basin Tertiary sediments at Crinum Coal Mine.

5.3.2.3 The hydraulic connectivity of the fracture network

The geotechnical studies indicate the fracture extent to the base of the clay-rich Tertiary sediments, which are up to 80 m thick in the study area (EIS Appendix J Table 5-1), and the surficial tensional cracks are projected to extend to a maximum of 10 m from the surface. Thus the longwall mining impacts are not predicted to result in connection from the target GMS coal to surface.

In addition, the surficial cracks will self-seal as a result of:

- sediment laden surface water runoff (when ephemeral creeks and overland flow occurs);
- swelling clays; and
- subsidence management.

Figure 6-7 in **Section 6.6** shows the existing fault network across the Red Hill Mining Lease. The fault mapping shows predominantly north-south faulting, limited connection of faults (limited fault network), and smaller discontinuous faults across the proposed mining area.

Figure 6-8 of **Section 6.6**, a geophysical seismic survey 2D cross-section, shows the following:

- there is minor displacement of the coal seams;
- the thrust faults are generally shallow (less than 20° dip) and become steeper as they propagate upwards;
- folds and faults have formed to accommodate strain, rather than a swarm of independent fractures;
- the fault traces extend to around 90 m below surface within the more competent Permian units and do not extend to surface; and
- several rolls are identified within the seismic survey data, which may be minor thrust faults but there is no corroborating evidence in the exploration bore logs.

In EIS Appendix I1 the subsidence impacts associated with faulting are considered to be limited to the vicinity of faulting, based on experience from Bowen Basin longwall mining sites. **Figure 6-7** shows the location of mapped and probable faults, as discussed above, which strike north-south formed as a response to stress. No faults are mapped east-west so as to create a network of fractures or preferential pathways between the mine footprint and the Burton Range Thrust Fault located approximately 10 km east of the EIS study area. The localised effects (EIS Appendix I1) indicate that the potential for the longwall mining goaf to increase the fault network is minimal. The maximum subsidence, extracting a 10 m coal seam, is predicted to impact an area of only some 35 m either side of the panels.

5.3.2.4 Size and distribution of surface cracking

SCT (2010), based on their site assessment (underground at BRM) and their modelling, noted that the Tertiary sediments are not significantly impacted, but tend to drape onto the Permian subsided rock. Tension cracks are considered to form at the surface with some re-working of the soft sediments.

The surface subsidence cracking is predicted to extend some 35 m either side of the chain pillars, have a maximum width of 0.5 m, and a maximum depth of 10 m (IMC 2011 and Appendix I1 of the EIS).

5.3.2.5 Potential unconventional subsidence movements

Unconventional subsidence is the component of subsidence which appears to be influenced by topographic effects whereby hills or valleys cause additional movements such as a reduction in subsidence (sometimes termed 'upsidence') or additional horizontal movements such as valley closure.

The topography overlying the Red Hill Mining Lease is considered to be sufficiently flat so that topography does not markedly impact on subsidence predictions. This is based on:

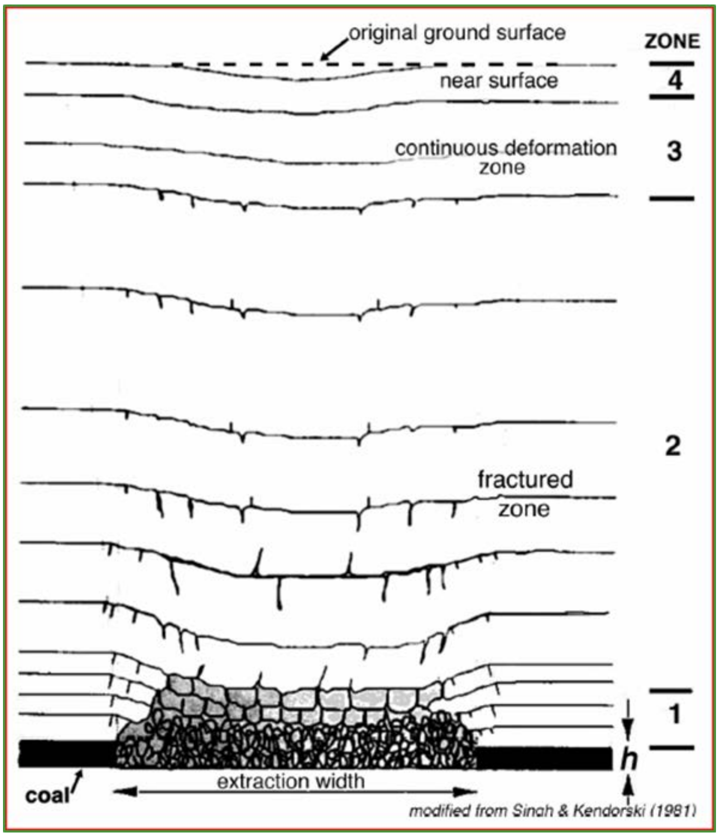
- the contemporary floodplain is a relatively narrow (150 to 500 m wide) band on one or both sides of the Isaac River channel that is 2 to 4 m lower in elevation than the terrace (2,000 to 5,000 m wide);
- the Isaac River drains the Red Hill Mining Lease area at gradients that are generally less than 1:100; and
- bedrock controls are not dominant within the reach of the Isaac River through the Red Hill Mining Lease, which is categorised as a low to moderate sinuosity alluvial stream.

5.3.2.6 The impact of faults on subsidence movements, resulting in impacts to aquifers and groundwater flow paths.

EIS Appendix J Section 7.3.7 details the simulation of the goaf, including the alteration of model layers over time in response to the alterations to aquifer parameters due to the goaf.

The subsidence and goaf profile is divided into four distinct zones (Singh and Kendorski, 1981) as shown in **Figure 5-1**.

Figure 5-1 Subsidence and goaf profile



The four zones include:

- In zone 1, the totally caved roof thickness is 2 to 10 times the thickness of the mined out coal.
- In zone 2, the fractured zone, partial fracturing of strata occurs from 10 to 24 times the thickness of the mined out coal.
- In zone 3, the continuous deformation zone, buckling of strata occurs from 24 to 64 times the thickness of the mined out coal.
- In zone 4, surface subsidence.

The caved and fractured zones alter the natural groundwater flow system and can potentially introduce significant vertical leakage through fractures. The highest vertical leakage is considered to occur in the caved zone (zone 1).

As discussed in **Section 6.4** of this report, the conceptual groundwater model layers (12 and 13) were altered and fracturing was simulated to extend above the longwall panels. Conceptual model **Figure** 6-5 shows that the fracturing, some 20 times the coal seam thickness from depths of 200 m to 450 m below ground level from west to east, does not extend through the overlying Fort Cooper Coal Measures or the Tertiary sediments.

Fracturing may occur within the surficial material (as a result of surface subsidence); however, this fracturing is predicted to only occur to a depth of 10 m and so will not extend downwards to connect to the altered units below. The clay-rich nature of the Tertiary sediments (**Section 6.10**) limits the groundwater potential of this unit, thus should alteration of the Tertiary sediments increase the vertical hydraulic conductivity (fractures), limited groundwater will drain from this unit due to its low horizontal hydraulic conductivity (**Section 6.4**).

It was concluded that the risk of direct hydraulic connectivity between the ground surface and the coal seam, even after the goaf, was low based on:

- the nature and extent of faulting (**Section 6.6**);
- the aquitard nature of the overburden (between the GMS coal seam and the Tertiary overburden);
- the clay-rich Tertiary sediments (saprolite);
- the limited extent of vertical fracturing due to surface subsidence;
- the potential for fracturing above the longwall panels some 20 times the coal seam thickness, which does not extend into the Tertiary sediments;
- the limited influence of faulting on the potential subsidence; and
- the ephemeral and silt laden nature of the surface water bodies, particularly the Isaac River.

5.3.2.7 River erosion

In the EIS it was considered that, to reduce subsidence proximal to the Isaac River, limited coal thickness recovery (3.9 m) would be considered. This reduced coal extraction would minimise subsidence impacts on the river flow (EIS Appendix I1).

The Alluvium geomorphic assessment (EIS Appendix I6) considered the scenario of -5 to -6 m maximum subsidence expressed at the surface. The scenario where subsidence under the Isaac River is limited to approximately 2.5 m due to a reduced coal extraction thickness of 3.9 m is referred to as the “mitigated” scenario within the EIS. However, this creates potential for perching the river and in some instances increases the risk of avulsion (abandonment of the river channel and the formation of a new river channel) to occur during flood events. Hence BMA is no longer considering this mitigation option for mining under the river. The proposed mitigation measures are discussed in **Section 5.10**.

The monitoring program currently implemented at BRM includes the monitoring of cracking and areas with increased potential for river erosion. A similar monitoring program is proposed for RHM. In addition, the manual surveying of subsidence as mining progresses is routine and will form part of RHM.

5.4 Volume of Subsidence Voids

BMA acknowledges that there are inherent uncertainties in the estimation of the volume of subsidence voids as stated in Section 7 of the EIS and Appendix I7 of the EIS. The other subsidence volumes were not included in the subsidence hydrology estimates for the following reasons:

- In-river subsidence – The 1,309 ML of total estimated subsidence voids within the Isaac River would occur incrementally over a 20 year timeframe and it is expected that some degree of infilling would cumulatively occur over this time. The quantum of in-filling over time is difficult to predict. As the in-filling occurs, the volume of water that could be stored within the voids would reduce due to sand/sediment accumulation and conveyance of the water through the unsubsided river bed. It should be noted that there are potentially several positive benefits including the re-establishment (if only temporary) of pools along the river for aquatic habitat. Section 2.2 of Appendix I7 states that *"The condition of the Isaac River is compromised by the excess sediment inputs that have been generated through the catchment with changes in land use. This has smothered nearly all bedforms, infilling pools and creating a smooth sand bed profile with limited potential for aquatic habitat outside of the wet season."*
- Subsidence voids less than two hectares – the volume of voids with surface areas less than two hectares were excluded as they had void depths less than 0.5 m. This is within the uncertainty of the 0.5 m subsidence contours. The accuracy of the volumes could not, therefore, be calculated accurately.
- Uncertainties in subsidence prediction model and surface cracks – surface cracks that could form within the subsided area under the Isaac River would likely self-seal due to the large volume of sediment present in the river bed. Additionally, as stated in Section 7.3 of the EIS, an adaptive management approach is proposed to monitor the subsidence areas and mitigate large cracks. This work will be in accordance with the subsidence management plan.

Notwithstanding the above, the conclusions drawn in the EIS are not sensitive to these assumptions. For example, if the volume of estimated subsidence voids was increased by 25 per cent (total in-river subsidence (1,309 ML) + an assumed 1,000 ML for storages with areas less than two hectares = 2,375 ML) from 9,500 ML to 11,875 ML, the potential reduction in mean annual flow from the Isaac River would increase from approximately 1,600 ML/year to 2,000 ML/year. A reduction of 2,000 ML/year in mean annual flow would represent approximately a 3.5 per cent reduction at the Isaac River Goonyella Gauge and approximately a 0.1 per cent reduction in the Isaac River flow at Yatton gauge. As previously stated in Section 6.2 of Appendix I7, *"…the project impact on Isaac River flow volumes will not materially impact on the State's ability to meet the Water Resource Plan environmental flow objectives."*

5.5 Geomorphic Impacts of Subsidence

5.5.1 Isaac River

The sand volume currently in the Isaac River channel is estimated to be approximately 2.2 million cubic metres (m^3) between Burton Gorge Dam and Red Hill Mining Lease. This exceeds the volume of subsidence voids predicted to be created by the proposed project and Broadmeadow Mines combined. At a macro level there is sufficient sediment supply, even without additional sediment inputs from catchment processes.

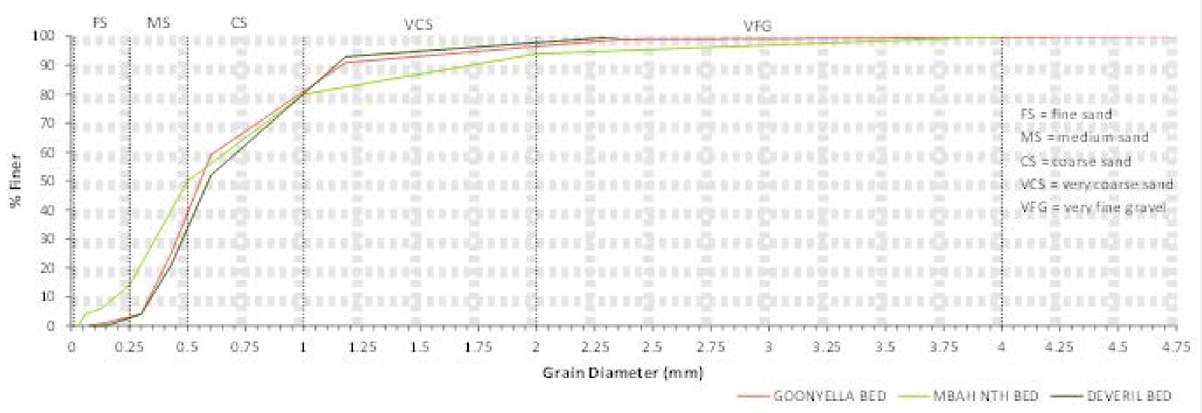
The geomorphic assessment undertaken for the EIS identified the potential for river sediment supply limited conditions at the reach scale. For example, following subsidence at the Red Hill Mining Lease, bed load starvation (supply limited conditions) is predicted for the BRM reach of the Isaac River with the potential to exacerbate instabilities in the river's diversion. The Isaac River Cumulative Impact Assessment (IRCIA) sediment transport modelling suggests that these impacts will require management over an extended timeframe, approximately 40 years based on the past flow record from 1898 to 1995. An extended drought (such as experienced post 1995) is likely to result in this timeframe increasing. Similarly, a series of wet years, not characteristic of the 97 years of flow record, would reduce the timeframe for infilling.

SedNet constructs a sediment budget at a regional scale and in the case of the Fitzroy Basin model is primarily focused on suspended sediment load (Dougall *et. al*. 2006). The modelling undertaken for the IRCIA and input into the EIS Geomorphic Assessment is a reach scale model of bed load sediment transport. The Integrated Quantity Quality Model (IQQM) model was used for the sole purpose of providing a flow duration curve to apply to predicted sediment transport rates.

LiDAR survey data were not available pre and post subsidence and pre and post streamflow to enable detailed calibration of the IRCIA sediment transport model. However, with regard to the quantities of sediment captured and transported, the model has been shown to compare well with monitoring data at the BRM, located immediately downstream of the proposed RHM.

The sediment transport modelling presented in the EIS is for bed material load with the mobile sand bed dominated by coarse sand as shown in **Figure 5-2**.

Figure 5-2 Particle size distribution of mobile sand bed of the Isaac River

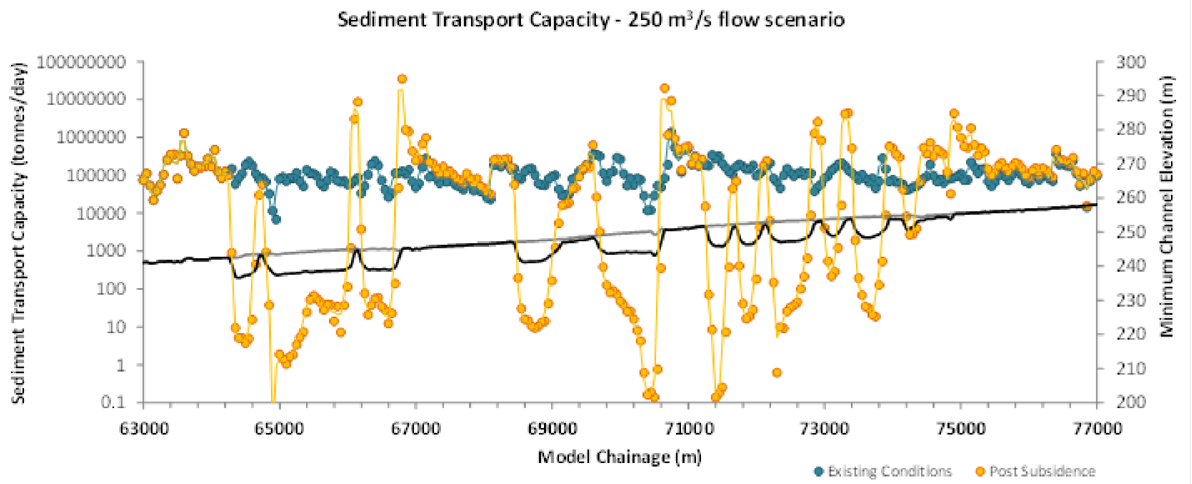


The assessment method adopts a reach average sediment transport rate to predict the movement of these coarser particles and the rate of infilling for the subsidence reach. The modelling has been used as input into the geomorphic assessment and, when applied to the flow duration curve, provides an indication of the timeframe for managing the risks of bed and bank instabilities following subsidence.

Sediment transport equations are semi-empirical and it is critically important that a relationship is selected that is appropriate for the flow and sediment characteristics of the river as modelled rates can vary by orders of magnitude. Guidance for appropriate selection is provided by the HEC-RAS hydraulic reference manual (Brunner 2002) and the Ackers-White equation was tested for the Isaac River and shown to slightly over-predict against field observations of infilling of subsidence troughs at Moranbah North Mine, which were the only longwall panels impacting the river at the time. No correction to the sediment transport rates was applied due to the adopted values being an average, with variability expected a local scale.

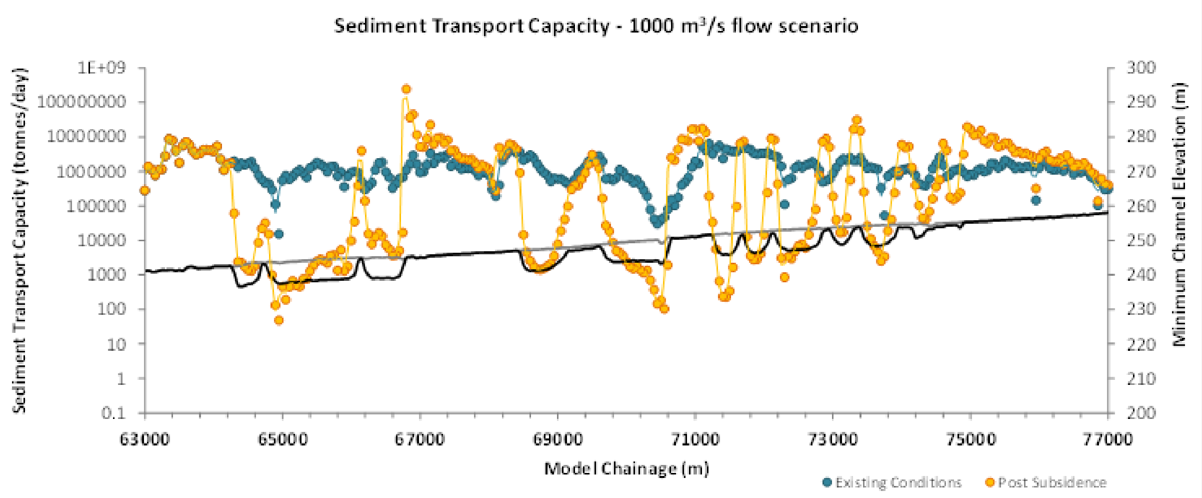
The reduction in hydraulic parameters through the subsidence trough does support the capture of the majority of bed load during flow events. In addition, predictions of sediment transport capacities pre and post subsidence from the proposed project show a reduction of multiple orders of magnitude to almost zero for moderate flow conditions (see **Figure 5-3**).

Figure 5-3 IRCIA predictions for RHM existing conditions and post subsidence for moderate flow



For high flows (**Figure 5-4**), sediment transport rates through subsidence troughs are predicted to be greater than for low flow events (100 to 1000 tonnes/day). These rates are minor and have negligible impact on the estimated timeframe for infilling.

Figure 5-4 IRCIA predictions for RHM existing conditions and post subsidence for high flow



Observations at existing subsided sections of the river at Moranbah North Mine and BRM support the modelling results across a range of low to moderately high flow events. Larger flow events do have the capacity to mobilise some bed sediment in the subsided troughs. In the same events there are large inputs from upstream, replenishing the bedload moving over the top of the subsided bed profile. If this supply is cut off, then infilling will take longer.

Potential bank erosion has been considered through the application of the Bank Stability and Toe Erosion Model (BSTEM). BSTEM is a model that simulates the hydraulic and geotechnical processes that contribute to mass failure (the bank stability model) and fluvial scour (the toe erosion model) in stream banks.

BSTEM model assumptions and results are summarised in **Appendix C**. The modelled scenarios considered a typical bank of the Isaac River located over a pillar zone during moderate and extreme flows for a range of event durations. Pillar zones are susceptible to bank erosion due to rapid drawdown of the water surface post subsidence. For baseline conditions, the estimated toe erosion is predicted to be minimal. However, following subsidence, the toe erosion is significant, with an estimate of up to 25 m of toe erosion from a single large-scale event. This is likely to be an overestimate due to the conservative assumption of erodible silt for bank material. However, where pile field mitigation works have been delayed, observations of bench retreat and bank erosion have been up to 10 m following substantial flow events within the Isaac River.

BSTEM has also been used to represent a mitigation scenario for the construction of pile field mitigation works over the pillar zone. In this case, the toe erosion model outputs indicate that a pile field consisting of four pile field retards will be sufficient to reduce total toe erosion volumes to the levels estimated for the pre-subsidence scenario, whilst a pile field consisting of six pile field retards will reduce total toe erosion volumes to a negligible level for both moderate and large flow events. These modelling results should be viewed with caution given the lack of calibration data. However, field observations show that pile fields have performed well in protecting bank toe erosion to date.

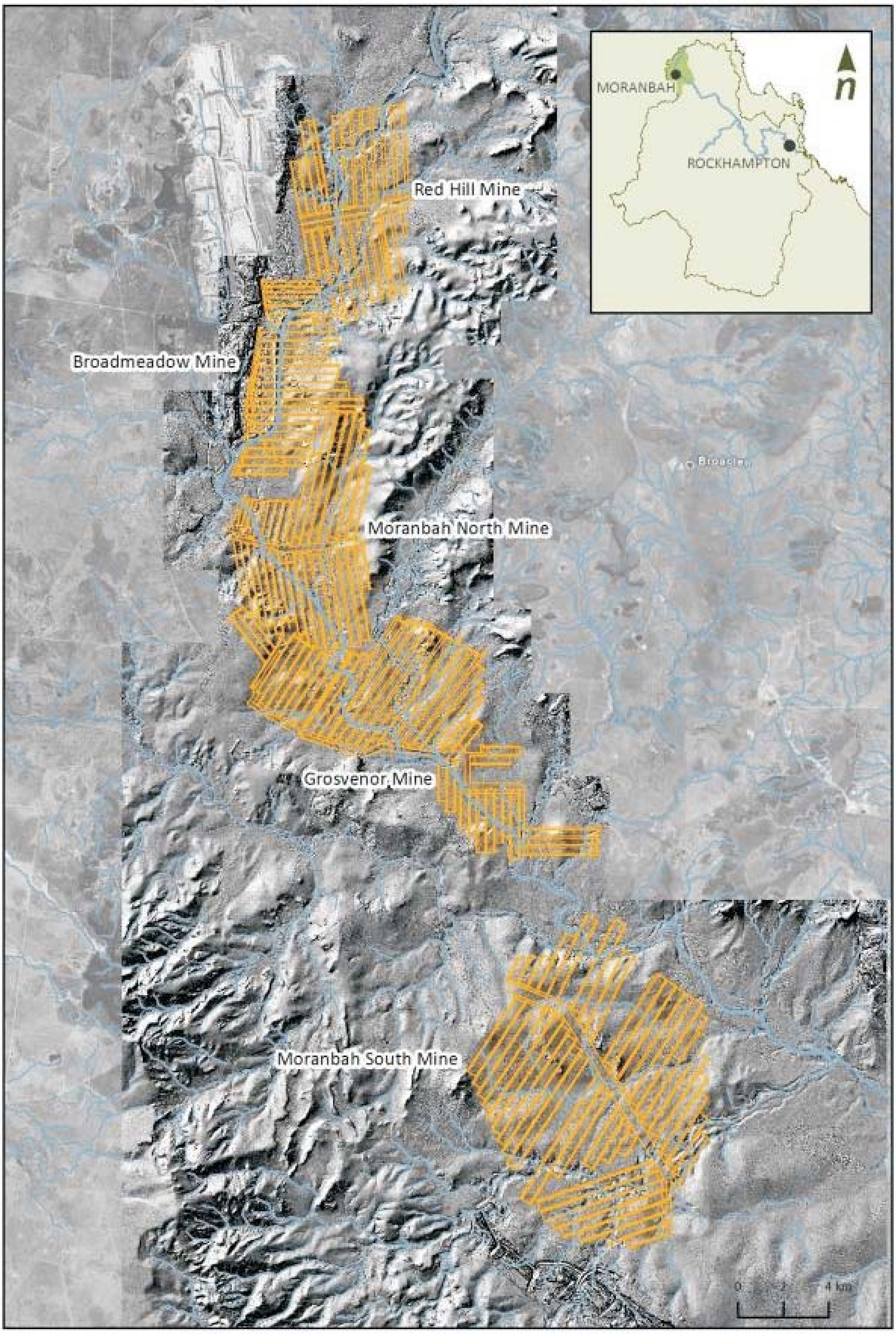
The EIS has assessed avulsion risks qualitatively based on the quantitative hydraulic modelling of extreme events. Long term geomorphic landform stability modelling has not been undertaken for the project site. Within Australia, landform evolution models such as SIBERIA and Cellular Automation Evolutionary Slope and River (CAESAR) have been applied to post mining built landforms such as waste rock dumps and tailings facilities. Model suitability to subsided terrain appears yet to be tested. Their application to the proposed project will require substantial investment in testing, survey and calibration of model parameters and could be undertaken within the context of long term planning for the rehabilitation of the Isaac River diversion.

The meander cutoff through panel 205 (refer to EIS Figure 7-17) is highly likely to occur and the system will be managed accordingly. The avulsion risk in other panels is driven by extreme events with low probability of occurrence. The risk in some of these panels could be mitigated with reasonable earthworks that do not cause more environmental harm than they mitigate. Throughout the operation, avulsion risk will be partly mitigated through maximising vegetation coverage.

The location of the project site in relation to other existing and proposed underground mines on the Isaac River as currently understood is shown on **Figure 5-5**. Sand extraction occurs within this reach of the Isaac River with allocations illustrated on **Figure 5-6**. The sand extraction operations downstream of the project site including the Moranbah South reach of the Isaac River are summarised in **Table 5-2**.

Table 5-2 Sand extraction allocation and estimated remaining quantities

QMAN ID	Total Allocation	Annual Allocation (m^3)	Expiry Date (m^3)	Remaining Allocation from 2013 (m^3)	Isaac River Reach
300164/100802	17,500	3,500	31/08/2014	3,500	Moranbah North Mine
300164	17,500	3,500	31/08/2014	3,500	Moranbah North Mine
101072	30,000	6,000	31/05/2015	12,000	Grosvenor Mine
300150	225,000	45,000	30/11/2014	45,000	Grosvenor Mine
300334	225,000	45,000	31/12/2018	225,000	Between Grosvenor & Moranbah South
300052	325,000	65,000	31/05/2014	65,000	Moranbah South
			Total	354,000	



Source: Alluvium 2014

BMA
BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

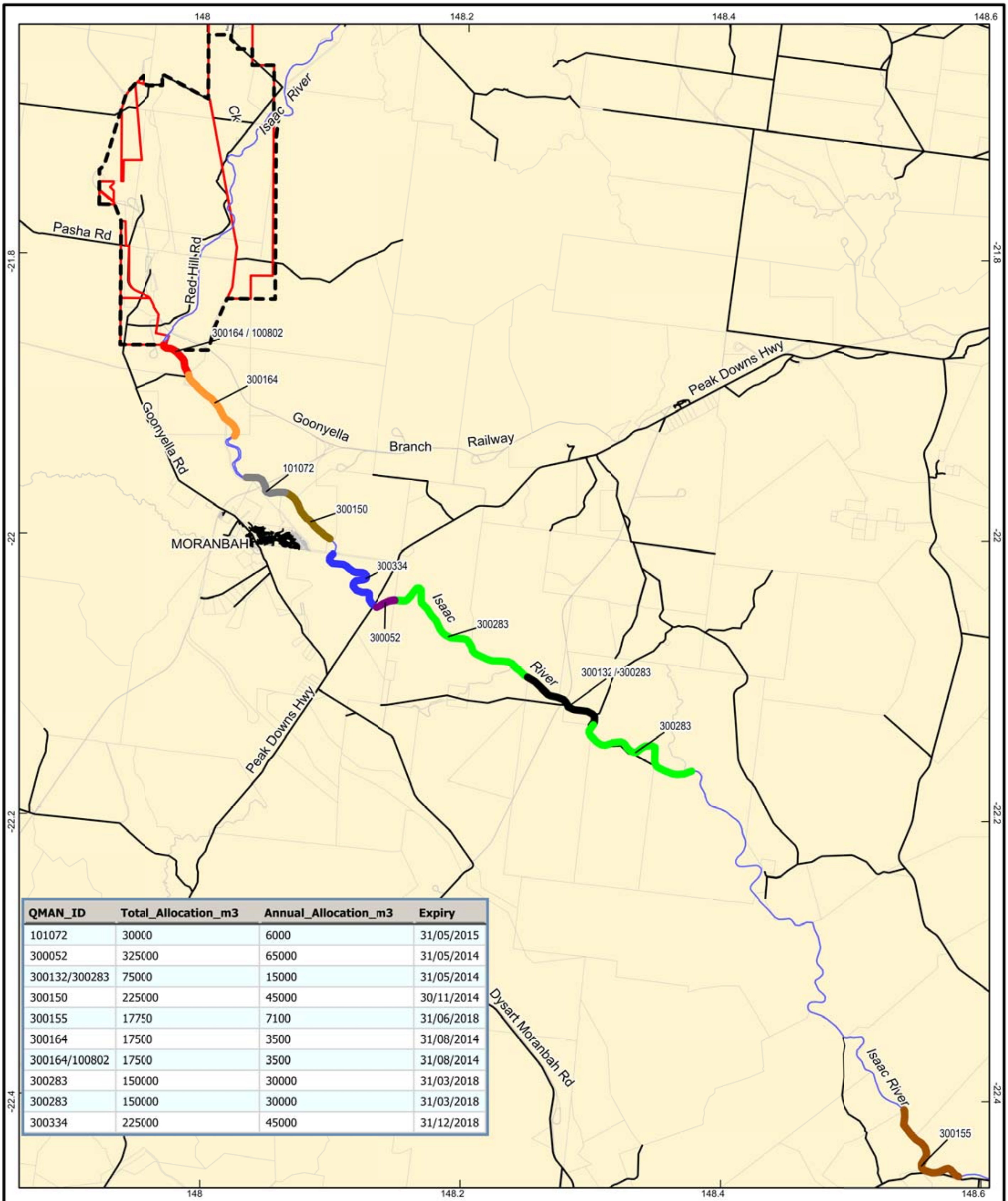
POTENTIAL EXTENT OF LONGWALL MINING WITHIN THE ISAAC RIVER STUDY AREA (BMA AND AAMC ONLY)

URS

SURFACE WATER

Figure: **5-5**

File No: **42627373-g-2278.cdr** Drawn: **VH** Approved: **CT** Date: **30-09-2014** Rev.**A** A4



QMAN_ID	Total_Allocation_m3	Annual_Allocation_m3	Expiry
101072	30000	6000	31/05/2015
300052	325000	65000	31/05/2014
300132/300283	75000	15000	31/05/2014
300150	225000	45000	30/11/2014
300155	17750	7100	31/06/2018
300164	17500	3500	31/08/2014
300164/100802	17500	3500	31/08/2014
300283	150000	30000	31/03/2018
300283	150000	30000	31/03/2018
300334	225000	45000	31/12/2018

NOTE: Resource data boundaries downloaded from QLD Dept Mines & Energy Website (http://www.webgis.nrm.qld.gov.au/webgis/webqmin/Run.htm.) and are correct as at 18 May 2011

N W E S

0 5 10Km
Scale 1:425,000 (A4)
Datum: GDA92

EIS Study Boundary
BMA Tenure/Tenement

BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

QUARRY MANAGEMENT AREAS

URS

SURFACE WATER

Figure: **5-6**

File No: **42627373-g-2268.wor** Drawn: **VH** Approved: **CT** Date: **30-09-2014** Rev. **A** A4

Figure 5-7 is a graphical representation of the location of the sand allocations in relation to predicted subsidence voids. Recent (2013) estimates regarding the quantity of mobile bed sediment available for transport post subsidence in the Isaac River channel has been estimated at approximately 5 million m^3, from Burton Gorge to Moranbah South as listed in **Table 5-3**. This figure includes the remnant raised reaches over the main headings at the Red Hill Mining Lease and Grosvenor Mine.

This is based on the sand bed area, upstream and downstream of mine areas, multiplied by an average depth of 2 m for the majority of the study area. Sand over the mined area will be subsided and assumed not to be available for transport (a conservative assumption).

Figure 5-7 Graphical representation of approximate quantities of in-channel sand available for sediment transport compared to the total predicted subsidence void and extraction quantities

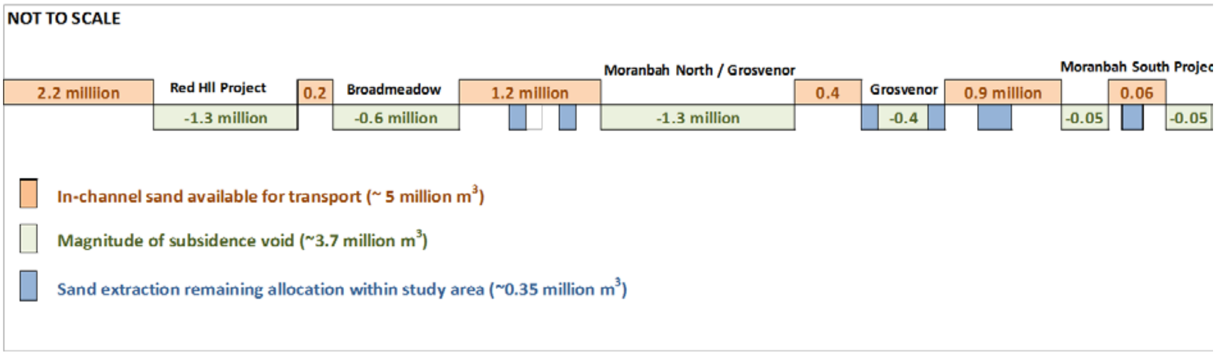


Table 5-3 Estimated quantities of channel sand available for transport

Reaches of the Isaac River not subsided From Burton Gorge to Moranbah South Project	Sand available for transport (m^3)	Sand available for transport (million m^3)
Burton Gorge to Red Hill	2,216,651	2.2
Remnant in Red Hill Reach	154,126	0.2
Between Red Hill and Broadmeadow Mine	211,136	0.2
Broadmeadow subsidence reach to Moranbah North Mine subsided reach	1,151,909	1.2
Remnant in Grosvenor Mine Reach	372,431	0.4
Grosvenor Mine to Moranbah South	867,886	0.9
Moranbah South Project from LW105 to LW106	61,221	0.06
Total	5,035,360	5.0

At a macro level there are sufficient mobile bed sediments in the Isaac River to compensate for the subsidence voids and remaining sand extraction allocations without additional inputs from catchment sources. Therefore, the cumulative impact is not expected to change the sediment transport limited regime of the Isaac River over the long term, particularly with ongoing elevated input from erosion response to land use in the catchment. However, there will be reaches that become supply limited over the short to medium term, particularly at a local scale. Based on **Figure 5-7**, it would be expected that:

- Broadmeadow Mine reach becomes supply limited once mining at RHM lease subsides, the river (noting that a section of 3 to 4 km of the Isaac River diversion at Broadmeadow is already supply limited).
- Future subsidence at Moranbah North is likely to have implications for Grosvenor reaches.

- Moranbah South is unlikely to be greatly affected by interruptions to sediment supply due to its distance downstream and its relatively small-scale interaction with the river and tributary inputs.

Sand extraction, if not carefully managed, may exacerbate impacts at the local scale. However, given that the remaining sand allocations will expire by 2018, the minor quantity proposed for extraction through the Moranbah North reach (7,000 m^3) and its distance downstream of the project site (approximately 10 km), the cumulative impact of sand extraction in the short to medium term is considered negligible.

As indicated in Appendix I6 of the EIS, the impacts of longwall mining on alluvial stream systems such as the Isaac River were categorised by industry stakeholders in consultation with DERM (Department of Environment and Resource Management, now the Department of Environment and Heritage Protection (EHP)) in 2007 as part of the IRCIA undertaken by ACARP (Australian Coal Industry's Research Program), BMA and Anglo American Metallurgical Coal Pty Ltd.

The IRCIA identified that while there is potential for impacts on the Isaac River as a result of mine related subsidence, none were determined to be significant in terms of instigating long term large scale geomorphological change. Based on the then current mine plans and considered on a reach scale, subsidence voids in the river channel were predicted to have approximately 50 per cent or greater probability of infilling during the period of mining. Overall, subsidence voids were predicted to be infilled within 20 years after the cessation of mining unless there is a substantial reduction of sediment inputs from the Isaac River catchment (Section 7.3.5.1 of the EIS).

5.5.2 Goonyella Creek and 12 Mile Gully

The quantitative assessment of sediment transport capacity has been extended to include Goonyella Creek and 12 Mile Gully. The subsidence void created in-channel post subsidence is estimated at approximately 43,299 m^3 and 330,658 m^3 for Goonyella Creek and 12 Mile Gully, respectively. Goonyella Creek is impacted directly by 3 longwalls, whereas 12 Mile Gully is directly impacted by 7 longwall panels with some with multiple crossings.

Goonyella Creek and 12 Mile Gully have catchment areas of 107 km^2 and 84 km^2 respectively. Based on RORB model simulations of 1 in 10, 20 and 100 AEP flow events, the peak flow duration varies from 3 to 6 hours (refer to EIS Appendix I4). For each flow event the estimated sediment transport capacity by volume for both Goonyella Creek and 12 Mile Gully is provided in **Table 5-4**.

Table 5-4 Estimated sediment transport capacity for Goonyella Creek and 12 Mile Gully

	Goonyella Creek		12 Mile Gully	
Annual Exceedance Probability (AEP)	Peak Streamflow (m^3/s)	Sediment Transport Capacity (m^3)	Peak Streamflow (m^3/s)	Sediment Transport Capacity (m^3)
1 in 10	280	43,257	190	10,029
1 in 20	400	83,552	280	14,799
1 in 100	770	254,188	510	26,642

Post subsidence, the hydrological regime of Goonyella Creek is not likely to be greatly impacted by the proposed project. The volume of subsidence void in-channel is relatively small and assuming there is adequate sediment supply, troughs should infill during a 1 in 10 AEP event. However, Goonyella Creek is predominantly a suspended load system with limited bed load supply to the reach that is proposed to be subsided. Hence, infilling is unlikely without significant changes to erosion in the catchment. This means pools are likely to persist and, with robust channel boundary conditions, provide for net gain of aquatic habitat availability.

This assessment does not take into account existing or potential future mining activities upstream of the Red Hill Mining Lease boundary on Goonyella Creek.

The sediment transport capacity of 12 Mile Gully is substantially less than the subsidence void that is created in-channel. In addition, the flows are predicted to be significantly reduced as a result of the amount of storage in panel catchments. Subsequently, for the majority of time, minimal sediment is likely to be transported through or captured within much of the 12 Mile Gully reach traversing the RHM site. With the capture or attenuation of flows, this also means that peak flow rates will be reduced with subsequent reduction in the risk of major erosion.

Should the pillar zones erode between subsided panels, a cut and fill process will occur, creating a new longitudinal bed profile equilibrium in the longer term. Without mitigation, this could cause instability and export of suspended sediment well downstream. The length of the main headings means that incision all the way through it is of low likelihood; hence the subsided sections upstream of the main headings are likely to infill over the longer term.

During extreme flood events, flows from the Isaac River have the potential to be captured and diverted into 12 Mile Gully. This could result in the delivery of additional sediment to downstream reaches but equally could result in substantial bank erosion over pillar zones and at the downstream limit of the main headings.

5.6 Hydrological Impact of Subsidence Voids

The estimated changes to runoff volume have been presented in Section 4.5 of Appendix I7 (EIS). No changes to the timing of flows for 12 Mile Gully have been estimated as this would be rainfall event dependent (i.e. where in the catchment is the storm centred, how is it moving within the catchment, etc.). However, flows entering the Isaac River from 12 Mile Gully will be slightly delayed. The quantum of delay will depend on the volume of water in the voids prior to the rainfall event. For the more frequent rainfall events, up to 1 in 5 AEP, the delay is likely to be in the order of several hours. For the less frequent, heavier rainfall, events it would be significantly less.

Section 7.3.6 of the EIS states that *"There are no known human users of water relying on water directly from 12 Mile Gully and the potential loss is not considered significant in that context"*. Section 7.2 of the EIS states that *"There were no licenced water users identified within the EIS study area, however the Water Act does allow landholders adjacent to rivers to take water for stock and domestic purposes without a licence."* On this basis, any minor delays would have no significant impact to downstream human users.

The estimated surplus flow from the water balance model is the same as the offset flow used in subsidence hydrology calculations. Section 7.8 of Appendix I2 (Mine Water Management Overview Report) states that *"It is predicted that in the periods of surplus there could be an average surplus of up to 640 ML/yr of mine water."* An average flow 700 ML/year (rounded up from 640 ML/year) has been used in the subsidence hydrology calculations.

BMA will implement mitigation measures for the subsidence voids, as detailed in **Section 5.10**. Once the panel has subsided BMA will determine the actual depth and volume of the void, assess the degree of potential impacts and assess whether mitigating the subsidence void would create additional impacts (such as vegetation disturbance) compared to the potentially positive impacts from leaving the void as an ephemeral wetland that would act as valuable habitat. This strategy is consistent with the existing Goonyella Riverside and Broadmeadow Mine Subsidence Management Plan, and will be adopted for the proposed project.

It should be noted that at the time of the preparation of the EIS in December 2011, the EHP website showed that the estimated mean annual flow at the Yatton Gauge of 1,970,000 ML/year as presented in Appendix I7 represents 86 per cent of the Environmental Flow Objective (EFO) at that location. However, at the time of preparing this response, June 2014, the EHP website showed a mean annual flow of 2,025,400 ML/year at the Yatton Gauge, or approximately 90 per cent of the EFO. The potential impact of the project on the EFO being achieved should be considered on a relative basis, where the potential impact at the Yatton Gauge is estimated to be less than 0.1 per cent.

5.7 Water Quality Impacts of Subsidence Voids

The impacts on water quality in pools formed by subsidence were discussed in Section 5.2.6 of the EIS Surface Water Quality Technical Report (Appendix I8). The creation of pools in channels from subsidence voids was identified by the IRCIA and by URS (Appendix K3 EIS, Aquatic Ecology Technical report) as a positive impact due to the creation of deep pools that in the short term will create refuge habitat for both macroinvertebrates and fish during the dry season. However, these pools are expected to be temporary due to excess sediment input into the Isaac River system (Section 6 of Appendix I6 of the EIS).

Appendix I8 of the EIS indicated that, based on water quality in existing pools in local streams, water quality in subsidence ponds is likely to be variable over time. Initial inflows will be from surface water runoff and hence relatively low in salinity but potentially containing suspended solids collected from the catchment. As water is lost through evaporation, the concentration of salts and any dissolved contaminants may be expected to increase over time, as is observed in ponds forming in existing waterways in the EIS study area. There may also be changes to other physicochemical characteristics, which are expected to be consistent with naturally ponded areas. It is important to note, however, that the volume of voids likely to be formed in the channel by subsidence is small in comparison with the volume of water that flows through the Isaac River, even in small flood events such as a 1 in 5 AEP (Appendix I7 EIS). This means that any deteriorating water quality in pools formed by subsidence in the Isaac River will be greatly diluted by the channel flow and will have no significant effect on the water quality in the Isaac River. Indeed, subsidence that has occurred to date in the Isaac River downstream of the EIS study area at BRM and Moranbah North Mine has had no influence on the condition and water quality of the Isaac River.

Ponded areas forming in subsidence troughs along 12 Mile Gully are predicted to be semi-permanent and therefore most at risk of containing degraded water quality in the dry season. Depending on the extent of actual subsidence that occurs in this area, it may be necessary to drain these ponds as described in Appendix I7. Runoff from subsided areas will generally be trapped by subsidence troughs, and hence sediment mobilisation from subsided areas is not likely to be significant.

5.8 Flood Events

The void space estimated to be created in the Isaac River channel for each 5-year block of project mining, along with the cumulative void total, is provided in Table 7 of the Geomorphic Impact Assessment of the EIS (Appendix I6). Assuming no infilling during a period of 20 years, the cumulative void volume created by subsidence in the river channel would total 1,309,033 m^3 (1,309 ML). This volume represents a worst-case scenario as no account has been taken of progressive infilling and changes to river cross-sections over time. Based on the past flow record, there is a 36 per cent chance of the subsidence voids created in the Isaac River that fall within the project area infilling over the period of mining.

The worst-case scenario regarding extent and depth of subsidence voids outside the Isaac River channel was assessed and mapped (Subsidence Water Resources Hydrology Assessment, EIS Appendix I7). The mapping of potential subsidence void ponding extents and volumes outside the Isaac River channel identified 44 ponding areas larger than two hectares. The combined total storage volume of the worst-case subsidence voids is estimated to be approximately 9,500 ML.

Estimated catchment flood flows for the Isaac River and the various creeks from the baseline study assessment were used for the project case hydraulic flood modelling. All flood events in the Isaac River (including small events such as the 1 in 5 AEP) have large flood flow volumes and, hence, the influence of subsidence from the project will not substantially alter flood hydrology because the subsidence voids are small compared to design flood hydrograph volumes.

As described in Appendix I5 of the EIS (Flood Hydraulics Technical Report), a flooding assessment estimated the magnitude of flood flows for a range of potential flood events. The assessment then considered flood hydraulics to estimate the levels, speed (velocity) and “energy” of the flood flow through watercourses and across floodplains. This assessment considered both the baseline situation (no project) and a project case scenario. The baseline flood hydraulic model results show that the velocities through the various creeks typically ranges from 1 to 3.5 metres per second (m/s) and stream power is in the range of 200 to 400 watts per square metre (W/m^2). These values are generally within the range of the modelled results from the ACARP 2012 guidelines. Flood hydraulic model results indicated that hydraulic parameters for the project case were generally within a similar range to that of the baseline condition. It is important to note that whilst hydraulic modelling for the project case indicated that localised higher velocities and stream power were likely at the upstream end of subsidence areas and un-subsided pillar areas, and lower velocities and stream power likely within the subsided panels, the modelling assumptions made in this study were conservative. The current flood hydraulic modelling technology is not capable of modelling dynamic morphological responses during floods with sufficient reliability that takes account of actual sediment supply variability and the geological conditions of beds and banks of river channels. As a result of the conservative assumptions made, the changes to velocity and stream power that were modelled for the project case are likely to be overestimated.

Whilst temporary morphological change and associated impacts to water quality (localised in subsided areas) may be expected following flood events, these effects are very likely to be temporary and will not impact the water quality of the Isaac River channel. As indicated in the Geomorphic Impact Assessment of the EIS (Appendix I6) waterways are expected to morphologically adapt to the subsided profile, and subsidence voids are expected to infill with sediment. As the riverbank adapts to the changes in hydraulic energy conditions, any bank erosion is likely to be localised, temporary and managed by soft engineering techniques such as timber pile fields and enhancing riparian vegetation coverage (EIS Section 7.3.4.5 - Surface Water). In addition, all flood events in the Isaac River (including small events such as the 1 in 5 AEP) have large flood flow volumes. Temporary changes to sediment levels associated with subsidence will not substantially alter local and downstream water quality because the subsidence voids are very small compared to design flood hydrograph volumes. It is important to note that subsidence has occurred to date in the Isaac River downstream of the EIS study area at BRM and Moranbah North Mine has had no influence on the condition and water quality of the Isaac River. Geomorphic response to subsidence has been effectively managed at those sites to date.

Mitigating options for increased erosion potential in tributaries and panel catchments across the project area have also been described in the EIS (Table 7-18 and Table 7-19, Section 7). Monitoring of risk areas throughout the operational phase will be undertaken and erosion risk managed once subsidence has occurred (EIS Section 7.3.5.2 Section 7). Mitigation and management strategies for subsidence have been already been implemented for BRM downstream of RHM. These are based on the principles of adaptive management, and will be applied to the management approach for the proposed project (EIS Section 7.3.5.3 Section 7).

5.9 Capture of Overland Flow

A submitter requested clarification of the project's impact on overland flow. The project does not require the capture of overland flow. Water captured throughwatercourse subsidence resulting from mining does not constitute overland flow nor interference with water for the purposes of the *Water Act 2000*. Accordingly, it does not require authorisation under a water licence. All mines in the region operate according to this principle.

The project impact on Isaac River flow volumes will not materially impact on the State's ability to meet the Water Resource (Fitzroy Basin) Plan 2011 environmental flow objectives.". Further discussion of this issue is provided in Sections 7.2.1.2 and 7.3.5 of the EIS and the hydrological impacts of subsidence are discussed in **Sections 5.4** and **5.6**.

An adaptive management strategy will be applied to subsidence impacts, following the principles and objectives set out in the Broadmeadow Subsidence Management Plan. Further discussion of this plan and description of specific management strategies that will apply to this project are provided in **Section 5.10**.

5.10 Mitigation of Subsidence Impacts

The geomorphic assessment (EIS Appendix I6) considered only the scenario of -5 to -6 m maximum subsidence expressed at the surface. The scenario where subsidence under the Isaac River is limited to approximately 2.5 m due to a reduced coal extraction thickness is referred to as the "mitigated" scenario within the EIS. However, it creates potential for perching the river and in some instances increases the risk of avulsion to occur during flood events. Reducing thickness of extraction under the river is not a mitigating action for all river erosion processes. Hence BMA is no longer considering this mitigation option for mining under the river.

The monitoring program currently implemented at BRM includes the monitoring of cracking and areas with increased potential for erosion. A similar monitoring program is proposed for the proposed project. In addition, the manual surveying of subsidence as mining progresses is routine and will form part of RHM operations.

Mitigation of the potential for gully and tunnel erosion from surface cracking where sufficient gradient exists in the landscape via ripping of cracks is standard practice in the central Queensland mining industry and will occur at RHM. Where the terrain is relatively flat and in particular where soils are heavier, self-sealing of cracks is observed at BRM.

The EIS contains a number of commitments to mitigate the impact of subsidence. These include:

- If necessary, construct drainage channels to drain permanent ponds created by subsidence so that downstream flows are not significantly reduced. A future assessment will be undertaken based on the actual level of subsidence and an assessment made of the net benefit in relation to constructing the drains.
- Subsidence management and monitoring for the BRM extensions will be integrated with existing BRM subsidence management plan for operations.
- Prior to the commencement of proposed project, a subsidence management plan will be prepared. The plan will be consistent with the BRM subsidence management plan and adopt measures that have been successful for BRM operations, covering:
  - — a description of the pre-subsidence landscape including:
    - ecological values;
    - land use and agricultural land suitability;
    - topography;
    - geology;
    - soil types and constraints;
    - watercourses, including cross sectional and longitudinal profiles;
    - surface water quality;
    - groundwater resources;
    - infrastructure; and
    - cultural heritage.
  - — environmental, social and economic values and environmental quality objectives;
  - — impacts of subsidence:
    - predicted subsidence effects (first order effects) including:
      - likely depth of subsidence;
      - post subsidence topography and formation of subsidence ponds; and
      - timing of subsidence.
    - geomorphic response (second order effects):
      - areas of increase channel erosion risk;
      - areas of avulsion risk;
      - hydraulic impacts; and
      - sediment transport impacts.
    - water quality and quantity (third order effects):
      - in-channel ponding;
      - overland flow capture and storage;

        - surface water quality; and
        - groundwater.
    - vegetation and habitat (fourth order effects):
        - trees and shrubs; and
        - grasses and pasture.
    - effects on infrastructure.
  - management approach:
    - proactive and preventative works;
    - responsive works and adaptive management based on observed outcomes;
    - rehabilitation; and
    - monitoring and corrective action.
  - reporting.
- Proactive measures, such as bank stabilisation works, will be implemented in advance of subsidence. Where works are required to repair surface cracks from subsidence or erosion, techniques that minimise impacts on remnant native vegetation will be used.
- An adaptive management approach is proposed to subsidence management, consistent with approaches currently in place for BRM and other mines in the Isaac River sub-basin. Basic principles of adaptive management rely on:
  - assessment of environmental and social risk associated with changes observed;
  - design of operational treatments appropriate to the significance of the risks associated with observed changes - operational treatments may include both proactive and reactive measures;
  - implementation of treatments;
  - monitoring against key response indicators to test effectiveness of the treatment;
  - re-evaluation of effectiveness of the implemented mitigation measures; and
  - adjustment of policies and practices.
- Based on experience managing subsidence at the BRM, the following controls will be implemented:
  - Proactive works as required to stabilise streams prior to subsidence, potentially including:
    - installing timber groynes/pile field retards or other toe of bank protection measures at the base of the channel banks (extending into the channel) to mitigate erosion undercutting the channel banks and to facilitate the creation of in-channel benches;
    - implementing toe of bank protection measures near the upstream limits of subsidence on the Isaac River - these measures will most likely also be in the form of timber groynes or pile fields; and
    - maintaining and enhancing high density vegetation cover on the Isaac River and other tributaries where potential for avulsion or cut-off is identified.
  - Where surface cracks do not self-seal, or are large enough and located such as to pose a safety risk, repair of surface cracking. This may include ripping the surface surrounding the cracks, regrading to a smooth surface profile, and revegetating the cracked areas. Techniques

will minimise disturbance to healthy vegetation. Grasses and other groundcover will be slashed rather than cleared to allow access and if vegetation is to be cleared, it will be cleared to ground level only.
  - Repair of erosion wherever this may result in loss of topsoil resources or degradation of downstream water quality.
  - Management of stock access prior to and during subsidence and until a stable landform is achieved.
  - Signage and fencing to restrict human and vehicle access to subsided areas where a hazard exists, or where this is necessary to allow vegetation to re-establish.
  - For more substantial cracks (predicted up to 0.5 m wide):
    - topsoil will be stripped and stockpiled;
    - clay material will be imported to fill and seal cracks;
    - topsoil will be respread once cracks have sealed; and
    - the area will be seeded with appropriate plant species.
- After subsidence has occurred in the 12 Mile Gully catchment:
  - assess the depth and volume of subsidence troughs;
  - monitor sediment deposition;
  - determine whether partial drainage of selected ponds is required to maintain overall flows from the 12 Mile Gully catchment; and
  - if partial drainage is required, design and construct channels to mimic natural channels as closely as possible, in particular creating a stable flow path.
- The Subsidence Management Plan will be revised annually.
- Subsidence management will be closely integrated with management of soils, terrestrial ecology and rehabilitation.
- Prior to commencement of mining under the Isaac River, Goonyella Creek and 12 Mile Gully, a baseline data set of existing stream conditions and influences will be collected. This will include:
  - establishment of monitoring points, typically across pillars which are the main focus for erosion and bank/channel instability;
  - collection of information based on the Index of Diversion Condition;
  - photographic transects;
  - aerial photography;
  - cross section and long section survey;
  - riparian vegetation assessment;
  - flow event information; and
  - qualitative geomorphological description.

  Consideration will be given to monitoring requirements in any guidelines that may be issued by EHP, to provide for consistency in monitoring across the sub-basin.
- Where monitoring indicates that performance outcomes are not being achieved in relation to subsidence or related areas of terrestrial ecology, aquatic ecology, soil management and rehabilitation, corrective actions will be undertaken and incorporated into the adaptive management approach to subsidence.

5.11 Flooding

There is potential for flood risk during the construction of the levee and minor impacts post-levee construction are discussed in the following areas of the EIS:

- Table 7-12 in Section 7.3.1 of the EIS summarises the potential impacts during construction of the levee and mitigation to reduce the impacts. Section 7.3.1 of the EIS also states that the construction phase is unlikely to adversely impact on flood occurrence or severity, particularly since the levee embankment would not store water against it until floods less frequent than the 1 in 100 AEP event.
- The flood modelling results in Appendix I5 of the EIS show an increase in floodplain waterway area for the project due to water flowing over some of the subsided panels.

At the time of the design of the northern levee, either:

- the unsubsided pillar area would be considered as an extension of the northern levee and investigated/designed accordingly, taking into account geotechnical investigations, geologic considerations and any updates to subsidence prediction models, or
- the northern levee may need to be extended further north within the future RH103 panel to natural, unsubsided ground.

As such, the statement in EIS Section 7.3.3.3 applies to the proposed engineered levee and the unsubsided pillar area acting as a levee: *"If a levee is used to provide flood protection for the MIA and mine access, subsidence of longwall panel RH103 will affect the levee by subsiding the embankment up to a maximum of six metres. The impacts to the physical integrity of the levee embankment may include reduced stability of the embankment in that section and increased risk of internal erosion failure (piping through embankment or foundation) due to cracking of the levee or the levee foundations. The crest level of levee embankment after subsidence would significantly reduce the flood immunity and would need to be reinstated back to design flood level requirements. Several options exist and would need to be evaluated in advance of planned subsidence of panel RH103."*

The purpose of the levee is to minimise the volume of water from regional flooding which would report to the mine water management system. This levee will be designed to meet the requirements of the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EHP 2013c) and provide a minimum of 1 in 1,000 AEP flood protection. The location of the levee will prevent interaction between regional flooding from the Isaac River and longwall panels RH101 and RH102 for events up to the 1 in 1,000 AEP flood event.

Section 2.3 of EIS Appendix I5 states that *"The bridge will be designed to provide a suitable level of flood immunity and also to minimise impediment to flood flows within the river channel or floodplain. These requirements will be determined during detailed design."* The AEP flood immunity of the bridge has not yet been determined. However, the flood inundation extents from EIS Appendix I5 for baseline and project conditions show that in the vicinity of the proposed bridge crossing, the river does not inundate the floodplain until floods less frequent than the 1 in 50 AEP to 1 in 100 AEP event. On this basis, the bridge will likely have a flood immunity of around the 1 in 50 AEP to 1 in 100 AEP event.

EIS Section 7.3.3.1 states that *"It is intended that the Isaac River bridge will be designed to provide minimal obstruction to flood flows and, hence, should have no significant impact on flooding."* Any impacts to flood levels or floodplain interaction are expected to localised. Changes to flood volume (and hence to downstream users) are likely to be insignificant and would only occur due to increases in floodplain interaction. Changes to timing of floods are expected to be insignificant.

A submission requested that the Isaac River flood model be extended further downstream to assess the potential impacts of the project. The existing model showed no impacts beyond the proposed levee embankment, and since the flow is in the subcritical flow regime, no additional modelling downstream is required.

5.12 Sediment Generation from River Bank Erosion

Sediment from bank erosion caused by subsidence has not been included in the sediment generation model as it is not expected to be significant following adoption of mitigation measures. EIS Appendix I8 Section 5.2.6 provides a discussion of the potential water quality impacts from sediment erosion without mitigation. However, potential bank erosion has been considered through the application of the BSTEM. BSTEM is an Excel-based model that simulates the hydraulic and geotechnical processes that contribute to mass failure (the bank stability model) and fluvial scour (the toe erosion model) in stream banks.

BSTEM model assumptions and results are summarised in **Appendix C**. Scenarios considered a typical bank of the Isaac River located over a pillar zone during moderate and extreme flows for a range of event durations. This location is susceptible to bank erosion due to rapid drawdown of the water surface post subsidence. For baseline conditions, the estimated toe erosion is predicted to be minimal. However, following subsidence, the toe erosion is significant, with an estimate of up to 25 m of toe erosion from a single large-scale event. This is likely to be an overestimate due to the conservative assumption of erodible silt for bank material.

Measures to prevent this impact and provide protection to the toe of the river bank have primarily involved the use of timber pile fields, as shown in **Figure 5-8**. Timber pile fields aim to reduce flow velocity against the toe of the bank, protecting the bank but also resulting in sediment deposition and vegetation regeneration. Their intent is to perform the required function of bank stabilisation but also to provide conditions whereby vegetation can be established and perform the same role as the structural works once their design life is exceeded. Timber pile fields at LW104-5 pillar have maintained a bench against toe of bank, mitigating the elevated bank erosion risk while both longwalls have infilled.

Where pile field mitigation works have been delayed, observations of bench retreat and bank erosion have been up to 10 m following substantial flow events within the Isaac River.

BSTEM was also used to represent a mitigation scenario for the construction of pile fields over the pillar zone. In this case, the toe erosion model outputs indicate that a pile field consisting of four pile field retards will be sufficient to reduce total toe erosion volumes to the levels estimated for the pre-subsidence scenario, whilst a pile field consisting of six pile field retards will reduce total toe erosion volumes to a negligible level for both moderate and large flow events. These modelling results should be viewed with caution given the lack of calibration data. However, field observations show that pile fields have performed well in protecting bank toe erosion to date.

The EIS has assessed avulsion risks qualitatively based on the quantitative hydraulic modelling of extreme events. A quantitative long term geomorphic landform stability assessment has not been undertaken as there are no suitable models which deal with subsided terrain. The assessments undertaken, and proposed mitigations, are considered appropriate to the identified risk.

The meander cutoff through panel 205 is highly likely and the system should be managed accordingly to allow that to occur. The avulsion risk in other panels is driven by extreme events with low probability of occurrence. The risk in some of these panels could be mitigated with reasonable earthworks that do not cause more environmental harm than they mitigate. Throughout the operation, avulsion risk should be partly mitigated through maximising vegetation coverage.

Figure 5-8 Timber Pile Fields at LW104-5

5.13 Water Quality Criteria

Water quality objectives (WQOs) for total and dissolved levels of metals are provided in Table 4-1 of EIS Appendix I8. WQOs for most parameters were derived from the Environmental Protection (Water) Policy (EPP (Water) 2011 and the ANZECC (2000) guidelines. The following sections outline WQOs for those parameters that differ from these sources. The proposed monitoring program is described in **Section 5.18**.

Modified WQOs for EC, dissolved aluminium, copper and chromium were taken from the existing EA (EPML00853413, dated 6 September 2013), given that mine water arising from the project's operations will be incorporated into the existing GRB mine complex water management system. These modified WQOs were previously approved by EHP. Discharges will not exceed the volumes or water quality criteria that have already been approved for the GRB project. The guideline values for metals derived from the GRB mine complex EA were published on 6 September 2013 and relate to trigger levels of metals for the section of the Isaac River immediately below the release point from GRM. Guideline values for metals to protect several environmental values are also presented in Table 4-3 of Appendix I8 of the EIS.

The WQOs were aligned with the findings of the ACARP report (2012). For example, the recommended value of 2,000 µS/cm for electrical conductivity (EC) will provide protection for more than 95 per cent of aquatic species, in accordance with the findings for ecotoxicity of the Artificial Mine Water Solution 1 applied in the ACARP study (where 2.433 mS/cm (or 2,433 µS/cm) was identified as the EC concentration at which 95 per cent ecosystem protection could be achieved).

Locally derived values were used on the basis of background water quality data for those parameters that were identified as existing at natural levels that were higher than the recommended guidelines. This was in accordance with the ANZECC (2000) guidelines.

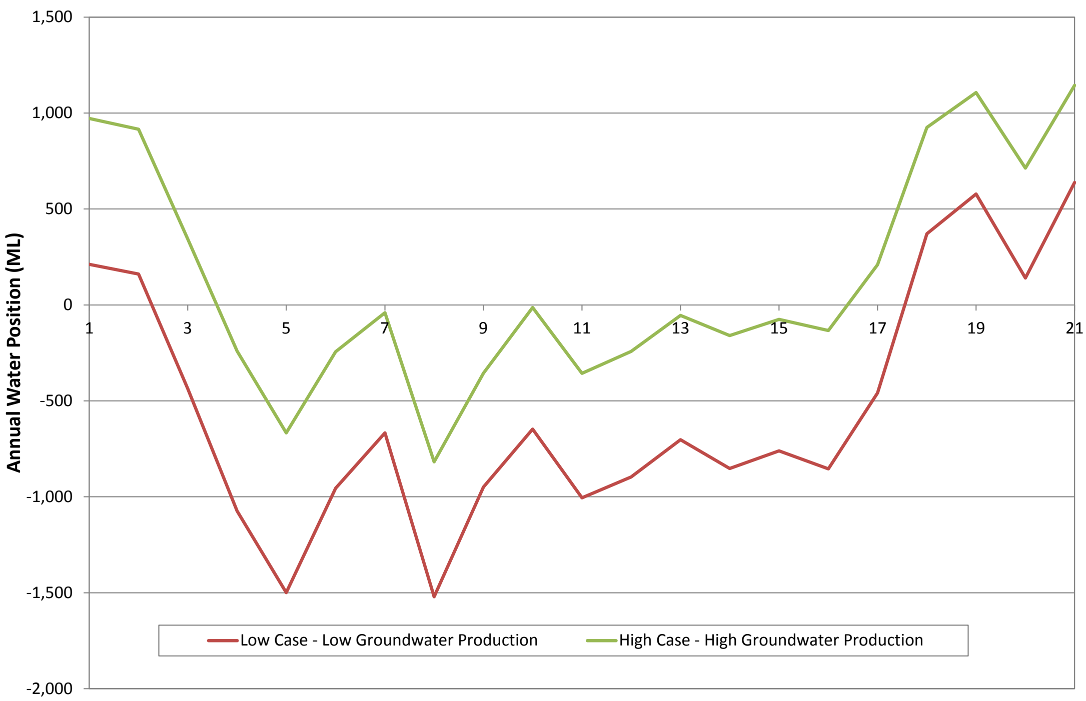
The WQOs for EC were aligned with the findings of an ecotoxicology report commissioned by ACARP in 2012, and were also developed in accordance with the EPP (Water) and Queensland Water Quality Guidelines (QWQG 2009).

All mine water produced by the project will be transferred to the adjacent GRB mine complex for reuse and management within the existing GRB mine water management system. If mine water needs to be released during periods of water surplus (e.g. during the wet season), the releases will be subject to the regulatory conditions of the existing EA for the GRB mine complex (EPML00853413). The circumstances under which releases may occur from the existing discharge point to the Isaac River, and the related EA conditions applied to the GRB mine complex, are further detailed in Section 4.1 of EIS Appendix I8. The transfer of water between storages within the existing GRM mining lease is an operational responsibility and is not controlled by way of EA conditions. The ultimate storage location for water from the project will be determined by the existing site management once the project becomes operational and will depend on the prevailing storage inventory and coal processing demands. However, the transfer of water from the project to GRM will not occur into GS4A dam, which is the licenced point of discharge for GRM, unless site management consider that appropriate conditions exist to ensure compliance with the water release conditions.

The results of water balance modelling show the site operating above the regulated storage capacity but within the capacity of the site, including contingency storage in low priority mining pits. Model results show only a minor increase in stored water volume requirements at GRB, in the order of 3 per cent, due to the addition of water from the project. This minor increase in stored water volume can be accommodated in GRB's existing storage capacity.

Figure 5-9 below shows the high and low case for potential water production from RHM and the estimated demand for processing of coal at the RHM CHPP. The figure highlights that RHM operations will consume more water than they produce over the life of mine.

Figure 5-9 Predicted Water Balance for RHM



The GRB mine complex is part of the Fitzroy Basin Pilot Mine Water Release Scheme administered by the Queensland Department of State Development, Infrastructure and Planning (DSDIP), which was initiated for the 2012/2013 wet season.

The scheme was developed in response to adverse effects on the productivity of a number of coal mines in the Fitzroy Basin as a result of the retention of excess water since the 2008/2009 wet season.

The pilot scheme was structured to provide for improved release opportunities whilst maintaining a controlled and managed form of release. As part of the scheme an amended EA was issued for the GRB mine, incorporating a modified downstream limit on EC within the Isaac River and other receiving waters, as well as changes in the flow rate triggers defining the commencement and cessation of release events. As a result of the pilot scheme, an Enhanced Environmental Monitoring Program was developed and implemented to ensure that water quality in the Fitzroy catchment is suitable for drinking and other downstream uses.

A report on the effectiveness of the pilot release scheme found that during the 2012/2013 wet season, there was a “17 per cent reduction in legacy water volume” for the GRB mine complex, and there were “no measured effects on salinity levels downstream of the Isaac/Connors confluence” (i.e. as a result of releases from the 16 mines in the Isaac and Connors River catchments) (Droop and Jacob 2013 p12-13). A short term increase in EC against background levels was attributed to mine releases upstream of the Isaac River at Deverill. However, EC subsequently returned to a background level “not inconsistent with background water quality” once releases ceased (Droop and Jacob 2013 p13).

As discussed further in **Section 7.2**, the RHM project will not adversely impact on the capability of the GRB mine water management system to comply with the current EA conditions for flow release limits and salinity compliance limits applicable in the Isaac River downstream of the mine releases.

5.14 Water Quality Data

The existing mine water management regime at GRM is discussed in Section 5.2 of Appendix I2 of the EIS and existing release criteria are described in Section 7.2.3.4 of the EIS. Water quality objectives and guidelines for the GRB complex are detailed in Section 7.2.6.2 of the EIS, while historical water quality testing data (for the period August 2010 to April 2011) at the GRB complex is described in Section 7.2.6.3 of the EIS.

The extent of water quality data assessed for the EIS was considered to be appropriate at the time of its preparation, given that approval had already been granted for the GRB mine complex on the basis of a similar level of information (and monitoring period). It was not necessary to determine reference values in accordance with the QWQG because there is an existing EA which will be applicable to the proposed project. In addition, water quality data are being provided to EHP as part of ongoing regulatory monitoring requirements, and the monitoring methodology has previously been accepted by EHP. In the event of releases from the GRB mine water management system, laboratory results are provided to EHP within 28 days of each release event.

A summary of release events for the 2012/2013 wet season is shown in **Table 5-5**.

Table 5-5 Summary of Exceedances for Release & Discharge Events at GRB Mine Complex for 2012/2013 Wet Season

Event Type	Date/Duration	Exceedance Observed	Trigger Level	Actions Taken
Controlled Release	15-16/07/2012 30.5 Hrs	Table W3 Release Contaminant Limits. Dissolved Zn(23 µg/L), U(1.9 µg/L) & NO_3(1800 µg/L)	Zn – 8 µg/L U – 1 µg/L NO_3 - µg/L	In compliance with Condition W6(1) no action was taken
Uncontrolled Release from authorised release point	10/09/2012 6 Hrs	Table W4 Receiving Waters Minimum Flow	≥ 3 m^3/s	Incident report sent, investigation conducted
Uncontrolled Discharge from GRM sed dams	16/10/2012 20 Hrs	Table W4 Receiving Waters Minimum Flow. Condition W2, Table W1 Release of Waters other than from Authorised Discharge Point	≥ 3 m^3/s Discharge point 1, GS4a Dam (Eureka Ck)	Incident report sent, investigation conducted
Controlled Release	2-6/03/13 108.25 Hrs	Table W3 Release Contaminant Limits. Dissolved Zn(21µg/L) & Ni(14 µg/L)	Zn – 8 µg/L Ni – 11 µg/L	Zn - In compliance with Condition W6(2)(a) no action was taken Ni – As per W6(2)(b)
Controlled Release	26-27/04/2013 25.33 Hrs	Table W3 Release Contaminant Limits. Dissolved Ni(13 µg/L)	Ni – 11 µg/L	In compliance with Condition W6(1) no action was taken
Uncontrolled Release from authorised release point	28/04/2013 15 Hrs	Table W4 Receiving Waters Minimum Flow	≥ 3 m^3/s	Incident report sent, investigation conducted

A number of uncontrolled releases occurred where receiving waters did not meet the minimum flow requirement. For each of these cases an investigation was carried out and a report provided to EHP. In other controlled releases a number of trigger levels were exceeded, but only one water quality criterion was exceeded. For the March 2013 release it was written in the 28 day release report submitted to EHP that nickel results were measured to be above background monitoring results; however, the potential environmental harm impacts were deemed to be minor as nickel concentrations were only 3 µg/L above the release contaminant limit in mine affected water and 4 µg/L in downstream receiving waters. Further dilution of water downriver would be significant enough to further dilute the concentration of nickel in the receiving waters and reduce the possibility of significant environmental harm. Investigation of results observed in samples collected from Goonyella Creek indicated elevated levels of nickel in these samples and that the release activities of upstream users was influencing the results and those of results observed for samples collected by GRM.

It is noted that detection limits were not included in the EIS. However it was assumed that a NATA-certified laboratory would be engaged to undertake the analysis using standard methodology and detection limits. Hence it is not considered necessary to amend the EIS to include this information at this stage.

Additional locations at 12 Mile Gully (RHSW 1 (Upstream) and RSHW8 (Downstream)) and Goonyella Creek (RHSW3) were proposed for ongoing water quality monitoring in Section 6 of EIS Appendix I8. These locations are depicted on Figure 6-1 of EIS Appendix I8. The same section also provides details of monitoring parameters and frequencies for the proposed expanded monitoring program. Refer also to responses contained in **Section 5.17** of this report.

5.15 Water Discharges

The definition of mine water adopted in the EIS, specifically in Appendix I2 (Mine Water Management Overview Report) and Appendix I3 (Mine Water Balance Report), includes all sources of runoff and wastewater. The definition of mine water therefore is:

- pit water, tailings dam water, processing plant water;
- water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the *Environmental Protection Regulation 2008* if it had not formed part of the mining activity;
- rainfall runoff that has been in contact with any areas disturbed by mining activities that have not yet been rehabilitated. This excludes rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed to manage runoff containing sediment only, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water;
- groundwater that has been in contact with any areas disturbed by mining activities that have not yet been rehabilitated;
- groundwater from the mine’s dewatering activities; and
- a mix of mine-affected water and other water.

The water balance model undertaken for the project (Appendix I3 of the EIS) was undertaken using the widely used GoldSim software modelling package, and built upon the operational GoldSim model of the GRB mine complex developed by Engeny (2013 model last modified February 2013). This water balance model builds onan operational water balance for an existing mine (GRB mine complex)which has been verified and refined as part of the operational process.

The water balance modelling described in Appendix I3 of the EIS (Water Balance Technical Report) which addressed all rainfall runoff and other sources of waste water in the project area indicates that the project will:

- not adversely impact the capability of the GRB mine water management system to comply with the EA criteria for salinity compliance limits applicable in the Isaac River downstream of the mine releases;
- not significantly impact on the requirements for external water supply;
- not significantly change to the water quality in the Isaac River downstream of the GRB mine complex;
- not adversely impact the GRB mine water management network which has sufficient storage capacity (including use of low priority pits for contingency storage) to cater for maximum mine water volumes from the combined GRB mine complex and proposed project operations that could occur (based on climate extremes evident in available historical data); and
- comply with the EA conditions for release of mine water from GS4A for salinity and flow criteria.

As the project is an underground mine, the collection of mine water from disturbed catchment runoff is limited and hence groundwater dewatering will be the main source of mine water generated. Groundwater from the project will be discharged to the GRB mine water management system via a 50 ML transfer dam. Under normal conditions any surplus water produced by the project would be used by the GRB mine complex operation, which will include processing coal from the RHM and the BRM extension, and GRB water requirements exceeding its external supply.

During periods of high rainfall, any additional mine water from project may require additional management actions at GRB mine complex (e.g. additional storage, reduce minimum inventory) (Appendix I2 of the EIS). The mine water management at GRB mine complex has the capacity to manage the site inventory for the majority of the time, although there is a requirement for use of low priority pits as an emergency contingency storage (Section 6.4 of EIS Appendix I2). Under the current EA for the GRB mine complex, the mine water management system needs to have sufficient capability to have no unauthorised discharge of mine water for wet season rainfall events up to a 1 in 10 ARI wet season. As discussed in Section 4.1 of Appendix I3 of the EIS (Water Balance Technical Report), water balance modelling indicated that there were only three exceedance events over the 108 year modelling period for both the baseline and the project scenarios. This demonstrates that the GRB mine water management system has sufficient capability to manage wet seasons up to 1 in 10 year ARI, and that the project will not adversely impact the existing mine water management system.

As indicated in Section 1.3.3 of Appendix I3 of the EIS (Mine Water Balance), the water balance for the project is predicted to vary between surplus and deficit over the life of the mine, which is due to the balance between the pre-mining drainage of groundwater and the production schedule. There are three phases of water positions during the project life:

- Years 1 to 3 – initial surplus – this is a result of the pre-mining drainage of groundwater coupled with lower production at project start-up;
- Years 3 to 17 – deficit – this is due to the production demand being in excess of the projected groundwater generation; and
- Years 18 to 23 – average annual surplus of approximately 640 ML/year – projected groundwater generation peaks after the peak in production demand.

The initial surplus between years 1 and 3 is a result of pre-mining drainage of gas and associated groundwater. This potential surplus may vary between 200 and 1,000 ML. This short term surplus would be integrated into the GRB mine complex operations for reuse. This storage requirement is temporary because if not consumed by the GRB mine complex, the surplus will be consumed in processing RHM coal after year 3 as its annual water balance is predicted to be in deficit.

The EC of groundwater in the project area has been well characterised and found to be highly variable. Nonetheless, irrespective of the variability in the local groundwater's EC, all excess mine water generated by the project will be managed by the existing GRB mine water management system and thus any discharges will need to comply with existing EA (EPML00853413) conditions for the GRB mine complex. Modelling (Appendix I3 of the EIS) has shown that the project's mine water will not impact on the ability of the GRB mine complex to achieve compliance with the existing EA. Furthermore, the receiving water and discharges will continue to be monitored to ensure that they remain compliant with their respective 2,000 and 10,000 µS/cm trigger limits for EC.

The water balance modelling undertaken in Appendix I3 of the EIS (Mine Water Balance) estimates the salinity of the system. The GRB mine complex EA also refers to the monitoring of other water quality parameters such as pH, turbidity and sulphate. Whilst salinity is considered the dominant contaminant for modelling purposes, it has been assumed that the GRB mine complex will also monitor these additional parameters in accordance with the EA before commencing a release.

5.16 Leachate

The RHM MIA (including the rejects stock pile area) will be designed to separate mine-affected water (definition as documented in the EHP (2013b) Model Water Conditions for Coal Mines in the Fitzroy Basin) from clean water. Mine-affected water will be collected and diverted into the mine water management system described in Section 2.3 of Appendix I2 of the EIS. Minimising the volume of mine-affected water is a standard practice at BMA greenfield operations.

Historical studies (1992 to 2007) as well as the studies undertaken for the EIS have shown that the likelihood of acid generation or potential toxicants in drainage from stored mineral waste is low. The runoff and seepage water quality resulting from contact with mineral waste materials is expected to contain dissolved metal and sulphate concentrations that are well below the Australian livestock drinking water guidelines (ANZECC 2000) (see EIS Appendix H – Table 3-5 (overburden), Table 3-12 (coal roof and floor), Table 3-19 (coarse rejects), Table 3-26 (tailings)). Sulphate and calcium concentrations in leachates may exceed the Australian livestock drinking water guidelines, but given the re-use of decant water from the tailings dams in the CHPP, and the semi-arid to arid climate of the region where mean annual evaporation exceeds the mean annual rainfall by approximately four times, migration of metal (and sulphate) contaminants via seepage through the tailings will be limited as will the potential risk for drainage to migrate off site.

Even though the current acid mine drainage risk is low, it is proposed to undertake laboratory scale kinetic leach column tests during the project's mining phase to improve predictions on seepage quality and release rates of environmentally important metals. This approach is consistent with the water/leachate quality monitoring currently being undertaken at GRB mine complex under the existing EA (EPML00853413). The list of parameters for monitoring leachates/water quality has been refined over a long period of time and is reflective of the cumulative knowledge collected to date.

The geochemical testing undertaken for the EIS included sampling and analysis of 45 drill cores across the EIS study area. This showed that the nature of the waste materials is consistent across the site and that its spatial variability is minimal. The study design, sampling and testing methodologies were consistent with industry practice, other coal mines in Queensland, and accepted guidelines including:

- DERM (1995). Assessment and management of acid drainage, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland, QLD, Australia.
- DITR (2007). Managing acid and metalliferous drainage, Leading Practice Sustainable Development Program for the Mining Industry, Canberra, Australia.
- Australian Mineral Industries Research Association International Limited (AMIRA) (2002). Prediction and Kinetic Control of Acid Mine Drainage. Acid Rock Drainage (ARD) Test Handbook, May 2002.
- The International Network for Acid Prevention (INAP), 2009. Global Acid Rock Drainage Guide (GARD Guide).

In addition to this testing, further geochemical characterisation of mineral waste materials is planned for the project's disturbance areas ahead of mining to confirm the expected geochemical characteristics of these materials. This will include characterisation of reject materials (coarse rejects and dewatered tailings) to be undertaken to verify their expected geochemical nature and laboratory scale kinetic leach column tests.

Seepage/leachate quality has been compared with the Australian Livestock Drinking Water Guidelines because the project is located in a sparsely populated rural area where surrounding areas have historically, and are currently, used for cattle grazing where mining activity is not currently occurring. The majority of the landscape not disturbed by mining activity has previously been cleared and maintained for grazing. Therefore, the principal use of surface and groundwater in the region is for stock watering.

To assist in identifying risks to downstream aquatic ecosystems, existing geochemical data from the GRM mine complex are provided in the tables below which have been reproduced from EIS Appendix H – Geochemical Assessment of the EIS. The results have been compared to the trigger values for the 95 per cent protection of aquatic species (ANZECC 2000). The water-extractable dissolved metal concentrations for the mineral waste samples are generally below the trigger values, where guideline values exist. The concentrations of aluminium, chromium and copper in some samples exceed the trigger values (ANZECC 2000) but it is noted that they do not exceed (or marginally exceed) the Release Contaminant Trigger Investigation Levels (1.530 mg/L (Al), 0.003 mg/L (Cr) and 0.003 mg/L (Cu)) under the current EA (at GRB) based on the 80th percentile of four background sites and comparison with upstream values. Elevated concentrations of arsenic, molybdenum and nickel above the ANZECC (2000) trigger values and/or Release Contaminant Trigger Investigation Levels are noted in some samples, but it should be recognised that the water extractable dissolved metal concentrations are conservative and likely to overestimate the actual concentrations observed in the field because metal leachability analysis was completed on continuously agitated pulverised sample suspensions. It is noted that arsenic is not amongst the contaminants of potential concern in the Contaminant Trigger Investigation Levels (under the existing EA for GRB), which been refined over a long period of time and reflect the cumulative observations collected in the field to date.

Table 5-6 Water Extractable Dissolved Metal Concentrations in Composited Overburden Samples

URS composite number		GRM 01, GRM 05-08	GRM 02, GRM 14-16	GRM 03, GRM 17	GRM 04, GRM 09-13	GRM 18	GRM 19	GRM 20	GRM 21	GRM 22
No. of Samples		5	4	2	6	1	1	1	1	1
Parameters	**Aquatic Ecosystem 95% Protection[a]**	Siltstone#	Claystone#	Carbonaceous Claystone#	Sandstone#	Sandstone/ Silstone	Conglomerate	Siltstone/ Claystone/ Sandstone	Shale	Mudstone
Ca	--	1.4	1.0	2.7	1.3	<1	<1	<1	<1	<1
Mg	--	1.0	1.0	1.2	1.0	<1	<1	<1	<1	<1
SO_4^{2-}	--[b]	137	75	79	75	11.6	22.4	23.3	4.6	10.2
Al	0.055	0.75	0.18	0.16	0.50	0.04	0.04	0.04	0.08	0.11
As	0.037[c]	0.096	0.026	0.009	0.090	0.006	0.005	0.089	0.003	0.004
B	0.370	0.10	0.03	0.01	0.06	<0.1	<0.1	<0.1	<0.1	<0.1
Cd	0.0002	0.0003	0.0001	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cr	0.001[d]	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ID	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.0014	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	0.0034	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	0.0006[e]	0.0003	0.0001	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mo	0.034[f]	0.043	0.015	0.014	0.029	0.002	0.010	0.010	0.002	0.009
Ni	0.011	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	0.11	0.02	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
U	ID	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.008	0.005	0.003	0.003	0.005	<0.005	<0.005	<0.005	<0.005	<0.005

All values in mg/L. #Mean value; where values were less than the limit of reporting (LOR), the LOR value was used for calculation purposes.

[a]ANZECC (2000). ID = insufficient data to derive reliable trigger value.

[b]No guideline value. Sulphate concentration in EA is correlated to EC value (10,000 µS/cm). EC (1:5) for all samples tested ranged from 138 to 2,370 µS/cm.

[c]Sum of arsenic (III) and arsenic (V).

[d]Value for chromium (VI)

[e]Value for inorganic mercury

[f]Low reliability trigger value (ANZECC 2000)

Table 5-7 Water Extractable Dissolved Metal Concentrations in Both Composited Coal Roof and Coal Floor Samples

URS composite number		GRM 23	GRM 24	GRM 25	GRM 26	GRM 27	GRM 28	GRM 29	GRM 30	GRM 31	GRM 32	GRM 33	GRM 34
Sample Type		Roof	Roof	Roof	Roof	Roof	Floor	Floor	Floor	Floor	Floor	Floor	Floor
Parameters	Aquatic Ecosystem 95% Protection[a]	Carbonaceous Claystone	Siltstone	Siltstone (Shale/ Siltstone)	Sandstone/ Siltstone/ Claystone	Shale	Siltstone	Siltstone	Shale / Sandstone	Sandstone	Claystone	Siltstone	Carbonaceous Mudstone/ Siltstone
Ca	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mg	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SO_4^{2}	--[b]	20.9	15.2	14.6	14.9	104	8.0	11.2	9.1	21.0	18.7	43.3	18.4
Al	0.055	0.02	0.12	0.05	0.07	<0.01	0.26	0.15	0.19	0.04	0.16	0.03	0.09
As	0.037[c]	<0.001	0.002	0.019	0.039	<0.001	<0.001	0.003	0.009	0.010	0.003	0.019	0.005
B	0.370	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cd	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cr	0.001[d]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	0.0006[e]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mo	0.034[f]	0.002	0.008	0.005	0.010	0.006	0.003	0.002	0.008	0.006	0.008	0.006	0.004
Ni	0.011	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	0.11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
U	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

All values in mg/L. [#]Mean value; where values were less than the limit of reporting (LOR), the LOR value was used for calculation purposes.

[a]ANZECC (2000). ID = insufficient data to derive reliable trigger value.

[b]No guideline value. Sulphate concentration in EA is correlated to EC value (10,000 µS/cm). EC (1:5) for all samples tested ranged from 138 to 2,370 µS/cm.

[c]Sum of arsenic (III) and arsenic (V).

[d]Value for chromium (VI)

[e]Value for inorganic mercury

[f]Low reliability trigger value (ANZECC 2000)

Table 5-8 Water Extractable Dissolved Metal Concentrations in Coarse Reject Samples

Parameters	Aquatic Ecosystem 95% Protection[a]	Riverside				Goonyella			
		ca. 2003	May 2009	Dec 2009	May 2011	Mid 2006	ca. 2008	Mid 2010	May 2011
Ca	--	12	<1	<1	2	24	31	143	13
Mg	--	23	<1	<1	2	17	33	83	12
SO_4^{2-}	--[b]	1043	108	383	357	597	83	699	171
Al	0.055	<0.01	0.87	0.01	0.04	0.02	<0.01	0.21	0.01
As	0.037[c]	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
B	0.370	0.3	0.2	0.2	0.2	0.1	<0.1	<0.1	0.2
Cd	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cr	0.001[d]	<0.001	0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Co	ID	0.002	<0.001	<0.001	<0.001	<0.001	0.023	<0.001	<0.001
Cu	0.0014	0.002	0.003	<0.001	0.001	0.001	<0.001	0.003	0.002
Pb	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	0.0006[e]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mo	0.034[f]	<0.001	0.012	<0.001	0.005	0.011	0.001	0.018	0.001
Ni	0.011	0.001	0.001	<0.001	<0.001	<0.001	0.059	0.001	<0.001
Se	0.11	0.02	0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01
U	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

All values in mg/L. [#]Mean value; where values were less than the limit of reporting (LOR), the LOR value was used for calculation purposes.

[a]ANZECC (2000). ID = insufficient data to derive reliable trigger value.

[b]No guideline value. Sulphate concentration in EA is correlated to EC value (10,000 µS/cm). EC (1:5) for all samples tested ranged from 138 to 2,370 µS/cm.

[c]Sum of arsenic (III) and arsenic (V).

[d]Value for chromium (VI)

[e]Value for inorganic mercury

[f]Low reliability trigger value (ANZECC 2000)

Table 5-9 Water Extractable Dissolved Metal Concentrations in RS1 and GS1 Tailings Samples

Parameters	Aquatic Ecosystem 95% Protection[a]	Riverside					Goonyella				
		ca. 2008	Nov 2010	Dec 2010	Jan 2011	Mar 2011	May 2006	Nov 2009	May 2010	Nov 2010	Apr 2011
Ca	--	38	139	29	333	103	2792	2218	76	364	14
Mg	--	41	139	25	121	83	392	548	64	207	9
SO_4^{2-}	--[b]	1,191	2,472	1,030	1,536	1,205	7,833	8,301	1,012	2,196	363
Al	0.055	0.10	<0.01	0.02	0.02	0.03	4.89	0.04	0.02	0.02	0.07
As	0.037[c]	<0.001	<0.001	<0.001	<0.001	<0.001	0.009	<0.001	<0.001	<0.001	<0.001
B	0.370	0.2	0.2	0.2	0.1	<0.1	<0.1	0.1	0.1	<0.1	0.2
Cd	0.0002	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cr	0.001[d]	0.005	0.002	0.001	0.002	<0.001	0.003	0.001	<0.001	<0.001	0.002
Co	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.0014	<0.001	<0.001	<0.001	<0.001	0.001	0.004	<0.001	0.002	<0.001	<0.001
Pb	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Hg	0.0006[e]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mo	0.034[f]	0.124	0.002	0.005	0.009	<0.001	0.032	0.004	0.010	0.006	0.009
Ni	0.011	<0.001	0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Se	0.11	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
U	ID	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

All values in mg/L. [#]Mean value; where values were less than the limit of reporting (LOR), the LOR value was used for calculation purposes.

[a]ANZECC (2000). ID = insufficient data to derive reliable trigger value.

[b]No guideline value. Sulphate concentration in EA is correlated to EC value (10,000 µS/cm). EC (1:5) for all samples tested ranged from 138 to 2,370 µS/cm.

[c]Sum of arsenic (III) and arsenic (V).

[d]Value for chromium (VI)

[e]Value for inorganic mercury

[f]Low reliability trigger value (ANZECC 2000)

5.17 Cumulative Impacts

The Release Scheme Evaluation Report (Gilbert & Sutherland and Marsden Jacob Associates 2013) indicates that whilst elevated EC levels were measured at Deverill, the effect was short-lived with EC levels following release periods reducing to levels consistent with pre-release levels. The monitoring location at Deverill is located immediately downstream of the pilot scheme participant mines and the size of the flow event provided an opportunity for the mines to release stored water which lead to EC levels that were elevated above what would be background levels without release. This study concluded that the Pilot Water Release Scheme had not materially affected the salinity levels downstream of the participant mines, and that the basin and catchment-scale salinity behaviour within the Fitzroy Basin appears characterised by diffuse sources of salts, both natural in origin as well as influenced by previous and current catchment management practices.

Any mine-affected water from the project that discharges into the receiving environment will be subject to EA conditions designed to protect local and downstream environmental values. In addition, the project will operate under all relevant guidelines and policies that are aimed at mitigating cumulative impacts in the Fitzroy River Basin.

Further to the Pilot Water Release Scheme, the EHP has recently issued an operational policy that provides guidance to the mining industry in the Fitzroy River Basin in relation to releases of mine-affected water under enhanced EA conditions and management of cumulative impacts (EHP 2014). This policy is designed to provide protection to local environmental values located downstream of mine water release points through the requirement for mines to conduct a detailed assessment on the localised impacts of these releases. The policy also specifies acceptable water quality limits for downstream locations that are subject to cumulative impacts from mine-affected water releases across the Fitzroy River Basin.

See also information provided at **Section 5.13**

5.18 Water Quality Monitoring

Water quality monitoring will be carried out for the criteria described in **Section 5.13**. The proposed additional monitoring locations for 12 Mile Gully (RHSW1) and Goonyella Creek (RHSW3) are located upstream of the operational mining areas and will not be subject to subsidence impacts. These locations will act as controls for determining the extent of impacts arising from subsidence downstream. Refer to Figure 6-1 of EIS Appendix I8 for the proposed locations of RHSW1 and RHSW3, and Figure 1-5 of EIS Appendix I7 for estimated depths of subsidence resulting from the RHM's operations.

The Receiving Environment Monitoring Program (REMP) for the GRB mine complex, as per the existing EA (EPML00853413), will also address the project's monitoring requirements. There may be slight variations to the REMP as the project progresses. Biological monitoring of macroinvertebrates is required by the current EA, along with the development of a subsidence management plan which includes assessment of the impacts of subsidence on watercourses and floodplains and an ongoing monitoring, evaluation and maintenance program (including baseline assessment, and monitoring of surface water and groundwater quality). Further discussion of the water quality objectives can be found in **Section 5.13**.

Table 5-10 Proposed Surface Water Monitoring Locations (adapted from Table 6-2 of EIS Appendix I8)

	Site Description	GIS Coordinates	
		Latitude	Longitude
Upstream Background Monitoring Locations (Controls)			
RHSW1	12 Mile Gully	-21.740032	148.053816
RHSW2	Upper Isaac u/s Red Hill	-21.7081	148.042489
RHSW3	Goonyella Creek	-21.712069	148.020328
Downstream Monitoring Locations			
RHSW7	Upper Isaac	-21.801764	147.994955
RHSW8	12 Mile Gully Downstream	-21.78033	148.02174
RHSW9	Isaac River Rail Bridge	-21.855446	147.973224
RHSW10	Lower Isaac	-21.870222	147.975359

5.19 Sulphate Monitoring Results

A quality assurance assessment has been conducted on the 2010-2011 water quality dataset. This assessment has revealed that the unit of measure for sulphate is incorrect for concentrations in the thousands. These higher sulphate concentration data (e.g. in Upper Eureka Creek) presented in Appendix A of the Red Hill Surface Water Quality Technical Report (dated 4 October 2013) are in microgram per litre (µg/L). Appendix A has been amended and re-issued (**Appendix D**). Table 7-9 (Section 7) of the EIS has also been amended to reflect Appendix A. The revised table is provided below as **Table 5-11**. As a result of correction of this error, the median sulphate value for Fisher Creek was reduced from 2.0 mg/L to 1.0 mg/L and from 2.6 mg/L to 2.2 mg/L for Upper Eureka Creek. There is no change to the status of sulphate monitoring results in relation to the WQO (all median results are well below the WQO of 1,000 mg/L).

Table 5-11 Median Values for Physico-Chemical Parameters – (2010-2011)

Site	Number of Samples (n)	Total suspended solids (TSS) (mg/L)	EC (µS/cm)	Sulphate (mg/L)	pH (pH units)	Ammonia N (µg/L)	Turbidity (NTU)
Fisher Creek	12	**98**	103	1.0	7.3	10	**371**
Platypus Creek	11	**116**	77	1	7.2	10	**262**
Upper Eureka	51	**183**	170	2.2	7.4	20	**238**
Upper Isaac	45	**340**	170	2	7.8	20	**450**
Lower Isaac	51	**380**	220	4.8	7.8	10	**597**
Water Quality Objective		30	2,000	1,000	6.5 - 8.5	20	50

Note: Bold denotes median values exceeding water quality objectives

5.20 Management Strategy

5.20.1 Context of Water Quality Exceedences

Water balance modelling described in Section 5.1 of Appendix I3 of the EIS (Water Balance Modelling) shows that for both baseline (GRB mine complex) and project (GRB mine complex plus the Red Hill Mining Lease) scenarios, the occurrences when EC of releases from GS4A causes the downstream EA receiving water EC trigger level of 2,000 µS/cm to be exceeded were identical; in other words the RHM had no impact on the GRB mine complex's ability to comply with its existing EA conditions. In addition, it is important to note that exceedances of the 2,000 µS/cm EC limit for the receiving environment were predicted to occur for both the baseline and project scenarios in only three one-day occurrences, during the 108-year modelling period. In each of these cases, the predicted receiving water flow was less than 1 m^3/s.

Similarly, modelled compliance of the flow trigger for both the baseline and the project scenarios indicated that the project would result in no change in compliance from the baseline scenario (Section 5.1 Appendix I3 EIS Water Balance Modelling). Therefore there is no need to amend the current mine water management plan or design any additional mitigation measures to accommodate the project.

As indicated in Section 7.3.4 of Section 7 of the EIS (Surface Water), it is expected that the project's water demand will exceed the volume of water produced from dewatering the RHM and the BRM extension, that is, the project will cause an overall water deficit for the combined mine complex (project scenario) over most operating years.

Mine water balance modelling was undertaken as part of the EIS to assess expected salinity levels at the downstream monitoring point in the worst-case scenario of surplus mine water being generated by the project (Appendix I3 EIS; Mine Water Balance). The results indicated that for 99 per cent of the time salinity concentrations downstream of the mine would comply with the EA condition of the GRB mine complex (EPML00853413) of 2,000 µS/cm with or without the addition of water from the proposed project. Furthermore, the modelling indicated that addition of the project's water slightly increases the salt levels in the receiving environment for around one to six per cent of the time. However, for 94 to 99 per cent of the time the difference between salt levels in the receiving environment with and without the project is negligible. Notwithstanding the modelling results, it is important to note that in most years of operation, the project's water demand will exceed its dewatering volumes and surplus water from the GRB mine complex will be required. No further quantification, such as analysis of the mixing zone, is considered justified given that the level of impact from the project is minimal.

5.20.2 Capacity of the GRB System

Mine water balance modelling in the EIS also indicated that the addition of water from the project would have a negligible impact on the GRB mine complex's water inventory and available storage. The modelling results indicated that the addition of any mine water from the project would not impact on the ability of the GRB mine complex to manage the project mine water and still achieve compliance with the existing EA.

As indicated in Section 5 of Appendix I3 of the EIS (Mine Water Balance), the existing GRB mine complex has sufficient capability to have no unauthorised discharges of mine water for wet season rainfall events up to a 1 in 10 year ARI wet season, and that the addition of mine water from the project will be accommodated within the site's storage capacity. The use of low priority pits as a contingency may be necessary only during rare extremely wet periods, during which time any mine water will be expected to be heavily diluted and will therefore be within the 10,000 µS/cm end-of-pipe EA release condition. This is confirmed by the water balance modelling described in Section 5.1 of Appendix I3 which shows that in the 108-year modelling period no exceedances to this end-of-pipe limit is expected as a result of the project.

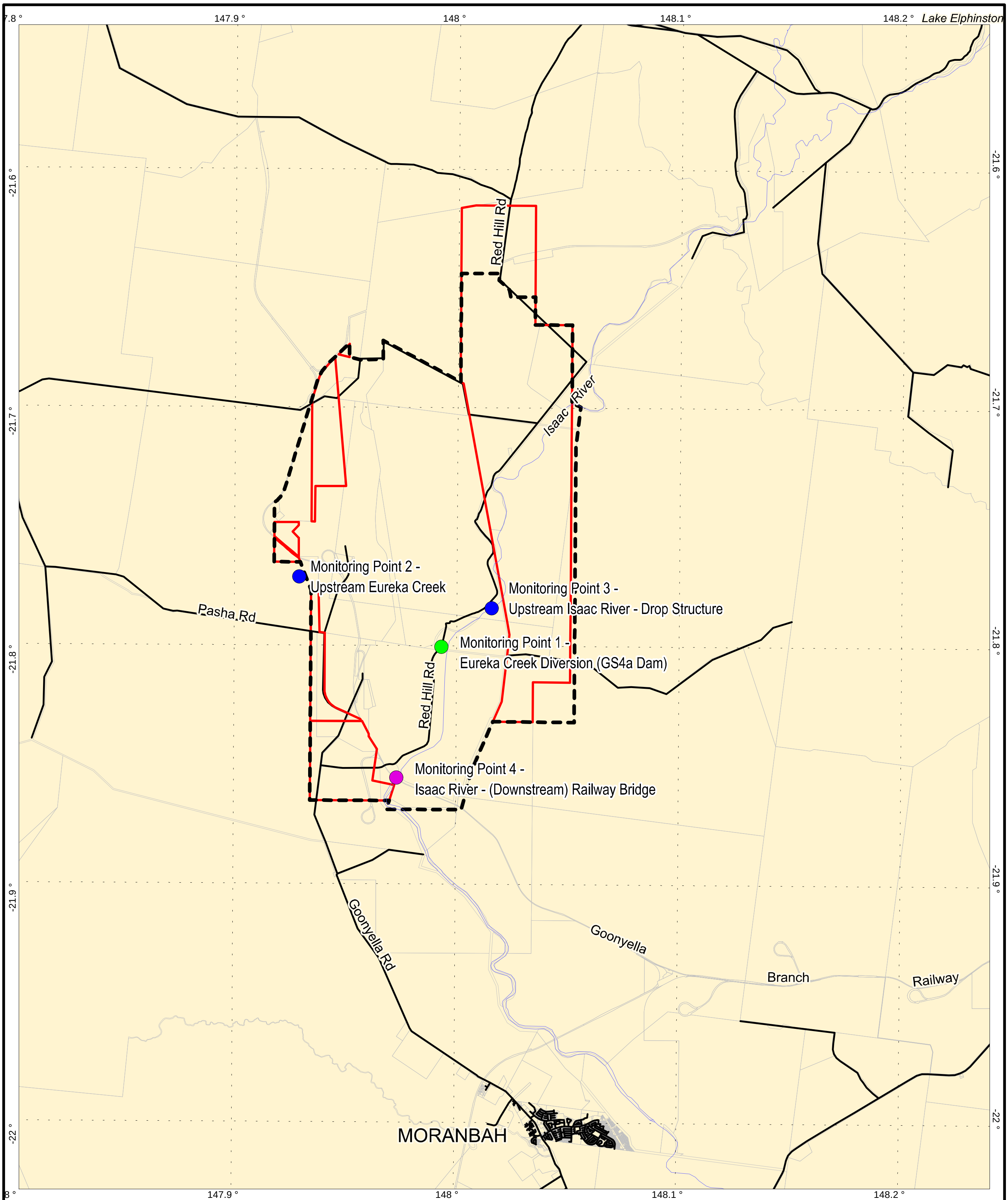
The water balance modelling undertaken for the EIS (Appendix I3 EIS; Mine Water Balance) indicated that the existing GRB mine complex has sufficient total storage capacity to manage extreme wet periods, and that the project will have no impact on the water management system of the existing GRB mine complex. As indicated in Section 7.3.4 of Section 7 of the EIS (Surface Water), it is expected that the water demand created by the project will exceed the volume of water its produces, that is, it will cause an overall deficit in water for the combined mine complex (project scenario) over most operating years.

DOTE commented that the mine water balance reported in the EIS did not identify all stores of water within the system and that additional information regarding the stores of water and estimated flows between these stores should be provided. It should be noted that:

- the movement and management of water across the current approved GRB site varies depending on mining and water stored on site;
- water management at GRB is conducted to ensure compliance with the existing EA conditions relating to discharge, i.e. BMA ensures the discharge criteria conditions are met through its management of water on site; and
- any additional water generated and stored on site from the project will not result in any marked changes or influence on the GRB mine water management system.

5.20.3 Monitoring

The release of mine-affected water into the receiving environment is currently monitored (water quality and macroinvertebrate monitoring) at locations specified by the current GRB mine complex EA (Table W6) (**Figure 5-10**). These sites include upstream background monitoring points (Eureka Creek, Isaac River upstream of Eureka Creek), release site monitoring points (Eureka Creek) and downstream monitoring points (Isaac River). Mine water from the project will be transferred to the GRB mine complex for storage and reuse; there are no direct discharges associated with the project (EIS Section 7 Surface Water). Hence no additional monitoring points are required.



NOTE: Resource data boundaries downloaded from QLD Dept Mines & Energy Website (http://www.webgis.nrm.qld.gov.au/webgis/webqmin/Run.htm.) and are correct as at 18 May 2011
Monitoring Points sourced from Goonyella Riverside and Broadmeadow Mines Environmental Authority EPML00853413

N W E S

0 2.5 5km

Scale 1:250,000 (A4)
Projection: MGA Zone 55 (GDA 94)

EIS Study Boundary
BMA Tenure/Tenement

Downstream Monitoring Points
Release Point Monitoring Points
Upstream Background Monitoring Points

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RECEIVING WATER MONITORING LOCATIONS

SURFACE WATER

Figure: **5-10**

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Section 6 Groundwater

6.1 Submissions

This section responds to submissions from the following:

- Department of Natural Resources and Mines
- Department of the Environment
- Isaac Regional Council
- Department of Agriculture, Fisheries and Forestry

6.2 Modelling Methodology

NRM requested additional rationale for the use of the same storage co-efficient within each of the different model layers.

As no pre-mining data are available and the groundwater resources have been altered due to the GRB mine complex activities since the 1970s, a literature review was undertaken of the available aquifer hydraulic parameter data available for the Bowen Basin. These data provided a probable range of parameters (hydraulic conductivity and storage) for the aquifers and aquitards located within the Red Hill Mining Lease and were used during model calibration.

Different groundwater models used in the Bowen Basin were reviewed and a representative range of confined aquifer storage values determined. The range of values and those used in the model are presented in **Table 6-1**.

Table 6-1 Aquifer Parameter Range and Data Sources

Layer	Unit	Storage Coefficient, Sc			Literature Reference	Specific Yield, Sy			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
1	Tertiary, Alluvium	0.000001	0.0001	0.00001	Min = AGE 2006; (Carborough Downs); Max = Arrow 2011; Ausenco/ Norwest (2012)	5%	20%	10%	Min = Arrow 2011; Ausenco/ Norwest 2012 (min and max)
2	Fort Cooper Coal Measures – Overburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), NTEC 2011, AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)
3	Fort Cooper Coal Measures FC1	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
4	Fort Cooper Coal Measures – Interburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)

Layer	Unit	Storage Coefficient, Sc			Literature Reference	Specific Yield, Sy			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
5	Fort Cooper Coal Measures FC2	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
6	Moranbah Coal Measures – Overburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)
7	Moranbah Coal Measures - GUS	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
8	Moranbah Coal Measures – Interburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)

Layer	Unit	Storage Coefficient, Sc			Literature Reference	Specific Yield, Sy			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
9	Moranbah Coal Measures – Goonyella ‘P’ Seam GP1	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
10	Moranbah Coal Measures – Interburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)
11	Moranbah Coal Measures – Goonyella ‘P’ Seam GP2	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
12	Moranbah Coal Measures – Interburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)

Layer	Unit	Storage Coefficient, Sc			Literature Reference	Specific Yield, Sy			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
13	Moranbah Coal Measures – GMS	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
14	Moranbah Coal Measures – Interburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006 (Carborough Downs), AGE 2008 (Ellensfield); Max = Ausenco/ Norwest (2012)
15	Moranbah Coal Measures –GLS	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	0.5%	5%	1%	Min = AGE 2006 (Carborough Downs); Max = Arrow 2011, Ausenco / Norwest 2012, NTEC 2011, MET SERVE 2010 (Eaglefield Expansion)
16	Moranbah Coal Measures – Underburden	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006; (Carborough Downs), AGE 2008 (Ellensfield); Max = Arrow 2011; Ausenco/ Norwest (2012)

Layer	Unit	Storage Coefficient, Sc			Literature Reference	Specific Yield, Sy			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
17	Back Creek Group	0.000001	0.0001	0.00001	Min= AGE 2006 (Carborough Downs); Ausenco/ Norwest (2012); Max = AGE 2008 (Ellensfield)	1%	10%	3%	Min = AGE 2006; (Carborough Downs), AGE 2008 (Ellensfield); Max = Arrow 2011; Ausenco/ Norwest (2012)

The confined aquifer storage is very low and has limited influence on model predictions; therefore it is not sensitive to change (refer to EIS Appendix J Section 7.5).

The specific yield (unconfined aquifer storage) was varied during model sensitivity analysis as this can change model predictions (refer to EIS Appendix J Section 7.5.4).

Mine dewatering causes the coal seams to become unconfined which results in altered model parameters. The model utilised time-varying properties to simulate these aquifer parameter changes with time due to coal extraction and goaf.

DOTE requested that the predictive groundwater modelling should include consideration of future operations. It was discussed with DOTE that the predictive modelling reported in the EIS considered the current GRB mine complex, future approved mining, and the proposed project to determine cumulative impacts. The future approved mining plans and schedules for these mining activities were known and were accommodated in the modelling, any possible unapproved future mining was not included as no data were available. As such, the modelling conducted and reported is considered to be of an appropriate scale; inclusion of an expanded study area is not considered to be necessary.

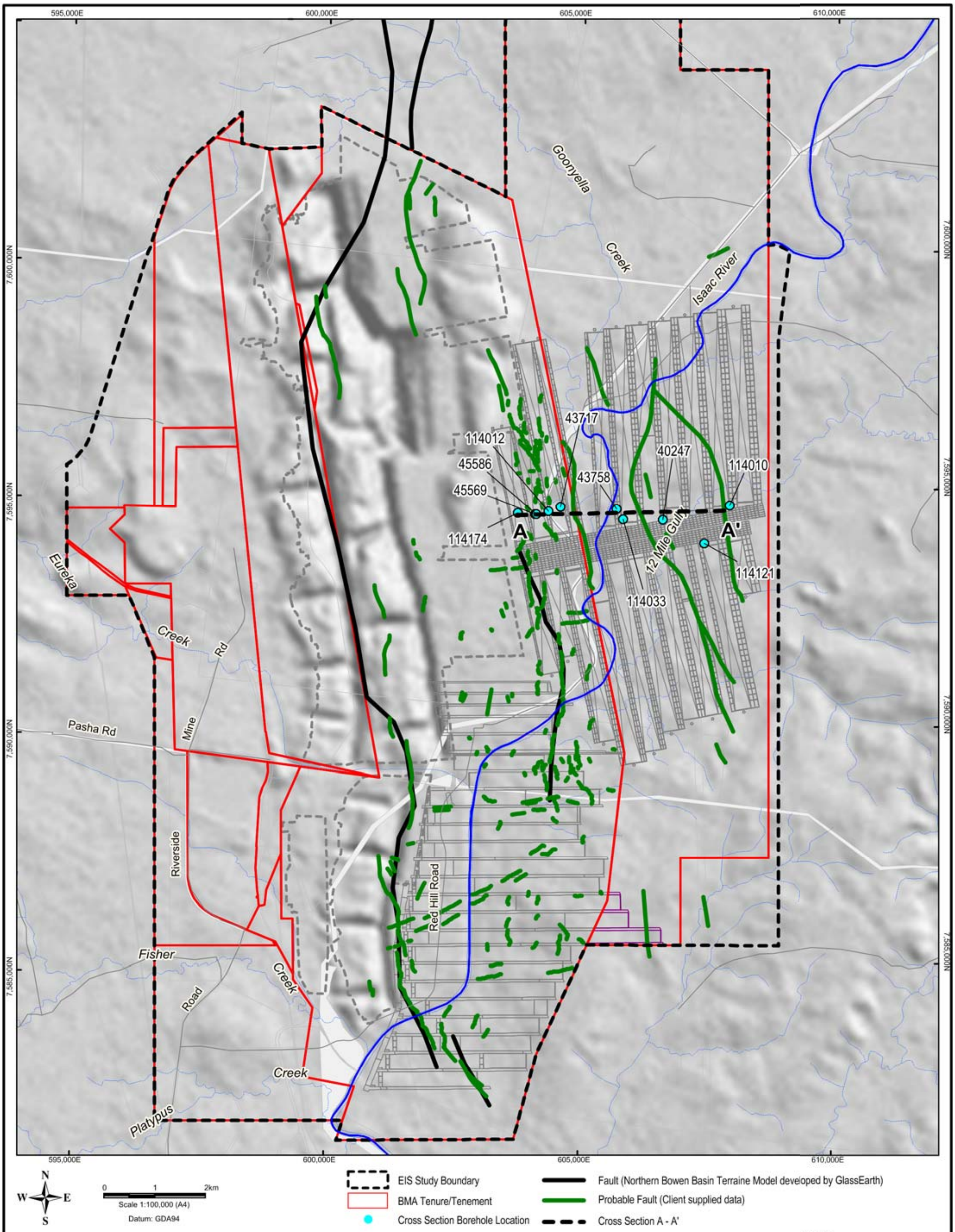
6.3 Geological Cross-sections

DOTE commented that only one geological cross section has been provided and that to assist with the evaluation of the geological cross-section additional information, an indication of the boreholes was requested.

A generalised cross-section based on mine geology model is presented in the groundwater reports. Nine exploration bores, in a west to east transect, were selected across the Red Hill Mining Lease footprint which were used to generate the geological cross-section. The locations of the exploration bores are included in **Figure 6-1a**. A fence diagram, using the main geological units mapped in the bore logs, was generated to provide a west-east cross-section. The fence diagram mimics the geological cross-section presented in EIS Appendix J. The fence diagram cross-section is presented in **Figure 6-1b**.

The detailed bore logs for the nine exploration bores are included in **Appendix E**.

Other bores in and around the EIS study area are shown in **Figure 6-2**



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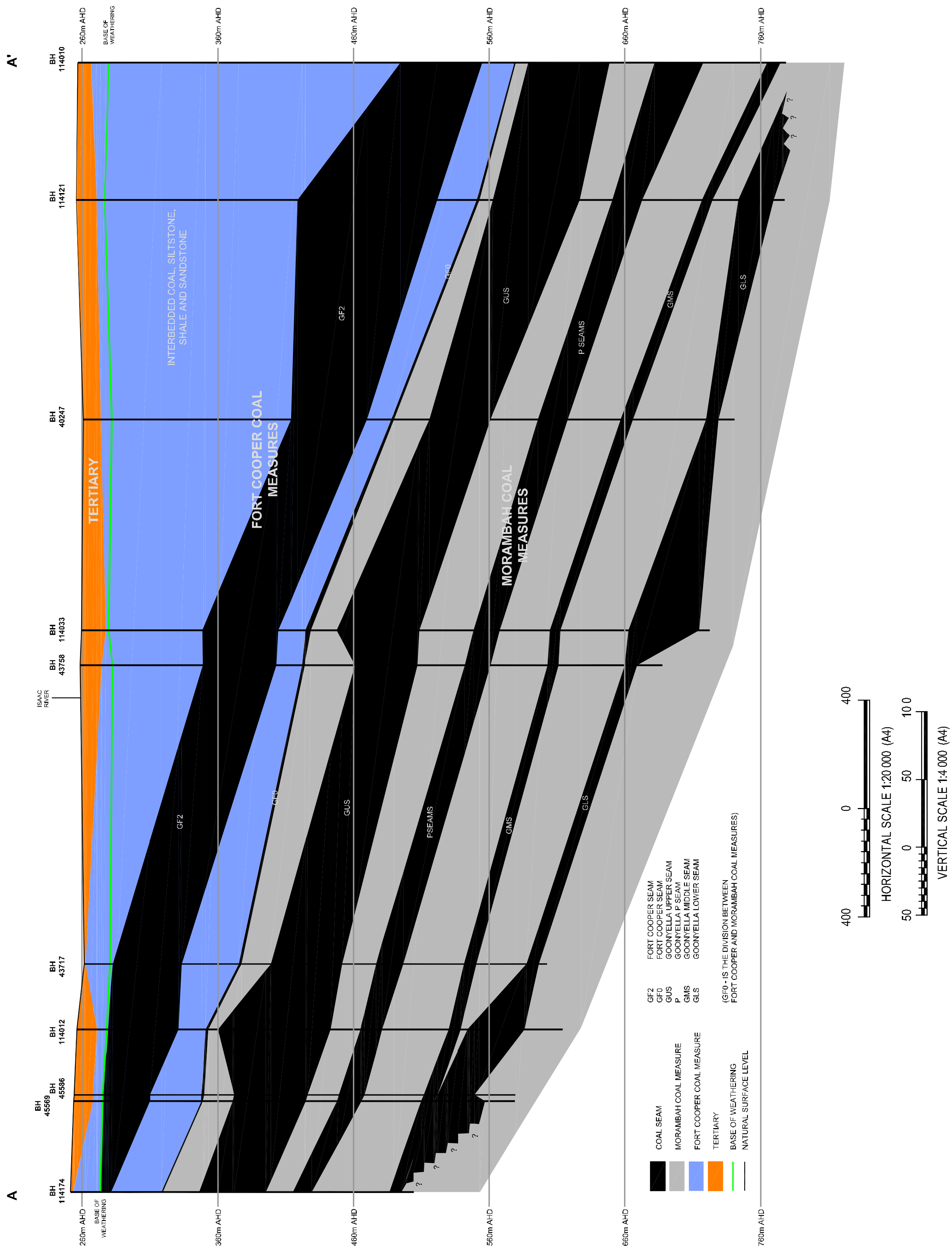
CROSS SECTION BOREHOLE LOCATIONS

GROUNDWATER

Figure: **6-1a**

File No: **42627373-g-2272.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev. **A** A4



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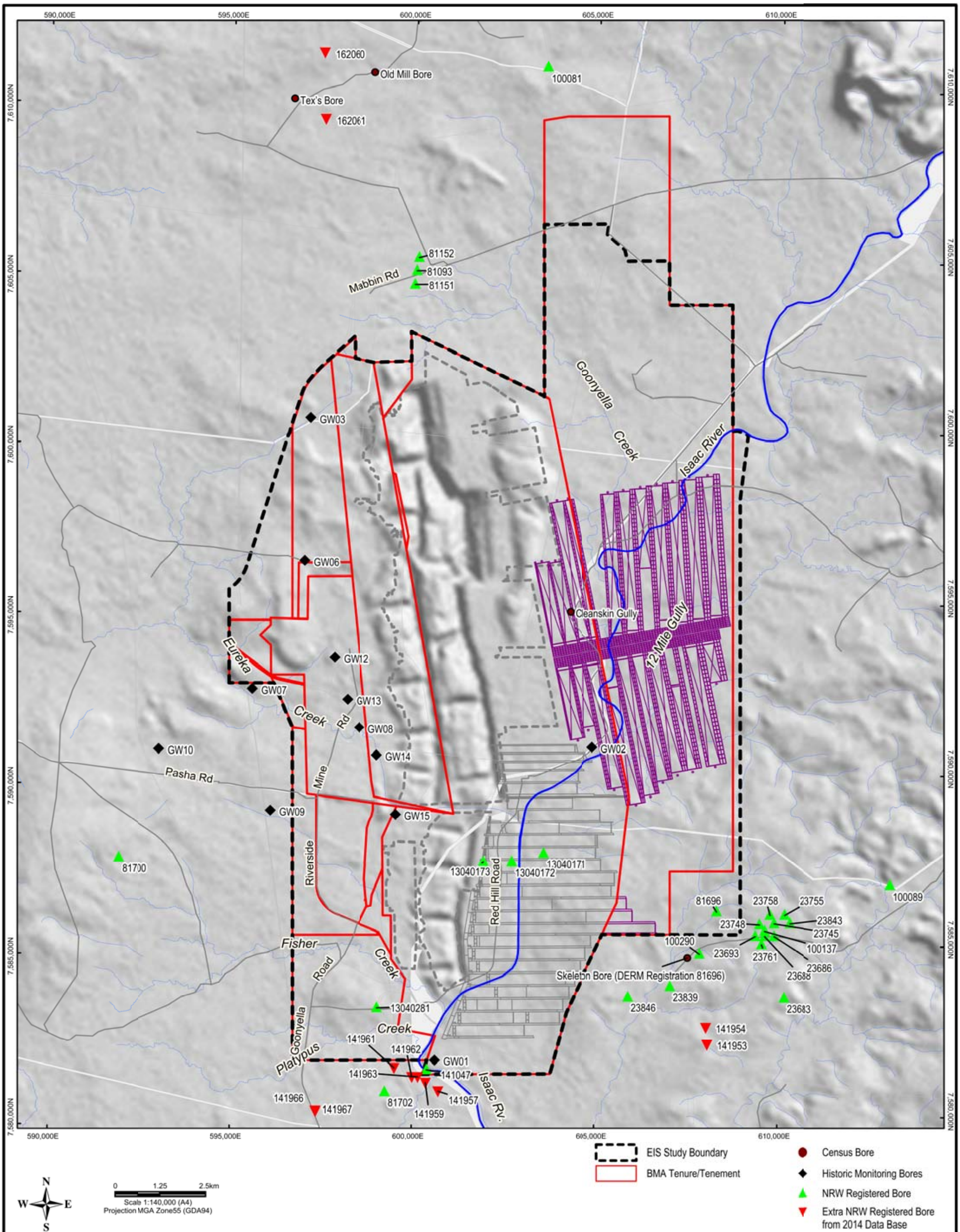
CROSS SECTION A-A'

URS

GROUNDWATER

Figure: **6-1b**

File No: **42627373-g-2273.dwg** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev. **A** A4



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BORE LOCATIONS

URS

GROUNDWATER

Figure: **6-2**

File No: **42627373-g-2263b.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev.**B** A4

6.4 Adequacy of the Conceptual Model

6.4.1 Conceptual Model

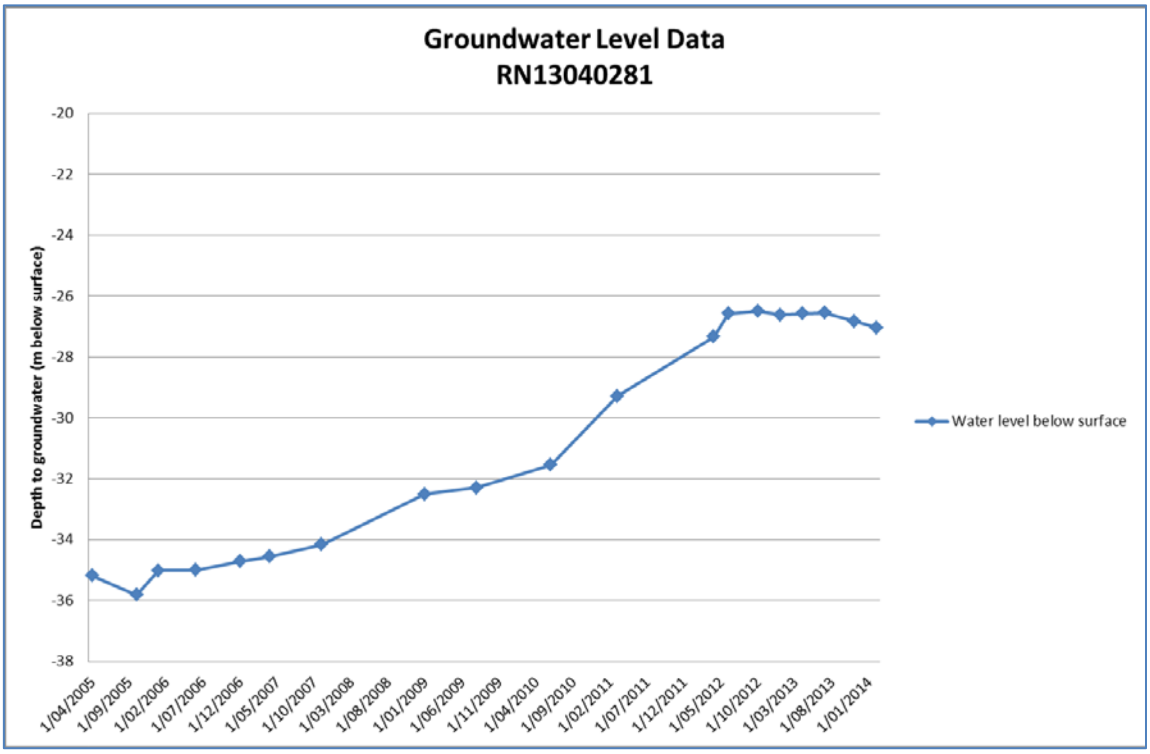
Additional information regarding the conceptualisation of the groundwater regimes, local and regional, was requested as it was considered that potential alternative interpretations for the conceptualisation of the groundwater regime within the region may be possible.

DOTE suggested that a hydrogeological conceptual diagram should be provided to clearly communicate the conceptualisation of the hydrogeological system. It is noted that the groundwater conceptual model (EIS Appendix J Section 7.3) used as the basis of the numerical groundwater model, was based on the available data and included the upper units of the Back Creek Group, the Blackwater Group, and the overlying unconfined units. No visual conceptual cross-sections were included but detailed groundwater data were used to construct the model.

The groundwater resources associated with the Quaternary alluvium, Tertiary sediments, and Tertiary basalts were included in the EIS Appendix J Section 6.1. It is noted that an aeromagnetic geophysical survey identified small discontinuous remnants to the south and in the west of the project site, with a larger continuous unit to the north (EIS Appendix J Figure 6-2). No basalt is mapped within the project footprint.

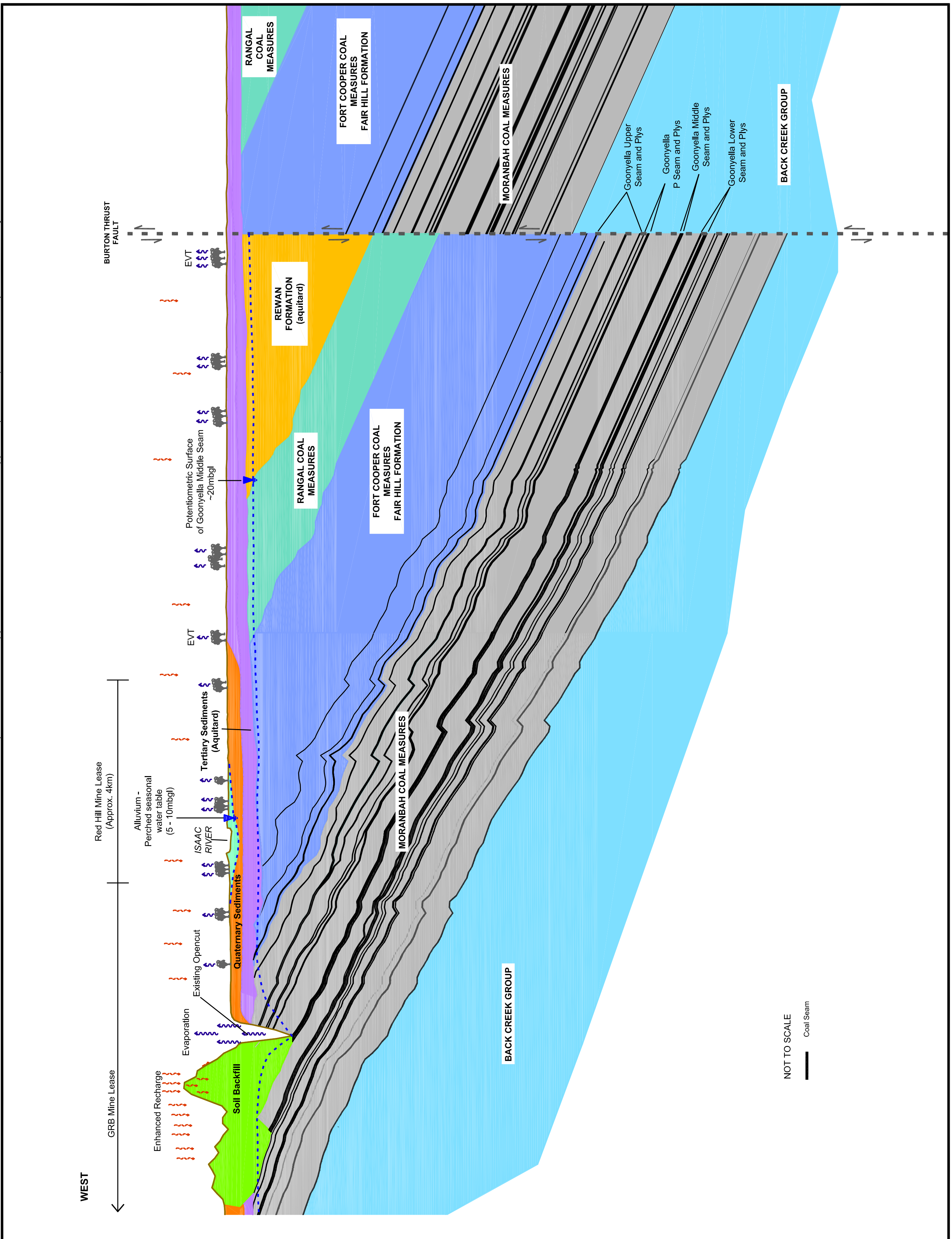
Regional groundwater monitoring within the vesicular basalt, NRM bore RN13040281 (**Figure 6-3**), indicates groundwater level increases over time (in response to recharge) indicating limited impact of mining on the Tertiary basalt aquifer to the southwest of the GRB mine complex. Thus the Tertiary basalt is not discussed further in the conceptualisation.

Figure 6-3 Groundwater levels in the basalt aquifer, RN13040281



Three conceptual cross-sections have been constructed to show:

- current groundwater resources, levels, aquifers, recharge and flow (**Figure 6-4**);
- end of RHM project activities (**Figure 6-5**); and
- long term groundwater levels after all mining at the GRB mine complex (including the project) has ceased (**Figure 6-6**).



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CONCEPTUAL GROUNDWATER MODEL - CURRENT GROUNDWATER RESOURCES

URS

GROUNDWATER

Figure: **6-4**

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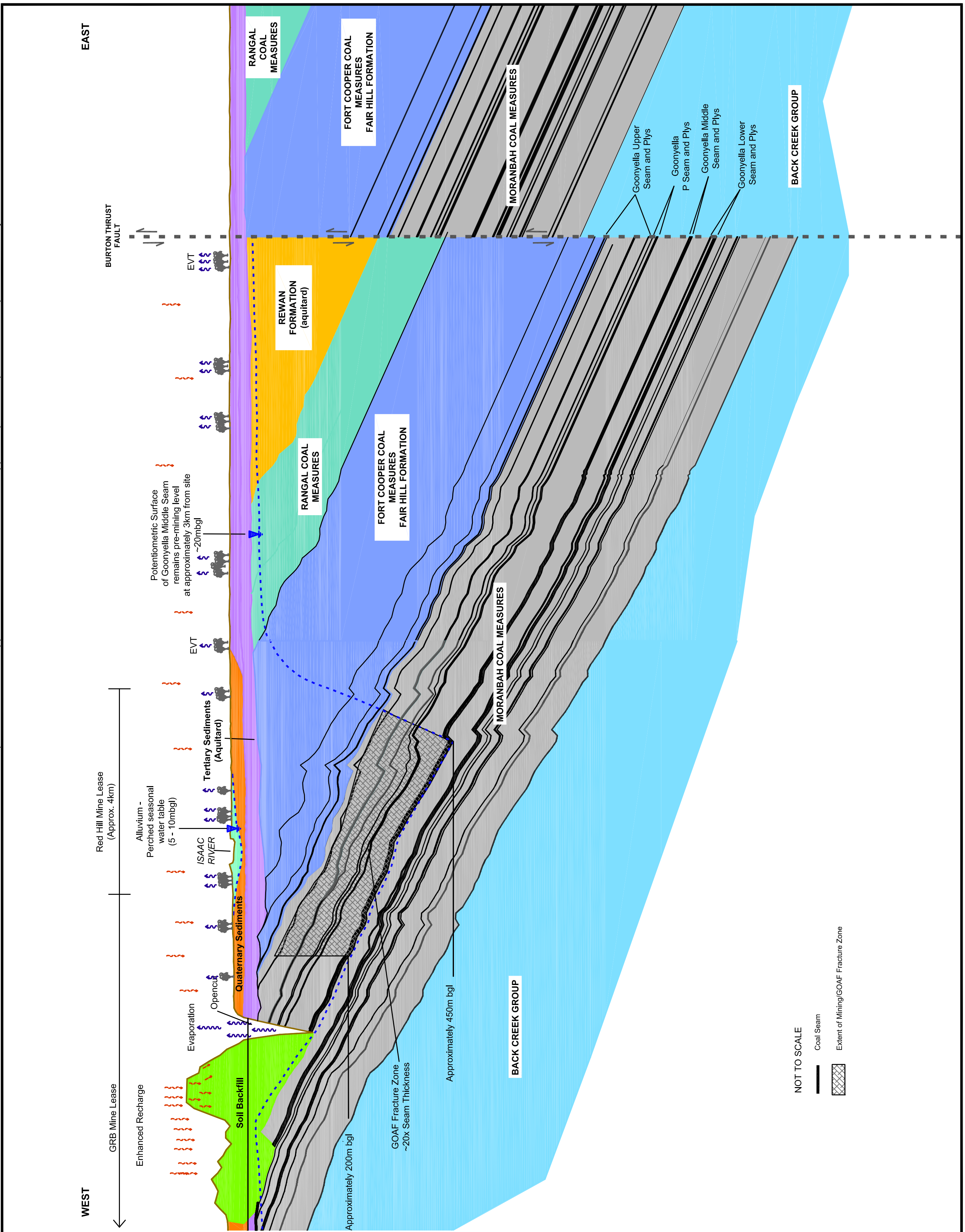

Source:

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CONCEPTUAL GROUNDWATER MODEL - END OF RED HILL MINING ACTIVITIES

URS

GROUNDWATER

Figure: **6-5**

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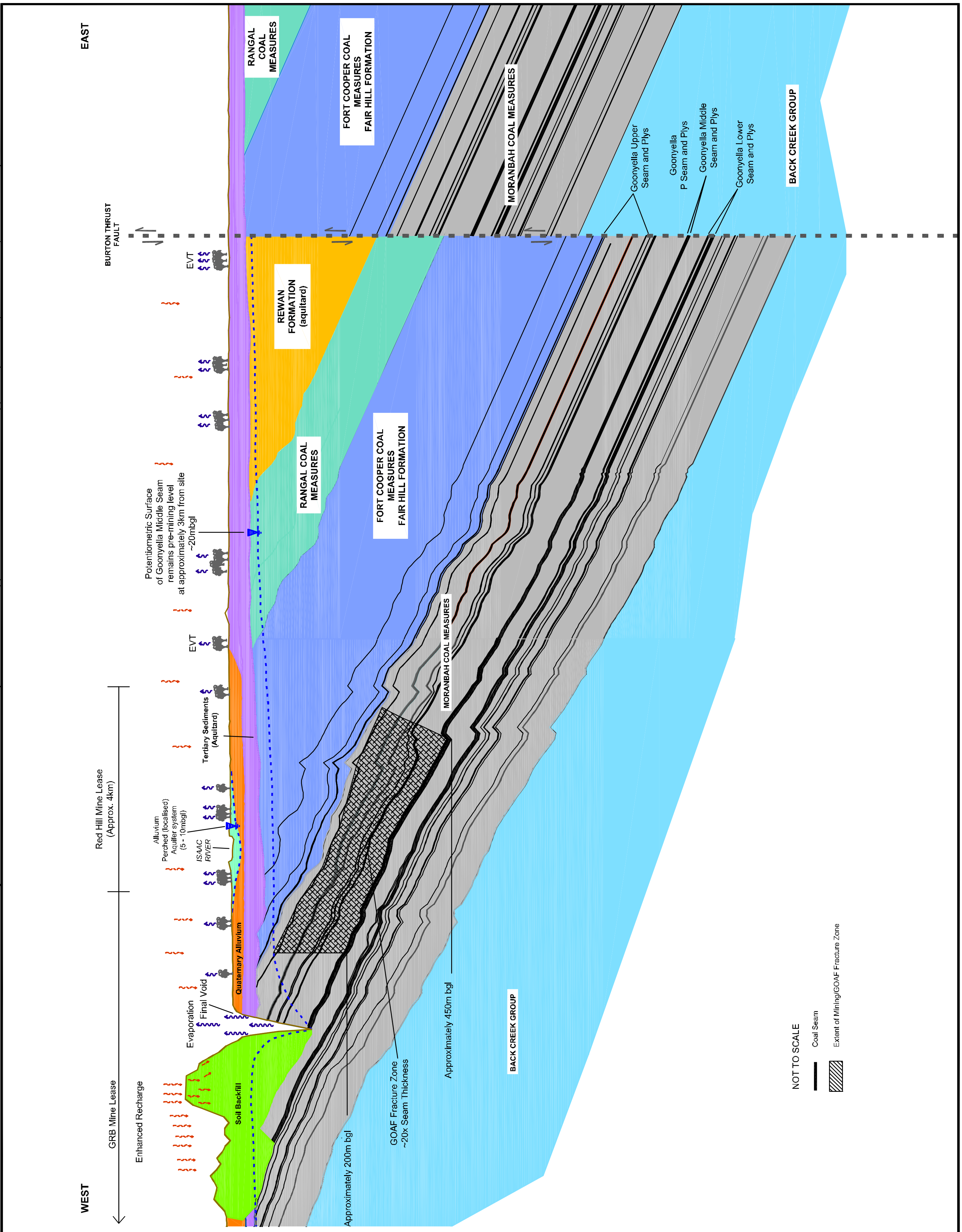

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CONCEPTUAL GROUNDWATER MODEL - LONG TERM

URS

GROUNDWATER

Figure: **6-6**

File No: **42627373-g-2261.dwg** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev. **A** A4

6.4.2 Quaternary Alluvium

The nature of the Quaternary alluvium, discussed in Section 6.1.1 of the EIS Appendix J, was based on the drilling results of:

- Monitoring bore GW01 that was drilled to 93 m (refer to **Section 6.10** of this report). The bore intersected 4 m of dry sub-rounded quartz sand (2 – 8 mm) overlying weathered mudstone to 37 m. Thus thin dry alluvium occurs adjacent to the Isaac River to the south of the Broadmeadow Mine.
- Monitoring bore GW02 that was drilled to 40 m adjacent to the Isaac River. The Isaac River alluvium (comprising silt and mud) was measured to a depth of 19 m below surface. Groundwater was measured at 21.22 m below surface in June 2009, indicating the alluvium was not saturated.
- Bore 43840 that was drilled to 15 m, through 5 m of alluvium, to intersect Tertiary sediments (shale) adjacent to the Isaac River. Bore 43840 failed to produce significant quantities of groundwater and recovery of the groundwater level, between stages of airlift development, was minimal.
- Monitoring bore GW08 that was drilled within the Eureka Creek alluvium and, intersected dry poorly sorted mud, siltstone, and sandstone clasts to 9 m, underlain by mudstone.

Thus the alluvium intersect on site, adjacent to the Isaac River, comprises dry surficial sand over unsaturated silt and mud. No groundwater level contours can be generated as alluvium, when saturated, does not form a consistent interconnected aquifer (refer to EIS Appendix J Section 6.1.1).

It is also noted that during a ground penetrating radar survey of the Isaac River at Moranbah North mine, accessible during the dry season, it was noted that all test pits dug for the survey within the bed sands were dry, or only damp in the base layer. This indicates that the Isaac River alluvium has limited effective storage, provides only limited volumes of base flow, and does not contain groundwater all year round.

6.4.3 Tertiary Sediments

As detailed in Section 6.1.2 of EIS Appendix J, the Tertiary sediments generally consist of discontinuous lenses of gravels and sands separated by sandy silts, sandy clays and clays. A review of the bore logs, as discussed above and in **Section 6.10** below, showed that the Tertiary sediments vary in thickness (up to approximately 80 m) and comprise mudstone and shale aquitards.

There are limited data to allow for an accurate depiction of groundwater flow patterns in the Tertiary and Quaternary sediments. However, it is common for the water table in unconfined aquifers to be a subdued reflection of topography, i.e. groundwater flow patterns are considered to mimic topography and drain towards the surface water bodies and broadly to the south.

Aquifer hydraulic conductivity within the Tertiary sediments is low (1×10^{-4} m/day) due to the presence of low permeability clays and sandy clays with isolated areas of loose more permeable sand (EIS Appendix J Section 6.1.2).

Laboratory tests conducted on overburden core above the coal seams provided estimates of the vertical hydraulic conductivity within the siltstone, claystone, and sandstone, which are either Tertiary or Permian overburden. The results indicate:

- siltstone overburden – vertical hydraulic conductivity of 8.64×10^{-5} to 8.64×10^{-7} m/day;
- claystone overburden - vertical hydraulic conductivity of 8.64×10^{-7} m/day;

- fine to medium grained sandstone - vertical hydraulic conductivity of 3.46×10^{-6} m/day; and
- very fine grained sandstone - vertical hydraulic conductivity of 3.46×10^{-5} m/day.

These low permeability units separate the unconfined (seasonal) aquifers from the coal seam aquifers.

A review of the groundwater data available from several of the nearby coal mines indicated the following:

- At the Grosvenor Coal Mine the groundwater occurrence in the Tertiary sediments is minor, as the Tertiary sediments were generally dry during exploration drilling. Groundwater occurrence within the Quaternary bed sands of the Isaac River was judged to be insignificant (JBT 2010).
- The Tertiary Suttor Formation across the Eaglefield Coal Mine range in thickness from zero up to 120 m and comprise mottled fissured clay (weathered basalt as recognised in the open pits). Exploration drilling indicates sporadic occurrence of groundwater within the Tertiary unit, most likely owing to deep weathering profiles and a resulting clay matrix. Owing to the heterogeneous nature of the Tertiary aquifer, groundwater level fluctuations are not uniform or systematic across the aquifer (MET Serve 2010).
- The Tertiary sediments at Middlemount Coal Mine comprise clay, silty clay, sandy clay and sand, with occasional gravel and weathered basalt. Aquifer tests within the Weathered Tertiary indicated poor groundwater potential with hydraulic conductivity values of 0.002 to 0.003 m/day (Parsons Brinckerhoff 2011).

6.4.4 Surface Water- Groundwater Interaction

For the model conceptualisation of the surface water–groundwater interaction it was considered that the interaction is limited to the alluvium. This interaction, as the river bed sands are dry for the majority of the year, does not result in groundwater supplying a marked base flow component to the Isaac River, i.e. the river does not receive significant inflows from groundwater resources. This conceptualisation was based on:

- The ephemeral nature of the Isaac River and its tributaries within the groundwater study area, the limited groundwater potential of the alluvium (clay-rich, thin, dry, etc.), and the limited effective storage of the alluvium located above low permeability sediments, indicate that the seasonal surface water bodies are separate from the confined aquifers.
- Groundwater level data from drilling on site indicate that, where groundwater does occur, the depth to groundwater in the alluvium was approximately 11 to 13 m below ground level (mbgl). The groundwater level in the alluvium, measured in a study by Thatcher (1976), was about 20 m above the piezometeric (confined) water level in the coal at the same location. These groundwater levels indicate a marked separation between the perched alluvium groundwater level and the piezometeric levels associated with the deeper coal seam aquifer groundwater. Groundwater level data (**Table 6-2**) for the GMS, as measured over time, indicates groundwater levels are consistently below the levels in the alluvium (> 19 m).
- The potential for hydraulic connection between the coal seam aquifers and the overlying surface water is limited as they are separated by sediments with low vertical hydraulic conductivity, as measured in the field and in the laboratory.

Table 6-2 Groundwater Level Data for the GMS Coal Seam

Bore	Easting	Northing	Coal Seam	Date	Water level (mbgl)	Water Level (m AHD*)
38266	602658.52	7583786.3	GMS	21/05/2006	27.23	216.22
38869	603064.44	7581950.1	GMS	19/03/1996	23.4	217.25
39512	601932.77	7582378.8	GMS	30/07/1995	21.9	218.36
39512	601932.77	7582378.8	GMS	21/05/2006	31.85	208.41
39514	601845.23	7583554.8	GMS	5/10/1995	24	217.24
39514	601845.23	7583554.8	GMS	18/05/2006	35.03	206.21
39598	603166.10	7586457.2	GMS	9/03/1996	27.18	222.37
39605	603769.58	7585503.5	GMS	15/03/2006	48.26	208.33
39616	602837.55	7584175.2	GMS	20/03/2006	19.28	224.95
39620	604563.05	7585436.8	GMS	14/03/2006	60.8	219.18
39629	605031.76	7588414.2	GMS	11/03/2006	39.52	221.59
39658	603014.26	7586364.8	GMS	6/03/1996	38.5	210.6
40942	605397.95	7589587.0	GMS	12/10/1998	33.81	224.56
40980	603216.23	7589135.0	GMS	12/10/1998	29.79	221.14
40983	603981.64	7589694.9	GMS	12/10/1998	50.59	198.35
41236	604372.95	7589354.2	GMS	12/10/1998	35.81	221.32
41602	602620.05	7589366.1	GMS	12/10/1998	54.95	195.44
40448N	603270.05	7589364.1	GMS	12/10/1998	21.4	230.66

*Australian Height Datum

The conceptual model, as shown in **Figure 6-4** to **Figure 6-6**, shows the surface water and water table (seasonal) associated with the discontinuous unconfined aquifers as perched water. It is noted that in the numerical modelling the alluvium and unconfined aquifers are considered to be saturated (i.e. always containing groundwater) so as to assess the potential for impacts on the overlying perched water resources should induced flow occur from these resources to the dewatered, depressurised and altered coal seam aquifers (EIS Appendix J Section 7.5.2).

The conceptual model, based on regional and site-specific information, allows for the construction and calibration of a numerical groundwater model which enables simulation of the proposed mining activities and related groundwater level alterations and assessment of potential direct and indirect impacts.

Prediction uncertainty can arise as a result of uncertainties in model conceptualisation. The effects of alternative conceptualisations on the calibrated model were not explored because the alternatives were considered very limited. The model had been based on the best available information and understanding of the groundwater regime gained from site-specific studies.

6.5 Adequacy of the Numerical Model

6.5.1 Permeability Units

DOTE highlighted that in the water sections of the EIS, the term permeability (units of length squared) has been used in some instances as well as hydraulic conductivity (units of length/time).

Aquifer hydraulic conductivity considered in the groundwater studies is measured in m/day (unit of length/time). This term, similar to the concept of permeability, is used in the description of aquifers in EIS Appendix J.

Rock permeability, considered to change with depth, is estimated in milliDarcies (mD), where 1 darcy is equivalent to approximately 10^{-12} m^2 (unit of length squared). The unit of cm^2 is also sometimes used (1 cm^2 = 10^{-4} m^2 = 10^8 D).

While the difference in terminology is noted, the applications of these terms or their units have no effect on the modelling study and subsequent results.

6.5.2 Calibration

It is acknowledged that the groundwater model was only calibrated in steady state as there were insufficient data to undertake transient model calibration. Thus the approach to verify the reliability of the model included an uncertainty analysis for the predictive model, as discussed in EIS Appendix J Section 7.5.4.

Prediction uncertainty arises mainly as a result of uncertainties in model conceptualisation and model parameters. The effects of alternative conceptualisations on the calibrated model were not explored in this study because the alternatives were considered very limited as the model had been based on the best available information and understanding of the groundwater regime gained from site-specific studies.

No transient calibration was conducted, resulting in a range of storage values having to be considered when calibrating the model. These values (see **Section 6.2**) were obtained from a number of groundwater model studies within the same geology in the Bowen Basin. In order to assess the validity and potential bias of these calibrated model parameters, parameter uncertainty was explored through varying selected parameters.

Selected parameters were varied (one at a time) in the predictive model to examine the impacts on groundwater predictions. The base case model used was the calibrated predictive model using the time-varying properties approach for goaf simulation. The base case parameters were then varied to assess predicted changes.

Uncertainty was assessed by conducting 12 additional model runs with varying parameters as shown in EIS Appendix J Table 7–8. The horizontal hydraulic conductivity (Kh) and vertical hydraulic conductivity (Kv) distributions were varied to consider different scenarios.

The storage model parameter specific yield (Sy) for coal seams (confined aquifers become unconfined during mining) in the base case was 0.01 (1 per cent). This parameter was doubled (sensitivity run 5) to assess the effect of higher Sy compared to the base case.

The predicted drawdown in the alluvium and GMS, as presented in EIS Appendix J Table 7-9, indicates that increased specific yield in the coal seam layer will lead to a slightly increased drawdown of 8.33 m compared to 8.26 m (base case) in the alluvium at year 2068. Total groundwater ingress at the end of mining is slightly higher at 147 gigalitre (GL) compared to 146 GL over the life of project (EIS Appendix J Table 7-10). Thus the storage parameter in the model is recognised as valid and the model is not sensitive to changes in this parameters.

Any uncertainty in the model will be addressed through the refinement of the model and verification/comparison of groundwater model predictions to actual groundwater monitoring results compiled during mining. BMA is committed to model refinement and re-running model predictions at regular intervals (not longer than 3 years) during mining as additional groundwater level, ingress and dewatering data become available.

6.5.3 Model Parameters

It is acknowledged that there are limitations around the model, as detailed in EIS Appendix J Section 7.4.4. This is due the groundwater flow model being a simplification of the real system. Limitations resulting from the simplification can be associated with the conceptual model, the model grid scale, inaccuracies in the (measurement of) data, and the incomplete knowledge of the spatial variability of input parameters.

There are no pre-mining groundwater levels available since mining began in the 1970s. All available groundwater level measurements have already been potentially impacted by mine dewatering. As no accurate long-term dewatering rates were available, the model could not be developed with a transient calibration. To address this, the rule of parameter parsimony was adopted.

The best data available were the site-specific and regional hydraulic conductivity values from aquifer tests, core tests, and the spatial distribution with depth information, which reduced the uncertainty around aquifer hydraulic parameters in the model.

The groundwater model was calibrated to capture the regional groundwater flow trend identified from monitored groundwater levels with the objective of obtaining an acceptable starting condition that represented the regional trend for the predictive simulation and reasonable parameter ranges. Verification of model reliability was conducted by undertaking uncertainty analysis for the predictive model (as discussed above).

The major calibration target of the model was the regional groundwater flow trend with constraints of reasonable ranges of hydraulic conductivity (horizontal and vertical) and recharge. The parameter estimation program PEST along with detailed parameter output verification was used to calibrate the parameters of the regional groundwater flow model. PEST implements a nonlinear least-squares regression method to estimate model parameters by minimising the sum of squared weighted residuals of groundwater levels. This calibration process is a recognised modelling approach, as detailed in the Australian Groundwater Modelling Guidelines, June 2012.

The hydraulic conductivity range and sources of data are provided in **Table 6-3**. These data were used as limits in the PEST calibration approach. The calibrated values were checked against the site-specific and regional hydraulic conductivity values from aquifer tests, core tests, and the spatial distribution with depth information where available.

Table 6-3 Hydraulic Conductivity Data and Literature Reference

Layer	Unit	K(horizontal) (m/day)			Literature Reference	K(vertical) (m/day)			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
1	Tertiary, Alluvium	0.01	10	0.49	Arrow 2011	0.001	0.5	0.049	Max= Arrow 2011; Min = AGE 2008 (0.03- 0.08) Ellensfield
2	Fort Cooper Coal Measures – Overburden	0.00001	0.05	0.000108	Arrow 2011	0.000001	0.0001	0.0000108	Max= Arrow 2011; NTEC, 2011 (0.00001- 0.001)
3	Fort Cooper Coal Measures FC1	0.0001	0.1	0.001	Arrow 2011	0.00001	0.001	0.0001	Arrow 2011
4	Fort Cooper Coal Measures – Interburden	0.00001	0.05	0.000108	Arrow 2011	0.000001	0.0001	0.0000108	Max= Arrow 2011; NTEC, 2011 (0.00001- 0.001)
5	Fort Cooper Coal Measures FC2	0.0001	0.1	0.001	Arrow 2011	0.00001	0.001	0.0001	Arrow 2011
6	Moranbah Coal Measures – Overburden	0.00001	0.05	0.000108	NTEC, 2011 (0.0001-0.01)	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001- 0.001)
7	Moranbah Coal Measures - GUS	0.00001	0.025	Distribution*	max= URS 2010 (Goonyella)/ MET 2010 (Eaglefield): min = NTEC 2011 (0.0001)	0.000001	0.0025	Distribution* x 0.1	max= NTEC 2011 (Blackwater); min= NTEC 2011 (0.00001)
8	Moranbah Coal Measures – Interburden	0.00001	0.05	0.000108	NTEC, 2011 (0.0001-0.01)	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001- 0.001)
9	Moranbah Coal Measures – Goonyella 'P' Seam GP1	0.00001	0.025	Distribution*	max= URS 2010 (Goonyella)/ MET 2010 (Eaglefield): min = NTEC 2011 (0.0001)	0.000001	0.0025	Distribution* x 0.1	max= NTEC 2011 (Blackwater); min= NTEC 2011 (0.00001)

Layer	Unit	K(horizontal) (m/day)			Literature Reference	K(vertical) (m/day)			Literature Reference
		Min.	Max.	Calibrated Value		Min.	Max.	Calibrated Value	
10	Moranbah Coal Measures – Interburden	0.00001	0.05	0.000108	NTEC, 2011 (0.0001-0.01)	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001- 0.001)
11	Moranbah Coal Measures – Goonyella ‘P’ Seam GP2	0.00001	0.025	Distribution*	max= URS 2010 (Goonyella)/ MET 2010 (Eaglefield): min = NTEC 2011 (0.0001)	0.000001	0.0025	Distribution* x 0.1	max= NTEC 2011 (Blackwater); min= NTEC 2011 (0.00001)
12	Moranbah Coal Measures – Interburden	0.00001	0.05	0.000108	NTEC, 2011 (0.0001-0.01)	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001- 0.001)
13	Moranbah Coal Measures – GMS	0.00001	0.025	Distribution*	Reeves & O’Neill 1989 (Broadmeadow); URS 2010 (Goonyella); JBT 2010 (Grosvenor)	0.000001	0.0025	Distribution* x 0.1	Max = MET, 2010 (Eaglefield)/ NTEC 2011 (Blackwater; Min = NTEC 2011 (0.00001)
14	Moranbah Coal Measures – Interburden	0.00001	0.05	0.000108	NTEC, 2011 (0.0001-0.01)	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001- 0.001)
15	Moranbah Coal Measures – GLS	0.00001	0.025	Distribution*	Reeves & O’Neill 1989 (7E-04; Broadmeadow); MET 2010 (1E-03; Eaglefield)	0.000001	0.0025	Distribution* x 0.1	Reeves & O,Neill 1989 (7E-04; Broadmeadow); MET 2010 (1E-03; Eaglefield)
16	Moranbah Coal Measures – Underburden	0.00001	0.05	0.000108	NTEC, 2011 (0.0001-0.01)	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001- 0.001)
17	Back Creek Group	0.00001	0.05	0.000108	NTEC, 2011	0.000001	0.0001	0.0000108	NTEC, 2011 (0.00001-0.001)

Notes:

Recharge = 1.00E-07 m/day

* K distribution derived from the WDS regression formula- 233.52*EXP(-0.016 x depth)

6.5.4 Recharge

To clarify the volume of recharge applied in the model, the following points have been compiled:

- Recharge to the confined GMS target coal seam aquifer was determined to be 1 x 10^{-7} m/day across the model domain (as the GMS seam is mapped across the model domain). Based on the size of the model (1,104 km^2) a low recharge volume of 110.4 m^3/day (representing deep drainage to the confined aquifer) was used. This volume of recharge, 40,296 m^3/year is < 0.01 pr cent of the total rainfall received across the model domain (662.4 x 10^6 m^3), using the average annual rainfall of 600 mm/year (EIS Appendix J Section 4.2).
- The recharge to the confined Permian coal seams is very low due to the thick clay-rich Tertiary cover, mining at the subcrop, and very low vertical permeability of the overburden above the coal seam (**Section 6.4** of this report).
- Recharge to the unconfined seasonal aquifers was not considered as this water leaves site either through surface water discharge or evapotranspiration. Based on the groundwater level data available, these perched water resources are regularly recharged through rain and flood events and are not reliant on upward groundwater movement. For consideration of impacts the Quaternary and Tertiary sediments (unconfined seasonal aquifers) were considered to be saturated all year around.
- The use of very small recharge allows for the consideration of the largest potential impact of mine dewatering. This combined with the approach that the top model layer, comprising alluvium and Tertiary, is always saturated allowed for the assessment of the highest potential impacts on groundwater levels.

Using the low calibrated recharge allowed for an assessment of a “worst-case” simulation of head decrease and drawdown propagation. The model allowed for the simulation of mine dewatering using drains, which removed groundwater from storage (i.e. the groundwater held within the aquifers), through flow, and induced flow from overlying and underlying units.

6.6 Faulting

6.6.1 Fault Details

Available fault data, both regional and site specific, has been compiled from the following sources:

- 1:100,000 scale map Geological Structures;
- 1:100,000 Bowen Basin Structures;
- Glass earth dataset; and
- 2013 Red Hill 2D seismic survey.

These data were included on the geological map, **Figure 6-7** which includes the proposed project mine plan.

In order to better evaluate the faults, cross-sections through the project area have been generated using the seismic data to evaluate their extent with regards to possible connection of Permian age coal seams, Tertiary age overburden, Quaternary age alluvium and sediments.

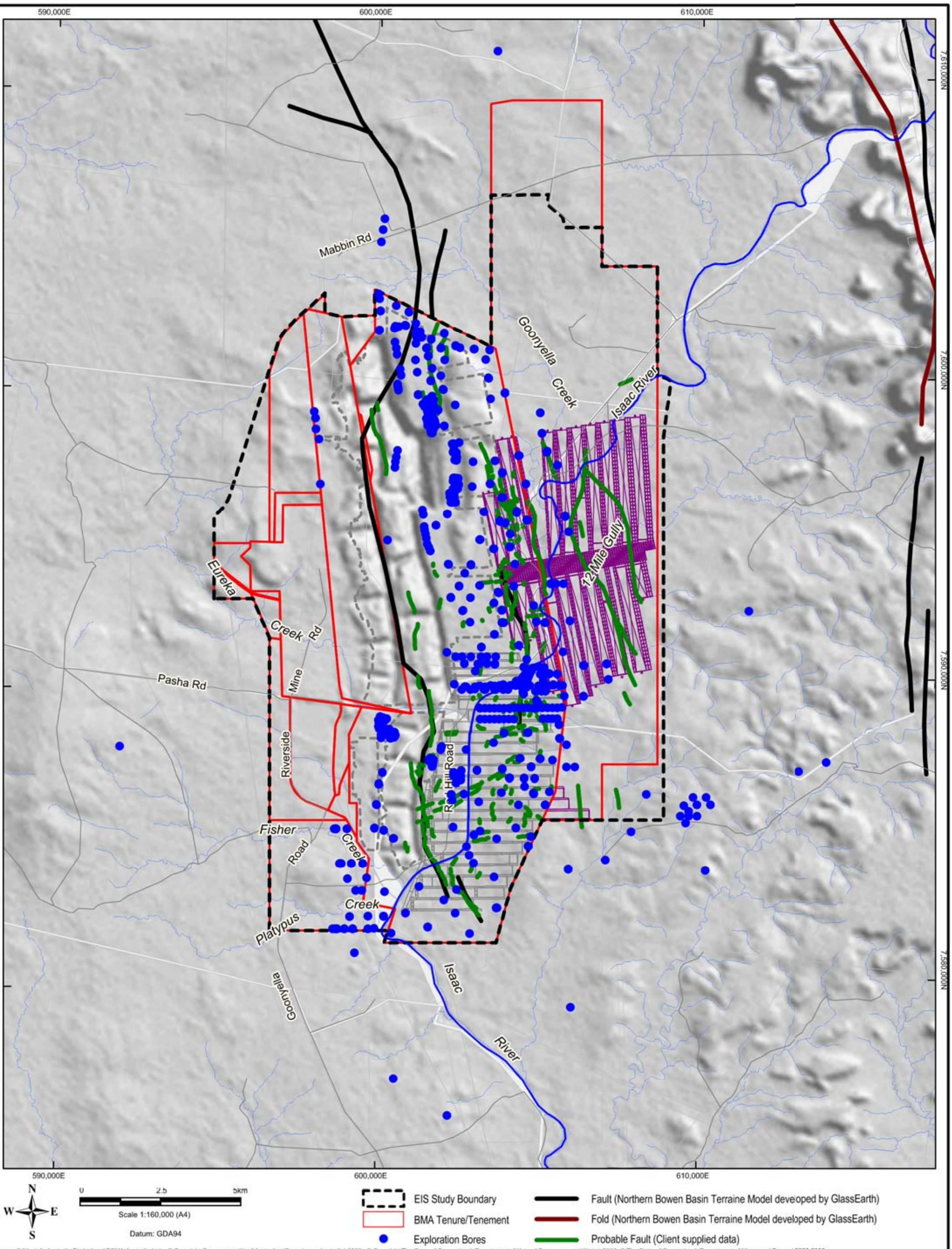
The mapped faulting and the probable faults (confident and probable faults as determined through the 2D seismic survey) delineated from the geophysical survey information, indicate predominantly north-south faulting, limited connection of faults (limited fault network), and smaller discontinuous faults across the proposed mining area.

Figure 6-8 provides a 2D cross-section, from southwest to northeast, across the project footprint. The figure shows the following:

- there is minor displacement of the coal seams;
- the thrust faults are generally shallow (less than 20° dip) and become steeper as they propagate upwards;
- folds and faults have formed to accommodate strain, rather than a swarm of independent fractures;
- the fault traces extend to around 90 m below surface within the more competent Permian units and do not extend to surface; and
- several rolls are identified within the seismic survey data, which may be minor thrust faults but there is no corroborating evidence in the exploration bore logs.

All the seismic cross-sections, including **Figure 6-9**, show the probable faults (classified as confident and probable faults by BMA) within the more competent Permian coal seams and interburden. The fault traces do not extend into the more clay-rich and altered Tertiary cover.

Referencing the Bowen Basin Supermodel 2000 (ACARP project C9021, 2002), it is noted that “all normal faults, including the reactivated ones are truncated by the Tertiary unconformity”. Additionally, thrust faults appear to be more recent than the normal faults, but are also truncated by the Tertiary unconformity.



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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

GEOLOGICAL STRUCTURES

URS

GROUNDWATER

Figure: **6-7**

File No: **42627373-g-2262b.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev.**B** A4

Figure 6-8 Cross-section showing Faulting within the RHM Footprint

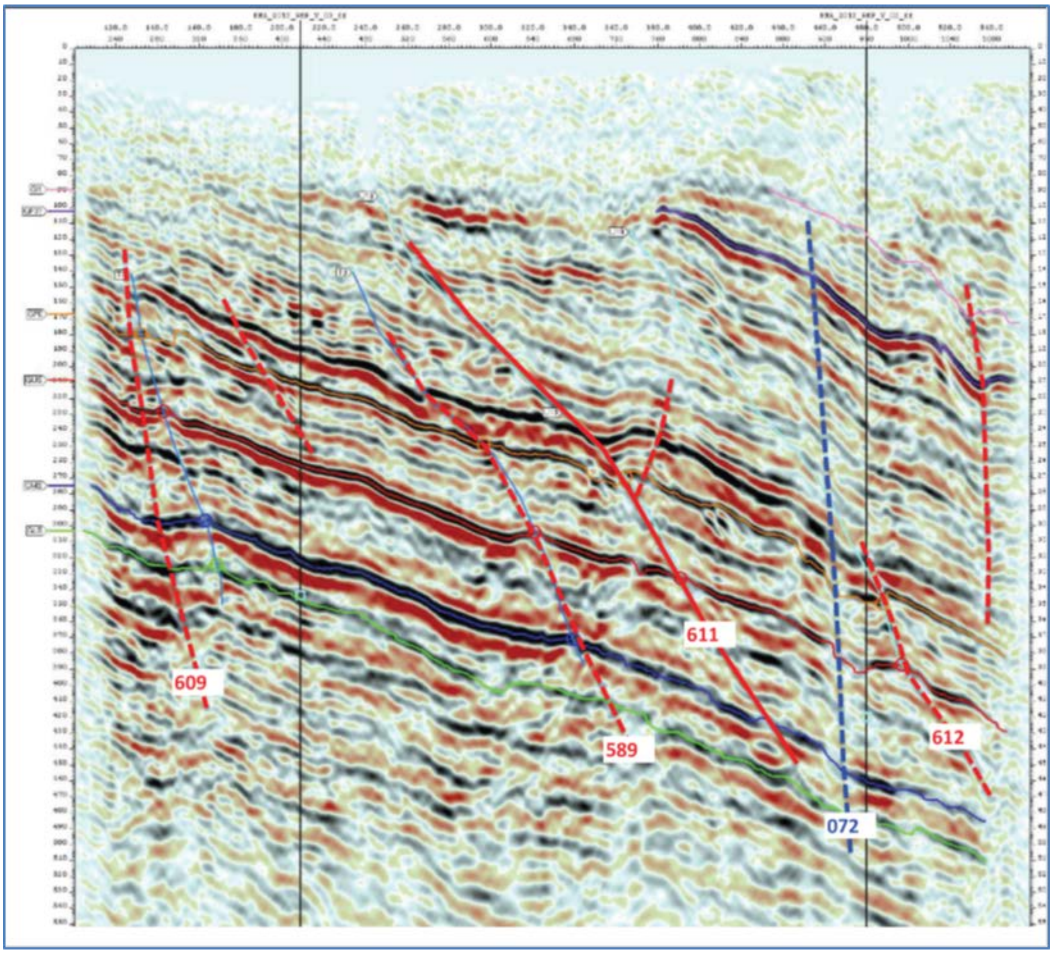
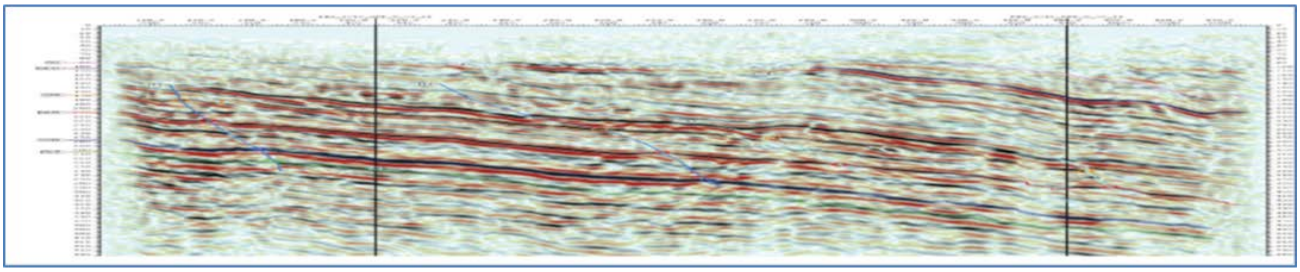


Figure 6-9 Thick Cross-section showing Faulting within the RHM Footprint



6.6.2 Groundwater Potential and Faults

NRM and DOTE have questioned the nature of the faults and their potential to act as preferential flow paths, specifically from the overlying seasonal aquifers to the dewatered/depressurised coal seams.

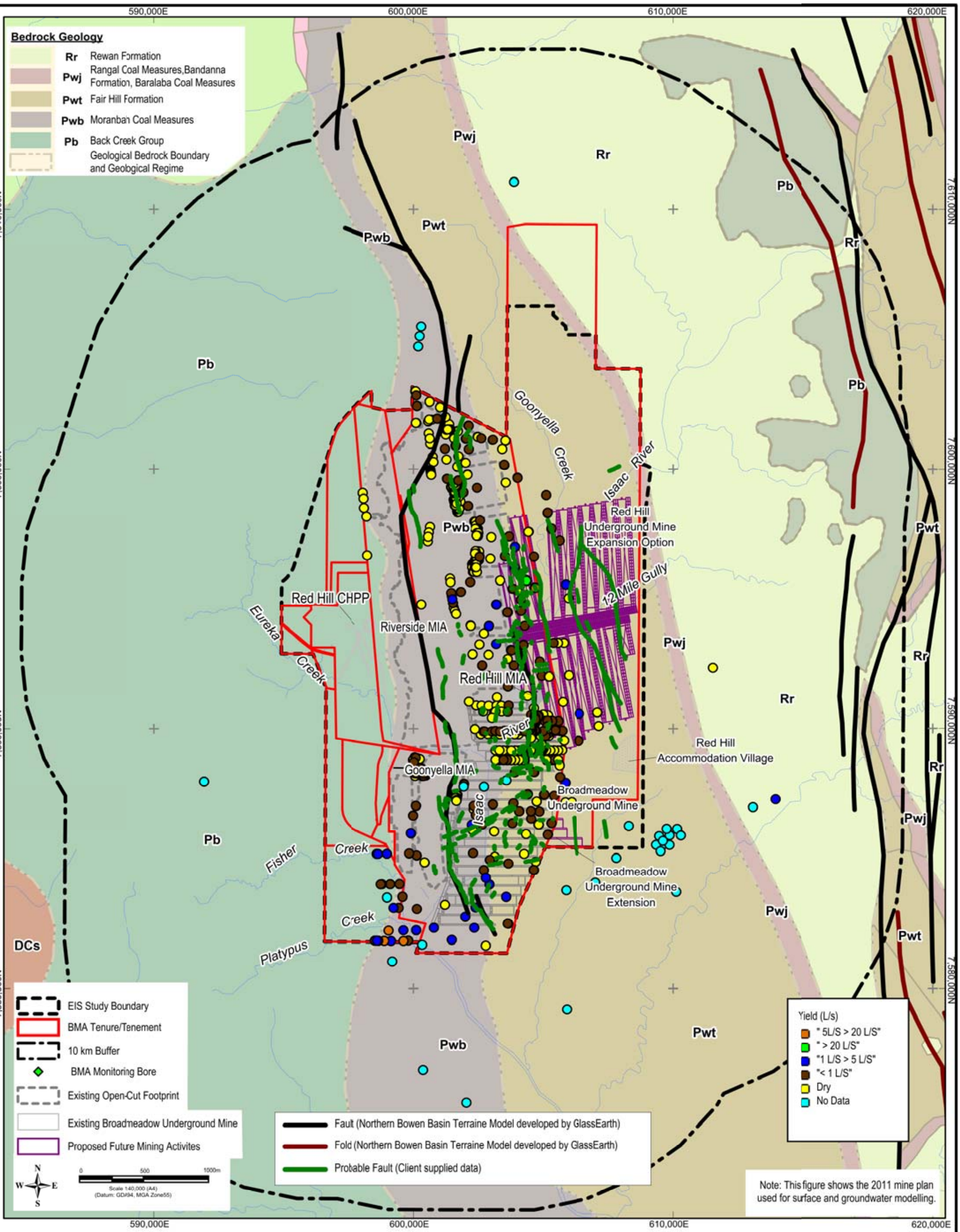
The location and the potential for connecting the mine workings to the overlying water bearing beds are discussed above. Based on the available geophysical data there is no evidence of faults extending through the altered parent sediments (either Permian or Tertiary) to the surface.

In terms of the nature of faulting within the area, consideration was given to the historic measured groundwater yields across the site (blow yields during the exploration bore drilling) and the mapped faults. The majority of the faults have been mined across the GRM and the open pits are dry after continued mining, indicating limited groundwater resources. However, it was considered that the historical data could provide an indication of whether faulting enhanced groundwater potential (through zones of increased hydraulic conductivity and transmissivity due to open fractures).

Figure 6-10 presents the mapped faults and the exploration bores, with the bores having been classified according to the blow out yields measured at the end of drilling. The mapping indicates a negligible correlation between groundwater yield (potential) and faults across the GRB mine complex and the project footprint. The majority of the dry and low yielding bores are located on or adjacent to faults. The higher yielding bores, specifically the three located along the southern mine lease boundary, are related to Tertiary basalt fractured rock or located within areas with no mapped faults.

It is considered that the faults do not markedly enhance groundwater potential and thus do not provide preferential flow paths for groundwater movement.

Faulting may provide barriers to flow and reduce the extent of the drawdown. However, insufficient data are available to confirmwhether the faults compartmentalise the groundwater resources related to the project. Therefore, for the groundwater impact predictions, no faults were included in the model, which allowed for the largest potential drawdown impacts (i.e. worst-case) to be assessed.



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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

GEOLOGICAL STRUCTURES AND BORES COLOURED BY BLOW-OUT YIELD

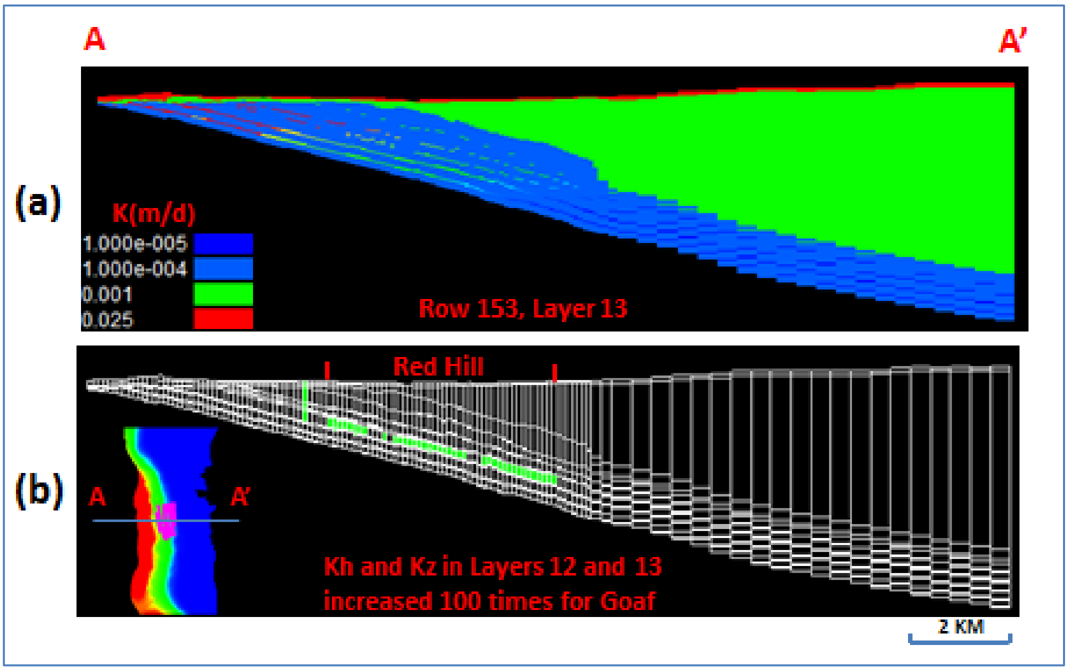
URS | GROUNDWATER | Figure: 6-10
File No: 42627373-g-2258.wor | Drawn: VH | Approved: CT | Date: 19-09-2014 | Rev.A | A4

6.6.3 Longwall Mining Collapse

NRM questioned whether the fracture zone, created as a result of longwall mining, could extend to intersect the Tertiary/Alluvial layers (unconfined units) and result in the loss of water from the Isaac River during stream flows. They also asked to consider modifying model layer 12 (the interburden above the target GMS coal seam). In addition, the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) was asked to consider the validity of the EIS conclusion that there is a low risk of direct hydraulic connection between the surface and the coal seam as a result of subsidence.The following provides a response to NRM's submission, as well as providing additional information for IESC consideration. It is noted that:

- EIS Appendix J Section 7.3.7 details the simulation of the goaf, including the alteration of model layer 12 over time in response to the alterations to aquifer parameters due to goaf.
- The conceptualisation of the goaf, as included in the modelling, is shown in the conceptual figures in **Section 6.4** of this report. Model layers 12 and 13 were altered and fracturing was simulated to extend above the longwall panels. Conceptual model **Figure 6-5** shows that the extent of mining, some 20 times the coal seam thickness and from depths of 200 m to 450 m below ground level from west to east, does not extend into the overlying Fort Cooper Coal Measures or the Tertiary sediments. Cross-sections through the model layers before and after goaf are shown in **Figure** 6-11. Green colour cells withing the Red Hill extent, cross section (b), are goaf areas in Layers 12 and 13.
- Fracturing may occur within the Tertiary material (as a result of surface subsidence); however, this fracturing is predicted to occur to a depth of 10 m only and so will not extend downwards to connect to the altered units below (refer to **Section 5.3** above). In addition, it is considered that these surficial cracks will self-seal as a result of:
  - — sediment laden surface water runoff (when ephemeral creeks and overland flow occur);
  - — swelling clays; and
  - — subsidence management.

Figure 6-11 Cross-sections through the Groundwater Numerical Model



6.6.4 Subsidence and Faulting

The subsidence predictions in EIS Appendix I1 consider the effects of subsidence in the vicinity of faulting or areas of geological variation (such as intrusions) and are based on experience from Bowen Basin longwall mining sites. The impacts associated with faulting are generally very localised and can usually be easily rehabilitated or managed on a case-by-case basis.

Figure 6-7 shows the location of mapped and probable faults, as discussed above, which strike north-south formed as a response to stress. No faults are mapped east-west so as to create a network of fractures or preferential pathways between the mine footprint and the Burton Range Thrust Fault located approximately 10 km east of the EIS study area. The localised effects (EIS Appendix I1) indicate that the potential for longwall mining goaf to create an increased fault network is minimal. The maximum subsidence, extracting a 10 m coal seam, is predicted to only impact an area some 35 m either side of the panels.

It was concluded that the risk of direct hydraulic connectivity between the ground surface and the coal seam, even after goaf, was low based on:

- the nature and extent of faulting;
- the aquitard nature of the overburden (between the GMS coal seam and the Tertiary overburden);
- the clay-rich Tertiary saprolite;
- the limited extent of vertical fracturing due to surface subsidence;
- the potential for fracturing above the longwall panels (some 20 times the coal seam thickness) is below the Tertiary;
- the limited influence of faulting on the potential subsidence; and
- the ephemeral and silt laden nature of the surface water bodies, particularly the Isaac River.

The inclusion of saturated unconfined units, simulating permanent water resources within the model layer 1, allowed for the assessment of potential reduction in water resources as a result of longwall mining, both goaf alterations and induced flow due to depressurisation, to be evaluated.

The assessment of the dewatered alluvium, and in turn the potential for impacts on the surface water, was therefore considered. The Isaac River (in the project area) does not receive significant inflows from groundwater resources. This volume is minor due to the limited thickness, storage capacity, and discontinuous nature of the alluvium, so that the impact on the surface water flow during the wet season is considered negligible.

6.7 Impacts on Shallow Aquifers

The seasonal groundwater resources are limited and do not provide sustainable cattle stock water across the project footprint.

Engineered structures (with foundations) could potentially impact on shallow, perched seasonal groundwater within the shallow alluvium. Should structures with foundations be constructed within this alluvium, then the (seasonal) flow of groundwater towards rivers and creeks can potentially be blocked or retarded. The design of these structures will take this potential impact into account and mitigation measures will be developed before and during the design stage. However, as the shallow aquifers do not provide sustainable cattle stock water across the project footprint, such mitigation measures may not be required.

6.8 Interaction of Surface and Ground Water

6.8.1 Effect on Surface Flows

NRM considered that predictive modelling should include simulation of groundwater/surface water interactions of surface water streams. Based on the information presented in **Section 6.4**, it is considered that the seasonal surface water bodies and unconfined water tables are perched above the confined groundwater resources.

The surface water bodies are separated from the confined groundwater resources by thick low permeable aquitards and recognised to have no hydraulic connection based on groundwater level data, where the depth to groundwater in the alluvium was approximately 11 to 13 m below ground level and the piezometeric level for the GMS seam is >19 m below ground level. These groundwater level data indicate potential for groundwater to move downwards and as such the surface water and surficial aquifers are not recognised to receive groundwater from the underlying confined aquifers.

For the predictive modelling, surface water–groundwater interaction was considered to be limited. The alluvium, which receives recharge from direct rainfall and surface water flow, is recognised has having minor surface water–groundwater interaction. The river bed sands are dry for the majority of the year and hence any groundwater in the alluvium does not supply a marked base flow component to the Isaac River, i.e. the river does not receive significant inflows from groundwater resources.

The predictive modelling does not include any surface water-groundwater interaction based on the nature of the surface water being separated from the groundwater resources to be directly impacted by mining. It is noted, however, that the predictive modelling does assess the potential for induced flow (indirect) impacts on the alluvium and unconfined aquifers. The model simulates induced flow from these units, saturated in the model (i.e. always containing groundwater), to the underlying dewatered and depressurised coal seam. This allows for a "worst-case" assessment of possible drawdown in these units as they seasonally become dry naturally (EIS Appendix J Section 7.5.2).

The assessment of the dewatered alluvium, and in turn the potential for impacts on surface water, was therefore considered. The Isaac River in the project area does not receive significant inflows from groundwater resources and the ingress from the upper layers in the model water balance is minor, hence the impact on the surface water flow during the wet season is considered negligible.

BMA has committed to the refinement of the predictive model, through the verification/comparison of groundwater model predictions to actual groundwater monitoring results compiled during mining. This model refinement and re-running will be undertaken at regular intervals (not longer than 3 years) during mining, as additional groundwater level, ingress and dewatering data become available. Should additional data, contrary to what is currently understood on site, become available then the model can be refined to include integrated surface water–groundwater modelling.

6.8.2 Hydraulic connectivity of subsidence fractures

The potential for direct hydraulic connectivity between the ground surface and the coal seam, based on the height of fracturing and the hydraulic conductivity of the fracture network, has been considered in **Section 5.3** (Subsidence Predictions) and **Section 6.6** (Faulting).

Further details on the risk of direct hydraulic connectivity between the ground surface and the coal seam, even after goaf, are provided in **Section 6.6.4**.

6.8.3 Vertical Extent and Hydraulic Connectivity of Subsidence Fractures

As discussed in **Section 5.3**, fracture modelling for the BRM LTCC indicated that the mining induced fractures are predicted to extend to the base of the Tertiary sediments for mining at 150 m and 250 m depth. This is considered to be in the range for the proposed mining at the shallowest part of the RHM longwall panels (approximately 200 m from surface).

The height of fracturing extends to the Tertiary sediments. The Tertiary sediments, composed of an intercalation of sands, gravels, and soft clays of medium to high plasticity, are not predicted to display any significant shear strain other than tensile fractures adjacent to the pillar edges at surface. The surficial tensional cracks are projected to extent to a maximum of 10 m from surface.

As recognised from field work in the Bowen Basin Tertiary sediments at the Crinum Coal Mine, the sands and clays in the Tertiary sediments can readily deflect over the fractured rock below and maintain their overall integrity in response to shallow mining.

Fracturing may occur within the Tertiary material (as a result of surface subsidence); however this fracturing is predicted to only occur to a maximum depth of 10 m and so will not extend through the entire Tertiary unit, some 80 m thick. Thus the longwall mining impacts are not predicted to result in connection from the target GMS coal to the surface.

6.8.4 Hydraulic Conductivity Alteration due to Subsidence

The aquifer parameters in the model were increased over time, in response to the impacts of goaf. The vertical and horizontal hydraulic conductivity values were increased 10 times from the original values for the goaf area within layers 12 and 13. This increase in hydraulic conductivity was maintained for these model layers over the model run. As limited data are available for the actual changes to the aquifer hydraulic parameters in response to the goaf, an uncertainty analysis of the base case model (with the 10 times increase) was conducted (EIS Appendix J Section 7.5.4).

The uncertainty analysis allowed for the increase (and decrease) of the altered base case vertical and horizontal hydraulic conductivity values, such that the vertical hydraulic conductivity was increase by a factor of 5 for the coal and overburden. Sensitivity run eight had a higher vertical hydraulic conductivity value for the interburden, which allowed more leakage to the GMS.

Through the analysis of parameter uncertainty, it was identified that uncertainty of vertical hydraulic conductivity of the interburden between coal seams could have marked impacts on predicted groundwater drawdown and inflow because the chosen sensitivity of the vertical hydraulic conductivity of 5×10^{-5} m/day (five times the base case value) was still within the reasonable parameter range.

The clay-rich nature of the Tertiary sediments (**Section 6.10**) limits the groundwater potential of this unit, thus should alteration of the Tertiary sediments increase the vertical hydraulic conductivity (fractures), limited groundwater will drain from this unit due to the low horizontal hydraulic conductivity (**Section 6.4**).

Any uncertainty in the model will be addressed through the refinement of the model and verification/comparison of groundwater model predictions to actual groundwater monitoring results compiled during mining. BMA is committed to model refinement and re-running model predictions at regular intervals (not longer than 3 years) during mining, as additional groundwater level, ingress, aquifer hydraulic parameter, and dewatering data become available.

6.8.5 Surface Water Loss to Groundwater

The seasonal surface water resources are recognised to be perched above the groundwater resources across the mine footprint (**Section 6.4**). The nature and response of the Tertiary sediments (aquitard separating the surface water and groundwater resources), as discussed in **Section 5.3** and **Section 6.4**, limit the potential for hydraulic connection between the surface water resources and the target coal seam, even after longwall mining.

Further details on the risk of direct hydraulic connectivity between the ground surface and the coal seam, even after goaf, are provided in **Section 6.6.4**.

The inclusion of saturated unconfined units, simulating permanent water resources within the model layer 1, allowed for the assessment of a potential reduction in water resources as a result of longwall mining, both goaf alterations and induced flow due to depressurisation, to be evaluated. The assessment of the dewatered alluvium, and in turn the potential for impacts on the surface water, was therefore considered. The Isaac River in the project area does not receive significant inflows from groundwater resources and the ingress from the upper layers in the model water balance. This is due to the limited alluvium thickness, storage capacity, and discontinuous nature is minor, such that the impact on the surface water flow during the wet season is considered negligible.

6.8.6 Management and Mitigation

DAFF considers that BMA should update the subsidence management and mitigation options should any adverse subsidence effects occur.

BMA is committed to monitoring subsidence impacts, including sub-surface subsidence fracturing (extent and depth), borehole deformation, and alteration to aquifer hydraulic parameters (including vertical hydraulic conductivity). The monitoring will allow for the comparison of subsidence predictions and where required the subsidence management plan will be updated should subsidence occur to depths greater than predicted.

The monitoring will allow BMA, which uses an adaptive management approach, to make informed management decisions.

DOTE has asked that clear commitments to mitigation of subsidence impacts should be provided.

BMA has provided additional details and commitments regarding subsidence adaptive management approach, the majority of which are included in the BRM subsidence management plan. These details are included in Appendix S to the EIS.

The monitoring program currently implemented at BRM includes the monitoring of cracking and areas with increased potential for erosion. A similar monitoring program is proposed for the project. In addition, the manual surveying of subsidence as mining progresses is routine and will form part of the project's operations.

Mitigation of gully and tunnel erosion from surface cracking by ripping and stabilising affected areas is standard practice in the central Queensland mining industry and will be implemented for the project as necessary.

6.9 Drawdown Predictions

6.9.1 Drawdown Contour Maps

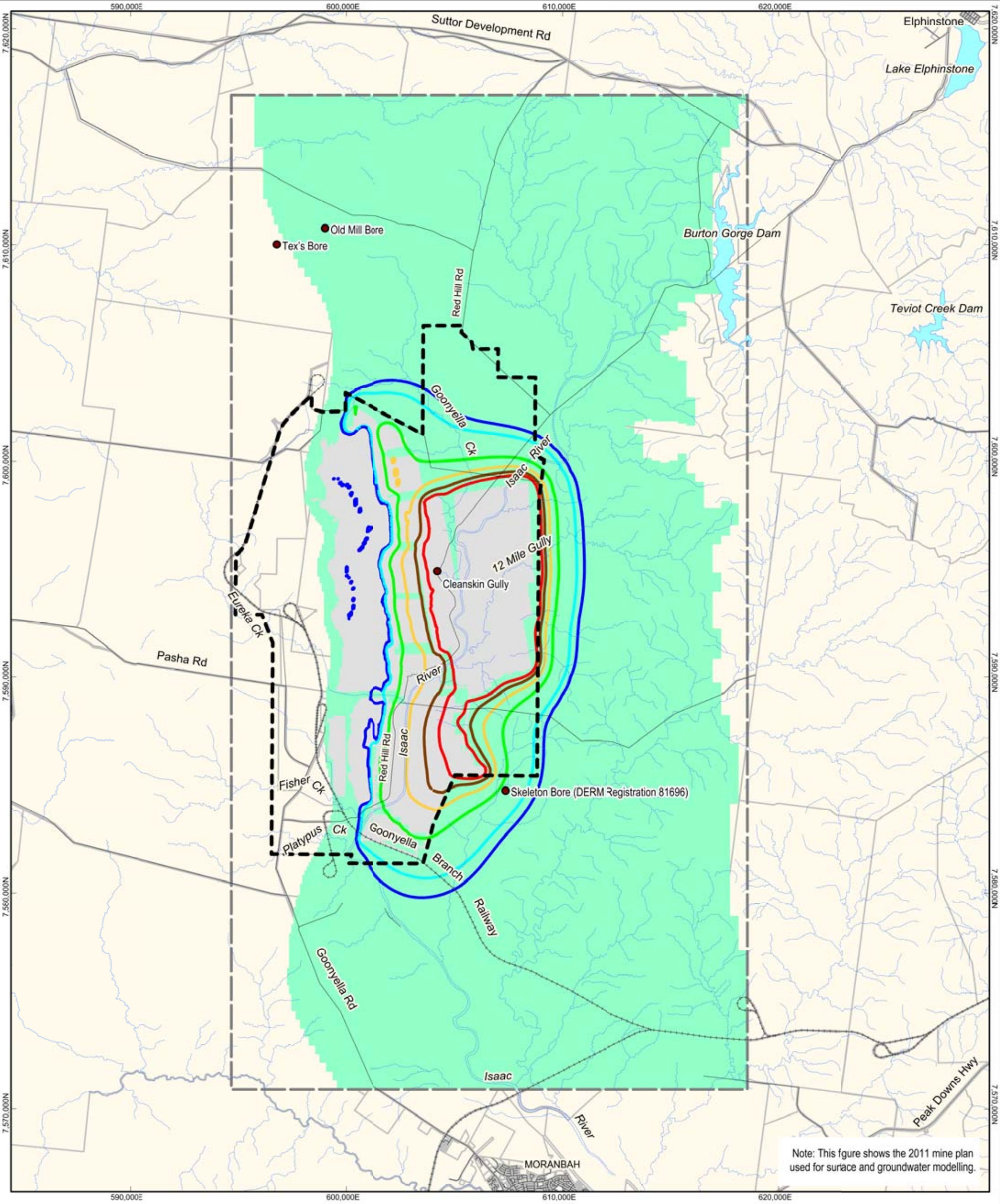
NRM and the Isaac Regional Council (IRC) have requested updated projected drawdown contour maps, on topographic backgrounds, which include bores and surface water features to allow for more clarity regarding the potential groundwater impacts.

Projected drawdown contours, generated for the Permian and overlying surficial units at different periods during the life of the mine, have been transposed onto a topographical base map to allow for clarification of the extent of drawdown within the upper Isaac River catchment area.

The significance of drawdown on groundwater, including groundwater bores, is discussed further in **Section 4.2.2.2**. A drawdown of greater than 5 m would be considered significant if such a drawdown was to affect a recognised groundwater user. There are no such users within the predicted 5 m drawdown contour. However, identified bores just outside this contour will be monitored and should users be impacted, BMA is committed to entering make good agreements.

Section 6.14 details the monitoring and management program designed to address such impacts on users of this groundwater resource.

These figures are included in **Figure 6-12** to **Figure 6-19**.



N
W E
S

0 1.5 5km

Scale 1:250,000 (A4)
Projection: MGA Zone55 (GDA94)

Drawdown (m)

5	100
10	150
50	200

EIS Study Boundary

Open-Cut and Underground Mining Operations

Model Extent

Model Boundary

Census Bore

NOTE: GMS refers to the Goonyella Middle Seam
GRB refers to Goonyella Riverside and Broadmeadow mine

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RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

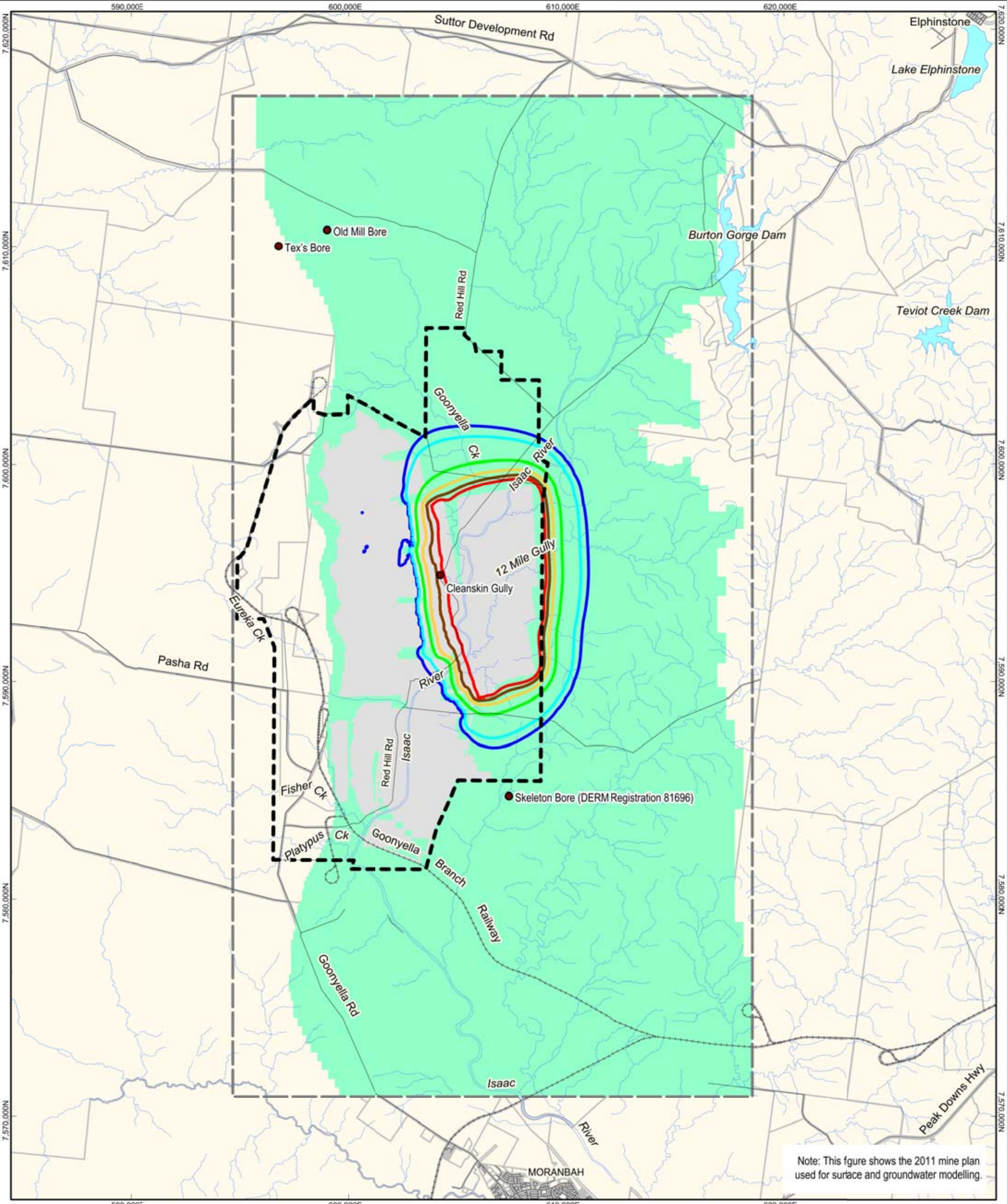
DRAWDOWN PREDICTION FOR GMS AT END OF RED HILL MINING LEASE MINING WITH GRB MINING

URS

GROUNDWATER

Figure: **6-12**

File No: **42627373-g-2264.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev.**A** A4



Scale 1:250,000 (A4)
Projection: MGA zone55 (GDA94)

Drawdown (m)

5	100
10	150
50	200

EIS Study Boundary
Open-Cut and Underground Mining Operations
Model Extent
Model Boundary
Census Bore

NOTE: GMS refers to the Goonyella Middle Seam
GRB refers to Goonyella Riverside and Broadmeadow mine

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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

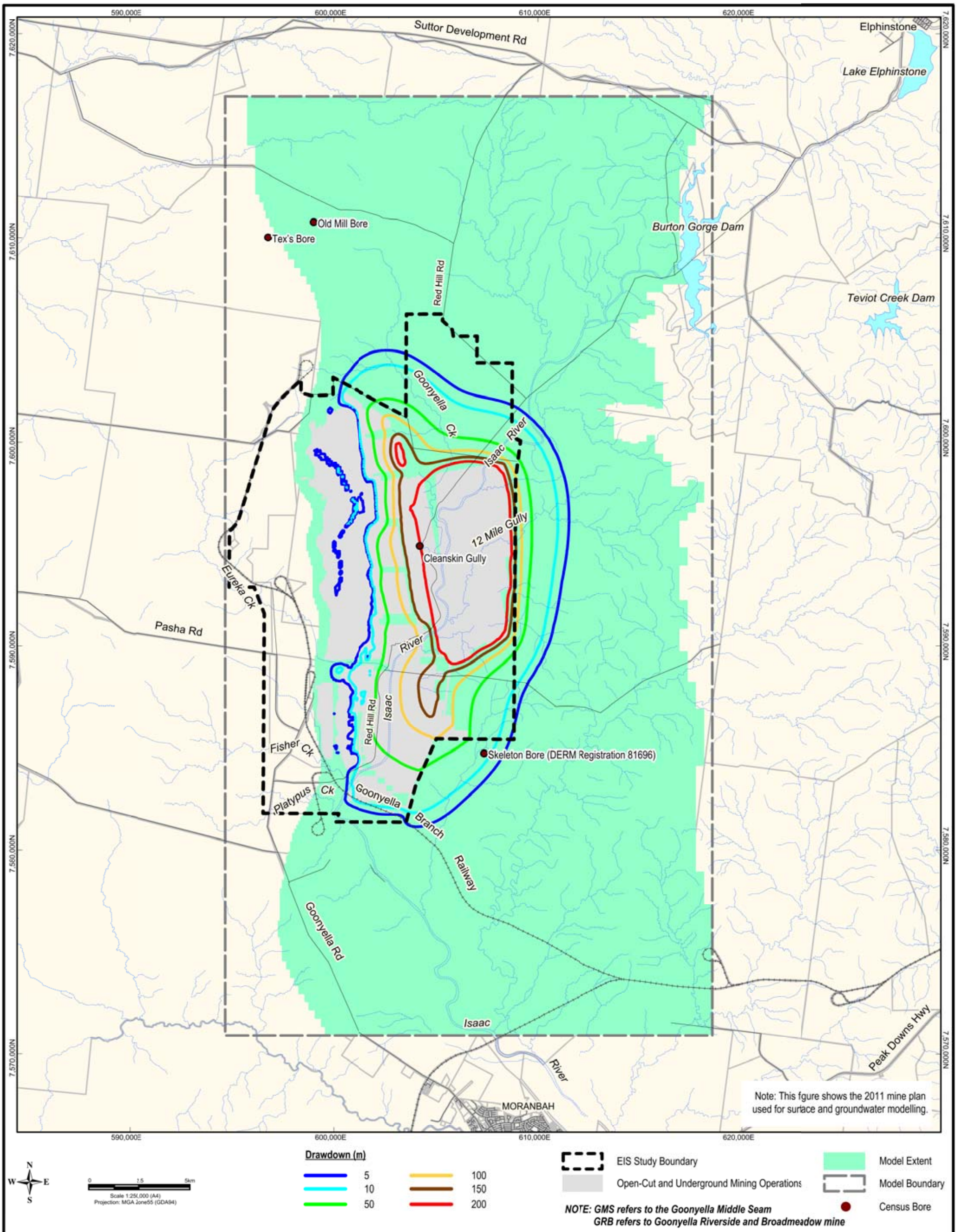
DRAWDOWN PREDICTION FOR GMS AT END OF RED HILL MINING LEASE MINING ONLY

URS

GROUNDWATER

Figure: **6-13**

File No: **42627373-g-2264.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev. **A** A4



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RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

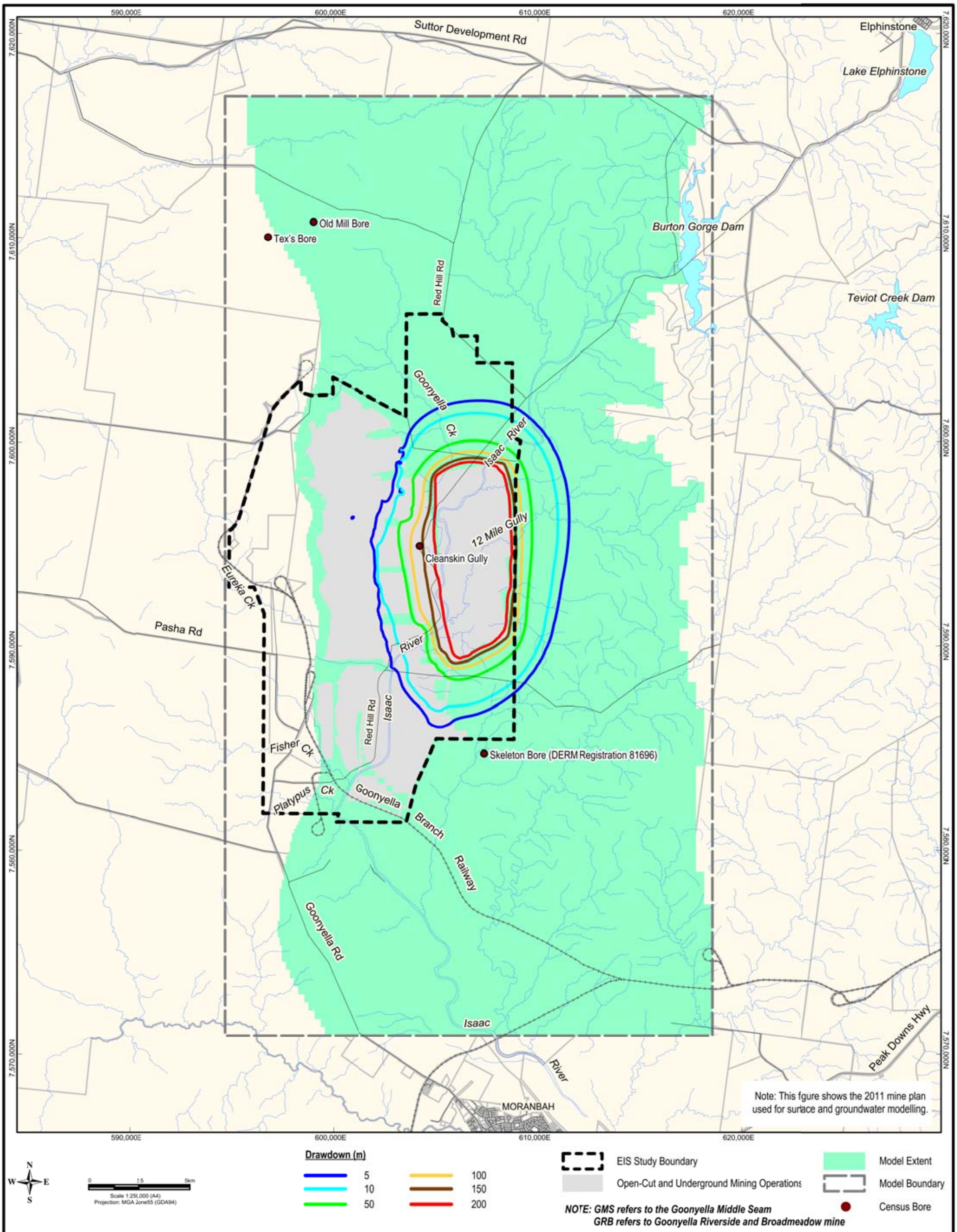
DRAWDOWN PREDICTION FOR GMS AT THE END OF GRB MINING WITH RED HILL MINING LEASE

URS

GROUNDWATER

Figure: **6-14**

File No: **42627373-g-2265.wor** | Drawn: **VH** | Approved: **CT** | Date: **19-09-2014** | Rev. **A** | A4



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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

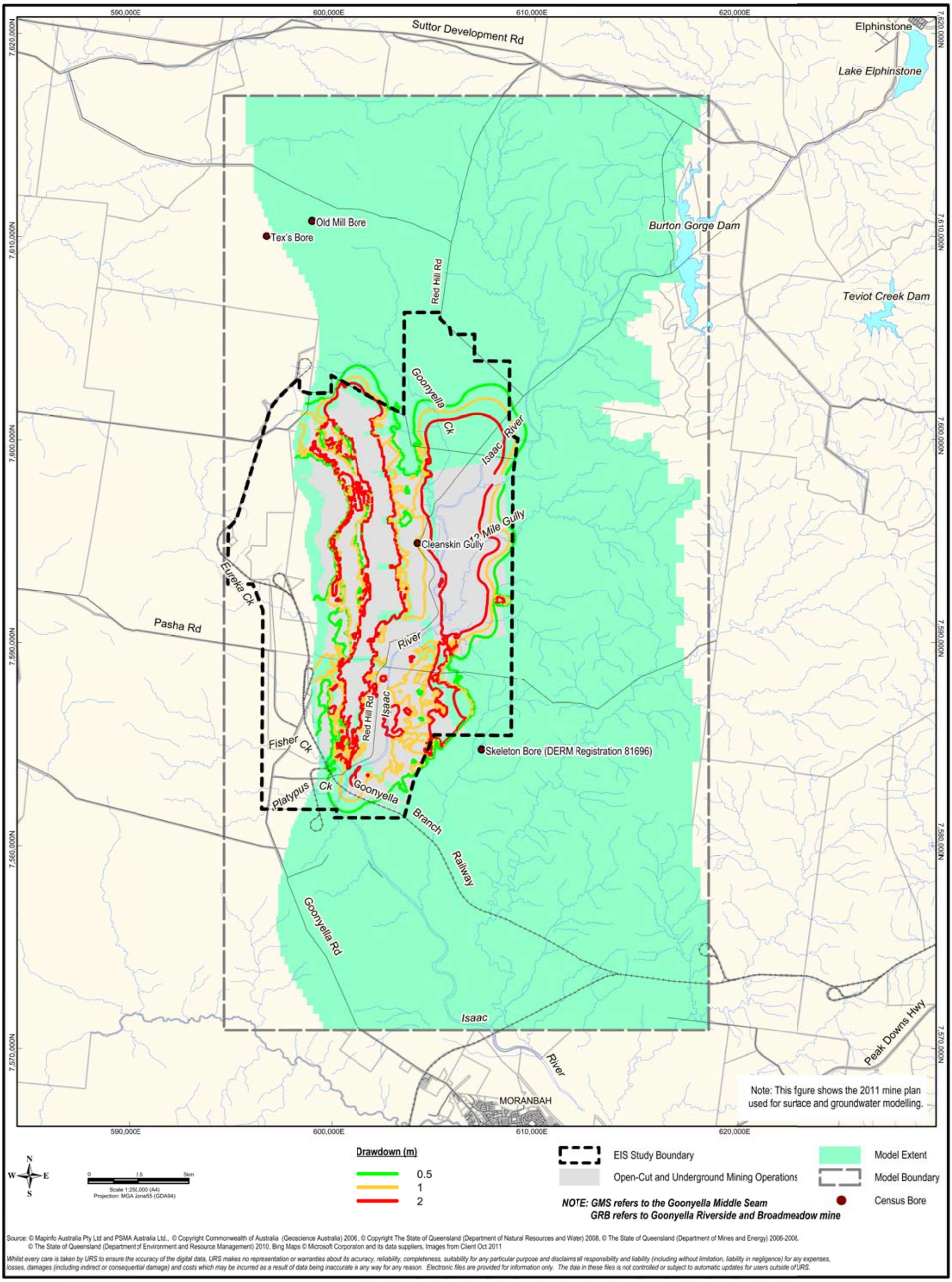
DRAWDOWN PREDICTION FOR GMS AT THE END OF GRB MINING, RED HILL MINING LEASE ONLY

URS

GROUNDWATER

Figure: **6-15**

File No: **42627373-g-2265.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev.**A** A4



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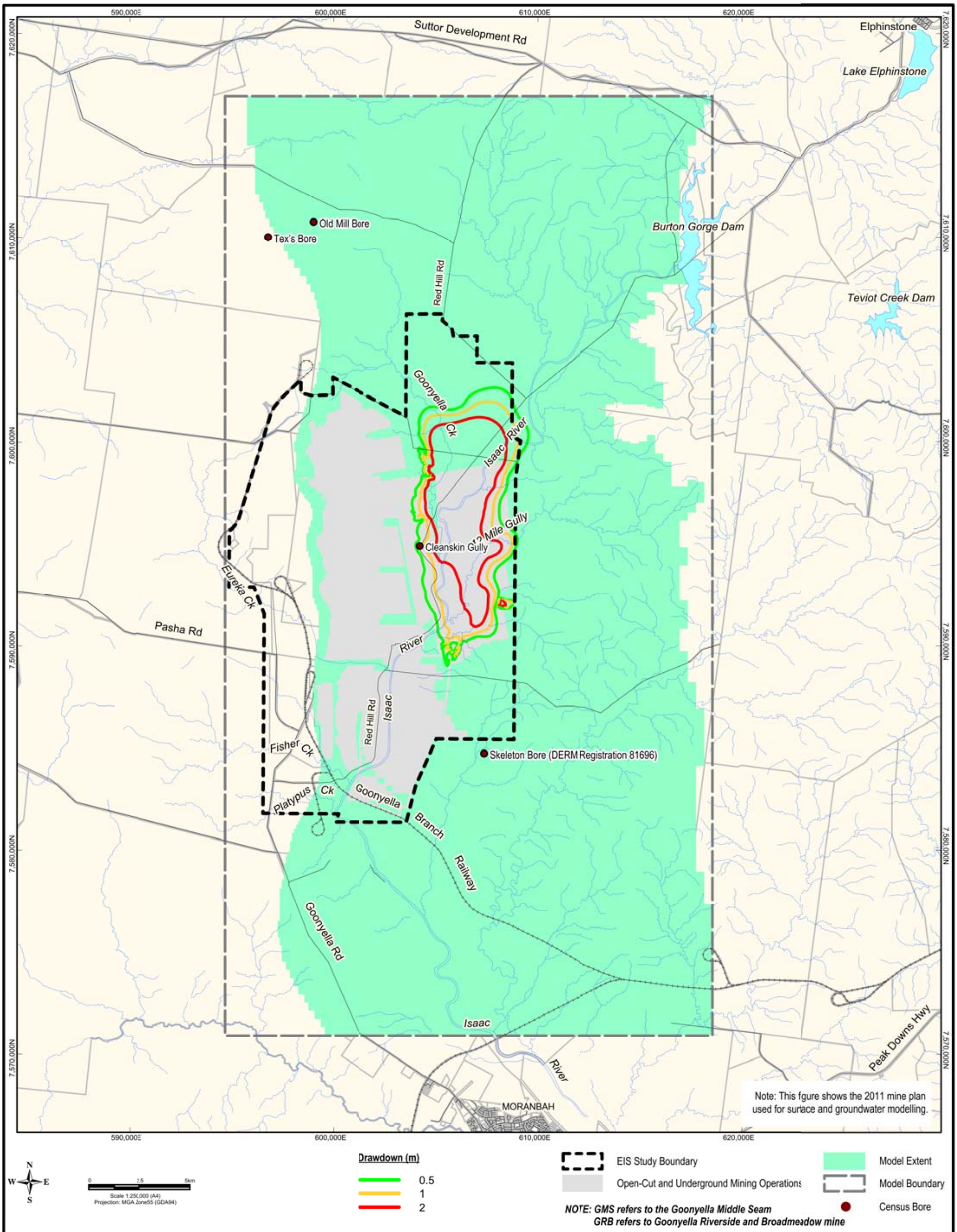
RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

DRAWDOWN PREDICTION FOR TERTIARY - QUATERNARY AT THE END OF RED HILL MINING LEASE MINING WITH GRB MINING

URS | GROUNDWATER | Figure: 6-16

File No: 42627373-g-2266.wor | Drawn: VH | Approved: CT | Date: 19-09-2014 | Rev. A | A4



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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

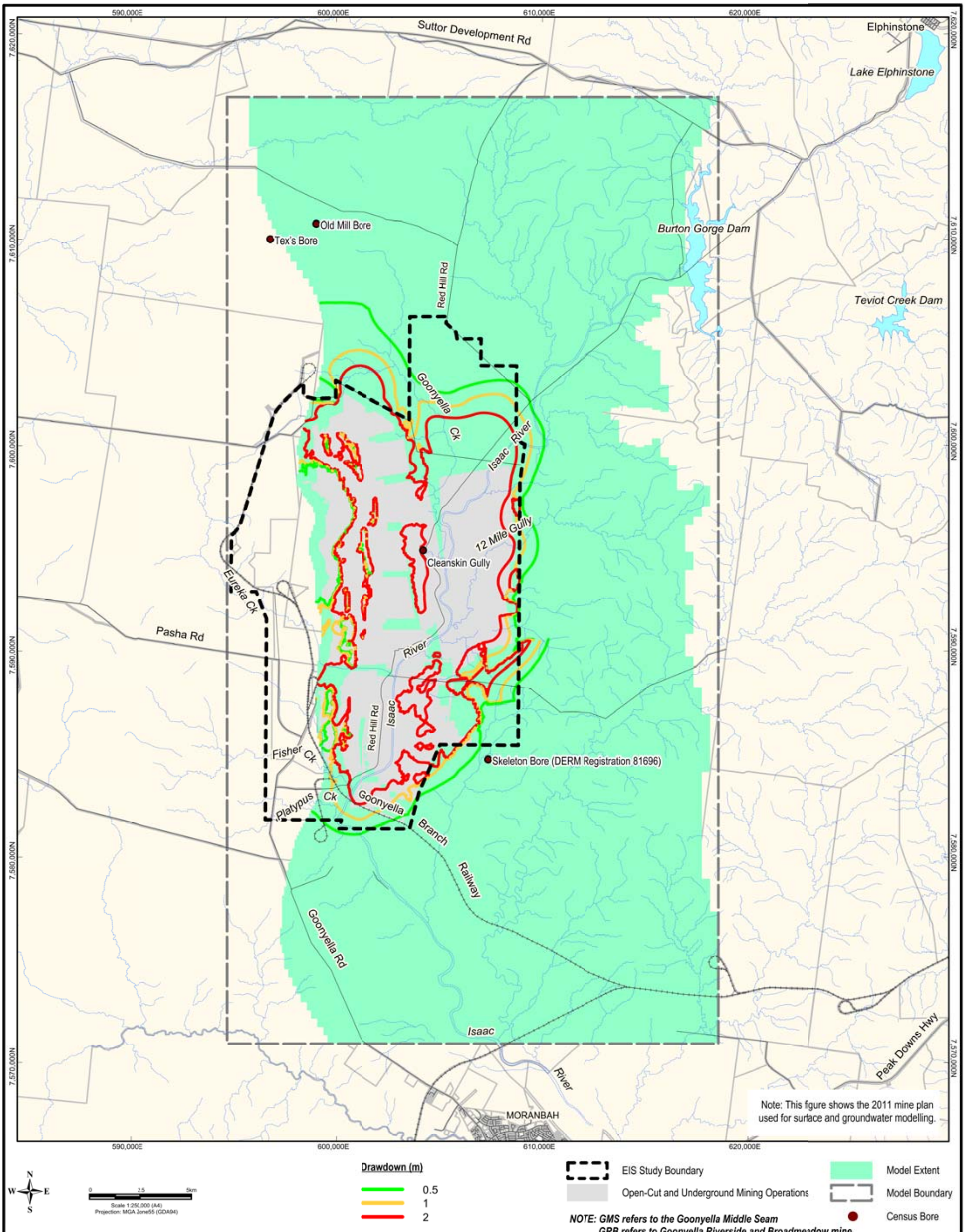
DRAWDOWN PREDICTION FOR TERTIARY - QUATERNARY AT THE END OF RED HILL MINING LEASE MINING ONLY

URS

GROUNDWATER

Figure: **6-17**

File No: **42627373-g-2266.wor** Drawn: **VH** Approved: **--** Date: **19-09-2014** Rev.**A** A4



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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

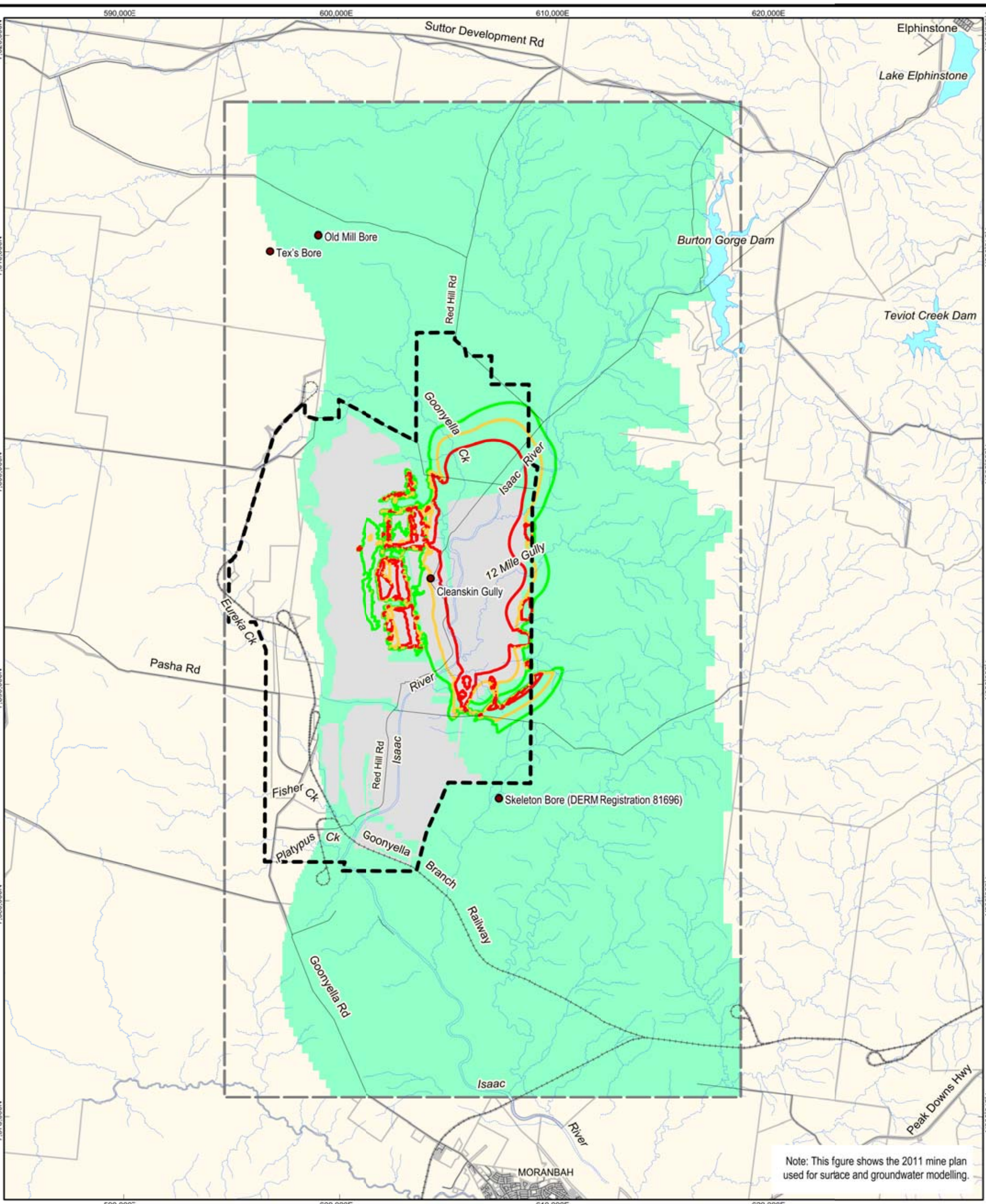
DRAWDOWN PREDICTION FOR TERTIARY - QUATERNARY AT THE END OF GRB MINING WITH RED HILL MINING LEASE

URS

GROUNDWATER

Figure: **6-18**

File No: **42627373-g-2267.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev. **A** A4



Scale 1:250,000 (A4)
Projection: MGA Zone55 (GDA94)

Drawdown (m)

- 0.5
- 1
- 2

EIS Study Boundary

Open-Cut and Underground Mining Operations

Model Extent

Model Boundary

Census Bore

NOTE: GMS refers to the Goonyella Middle Seam
GRB refers to Goonyella Riverside and Broadmeadow mine

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ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

DRAWDOWN PREDICTION FOR TERTIARY - QUATERNARY AT THE END OF GRB MINING, RED HILL MINING LEASE ONLY

URS | GROUNDWATER | Figure: 6-19

File No: 42627373-g-2267.wor | Drawn: VH | Approved: CT | Date: 19-09-2014 | Rev. A | A4

6.9.2 Drawdown and Model Sensitivity Runs

NRM noted the EIS Appendix J Section 7.5.4 included model sensitivity runs which included a worst-case (run 8) and requested additional information on the run compared to the base case.

During the predictive modelling conducted to assess the potential impacts of the proposed mining on the groundwater resources, an unlikely scenario of increased vertical hydraulic conductivity (by a factor of 5, Table 7-8 in EIS Appendix J) was included in all of the model layers, including the Tertiary sediments. This is deemed unlikely based on:

- Limited potential of fracturing in the Tertiary sediments (**Section 5.3**). The Tertiary sediments (composed of an intercalation of sands, gravels, and soft clays of medium to high plasticity) are not predicted to display any significant shear strain other than tensile fractures adjacent to the pillar edges at the surface (to a maximum depth of 10 m). The modelling conducted for the shallow mining at BRM indicates that the sands and clays in the Tertiary sediments can readily deflect over the fractured rock below and maintain their overall integrity. This has been noted in the Bowen Basin Tertiary sediments at the Crinum Coal Mine.
- The geotechnical studies indicate that fractures extend to the base of the clay-rich Tertiary sediments which are up to 80 m thick in the study area (EIS Appendix J Table 5-1), and that the surficial tensional cracks are projected to extend no further than 10 m below the surface. Thus the longwall mining impacts are not predicted to result in connection from the target GMS coal to the surface.
- The clay-rich nature of the Tertiary sediments (**Section 6.10**) limit the groundwater potential of this unit, thus should alteration of the Tertiary sediments increase the vertical hydraulic conductivity (fractures), limited groundwater will drain from this unit due to its low horizontal hydraulic conductivity (**Section 6.4**).

The worst-case model scenario (run 8) resulted in the highest predicted total inflow, some 214 GL over the life of the mine (EIS Appendix J Table 7-10). It is noted, however, that the drawdown projected in the GMS coal seam is not as deep as the drawdown for the base case, thus the maximum extent of drawdown away from the mine (associated with the target coal seam due to active dewatering and resultant depressurisation) would not extend as far as that predicted for the base case, as presented in EIS Appendix J.

The additional volumes of ingress, using the unlikely run 8 scenario, is as a result of inducted flow from the overlying units, hence the possible deeper drawdown within the surficial units (assuming they were always saturated and in hydraulic connectivity with the underlying confined units).

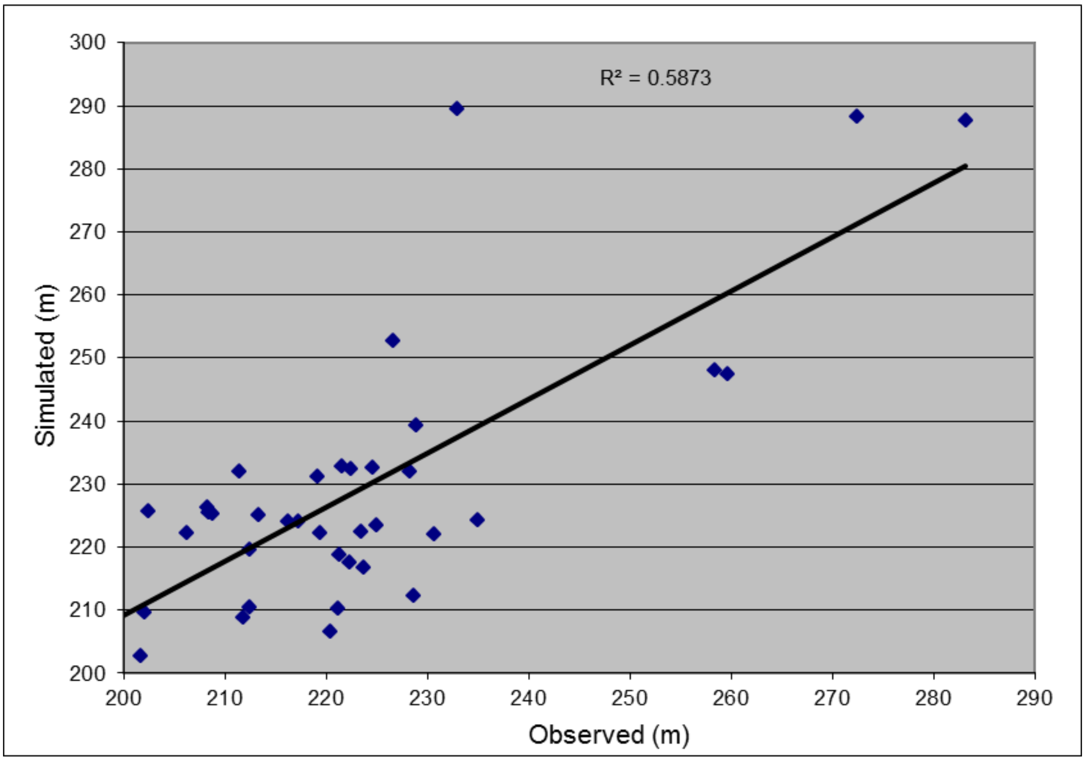
It is therefore considered that the generation of drawdown contours for this scenario will not provide a larger zone of influence and would not be appropriate as the model is less accurately calibrated, when compared to the base case (Table 7-4 in EIS Appendix J), using the increased vertical hydraulic conductivity values (as shown in **Table 6-4** and **Figure 6-20**).

Table 6-4 Model Statistics for Base Case and Scenario Run 8 for Comparison

Statistic parameter	Base Case	Scenario Run 8
Mean error (m)	-4.09	-5.96
Root Mean Square Error (m)	11.57	14.80
Standard Deviation (m)	10.97	13.73
Head Range (m)	87.73	87.73
Mean Error %	-4.6%	-6.79%
Root Mean Square Error %	13.2%	16.9%
Standard Deviation %	12.5%	15.6%
R^2 (Chart 7-1 in EIS Appendix J)	0.69	0.58*

* See Figure 6-20

Figure 6-20 Run 8 Modelled versus Observed Head Values



6.9.3 Revised Impact Predictions on Groundwater Users

The groundwater drawdown contours projected over the life of the project for the Permian and overlying younger sediments have been included on **Figure 6-12** to **Figure 6-19**. The following was noted regarding the potential impacts on the census bores:

- Cleanskin Bore is located within the approved GRM area and will be impacted by mining. This was mistakenly omitted from the initial EIS groundwater report, EIS Appendix J;
- the proposed project alone is not predicted to impact on Skeleton Bore (**Figure 6-15**);
- census bores, Skeleton Bore and Cleanskin Gully Bore (**Table 6-6** and **Figure 6-2**) are predicted to be impacted by the cumulative impact of mining at RHM and GRM (**Figure 6-12**); Skeleton Bore, approximately 25 m deep, may be installed into Quaternary – Tertiary sediments. Worst-case drawdown predictions in the unconfined surficial units are not recognised to impact on Skeleton Bore (**Figure 6-16** to **Figure 6-19**); and
- no impact on census bores, Tex's Bore and Old Mill Bore (**Figure 6-2** and **Table 6-6**), is predicted (**Figure 6-12** to **Figure 6-19**).

Based on the location of the Cleanskin Gully bore, it is certain that this bore will be lost during the approved and/or proposed mining operations. It is acknowledged that BMA has a compensation agreement with the bore user in the event that the bore is no longer available for water supply.

Should monitoring show any impacts, BMA is committed to providing make good arrangements for affected parties.

6.10 Drilling Data

6.10.1 Bore GW01

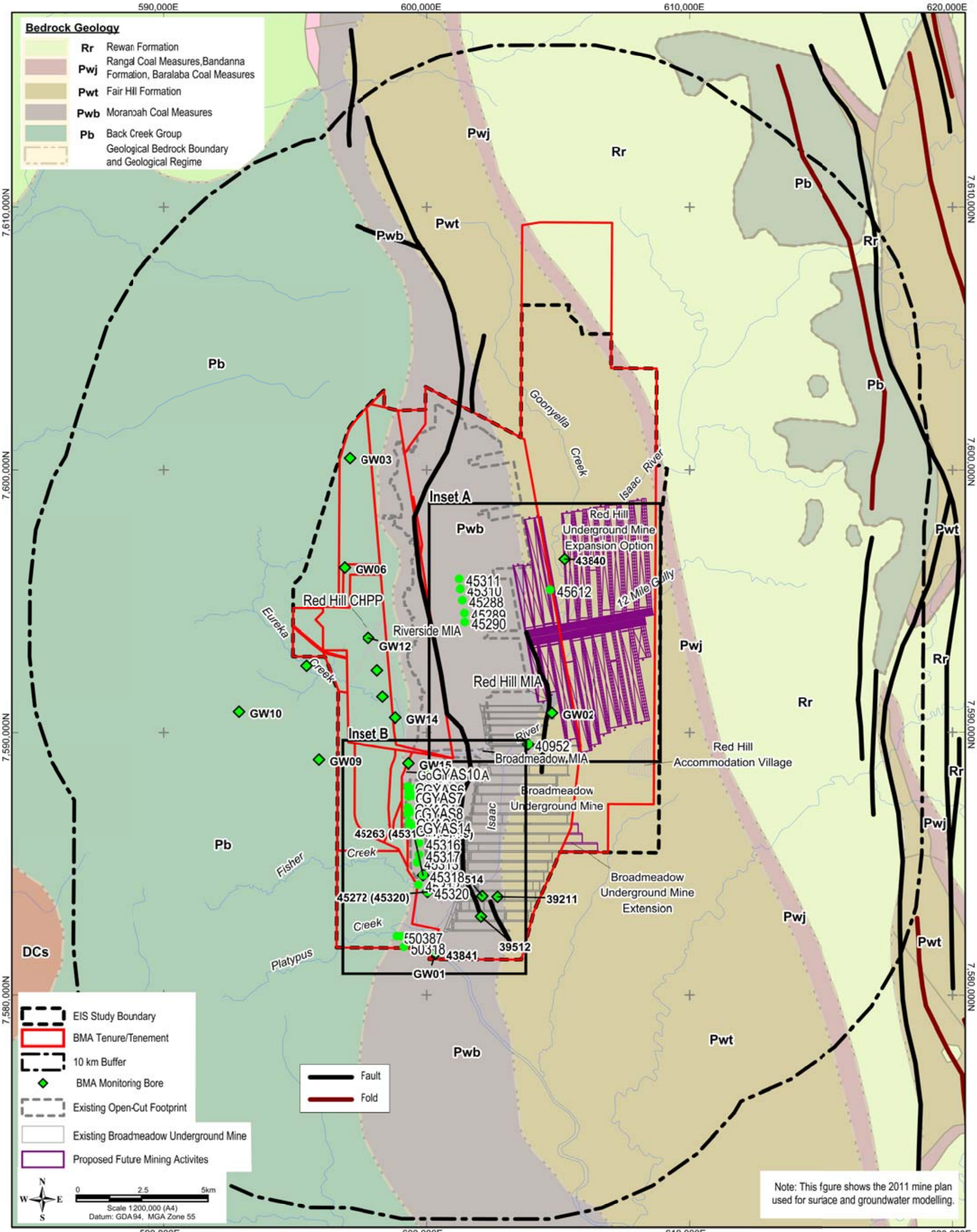
NRM commented that monitoring bore GW01, although referred to in the EIS Appendix J report, was not included in Figure 6-2 of the EIS.

Bore GW01 is located to the south of BRM adjacent to the old bore 43841 on the banks of the Isaac River. Unfortunately the RN number 43841 covers the GW01 number on EIS Appendix J Figure 6-2. A new figure, **Figure 6-21**, has been generated to clearly indicate the location of bore GW01.

For completeness the bore log for GW01 is included in **Table 6-5**.

Table 6-5 Geological Bore Log for Monitoring Bore GW01

Depth	Bottom	Description
0	3	SAND, very fine grained, light tan changing to reddish tan, well sorted, poor plasticity, dry
3	4	SAND, fine to coarse grained, reddish tan, poorly sorted- sub-angular to sub-rounded quartz sand (2-8 mm), poor plasticity, dry
4	10	muddy SAND, fine to medium grained, light brown, poorly sorted, poor to moderate plasticity, dry
10	14	muddy SAND, fine to coarse grained quartz sand, tan brown, poorly sorted with sub-angular to sub-rounded mudstone clasts (5-50 mm), poor to moderate plasticity, wet
14	20	muddy SAND, medium grained quartz sand, tan brown, moderately well sorted, poor to moderate plasticity
20	22	silty MUD, tan brown, well sorted, good plasticity
22	27	sandy MUD, fine grained sand, reddish grey, red streaks when mud clasts broken, well sorted, good plasticity
27	33	sandy MUD, medium to coarse grained sand, dull grey, moderately well sorted, good plasticity
33	37	ALLUVIUM, medium to large sandstone and siltstone gravel, grey, sub-angular to angular clasts, mud matrix
37	39	SANDSTONE, fine to medium grained, grey, friable, weathered top of 39-43 m
39	43	SANDSTONE, fine to med grained, grey, fresh, indurated
43	44	carbonaceous MUD, dark grey to black, well sorted, friable, good plasticity
44	46	MUD with small amount of fine to medium sand, terracotta red, moderately well sorted, friable, good plasticity
46	51	MUDSTONE, golden tan, well to moderately well sorted- small sub-angular, indurated sandstone clasts (6-8 mm), friable, good plasticity
51	54	MUDSTONE, terracotta red, organic rich, well sorted, moderately well indurated, good plasticity
54	59	MUDSTONE, golden tan, well sorted, moderately well indurated but still friable, good plasticity
59	62	carbonaceous MUDSTONE, dark grey, well sorted, friable, good plasticity
62	63	muddy SAND, medium grained, grey sand, dark grey carbonaceous mud, moderately well sorted, friable, moderate to good plasticity
63	66	carbonaceous MUDSTONE, dark grey, well sorted, well indurated, good plasticity
66	69	MUDSTONE, very small amount of fine grained sand, dark grey, moderately well sorted- sub-angular, black indurated mudstone clasts (3-7 mm), friable, good plasticity
69	73	MUDSTONE, dark grey, well sorted, friable, good plasticity
73	76	SANDSTONE, fine grained, light grey, well sorted, friable, moderate plasticity
76	78	LOST SAMPLE
78	80	MUDSTONE, black, well sorted, indurated but still friable, good plasticity
80	81	SANDSTONE, fine grained, black, well sorted, indurated but friable
81	87	SANDSTONE, fine grained, light grey, well sorted, indurated but friable
87	92	MUDSTONE, very dark grey, moderately well sorted- small coal clasts in sample (5-8 mm)
92	93	SANDSTONE, fine grained, black, moderately well sorted- small rounded to sub-angular tan mudstone clasts, friable



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RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

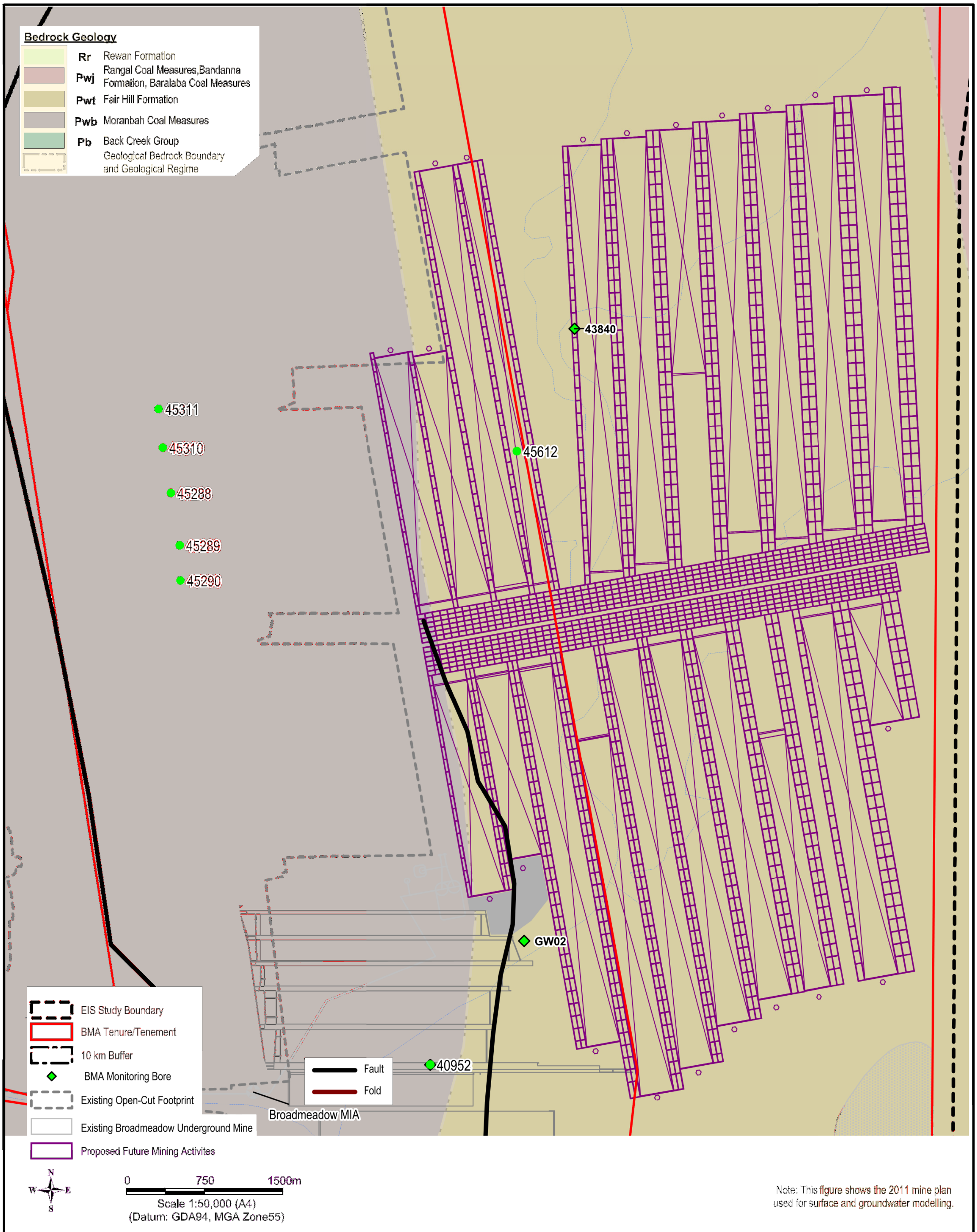
REFERENCE BORES

URS

GROUNDWATER

Figure: 6-21

File No: 42627373-g-2257.wor | Drawn: VH | Approved: CT | Date: 19-09-2014 | Rev. A | A4



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RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

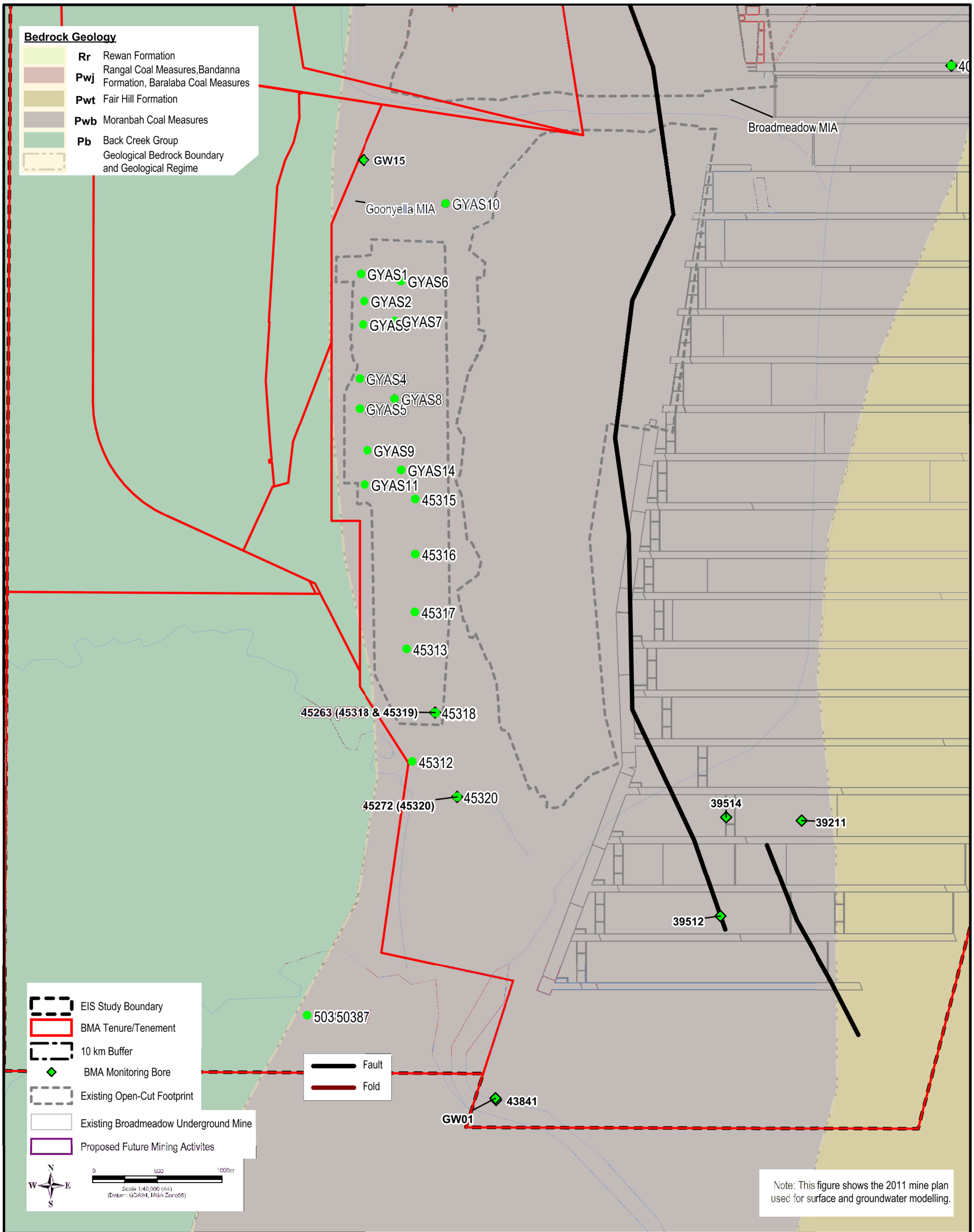
REFERENCE BORES INSET A

URS

GROUNDWATER

Figure: **6-21a**

File No: **42627373-g-2257.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev.**A** A4



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RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

REFERENCE BORES
INSET B

URS

GROUNDWATER

Figure: **6-21b**

File No: **42627373-g-2257.wor** Drawn: **VH** Approved: **CT** Date: **19-09-2014** Rev.**A** A4

6.10.2 Groundwater Potential

The information used for EIS Chart 6-1 was obtained from 699 exploration bores drilled across the GRB mine complex, intersecting the Moranbah and Rangal coal measures. The information recorded included water records and final blow yield. The water records included water strikes, dampness, or dry holes. These bores, colour coded to yields, are included in **Figure 6-10**.

The data included in Chart 6-1 were the blow-out yield recorded and the corresponding depth of the water strike. The shallowest groundwater was intersected at 31 m (bore 50318), which had a yield of 0.07 L/s. This agrees with the conceptualisation that the alluvium (seasonally) and Tertiary cover has little or no groundwater potential.

The three bores with the highest airlift yields (bores 50388, 45612, and 50387) are all located adjacent to each other along the southern boundary of the GRB mine lease within weathered Tertiary basalt overlying the Moranbah Coal Measures. The transient groundwater level data compiled for NRM bore RN13040281 (**Figure 6-3**) (vesicular basalt) indicates groundwater level increase over time. This suggests limited impact of mining on the Tertiary basalt aquifer to the southwest of the GRB complex.

Regional and local faults (see **Section 6.6**) are included on **Figure 6-10** along with the exploration bores. It is evident from the bore yield data (random yield distribution), location of faults, and the dry nature of the GRM pits, that the faulting has limited influence on groundwater potential.

The mine pits across the GRM are dry as limited groundwater is associated with the underlying geology. Any ingress on damp/wet pit walls is removed through evaporation. Groundwater ingress into the mine workings is limited due to:

- limited volumes of groundwater associated with the faults (i.e. limited storage and recharge capacity of the faults);
- little or no fault interconnection;
- the aquitard nature of the units intersected in the faults;
- the discontinuous nature of the faults which don’t extend into the Tertiary sediments; and
- low aquifer hydraulic parameters which limit the zone of influence around the mine (even after long periods of mining at GRM). This is recognised in the groundwater level data, measured in bores adjacent to the mine (such as Cleanskin Gully Bore and RN13040281 (**Figure 6-3**)) and the groundwater level data presented in the Eaglefield EIS (Met Serve 2010). The groundwater level data, around 275 m AHD for the monitoring bores approximately 3 km north and along strike of Goonyella, confirm the limited extent of drawdown around GRM as included in the groundwater model, EIS Appendix J Figure 7-5.

6.10.3 Registered Bores

NRM requested clarification regarding the number of surrounding bores discussed in EIS Appendix J Section 6.3. A review of available the data of registered/private bores revealed:

- 27 registered bores, not related to BMA, are located within a 5 km radius of RHM;
- These bores include 23 private bores and 4 NRM monitoring bores;
- Of the 23 private bores, 16 are associated with coal seam gas operators; and
- Of the 7 remaining, 4 are listed as destroyed while the remaining 3 bores do not include any details.

It is noted that 12 additional registered bores have been included on the NRM bore database since the compilation of the registered bore data for inclusion in the EIS Appendix J report (these bores are highlighted in red on **Figure 6-2**).

The additional 12 registered bores are newly registered as monitoring bores, 10 to the south across the Grosvenor Mine lease area and 2 to the north for coal seam gas operators.

6.10.4 Bore Census Details

As per the request from NRM, the information for the four census bores was reassessed and verified and is presented in **Table 6-6**. This table is refined from EIS Appendix J Table 6-4.

Table 6-6 Summary of Information Collected During Bore Census

Bore Name	Easting Zone 55 AGD94	Northing Zone 55 AGD94	Drilled Depth (mbgl)	Depth to Water (mbgl)	Water Use	Pumping Rate (L/s)	Landholder Description of Water Quality
Tex's Bore	596676	7609837	118.9	34.13	Domestic and stock watering in drought	4.5	
Old Mill Bore	598897	7610587	117.1	90.66	Stock watering	1.9	
Skeleton Bore (RN 81696)	607261	7584559	63.7	28.41	Stock watering when required	1.3	'Good'
Cleanskin Gully	604125	7594723	25.34	14.02	Stock watering when required	2.6	'Good'

These bores have been included on **Figure 6-2** which indicates the bore labelled Cleanskin Gully is located within the proposed project footprint (on the GRM approved mine lease) and not adjacent the BRM extension panels as stated in the EIS.

The bore was drilled in 1963 to a depth of 25.34 m and includes 5" (127 mm) steel casing. Groundwater was intersected at 14.29 m below surface; however, groundwater level was measured at 14.02 m below surface on 13 July 2011. The bore is equipped with a jet pump capable of delivering 2,000 gallons per hour (2.6 L/s) where required. The groundwater quality is considered good and suitable for stock watering by the owner.

Based on the location of this bore it is certain that this bore will be lost during the approved and/or proposed mining operations. It is acknowledged that BMA has an existing compensation agreement with the owner in the event that the bore is no longer available for water supply.

6.10.5 Bore Data

NRM commented on EIS Appendix J Section 6.1.1 that the provision of aquifer parameter testing for monitoring bores GW01 and RN43840, constructed to intersect the Isaac River alluvium, would possibly provide more representative data regarding the Isaac River alluvium.

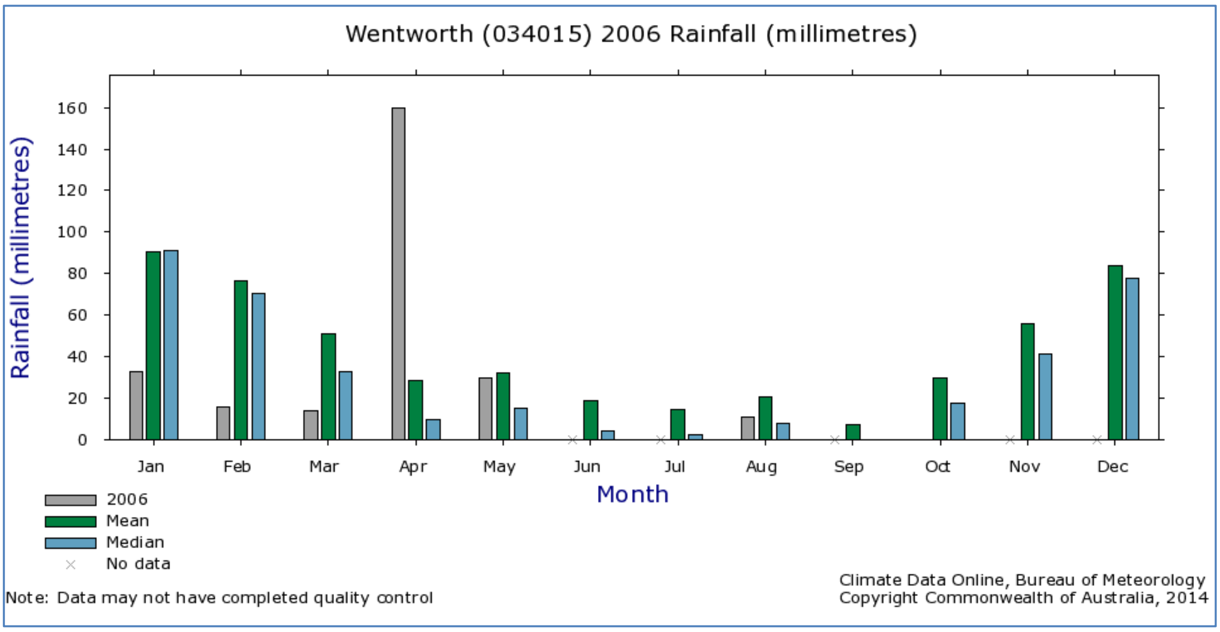
Bore 43840 was drilled to 15 m in April 2006 to intersect Tertiary sediments (considered to be shale) adjacent to the Isaac River (AGE 2006). Bore 43840 failed to produce significant quantities of groundwater and recovery of the groundwater level, between stages of airlift development, was minimal.

During the drilling 43840, no groundwater occurred in the surficial 5 m sand interval and the first appearance of moist drilling cuttings occurred at the base of the Tertiary sequence. Despite this observation, it was decided to slot the interval from approximately 4 m depth to the base of the hole. Groundwater levels measured the morning following the construction of the monitoring bore showed that the groundwater level had not recovered to the level of the base of the sand, supporting the observation that the sand at this site is unsaturated.

No records of any aquifer tests were located with regards to bore 43840.

It is noted that April 2006 was a significantly wet month, compared to historic rainfall statistics (Bureau of Meteorology weather station 034015, 1963 to 2014) (**Figure 6-22**), indicating the limited groundwater potential of the alluvium intersected along the Isaac River.

Figure 6-22 Rainfall Data for 2006 at Wentworth (Moranbah)



Bore GW01 was drilled to 93 m in May 2009 (refer to **Table 6-5**). The bore intersected 4 m of dry sub-rounded quartz sand (2 – 8 mm) overlying weathered mudstone to 37 m. Interbedded mudstone, sandstone and carbonaceous shale was intersected within the Permian sediments.

A variable head test conducted on GW01 provided a low hydraulic conductivity value of 2.63×10^{-4} m/day for the Permian units screened within this bore.

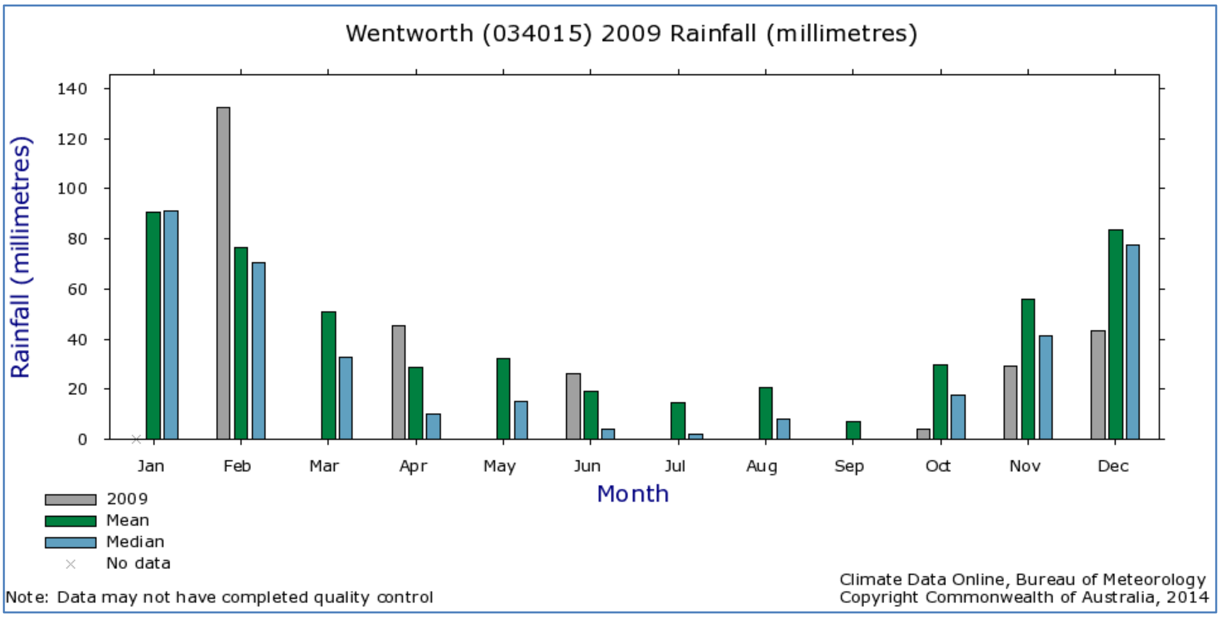
Bore GW02 was drilled to 40 m adjacent to the Isaac River (between the proposed RHM and the BRM panels (**Figure 6-21**), although the bore was not commissioned. The Isaac River alluvium (comprising silt and mud) was measured to a depth of 19 m below surface (**Table 6-7** presents the bore log). Groundwater was measured at 21.22 m below surface in June 2009, indicating the alluvium was not saturated. June 2009 received above average rainfall (**Figure 6-23**) but it is noted that June is in the dry season.

Table 6-7 Geological Bore Log for GW02

Depth	Bottom	Description
0	1	TOPSOIL, silty sand, very fine grained, light brown/tan, well sorted, unconsolidated, moderate plasticity, dry
1	3	silty MUD, very fine grained, reddish brown, poorly consolidated, well sorted, friable, good plasticity, dry
3	4	SILT, golden tan, very fine grained, poorly consolidated, well sorted, moderate to good plasticity, dry
4	5	silty MUD with some sand, fine grained, reddish tan, poorly to moderately well sorted, friable, good plasticity, dry
5	7	silty MUD, very fine grained, reddish tan, poorly to mod sorted, friable, good plasticity, slightly moist with increasing moisture and reduction of silt with depth to 7.0 m
7	9	muddy SILT, fine grained, orange tan, well sorted, poorly consolidated, friable, good plasticity, dry
9	10	silty MUD, very fine grained, reddish brown silt, grey to dark grey mud clasts, moderately well sorted within clay, friable, moist clay, dry silt
10	13	silty SAND, fine grained, orangey brown, fine to medium grained sands, moderately well sorted, poorly consolidated, friable, moderate to poor plasticity, slightly moist
13	15	SILT, very fine grained, very dull grey, well sorted, friable, good plasticity, slightly moist
15	16	muddy SILT, khaki colour, very fine grained, well sorted, poorly consolidated, friable, good plasticity, slightly moist
16	18	MUD, golden tan, very well sorted, poorly consolidated, friable, very good plasticity, slightly moist
18	19	carbonaceous MUD, black to very dark grey, very fine grained, poorly consolidated, very good plasticity, slightly moist
19	22	COAL, well indurated clasts, dry, no organics present
22	23	carbonaceous MUD with coal clasts and lignite, black to dark grey, brown lignite, dry
23	25	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry
25	27	COAL, well indurated clasts, dry, no organics present
27	28	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry
28	30	COAL, well indurated clasts, dry, no organics present
30	31	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry
31	33	carbonaceous MUD with small, sub-ang coal clasts (?10 mm), mod well sorted, very good plasticity, very wet
33	34	COAL, well indurated clasts, dry, no organics present
34	34.5	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry
34.5	35.5	COAL, well indurated clasts, dry, no organics present
35.5	36	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry
36	37	COAL, well indurated clasts, dry, no organics present
37	37.5	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry
37.5	39	COAL, well indurated clasts, dry, no organics present
39	40	SILT, fine grained, very dull grey, well sorted, poorly consolidated, good plasticity, dry

The bore construction included 50 m uPVC class 18 screen from 23 to 29 m, below the alluvium. A variable head test on this bore indicated an aquifer hydraulic conductivity of 5.62 x 10^{-3} m/day for the Permian units within this bore.

Figure 6-23 Rainfall data for 2009 at Wentworth (Moranbah)



6.11 Hydrochemistry Data

NRM commented that the chemistry data presented in EIS Appendix J Section 6.2 for the Goonyella Lower Seam (GLS) included an unusually low EC reading of 387 µS/cm.

The laboratory data for the GLS coal seam indicates EC values from six historical groundwater samples. These data are summarised in **Table 6-8**.

Table 6-8 GLS Groundwater Data

Bore	40952	40933	40994	40995	45318	45320
Date	May-06	May-98	May-98	May-98	May-06	May-06
Electrical Conductivity (µS/cm)	691	5,430	2,820	2,630	387	20,803
Total Dissolved Solids (mg/L)	480	2,971	1,660	1,431	200	12,900
Sodium (mg/L Na)	47	1,096	586	563	40	3,560
Chloride (mg/L Cl)	72	2,024	868	959	69	7,510

The original laboratory results were checked and confirm the low EC readings for the groundwater sample collected from bore 45318 (ALS work order EB0604931, dated 2 June 2006).

Available records indicate that bore 45318 was drilled on 12 November 2003 to a depth of 64.50 m; the GLS seam was intersected between 55 and 61 m below surface. The bore was screened between 55 and 61 m below surface and completed with bentonite seal. Groundwater level was measured at 33.58 m below ground level (213.39 m AHD) on 26 November 2003. The EC value recorded during this gauging event was 26,700 µS/cm.

Based on available bore construction details it does not appear that the low EC groundwater sample reported to be collected from bore 45318 is as a result of mixing with surface water. It would appear to be an error in reporting, i.e. sample collected from a different source bore and mistakenly attributed to bore 45318.

Additional GLS chemistry data were compiled to allow for a reassessment of the variability of salinity within this unit. **Table 6-9** presents these historic data. None of these bores indicate low EC values within the GLS seam across the entire site.

Table 6-9 GLS Data

Bore	GLS top (mbgl)	GLS depth (mbgl)	Date	Electrical Conductivity (µS/cm)
45288	38.55	47.80	21/11/2003	4,100
45289	36.26	45.63	21/11/2003	5,100
45290	41.43	50.56	21/11/2003	4,000
45310	38.09	47.55	20/11/2003	4,100
45311	34.34	43.65	20/11/2003	6,400
45312	35.50	41.50	27/11/2003	26,300
45313	46.50	52.10	27/11/2003	31,300
45315	61.50	69.50	26/11/2003	31,300
45316	49.00	58.25	26/11/2003	23,100
45317	51.00	59.50	26/11/2003	28,100
45318	55.00	61.00	26/11/2003	26,700
45320	46.50	55.50	26/11/2003	27,800
GYAS1	42.00	50.00	06/04/2001	21,600
GYAS2	42.00	50.00	06/04/2001	24,500
GYAS3	40.20	48.70	08/04/2001	27,800
GYAS4	37.50	43.50	03/04/2001	25,400
GYAS5	39.20	47.10	04/04/2001	26,900
GYAS6	54.50	61.70	05/04/2001	28,100
GYAS7	48.20	54.90	08/04/2001	24,400
GYAS8	48.10	55.00	05/04/2001	24,600
GYAS9	41.60	49.50	04/04/2001	23,700
GYAS10	60.60	65.80	09/04/2001	23,200
GYAS11	39.00	47.00	04/04/2001	25,100
GYAS14	52.60	60.50	05/04/2001	25,600

The bores used to consider the groundwater quality associated with the GLS are plotted on **Figure 6-21**. The hydrochemistry data indicate variation in GLS coal seam groundwater quality with location across the GRB mine complex. The bores with the lowest salinity concentrations (bores 45288, 45289, 45290, 45310, and 45311) were all located within the GRM open pits down dip from the subcrop. The remaining bores are located close to subcrop (based on the geological mapping) west of the BRM.

The available geological and hydrochemical data show no correlation between subcrop and possible recharge impacts on groundwater quality within the GLS seam.

6.12 Stygofauna Survey

BMA confirms that a second stygofauna sampling was not undertaken. It was initially considered that a second stygofauna sampling event may be required as the sampling net mesh size (150 µm), used during the stygofauna sampling was larger than the recommended 50 µm. However, field staff confirmed that the larger mesh size was employed due to the turbid nature of the groundwater samples.

The Western Australia EPA Guidance Statement No. 54a, Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (EPA 2007) indicates that the use of a large mesh size is appropriate for high turbidity samples. It is noted that the high turbidity would limit stygofauna presence, which was reflected in the absence of stygofauna in any of the 5 groundwater samples assessed.

Poor groundwater quality, low permeability and porosity (clay-rich), limited recharge, and the unsaturated (seasonal) nature of the more favourable stygofauna habitat alluvium, also indicate limited stygofauna potential.

A review of available stygofauna occurrence in the Bowen Basin was conducted (Arrow 2012). This considered the occurrence of stygofauna in the Bowen Basin based on 13 completed studies for mineral (coal) development projects. Of the 13 studies completed, 127 groundwater sites have been sampled for stygofauna. Of the groundwater sites that have been sampled:

- 19 per cent (24) were in unconsolidated sediment (alluvium);
- 26 per cent (33) were in porous sedimentary rock (sandstone);
- 20 per cent (26) were in fractured rock (basalt);
- 19 per cent (24) were in coal seams; and
- 16 percent (20) had no aquifer recorded.

Based on the available data, out of the 127 sites that were sampled in the Bowen Basin, only 12 per cent (15 sites) contained stygofauna, and the majority of these bores were in alluvial aquifers in unconsolidated sediments. All of the recorded stygofauna were collected from alluvial/sedimentary aquifers and none were identified in coal seam aquifers.

A search of the Queensland Museum records revealed that a single stygofauna specimen has been lodged with the Queensland Museum (*Anzcyclops evryantennula*) from the Bowen Basin area. This specimen was collected near Clermont, Central Queensland, from an alluvial aquifer.

Data from the Bowen Basin stygofauna studies indicate:

- the optimal pH range for stygofauna presence in aquifers in the Bowen Basin is between pH 7.0 and pH 8.5;
- no stygofauna populations were detected where the EC of the groundwater was greater than 3,000 µS/cm; and
- stygofauna have not been detected in the basin where the depth to groundwater was greater than 20 m.

Stygofauna require permanent groundwater for survival. The presence of stygofauna indicates the long term existence of groundwater in that area. Quaternary alluvium in the project area, being alluvial sediments associated with the Isaac River and older sediments associated with floodplains and alluvial flats, are seasonally recharged through direct rainfall and stream flow loss. These units have limited effective storage and discharge groundwater during and immediately after the wet season.

River alluvium (with suitable porosity) near permanent waterways where the alluvium is constantly replenished and wet is more likely to support stygofauna than the older alluvium further from waterways or associated with highly ephemeral waterways that do not have capacity to maintain permanent water in the aquifers.

Most of the identified Australian stygofauna species live exclusively in groundwater. However the upper Isaac River is ephemeral and its associated aquifers do not contain sufficient permanent groundwater to support stygofauna populations.

NRM suggested the use of 10 existing monitoring bores for an additional stygofauna survey; these bores include: GW1, GW2, GW3, GW6, GW7, GW9, GW10, GW11, GW12, 43841, 45318, 45319, and 45320. **Figure 6-2** and **Figure 6-21**, show the location of bores across the study area. Relevant comments about these bores are given below:

- bore GW11 was not constructed;
- only bores 43841 and 45319 are not screened within coal or aquitards (siltstone, mudstone); and
- bore 45319, constructed within a fractured rock aquifer (basalt), has a groundwater level of 38.15 m below surface, pH 8.67, and EC value of 15,384 µS/cm. Based on available data it is unlikely that stygofauna would occur within this groundwater resource.

Bore 43841, located to the south of BRM, was constructed to a depth of 17.5 m into alluvium sand, adjacent to bore GW1. Groundwater level after construction was measured at 13.31 m below surface and it had a pH of 6.88 and an EC of 561 µS/cm. Thus while bore 43481 is located within a favourable stygofauna habitat, due to the lack of permanent water within the alluvium in this area (and as measured during the initial stygofauna sampling), the potential for stygofauna is limited.

6.13 Groundwater Dependent Ecosystems

DOTE noted that there is a discrepancy with regards to whether there are groundwater dependent ecosystems (GDEs) between the discussion in EIS Appendix Q3, which includes comments that the regional groundwater system does not support GDEs, and the discussion of seasonal perched groundwater resources in the EIS Appendix J.

No GDEs have been identified within or adjacent to the project area. This is due to the perched and seasonal nature of the alluvial aquifer.

The alluvial aquifer, associated with the upper Isaac River catchment, is an unconfined to semi-confined aquifer with storage provided by its primary porosity. Potential for usable groundwater resources exists within the more permeable sand and gravel dominant sections of the alluvium, but variations in saturated thickness and bedrock outcrops indicate that the alluvium is not one continuous aquifer.

The alluvial aquifers are considered to be strongly linked to surface water with recharge occurring during stream flow events (SKM 2009). The majority of the surface water rivers and creeks within the study area are ephemeral and recharge of the alluvium is by:

- recharge from surface water flow or flooding (losing stream); and
- surface infiltration of direct rainfall and overland flow, where alluvium is exposed and no substantial clay barriers occur in the shallow sub-surface.

Available hydrologic data suggest that water infiltrates/drains to the base of the alluvium relatively quickly after rainfall events where more permeable units are at surface. This saturation is sporadic, producing semi-permanent, localised, and thin aquifers. A groundwater penetrating radar (GPR) survey was undertaken along the Isaac River, north of Moranbah that indicated the Isaac River bed sands were dry or only damp in the base layer (JBT Consulting 2010). This suggests that the groundwater occurrence is limited to deeper parts of the channel and may not be saturated all year round. Available drilling data indicate that the sediments adjacent to the Isaac River are generally dry to a depth below the base of the bed sands. This suggests that base flow of groundwater to the Isaac River is not significant (JBT Consulting 2010).

Due to the semi-arid climate, the ephemeral nature of the stream flow, and discontinuity of the more permeable gravel and sand layers, the groundwater resources in the Quaternary alluvium in the project area are not abundant. It is recognised from vegetation studies that the mapped flora and riparian vegetation rely on water trapped within the unsaturated zone as opposed to being groundwater dependent.

The suitability of groundwater from the alluvium aquifer(s) in the upper Isaac River is also limited by the groundwater quality. Groundwater is mostly brackish and poor quality, but has a spatially variable salinity and pockets of low-salinity groundwater occur in places (Raymond and McNeil 2011). It is noted from the 10 newly registered bores across the Grosvenor Mine lease (**Section 6.10.2**) that 4 bores (RN 141961, 141047, 141959, and 141957) were all reported to contain salty groundwater.

Raymond and McNeil (2011) described the alluvial groundwater as having an EC of 498 to 8,910 µS/cm (depth less than 30 mbgl) and 3,419-16,000 µS/cm (depth >30 mbgl). The pH, salinity and major ions for shallow registered groundwater monitoring bores that are located in upper Isaac River alluvium were analysed (see **Table 6-10**).

Table 6-10 Summary of Groundwater Quality for Upper Isaac River Alluvium (Registered bores)

Parameter	Unit	Min	Max	Average	No. Samples
pH		7	9	8	9
Conductivity	uS/cm	630	36,800	9,496	9
Total dissolved solids (TDS)	mg/L	365.5	27,351.5	6,381	9
Calcium	mg/L Ca	3.9	560	138	9
Magnesium	mg/L Mg	16	2,663	425	9
Sodium	mg/L Na	64.6	5,832	1,691	9
Chloride	mg/L Cl	56.8	15,720	3,407	9
Bicarbonate	mg/L HCO_3	277.1	970	596	9
Sulphate	mg/L SO_4	0	2,260	399	9

Footnotes:
1. All bores are located in alluvium of the Isaac River.
2. Data sourced from NRM registered bore database

These data confirm that the alluvial groundwater has a highly variable salinity, ranging from fresh to very saline and an ionic balance dominated by sodium (Na^+) and chloride (Cl^-). Groundwater in the Isaac River alluvium is mostly unacceptable for domestic use and too saline for stock watering or crop irrigation. However, there may exist pockets of low-salinity groundwater (Raymond and McNeil 2011).

6.14 Monitoring Program

BMA is committed to developing and implementing a groundwater monitoring and management program for RHM. This will include additional monitoring bores at an appropriate spatial and depth distribution to allow reasonable representation across all geological units identified as being potentially affected (directly and indirectly) by mining activities at RHM. The groundwater monitoring and management program will be developed by an appropriately qualified and experienced person and implemented at least six months prior to the commencement of mining activities at RHM, subsequent of completion of the baseline groundwater monitoring program.

6.14.1 Groundwater Monitoring and Management Program Objectives

The desired outcomes for the project's groundwater are to minimise potential impacts to surrounding landholders and environmental values. These outcomes need to be balanced with coal production requirements.

Effects from mine dewatering (drawdown) to provide safe dry working conditions are likely to manifest themselves on a more regional scale. Groundwater quality impacts may occur adjacent to mine water and waste storage facilities but due to drawdown are not predicted to migrate (within groundwater) off site. The system will be developed to effectively monitor the potential effects on identified groundwater environmental values (EVs).

Understanding the potential pathways and effects on EVs will assist in developing the groundwater monitoring network, which in turn will inform the groundwater management.

The overall objectives of the project's groundwater monitoring and management program will be to:

- establish an appropriate monitoring regime, both in space and time;
- develop a high quality background dataset against which potential impacts can be assessed and to gain a better understanding of groundwater (level and quality) variability;
- ensure mining does not adversely impact on the availability and suitability of groundwater for domestic and agricultural use (stock watering);
- identify potential impacts from the proposed mining activities with sufficient time to implement management and/or mitigation measures;
- assess mine water storage facilities to minimise the potential for impacts on shallow groundwater resources during the life of the mine and after mining ceases;
- recycle and reuse groundwater intersected during mining for mining activities and operations to limit the need to import water resources outside of the mine area;
- enable detection of long-term trends and potential cumulative effects from the mine and other future coal mining operations;
- generate data against which model predictions can be verified; and

- obtain high quality (repeatable and representative) data to develop trigger levels and contaminant limits for groundwater that could be impacted.

Based on suggestions provided in comments on the groundwater components of the EIS, the groundwater monitoring and management program will include the following site-specific objectives:

- validation of groundwater numerical model (including review of boundary and recharge conditions) to refine and confirm accuracy of groundwater impacts predicted;
- monitoring groundwater level in Quaternary alluvium, Tertiary sediments, and Permian sediments units present across the mine site to confirm existing groundwater flow patterns and monitor drawdown impacts;
- assessing geological structures and their influence on groundwater flow patterns and mine dewatering predictions;
- identification of groundwater drawdown for monitoring potential impacts to the Isaac River alluvium;
- refinement of potential impacts on water levels in the Tertiary and Quaternary units;
- estimation of groundwater inflows to mine workings using the (refined) groundwater model;
- monitoring of geological units throughout all phases of project life including for the period post-closure;
- identifying monitoring bores that will be replaced due to mining activities; and
- ensuring all potential groundwater impacts from mine dewatering and mine water and waste storage facilities (artificial recharge) are identified, mitigated and monitored.

6.14.2 Groundwater Monitoring and Management Program Approach

The establishment and implementation of a groundwater monitoring and management program will evolve and respond to the various stages of the mining project, i.e. the groundwater monitoring program will be different depending on the different project phases including baseline, construction, operations, and post closure activities.

In order to develop the optimum groundwater monitoring plan, BMA proposes a phased approach which will allow for the correct scientific development of the program and allow for variations over time to suit the site/mining phases.

The groundwater monitoring and management program for RHM will include detailed procedures and processes required to determine and assess the baseline hydrogeological regimes and develop trigger levels, contaminant limits, and water level thresholds, which will be used to assess the mining activities potential impacts on groundwater resources.

The baseline stage will involve:

- preparing a groundwater monitoring and management program;
- obtaining approval from the administering authority for the groundwater monitoring and management program;
- including the groundwater monitoring and management program in the mine's EA conditions;
- compiling representative groundwater quality samples from each aquifer or groundwater unit identified as potentially impacted (directly and indirectly) by mining activities;

- compiling baseline data for confined groundwater resources, i.e. the Permian and Tertiary (semi-confined) sediments, comprising at least 12 sampling events prior to mine activities at RHM (below the groundwater table) in order to obtain a statistically representative background groundwater quality dataset;
- compiling baseline data for unconfined groundwater resources, i.e. the Quaternary alluvium, comprising data compiled over a minimum of two wet seasons prior to mine activities at RHM (below the groundwater table) in order to obtain representative background groundwater quality dataset;
- determining trigger levels and contaminant limits prior to commencement of coal mining activities; and
- identifying natural fluctuations and trends in groundwater levels and hydrochemistry.

The groundwater monitoring and management program will be reviewed and modified as necessary over the mine life in response to monitoring results and changed mining conditions.

6.14.3 Groundwater Monitoring and Management Program Commitments

BMA's commitments regarding groundwater monitoring and management at RHM include:

- develop and implement a groundwater monitoring and management program detailing the location and frequency of groundwater monitoring activities, as well as trigger levels and response actions;
- expand the existing groundwater monitoring network over time to enable ongoing groundwater impact evaluations;
- install groundwater monitoring bores for shallow groundwater a minimum six months prior to works that may impact shallow aquifers, such as local mine related insfrastructure;
- undertake groundwater monitoring and sampling via a suitably qualified and experienced person in accordance with recognised procedures and guidelines;
- conduct an annual review of the monitoring data, using a suitably qualified and experienced person;
- include in the review an assessment of groundwater level and water quality data, and the suitability of the monitoring network;
- undertake groundwater modelling audits on a regular basis (intervals not exceeding three years) and provide the modelling results to the administering authority for review on request;
- investigate all groundwater-based complaints, including the maintenance of a complaints register. The register will be made available to the administering authority upon request; and
- implement make good agreements with recognised groundwater users affected by groundwater drawdown related to the project.

6.14.4 Baseline Groundwater Monitoring

Baseline groundwater quality and levels will be monitored at the locations and frequencies defined in **Table 6-11**, which also shows the formation that will be monitored. The quality characteristics that will be monitored are identified in **Table 6-12**. The location of the proposed monitoring bore network is shown on **Figure 6-24**.

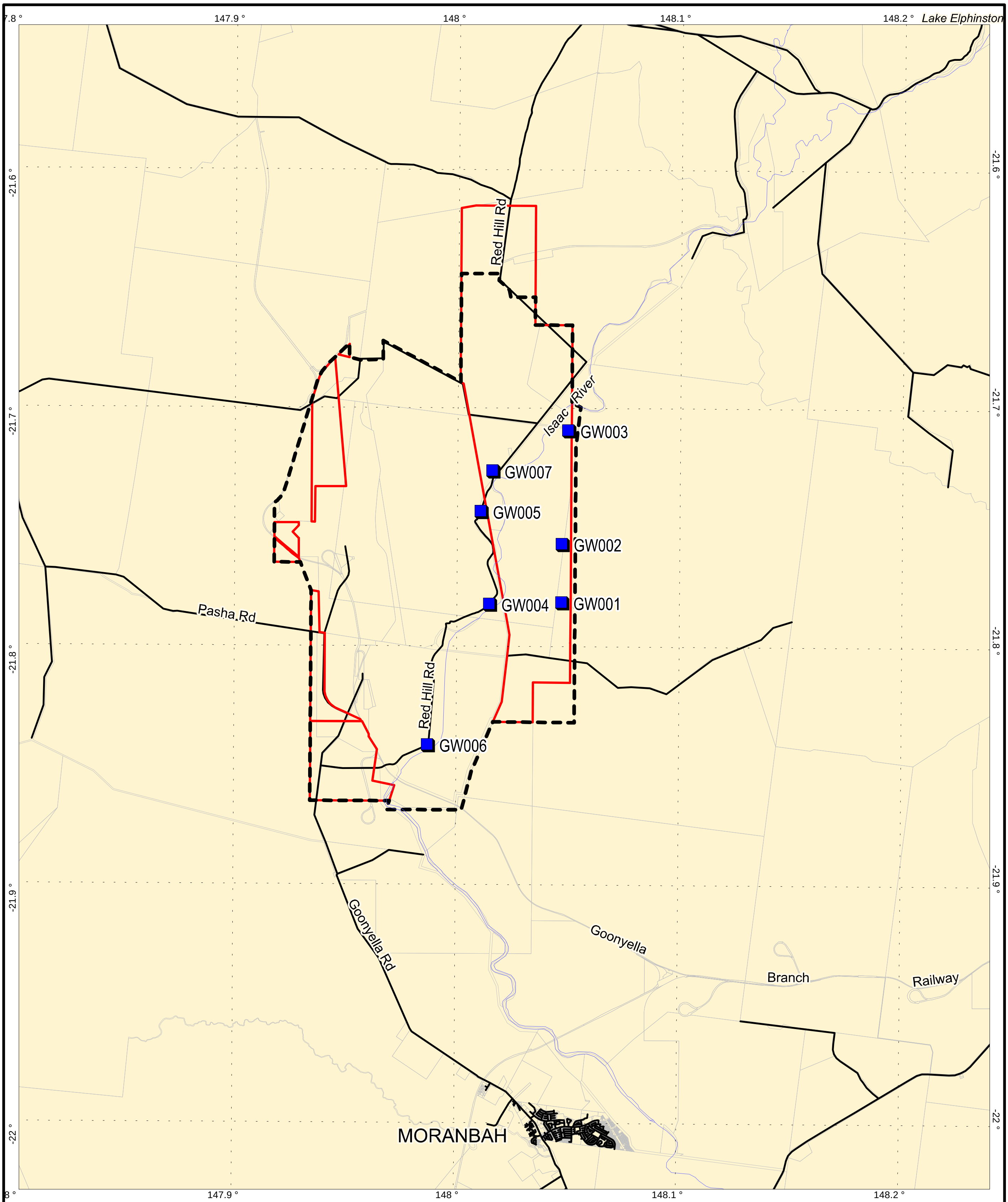
Table 6-11 Proposed Groundwater Monitoring Locations and Frequency

Monitoring Point	Location		Monitoring Point Type	Monitoring Frequency	
	Longitude (GDA84 Zone 55)	Latitude (GDA84 Zone 55)		Quality	Groundwater Level
ALLUVIUM					
GW004a	604809	7590705	Standpipe	Due to ephemeral nature, sample monthly over two wet seasons	No more than 12 hours using automatic water level loggers
GW005a	604420	7595020	Standpipe		
GW006a	601918	7584177	Standpipe		
GW007a	604966	7596895	Standpipe		
TERTIARY					
GW004b	604809	7590705	Standpipe	Once every 2 months for first 12 events	No more than 12 hours using automatic water level loggers
GW005b	604420	7595020	Standpipe		
GW006b	601918	7584177	Standpipe		
GW007b	604966	7596895	Standpipe		
GW001a	608163	7590768	VWP	-	
GW002a	608185	7593485	VWP	-	
GW003a	608487	7598765	VWP	-	
PERMIAN (GMS coal seam)					
GW004c	604809	7590705	Standpipe	Once every 2 months for first 12 events	No more than 12 hours using automatic water level loggers
GW007c	604966	7596895	Standpipe		
GW001a	608163	7590768	VWP	-	
GW002a	608185	7593485	VWP	-	
GW003a	608487	7598765	VWP	-	

VWP – vibrating wire piezometer

Table 6-12 Groundwater Quality Parameters

Parameter
pH (Units)
Electrical Conductivity (µS/cm)
Total Dissolved Solids (mg/L)
Calcium (mg/L Ca)
Magnesium (mg/L Mg)
Sodium (mg/L Na)
Potassium (mg/L K)
Chloride (mg/L Cl)
Sulphate (mg/L SO4)
Carbonate CO3 (mg/L)
Bicarbonate HCO3 (mg/L)
Nutrients
Total nitrogen (mg/L N)
Nitrogen oxides (mg/L NOx)
Ammonia (mg/L N)
Phosphorus (mg/L P)
Dissolved Metals
Aluminium (mg/L Al)
Arsenic (mg/L As)
Boron (mg/L B)
Cadmium (mg/L Cd)
Chromium (mg/L Cr)
Copper (mg/L Cu)
Iron (mg/L)
Lead (mg/L Pb)
Manganese (mg/L Mn)
Mercury (mg/L)
Nickel (mg/L Ni)
Selenium (mg/L)
Zinc (mg/L Zn)
Organics
Total Petroleum Hydrocarbons ppb (C_6 – C_{40})



NOTE: Resource data boundaries downloaded from QLD Dept Mines & Energy Website (http://www.webgis.nrm.qld.gov.au/webgis/webqmin/Run.htm.) and are correct as at 18 May 2011
Monitoring Points sourced from Goonyella Riverside and Broadmeadow Mines Environmental Authority EPML00853413

N W E S

0 2.5 5km
Scale 1:250,000 (A4)
Projection: MGA Zone 55 (GDA 94)

EIS Study Boundary
BMA Tenure/Tenement
Proposed Monitoring Points

BMA
BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

PROPOSED GROUNDWATER MONITORING LOCATIONS

URS

GROUNDWATER

Figure: **6-24**

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6.15 Post-closure Recovery

As stated in the EIS (Appendix J, Section 8.2.1), a detailed study of groundwater level recovery within RHM has not been conducted as part of the EIS because the closure requirements for the GRM will have a significant impact on recharge to groundwater and the rate of groundwater recovery.

Groundwater recovery after mining was considered during the predictive groundwater modelling and groundwater levels are expected to recover within RHM after closure during the period of continued operation of GRM, between 2040 and 2068.

Figure 6-13 presents the projected drawdown contours for the target GMS at the end of the project's life (2040). **Figure 6-15** presents the drawdown contours for the target GMS at the end of the approved GRB mining (2068). A comparison of the two projected groundwater contours indicates recovery between the end of RHM mining and GRB mining is limited. This is due to:

- little or no recharge to the confined Permian units simulated in the model, some 1×10^{-7} m/day across the model domain (**Section 6.5**);
- ongoing mining at GRB during the recovery period after cessation of RHM operations; and
- the influence of the GRM final/residual voids up dip of the RHM's underground workings.

The corresponding drawdown and limited recovery in the Quaternary/Tertiary layers for the same periods (**Figure 6-17** and **Figure 6-19**) is as a result of induced flow and the model simulation not including direct rainfall or surface water recharge. This is considered highly unlikely and is only included to provide an indication of the possible drawdown extent if the unconfined groundwater resources were saturated.

Figure 6-6 provides the conceptualisation of long term groundwater levels after mining has ceased at both RHM and GRB. Groundwater resources within the project footprint will recover due to:

- increased recharge in the backfill;
- direct rainfall into the final voids; and
- rainfall runoff from disturbed mine areas directed into the final voids.

These sources of water plus groundwater ingress after evaporation (reduced due to depth) will result in a pseudo steady state water level within the final voids. This water is considered to seep through the crown pillar between the underground workings and the open cut mine voids, which provides increased recharge (compared to natural low recharge) to the confined Permian sediments.

6.16 Cumulative Impacts

Both DOTE and NRM considered that there may be the potential for cumulative impacts of multiple mines and coal seam gas projects, within the area containing the RHM lease, to have a marked impact on groundwater resources.

Cumulative impacts were assessed using predictive modelling, which allowed for:

- evaluating drawdown impacts of two mining operations;
- evaluating mining at operations immediately adjacent to each other;
- mine dewatering within the same geology and hydrogeology; and
- simulating mining concurrently to assess impacts on the local and regional groundwater resources.

The predictive modelling approach, based on site-specific data that indicate that the impact of long term mine dewatering on the surrounding groundwater resources was limited (due to low aquifer parameters and compartmentalisation due to large fault structures), allowed for an assessment of the cumulative impact of the approved GRB mine and the proposed project on groundwater resources.

6.16.1 Cumulative Impacts from the GRB and the Proposed Project Operations

An estimated total groundwater volume of 35 GL will be removed during the proposed project operations (over 25 years), an average of 1,400 ML/year.

The total predicted cumulative groundwater ingress into the mine workings for both the project and the GRB mine complex (using the base case and over a 58 year mine life (until 2068)) is 146 GL, some 2,500 ML/year. This cumulative groundwater extraction will result in a drawdown of 5 m at the target coal seam and will extend 2.5 to 3 km around the mine workings.

The projected drawdown contours for the target coal seam at the end of the project life (2040) are shown in **Figure 6-13** (cumulative impacts from both project and GRB) and **Figure 6-14** (project only). The cumulative impact from the project is negligible down dip (to the east) as the drawdown extent is governed by the depth of mining and the hydraulic conductivity of the overlying units. The cumulative impact from the project is not significant to the north and south as this is controlled by the location of the open pits and longwall panels associated with the GRB mine complex. Thus the cumulative impact of two mining areas immediately adjacent to one another does not significantly increase drawdown from what is expected from the GRB mine complex alone.

The potential impacts associated with mine dewatering for the GRB mine complex will not change significantly due to the drawdown effects of the project.

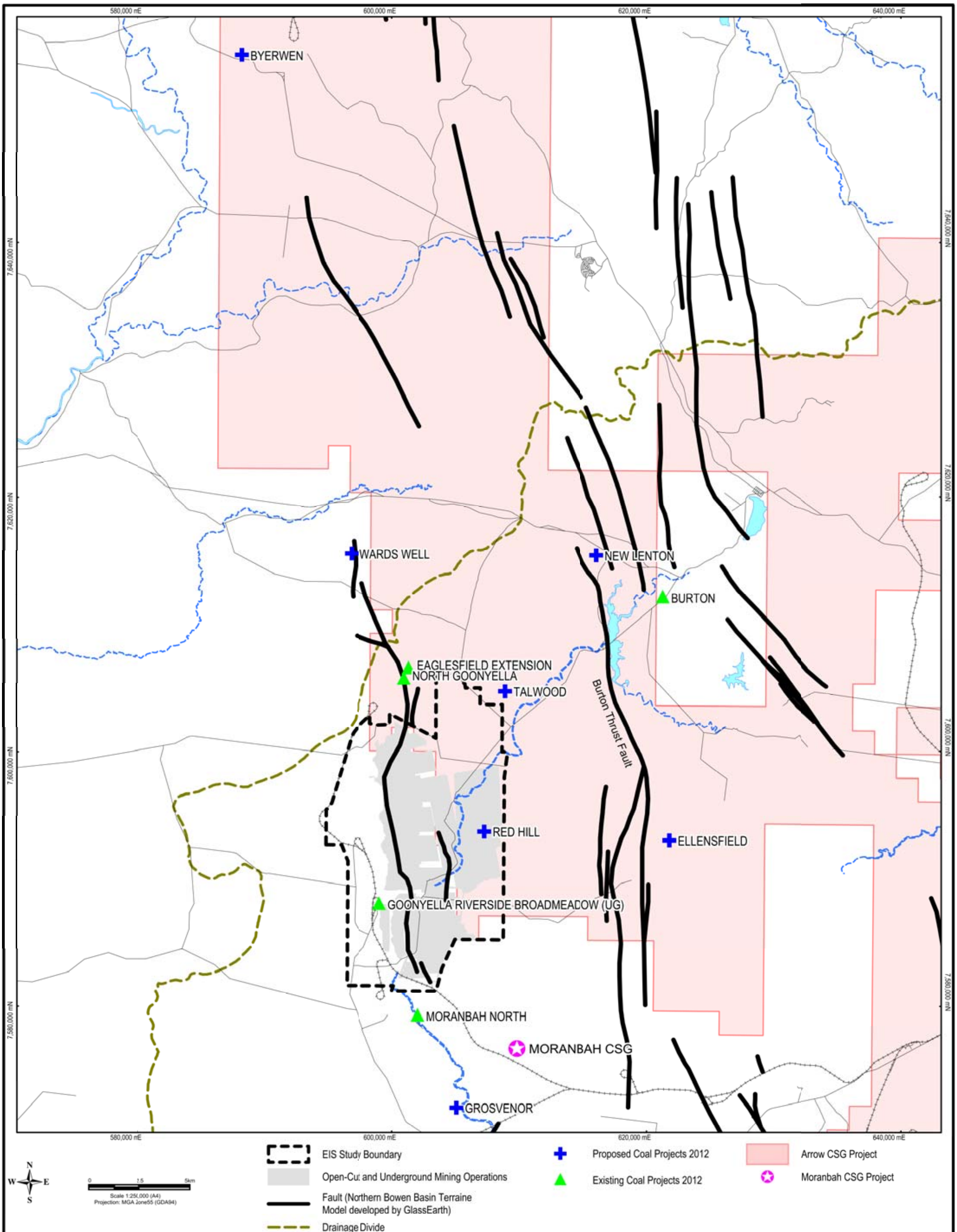
6.16.2 Cumulative Impacts from Surrounding Resource Projects

In addition to the GRB and the project, there are other mines and coal seam gas projects that will extract groundwater from the upper Isaac River catchment. The groundwater resources associated with the Permian coal seams are being/will be removed directly through mining or to produce coal seam gas resulting in reduced groundwater resources.

Based on the information compiled by the Department of Employment, Economic Development and Innovation in February 2012 and the Department of State Development, Infrastructure and Planning website, a list of existing and proposed coal and coal seam gas projects within the upper Isaac River catchment north of Moranbah was compiled (**Table 6-13**). **Figure 6-25** shows the location of these projects and the Bowen Coal Seam Gas (CSG) Project tenures.

Table 6-13 Coal Projects north of Moranbah in Isaac River catchment

Proposed Coal Projects 2012	Existing Coal Projects 2012	CSG Projects
Byerwen	Burton	Moranbah CSG
Wards Well	North Goonyella and Eaglefield	Arrow Bowen CSG
New Lenton (on hold)	Goonyella Riverside Broadmeadow	
Talwood	Moranbah North	
Red Hill		
Ellensfield		
Grosvenor		



Source: © Mapinfo Australia Pty Ltd and PSMA Australia Ltd., © Copyright Commonwealth of Australia (Geoscience Australia) 2006, © Copyright The State of Queensland (Department of Natural Resources and Water) 2008, © The State of Queensland (Department of Mines and Energy) 2006-2008, © The State of Queensland (Department of Environment and Resource Management) 2010, Bing Maps © Microsoft Corporation and its data suppliers, Images from Client Oct 2011

BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

COAL PROJECTS

URS

GROUNDWATER

Figure: **6-25**

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Groundwater information available for these projects is summarised below:

- Byerwen Coal Project – Drawdown of up to 2.3 km around South Pit 1, groundwater ingress up to 320 m^3/day. No cumulative total or average groundwater ingress volume provided (http://byerwen-eis.qcoal.com.au/).
- Wards Well – Exploration only to obtain data to support key decisions on the future development potential of Wards Well (Wards Well EPBC Referral, January 2011).
- New Lenton Coal Project – Project on hold.
- Talwood Coking Coal Project – pre-feasibility study being undertaken currently.

  Ellensfield Coal Mine Project – Predicted groundwater ingress of between 300 and 350 ML per year over a 19 year mine life, 5 m drawdown in the target coal extending some 2.5 km in the higher permeable shallow Permian sediments. Project separated from Red Hill Mining Lease by Burton Thrust Fault (https://www.ehp.qld.gov.au/management/impact-assessment/eis-processes/ellensfield_coal_mine_project.html).
- Grosvenor Coal Project – Impact from mining is estimated at 3 km from edge of mining, groundwater ingress rates into the underground workings are predicted to be approximately 190 ML/year, taking into account the existing Moranbah North dewatering impacts (Grosvenor EIS Groundwater Report, JBT Consulting 2010)
- Burton Widening Project – Burton mine was complete and rehabilitated. In late 2010 Peabody Energy re-entered Burton Pit to access coal. No details or EIS were located regarding these operations. Project separated from Red Hill Mining Lease by Burton Thrust Fault.
- North Goonyella and Eaglefield - North Goonyella mine is an underground coal mine that is owned and operated by Peabody Energy Australia Pty Ltd. The North Goonyella underground mine is located adjacent to the Eaglefield open-cut mine. The volume of groundwater removed from mine workings is not effectively recorded at either Eaglefield mine or North Goonyella mine. The removal of groundwater from aquifers by the mines will have an effect on groundwater levels immediately surrounding the mining areas, 5 m drawdown in Fort Cooper Coal Measures is estimated at less than 1 km from the workings (Eaglefield Expansion Project EIS Appendix F5, Met Serve 2010).
- Eaglefield Expansion Project – Estimated groundwater ingress, considering mine plan and schedule, is estimated at 210 ML/year for the first 5 years, 219 ML/year for the next 5 years, 168 ML/year for mine years 11 to 15, and 274 ML/year for final 4 years of mining to end of mine life. At the end of mine life the 2 m drawdown contour within the Permian coal measures is predicted to be located up to 4 km to the north and 2.5 km to the east of the mining lease boundary (Eaglefield Expansion Project EIS Appendix F5, Met Serve 2010).
- Moranbah CSG – Groundwater extraction was approximately 470 ML/year (2004 to 2008), no drawdown information available plus depressurisation across several coal measures not just the GMS coal seam (Grosvenor EIS Groundwater Report).
- Moranbah North – Approximately 336 ML/year is removed from coal measures, drawdown impact within the GMS coal seam occurs to a distance 2.5 km from the mining operations after 12 years of mining (Grosvenor EIS Groundwater Report).
- Arrow Bowen CSG – Predictive modelling indicates an estimated groundwater extraction of approximately 274 GL over 55 years, across the entire Bowen Basin CSG footprint (an average extraction of approximately 5 GL/year). The overall prediction is that 5 m drawdown in the deep

aquifers will spread no more than 1 to 10 km from the CSG wells after 110 years (i.e. 50 years post-operations).

The available information for these projects indicates that there would be limited drawdown impacts outside of the mine workings and limited groundwater resources based on the predicted groundwater ingress estimates. It is noted that the RHM extraction rates estimated from predictive modelling, including time varying aquifer parameters in response to longwall mining, are an order of magnitude higher than for the other coal mining projects. Thus the RHM adopted modelling provides an assessment of the worst-case drawdown.

Nevertheless, the cumulative impact assessment of the surrounding resource projects was considered using the GRB and RHM simulations, groundwater responses to historic mine dewatering, and the individual project studies. The assessment indicated:

- limited zone of influence of mine dewatering, both spatially and within overlying units (refer to **Section 6.4** basalt discussion) due to low permeable units;
- alteration in local groundwater flow patterns due to the creation of no-flow boundaries between coal projects where groundwater flow is directed towards the active mine dewatering and that these no-flow boundaries would change over time in response to different mine plans and schedules;
- increased drawdown along no-flow boundaries due to superposition of drawdown contours;
- changed aquifer parameters due to alteration from mining (backfill in open cuts and goaf fracturing in underground mines) which could enhance groundwater recharge and recovery;
- permanent alteration of groundwater resources due to open cut final voids which would act as groundwater “sinks” in perpetuity, resulting in localised drawdown around the residual voids;
- reduction in groundwater flow from north to south within the upper Isaac River catchment but with limited impacts due to little or no Permian age aquifer groundwater–surface water interaction; and
- limited increase in impact on surface water, vegetation communities, and unconfined seasonal perched groundwater other than those identified and managed for each individual project.

Based on the impact predictions for various projects, groundwater extraction will generally exceed recharge across the cumulative study area at the various projects sites at different times depending on mine schedules. The groundwater resources are predicted to recover as mining activities enhances groundwater potential to the base of residual voids.

Due to evaporation exceeding direct rainfall, groundwater ingress, and surface water inflow, the final voids will generally fill to a pseudo steady water level (variable with wet and dry seasons) which will be below regional groundwater levels. These groundwater “sinks” will result in groundwater loss from the area in perpetuity and altered groundwater levels immediately adjacent to the final voids. Groundwater loss will be markedly less than groundwater extraction during mining, but will result in a permanent alteration to groundwater resources.

It should be noted that any predictive groundwater modelling to consider cumulative impacts of all proposed resource projects in the upper Isaac River catchment would, based on the limited data and differences in impact assessment used between sites, result in a preliminary high level assessment containing numerous assumptions. This would reduce the validity of the results.

This conclusion is supported by the groundwater study undertaken by Arrow Energy for its Bowen Gas Project, which states *A review of publicly available mine data within the project area yielded* *insufficient information on the 40 existing mines within the Bowen Basin (i.e. geometries, schedules, and dewatering rates) to enable the accurate modelling of their cumulative groundwater impacts. A review of existing Department of Natural Resources and Mines groundwater database also reveals that there are no bore water level records showing distinct mine-related impacts in the northern Bowen Basin. This indicates that the Department of Natural Resources and Mines bore locations are not appropriate for assessing groundwater impacts from coal mining. Consequently, cumulative impacts of this coal mining were not able to be included in the proposed numerical groundwater model of the project* (Ausenco – Norwest (2012) Groundwater Model, Northern Bowen Basin Regional Model Impact Predictions, Queensland, Australia, October 10, 2012. Report prepared for Arrow Energy Pty. Ltd.).

Based on the large number of assumptions required, differences in conceptualisation (geology and groundwater), different mining methods, mine schedules, coal targets, and mine depths, and the limited data availability, it is considered that modelling would not provide a reliable assessment of the cumulative impacts of mine dewatering associated with the existing and proposed projects within the upper Isaac River catchment. The level of assessment undertaken in the EIS is considered appropriate to the identified impacts and associated risks.

Section 7 Water Balance

7.1 Submissions

This section responds to submissions from the following:

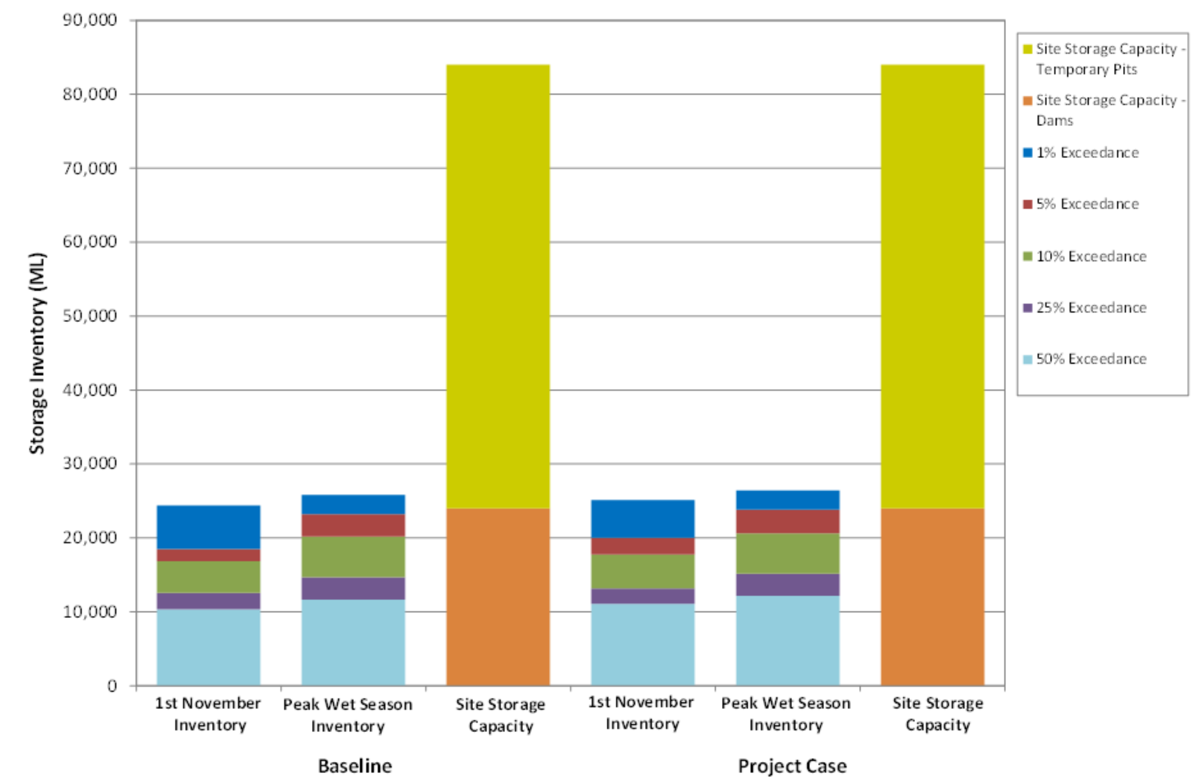
- Isaac Regional Council
- Department of Environment and Heritage Protection
- Department of the Environment

7.2 Water Storage

As described in Section 7.5 of Appendix I2 of the EIS (Mine Water Management Overview Report), under the current EA of the GRB mine complex, a number of water structures are regulated and require specific management including management of water storage levels prior to 1 November each year. The EA conditions require that the mine water system has sufficient capacity to ensure that there are no unauthorised discharges of mine water for wet season rainfall events up to a 1 in 10 year ARI wet season. Water quality objectives for releases are described in **Section 5.13**.

Figure 7-1 shows a comparison between the site storage capacity for regulated dams, the percentage exceedance for the volumes required at 1 November, and the percentage exceedance for the peak wet season inventory for the project case and baseline scenarios. As indicated in **Figure 7-1**, in the project case scenario there is predicted to be a small increase in volumes on site at 1 November. However, the predicted volumes are accommodated within the site storage capacity. The capacity of each relevant storage and pit used in the modelling study are provided in Appendix B of Appendix I3 of the EIS.The additional water storage requirement is negligible and will not affect the ability of the existing operation to discharge water in accordance with current EA conditions. There will be no significant change in the volume of water that must be stored in low priority pits. Environmental values will continue to be protected as the project will have no signficant impact on the water quality in the receiving environment.

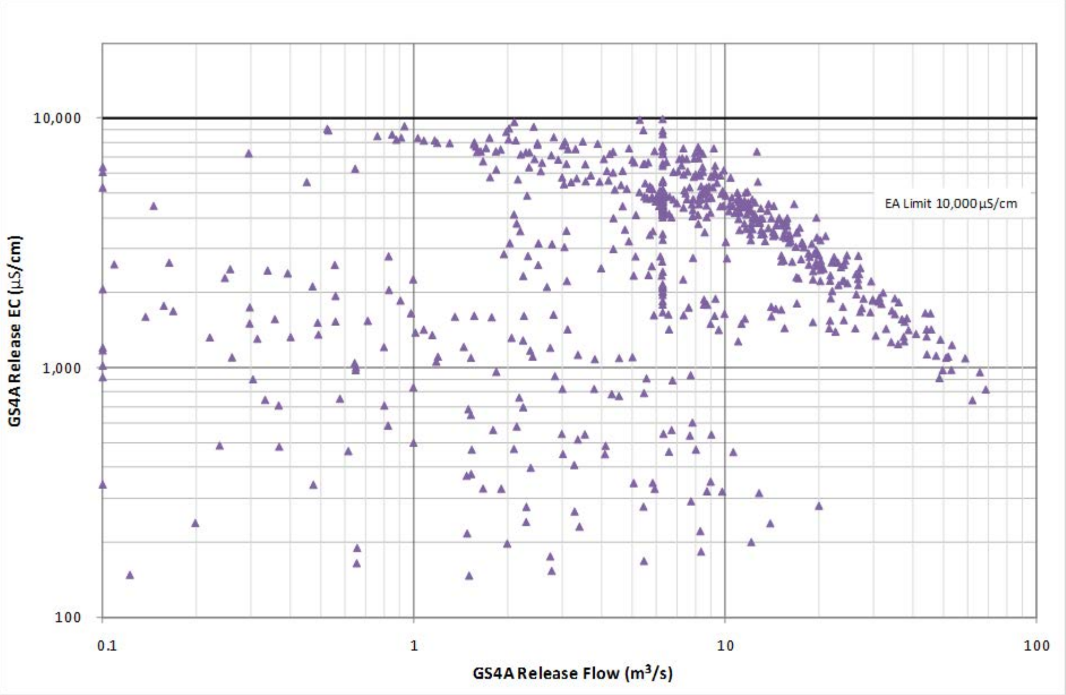
Figure 7-1 Project Case Scenario Regulatory Requirements for Regulated Structures



The water management system for the project includes an interface with the GRB mine water management system. As described in Section 7.3 of Appendix I2 of the EIS (Mine Water Management Overview Report), a project case scenario has been developed to assess any potential impacts that may result from the interface between the project and the GRB mine water management network under the worst-case scenario of 640 ML/year of surplus water from the project. The project case mine water balance modelling assessments of the impacts of a potential project water surplus on the GRB mine water management system (Section 7.4, Appendix I2 EIS; Section 7.3.2.5 EIS Surface Water Chapter) indicate that:

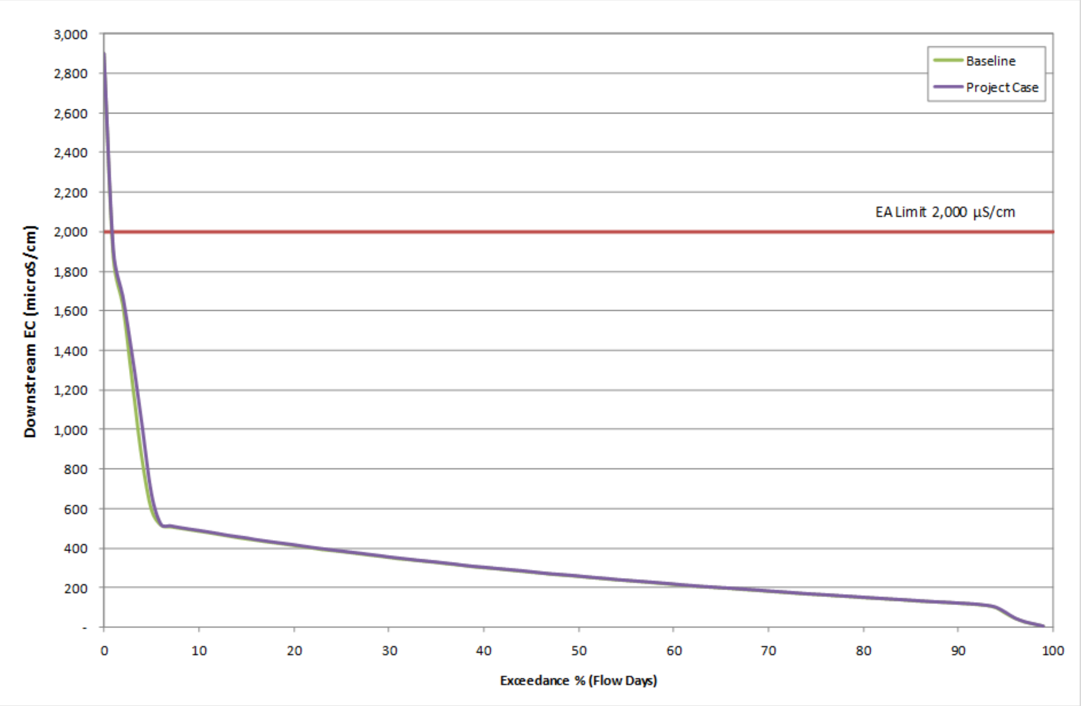
- The project will not adversely impact on the ability of the GRB mine water management system to comply with current EA conditions for release of mine water from GS4A for respective salinity criteria at the end-of-pipe limit (**Figure 7-2**);

Figure 7-2 Project Case Scenario Modelled Compliance with End-of-pipe Limit at GS4A



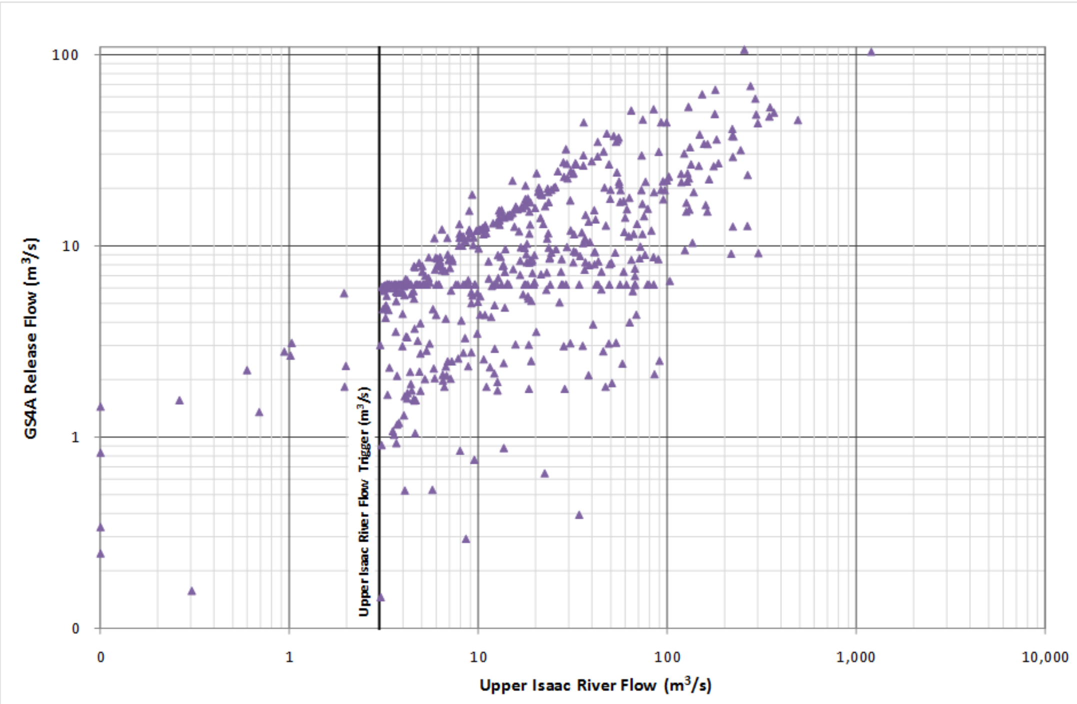
- The project will not adversely impact on the capability of the GRB mine water management system to comply with the current EA conditions for salinity compliance limits applicable in the Isaac River downstream of the mine releases. Similar to the baseline model, the project model identified three one-day occurrences, during the 108 year modelling period, that the EC of releases from GS4A causes the downstream EA receiving water trigger of 2,000 µS/cm to be exceeded (**Figure 7-3**).

Figure 7-3 Project Case Scenario Modelled Downstream Isaac Salinity Compliance at GS4A



- The project will not adversely impact on the capability of the GRB mine water management system to comply with the current EA conditions for flow release limits applicable in the Isaac River downstream of the mine releases. Similar to the baseline model, the project model identified 14 occurrences, during the 108 year modelling period, of the flow release from GS4A when the flow in the Upper Isaac River is less than 3 m^3/s and the release volume is greater than the natural flow recorded at monitoring point 2 on Eureka Creek (**Figure 7-4**). There are no active releases made from storages on the site in these events. The exceedances of the flow criteria are a result of variable rainfall in the area.

Figure 7-4 Baseline Scenario Modelled Compliance with Flow Trigger



As indicated in Section 5 of Appendix I3 of the EIS (Mine Water Balance) the existing GRB mine water management system has sufficient capability to have no unauthorised discharges of mine water for wet season rainfall events up to a 1 in 10 year ARI wet season, and that the addition of mine water from the project can be accommodated within the existing site storage capacity. The use of low priority pits as a contingency may only be necessary during rare extremely wet periods, during which time any mine water will be expected to be heavily diluted and will therefore be within the 10,000 µS/cm end-of-pipe limit EA release condition. This is confirmed by the water balance modelling described in Section 5.1 of Appendix I3 which shows that in the 108 year modelling period no exceedances to this end-of-pipe limit is expected as a result of the project.

As discussed in **Section 5.13**, the GRB mine complex is part of the Fitzroy Basin Pilot Mine Water Release Scheme, which was initiated for the 2012/2013 wet season. The EA for the GRB mine was amended as a result of the pilot study and incorporated modifications to the downstream limit of EC within the Isaac River as well as changes in the flow rate triggers defining the commencement and cessation of release events. In 2013, a comprehensive assessment of the releases undertaken against the amended EA conditions found that “the releases from pilot mines met all conditions significant to potential environmental harm and other release-related conditions in the EAs” (Droop and Jacob 2013; p4). The current conditions relating to end-of-pipe releases (e.g. EC of

10,000 µS/cm) and downstream (e.g. EC of 2,000 µS/cm) are considered appropriate to protect environmental values. It is anticipated that RHM will have no impact on the future ability of the GRB mine to comply with water release conditions in the existing EA.

Section 8 Terrestrial Ecology

8.1 Submissions

This section responds to submissions from the following:

- Department of Environment and Heritage Protection
- Department of Agriculture, Fisheries and Forestry
- Isaac Regional Council
- Department of the Environment

8.2 Survey Methodology

8.2.1 Fauna and Flora Descriptions

The terrestrial ecology chapter of the EIS (Section 9) provides a summary of the floral and faunal values of the project study area. A full description of the fauna and flora assemblages and their respective habitats is presented in the Red Hill Flora and Fauna Technical Reports (Appendix K1 and K2 respectively of the EIS).

8.2.2 Compliance with Commonwealth Survey Guidelines

The Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) (now DOTE) in 2010 and 2011 released a series of guidelines for surveys for threatened bats, birds, frogs, fish, mammals and reptiles. These guidelines provide a guide for stakeholders on the effort and methods considered appropriate when conducting a presence/absence survey for threatened species listed under the EPBC Act. The techniques and survey effort recommended are designed to detect a species if it is present, or to satisfy the argument that a species is not present or is present at very low abundance.

Targeted surveys for EPBC Act listed fauna species to the level outlined in the threatened fauna survey guidelines were not undertaken during the field survey as they are impractical at the EIS stage of the assessment process. The field survey aimed to characterise potential fauna habitat and identify locations where faunal populations might exist as a guide to future targeted surveys. The survey methodology was successful in meeting these aims. The fauna surveys utilised a range of standard fauna survey methods typically employed for terrestrial vertebrate surveys, in keeping with the Queensland state government guidelines (Eyre *et al*. 2012) and as per conditions of the study team's Scientific Purposes Permit and Animal Ethics approval.

8.2.3 Fauna Survey Effort

The GRB and project areas have been the subject of numerous fauna and flora surveys since 1998. Details of these surveys are presented in the Red Hill Flora and Fauna Technical Reports (Appendix K1 and K2 respectively of the EIS). As a result of this extensive survey program, seasonal conditions are well understood and fauna and flora assemblages are very well known. In addition, an excellent spatial coverage of the site has been achieved as a result of the various study requirements over time.

A summary of the various fauna surveys to date has been provided below to assist in appreciation of the overall survey effort undertaken.

1998 Dry season (WBM)

- 7-day survey;
- 4 sites in primary habitat types plus 2 sites in rehabilitation areas;
- survey techniques employed included:
  - cage, Elliottand pitfall traps;
  - bird census;
  - waterbird surveys;
  - active daytime reptile searches;
  - spotlighting surveys;
  - call playback surveys;
  - harp trapping and electronic detection of insectivorous bats; and
  - identification of animal tracks, scat and signs.
- survey techniques, effort and duration consist with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2000 dry season (WBM)

- 7-day survey;
- replication of methods and sites from the dry season 1998 survey; and
- survey techniques, effort and duration consist with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2002 wet season (WBM)

- 5-day survey;
- 6 representative sites within unmined land associated with proposed Ramp 4 underground project;
- survey techniques employed included:
  - Elliott and pitfall traps;
  - bird census;
  - active daytime reptile searches;
  - spotlighting surveys;
  - electronic detection of insectivorous bats; and
  - identification of animal scats and pellets.
- survey techniques, effort and duration consistent with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2005 dry season (Ecoserve and LAMR)

- 3-day survey;
- rapid biodiversity and habitat suitability assessments conducted over the extent of the mining leases; and
- conducted in conjunction with flora survey.

2005 late wet season (URS)

- 11-day survey;
- 8 sites in primary habitat types;
- survey techniques employed included:
  - pitfall, cage and Elliott trapping;
  - bird census;
  - active daytime reptile searches;
  - spotlighting surveys;
  - call playback surveys;
  - insectivorous bat surveys; and
  - identification of animal tracks, scat and signs.
- survey techniques, effort and duration consistent with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2005 (Ecoserve and LAMR)

- 6-day survey;
- rapid biodiversity assessments and targeted species surveys undertaken in representative or distinctive habitat types throughout the study area;
- survey techniques employed included:
  - pitfall trapping;
  - bird census;
  - waterbody surveys;
  - active daytime reptile searches;
  - driving spotlighting surveys;
  - call playback surveys;
  - insectivorous bat surveys; and
  - identification of animal tracks, scat and signs.
- survey techniques, effort and duration consistent with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2009 late wet season (URS)

- 9-day survey;
- 6 sites in primary habitat types;
- survey techniques employed included:
  - pitfall and Elliott trapping;

- — bird census;
- — active daytime reptile searches;
- — spotlighting surveys;
- — call playback surveys;
- — insectivorous bat surveys; and
- — identification of animal tracks, scat and signs.

- survey techniques, effort and duration consistent with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2009 dry season (URS)

- 12-day survey;
- 10 sites in primary habitat types;
- survey techniques employed included:
  - — pitfall and Elliott trapping;
  - — bird census;
  - — active daytime reptile searches;
  - — spotlighting surveys;
  - — call playback surveys;
  - — insectivorous bat surveys; and
  - — identification of animal tracks, scat and signs.
- survey techniques, effort and duration consistent with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

2011 early dry season (URS)

- 8 day survey;
- 3 sites in primary habitat types;
- survey techniques employed included:
  - — pitfall and Elliott trapping;
  - — bird census;
  - — active daytime reptile searches;
  - — spotlighting surveys;
  - — call playback surveys;
  - — insectivorous bat surveys; and
  - — identification of animal tracks, scat and signs.
- survey techniques, effort and duration consistent with requirements of Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012).

As detailed above, the fauna surveys undertaken for GRB and project areas are extensive and provide adequate seasonal coverage to fulfil the requirements of the terms of reference for the project's EIS. In addition, all remnant and non-remnant vegetation communities have been surveyed and excellent spatial coverage was achieved. It is also likely that the majority of vertebrate fauna species have been detected, with only a small number of extra bird species expected to be occasional visitors to the study area.

It is considered that the survey effort undertaken is satisfactory when considering the existing landscape conditions, as further described below.

8.2.4 Site Conditions and Habitat Values

As described in the EIS (Section 9 – Terrestrial Ecology), the ecological values of the EIS study area are considered typical for the altered Isaac River sub-catchment, with large areas of land historically cleared for grazing. Although some areas of remnant vegetation remain intact, most have been modified to some extent by historical and current land management practices. Some of the more significant historical events that led to changes in biodiversity are:

- the Moranbah area was settled by pastoralists in 1850s (SMH 2004) - land clearing began at this time;
- the introduction of the exotic pastoral species buffel grass – buffel grass has been the subject of agricultural extension activity in northern Australia at least since 1923 (Humphreys 1967);
- Brigalow clearing - most of the clearing has occurred since 1960 and is still continuing (DOTE 2014a); and
- Goonyella mine established open cut operations in 1971.

It is clear from extensive site observations that aside from the mine development, the greatest impacts on biodiversity have resulted from clearing and the introduction of buffel grass. Associated impacts include habitat loss, habitat fragmentation, grazing, inappropriate fire regimes, pasture improvement and the introduction and proliferation of exotic plants and animals. However, over the fauna and flora survey periods, little change in the condition or extent of habitat has been observed other than as a result of seasonal climatic variation.

The fauna survey effort was designed to take into account the disturbed nature of the site and the dominant land uses of mining and grazing. As a result, there is a very clear understanding of current and potential usage of the site by flora and fauna species, including NC Act and EPBC Act listed species. There was little observed change to habitat condition and extent over the survey period and no significant changes are thought to have occurred since the last survey; it is considered that the survey effort and findings are acceptable and no further baseline surveys are warranted.

8.3 Flora Survey Methodology

The flora surveys and vegetation community mapping was undertaken in accordance with the methodology employed by the Queensland Herbarium for the survey of Regional Ecosystems (REs) and vegetation communities (Neldner *et al*. 2005). The site data collected are robust and adequately support the revised mapping presented in the EIS Flora Survey Report (Appendix K1).

The flora survey methodology and field data collection were undertaken to comply with the established methodology commonly utilised for similar assessments for ecological impact studies of this scale. This is also the methodology required for the baseline flora assessment as outlined in the EIS Terms of Reference, which require that "site data should be recorded in a form compatible with the Queensland Herbarium CORVEG database and HERBRECS" as per Neldner *et al*. (2005)".

A significant flora field survey effort was undertaken over six survey periods during 2005, 2006, 2009 and 2011. **Table 8-1** below indicates the survey timing and effort (secondary, tertiary and quaternary sites surveyed) during this period.

The field surveys involved a botanical assessment at a number of representative sites within each remnant, non-remnant and regrowth vegetation community. The surveys employed a number of standard methods including secondary survey sites, tertiary survey sites, quaternary survey sites and random meander search areas. Community structural formation classes were also assessed according to Neldner *et al*. (2005). RE classification of communities was determined as per Sattler and Williams (1999), and in accordance with the Regional Ecosystems Description Database (REDD) (EHP 2013d).

Table 8-1 Number of Flora Survey Sites for each Survey Period

Survey Period	A: 17-26 October 2005	B: 30 January – 3 February 2006	C: 22-28 May 2006	D: 18-28 March 2009	E: 11-26 May 2009	F: March 2011	Total sites
Secondary Sites	**39**	**11**	**23**	**16**	**14**	**0**	**103**
Tertiary Sites	**0**	**0**	**0**	**0**	**0**	**16**	**16**
Quaternary Sites	**31**	**3**	**17**	**14**	**37**	**9**	**111**

The locations of all survey sites and survey areas for the six periods are shown on Figure 5-3 and Figure 5-6 respectively within the EIS Flora Survey Report (Appendix K1).

The EIS Flora Survey Report (Appendix K1) provides accurate and robust vegetation mapping that has been produced as an outcome of the substantial quantity of site survey data collected, an understanding of the site's vegetation characteristics acquired over the six different seasonal survey periods, and a rigorous interpretation of stereo pair aerial photo images (at a scale of 1:10,000 or greater) undertaken by an experienced and skilled ecological team with a sound understanding of the ecological values of the project site.

Field surveys employed 73 secondary survey sites within the survey area during the 2005 to 2006 survey period and 30 secondary survey sites during the 2009 survey. Secondary survey sites consisted of 10 m x 50 m (500 m^2) transects. Fieldwork within secondary survey sites included detailed floristic and structural analysis.

Floristic analysis included plant identification and species diversity characterisation of all flora present. Relative abundance was assigned for all species recorded. Plant identification and estimation of relative abundance was undertaken by an experienced botanist with previous survey experience of the bioregion.

Structural analysis included recording the height class and life form of the dominant species within each stratum present. The height of each stratum was recorded using a hand held Optilogic laser rangefinder. The crown separation ratio (CSR) of the mid and upper strata was calculated along the transect, crown gaps (distance between crowns) were recorded using an Optilogic laser rangefinder, and crown widths (spread) were recorded using ocular estimation. Foliage projection of the canopy and mid strata (where applicable) was calculated by converting CSR to foliage protection cover (FPC) (Walker and Hopkins 1999). The FPC of the ground layer was determined using ocular estimation of cover within five 1 m^2 subplots along the secondary transect.

Evidence of previous disturbance, fire history, incidence of exotic species and general notes on soil type and ecological integrity were compiled for each secondary survey site. Several time-encoded digital photographs were taken at each plot as a reference. Locations of data collection sites were recorded using a handheld global positioning system (GPS) unit.

Secondary transects were the primary means of data collection with subsequent analysis to determine the floristic and structural characteristics of each vegetation community surveyed on site. Secondary transect data were presented within the vegetation community descriptions (Appendix A) in the EIS Flora Survey Report (Appendix K1). Not all quaternary site data are presented within the EIS as it is considered supplementary data to compliment the secondary transect data. In addition, quaternary site data are not the prime method for the determination of vegetation community description. A list of all transect sites (secondary, tertiary and quaternary) associated with the determination of vegetation communities is provided in the EIS Flora Survey Report (Appendix K1).

8.4 Matters of National Environmental Significance

8.4.1 Clarification of Fauna Likelihood of Presence

An analysis of likelihood of presence for NC Act and EPBC Act listed fauna was conducted for the EIS Terrestrial Fauna Technical Report (Appendix K2). A subsequent likelihood of presence analysis was conducted for EPBC Act listed fauna within the EIS EPBC Act Report (Appendix Q2).

8.4.1.1 Eastern Long-eared Bat

Appendix Q2 of the EIS discounts the presence of the eastern long-eared bat on the basis of its distribution and lack of records from the study area. Advice was sought from microbat expert Greg Ford with respect to its distribution: *'Moranbah would be at (probably beyond) the extreme northerly limit for the species. As a general 'rule of thumb'*, *…it's a good chance of turning up in suitable habitats (large tracts) anywhere south of the Capricorn Highway, but probably only remote probability north of that'* (G. Ford pers. comm. 16 August 2013). The Capricorn Highway lies approximately 200 km to the south of Moranbah.

The eastern long-eared bat has not been recorded from the study area from any of the eight fauna surveys employing microbat trapping and/or Anabat call analysis. Calls from an unidentified *Nyctophilus* species were recorded during URS surveys in 2005 and during both survey periods in 2009. Greg Ford analysed the Anabat data in 2009 and made the following comments regarding the calls of *Nyctophilus*: *'The long-eared bats produce distinctive calls, but species within the genus cannot be differentiated. Up to three species potentially occur in the study area - N. bifax, N. geoffroyi and N. gouldi'* (G. Ford pers. comm. 2009).

The likelihood of presence assessment within the EIS EPBC Report (Appendix Q2) superseded the likelihood of presence rationale within the Terrestrial Fauna Technical Report (Appendix K2).

8.4.1.2 Yakka skink

Appendix Q2 of the EIS discounts the presence of the yakka skink on the basis of its distribution and lack of records from the study area.

The Atlas of Living Australia (ALA 2014) shows that the nearest records of the yakka skink to the study area are:

- 200 km to the south-east near Blackwater; and
- 180 km to the north-west near Mount Cooper Station.

In addition, the yakka skink was not recorded in any of the nine fauna surveys conducted since 1998.

The likelihood of presence assessment within the EIS EPBC Report (Appendix Q2) superseded the likelihood of presence rationale within the EIS Terrestrial Fauna Technical Report (Appendix K2).

8.4.1.3 Dunmall's snake

Appendix Q2 of the EIS discounts the presence of Dunmall's snake on the basis of its distribution and lack of records from the study area.

The Atlas of Living Australia (ALA 2014) shows that the nearest record of Dunmall's snake to the study area is approximately 120 km to the south-west near Clermont. All other records are greater than 300 km from the study area.

In addition, Dunmall's snake was not recorded in any of the nine fauna surveys conducted since 1998.

The likelihood of presence assessment within the EIS EPBC Report (Appendix Q2) superseded the likelihood of presence rationale within the EISTerrestrial Fauna Technical Report (Appendix K2).

8.4.1.4 Squatter pigeon

At the time of writing the EIS, habitat information for the squatter pigeon was limited, and as a result potential habitat mapping for the squatter pigeon was not undertaken. DOTE subsequently clarified the habitat requirements as an outcome of the 2011 Squatter Pigeon Workshop. With the availability of more refined habitat requirements, potential habitat mapping has been undertaken for this species. This is presented in **Section 8.7.3.1**.

8.4.2 Potential Impacts

Appendix Q2 (EPBC Act Report) of the EIS provides Significant Impact Criteria Assessments for the following fauna and flora species and Threatened Ecological Communities (TECs):

- *Dichanthium queenslandicum* (king bluegrass);
- *Dichanthium setosum* (bluegrass);
- *Digitaria porrecta* (finger panic grass);
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin;
- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- squatter pigeon;
- ornamental snake; and
- koala.

The Significant Impact Criteria Assessments provide a detailed analysis of the significance of potential impacts on these species under the assessment guidelines of the EPBC Act.

Potential impacts to fauna and flora species and TECs could arise as a result of the following project components:

- development of the RHM, including clearing for IMG infrastructure and subsidence;
- direct clearing for the project's surface facilities (industrial area, accommodation village, conveyor and (CHPP); or
- subsidence at the BRM panels extensions.

Potential habitat mapping was conducted for each of the fauna and flora species and TECs and included in Section 7.1 of Appendix Q2.

Updated potential habitat mapping was conducted as part of **Section 8.7.3** for squatter pigeon and koala. The latest data presented in this report supersede the data compiled in Appendix Q2 and have been used in **Table 8-2**.

The potential habitat mapping displays areas of high and low potential within the study area. It is within the identified potential habitat mapped that each of the significant impacts could potentially occur. It is not practicable to attribute each impact criterion to individual areas for each species. **Table 8-2** details which project components relate to each fauna and flora species and TEC. As the natural grasslands and brigalow TECs have been mapped on site and presence has been confirmed, separate categories for high and low potential habitat have not been developed.

Table 8-2 Project Components in which Fauna, Flora and TECs could be Potentially Impacted

Species	Potential Habitat Category	Project Component
Dichanthium queenslandicum (king bluegrass)	High Potential Habitat	RHM
	Low Potential Habitat	RHM
Dichanthium setosum (bluegrass)	High Potential Habitat	RHM
	Low Potential Habitat	RHM
Digitaria porrecta (finger panic grass)	High Potential Habitat	RHM
	Low Potential Habitat	RHM
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	Known Habitat	RHM
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Known Habitat	RHM Surface Facilities
Squatter pigeon (*Geophaps scripta scripta*)	High Potential Habitat	RHM Surface Facilities
	Low Potential Habitat	RHM Surface Facilities BRM
Ornamental snake (*Denisonia maculata*)	High Potential Habitat	RHM Surface Facilities BRM
	Low Potential Habitat	RHM Surface Facilities
Koala (*Phascolarctos cinereus*)	High Potential Habitat	RHM Surface Facilities
	Low Potential Habitat	RHM Surface Facilities BRM

Cotton pygmy geese (*Nettapus coromandelianus*) have been recorded within the study area utilising mine water storage dams. They have also been recorded in other studies throughout the Bowen Basin using farm dams and other large impoundments.

The mapping of potential subsidence void ponding extents and volumes outside the Isaac River channel identified 44 potential ponding areas (larger than two hectares). The subsidence voids are estimated to range from less than 10 ML capacity up to a maximum of approximately 1,100 ML. The average capacity would be approximately 210 ML. The areas of potential ponding would be up to 40 hectares, and the average area would be approximately 12 hectares.

Artificial impoundments in the Bowen Basin are typically colonised over time by a suite of aquatic and semi-aquatic plants on the shores and in shallow waters. Aquatic plant communities such as these form important breeding and feeding resources for a range of aquatic birds. The cotton pygmy goose is likely to utilise subsidence ponds for feeding or resting during seasonal movements. In addition, any trees (with hollows) which are killed by inundation of the voids can provide valuable nesting resources for a range of species including the cotton pygmy goose.

A wide variety of bird species will benefit from the ponding. Twenty-nine species of bird that could potentially use aquatic habitat have been recorded in the study area. Additionally, woodland and grassland bird species will benefit from the extra water sources, as will raptors which will gain from the abundance of prey generated by the new water bodies.

The ornamental snake (*Denisonia maculata*) is a terrestrial reptile that specialises in hunting frogs. Although the ornamental snake usually favours gilgai habitats, it was observed within the study area in a non-gilgai situation; dredging of a farm dam had resulted in piles of spoil being deposited on the perimeter of the dam. The dredging of the dam had inadvertently resulted in a gilgai-like formation and the hollows between the piles had captured water from recent rain and were acting as frog breeding habitat. The ornamental snake (and spotted pythons) was taking advantage of the conditions to hunt the abundant frogs.

As in the above example, the ponding of water within subsidence voids will provide substantial additional frog breeding habitat. As a result, the ornamental snake, and other vertebrate fauna that prey on frogs, will benefit from the added abundance of frogs.

Cane toads (*Rhinella marina*) are already on the site in large numbers. There is potential for an increase in the numbers of cane toads as a result of the provision of more water sources from ponding.

While the ornamental snake is one of the species considered to be potentially at risk from lethal ingestion of cane toad toxin (Phillips *et al*. 2003 in press in DOTE 2005), and it is likely that this is a factor in the decline of the species, there is lack of quantitative evidence that the species is declining, or has declined, as a direct result of lethal toxic ingestion of cane toad (DOTE 2005).

Further details on threats to the ornamental snake are presented in Section 7.2.7.5 of the EPBC Report (Appendix Q2).

8.4.2.1 Clarification of potential Impacts to the Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community

Discrepancies regarding the potential impacts to the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC have been highlighted. A thorough reanalysis of the available data has confirmed that the correct figure is 368.8 hectares. This is consistent with the data presented in the Offset Strategy (**Appendix B**).

The EIS comprehensively describes the Matters of National Environmental Significance (MNES) on the study area and assesses the potential impacts of the project on these values.

The EIS Flora and Fauna Technical Reports (Appendix K1 and Appendix K2 respectively) describe the floral and faunal assemblages present and provide detailed mapping of REs and TECs.

The Terrestrial Ecology Section of the EIS (Section 9) summarises the flora, fauna and vegetation communities present and provides a detailed assessment of potential impacts on these values by the project. A comprehensive raft of mitigation measures is proposed to manage the potential impacts.

The EPBC Report (Appendix Q2) describes the MNES present and potentially present in the study area. In addition, the following components are presented:

- a likelihood of occurrence assessment for MNES;
- potential habitat mapping for the MNES likely and known to be present;
- MNES profiles;
- significant impact criteria assessments; and
- proposed mitigation measures.

To assist in the identification of relevant text, **Table 8-3** details cross references for each of the required items of information.

Table 8-3 Cross-reference of Relevant Information provided in the EIS

Information Requested	EIS Cross References
Discuss the relevant species or community in respect of known threats and those threats posed by the proposed action	EIS Section 9 Terrestrial Ecology Section 9.3.1 Section 9.3.2 Section 9.4.1 Section 9.4.2 Section 9.5 Section 9.6 Appendix K1 Flora Survey Report Section 3.1 Section 3.2 Appendix K2 Fauna Technical Report Section 3.1 Section 3.2 Section 3.3 Appendix Q2 EPBC Report Section 5 Section 7 Section 8
Clearly describe the methodologies for presence/absence of the relevant species or community	EIS Section 9 Terrestrial Ecology Section 9.2.1 Section 9.2.2 Section 9.2.3 Appendix K1 Flora Survey Report Section 2.1 Section 2.2 Appendix K2 Fauna Technical Report Section 2.1 Section 2.2 Appendix Q2 EPBC Report Section 4
Quantify and discuss likely direct, indirect and downstream impacts from the proposed action, including subsidence	EIS Section 9 Terrestrial Ecology Section 9.6 Appendix Q2 EPBC Report Section 8
Identify relevant matters on maps with locations of infrastructure proposed	EIS Section 9 Terrestrial Ecology Figure 9-10 Figure 9-12 Figure 9-13 Figure 9-14 Appendix Q2 EPBC Report Figure 5-4 Figure 7-1 Figure 7-2 Figure 7-3 Figure 7-4 Figure 7-5

Information Requested	EIS Cross References
	Figure 7-6 Figure 7-7
Describe and assess the effectiveness of avoidance and mitigation measures and the anticipated benefit of these measures	EIS Section 9 Terrestrial Ecology Section 9.8 Appendix Q2 EPBC Report Section 8.3
Quantify and discuss residual impacts	Appendix Q2 EPBC Report Section 8.2 Section 8.3.1 Section 8.3.2 Section 8.3.9
Assess the level of impact and its acceptability and provide a rationale	EIS Section 9 Terrestrial Ecology Section 9.6 Section 9.7 Appendix Q2 EPBC Report Section 8
Must propose offsets to compensate for any residual significant impacts in accordance with the EPBC Act environment Offsets Policy and associated Offsets Assessment Guide	See below

8.4.3 Offsets

An offset strategy has been prepared (provided in **Appendix B)** that outlines the offset requirements under the Queensland *Environmental Offsets Act 2014*, and the Federal Government's EPBC Act.

As detailed in the offset strategy, BMA proposes to provide land based offsets through a staged strategy which will be finalised when the project's EA is issued. It will be based on determination of actual clearing areas as mining and associated IMG management and subsidence progresses. This staged offset strategy will be aligned to BMA's mine planning cycle to allow accurate identification of actual offsets required in each stage of mining. BMA currently conducts planning on a five year cycle.

8.5 Weed and Pest Management

8.5.1 Introduced fauna

As reported in the EIS (Section 9.4.2.4), nine introduced vertebrate fauna species were recorded within the survey area. Apart from domesticated horses (*Equus caballus*) and cattle (*Bos indicus*), the cane toad (*Rhinella marina*) and the European rabbit (*Oryctolagus cuniculus*), all have the capacity to be attracted to waste generated by the project and to potentially increase in numbers. The feral animals in this group identified on site are:

- house mouse (*Mus musculus*);
- dingo/dog (*Canis lupus dingo/familiaris*);
- fox (*Vulpes vulpes*);
- house cat (*Felis catus*); and
- feral pig (*Sus scrofa*).

The house mouse, dingo/dog, fox and house cat in particular often take advantage of poor waste management systems. Increases in populations of the dingo/dog, fox and house cat can result in increased impacts to native fauna. The house mouse can provide a hygiene issue, especially around accommodation villages.

Another feral animal issue identified in the EIS (Section 9.6.4.1) is the availability of water from subsidence ponding which can enhance habitat for pest fauna and non-native predators. This is especially relevant for the cane toad (*Rhinella marina*) and feral pig (*Sus scrofa*). Feral pigs will be managed as per the pest management plan. Management of cane toads is not required under the *Land Protection (Pest and Stock Route Management) Act 2002* and is not feasible.

In all cases it is unlikely that the proposed works will significantly result in the further proliferation of these species or the introduction of further feral vertebrate species.

Currently, BMA is conducting feral animal control at the GRB mine complex and is committed to continuing the management of feral animals. These and other management strategies will be included in a detailed pest management plan (PMP) that will be prepared prior to the commencement of construction. This plan will address risks associated with the movement of personnel and equipment.

Typical strategies in the PMP to minimise the opportunities for scavenging and proliferation of pest fauna will include:

- General (non-recyclable) waste will be collected by a licensed contractor and disposed to a licenced landfill facility. This will ensure that food scraps are not available on site for scavengers;
- Fauna-proof bins will be provided around the accommodation village and outlying facilities;
- Workers will be advised to dispose of food scraps properly and to not feed feral animals (especially cats); and
- Feral animal control will continue with target species and methods being reviewed over time based on monitoring and anecdotal reporting.

8.5.2 Weeds

The EIS acknowledges the potential for and threat of weed spread and introduction (Section 9.6.2.2 and Section 9.6.4.4).

Flora surveys for the EIS determined the presence of 46 exotic plant species. Of these, six species were identified as being of management concern. These include *Eriocereus martinii* (harrisia cactus), *Parthenium hysterophorus* (parthenium), *Opuntia stricta* var. *stricta* (prickly pear), *Opuntia tomentosa* (velvety tree pear) and *Sporobolus fertilis* (giant Parramatta grass). Additional weeds of concern including rubber vine (*Cryptostegia grandiflora*) and parkinsonia (*Parkinsonia aculeata*) could be introduced to the study area by vectors such as construction vehicles and earthmoving equipment.

Mitigation measures to be employed to minimise the introduction, spread and impacts of weeds are detailed in Section 9.8.1.1, Section 9.8.1.2 and Section 9.8.1.3 of the EIS. Section 9.8.1.5 of the EIS outlines potential strategies to be incorporated into the project's PMP. Weed and pest management measures will be incorporated into the site and construction management plans, and will include:

- identification of the origin of construction materials, machinery and equipment;
- management methods to control spread of declared weed species (in particular *Parthenium hysterophorus*), in keeping with regional management practice or Queensland DAFF pest control prescriptions;
- ongoing monitoring of the EIS study area to identify any new incidence of weed infestation;
- wash down protocols for any vehicles or machinery entering and leaving site;
- methods for weed eradication from the site in accordance with local management practice from the IRC and/or the Queensland Government's pest fact sheets (DAFF 2011); and
- promotion of awareness of weed management, by inclusion of weed issues, pictures and procedures into the project's site induction program.

The PMP will address risks associated with the movement of personnel and equipment.

The project will comply with relevant legislation where chemical control is the proposed mitigation measure for weeds.

8.6 Impacts on Riparian Vegetation

8.6.1 Impacts to Corridors

When examining the potential impacts of the project on wildlife corridors, it is important to take the region's historical and existing land uses into account. As discussed in **Section 8.2.4** above, the study area has been subjected to a range of historic and ongoing land use impacts, including settlement and initial clearing, the introduction of buffel grass, the clearing of brigalow, and the commencement of mining.

Brigalow Belt settlers and graziers initially opened up country through timber felling to facilitate grazing. The first patches of bushland to be cleared were those growing on the most fertile and productive soils (TWS 2014). Within the Brigalow Belt, and specifically within the study area, these were the alluvial flats along watercourses where fertile soil had been laid down by numerous floods. One of the prominent features in the cleared rural Australian landscape today is the sinuous remnants of vegetation along watercourses left as a relic of early clearing practices.

As available land became scarcer, and farming techniques changed, less fertile soils were cleared (TWS 2014), including brigalow. Prior to the Second World War, brigalow scrub was relatively untouched as it was difficult to clear by hand (McAlpine and Seabrook 2010). Since then the use of heavy earthmoving equipment has enabled significant areas to be cleared and the impacts of clearing and grazing on brigalow within the study area are evident.

The advent of mining has brought another suite of impacts to native ecosystems. However, it is likely that at the time of initial mine development much of the GRB site had been cleared or was heavily fragmented, and most impacts to biodiversity had occurred in the preceding 100 years.

The current landscape of the project area features a mixture of grassland (as pasture and remnant), regrowth and remnant woodland vegetation. There is already a high degree of fragmentation present, and many pockets of vegetation are isolated from each other and the Isaac River, the principal ecological corridor.

While local fauna movement may be impeded through clearing for project activities, it is unlikely that the project will significantly affect movement opportunities along the Isaac River.

The dominant land use in the surrounding area is grazing. As such, the majority of the site will be revegetated with pasture species consistent with an ongoing grazing land use. Revegetation with native trees and shrubs will take place along the Isaac River channel, with a particular focus on re-establishing riparian woodland communities.

A rehabilitation plan will be developed that includes details of suitable species of vegetation to achieve the relevant grazing and bushland post-mine land uses. Wherever practicable, landscaping and rehabilitation works will include endemic native species of local provenance, and will also make use of conservation significant flora species or species that can provide habitat opportunities for conservation significant fauna. Opportunities for re-establishment of corridors will be investigated.

8.6.2 Isaac River Connectivity

The Isaac River is acknowledged in the EIS as being of significance for fauna habitat and connectivity values. The riparian forest and alluvial woodland adjacent to the Isaac River is primary habitat for arboreal mammals and other native wildlife. Arboreal mammals were observed in low densities across the site and recorded at a relatively high density during surveys along the Isaac River. The Isaac River also provides the only north-south corridor for wildlife dispersing through the survey area.

The proposed mine development will result in several temporary infrastructure crossings of the Isaac River as IMG drainage infrastructure is installed. As mining progresses, the Isaac River will subside in places and this is likely to result in changes to riparian vegetation. However the project will not disrupt the north-south corridor function of the Isaac River and fauna use and movement along this corridor will continue. Natural breaks in connectivity along the Isaac River have historically occurred through bushfire, flooding and avulsion events. Management of vegetation related to pastoral activities has been the primary cause of loss of connectivity from an anthropogenic viewpoint.

BMA proposes to proactively manage impacts to the Isaac River by minimising disturbance to the river and associated riparian vegetation. A number of commitments have been made by BMA to ensure the Isaac River's values are not significantly impacted. These include:

- areas for clearing will be delineated to avoid inadvertent clearing;
- if habitat trees can be retained without compromising safety, they will be identified and marked;
- habitat features such as felled trees and logs will be considered for relocation to other areas where practical to provide microhabitat;
- following construction of the bridge across the Isaac River, disturbed areas not required will be stabilised and rehabilitated with riparian vegetation;
- designing and constructing IMG management infrastructure to minimise disturbance to riparian zones, particularly native vegetation, along the Isaac River and 12 Mile Gully and avoiding placement of gas wells within 100 m of these waterways wherever possible;

- minimise river crossings for IMG infrastructure by relying on the Isaac River bridge where practicable;
- where bridge crossing is not practicable, selecting river and creek crossings for IMG infrastructure where natural breaks in vegetation occur wherever possible, recognising that crossing locations must align with the pillars between each longwall panel;
- minimising the width of clearing required for any river crossing, and particularly retaining tall trees on either side of crossing locations wherever this is safe to do so;
- while the majority of the site will be revegetated with pasture species consistent with ongoing grazing land use, revegetation with native trees and shrubs will take place along the Isaac River channel, with a particular focus on re-establishing riparian woodland communities; and
- revegetation will be progressive as subsidence occurs, however, full restoration of the Isaac River corridor may not occur until the channel has re-established.

8.6.3 Red Hill Levee

Detailed design for the Red Hill levee has not yet commenced. However, preliminary design has determined that the levee will be situated to the west of Red Hill Road, a significant distance from the riparian zone of the Isaac River. The current interim location for the levee is within vegetation mapped in the EIS as:

- RE 11.4.2 - *Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains;
- RE 11.3.2 - *Eucalyptus populnea* woodland on alluvial plains; and
- RE 11.3.7 - *Corymbia* spp. woodland on alluvial plains.

‘Good quality riparian vegetation’ is riparian vegetation that has retained the floristic and structural elements of undisturbed riparian communities and possesses ecological functionality typical of these communities. Aerial photo analysis has determined that the vegetation communities potentially affected by the proposed levee have previously experienced varying levels of degradation from seismic exploration, subsidence, clearing for grazing and clearing for linear infrastructure. It is evident that none of the potentially impacted communities identifies as ‘good quality riparian vegetation’.

Irrespective of the vegetation communities present or their quality, BMA is committed to minimising impacts to natural values. With respect to the levee, this will be achieved through:

- site scouting to determine the most appropriate location of the levee in order to avoid impacts to vegetation communities and habitat, where practicable;
- pre-clearance surveys (within potential fauna habitat);
- minimising the construction footprint of the levee; and
- rehabilitation of the levee construction footprint to enhance values for fauna.

8.6.4 Incidental Mine Gas Infrastructure and Offsets

Development of the project will include clearing of vegetation for IMG infrastructure. As the actual areas to be disturbed by these activities are not yet known, the EIS assumes a maximum worst-case scenario of 100 per cent clearing of the area impacted.

As the worst-case scenario has been used for potential impact calculations, the quantification of residual impacts has not been undertaken.

As discussed in **Section 8.6.2**, the Isaac River and its tributaries have been identified as having a range of natural values and impact mitigation strategies have been developed to ensure that such values are retained wherever practical. This includes designing and constructing IMG infrastructure to minimise disturbance to riparian zones along the Isaac River and 12 Mile Gully and avoiding placement of gas wells within 50 m of these waterways wherever possible.

As rehabilitation of the post mining land surface is closely connected with subsidence effects, management of ecological impacts from IMG drainage requirements will be closely linked to the overall adaptive management approach to subsidence impacts.

BMA is committed to reducing potential impacts on biodiversity values through avoidance and mitigation measures, with offsets employed as a secondary measure to mitigate residual impacts. Due to uncertainties associated with IMG design and the degree of subsidence impacts on vegetation, BMA has developed a staged offset approach that accounts for actual losses, manages unavoidable losses, and incentivises avoidance to protect environmental values. The offset strategy is provided in **Appendix B**.

8.7 Impacts on Fauna

8.7.1 Habitat Mapping

Potential habitat mapping has been undertaken within the EIS EPBC Report (Appendix Q2) for a range of EPBC-listed flora and fauna species and threatened ecological communities. These are:

- *Dichanthium setosum* (bluegrass);
- *Dichanthium queenslandicum* (king bluegrass);
- *Digitaria porrecta* (finger panic grass);
- Squatter pigeon (*Geophaps scripta scripta*);
- Ornamental snake (*Denisonia maculata*);
- Koala (*Phascolarctos cinereus*) (combined populations of QLD, NSW and the ACT);
- TEC: Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin; and
- TEC: Brigalow (*Acacia harpophylla* Dominant and Co-dominant).

A submission was made requesting the quantification of residual impacts on brigalow scaly-foot, ornamental snake, little pied bat and koala habitats. As noted above, this process has been undertaken for the koala and ornamental snake within the EIS EPBC Report (Appendix Q2). At the time of writing the EIS, habitat information for the squatter pigeon was limited, and as a result potential habitat mapping for the squatter pigeon was not undertaken. DOTE subsequently clarified the habitat requirements as an outcome of the 2011 Squatter Pigeon Workshop. With the availability of more refined habitat requirements, potential habitat mapping has now been undertaken for this species.

For the koala, the potential habitat mapping has been revised to provide a more accurate estimation of usage on site by this species.

The section below details the methods used and results of potential habitat mapping and potential impact quantification for the squatter pigeon, brigalow scaly-foot, little pied bat and koala.

8.7.2 Potential Habitat Mapping Methodology

Potential habitat mapping using the field-validated RE mapping was undertaken for the four fauna species listed above within the EIS study area. The following methodology for habitat mapping was used:

- Potential habitat mapping criteria for each species were developed by analysing distribution and habitat preferences using desktop and field data. Field-verified REs were used as the primary criterion, with additional features such as waterways, land zones and regrowth communities also used where suitable.
- Upon the determination of habitat criteria, potential habitat types were further categorised into high potential habitat or low potential habitat (where applicable) based on further examination of the species' habitat preferences (explained further below).
- Using the criteria for high potential habitat or low potential habitat, mapping was undertaken and potential habitat areas for each species were calculated.
- Potential impacts of the project were then analysed by overlying the proposed project footprint with the potential habitat mapping.

Potential habitat types were categorised into one of the following:

- High potential habitat – species occurrences are commonly recorded in these areas; habitat provides superior habitat values and foraging potential compared to low potential habitat areas. Habitat that is preferential and has been identified during desktop investigations.
- Low potential habitat – habitat in which the species has been known to occur; however, it offers inferior habitat values or foraging potential compared to high potential habitat areas.
- Generally unsuitable habitat – habitat which is not suitable to usage or habitat by the species.

8.7.3 Fauna Profiles and Potential Habitat Mapping Criteria

8.7.3.1 Squatter pigeon (southern) (*Geophaps scripta scripta*)

Status

NC Act: Vulnerable

EPBC Act: Vulnerable

Distribution and Habitat Information

The known distribution of the squatter pigeon (southern) extends south from the Burdekin-Lynd divide in the southern region of Cape York Peninsula to the Border Rivers region of northern NSW, and from the east coast to Hughenden, Longreach and Charleville, Queensland (ALA - OEH 1999, 2006; Cooper *et al. in prep*.; Frith 1982b; Ford 1986; Higgins & Davies 1996; Schodde & Mason 1997, in prep.; Squatter Pigeon Workshop 2011; Storr 1984c in DOTE 2014b).

The squatter pigeon forages on the ground for seeds from grasses, herbs and shrubs (Chrome 1976b in DOTE 2014b). It feeds during the day on the ground and at night roosts on low branches. Breeding habitat occurs on stony rises occurring on sandy or gravelly soils, within 1 km of a suitable, permanent water body (Squatter Pigeon Workshop 2011 in DOTE 2014b). The nest is a depression scraped into the ground beneath a tussock of grass (Chisholm 1944; Lord 1956 in DOTE 2014b), bush, fallen tree or log (Frith 1982b in DOTE 2014b), and sparsely lined with grass (North 1913-14 in DOTE 2014b). The Squatter Pigeon is considered sedentary (Squatter Pigeon Workshop 2011 in DOTE 2014b) or locally nomadic (Frith 1982b in DOTE 2014b).

Threatening Processes

The main threats to the squatter pigeon include:

- loss and fragmentation of habitat due to clearing for agricultural purposes;
- the degradation of habitat by overgrazing by domesticated herbivores;
- the degradation of habitat by invasive weeds, such as buffel grass (*Pennisetum ciliare*); and
- predation by numerous avian and terrestrial predators (DOTE, 2014a).

Survey Guidelines and Field Methods

Survey techniques for the squatter pigeon are detailed in the *Survey Guidelines for Australia's Threatened Birds* (DEWHA, 2010). These include area searches, transect surveys in suitable habitat and flushing surveys.

Field survey methods included observations while traversing woodland and grassland. Most specimens were observed on farm tracks while driving around the site.

Desktop Assessment Results

Squatter pigeon records were returned from searches of the EPBC Protected Matters database and the Birds Australia database.

Field Results

Squatter pigeons have been recorded in the EIS study area on six separate occasions. These were during surveys undertaken by WBM in 1998, 2000 and 2002; and URS in 2005, 2009 and 2011.

The observations are clustered in two areas and are likely to represent a viable population using the site. All individuals were observed in areas which have been grazed and have some level of habitat degradation. Their occurrence may reflect the nearby presence of water rather than food resources, or be simply a result of increased visibility improving the likelihood of detection.

Habitat Mapping Criteria

In Queensland, squatter pigeon (southern) foraging and breeding habitat is known to occur on well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills (Land Zone 5), and lateritic (duplex) soils on low 'jump-ups' and escarpments (Land Zone 7). Breeding habitat is also within 1 km of a suitable, permanent water body (Squatter Pigeon Workshop 2011). As a result, the High Potential habitat category will comprise remnant or regrowth vegetation communities on land zone 5 and 7 within 1 km of water.

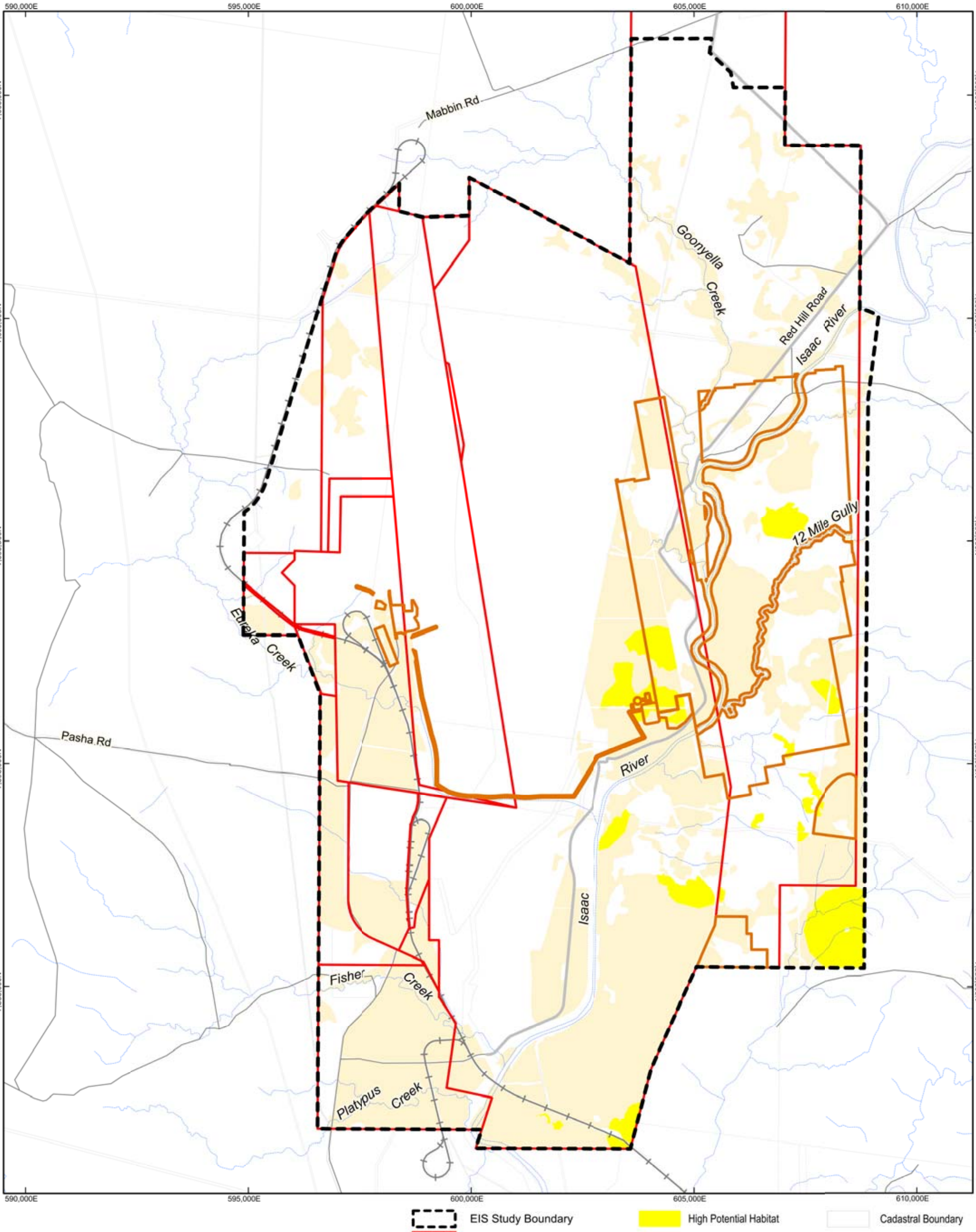
Low Potential Habitat comprises all other remnant or non-remnant vegetation communities that can be used for dispersal. The subspecies is unlikely to move far from woodland trees which provide protection from predatory birds (Squatter Pigeon Workshop 2011). Where scattered trees still occur, and the distance of cleared land between remnant trees or patches of habitat does not exceed 100 m, individuals may be found foraging in, or moving across, modified or degraded environments (Squatter Pigeon Workshop 2011).

All other areas (mine areas) are within the Generally Not Suitable category.

Potential habitat mapping criteria for the squatter pigeon are presented in **Table 8-4**. Potential habitat mapping is depicted on **Figure 8-1**.

Table 8-4 Potential Habitat Mapping Criteria for the Squatter Pigeon

Habitat Category	Criteria
High Potential Habitat	REs 11.5.3, 11.5.9, 11.5.16, 11.7.1, 11.7.2 within 1 km of permanent water
Low Potential Habitat	Remnant 11.3.1 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.7, 11.3.25, 11.3.36, 11.4.2, 11.4.7, 11.4.8, 11.4.9, 11.5.3, 11.5.9, 11.5.16, 11.7.1, 11.7.2, 11.9.1 Regrowth vegetation communities Non-remnant areas < 100 m from remnant trees or patches.
Generally Not Suitable	All other mine areas.



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SQUATTER PIGEON POTENTIAL HABITAT MAPPING

ECOLOGY

File No: 42627373-g-2274.wor | Drawn: VH | Approved: CT | Date: 24-09-2014

Figure: 8-1 | Rev. A | A4

8.7.3.2 Brigalow scaly-foot (Paradelma orientalis)

Status

NC Act: Vulnerable

EPBC Act: delisted (formerly Vulnerable)

Distribution and Habitat Information

The core of the species' distribution is within the Brigalow Belt of Queensland. This has recently been extended, from near Charleville in the west, to near Inglewood in the south, to near Pentland in the north (Schulz & Eyre 1997; *Kutt et al*. 2003 in SEWPaC 2011).

It is known from a range of vegetation communities, including (but not restricted to):

- Brigalow (*Acacia harpophylla*);
- gidgee (*Acacia cambagei*) woodland;
- poplar box (*Eucalyptus populnea*) woodland;
- narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*E. macrocarpa*) woodland; and
- tall woodland of Clarkson's bloodwood (*E. clarksoniana*), narrow-leaved ironbark (*E. crebra*) and Queensland peppermint (*E. exserta*) (SEWPaC 2011).

The species has a particular affinity for sandstone ridges (SEWPaC 2011).

Threatening Processes

Actual or potential threats to the brigalow scaly-foot include:

- loss of habitat due to clearing and thinning;
- grazing effects;
- inappropriate roadside management; and
- feral animals (Richardson 2006).

Survey Guidelines and Field Methods

Survey methods for the brigalow scaly-foot are detailed in the Survey guidelines for Australia's threatened reptiles (SEWPaC 2011). These include opportunistic searching in likely sheltering sites, including under rocks on sandstone ridges (Wilson & Knowles 1988 in SEWPaC 2011) and under timber and fallen bark on soil, particularly under slabs of stringybark and ironbark fallen from dead trees (Shea 1987; Schulz & Eyre 1997; Kutt et al. 2003 in SEWPaC 2011). Nocturnal spotlight searches of preferred feeding stations (the trunks of the rough-barked mountain hickory (*Acacia falciformis*)) are also recommended.

Within the study area, active diurnal and nocturnal searching for reptiles, amphibians and small mammals was conducted. This included scanning of trees and ground, searching beneath microhabitat such as rocks, fallen timber and peeling bark and digging through leaf litter and soil at tree bases. Active searches were undertaken within suitable microhabitat at each primary transect for a period of 30 minutes. Additional active searches were conducted throughout the study area within habitat identified as having potential microhabitat values for ground fauna and opportunistically during other survey activities or traverses.

Desktop Assessment Results

Results of the Wildnet database search in 2005 did not return records for the brigalow scaly-foot. A Wildnet database search conducted in 2009 returned four records for the brigalow scaly-foot. However, the Atlas of Living Australia shows the nearest record to the RHM site is within Dipperu National Park, located 65 km to the east.

Field Results

The brigalow scaly-foot was detected during the 1998 summer fauna survey (WBM 1998) near Ramp 4 between the Red Hill Road and the Isaac River (natural reach). It was not detected in any of the subsequent fauna field surveys.

Habitat Mapping Criteria

Essential Habitat (EH) Factors for the brigalow scaly-foot sourced from the Essential Habitat Database (EHP 2012) were used as the basis for development of the habitat mapping criteria. The EH Factors were filtered so that only REs found within the study area were retained. As most descriptions of preferred habitat exclude grassland REs, RE 11.8.11 (*Dichanthium sericeum* grassland on Cainozoic igneous rocks) has been excluded. The resultant list of REs has been used as criteria for the High Potential habitat category.

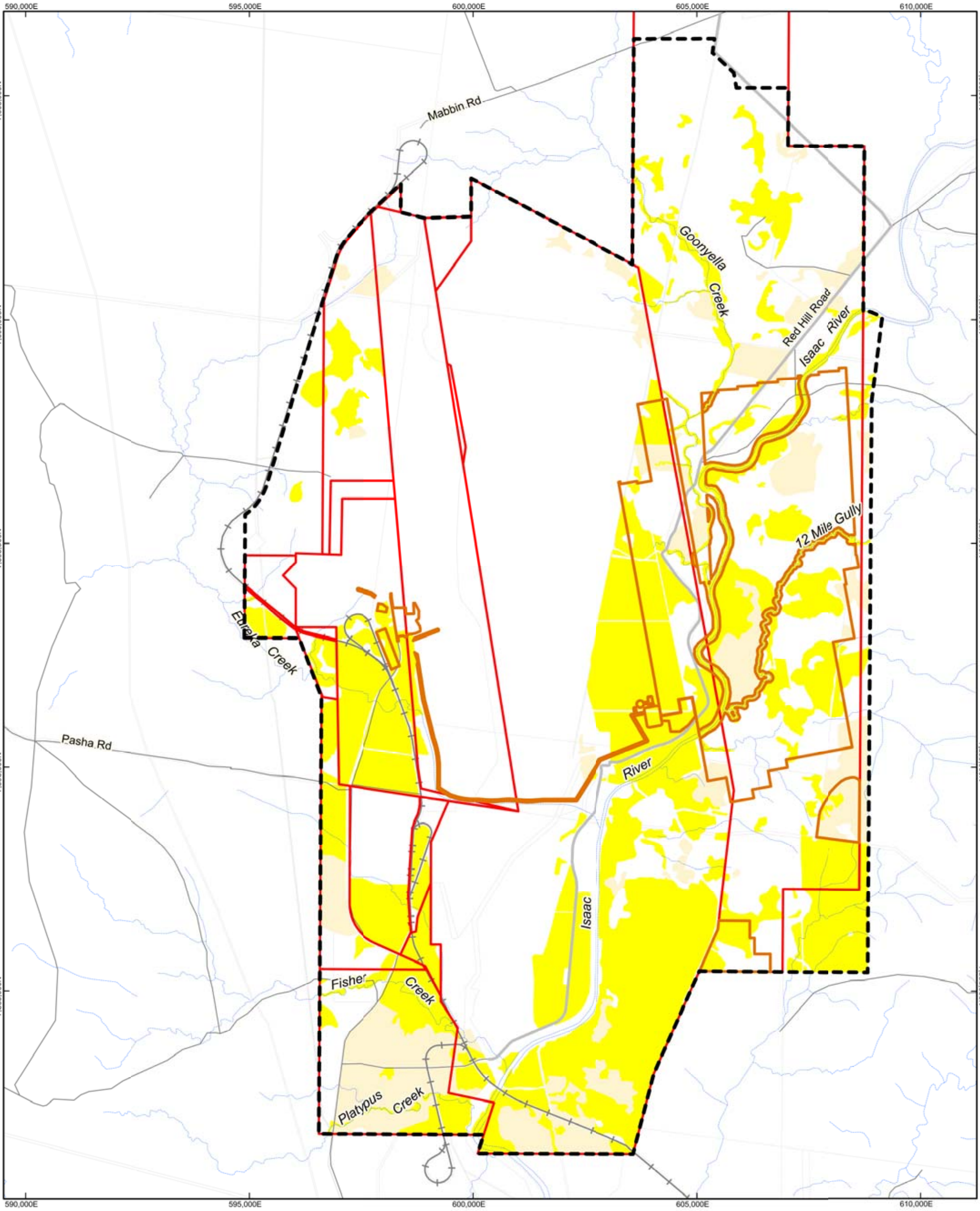
McDonald *et al*. 1991 (in DOTE 2014c) notes that specimens have been collected from cultivated areas, suggesting persistence despite clearing. Therefore, regrowth communities comprised of EH Factor REs form the Low Potential Habitat category for the brigalow scaly-foot.

All other areas (mine areas) are within the Generally Not Suitable category.

Potential habitat mapping criteria for the brigalow scaly-foot are presented in **Table 8-5**. Potential habitat mapping is depicted on **Figure 8-2**.

Table 8-5 Potential Habitat Mapping Criteria for the Brigalow Scaly-foot

Habitat Category	Criteria
High Potential Habitat	REs 11.3.1 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.7, 11.3.25, 11.3.36, 11.4.2, 11.4.7, 11.4.8, 11.4.9, 11.5.3, 11.5.9, 11.5.16, 11.7.1, 11.7.2, 11.9.1
Low Potential Habitat	Regrowth vegetation
Generally Not Suitable	All other mine areas.



EIS Study Boundary
BMA Tenure/Tenement
Potential Impact Area
High Potential Habitat
Low Potential Habitat
Cadastral Boundary
Road
Railway
Drainage

0 1.25 2.5km
Scale 1:120 000 (A4)
Datum: GDA 94, MGA Zone 55

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BRIGALOW SCALY-FOOT POTENTIAL HABITAT MAPPING

URS

ECOLOGY

Figure: 8-2

File No: 42627373-g-2275.wor | Drawn: VH | Approved: CT | Date: 30-09-2014 | Rev. A | A4

8.7.3.3 Little pied bat (*Chalinolobus picatus*)

Status

NC Act: Near Threatened

EPBC Act: not listed

Distribution and Habitat Information

The little pied bat is a small insectivorous bat whose range extends from the central Queensland coast, through western New South Wales and into far eastern South Australia (Van Dyck and Strahan 2008). Churchill (2008) notes that it has been caught in dry open forest, open woodland, chenopod shrublands and *Callitris* forest. It is now known to be captured more frequently close to permanent or semi-permanent water bodies (Ellis and Pennay 2008). In the Brigalow Belt region of central southern inland Queensland, it is found in brigalow/belah associations, semi-evergreen vine thickets, poplar box woodlands and *Callitris/Allocasuarina* dominated forests with emergent eucalypts (Duncan *et al*. in DSITIA 2012).

It is known to roost in black oak (*Casuarina pauper*) and Mulga (*Acacia aneura*) as well as bloodwoods and other large eucalypts (Churchill 2008). Other roosting habitat includes caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings (NSW DEC 2005).

Threatening Processes

While no threatening processes have been identified for this species, it is likely that populations will be threatened by:

- loss or modification of habitat;
- predation by cats;
- application of pesticides in or adjacent to foraging areas (NSW DEC 2005);
- roost disturbance;
- harvesting of timber in State Forest lands; and
- changing fire regimes (Ellis and Pennay, 2008).

Survey Guidelines and Field Methods

Targeted species survey guidelines are available for this species (DSITIA 2012).

Microbat surveys for the EIS were conducted in the following manner. Anabat II Bat Detectors were used to survey micro-chiropteran (insectivorous) bats by recording and analysing their echolocation calls. Detectors were placed in prospective microhabitat at various vegetation communities around the site. Anabat units were placed in potential bat 'flyways' just before dusk and left to record calls overnight.

Desktop Assessment Results

No records of this species were returned from the database searches. A recent review of records for the little pied bat in the Atlas of Living Australia showed no records in the vicinity of the RHM site. The little pied bat was detected by WBM in 2000 and 2002.

Field Results

The little pied bat was detected by URS in 2005. In 2009 and 2011 it was provisionally recorded during fieldwork. Microbat call analyst Greg Ford offered the following comments regarding Anabat records at Goonyella Riverside: *"(calls) similar to S(cotorepens) greyii / S. sanborni and V(esperdalus) baverstocki but C. picatus often has distinctive alternating pulse frequency; most calls could not be reliably differentiated but a few calls from at least 2 sites showed some evidence of frequency alternation"* (G. Ford 2009).

Habitat Mapping Criteria

Essential Habitat (EH) Factors for the little pied bat sourced from the Essential Habitat Database (EHP 2012) were used as the basis for development of the habitat mapping criteria. The EH Factors were filtered so that only REs found within the Red Hill study area were retained.

Further review of the EH REs was undertaken to remove REs where the dominant canopy species did not typically provide suitable roost habitat for the bat. These included wetland, grassland and shrubland REs. Given that the little pied bat forages in wide range of habitats, but tends to roost in trees that develop hollows or possess other suitable microhabitat features, the focus was to retain REs that support suitable microhabitat and exclude those that do not. Given that the species does not show specific resource or site fidelity and appears to favour a large range of vegetation communities for foraging and roosting, it is difficult to narrow the list of REs further. These REs have been used as criteria for the High Potential habitat category.

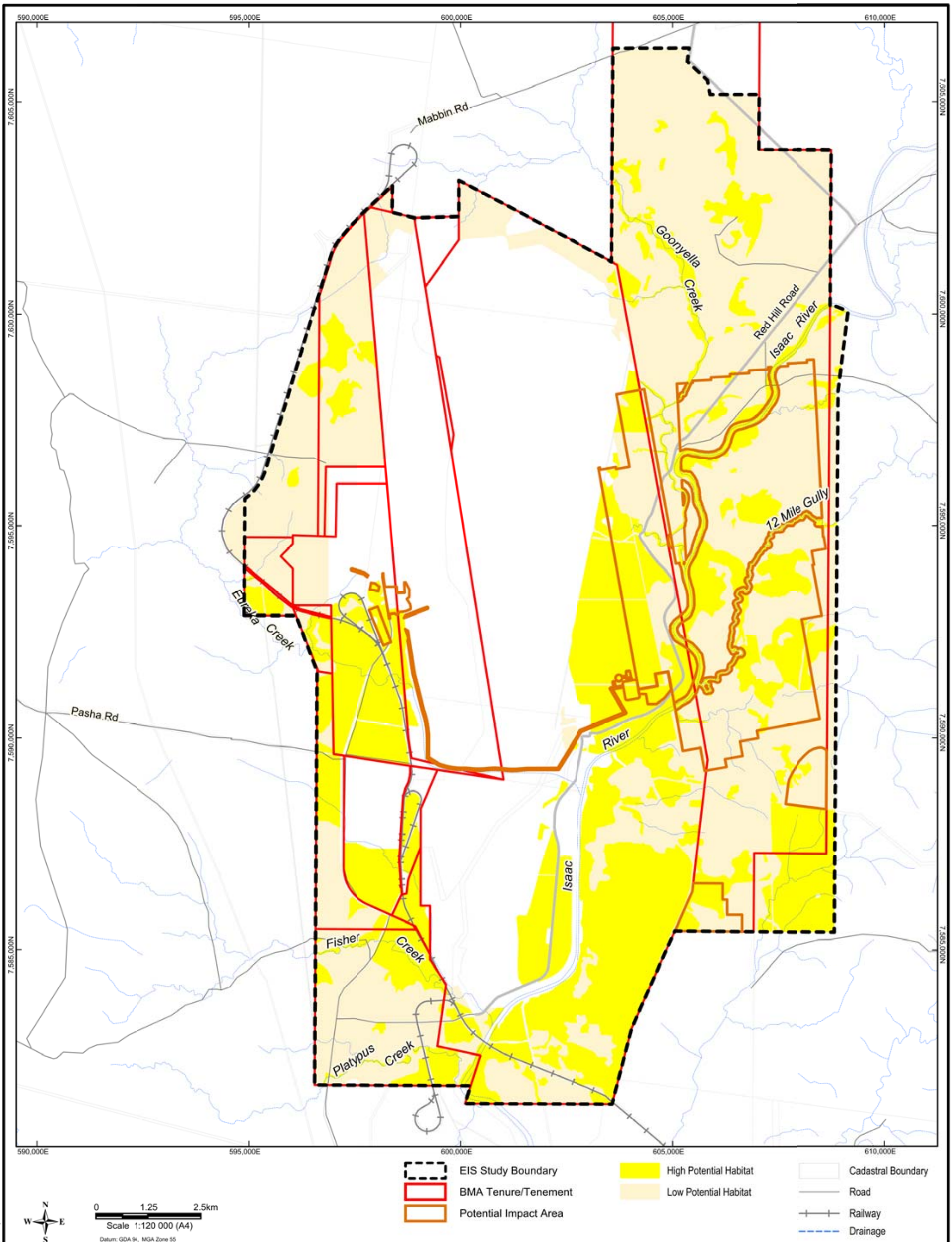
The little pied bat would forage in wetland, grassland and shrubland REs and regrowth and non-remnant communities. These have been used to identify Low Potential Habitat.

All other areas (mine areas) are within the Generally Not Suitable Category.

Potential habitat mapping criteria for the little pied bat are presented in **Table 8-6**. Potential habitat mapping is depicted on **Figure 8-3**.

Table 8-6 Potential Habitat Mapping Criteria for the Little Pied Bat

Habitat Category	Criteria
High Potential Habitat	REs 11.3.1 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.7, 11.3.25, 11.3.36, 11.4.2, 11.4.7, 11.4.8, 11.4.9, 11.5.3, 11.5.9, 11.5.16, 11.7.1, 11.7.2, 11.9.1
Low Potential Habitat	All other REs and regrowth and non-remnant vegetation
Generally Not Suitable	All other mine areas.



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LITTLE PIED BAT POTENTIAL HABITAT MAPPING

URS

ECOLOGY

Figure: 8-3

File No: 42627373-g-2276.wor | Drawn: VH | Approved: CT | Date: 30-09-2014 | Rev. A | A4

8.7.3.4 Koala (*Phascolarctos cinereus*)

Status

NC Act: Vulnerable (south-east Queensland bioregion); Special Least Concern (elsewhere).

EPBC Act: Vulnerable (combined populations of QLD, NSW and the ACT)

Distribution and Habitat Information

Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus Eucalyptus (Martin and Handasyde 1999 in DOTE 2014c). The distribution of koalas is also affected by altitude (limited to <800 m above sea level), temperature and, at the western and northern ends of the range, leaf moisture (Munks *et al.* 1996 in DOTE 2013c).

Within central Queensland, koalas have been studied at Tambo (Mitchell Grass Downs bioregion), Springsure and Blair Athol (both in Brigalow Belt North bioregion). Koalas in this region typically occur in low densities and have large home ranges (Ellis *et al*. 2002 in DOTE 2014c).

Threatening Processes

Koala populations are threatened by:

- habitat loss and fragmentation;
- mortality due to dog attacks and vehicle strikes;
- disease; and
- climate change and drought (DOTE 2014c).

Survey Guidelines and Field Methods

Survey guidelines for this species are presented within DOTE (2014d).

Targeted koala surveys were not undertaken as part of the field studies. Arboreal scans within potential koala habitat were undertaken, along with spotlighting and scat and scratch surveys.

Desktop Assessment Results

Ecoserve (2006) detected diagnostic tree trunk scratches and scats within the riparian zone of the Isaac River.

Field Results

A solitary koala was observed to the south-west of the EIS study area within poplar box (*Eucalyptus populnea*) woodland during a spotlighting survey.

Habitat Mapping Criteria

The single koala observed in the vicinity of the EIS study area was within poplar box (*Eucalyptus populnea*) woodland. However, the Isaac River riparian corridor is more likely to act as habitat for the koala due to the dominance of forest red gum (*E. tereticornis*), an important food tree, and to the movement opportunities offered by the corridor itself.

High potential habitat for the koala consists of RE 11.3.25 along waterways within the study area. This is consistent with McAlpine *et al.* (2006) who define Primary Habitat as ‘areas of forest or woodland where primary koala food tree species comprise at least 50 per cent of the overstorey trees’.

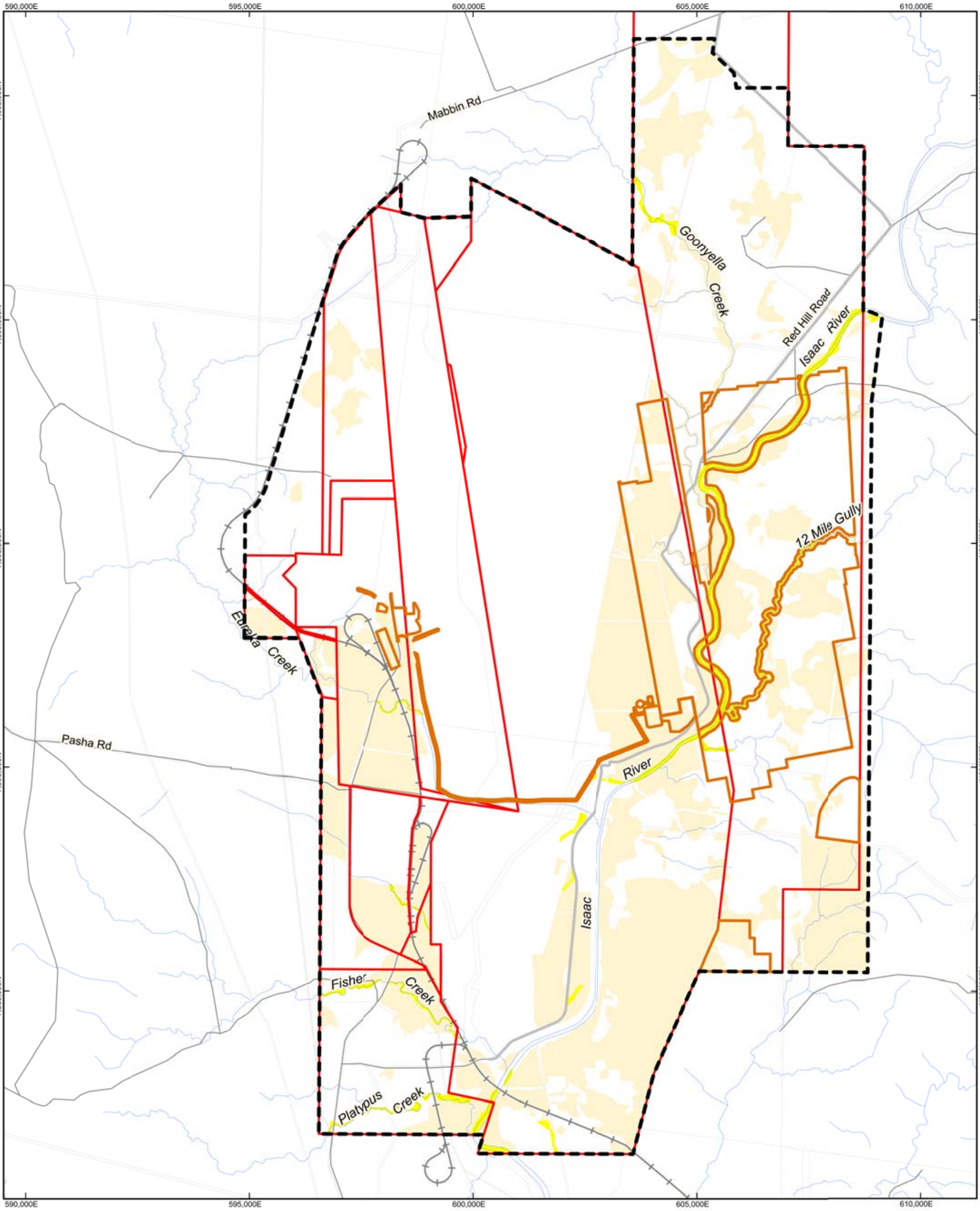
Low Potential Habitat comprises all other remnant vegetation. This vegetation would act as secondary habitat and for koala dispersal and movement throughout the landscape.

The Generally Not Suitable category comprises mine areas, native grassland, regrowth and non-remnant vegetation.

Potential habitat mapping criteria for the koala are presented in **Table 8-7**. Potential habitat mapping is depicted on **Figure 8-4**.

Table 8-7 Potential Habitat Mapping Criteria for the Koala

Habitat Category	Criteria
High Potential Habitat	RE 11.3.25
Low Potential Habitat	All other REs
Generally Not Suitable	All other mine areas, native grassland, regrowth and non-remnant vegetation.



EIS Study Boundary
BMA Tenure/Tenement
Potential Impact Area
High Potential Habitat
Low Potential Habitat
Cadastral Boundary
Road
Railway
Drainage

N S W E

0 1.25 2.5km

Scale 1:120 000 (A4)

Datum: GDA 94, MGA Zone 55

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KOALA POTENTIAL HABITAT MAPPING

URS

ECOLOGY

Figure: **8-4**

File No: **42627373-g-2277.wor** Drawn: **VH** Approved: **CT** Date: **30-09-2014** Rev. **A** A4

8.7.4 Potential impacts based on the potential habitat mapping

Potential impacts to the squatter pigeon, brigalow scaly-foot, little pied bat and koala could eventuate as a result of the following project components:

- development of the RHM, including clearing for IMG infrastructure and subsidence;
- direct clearing for surface facilities (industrial area, accommodation village, conveyor and CHPP); and
- subsidence at the BRM panels extensions.

Table 8-8 details the approximate areas of potential habitat impacted by each of the project components for each species.

Table 8-8 Potentially Impacted Habitat Areas for the Squatter Pigeon, Brigalow Scaly-foot, Little Pied Bat and Koala

Species	Potential Habitat Category	Approximate Potential Impact Areas (ha)			Approximate Total Area (ha)
		RHM	Surface Facilities	BRM panel extensions	
Squatter pigeon	High Potential Habitat	193	59	-	252
	Low Potential Habitat	2,238	274	100	2,612
Brigalow scaly-foot	High Potential Habitat	1,374	232	72	1,678
	Low Potential Habitat	420	92	-	512
Little pied bat	High Potential Habitat	1,374	232	72	2,612
	Low Potential Habitat	2,412	110	75	2,597
Koala	High Potential Habitat	131	3	-	134
	Low Potential Habitat	1,478	229	72	1,779

8.7.4.1 Squatter pigeon

The potential habitat mapping developed for this report identifies that approximately 252 hectares of high potential habitat and 2,612 hectares of low potential habitat for the species may be impacted by the project. However, this is likely to be an over-estimation of impacts to potential habitat as most records for the squatter pigeon within the EIS study area are concentrated in an area in the south-eastern sector of the study area to the east of Ramp 4 (Ecoserve 2005, 2006; WBM 1998, 2000, 2002; URS 2005, 2009, 2011). Therefore, a large proportion of the project footprint appears to be unutilised or underutilised by the squatter pigeon.

Breeding and foraging habitat forms high potential habitat for the squatter pigeon. The greatest short-term impact to the squatter pigeon is the loss of breeding habitat from clearing, as breeding pairs could be required to relocate to suitable habitat. Suitable breeding habitat for the squatter pigeon is found outside of the study area and these areas have the capacity to act as refuge in the short term. Observed feeding behaviour includes foraging in disturbed areas and on farm tracks. These areas are plentiful and as such feeding resources for the squatter pigeon will not be threatened. Subsidence is not likely to impact the squatter pigeon as their habitat requirements will not be affected.

A range of mitigation measures have been developed to minimise impacts to the squatter pigeon. These are presented in EIS Terrestrial Ecology Section 9.8 and the EIS Appendix Q2 EPBC Report Section 8.3. The implementation of the mitigation measures as described should reduce residual impacts to an insignificant level.

8.7.4.2 Brigalow scaly-foot

The potential habitat mapping analysis shows that 1,678 hectares of high potential habitat and 512 hectares of low potential habitat for the brigalow scaly-foot could be impacted by the project. However, given the lack of specimens captured since 1998 and the paucity of records from the region, it is likely that this potential habitat area is greatly exaggerated and actual habitat usage on site is much smaller. Subsidence should not impact the brigalow scaly-foot as its habitat resources will not be affected. The species may actually utilise subsidence-related soil cracks for shelter.

A range of mitigation measures have been developed to minimise impacts to the brigalow scaly-foot. These are presented in the EIS Terrestrial Ecology Section 9.8. The use of spotter-catchers during clearing activities will reduce the opportunity for impacts to the brigalow scaly-foot. The implementation of the mitigation measures as described should reduce residual impacts to an insignificant level.

8.7.4.3 Little pied bat

The potential habitat mapping exercise identified approximately 2,612 hectares of high potential habitat and 2,597 of low potential habitat for the little pied bat. This is likely to be an overestimation as only a small proportion of the identified potential habitat (i.e. a number of trees) within the study area could be actually used by the little pied bat for roosting. The Action Plan for Australian Bats (Environment Australia 1999) notes that loss of mature roost trees in inland areas, particularly in riverine environments, may result in loss of roost sites in some areas. As impacts to the Isaac River riparian corridor are to be minimised, roost sites in RE 11.3.25 should be retained.

Feeding habitat is broad and includes remnant, regrowth, pasture and disturbed environs. Therefore, ample feeding habitat will be available. Should trees containing roosts of the little pied bat be impacted by subsidence (e.g. leaning or falling), they may be abandoned. In this case, alternative suitable roost trees are found throughout the study area. Otherwise subsidence should have little impact on this species.

A range of mitigation measures have been developed to minimise impacts to the little pied bat. These are presented in the EIS Terrestrial Ecology Section 9.8. The implementation of the mitigation measures as described should reduce residual impacts to an insignificant level.

8.7.4.4 Koala

The potential habitat mapping developed for this report identifies that approximately 134 hectares of high potential habitat and 1,779 hectares of low potential habitat for the koala may be impacted by the project. The core potential koala habitat is within the riparian corridor of the Isaac River and other watercourses that support RE 11.3.25. Although BMA is seeking approval for up to 100 per cent clearance, impacts to the Isaac River riparian corridor are to be minimised. Subsidence could potentially impact individual trees within the Isaac River riparian corridor. However, this should not affect the species on the whole.

A range of mitigation measures have been developed to minimise impacts to the koala. These are presented in the EIS Terrestrial Ecology Section 9.8 and the Appendix Q2 EPBC Report Section 8.3. The implementation of the mitigation measures as described should reduce residual impacts to an insignificant level. Despite the likely insignificant residual impacts post impact mitigation, BMA will incorporate offsets for the impacted vegetation that comprises Koala habitat as part of the offset strategy in **Appendix B**.

8.8 Cumulative Impacts

Section 21.3.5 of the EIS provides a description of the potential cumulative impacts on terrestrial ecology values from a range of other proposed projects in the region, including:

- Eaglefield Coal Mine Expansion- Peabody;
- Ellensfield Coal Mine Project – Vale;
- Grosvenor Coal Mine Project – Anglo Coal;
- New Lenton Coal Mine Project – New Hope;
- Eagle Downs Coal Mine Expansion – Aquila;
- Caval Ridge Coal Mine Project – BMA (now operational);
- Daunia Coal Mine Project – BMA (now operational);
- Millennium Coal Mine – Peabody;
- Moranbah South Project – Anglo Coal and Exxaro Australia Pty Ltd.;
- Connors River Dam and Pipeline – Sunwater;
- Goonyella to Abbot Point Rail Expansion Project – Aurizon;
- Bowen Gas Pipeline – Arrow Energy; and
- Bowen Gas Project – Arrow Energy.

Some of these projects may have overlapping construction phases with the proposed RHM Project. The published impacts of the Eaglefield Coal Mine Expansion, Ellensfield Coal Mine Project, Grosvenor Coal Mine Project, Eagle Downs Coal Mine Expansion, Caval Ridge Coal Mine Project, Daunia Coal Mine Project, and Millennium Coal Mine combine to a total of approximately 3,500 hectares of remnant vegetation to be cleared. This represents 0.4 per cent of remnant vegetation within the subregion. This estimate includes approximately 940 hectares of EPBC-listed TECs, endangered REs or of concern REs. Given the similarity in environment of the other mining projects considered in the cumulative assessment, and the proximity of most of these projects to each other, it is expected that the TECs impacted by their development will be similar to those impacted by the RHM Project.

The current method for estimating potential impacts on EPBC-listed flora and fauna species for individual projects is to undertake potential habitat mapping for each species. As not all of the project studies have included this type of assessment, comparison of impacts between projects is not possible. However, as with the TECs, it is likely that habitats across all projects hold similar values as those found at Red Hill for EPBC-listed flora and fauna species.

Section 9 Aquatic Ecology

9.1 Submissions

This section responds to submissions from the following:

- Department of Environment and Heritage Protection
- Department of the Environment

9.2 Context of Proposed Releases

As indicated in Appendix K3 (Aquatic Ecology) of the EIS, the Isaac River and its tributaries are highly ephemeral sustaining flows for only short periods of time after substantial rain events. Biota that are sustained in standing pools over the dry season are naturally resilient against deteriorating water quality, given that levels of salinity and other nutrients reach high levels as water in these standing pools evaporates. In-situ water quality results from field studies undertaken during the dry season (May 2011) (EIS Appendix K3 Aquatic Ecology) indicated elevated EC at some sites unaffected by mining.

Notwithstanding the above, mine water generated by the project will be managed by the existing GRB mine water management system the releases from which are conditioned by the current EA for the GRB mine complex (EPML008853413). The discharge of mine-affected water from the GRB mine complex is conditioned by flows in the Isaac River (Table W4 of EA), mine-affected water quality (Table W2 of EA), and trigger levels of the receiving environment designed to protect the identified environmental values, including aquatic ecology.

As discussed in **Section 5.13** above, the GRB complex is part of the Fitzroy Basin Pilot Mine Water Release Scheme, which was established during the 2012/2013 wet season. The GRB complex is one of seven coal mines which met the eligibility criteria to also participate in the 2013/2014 coal mine water release pilot. The scheme was developed in response to adverse effects on the productivity of a number of coal mines in the Fitzroy Basin as a result of the retention of excess water since the 2008/2009 wet season.

The pilot scheme was structured to provide for improved release opportunities whilst maintaining a controlled and managed form of release. The 2013/2014 release pilot is supported by an operational policy and guideline which sets out the requirements for mines to participate. The policy provides protection to local EVs such as stock, domestic and irrigation water supplies located downstream of mine water release points through the requirement for mines to conduct a detailed assessment on the localised impacts of these releases. The policy also specifies acceptable water quality limits for downstream locations that are subject to cumulative impacts from mine-affected water.

As part of the scheme an amended EA was issued for the GRB mine, incorporating a modified downstream limit on EC within the Isaac River and other receiving waters, as well as changes in the flow rate triggers defining the commencement and cessation of release events. As a result of the pilot scheme, an Enhanced Environmental Monitoring Program was developed and implemented to ensure that water quality in the Fitzroy catchment is suitable for drinking and other downstream uses.

The participation of GRB mine complex in the 2012/13 coal mine water release pilot confirmed that mine-affected water discharged under its EA had no significant impact on the water quality of the receiving environment. A recent report detailing the effectiveness of the 2012/13 pilot mine water release scheme (Gilbert & Sutherland and Marsden Jacob Associates 2013) concluded that:

- mine operators' managed releases within all required regulatory flow and water quality limits of their EA conditions; and
- there were no measured effects on salinity levels from downstream of Isaac/ Connors confluence.

Indeed, the authors of this report made a significant point of note that based on their assessment, basin and catchment-scale salinity behaviour within the Fitzroy Basin appears characterised by diffuse sources of salts, potentially both natural in origin as well as influenced by previous and current catchment management practices.

As discussed in **Section 5.20.2**, the water balance modelling undertaken for the EIS (Appendix I3 EIS; Mine Water Balance) indicated that the existing GRB mine water management system has sufficient total storage capacity to manage extreme wet periods, and this will continue to be the case when the project's water is included. The project will not adversely impact on the ability of the GRB mine water management system to comply with the existing EA conditions which will continue to be complied with following inclusion of the project. Hence the project will not affect downstream water quality and the associated aquatic ecology values.

9.3 Environmental Values

Environmental values (EVs) for the receiving environment (for local scale, Isaac River main channel and the Isaac River northern tributaries) are detailed in Section 2.2 of EIS Appendix I8, as Table 2-1. This table is reproduced below as **Table 9-1**. EVs for the Isaac River main channel and northern tributaries were obtained from Schedule 1 of the EPP (Water) 2009[1]. Local scale EVs were identified by assessing the scheduled catchment EVs in context of the current dominant land activities (i.e coal mining).

Potential impacts on these EVs from the Project are discussed in Section 5 of EIS Appendix I8.

Water quality objectives were derived for the protection of aquatic ecosystem environmental values, and are outlined in Section 4.1 of EIS Appendix I8. They include objectives from Schedule 1 of the EPP (Water), ANZECC 2000 guidelines, and local reference data. The WQOs were also aligned with the findings of the ACARP report (2012). For example, the recommended value of 2,000 µS/cm for EC will provide protection for more than 95 per cent of aquatic species, in accordance with the findings for ecotoxicity of the Artificial Mine Water Solution 1 applied in the ACARP study (where 2.433 mS/cm (or 2,433 µS/cm) was identified as the EC concentration at which 95 per cent ecosystem protection could be achieved).

The WQOs for the protection of aquatic ecosystems are more stringent than guidelines for the protection of other EVs, such as stock watering. As a result, compliance against these WQOs will ensure protection of all EVs relevant to RHM. The EC limit included in the GRB mine EA was sourced from the ACARP study and is designed for the protection of aquatic ecosystem environmental values.

[1] Department of Environment and Heritage Protection 2011. *Environmental Protection (Water) Policy 2009 Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No 130 (part), including all waters of the Isaac River Sub-basin (including Connors River)*. September 2011 (Re-published in July 2013).

Table 9-1 Environmental Values for the Receiving Environment

Environmental Values	Local Scale	Isaac River main channel – developed areas	Isaac Northern tributaries – developed areas
Aquatic Ecosystem Environmental Values			
Protection of high ecological value aquatic habitat	×	×	×
Protection of slightly to moderately disturbed aquatic habitat	✓	✓	✓
Protection of highly disturbed aquatic habitat	×	×	×
Human Use Environmental Values			
Suitability for crop irrigation	×	×	✓
Suitability for farm use	×	✓	✓
Suitability for stock watering	✓	✓	✓
Suitability for aquaculture	×	×	×
Suitability for human consumers of aquatic food	×	×	✓
Suitability for primary contact recreation (e.g. swimming)	×	✓	✓
Suitability for secondary contact recreation (e.g. boating)	×	✓	✓
Suitability for visual (no contact) recreation	✓	✓	✓
Suitability for drinking water supply	×	×	✓
Suitability for industrial use (including manufacturing plants, power generation)	×	✓	✓
Protection of cultural and spiritual values	✓	✓	✓

9.4 Water Quality Sensitivity Scoring

The implications of using SIGNAL2 and SIGNAL95 to assess a site's status in terms of water quality have been detailed in EIS Section 10.1.5. SIGNAL2 considers pollution sensitivities from a wide range of settings to arrive at a particular sensitivity score. SIGNAL95 can be used as a support for SIGNAL2 when characterising a site. SIGNAL95 and SIGNAL2 provide different views of the data and together provide for an interpretation of water quality from observed biota. They are essentially two separate (although similar) scoring systems. They are commonly used together by aquatic ecologists.

9.5 Survey Methodology

The most recent aquatic ecology survey was conducted in May 2011. Other aquatic ecology surveys of the GRB mine complex area were undertaken during 1998, 2000 and 2005 by WBM and by URS in 2009. These previous results have been used to provide greater context and background to support the findings of the 2011 study.

The ecological values of the EIS study area are considered typical for the altered Isaac River sub-catchment, with large areas of land historically cleared for grazing. Although some areas of remnant vegetation remain intact, most have been modified to some extent by historical and current land management practices. The ephemeral streams within the study area including the Isaac River and 12 Mile Gully also exhibit impacts from the historical management of vegetation with a much reduced riparian strip and alterations to vegetation community structure and floristics. Additionally, prior to catchment clearing and subsequent erosion, the Isaac River had been described as having large reedsurrounded pools (Leichhardt 1847). There is currently no permanent stream water within the study area.

The 2011 report satisfactorily describes the aquatic environment in light of the ephemerality of the streams and altered in-stream conditions and subsequent reduction in opportunities for aquatic fauna and flora assemblages.

9.6 Impacts of Subsidence on Aquatic Ecology

Streams within the study area, including the Isaac River and 12 Mile Gully, are ephemeral. Apart from short periods of flow and temporary retention of water in small pools, there is no opportunity for aquatic fauna and flora to become permanently established.

At the time of exploration and settlement, the Isaac River was noted to feature large pools. These have long since filled in as sediment released from clearing activities in the catchment has mobilised into the waterways. This modification predated mining by many decades.

Underground mining has previously caused subsidence and it is expected that the project will also result in some subsidence of the surface landform. Where subsidence intersects with watercourses such as the Isaac River and 12 Mile Gully, depressions in the stream bed may result. Water flows will fill these depressions following sustained rain in the catchment. The depth of the pools relative to the riffles means they will withstand evaporation longer and will retain water for some time after flows cease. It is within these pools that aquatic life may be sustained for a short period. The period of water retention will depend on:

- depth of pool;
- volume of flow to fill pool;
- seasonal variation of evaporation rate;
- degree of shading of pool;
- permeability of substrate; and
- instances of repeat flows.

Nevertheless, the pools created will be ephemeral and would not be expected to survive the dry season.

A range of vertebrate and invertebrate fauna will utilise the pools while they exist and employ various mechanisms to colonise newly formed aquatic habitat.

Fish such as the bony bream (*Nemaralosa erebi*) and spangled perch (*Leiopotherapon unicolor*) take advantage of flows to rapidly seek new habitat. Crustaceans such as freshwater crayfish (*Cherax spp*.) burrow into the bank or substrate and seal the burrow with a mud chimney when water dries up (MDFRC 2013). They will then emerge when water refills the pool. Insects will generally take advantage of the arrival of water to breed and lay eggs. Burrowing frogs such as the ornate burrowing frog (*Platyplectrum ornatum*) burrow into sand during dry spells and emerge during rain.

Due to the ephemeral nature of the pools, habitat created is temporary and many of the fauna species have a limited lifespan; any fish trapped in the pool will die as the water dries up. Frogs and crayfish will retreat to the substrate. Over time, sediment transported downstream will fill the pools and the Isaac River will again have reduced aquatic habitat.

Section 10 Offset Strategy

10.1 Submissions

This section responds to submissions from the following:

- Department of Environment and Heritage Protection
- Department of Natural Resources and Mines
- Department of the Environment

10.2 Development of an Offset Strategy

BMA is committed to reducing potential impacts on biodiversity values through avoidance and mitigation measures, with offsets employed as a secondary measure to mitigate residual impacts. Due to uncertainties associated with IMG design and the degree of subsidence impacts on vegetation, BMA has developed a staged offset approach that accounts for actual losses, manages unavoidable losses and incentivises avoidance to protect environmental values.

BMA has completed an offset strategy for the project in accordance with the *Queensland Environmental Offsets Act 2014* and the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy, October 2013* (**Appendix B**). The offset strategy details relevant commitments and mitigation measures that will be taken to avoid and minimise impacts, identifies disturbance areas to biodiversity values, and provides evidence that there are opportunities within the region to offset estimated losses. Potential residual impacts for the project are quantified in the offset strategy.

The offset strategy also outlines the steps required to be undertaken prior to the start of each project stage and includes an assessment of offset requirements and associated ecological equivalence surveys to be undertaken. The offsets approach for each project stage includes the following steps:

- Estimate disturbance and undertake ecological equivalence – estimate area of disturbance on biodiversity values. Undertake ecological equivalence assessments of potentially impacted biodiversity values to inform the Biodiversity Offset Management Plan.
- Prepare Offset Management Plan – suitable offset areas which meet criteria for the specific environmental value will be identified. Offset areas will be sought for the maximum disturbance area pertaining to the relevant development stage.
- Deliver offsets and reconcile impacts – offset areas will be delivered following approval of Biodiversity Offset Management Plan from Commonwealth and State regulators within the agreed timeframe. Actual impacts associated with previous development stages will be determined and reconciled against estimated disturbances and the balance accrued against the values actually offset.

Timing of delivery for the Biodiversity Offset Management Plan will be determined following discussions with relevant regulatory agencies.

Section 11 Land

11.1 Submissions

This section responds to submissions from the following:

- Powerlink
- Department of Natural Resources and Mines
- Isaac Regional Cuncil
- Department of Environment and Heritage Protection

11.2 Soils and Land Suitability

The land suitability assessment described in the EIS was undertaken in accordance with the *Land Suitability Assessment Techniques* (1995). This document cites the work undertaken by Shields and Williams in 1991 as a methodology of assessment, in particular the criteria used. The *Land Suitability Assessment Techniques* (1995) notes that the criteria used are necessarily general to be applicable over a wide area. The 2011 assessment utilised work undertaken in 2007 (unpublished) which included a land suitability and agricultural land class assessment. The 2011 assessment supplemented this with further soil profile investigations and laboratory testing to provide a robust assessment of agricultural land value. The 2007 report included three criteria not published in the land suitability assessment guidelines. These were soil texture, soil type distribution and sodicity. The 2011 assessment factored these criteria into the 'adjusted' land suitability rankings.

Appendix F2 of the EIS shows the tabulated water availability results in Table 15 and the applicable land suitability ranking in Table 16. Upon revision of these two tables, two errors were discovered in Table 15, which influenced the resultant plant available water capacity for soil types 3a and 8a. This subsequently influenced the land suitability rankings as shown in **Table 11-1**.

The 'adjusted water availability' row in Table 16 of EIS Appendix F2 accounts for the factors not considered in the 1995 assessment techniques. These include managing these soils for risk and practicalities of undertaking cropping, based on the site conditions, the rainfall patterns, agricultural and economic risks. The need for consistent land suitability techniques is recognised; however, there is also a need for an additional robust review and adjustment of the key parameters when the theoretical based thresholds do not reflect the on-ground constraints. Therefore the 'adjusted available water' has been added to provide such an assessment.

Table 11-1 shows the land suitability rankings for the various soil types, without the 'adjusted available water' row. The results of this assessment show the following soil types as highly suitable for rainfed cropping without long term environmental risks and with high probability of successful crops and returns.

3b - Brown Kandasol

The description below highlights the requirement of an 'adjustment' to the land suitability criteria. This is to account for topography which may be unsuited to cropping ventures, and moderate to high dispersion below 15 cm, which if placed under a regular cropping regime, could lead to tunnel erosion and subsoil structure decline. See section 3.2.5 of EIS Appendix F2 for detailed description.

Description: The Brown Kandosol soils comprise deep (>1 m) mainly massive yellow-brown earths with sandy loam to light clayey surface soils grading to light to medium or heavy clay subsoils, locally with ferruginous gravelly layers included. The topsoil is typically slightly to moderately dispersive, non-saline, though in some instances slightly saline, and mainly neutral to slightly acidic. The subsoils are moderately to strongly dispersive, generally non-saline, with some slightly to moderately saline soils present, and mildly to moderately alkaline.

Location: This soil type occurs on gently inclined slopes to drainage lines, on flat to depressional plains, in depressional drainage ways and on gently inclined broadly rounded interfluves and low rises.

Land Use: The land overlying these soils is currently used for extensive grazing, having been previously cleared of trees, cultivated and improved with native and exotic pasture species.

5 – Brown Chromosol

The description below and the soil information in Section 3.2.7 of EIS Appendix F2 show this soil to be well suited to grazing within the region. The location of these soils on alluvial terraces, broadly rounded rises and dissection slope interfluves shows the topography may not be suitable for regular cropping given the gradients and potential for channelled surface water erosion and flooding in high storm events common in this region. The soil also displays a potential drainage issue with a bleached A2 horizon and diffuse mottling. The subsoil within this unit also includes some strongly dispersive material which can limit crop yield and increase erosion risk under a cropping regime.

Description: The Brown Chromosol soils include deep (>1 m) mostly thick sandy and loamy surface duplex soils generally with a pale (A2) horizon over brown or yellow-brown, sometimes diffusely mottled non-sodic to marginally sodic, non-saline sandy clay or medium to heavy clay subsoils. The topsoil is structurally stable with a low potential for dispersion. The majority of topsoil is non-saline although it can be slightly saline and is slightly acidic to moderately alkaline. The subsoil varies from slightly dispersive to strongly dispersive, is generally slightly to non-saline, although occasionally moderately saline, and is neutral to slightly alkaline pH value. The analytical information of the representative site for this soil type is presented in Table 7 of EIS Appendix F2.

Location: These soils occur on alluvial terraces and on broadly rounded rises and dissection slope interfluves, common throughout the eastern areas of the EIS study area, encompassing an area of 1861.2 hectares, or 15.1 per cent of the EIS study area as shown in Figure 3 of EIS Appendix F2. This soil type is represented by C82 and C121.

Land Use: The land overlying these soils is currently used for extensive grazing, having been previously cleared of trees, cultivated and improved with native and exotic pasture species.

6 – Brown Sodosol

This soil unit is not suited to cropping for various reasons, despite fulfilling the land suitability assessment criteria to the contrary. The description below highlights the high risks associated with exposing the sodic and dispersive subsoil to surface water, including erosion from channelised and subsurface flows, and low crop yield. Salinity varies within this soil unit and can include moderate to high salinity subsoils as described below.

Description: The Brown Sodosol soils comprise medium to deep hard-set thin loamy surface duplex soils usually with a pale or bleached sub-surface (A2) horizon with dark brown, yellowish-brown and in places reddish-brown, light medium to heavy clay deep subsoils. The topsoil is non-dispersive to moderately dispersive, is generally moderately saline, and the topsoil was generally neutral, or in some instances moderately acidic. The subsoils are generally highly sodic and dispersive, moderately to highly saline, and moderately acidic to moderately alkaline.

Location: These soils occur on alluvial flats, back-plains and older alluvial plains, on gently inclined plains, gently undulating rises dissection and on slope interfluves and slopes to drainage, encompassing an area of 1933.7 hectares, or 15.7 per cent of the EIS study area as shown in Figure 3 of EIS Appendix F2. This soil type is represented by site B40.

Land Use: The land overlying these soils is currently used for extensive grazing, having been previously cleared of trees, cultivated and improved with native and exotic pasture species.

8b – Deep Vertosols

These soils were considered marginal in the adjusted Land Suitability ranking given the high fertility and water holding capacity. Previous work (2007) included 8a, 8b and 8c in land suitable for cropping. However, while 8b has limited constraints, soil 8a has shallow depth constraints and 8c has plant available water capacity constraints based on salinity. These constraints vary across the site. The assessment took into account the available soil profile data and laboratory analysis. Vertosols can have high buffering capacities and characteristics that reduce the impact of typically high values of salinity and soil depth. Colloquially they are very forgiving soils that have the ability to produce high yields despite some limiting factors. The description of Soil 8b is outlined below.

Description: Vertosols are characterised by deep (>1 m) cracking clay soils with a thin weak self-mulching surface soil over dark brown or brown strongly structured mostly sodic heavy clay subsoils, tending to massive, strongly sodic, often calcareous heavy clay in the deeper subsoils. The topsoil is mainly nondispersive, occasionally moderately dispersive. It varies from non-saline to moderately saline and is slightly acidic to slightly alkaline. The subsoils are generally non-dispersive to moderately dispersive, moderately saline to extremely saline, and neutral to moderately alkaline. The key characteristics of the Vertosols are their uniform medium to heavy clay texture throughout the profile, pronounced swelling and shrinkage properties on wetting and drying. The Deep Vertosols are widely associated with gilgai micro relief.

Location: This soil type occurs extensively, mainly in the northern sector of the EIS study area. It comprises drainage lines, drainage flats and alluvial plain, on near level older alluvial plains and gently undulating plain, and on gently inclined slopes, foot-slopes and low rises. It encompasses an area of 589.2 hectares, or 4.77 per cent of the EIS study area, as shown in Figure 3 of EIS Appendix F2. This soil type is represented by observation point A10.

Land Use: The land overlying these soils is currently used for extensive grazing, having been previously cleared of trees, cultivated and improved with native and exotic pasture species.

Table 11-1 Revised Land Suitability Rankings for Rainfed Broadacre Cropping using Shields and Williams assumptions

Limitations	Soil Types										
	1	2	3a	3b	4	5	6	7	8a	8b	8c
Tabled Water availability	n/a	5	5	2	5	1	1	5	5	1	5
Nutrient deficiency	n/a	n/a	2	3	2	2	2	5	2	2	2
Soil physical factors	3	2	2	2	3	3	3	3	2	3	3
Soil workability	2	1	1	1	2	2	2	2	1	2	2
Salinity	n/a	n/a	1	1	5	1	1	4	1	1	1
Rockiness	4	1	1	2	2	1	1	1	1	1	1
Microrelief	1	1	1	1	1	1	1	1	1	3	3
Wetness	1	1	1	1	1	3	2	1	2	3	3
Topography	1	1	2	2	1	2	3	1	1	1	1
Water erosion	4	2	2	2	3	2	3	2	2	2	2
Flooding	1	2	1	1	1	1	1	1	1	1	1
Overall Ranking:	4	5	5	3	5	3	3	5	5	3	5
Soil Type Suitable?	No	No	No	Yes	No	Yes	Yes	No	No	Yes	No

Plant water availability has been reassessed according to Shields and Williams (1991) Land Resource Survey of the Kilcummin Area and results are presented in **Table 11-2**.

Table 11-2 Plant Available Water Capacity – Revised Calculations

Soil Unit	Horizon	Limitation/s	Average ERD Depth (cm)	Average AWC (mm)	Average PAWC (mm)
1. Lithic Rudosol	1	-	n/a	n/a	n/a
		Total	**0**	**0**	**0**
2. Tenosol	1	none	40	64	64
	2	6	40	64	0
		Total	**80**	**128**	**64**
3a. Red Kandosol	1	None	20	48	48
	2	3 (ESP 21)	40	52	0
	3	3 (ESP 102)	40	96	0
		Total	**100**	**196**	**48**
3b. Brown Kandosol	1	none	30	48	48
	2	none	50	80	80
		Total	**80**	**128**	**128**
4. Brown Kurosol	1	none	15	19.5	19.5
	2	none	15	19.5	19.5
	3	1, 2, 3	30	36	0
	4	1, 3, 4	50	60	0
		Total	**110**	**39**	**39**
5. Brown Chromosol	1	none	15	30	30
	2	none	25	50	50
	3	none	60	78	78
		Total	**100**	**158**	**158**

Soil Unit	Horizon	Limitation/s	Average ERD Depth (cm)	Average AWC (mm)	Average PAWC (mm)
6. Brown Sodosol	1	none	25	50	50
	2	none	25	50	50
	3	none	40	52	52
		Total	**90**	**152**	**152**
7. Brown Dermosol	1	none	10	13	13
	2	none	20	26	26
	3	1, 2, 3	90	117	0
		Total	**120**	**156**	**39**
8a. Shallow Vertosols	1	none	20	24	24
	2	none	20	24	24
	3	Weathered Rock	60	72	0
		Total	**100**	**120**	**48**
8b. Deep Vertosols	1	none	20	26	26
	2	none	40	52	52
	3	none	50	65	65
	4	none	60	78	78
		Total	**170**	**221**	**221**
8c. Deep Salic Vertosols	1	3	15	19.5	0
	2	3	30	39	0
	3	3	75	97.5	0
		Total	**120**	**156**	**0**

The land suitability assessment for the EIS project area shows an understanding and appreciation of the practical constraints to employing a regular cropping regime on the land and soil types within the area. According to Shields and Williams (1991) the likelihood of cropping success for land suitability Class 3 is between 40 per cent and 70 per cent. This means that the four soil types classed as 'suitable' for rainfed cropping as listed above will provide a successful crop between 40 per cent and 70 per cent of the time.

The adjusted land suitability ranking has accounted for these risks, based on a detailed assessment of the topography, climate and soil types within the project area. Allowing for a correction of Soil 8a in Table 15 of EIS Appendix F2, the assessment found that only the 8b Deep Vertosols of the northern section of the project area are marginally suitable for successful rainfed cropping enterprises.

The original land suitability assessment (including Figures 9 and 10 of EIS Appendix F2), which included an adjusted land suitability ranking, is supported. A revised land suitability assessment has been provided (without adjustment) inclusive of further details on soil type, topography and historical and current land use data. This should be taken into account when determining land suitability for rainfed cropping.

Appendices 1, 2 and 3 of EIS Appendix F2 were not included in the EIS. These are provided in **Appendix F.**

Figures 4A, 4B, 5A, 5B and 5C of EIS Appendix F2 were not included in the EIS. These are provided in **Appendix G**.

11.3 Emerson Aggregate Test (EAT) Rating of Shallow Vertosols

In Appendix F2 of the EIS, the shallow vertosols were considered unsuitable for stripping and rehabilitation. These soils have a high clay texture content and therefore there are potential problems associated with handling, respreading onto rehabilitated land, and seed germination in dry conditions. The Emerson aggregate test did not contribute to this recommendation.

In the event of surface disturbance where the clay can be windrowed or stockpiled adjacent the disturbance all soils on site, should be pushed back over the disturbance area. The soils assessment was based on the use of shallow vertisols in other areas, including slopes that may require rehabilitation. However, the shallow vertisols are not as suitable for this purpose as those soils with a lower clay content.

11.4 Contaminated Soils

BMA is committed to conducting further investigations of potentially contaminated sites prior to disturbance. BMA will develop remediation and/or management plans to prevent inadvertent release of contaminants to the environment or exposure of workers to contaminants (commitment 23, Appendix S of the EIS).

Further investigation of site 1 (Riverside Homestead domestic waste, cattle dip and fuel storage) and site 10 (Riverside minor waste dump area) is required prior to disturbance in these areas to determine whether contaminants are present at levels exceeding Queensland draft contaminated land guidelines (Department of Environment 1998) and National Environmental Protection Measures (NEPC 2009).

A protocol for investigation of these areas adhering to the draft guidelines (Department of Environment 1998) will be developed, prior to disturbance of potentially contaminated land. This will include site inspections and a comprehensive sampling program to identify potential impacts to soils and groundwater.

If soil contamination is identified, an appropriate remediation or site management strategy will be implemented (potentially on site containment or off site disposal) (commitment 43, Appendix S of the EIS).

Appendix S of the EIS contains BMA's commitments to the identification, assessment, mitigation and management of contaminated land in the project area (commitments 23 to 48).

11.5 Power Infrastructure

BMA acknowledges that the ongoing operation of Powerlink infrastructure must not be placed at risk by mining operations and that relevant engineering and geological investigations must be completed by BMA and shared with Powerlink in advance of mining in the relevant area. Given that the RHM underground expansion option will not commence for at least several years, there is no immediate risk of any impacts on Powerlink infrastructure. Where required, relocation arrangements will be in place in advance of impacts. BMA has entered into many similar infrastructure relocation agreements in the past and there are no special circumstances in this case that would suggest a cause for concern. BMA commits to facilitate unconstrained access for Powerlink in accordance with the *Electrical Safety Regulation 2013*.

Existing and proposed infrastructure within the EIS study, including the Powerlink substation, are shown on **Figure 11-1**.

11.6 Stock Routes

DNRM advised in its submission that, in relation to the possible shifting of stock routes, the preference is for one major shift rather than several piecemeal realignments. DNRM recommended continued negotiations between IRC, BMA, and DNRM to attempt to find a practical one-stop solution for the Stock Route in the interests of economy and efficiencies for all organisations.

BMA agrees with this recommendation and has had initial discussions with the stock route administrators for the area (DNRM personnel based in Longreach and the IRC) and considers that the viability of the stock route can readily be maintained in accordance with DNRM requirements. BMA will monitor the potential impact of mining (e.g. subsidence) over time in conjunction with DNRM and the IRC.

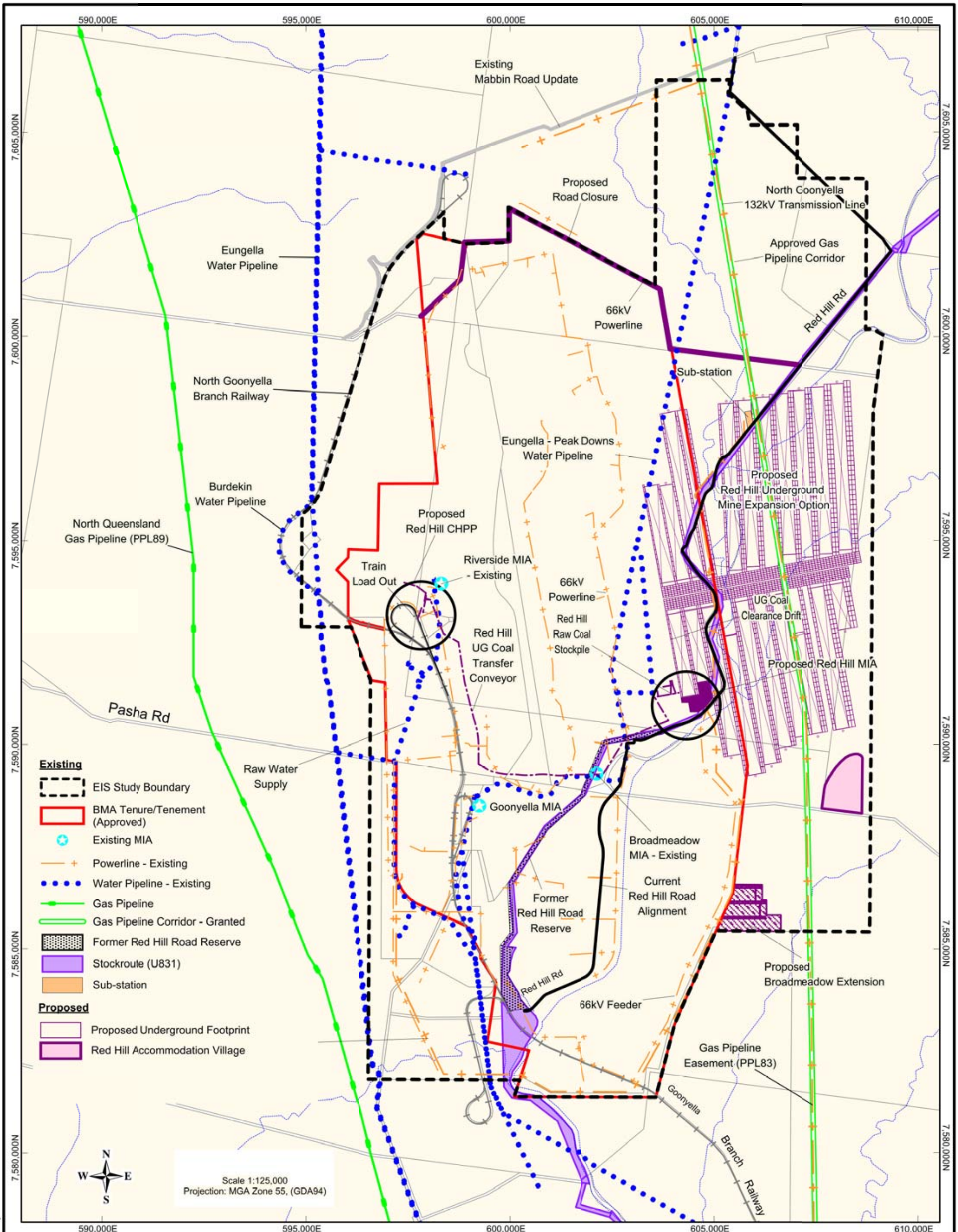
There is a risk of subsidence impacts on a 4 km section of the stock route approximately 5 years after the commencement of the RHM mining operations. The stability of fencing associated with a further 6 km of the stock route could be affected over several years from about year 14 of mining operations as modelled in the EIS.

BMA expects that any required remediation will not present any substantive challenges and BMA will rehabilitate or treat the land within or adjacent to the existing route as necessary to maintain the viability of the route through the mining leases associated with the GRB mining complex and MLA70421.

BMA is committed to identifying and implementing one realignment (as opposed to multiple minor adjustments over time) to maintain the continuous viability of the stock route.

11.7 Land Use Impacts

Field investigations undertaken in March 2011 revealed that the only land uses that may be considered sensitive land and that may be impacted by the project are homesteads and rural residences (Section 5.1.8.4 of the EIS). The project is not expected to have a direct land use impact on any urban land uses of a commercial, industrial or residential nature in Moranbah (Section 5.1.8.5 of the EIS).



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BNE

BMA
BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ADDENDUM ENVIRONMENTAL IMPACT STATEMENT

EXISTING AND PROPOSED INFRASTRUCTURE

URS

LAND

Figure: 11-1

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Section 12 Noise and Vibration

12.1 Submissions

This section responds to submissions from the following:

- Isaac Regional Council
- Department of Environment and Heritage Protection
- Department of Health

12.2 Sensitive Receptors

For the purposes of environmental noise assessment, accommodation villages associated with the development are specifically excluded from consideration as sensitive receptors. Nevertheless, since the health and well-being of accommodation residents are considered important, noise level criteria have been nominated at the accommodation villages during both the construction phase (Noise and Vibration Assessment report, Appendix M, section 4.1.2 of the EIS) and operational phase (Appendix M, section 4.2.3 of the EIS). The noise level considerations for BMA owned residential properties, including Eureka Village and the proposed Red Hill Accommodation Village, are based on sleep preservation and minimising the risk of adverse health effects (Appendix M, section 4.2.3 of the EIS).

12.3 Noise Criteria

The EIS noise assessment was undertaken in 2011 in accordance with the then current QLD EPA (now EHP) guideline “Planning for Noise Control” (2004). This guideline has since been withdrawn from EHP publications. The current EHP guidelines which include guidance for noise and/or vibration assessment are “Guideline - Mining: Model Mining Conditions” (June 2013) and “Guideline: *Environmental Protection Act 1994*: Application requirements for activities with noise impacts” (March 2013). The guideline “Model Mining Conditions” nominates standard limits for noise and blasting airblast and ground vibration which are different from those obtained by following the procedures in “Planning for Noise Control”.

In general terms and in specific regard to the Red Hill project, the ‘average’ (LAeq) noise level limits rcommended by the “Model Mining Conditions” are less stringent that those derived according to “Planning for Noise Control”, by 7 dB(A) during the strictest time period (night-time on Sundays and public holidays). Therefore undertaking the assessment according to “Planning for Noise Control” results in lower overall noise levels and associated lower noise impact.

However, the “Model Mining Conditions” seem to be designed to impose slightly stricter regulation on the release of short-term transient (L_{A1}) noise levels during more sensitive times (evenings, night-time, Sundays and public holidays) than the limit for the short-term maximum noise level (maxL_{pA}) nominated in “Planning for Noise Control”. Therefore having undertaken the assessment in accordance with the former guideline may result in slightly less protection of amenity against noise that can result in sleep disturbance. However the different assessment parameters used in the two guidelines L_{A1} and L_{Amax} are not equivalent and not directly comparable so this outcome is not certain. Additionally the “Model Mining Conditions” guideline does not restrict the frequency of occurrence of transient noise events but the former “Planning for Noise Control” guideline did (up to 15 times per night).

The “Planning for Noise Control” guideline referenced and reproduced noise level criteria for sleep disturbance recommended by the World Health Organisation in 1999. These same criteria were also reproduced in the report “The health effects of environmental noise – other than hearing loss” Commonwealth of Australia, enHealth Council (2004). The recommended limit for maximum noise levels to provide some protection against sleep disturbance given in the QLD EPA guideline is 45 dB(A) $maxL_{pA}$ internally within bedrooms up to about 10-15 times per night.

In order to assess against this criterion, the EIS assumed a conservative façade attenuation of 5 dB(A) noise reduction from outside to inside a building, based on fully open windows. This resulted in an external noise limit of 50 dB(A) L_{Amax} to protect sleep.

A report published by the World Health Organisation “Night Noise Guidelines for Europe” (2009) recommends a maximum indoor noise level of 42 dB(A) $L_{A\ max}$, indoor.

The typical façade attenuation noise reductions due to window opening given in the EPA guideline “Planning for Noise Control” are 5 dB(A) due to fully open windows and 10 dB(A) for partially open windows. These façade noise reductions are considered to be somewhat conservative and many residential buildings would commonly achieve better façade noise attenuation through windows than these values. Nevertheless, based on the typical façade attenuation due to window opening given in the guideline, the WHO 2009 guidelines would be achieved with partially closed windows or would be limited to a 5 per cent probability of sleep disturbance if windows were fully open.

12.4 Construction Activities

Although there are no explicit noise level limits for construction noise in Queensland legislation, the EIS nominated noise level criteria for the construction phase at independently owned residential properties and BMA owned residential properties. The nominated noise limits were 50 dB(A) $_{LAmax}$ (external) and 65 dB(A) $_{LAmax}$ (external) respectively. The noise level criteria were selected with the aim of providing protection for the occupants from sleep disturbance which was not assumed to be solely applicable during the night time because of the presence of shift workers in residence.

Compliance with the nominated noise level criteria during the construction phase is expected to conform with the requirements of the *Environmental Protection Act 1994* by avoiding environmental harm or environmental nuisance.

Construction will be carried out 24 hours per day, as noted in Section 13.1.1.2 of the EIS. However, as noted in Section 13.1.13.1 of the EIS, where construction noise may affect adjacent residential premises or other residential accommodation (including hotels, motels, serviced units or backpacker accommodation), it is recommended to limit the hours of construction activities to Monday to Saturday from 6.30am to 6.30pm. For construction works outside these hours, particular noise limits may be required to prevent disturbances at independently owned residential properties. No limits on construction hours are required at other locations.

12.5 Monitoring

Noise and vibration monitoring will be undertaken as and when required and directed by EHP. Details of all noise and vibration monitoring results will be provided to EHP in accordance with the EA conditions. Details of any noise or vibration complaint(s) will be provided to EHP in accordance with the EA conditions.

Section 13 Air Quality

13.1 Submissions

This section responds to submissions from the following:

- Department of Transport and Main Roads
- Department of Environment and Heritage Protection
- Department of Health
- Isaac Regional Council

13.2 Sensitive Receptors

The air quality assessment presented in the EIS considered homesteads and commercial premises, such as the Moranbah Water Treatment Plant, within 30 km of the project boundary. This complies with the project's EIS Terms of Reference (Queensland Government 2013), which requires that "*ground level predictions should be made at any residential, industrial, agricultural, commercial and community developments believed to be sensitive to the effects of predicted emissions*."

As noted in the EIS at Appendix L F.2, the EHP Model Mining Conditions, EM944 (EHP 2013a), state that the "*terms 'sensitive place' and 'commercial place' used in these model conditions do not include places that are within the boundaries of the mining lease, nor places that are owned or leased by the holder of the authority or its related companies. For example, a mining camp operated by the holder of the authority would not be a sensitive place*." This approach was followed in selecting sensitive receptors for assessment.

13.3 Air Quality Criteria

The EIS adopts a criterion of 120 mg/m^2/day for dust deposition. This is in line with the latest EHP Model Mining Conditions, EM944 (EHP 2013a), Condition B4 (a). For Total Suspended Particles, PM_{10} and $PM_{2.5}$, the EIS adopts the ambient air quality objectives set by the Queensland Environmental Protection Policy (Air). These criteria are predicted to be exceeded in the existing mining scenario presented, without a contribution from the project. The project is predicted to have little impact on air quality in the airshed (see Section 11.4.6.1 of the EIS), with no additional exceedences predicted in the future mining scenario (see Section 11.4.6.2 of the EIS).

Concentrations of particulates in both scenarios are expected to comply with the GRB mine complex EA limit for 24-hour average PM_{10} of 150 µg.m^{-3}. BMA notes that the EHP Model Mining Conditions (EHP 2013a) propose a lower criterion for new mining projects of PM_{10} of 50 µg.m^{-3} over a 24-hour averaging time, for no more than 5 exceedences recorded each year. However, the guidance document also states that model mining conditions should not be imposed on an existing project if there is no increase in impacts or only a trivial increase in impacts as a result of the change. As the project is predicted to have little impact on local air quality, it is appropriate to assess the current operations in the context of the existing EA conditions for the GRB mine complex.

13.4 Baseline Data

The EIS presents monitoring data for PM_{10} from Moranbah Airport and uses this to estimate background concentrations. The EIS also acknowledges that there are difficulties in obtaining air quality data that are not influenced by anthropogenic emission sources and that estimating background levels within the local airshed is further complicated by the fact that background levels of pollutants can be highly variable over time and at different locations. Notwithstanding this, data from Moranbah Airport represents the best baseline information currently available.

The EIS concludes that the project will have a negligible impact on air quality and this conclusion is not sensitive to the assumption on background concentrations. Selecting an alternative site would not affect the conclusions of the assessment.

13.5 Dust Emissions

The EIS addressed operational emissions of dust and set out dust reduction measures that will be considered for the project.

Potential sources of dust from the project that were identified include train load-out. Coal dust emissions may also occur during rail transport to the export port. An assessment of this source (Connell Hatch 2008) showed that it comprises dust lost due to:

- lift-off from the surface of loaded wagons;
- lift-off from spilled coal in the corridor;
- door leakage;
- parasitic load; and
- residual coal in unloaded wagons.

The most significant factor identified was coal lost from the surface of loaded wagons.

BMA currently operates in accordance with the Central Queensland Coal Dust Management Plan (QR National 2010). Mitigation measures employed include:

- partial enclosure of transfer points;
- profiling of loaded coal to reduce drag and dust lift-off; and
- spray veneering of loaded coal using binding polymer to reduce dust lift-off.

QR National (2010) concluded on the basis of a literature review and test program that surface veneering could reduce coal lift-off from the surface of loaded wagons by at least 85 per cent.

A review of programs to monitor from coal trains in Queensland (Connell Hatch 2008) found that outside the rail corridor, defined as approximately 10 m from the tracks, coal dust concentrations were below air quality objectives for the protection of human health and amenity. The data considered in the Connell Hatch report are from studies undertaken between 1993 and 2007. Since these studies were completed, mining operations in central Queensland have adopted additional measures to reduce dust emissions from coal trains, such as surface veneering. More recent studies, summarised in Katestone (2013), also found that air quality objectives were not exceeded as a result of dust emissions from coal trains. Potential impacts from this source and the cumulative impact of coal trains in the region are, therefore, expected to be negligible outside the immediate rail corridor.

13.6 Mitigation

Mitigation measures to be applied to control dust emissions are discussed at Section 11.4.3 of the EIS and Appendix L Section D.4. Operational measures to control air emissions at the GRB mine complex are contained in the GRB Complex Plan Air Emissions Management Plan (BMA 2014a). They include:

- Drilling
  - application of water spray dependent upon moisture content of drill material, water spray system mounted on drill plant and operated by drill operator.
- Blasting
  - drill pattern design;
  - scheduling of blast to avoid unfavourable weather conditions such as low level inversions, and/or wind in the direction of sensitive receptors;
  - explosive trucks calibrated to deliver the right fuel mixture when loading explosives.
- Hauling of Coal and& Overburden
  - watering of haul roads using fixed sprays or water carts;
  - sweeping of roads to avoid silt build up;
  - regular grading and gravelling of heavy traffic areas (e.g. intersections);
  - reduction of travelling speed via application of speed limits.
- Road Grading
  - watering of haul roads using fixed sprays or water carts.
- Wind Erosion (Coal Stockpiles)
  - bypassing of stockpile via direct loading;
  - reduction in stockpile height.
- Wind Erosion (Exposed Areas)
  - full rehabilitation and revegetation of exposed areas upon completion of works;
  - active planning to minimise areas of disturbance on site.
- Wind Erosion (Overburden Emplacements)
  - active planning to minimise pre- strip volumes;
  - full rehabilitation and revegetation of overburden emplacements upon completion of works;
  - maximise in-pit emplacement of overburden;
  - locate new designated overburden sites in areas less exposed to wind and weather if practical.
- Dozing
  - minimise travel speed and travel distance;
  - watering of haul roads using fixed sprays or water carts;
  - provision of in-pit dumping locations for periods of high winds, where practicable.
- Stacking of Coal
  - bypassing of stockpile via direct loading;
  - coal moisture management.

- Reclaiming of Coal
  - utilisation of water sprays e.g. bucket wheel sprays.
  - reclamation of tunnel with minimal mechanical disturbance.
- Load out of Rejects
  - rejects moisture management;
  - limit of load size to ensure rejects are not above the level of truck tray sidewalls;
  - utilisation of water sprays.
- Train Load In/Out
  - coal moisture management;
  - veneering of coal surface prior to train departure in accordance with QR network licence requirements.
- Coal Handling and Preparation Plant
  - dust suppression on coal handling equipment;
  - veneering on coal;
  - water carts on access roads;
  - monitoring of coal moisture content – monitoring conducted 2 hourly, when monitoring indicates dry product manual hosing is initiated.

Prior to construction and once the project is operational, air quality management measures will be reviewed to ensure they are adequate. However, the additional underground mining and surface infrastructure associated with the project are not expected to significantly increase emissions or result in additional exceedences of air quality objectives. Therefore there is no predicted increase in risk to human health at surrounding sensitive receivers due to impacts on air quality.

Air quality monitoring at the GRB mine complex is used to:

- assess performance against compliance with performance indicators and statutory requirements; and
- demonstrate the effectiveness of air emissions operational controls and evaluate performance against compliance with requirements and the objective of continual improvement.

Relevant procedures are set out in the GRB Mine Complex Environment Sampling & Monitoring Schedule (BMA 2014b) and include:

- dust deposition monitoring according to AS 3580.10.1-2003 Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method; and
- real time PM_{10} monitoring using a Tapered Element Oscillating Microbalance (TEOM).

Section 14 Greenhouse Gases

14.1 Submissions

This section responds to submissions from the following:

- Isaac Regional Council

14.2 Methodology

The greenhouse gas emission inventory for the project is based on the methodology detailed in the Greenhouse Gas Protocol (the protocol) (World Business Council 2004) and the relevant emission factors in the National Greenhouse Accounts (NGA) Factors (DCCEE 2011).

As noted in the EIS Section 12.1.4.6, the inventory does not consider emissions or sequestration arising from land use, land use change and forestry, such as rehabilitation and clearing. Areas to be cleared by the project are very small and are not highly forested, so the greenhouse gas emissions from land clearing or sequestration from forestry are considered to be immaterial. Other sources, such as the transport of waste were also considered to be immaterial as they were likely to constitute less than 5 per cent of the inventory.

BMA will calculate and report project emissions in line with all relevant greenhouse gas legislation in force when the project commences.

14.3 Mitigation

BMA has made commitments in Appendix S of the EIS to minimise greenhouse gas emissions from the project. These include commitments to:

- implement greenhouse gas minimisation measures and site-based programs particularly targeting:
  - electrical efficiency;
  - diesel efficiency;
  - fugitive emissions.
- determine most appropriate means to safely manage and preferably beneficially use IMG in a manner compliant with the *Mineral Resources Act 1989* and *Petroleum and Gas (Production and Safety) Act 2004*;
- consider energy efficiency in selection and design of buildings, plant and equipment including:
  - high efficiency electrical motors;
  - variable speed pumps, possibly with high-efficiency linings;
  - variable speed conveyors to match belt speeds to load.
- consider energy efficiency in personnel and material transportation methods and routes;
- minimise diesel consumption in mobile plant and for the production of stationary energy;
- participate in corporate energy efficiency and greenhouse gas reduction corporate programs and government initiatives, including:
  - energy excellence program;
  - mine methane management.

- if safe and practicable, minimise venting of goaf gas through flaring or mixing with IMG for beneficial use options;
- record diesel, electricity and other energy consumption using National Greenhouse and Energy Reporting system requirements; and
- regularly monitor the compressed air circuit so that leaks are repaired in a timely manner.

Section 15 Transport

15.1 Submissions

This section responds to submissions from the following:

- Queensland Ambulance Service
- Isaac Regional Council
- Private submitters

15.2 Emergency Services Commitments

BMA will continue to implement its existing cooperative engagement framework with local and regional emergency service providers. The BRM extension will be managed through existing GRB mine complex site arrangements.

Prior to the commencement of the RHM and GRM construction and operation, engagement with emergency service providers will advise of:

- orientation to the accommodation village and its emergency response procedures;
- the anticipated workforce build up;
- major activities which would place;
- demand on local services;
- behavioural standards; and
- communication protocols.

The project will implement the BHP Billiton Group Level Documents and company policies that are in use at all BMA operations and provide the basis for effective management of employee and public health and safety as well as environmental protection.

BMA commits to prepare and implement an emergency management plan for the construction and operation phases (or update existing plans where appropriate) (Appendix S Commitment Update, Commitment 249 (amended from 223)). The plan will take a risk-based approach, focusing on likely emergency, disaster and emergency health scenarios for worksites and the Red Hill accommodation village.

The plan will be prepared in consultation with relevant emergency service providers including the Queensland Fire and Rescue Service, Queensland Police Service, Rural Fire Service, Queensland Ambulance Service (QAS), Queensland Mines and Rescue, Queensland Chemical Hazards and Emergency Management, the Moranbah Hospital and/or IRC. The requirements of the IRC Counter

Disaster Plan and the Queensland Mines Rescue Service will be considered when preparing the plan. The RACQ Central Queensland Rescue Service will also be consulted through existing relationships and connections. These external stakeholders will be consulted in the development of the plan. It will be in line with relevant health, safety and emergency management legislation and regularly updated and/or tested via mock exercises.

The plan will include emergency access requirements, possible landing sites and any limitations for emergency vehicles. QAS will be advised of any diversions, restrictions or limitations on road infrastructure that may impact on the delivery of ambulance services.

The GRM incremental expansion and the RHM underground expansion option will also employ site paramedics and provide first aid and fire training to nominated employees who will be able to assist in emergencies and/or on site incidents.

15.3 Traffic Movements

The road impact assessment (Appendix N of the EIS) was carried out in accordance with the EIS Terms of Reference, specifically following the Guidelines for Assessment of Road Impacts of Development (Department of Transport and Main Roads (TMR) 2006) which identify the procedure for assessing the road impacts of developments in Queensland. The objective of the assessment was to identify the impacts on the state-controlled, council-controlled and private road networks (open to the public) and, where appropriate, identify mitigation strategies.

IRC has noted that Goonyella Road currently has traffic restrictions that prohibit slow vehicles and wide loads between 5 AM and 7 AM, and 5 PM and 7 PM. The assessment conservatively assumed that the road network peak periods and project's peak traffic generation periods will coincide. This assumption is conservative and provides TMR and IRC assurance that, irrespective of eventual shift times adopted, the performance of the road network should be no worse than that reported in the EIS. An assessment of junction capacity outside peak hours (including for slow and wide loads) is not needed to determine whether intersections need to be upgraded.

Annual Average Daily Traffic (the volume of traffic over a day as averaged from a complete years' worth of traffic counts) and Average Daily Traffic (the volume of traffic over a day as averaged from an incomplete year's worth of traffic counts) have been provided for Peak Downs Highway and Moranbah Access Road (Appendix N, Sections 3.1 and 3.2 of the EIS). Traffic assessments prepared for other nearby projects were also considered, including Isaac Plains South (previously known as Integrated Isaac Plains Project), Eagle Downs, Caval Ridge and Grosvenor.

15.4 Impact Assessment

The BRM extension will not increase transport infrastructure requirements associated with the existing GRM mine complex operations as the existing BRM workforce will be utilised and no additional mine infrastructure will be required (refer to Section 5.1.10.1 of the EIS).

In its submission, the IRC has referred to Section 14.4.6 of the EIS and queried the impact on public access to the Moranbah Airport given the 30 additional round trips per week at the Moranbah Airport estimated to occur during operations. There will be no impact on public access to the Moranbah Airport as the result of the estimated additional round trips. As required by the development approval that applies to the airport, BMA provides quarterly updates to the IRC regarding the level of capacity utilisation at airport. As confirmed by the ongoing reporting, approximately 40 per cent of the airport's authorised passenger usage capacity is currently available to absorb additional flights that would be associated with future developments such as the RHM.

15.5 Mitigation

An assessment was undertaken of the potential impact on the pavement of nearby state-controlled roads, including the Peak Downs Highway from Moranbah Access Road to Nebo. The proportional increase in equivalent standard axles (a key measure for pavement distress) would be a maximum of 2.5 per cent which is below the accepted threshold of 5 per cent documented in TMR's Guidelines for Assessment of Road Impacts of Development (2006). The assessed scenario included consideration of an overlap of construction and operations phases. In accordance with TMR's guidelines and significance criteria, this means that no contribution is required towards state-controlled pavement impacts. It is noted that reassessment may potentially be warranted should the estimated material movements change significantly.

Assessment of pavement impacts is not typically undertaken for council-controlled roads as councils have other mechanisms for collecting contributions, such as rates and infrastructure charging schemes.

The EIS traffic impact assessment indicated that, irrespective of the project proceeding, the existing forms of the Goonyella Road/Curtin Street, Goonyella Road/Moranbah Access Road/Mills Avenue and Peak Downs Highway/Moranbah Access Road intersections are likely to operate outside generally accepted performance thresholds. It is considered that these intersections will warrant upgrading (based on traffic growth projections) regardless of the project's timing. It is therefore reasonable for BMA to make a proportionate contribution towards upgrade costs (i.e. not fully fund) once the decision has been made that the project will proceed and the final staging for execution is known (refer to Section 14.4.1.3 of the EIS).

Section 16 Waste

16.1 Submissions

This section responds to submissions from the following:

- Isaac Regional Council
- Department of Environment and Heritage Protection

16.2 Mine Waste

16.2.1 Management of Mine Waste

Mineral waste disposal includes the disposal of spoil and rejects. The EIS states that mineral waste will be disposed of into the existing GRB mine complex waste disposal facilities (Section 6.2.3 of the EIS).

As the project involves only underground mining, the waste rock material located above (overburden) and between the coal seams (interburden) is removed only during the construction of drifts for access and services, and main drives for coal longwall access and coal transport. For the purposes of this discussion, these waste rock materials will be collectively called spoil (or overburden). The BRM extension will not generate additional quantities of overburden. The underground mining activities at RHM will not generate any substantial quantities of overburden.

Spoil material with suitable geotechnical properties will be used for engineering and construction purposes such as bulk fill, road sub-base and construction material for laydown areas. Spoil that is unsuitable for engineering purposes or in excess of requirements will be placed in the GRB mine complex existing waste storage facilities according to the existing approved overburden management practices.

Coarse rejects and fine materials (tailings) will be produced from coal processing, with an estimated one million tonnes (mt) from the BRM extension and 43 mt to be produced over the life of the RHM. All rejects (dense medium coarse rejects, fine rejects and dewatered tailings) from the rejects bin will be placed within the existing GRB mine complex waste storage facilities. This means that project does not need to create stand-alone waste storage facilities and there is no anticipated requirement for an increase to or construction of a new tailings dam as a consequence of the project.

As all mineral wastes will be disposed of in the GRB mine complex mineral waste disposal areas, management of these wastes will be in accordance with the existing GRB mine complex site practices (Section 6.5.1 of the EIS). These include the following general strategies:

- Where the overburden materials have properties suitable for engineering purposes, these materials will be reused where practical.
- Excavated spoil (waste rock material) with properties unsuitable for engineering and construction purposes will be placed in designated mineral waste disposal areas at the GRB mine complex according to the existing approved overburden management practices.
- All reject materials (i.e. dense medium, coarse and fine rejects, and dewatered tailings) will be loaded into trucks and dumped onto the in-pit spoil dumps. Mixing and compaction will occur as appropriate to the properties of the materials to achieve a sustainable final landform. All reject materials will be mixed via alternating disposal of the reject and spoil material into the in-pit spoil dumps at the GRB mine complex.
- Spoil dumps will be shaped in accordance with EHP’s Guideline 18 Rehabilitation requirements for mining projects and will be covered with a suitable growth media and revegetated with pasture species for a post-mining land use of grazing, or a combination of native grasses supplemented with introduced pasture species in areas where continuous pasture cover is necessary for erosion control.
- No reject material will be placed below the pre-mining groundwater table and all dumps will be designed and constructed to be free draining so as to minimise the potential for geotechnical instability.

The GRB mine complex mineral waste disposal areas will be rehabilitated in accordance with the existing Goonyella Riverside and Broadmeadow Mine Rehabilitation Management Plan (BMA 2011). The objectives, indicators and success criteria associated with this plan are provided in **Section 18.2**.

16.2.2 Acid Generating Potential

Static geochemical tests were performed to determine the total acid generating and total acid neutralising potential of mineral waste samples from the EIS study area (Section 6.3.1 of the EIS). The geochemical tests are static in that the tests determine the chemical status of the tailings sample at one point in time, irrespective of how the acid mine drainage (AMD) may develop over time.

The net acid generating potential (NAPP) and net acid generation (NAG) tests (corrected for total organic carbon where appropriate) were used to predict the potential of the mineral waste samples to generate acid. The acid generating potential of a sample is classified based on the geochemical classification criteria adopted by the Department of Resources, Energy and Tourism (formerly Department of Industry, Tourism and Resources) (DITR 2007) as shown in **Table 16-1**.

Table 16-1 Geochemical Classification Criteria

Geochemical Classification	$NAPP_{CRS}$ (kg H_2SO_4/t)[1]	NAGpH	Proportion of samples
Potentially acid forming (PAF)	>10	<4.5	6%
Potentially acid forming – low capacity (PAF-LC)	0 to 10	<4.5	2%
Non-acid forming (NAF)	-100 to <0	≥4.5	86%
Acid consuming (AC)	<-100	≥4.5	
Uncertain (UC)[2]	>0	≥4.5	
	<0	<4.5	6%

Note 1: $NAPP_{CRS}$ (kg H_2SO_4/t) = [sulphide-sulphur (%) x 30.6] – [acid neutralising capacity (ANC) ((kg H_2SO_4/t)]
Note 2: Further testing required to confirm material classification.

The geochemical test data collected from the five drill holes indicate that overburden and almost all potential reject (i.e. coal roof and coal floor) samples tested are non-acid forming (NAF) and have very low sulphide-sulphur concentrations (<0.1 per cent).

The project is expected to generate limited acid generating materials, thus will require limited neutralising material for LOM. The project will generate 32 mt of coarse rejects over LOM. Fifteen per cent (or 4.8 mt) is expected to be PAF/PAF-LC. The amount of Aglime or similar required to treat this amount is conservatively estimated at 82,000 tonnes over LOM. It should be noted that this is a very conservative estimate since the surrounding bulk spoil material in in-pit spoil dumps is expected to contain excess ANC.

As all mineral wastes will be disposed of in the GRB mine complex mineral waste disposal areas, management of these wastes will be in accordance with existing GRB mine complex site practices (Section 6.5.1 of the EIS). These include the following general strategies for potentially acid forming (PAF) wastes:

- If marked amounts of PAF rejects are encountered, lime dosing of compacted coarse reject layers (one to two metres) will be used as a precautionary measure to extend the lag period in the unlikely event of acid generation.
- Given that some coarse reject samples have been classified as potentially acid forming-low capacity, potentially contaminated water from run of mine (ROM) coal and product coal stockpiles will be contained to avoid interaction with clean waters as a precautionary measure.

- Geochemical test results indicate that some rejects may be PAF. If leachates from dewatered tailings from the belt filter presses generate leachate pH <5.0, then BMA will consider lime admentment. In terms of dewatered tailings, 12 mt will be generated over LOM, with 8.4 mt PAF/PAF-LC. The amount of Aglime or similar required to treat this amount is conservatively estimated at 277,000 tonnes over LOM. It should be noted that this is a very conservative estimate since the surrounding bulk spoil material in in-pit spoil dumps is expected to contain excess ANC.

BMA will undertake ongoing operational geochemical characterisation of mineral waste materials in project's planned disturbance areas ahead of mining to confirm the expected geochemical characteristics of these materials (Section 6.5.2 of the EIS). Characterisation of reject materials (coarse rejects and dewatered tailings) from the project will also be undertaken to verify their expected geochemical nature. These data will be used to re-evaluate and update the management and disposal strategies for reject materials.

BMA will conduct an ongoing geochemical assessment program that is commensurate with the current AMD risk of the mineral wastes.

16.3 General Waste

Preferentially, tyres will be reused for practical uses on site such as barriers, drainage and markers or removed by the tyre supplier for reprocessing. Tyres used for these purposes will be installed to prevent mosquito breeding by filling with dirt or drilling them out. Stockpiling of tyres on site will be limited to minimise the risk of combustion, water retention and mosquito breeding (Section 15.5.1 of the EIS).

Preferentially, green waste will be reused on site as is, or mulched where required for land shaping and interim rehabilitation activities. Where vegetation cannot be used on site, it will be transferred to a landfill green waste area (Section 15.5.1 of the EIS).

Any oils and greases generated as part of field service activities will be handled and disposed of appropriately. As described in Table 15-1 of the EIS, these wastes will be collected and stored in tan coloured bins for bulk transport to an authorised waste management facility for either recycling or for further re-use as oil or fuel (e.g. at Collinsville Power Station). Waste tracking will apply.

As described in Table 15-1 of the EIS, waste batteries will be stored on bunded pallets at a waste management pad for removal from site by a licenced contractor for recycling. This waste management pad will be covered.

Sewage will be handled following existing procedures at the GRB mine complex, where it is treated at on site STPs in accordance with EA requirements. Sludge will be removed by a licensed contractor for treatment and processing off site. The GRB mine complex EA also allows reuse for dust suppression, or disposal by evaporation or irrigation. If disposal by irrigation is selected, an assessment of soil types and irrigation area requirements will be undertaken to determine the area required for irrigation and other irrigation management requirements. Effluent quality characteristics with regard to bacteriological characteristics will depend on the proposed disposal method and risk of human contact with treated wastewater.

16.4 Waste Disposal

The project will not cause a sharp increase in demand for landfill or other waste management services and is not expected to affect overall availability and capacity of waste management facilities (Section 15.4 of the EIS). BMA will continue ongoing consultation activities with IRC to discuss the potential impacts of waste and mitigations for the Moranbah Landfill.

Waste materials will be transported by waste transport contractors authorised under the *Sustainable Planning Act 2009* and *Environmental Protection Act 1994* using the waste transport tracking system established under the *Environmental Protection Act 1994.* BMA will engage a waste contractor that will fulfil environmental and legislative requirements.

Section 17 Hazard and Risk

17.1 Submissions

This section responds to submissions from the following:

- Queensland Ambulance Service
- Department of Health
- Isaac Regional Council

17.2 Alcohol

The accommodation facility is to have a wet bar which will be managed in accordance with BMA's policies, which are implemented effectively at other BMA licenced venues.

17.3 Potable Water

The estimated raw water demand for potable uses (drinking water, amenities) is an additional 75 ML/year over and above baseline requirements for the existing GRB mine complex operations. Total combined water demand for the GRB mine complex and project operations will be 255 ML/year (Section 7.3.2.3 of the EIS).

Potable water requirements for the project's operation will be sourced from external pipeline raw water supply. An additional tie-in to the Eungella pipeline will be constructed in the vicinity of the Red Hill industrial area but no new allocations are required (Section 3.9.2 of the EIS).

Potable water will be treated, tested and stored in accordance with existing practice at BMA sites and in accordance with standard BMA procedures.

17.4 Disease Vectors, Vermin and Pests

It is not expected that the project will increase the risk of the workforce being exposed to disease vectors such as mosquitoes or rodents, but mitigation measures will include:

- all site personnel will wear appropriate personal protective equipment in the field and where appropriate use insect repellent, and ensure first aid kits are available;
- awareness of appropriate hygiene will be developed through workforce induction and training;
- on site water management will limit the potential for increase in disease vectors such as mosquitoes and biting midges; and
- should the ponds created through subsidence result in mosquito or midge breeding, eradication programs will be implemented in conjunction with Queensland Health and the local authority.

Control measures to prevent increase in local populations and spread of biting insect species and feral animals will be contained within a pest management plan to be implemented on an as-needs basis (Section 20.6.2.10 of the EIS).

The terrestrial ecology assessment did not identify any significant impacts associated with other pest species (Section 9.6.4.7 of the EIS).

Section 18 Decommissioning and Rehabilitation

18.1 Submissions

This section responds to submissions from the following:

- Department of Environment and Heritage Protection

18.2 Rehabilitation Management Plan

As stated in the EIS, BMA is committed to developing a rehabilitation management plan for the project prior to the commencement of mining (Section 5.5 of the EIS). This plan will be based on the existing Goonyella Riverside and Broadmeadow Mine Rehabilitation Management Plan (BMA 2011).

The goal of the existing rehabilitation management plan is that all areas disturbed by mining activities will be rehabilitated to safe, non-polluting, stable landforms with a self-sustaining vegetation cover that achieves agreed post-mine land uses. Rehabilitation of land disturbed by the project will:

- *Achieve acceptable post-disturbance land use suitability* – Rehabilitation will aim to create a stable landform with land use capability and/or suitability similar to that prior to disturbance, unless other beneficial land uses are pre-determined and agreed.
- *Create stable post-disturbance landforms* - Mine wastes and disturbed land will be rehabilitated to a safe condition that is self-sustaining, or to a condition where maintenance requirements are consistent with an agreed post-mining land use.
- *Preserve downstream water quality* – Surface and ground waters that leave the mining leases will not be degraded to a significant extent and will conform with EA conditions. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

The rehabilitation objectives set to achieve these goals are identified in **Table 18-1**.

Table 18-1 Rehabilitation Objectives

Goal	Objective
Safety	The site is safe for humans and animals (including stock and wildlife), now and in the foreseeable future.
Non-polluting	Hazardous material is adequately managed. Acid mine drainage will be avoided and will not cause serious environmental harm. Potentially contaminated water will be contained on site.
Stable Landform	Very low probability of unpredicted subsidence, slope slippage/slumping or rock falls with serious consequences (including serious environmental harm). Landform design achieves appropriate erosion rates. Vegetation cover is established to minimise erosion.
Sustainable Land Use	Soil properties support and will continue to support proposed post-mine land uses. Specified self-sustaining vegetation (natural or grassland for grazing) is established. Waterbodies to be retained on site (if any) have a low risk of causing environmental harm. Land use is established with comparable management requirements to similarly used non-mined land.

To achieve the goals and objectives above, rehabilitation of disturbed land will be conducted so that:

- suitable species of vegetation are planted and established to achieve the relevant post-mine land uses;
- potential for erosion is minimised through appropriate design of landforms including drainage measures, and appropriate management of dust-generating activities;
- the water quality of any residual water body meets criteria for subsequent use and does not have the potential to cause environmental harm; and
- the final landform is geotechnically stable and has a low risk of mass failure.

The proposed rehabilitation methods for the project are provided in Section 5.5.6 of the EIS. These rehabilitation methods address surface facilities and infrastructure, subsided areas, soil management and revegetation.

The completion criteria and associated indicators presented below have been designed for the existing management plan to measure the success of rehabilitation and the rehabilitation objectives.

These completion criteria are presented in **Table 18-2** to **Table 18-5**.

Table 18-2 Completion Criteria for Rehabilitation of Spoil Dumps

Goal	Objective	Parameter/Indicator	Completion Criteria
Safe	The site is safe for humans and animals (including stock and wildlife), now and in the foreseeable future.	Safety assessment of slopes that are >30° and >5 m in height (if any)	Certification that slopes are safe. Predictions/risk assessment to be made about future safety.
		Exposure to and availability of heavy metals and other toxic materials (selection will be made based on relevance to site)	Certification that spoil material is safe and predictions about future changes.
		Technical design of landform	Engineers certification of construction and maintenance to specified geotechnical design performance.
		Low risk of fire	Site management planning provide adequate measures for fire reduction (e.g. minimise accumulation of dry matter).
Non-polluting	Acid mine drainage (if any) will not cause serious environmental harm.	Encapsulation configuration	Cover of any reject layers meets design specification to ensure no seepage.
		Hydrostatic head/temperature in spoil dumps.	Certification that monitoring data show no unexpected rise of water levels or temperature.
		Downstream groundwater monitoring	Certification that monitoring data meet specified criteria relevant to potential contaminants.
	Polluted/ contaminated water will be contained on site.	Downstream surface water monitoring	Certification that drainage structures and sediment dams are effective in controlling surface water runoff, and minimising quantities of polluted water and containing it on site. Certification that monitoring data meet specified criteria relevant to potential contaminants.
		Geotechnical characterisation of spoil	Documented evidence that geochemical characterisation of soil material has been incorporated into design of spoil dumps.
			Evidence that appropriate risk assessment has been undertaken and control measures are in place.
Stable landform	Very low probability of landform slumping with serious consequences (including serious environmental harm).	Past record of slope failure/slumping	Evidence that appropriate risk assessment was undertaken and control measures are in place to prevent recurrence.
		Slope angle and length	Evidence in rehabilitation report that relevant EA conditions have been complied with: • No less than 75% of the area has slopes <11° and up to 25% of the area has slopes >11°. • Where reject layers are present and exposed, the landform is capped. • No mass failure of slopes.

Goal	Objective	Parameter/Indicator	Completion Criteria
		Geotechnical, geochemical and hydrological studies of existing structures (outer batter slopes of spoil dumps) and proposed spoil dumps	Documented evidence that appropriate risk assessment has been undertaken and control measures are in place for existing dumps. Evidence that results of geotechnical, hydrological and geochemical assessment have been incorporated into design of spoil dumps as final landforms.
	Landform design achieves appropriate erosion rates	Engineered structures to control water flow	Documented evidence that drainage structures are in place as per design requirements and functioning effectively. Erosion control structures installed at vertical intervals not to exceed 7 m.
		Rate of soil loss and sediment yield	Evidence in rehabilitation monitoring reports that measured erosion rates meet limits set from reference sites (to be determined) or calculated from Universal Soil Loss Equation (currently <40 tonnes/ha/yr). Dimensions and frequency of occurrence of sheet wash, erosion rills and gullies are no greater than that in reference sites that exhibit similar landform characteristics.
Sustainable land use	Soil properties support and will continue to support proposed post-mine land use.	Chemical properties (e.g. pH, salinity, nutrients, trace elements) of topsoil and other subsoil/growth medium for vegetation	Evidence in rehabilitation reporting that topsoil chemistry satisfies EA requirements: • Soil salinity content is <0.6 dS/m. • Soil pH is between 5.5 and 8.5. • Soil Exchange Sodium Percentage (ESP) is <40%. Note: Aim is to achieve <14%.
		Physical properties (e.g. type, colour, texture, coherence, water infiltration, stability etc)	Topsoil returned to a depth of 200-300 mm (comprising 100-150 mm of upper layer topsoil) where possible. Physical properties to be achieved to within 2 standard deviations of that in reference sites and determined by soil testing and Landscape Function Analysis (LFA).
		Biological properties (e.g. nutrient cycling, microbial biomass etc)	Evidence of the following occurring to within 2 standard deviations of that in reference sites: • Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. • Adequate macro and micro-nutrients are present. • Invertebrates present.
	Specified self-sustaining vegetation and habitat established.	Ecosystem definition	Area accomplishes and remains as a healthy working native bushland ecosystem on steeper slopes and pasture for grazing on shallower slopes (<3°).
		Vegetation parameter monitoring	Structural and floristic parameters represents to within 2 standard deviations of appropriate native bushland reference sites (to be

Goal	Objective	Parameter/Indicator	Completion Criteria
			determined). More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead. Certification that weed management is successful Evidence of second generation of tree/shrub species.
		Fauna monitoring	Habitat complexity is within 2 standard deviations of reference site values for pasture or native bushland as appropriate. Evidence of active use of habitat provided during rehabilitation such as nest boxes, stags and logs and signs of natural generation of shelter sources including leaf litter.
			Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character etc) from each faunal assemblage group (e.g. reptiles, birds, mammals, amphibians), present in the ecosystem type based on values of reference sites (to be determined).
			Presence of representatives of a broad range of invertebrate functional indicator groups involved in different ecological processes based on values of reference sites (to be determined).
	Land use is established with comparable management requirements to similarly used un-mined land.	Extent of management required	Evidence that management required for grazing is similar to that required for grazing on adjacent un-mined land. Evidence that management required of native bushland is similar to that of bushland in adjacent un-mined areas.

Table 18-3 Completion Criteria for Rehabilitation of Reject Dumps

Goal	Objective	Parameter/Indicator	Completion Criteria
Safe	The site is safe for humans and animals (including stock and wildlife), now and in the foreseeable future.	Safety assessment of slopes that are >30° and >5 m in height (if any)	Certification that slopes are safe. Predictions to be made about future safety.
		Exposure to and availability of heavy metals and other toxic materials (selection will be made based on relevance to site)	Certification that spoil material is safe and predictions about future changes.
			Leaching tests meet specified guideline values (using standard protocols such as US EPA Toxic Characteristic Leaching Procedure).
			Site management planning provide adequate measures for fire reduction (e.g. minimise accumulation of dry matter).
		Technical design of landform	Engineers certification of construction and maintenance to specified geotechnical design performance.
		Low risk of fire	Site management planning provide adequate measures for fire reduction (e.g. minimise accumulation of dry matter).
		Adequacy and predicted long-term performance of fencing	Documented evidence that adequate safety planning has been implemented, including fencing to prevent stock accessing dump slopes.
Non-polluting	Hazardous material is adequately managed.	Technical design of capping	Engineer's certification of construction and maintenance to design performance. Cover layers meet design specification to ensure no seepage. Where reject layers are present and exposed, the landform is capped. Cover comprises a minimum of 1.5 m of insert cover material, must be sufficient to break capillary rise of solutes. Landform is externally draining or in-pit. No acid leachate.
	Acid mine drainage (if any) will not cause serious environmental harm.	Hydrostatic head/temperature in spoil dumps.	Certification that monitoring data show no unexpected rise of water levels or temperature.
		Downstream groundwater monitoring	Certification that monitoring data meet specified criteria relevant to potential contaminants.
	Polluted/ contaminated water will be contained on site.	Downstream surface water monitoring	Certification that drainage structures and sediment dams are effective in controlling surface water runoff, and minimising quantities of polluted water and containing it on site. Certification that monitoring data meet specified criteria relevant to potential contaminants.
Stable landform	Very low probability of landform slumping with serious consequences	Past record of slope failure/slumping	Evidence that appropriate risk assessment was undertaken and control measures are in place to prevent recurrence.
		Geotechnical, geochemical and	Documented evidence that appropriate risk assessment has been

Goal	Objective	Parameter/Indicator	Completion Criteria
	(including serious environmental harm).	hydrological studies of existing structures (outer batter slopes of spoil dumps) and proposed spoil dumps	undertaken and control measures are in place for existing dumps. Evidence that results of geotechnical, hydrological and geochemical assessment have been incorporated into design of spoil dumps as final landforms.
	Landform design achieves appropriate erosion rates.	Engineered structures to control water flow	Documented evidence that drainage structures are in place as per design requirements and functioning effectively. Erosion control structures installed at vertical intervals not to exceed 7 m.
		Rate of soil loss and sediment yield	Evidence in rehabilitation monitoring reports that measured erosion rates meet limits set from reference sites (to be determined) or calculated from Universal Soil Loss Equation (currently <40 tonnes/ha/yr). Dimensions and frequency of occurrence of sheet wash, erosion rills and gullies are no greater than that in reference sites that exhibit similar landform characteristics.
Sustainable land use	Soil properties support and will continue to support proposed post-mine land use.	Chemical properties (e.g. pH, salinity, nutrients, trace elements) of topsoil and other subsoil/growth medium for vegetation	Evidence in rehabilitation reporting that topsoil chemistry satisfies EA requirements: • Soil salinity content is <0.6 dS/m. • Soil pH is between 5.5 and 8.5. • Soil Exchange Sodium Percentage (ESP) is <40%. Note: Aim is to achieve <14%.
		Physical properties (e.g. type, colour, texture, coherence, water infiltration, stability etc)	Topsoil returned to a depth of 200-300 mm (comprising 100-150 mm of upper layer topsoil) where possible. Physical properties to be achieved to within 2 standard deviations of that in reference sites and determined by soil testing and LFA.
		Biological properties (e.g. nutrient cycling, microbial biomass etc)	Evidence of the following occurring to within 2 standard deviations of that in reference sites: • Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. • Adequate macro and micro-nutrients are present. • Invertebrates present.
	Specified self-sustaining vegetation and habitat established.	Ecosystem definition	Area accomplishes and remains as a healthy working native bushland ecosystem on steeper slopes and pasture for grazing on shallower slopes (<3°).
		Vegetation parameter monitoring	Structural and floristic parameters represents to within 2 standard deviations of appropriate native bushland reference sites (to be determined). More than 75% of shrubs and/or trees are healthy when ranked healthy,

Goal	Objective	Parameter/Indicator	Completion Criteria
			sick or dead. Certification that weed management issuccessful. Evidence of second generation of tree/shrub species.
		Fauna monitoring	Habitat complexity is within 2 standard deviations of reference site values for pasture or native bushland as appropriate. Evidence of active use of habitat provided during rehabilitation such as nest boxes, stags and logs and signs of natural generation of shelter sources including leaf litter.
			Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character etc) from each faunal assemblage group (e.g. reptiles, birds, mammals, amphibians), present in the ecosystem type based on values of reference sites (to be determined).
			Presence of representatives of a broad range of invertebrate functional indicator groups involved in different ecological processes based on values of reference sites (to be determined).
	Land use is established with comparable management requirements to similarly used un-mined land.	Achieves agreed stocking capacity/capability distribution where possible (potential for erosion/damage to slopes which may be fenced off).	Use of rehabilitated land meets specified yield (e.g. 90% of un-mined land).

Table 18-4 Completion Criteria for Rehabilitation of Industrial Areas, Infrastructure, Power Facilities and Haul Roads

Goal	Objective	Parameter/Indicator	Completion Criteria
Safe	The site is safe for humans and animals (including stock and wildlife), now and in the foreseeable future.	Safety assessment of landform	Certification that final landform safe. Predictions to be made about future safety.
		Low risk of fire	Site management planning provides adequate measures for fire reduction (e.g. minimise accumulation of dry matter).
		Adequacy and predicted long-term performance of any safety measures	Documented evidence that adequate safety planning and measures required in safety investigation report have been implemented. Predictions/risk assessment to be made about future safety.
Non-polluting	Hazardous material is adequately managed.	Results of site contaminated land assessment report	Contaminated sites remediated and removed from EPA's Environmental Management Register or Contaminated Land Register. Tarmac, paddings, footing, hardstand removed from site unless otherwise agreed with landholder(s).
		Downstream groundwater monitoring	Certification that monitoring data meet specified criteria relevant to potential contaminants, including hydrocarbons.
	Polluted/ contaminated water will be contained on site.	Downstream surface water monitoring	Certification that drainage structures and sediment dams are effective in controlling surface water runoff, and minimising quantities of polluted water and containing it on site. Certification that monitoring data meet specified criteria relevant to potential contaminants.
Stable landform	Landform design achieves appropriate erosion rates.	Slope angle and length	Evidence in rehabilitation report that relevant EA conditions have been complied with.
		Engineered structures to control water flow	Documented evidence that any drainage structures are in place as per design requirements and functioning effectively.
		Rate of soil loss and sediment yield	Evidence in rehabilitation monitoring reports that measured erosion rates meet limits set from reference sites (to be determined) or calculated from Universal Soil Loss Equation (currently <40 tonnes/ha/yr). Dimensions and frequency of occurrence of sheet wash, erosion rills and gullies are no greater than that in reference sites that exhibit similar landform characteristics.
Sustainable land use	Soil properties support and will continue to support proposed post-mine land use.	Chemical properties (e.g. pH, salinity, nutrients, trace elements) of topsoil and other subsoil/growth medium for vegetation	Evidence in rehabilitation reporting that topsoil chemistry satisfies EA requirements: • Soil salinity content is <0.6 dS/m. • Soil pH is between 5.5 and 8.5. • Soil Exchange Sodium Percentage (ESP) is <40%. Note: Aim is to achieve <14%.
		Physical properties (e.g. type, colour,	Topsoil returned to a depth of 200-300 mm (comprising 100-150 mm of

Goal	Objective	Parameter/Indicator	Completion Criteria
		texture, coherence, water infiltration, stability etc)	upper layer topsoil) where possible. Physical properties to be achieved to within 2 standard deviations of that in reference sites and determined by soil testing and LFA.
		Biological properties (e.g. nutrient cycling, microbial biomass etc)	Evidence of the following occurring to within 2 standard deviations of that in reference sites: • Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. • Adequate macro and micro-nutrients are present. • Invertebrates present.
	Specified self-sustaining vegetation and habitat established.	Ecosystem definition	Area accomplishes and remains as a healthy grassland ecosystem.
		Vegetation parameter monitoring	Structural and floristic parameters represents to within 2 standard deviations of appropriate native bushland reference sites (to be determined). More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead. Certification that weed management is successful. Evidence of second generation of tree/shrub species.
		Fauna monitoring	Habitat complexity is within 2 standard deviations of reference site values for pasture or native bushland as appropriate. Evidence of active use of habitat provided during rehabilitation such as nest boxes, stags and logs and signs of natural generation of shelter sources including leaf litter.
			Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character etc) from each faunal assemblage group (e.g. reptiles, birds, mammals, amphibians), present in the ecosystem type based on values of reference sites (to be determined).
			Presence of representatives of a broad range of invertebrate functional indicator groups involved in different ecological processes based on values of reference sites (to be determined).
	Land use is established with comparable management requirements to similarly used un-mined land.	Achieves agreed stocking capacity/capability distribution where possible (potential for erosion/damage to slopes which may be fenced off).	Use of rehabilitated land meets specified yield (e.g. 90% of un-mined land)

Table 18-5 Completion Criteria for Rehabilitation of Watercourse Diversions and Subsided Areas

Goal	Objective	Parameter/Indicator	Completion Criteria
Safe	The site is safe for humans and animals (including stock and wildlife), now and in the foreseeable future.	Safety assessment of landform	Certification that diversions and subsided areas are safe. Predictions to be made about future safety.
		Adequacy and predicted long-term performance of any safety measures	Documented evidence that adequate risk assessment, safety planning and measures required in safety investigation report have been implemented. Predictions/risk assessment to be made about future safety.
Non-polluting	Polluted/ contaminated water will be contained on site.	Downstream surface water monitoring	Certification that drainage structures are effective in controlling surface water runoff, and minimising quantities of polluted water entering the diversions. Certification that monitoring data meet specified criteria relevant to potential contaminants. Monitoring of receiving surface water quality (as relates to impacts of any discharges) complies with EA conditions: Receiving waters monitored daily at downstream lease boundary of Isaac River have contaminant limits of electrical conductivity maximum of 2,000 µS/cm, pH range of 6.5 to 9.0.
		Downstream groundwater monitoring	Certification that monitoring data meet specified criteria relevant to potential contaminants.
Stable landform	Very low probability of landform slumping with serious consequences (including serious environmental harm).	Past record of slope failure/slumping	Evidence that appropriate risk assessment was undertaken and control measures are in place to prevent recurrence.
		Geotechnical, geochemical and hydrological studies of existing structures (outer batter slopes of spoil dumps) and proposed spoil dumps	Documented evidence that appropriate risk assessment has been undertaken and control measures are in place for existing dumps. Evidence that results of geotechnical, hydrological and geochemical assessment have been incorporated into design of spoil dumps as final landforms.
	Very low probability of residual subsidence impacts with serious consequences (including serious environmental harm).	Geotechnical, engineering and hydrological assessment of subsided areas.	Documented evidence that appropriate risk assessment has been undertaken for subsided areas and appropriate control measures are in place. Evidence that results of geotechnical, hydrological and engineering assessment have been incorporated into design of rehabilitation of subsided areas.
	Landform design achieves appropriate erosion rates	Engineered structures to control water flow	Documented evidence that drainage structures are in place as per design requirements and functioning effectively. Erosion control structures installed at vertical intervals not to exceed 7 m.

Goal	Objective	Parameter/Indicator	Completion Criteria
		Rate of soil loss and sediment yield	Evidence in rehabilitation monitoring reports that measured erosion rates meet limits set from reference sites (to be determined) or calculated from Universal Soil Loss Equation (currently <40 tonnes/ha/yr). Dimensions and frequency of occurrence of sheet wash, erosion rills and gullies are no greater than that in reference sites that exhibit similar landform characteristics.
Sustainable land use	Soil properties support and will continue to support proposed post-mine land use.	Chemical properties (e.g. pH, salinity, nutrients, trace elements) of topsoil and other subsoil/growth medium for vegetation	Evidence in rehabilitation reporting that topsoil chemistry satisfies EA requirements: • Soil salinity content is <0.6 dS/m. • Soil pH is between 5.5 and 8.5. • Soil Exchange Sodium Percentage (ESP) is <40%. Note: Aim is to achieve <14%.
		Physical properties (e.g. type, colour, texture, coherence, water infiltration, stability etc)	Topsoil returned to a depth of 200-300 mm (comprising 100-150 mm of upper layer topsoil) where possible. Physical properties to be achieved to within 2 standard deviations of that in reference sites and determined by soil testing and LFA.
		Biological properties (e.g. nutrient cycling, microbial biomass etc)	Evidence of the following occurring to within 2 standard deviations of that in reference sites: • Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. • Adequate macro and micro-nutrients are present. • Invertebrates present.
	Specified self-sustaining vegetation and habitat established.	Ecosystem definition	Area accomplishes and remains as a healthy riverine ecosystem for watercourse diversions and where watercourses impacted by subsidence. Area accomplishes and remains as healthy bushland or pasture ecosystems as appropriate for subsided non-riparian areas.
		Vegetation parameter monitoring	Structural and floristic parameters represents to within 2 standard deviations of appropriate native bushland reference sites (to be determined). More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead. Certification that weed management is successful. Evidence of second generation of tree/shrub species.
		Fauna monitoring	Habitat complexity is within 2 standard deviations of reference site values for pasture or native bushland as appropriate.

Goal	Objective	Parameter/Indicator	Completion Criteria
			Evidence of active use of habitat provided during rehabilitation such as nest boxes, stags and logs and signs of natural generation of shelter sources including leaf litter.
			Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character etc) from each faunal assemblage group (e.g. reptiles, birds, mammals, amphibians), present in the ecosystem type based on values of reference sites (to be determined).
			Presence of representatives of a broad range of invertebrate functional indicator groups involved in different ecological processes based on values of reference sites (to be determined).
	Land use is established with comparable management requirements to similarly used un-mined land.	Extent of management required	Evidence that management required of native bushland and pasture is similar to that of adjacent un-subsided bushland and pasture. Evidence that management required of diverted and/or subsided reaches of watercourses (including associated riparian vegetation) is similar to that of other un-impacted reaches in the area.

Section 19 Project Commitments

The list of project commitments (Appendix S of the EIS) has been updated and reissued.

Section 20 References

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Appendix A EIS Submission Analysis Register Cross-reference

Red Hill Mining project - EIS Submission Analysis Register													Proponent to complete
Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
1.1	Department of National Parks, Recreation, Sport and Racing	State Government	Project-wide	Administrative/Other	Legislation/Administering authorities	**Section 1 - 1.13 Project Approvals - Table 1-2** Table incorrectly states DAFF administers parts of the NCA relevant to wildlife management. The NCA is administered by DAFF to the extent that it is relevant to demonstrated and exhibited native animals (the management of wildlife under the NCA is administered by EHP)	These errors be addressed/clarified in the final EIS	Nature Conservation Act (permit for interfering with species)	No	Proponent to note		Proponent to note incorrect references	Submission noted
1.2			Project-wide	Administrative/Other	Legislation/Administering authorities	**Section 9 - 9.5.3 Description of Environmentally Sensitive Areas - Special Forestry Areas (Page 9 – 50)** State parks is not a recognised term to describe areas declared under the *Forestry Act 1959* and it should be removed from the EIS. This section also incorrectly states that EHP is responsible for the management of 'special forestry areas' under the Forestry Act.	These errors be addressed/clarified in the final EIS	Forestry Act	No	Proponent to note		Proponent to note incorrect references	Submission noted
1.3			Project-wide	Administrative/Other	Legislation/Administering authorities	**9.5.3.3 Category C ESAs - Nature Refuges and Resource Reserves (Page 9 -51) and State forests (Page 9-51)** This section incorrectly states that EHP is responsible for administering those parts of the NCA relevant to resource reserves. This section also incorrectly states that EHP is responsible for the management of State Forests under the Forestry Act.	These errors be addressed/clarified in the final EIS	Forestry Act	No	Proponent to note		Proponent to note incorrect references	Submission noted
2	Department of State Development, Infrastructure and Planning	State Government	Project-wide	Administrative/Other	Legislation/Administering authorities	**Section 5.3 Land Resources** The Regional Planning Interests Bill (RPI Bill) proposes to require resource activities authorised under Resource Acts to align with the regional land use policies of regional plans as well as other areas of regional interest prescribed in the Bill, including SCL.	Should the project's level of impact on SCL change it may become subject to the provisions of this new legislation rather than the existing SCL Act 2011 (as discussed in the EIS) which is to be repealed by the RPI Bill.	RPI Bill	No	Proponent to note	Proponent to note that should the project's level of impact on SCL change it may become subject to the provisions of the new legislation.	Proponent to note	Appendix T Section 4.3 Regional Planning Interests Act
3.1	Department of State Development, Infrastructure and Planning	State Government	Project-wide	Administrative/Other	Legislation/Administering authorities	**Section 1.13.4.1 and 5.1.7.3** Refers to lapsed State Planning Policies (SPP's).	Update to reflect single SPP	N/A	No	Proponent to note		Proponent to note single SPP	Submission noted
3.2				Administrative/Other	Legislation/Administering authorities	**Section 5.1.7.6 -** Refers to the Moranbah UDA draft Structure Plan. The ULDA Act has been repealed and replaced with the Economic Development (ED) Act 2012.	Update EIS to reflect the new ED Act and adopted Moranbah UDA Development Scheme.	ED Act	No	Proponent to note		Proponent to note new ED Act and adopted Moranbah UDA Development Scheme	Submission noted
3.3				Administrative/Other	Legislation/Administering authorities	**Section 1 & Section 5** The Regional Planning Interests Bill 2013 integrates the policy objectives of the Strategic Cropping Land Act 2011 by identifying strategic cropping land as areas of regional interest. The bill introduces an assessment framework to manage the impact of resource activities on areas of the state identified as areas of regional interest. The commencement of the bill will repeal of the Strategic Cropping Land Act 2011.	Update EIS to reflect the Regional Planning Interests Bill 2013.	RPI Bill	No	Proponent to note		Proponent to note new Regional Planning Interests Bill	Appendix T Section 4.3 Regional Planning Interests Act
4.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.1 - Housing/Accommodation** - Increased vacancy rates in Moranbah due to construction of accommodation villages/mine camps	Mining companies to give their workforce the choice for local subsidised rental accommodation or camp accommodation. Mining companies given tax incentives for housing staff locally. Mining companies taxed for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted in relation to future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
4.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - FIFO - Consider local workers first.** Social impact from the use of remote workforces. Provide incentives for more people to settle in the township. Currently, BMA and other companies (Peabody at Moorevale) have adopted a 100% FIFO policy and there is no way that employees are able to live in the local community for fear of losing their jobs.	Local workers applying for jobs in the Bowen basin to be considered before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the red hill mine. All BMA employees given the option of subsidised housing, or the option to lease / buy a property in the local town of Moranbah. Tax incentives given to mining companies for employing people that live in Bowen basin postcodes. Or taxes on every FIFO employee the mining companies hire.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
4.3			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Community concern on availability of local employment options.** Oversupply of housing in Central Qld. No job opportunities in Moranbah. Moving to Cairns and Brisbane to get work.	Workers that reside in the Moranbah/Mackay areas need to be considered first for the jobs so that they don't have to move to get employment within their region.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
4.4			Project-wide	Social impact assessment/SIA	Social - Regional economies and businesses	**Section 17.5.1.3 - Local businesses are suffering**. Declining population. as people move from the region to secure mining employment (usually moving to Brisbane or Cairns).	BMA to maintain a % of employees that live in the local community. Tax incentives given for mining companies that house their employees in the local community. Mining companies to give employees a choice between a flight allowance or a rental allowance so they can live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
4.5			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
4.6			Project-wide	Social impact assessment/SIA	Social - Community values and change	**Section 17.5.1.6** - Remote workforces was leading to a **decreased feeling of community in Moranbah**. Property owners cant get tenants	BMA to accommodate more of their staff in town, and to offer their staff the choice of camp or local accommodation. Flight allowances could be converted into a weekly rental accommodation allowance for those who wish to reside in the town. Mining camps and flights to be taxed to encourage mines to give their staff a choice of living arrangement.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
4.7			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.8** - Some stakeholders voiced **dissatisfaction with various levels of government and government delivery** **of social infrastructure and services** to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
4.8			Project-wide	Transport	Transport - road	**Section 17.5.1.8** - Concerns regarding **traffic and transport impacts** were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	Transport Infrastructure Act (approval for works associated with a state controlled road)	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
4.9			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**Section 17.5.4.2** - The project should bring **jobs, apprenticeships and trainee schemes to the community, employing local people first** before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
4.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3 -** There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
4.11			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for **BMA and was told she would lose her job if she signed a lease.**	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.1 - Housing/Accommodation** - Increased vacancy rates in Moranbah due to construction of accommodation villages/mine camps	Mining companies to give their workforce the choice for local subsidised rental accommodation or camp accommodation. Mining companies given tax incentives for housing staff locally. Mining companies taxed for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - FIFO - Consider local workers first.** Social impact from the use of remote workforces. Provide incentives for more people to settle in the township. Currently, BMA and other companies (Peabody at Moorevale) have adopted a 100% FIFO policy and there is no way that employees are able to live in the local community for fear of losing their jobs.	Local workers applying for jobs in the Bowen basin to be considered before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the red hill mine. All BMA employees given the option of subsidised housing, or the option to lease / buy a property in the local town of Moranbah. Tax incentives given to mining companies for employing people that live in Bowen basin postcodes. Or taxes on every FIFO employee the mining companies hire.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.3			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Community concern on availability of local employment options.** Oversupply of housing in Central Qld. No job opportunities in Moranbah. Moving to Cairns and Brisbane to get work.	Workers that reside in the Moranbah/Mackay areas need to be considered first for the jobs so that they don't have to move to get employment within their region.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.4			Project-wide	Social impact assessment/SIA	Social - Regional economies and businesses	**Section 17.5.1.3 - Local businesses are suffering**. Declining population. as people move from the region to secure mining employment (usually moving to Brisbane or Cairns).	BMA to maintain a % of employees that live in the local community. Tax incentives given for mining companies that house their employees in the local community Mining companies to give employees a choice between a flight allowance or a rental allowance so they can live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.5			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
5.6			Project-wide	Social impact assessment/SIA	Social - Community values and change	**Section 17.5.1.6** - Remote workforces was leading to a **decreased feeling of community in Moranbah**. Property owners cant get tenants	BMA to accommodate more of their staff in town, and to offer their staff the choice of camp or local accommodation. Flight allowances could be converted into a weekly rental accommodation allowance for those who wish to reside in the town. Mining camps and flights to be taxed to encourage mines to give their staff a choice of living arrangement.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.7			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.8** - Some stakeholders voiced **dissatisfaction with various levels of government and government delivery of social infrastructure and services** to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
5.8			Project-wide	Transport	Transport - road	**Section 17.5.1.8** - Concerns regarding **traffic and transport impacts** were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
5.9			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**Section 17.5.4.2** - The project should bring **jobs, apprenticeships and trainee schemes to the community, employing local people first** before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Strategies included in SIA/ Action Plan	Proponent to note	Submission noted
5.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
5.11			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for **BMA and was told she would lose her job if she signed a lease.**	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
6.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.1 - Housing/Accommodation** - Increased vacancy rates in Moranbah due to construction of accommodation villages/mine camps	Mining companies to give their workforce the choice for local subsidised rental accommodation or camp accommodation. Mining companies given tax incentives for housing staff locally. Mining companies taxed for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
6.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - FIFO - Consider local workers first.** Social impact from the use of remote workforces. Provide incentives for more people to settle in the township. Currently, BMA and other companies (Peabody at Moorevale) have adopted a 100% FIFO policy and there is no way that employees are able to live in the local community for fear of losing their jobs.	Local workers applying for jobs in the Bowen basin to be considered before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the red hill mine. All BMA employees given the option of subsidised housing, or the option to lease / buy a property in the local town of Moranbah. Tax incentives given to mining companies for employing people that live in Bowen basin postcodes. Or taxes on every FIFO employee the mining companies hire.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
6.3			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Community concern on availability of local employment options.** Oversupply of housing in Central Qld. No job opportunities in Moranbah. Moving to Cairns and Brisbane to get work.	Workers that reside in the Moranbah/Mackay areas need to be considered first for the jobs so that they don't have to move to get employment within their region.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
6.4			Project-wide	Social impact assessment/SIA	Social - Regional economies and businesses	**Section 17.5.1.3 - Local businesses are suffering**. Declining population as people move from the region to secure mining employment (usually moving to Brisbane or Cairns).	BMA to maintain a % of employees that live in the local community. Tax incentives given for mining companies that house their employees in the local community Mining companies to give employees a choice between a flight allowance or a rental allowance so they can live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
6.5			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
6.6			Project-wide	Social impact assessment/SIA	Social - Community values and change	**Section 17.5.1.6** - Remote workforces was leading to a **decreased feeling of community in Moranbah**. Property owners cant get tenants	BMA to accommodate more of their staff in town, and to offer their staff the choice of camp or local accommodation. Flight allowances could be converted into a weekly rental accommodation allowance for those who wish to reside in the town. Mining camps and flights to be taxed to encourage mines to give their staff a choice of living arrangement.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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6.7			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.8** - Some stakeholders voiced **dissatisfaction with various levels of government and government delivery of social infrastructure and services** to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
6.8			Project-wide	Transport	Transport - road	**Section 17.5.1.8** - Concerns regarding **traffic and transport impacts** were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
6.9			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**Section 17.5.4.2** - The project should bring **jobs, apprenticeships and trainee schemes to the community, employing local people first** before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Strategies included in SIA/ Action Plan	Proponent to note	Submission noted
6.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
6.11			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for **BMA and was told she would lose her job if she signed a lease.**	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
7.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.1 - Housing/Accommodation** - Increased vacancy rates in Moranbah due to construction of accommodation villages/mine camps	Mining companies to give their workforce the choice for local subsidised rental accommodation or camp accommodation. Mining companies given tax incentives for housing staff locally. Mining companies taxed for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
7.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - FIFO - Consider local workers first.** Social impact from the use of remote workforces. Provide incentives for more people to settle in the township. Currently, BMA and other companies (Peabody at Moorevale) have adopted a 100% FIFO policy and there is no way that employees are able to live in the local community for fear of losing their jobs.	Local workers applying for jobs in the Bowen basin to be considered before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the red hill mine. All BMA employees given the option of subsidised housing, or the option to lease / buy a property in the local town of Moranbah. Tax incentives given to mining companies for employing people that live in Bowen basin postcodes. Or taxes on every FIFO employee the mining companies hire.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
7.3			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Community concern on availability of local employment options.** Oversupply of housing in Central Qld. No job opportunities in Moranbah. Moving to Cairns and Brisbane to get work.	Workers that reside in the Moranbah/Mackay areas need to be considered first for the jobs so that they don't have to move to get employment within their region.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
7.4			Project-wide	Social impact assessment/SIA	Social - Regional economies and businesses	**Section 17.5.1.3 - Local businesses are suffering**. Declining population. as people move from the region to secure mining employment (usually moving to Brisbane or Cairns).	BMA to maintain a % of employees that live in the local community. Tax incentives given for mining companies that house their employees in the local community Mining companies to give employees a choice between a flight allowance or a rental allowance so they can live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
7.5			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
7.6			Project-wide	Social impact assessment/SIA	Social - Community values and change	**Section 17.5.1.6** - Remote workforces was leading to a **decreased feeling of community in Moranbah**. Property owners cant get tenants	BMA to accommodate more of their staff in town, and to offer their staff the choice of camp or local accommodation. Flight allowances could be converted into a weekly rental accommodation allowance for those who wish to reside in the town. Mining camps and flights to be taxed to encourage mines to give their staff a choice of living arrangement.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
7.7			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.8** - Some stakeholders voiced **dissatisfaction with various levels of government and government delivery of social infrastructure and services** to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Appendix U

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7.8			Project-wide	Transport	Transport - road	**Section 17.5.1.8** - Concerns regarding **traffic and transport impacts** were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
7.9			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**Section 17.5.4.2** - The project should bring **jobs, apprenticeships and trainee schemes to the community, employing local people first** before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Strategies included in SIA/ Action Plan	Proponent to note	Submission noted
7.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3 -** There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Submission noted
7.11			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for **BMA and was told she would lose her job if she signed a lease.**	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
8.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Community values and change	**Section 18.3** - **Concern with 100% FIFO -** Opportunity to grow the town of Moranbah. Major opportunity to turn a town into a city.	Use up the vacancy in town first before allowing FIFO. Encourage and employ locals.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
8.2			Project-wide	Hazard and Risk	Hazard and risk - health and safety	**Section 18.3** - Increased air traffic. Safety concerns due to weather conditions	Reduce FIFO amount by a min of 25%	N/A	Yes	Proponent to provide response	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Clarification of workforce management arrangements in relation to FIFO	Appendix U
9.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.1 - Housing/Accommodation** - Increased vacancy rates in Moranbah, purchase price and asking rents per week have dropped significantly making it affordable for BMA workers to live in town.	Give mining companies some tax incentives for providing local housing rather than FIFO	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
9.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Remote workforce** 100% FIFO Policy and building 3,000 worker accommodation is the exact opposite to employing more local workers and providing incentives for more people to settle in town.	Give local mining workers a fair go to apply for jobs in the Bowen Basin, rather than a focus on FIFO. Restrict the % of FIFO workers that BMA can hire at Red Hill.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
9.3			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Remote workforce** - Availability of local employment - leading to a decline of Moranbah's population and impact on Moranbah's future as a Community Centre. Locals are forced to move to Brisbane to get their jobs back.	Consider local workers in the Bowen Basin before a FIFO worker. Tax incentives to mining companies to employee locally. Tax mining companies for FIFO employees.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
9.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.3** - Attracting and retaining employees. Local businesses are suffering. Having 100% FIFO at RHM	Provide a mandate for BMA to have a % of employees to live in the local community. Give tax incentives to mining companies for employing locally.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
9.5			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U

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9.6			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.6 - Decreased feeling of community**	Introduce incentives to companies to live in the town or in a camp	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
10	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 -** Using remote workforce due to requiring large amounts of labour to fulfil long term growth plans.	Only using a remote workforce as a last resort after rigorous local advertising.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
11.1	Queensland Ambulance Service	State Government	Project-wide	Emergency response	Emergency management	**Section 14 (Transport) - Emergency Response** - Identify and consult with QAS of any diversions, restrictions, limitation on road infrastructure that may impact on delivery of ambulance services.	Advise QAS of any diversions, restrictions, limitations on road infrastructure that may impact on the delivery of ambulance services. Identify possible landing site for both the rescue helicopter service and fixed wing aircraft services if required. This should include landing zone, flight paths, lighting and wind sock.	N/A	Yes	Proponent to provide response		Proponent to provide a response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix T Section 15.2 Emergency Service Commitments Appendix S Commitments Update
11.2			Project-wide	Emergency response	Emergency management	**Section 18 (Social) - Emergency response -** Liaise with QAS once a consultative working group commences.	Provide meeting advice to the Queensland Ambulance Service (QAS) once a consultative working group commences.	N/A	Yes	Proponent to provide response		Proponent to note. Update EIS, Appendix S - BMA Commitments, as required.	Appendix U
11.3			Project-wide	Emergency response	Emergency management	**Section 18 (Social) - Emergency response -** Potential impact on surrounding community social services and infrastructure should population significantly increased	Identify impacts on surrounding community social services and infrastructure should population significantly increase.	N/A	Yes	Proponent to provide response		Proponent to provide a response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix U
11.4			Project-wide	Emergency response	Emergency management	**Section 18 (Social) - Emergency response -** Potential impacts on local residents and emergency service personnel accessing affordable accommodation.	Identify management strategies for securing accommodation.	N/A	Yes	Proponent to provide response		Proponent to provide a response.	Appendix U
11.5			Project-wide	Emergency response	Emergency management	**Section 18 (Social) - Emergency response -** Provision of a paramedic service on site	Consult with QAS in relation to the provision of a paramedic service on the site	N/A	No	Proponent to note		Proponent to note.	Appendix T Section 15.2 Emergency Service Commitments Appendix S Commitments Update
11.6			Project-wide	Emergency response	Emergency management	**Section 19 (Economic) - Emergency Response -** Opportunity to align communication network	The QAS would request support to piggy back communication technology on planned towers or investigate assisting QAS to install appropriate technology in the area.	N/A	No	Proponent to note		Proponent to note	Submission noted
11.7			Project-wide	Emergency response	Emergency management	**Section 20 (Health Safety and Risk) - Emergency Response-** Consultation with QAS regarding treatment plans for injured workers.	Consult with the Queensland Chemical Hazards & Emergency Management and the Medical Director of the Queensland Ambulance service.	N/A	No	Proponent to note		Proponent to note.	Appendix T Section 15.2 Emergency Service Commitments
11.8			Project-wide	Emergency response	Emergency management	**Section 20 (Health Safety and Risk) - Emergency Response** - Provision of information to QAS relating to a Major Emergency Incident Plan, hazard and risk assessment, planned exercises, disaster management systems, evacuation maps and fatigue management policy.	Formulate and provide a copy of the Major Emergency Incident Plan, Hazards and Risk Assessment, planned exercises, Disaster Management Systems, Evacuation Maps, Fatigue Management Policy.	N/A	No	Proponent to note		Proponent to note.	Appendix T Section 15.2 Emergency Service Commitments Appendix S Commitments Update
11.9			Project-wide	Emergency response	Emergency management	Clarify if accommodation camp will be a wet or dry camp	Clarify if accommodation camp will be a wet or dry camp	N/A	Yes	Clarify issues with proponent/agencies prior to CG report		Proponent to clarify.	Appendix T Section 17.2 Alcohol
12	Department of Tourism, Major Events, Small Business and the Commonwealth Games	State Government				**No comment** - there are no issues associated with the project related to the department							No response required
13	Department of State Development, Infrastructure and Planning	State Government				**No comment** - there are no issues associated with the project related to the department							No response required
14	Department of Aboriginal and Torres Strait Islander and Multicultural Affairs	State Government	Project-wide	General Comment	General Comment	Positive feedback in terms of the department's engagement with BMA for the Daunia and Caval Ridge mines. A similar session may assist BMA in reaching their Aboriginal and Torres Strait Islander employment goals.	The department would welcome the opportunity to meet with the proponent in the pre-construction stage to assist the proponent in meeting their Aboriginal and Torres Strait Islander employment, training and business engagement goals.	N/A	No	Proponent to note		Proponent to note	Appendix S Commitments Update
15.1	Department of Agriculture, Fisheries and Forestry	State Government	Project-wide	Compliance	Legislation/Administering authorities	**Section 1 - 1.13.3.15 P.1-34** - No reference to the possible application of the Queensland Plant Protection Act 1989 - Biosecurity Queensland	General biosecurity awareness of plant health risks	N/A	Yes	Clarify issues with proponent/agencies prior to CG report		Proponent to clarify.	Appendix T Section 8.5 Weed and Pest Management
15.2			Project-wide	Approvals	Legislation/Administering authorities	**Section 1 - 1.13.3.15 P.1-34** - No reference to the possible application of the Forestry Act 1959 - (Forestry and Fisheries)	Approval will be required under the Forestry Act 1959 for the taking or disturbance of State owned land if not authorised under the Mineral Resources Act 1989. DAFF must be contacted if timber or quarry material from State forest is re-used on site for logs, poles, fence etc.	Forestry Act	No	Proponent to note		Proponent to note approval requirements relating to the taking or disturbance of state owned land.	Appendix T Section 4.4 Other Approvals
15.3			Project-wide	Compliance	Legislation/Administering authorities	**Section 1 - 1.13 Required approvals (Fisheries Queensland)** All minor crossings such as bridge works must ensure works have minimal impact upon the aquatic environment	DAFF recommends obtaining copies of fishery habitats policy and guidelines and ensure they are utilised in the design and construction works.	N/A	No	Proponent to note		Proponent to note guidelines	Submission noted

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
15.4			Project-wide	Approvals	Legislation/Administering authorities	**(p5-38 C5.1.8.2)** Project not to impact on an existing permit for taking quarry materials authorised under the Forestry Act. (MLA 70421 covers Sales Permit issued to Peabody for taking State owned quarry materials from L4 SP199176 now L41 SP235904)	Need to ensure that access to operations on the supply zone can continue. Contact DAFF - Andy Page 4095 7053 to confirm if quarry operations can continue under the Forestry Act.	Forestry Act	No	Proponent to note		Proponent to note.	Appendix T Section 3.4 Supply of Construction Materials
15.5			Project-wide	Compliance	Legislation/Administering authorities	(P5-181 C5.5.6.5) The application of legislation where chemical control is the proposed mitigation measure for weeds	Ensure the project is compliant with the Chemical Usage (Agricultural and Veterinary) Control Act 1988 (Use Controls) and Agricultural Chemicals Distributions Control Act 1966 (Licensing controls)	N/A	No	Proponent to note		Proponent to note	Appendix T Section 8.5.2 Weeds
15.6			Project-wide	Subsidence	Mitigation/management	(P7-55 C7.3.5) Impacts of subsidence on River geomorphology	The proponent should update the subsidence management and mitigation options should any adverse subsidence effects occur.	N/A	No	Proponent to note	Refer to EHP requirements in relation to Subsidence management Plan	Proponent to note	Appendix T Section 5.10 Mitigation of Subsidence Impacts Appendix T Section 6.8.6 Management and Mitigation
15.7			Project-wide	Terrestrial Ecology	Mitigation/management	**(p9-91 C9.8.1.5 and p9-94 C9.8.2.3)** Consideration of pest animals and measures to ensure numbers will not increase as a result of the project	Include a discussion and measures to ensure numbers of pest animals will not increase as a result of the project. For example, ensuring food and other organic waste is stored securely or taken offsite.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response. Update EIS, as required	Appendix T Section 8.5 Weed and Pest Management
15.8			Proposed Red Hill underground mine	Aquatic ecology	Aquatic ecology impacts	**(p10-11 C10.2.2)** Bridge design and construction	DAFF recommends the applicant obtain a copy of Fisheries policy guidelines and fact sheets in regards to waterway barrier works.	N/A	No	Proponent to note		Proponent to note	Submission noted
16.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.1 and 17.2 - Housing impacts** - Increased vacancies in the area as well as Bushlark Grove Estate - affordable housing and land that can not be sold. Rental and land prices are affordable. 100% FIFO will not assist in housing workers in the community. Against the interest of the local community/not supporting the community	State Government to take account of the situation - do not approve 100% FIFO for Red Hill. Repeal 100% FIFO arrangement for Caval Ridge and Daunia. Mining companies to subsidise the rental accommodation to a value that is less than the total cost of flying workers	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
16.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.1 and 17.5.4.1 - Remote workforce** - 100% FIFO - not allowing their workers to live in the local community, nor enter the local community for fear of being sacked. 200 locals have been sacked by Peabody and jobs are now advertised as FIFO in Brisbane.	CG require BMA to formally respond to the housing/remote workforce situation. Restrict the % of FIFO workers that BMA can employ at the Red Hill mine e.g.. 80%	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
16.3			Project-wide	Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Community concern on availability of local employment options.** No job opportunities in Moranbah. Moving to Cairns and Brisbane to get work. Sustaining Moranbah's population growth	Workers that reside in the Moranbah/Mackay areas need to be considered first for the jobs so that they don't have to move to get employment within their region.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
16.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
16.5			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.6 - Decreased feeling of community**	Introduce incentives to companies to live in the town or in a camp. BMA to maintain a % of employees that live in the local community for the Red Hill Mine. BMA to sponsor more local activities.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
16.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.8** - Some stakeholders voiced **dissatisfaction with various levels of government and government delivery of social infrastructure and services** to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
16.7			Project-wide	Transport	Transport - road	**Section 17.5.1.8** - Concerns regarding **traffic and transport impacts** were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
16.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**Section 17.5.4.2** - The project should bring **jobs, apprenticeships and trainee schemes to the community, employing local people first** before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
16.9			Project-wide	Social impact assessment/SIA	Social - Community values and change	**Section 17.5.5.3** - Council representatives were concerned that Moranbah was beginning to turn into a town with a large population of non-residents, limiting opportunities for permanent population to grow	State Gov. should listen to Local Gov. and oppose 100% FIFO. Tax incentives for allowing employees to live in the local community.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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16.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for **BMA and was told she would lose her job if she signed a lease.**	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
16.11			Project-wide	Social impact assessment/SIA	Social - Regional economies and businesses	**Section 18.3.2 and 18.4** - No social or economic benefit for the local or regional community if people have to move to Brisbane or Cairns to get jobs.	Introduce incentives to companies to live in the town or in a camp. BMA to maintain a % of employees that live in the local community for the Red Hill Mine.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
17.1	Asia Pacific Strategy	Public Organisation	Project-wide	Climate, Natural Hazards and Climate Change	Impacts	**Section 4.10.1** - Predicted impacts are focused on Qld rather than Australia. Tables 4-4 and 4-5 underestimate impacts of global warming, climate change, extreme weather events as matters of national environmental significance requiring assessment under EPBC Act	Include holistic EIS assessments to advance the TOR requirements set out in Appendix A Sections 5.1 and 5.8.5	N/A	No	Nil- Issue outside of scope	Relevant sections of TOR have been satisfactorily addressed	No requirements	ToR addressed
17.2			Project-wide	Greenhouse Gas Emissions	Impacts	**Section 5.9.1** is flawed - reliance on National Greenhouse Accounts. Data provided in Section 12.1.6 Table 12-8 suggest Scope 3 greenhouse emissions constitute some 97% of total global greenhouse gas emissions stemming from project approval.	Revise all EIS sections mandated by Appendix A Section 5.8.5 TOR requirements to address global warming, climate change, rising sea level, extreme weather events and ocean acidification consequences of project approval. Provide comprehensive mitigation measures and management strategies to address matters of national environmental significance required under the EPBC Act.	N/A	No	Nil- Issue outside of scope	Scope 2 emissions have been satisfactorily assessed and scope 3 emissions are not required to be assessed under the TOR.	No requirements	ToR addressed
17.3			Project-wide	Greenhouse Gas Emissions	Greenhouse Gas Emissions	**Section 19** - TOR is flawed - does not advance requirements of the Sustainable Planning Act with respect to economic assessment. Scope 2 and 3 externality costs associated with 97% of greenhouse gas emissions stemming from approval are not assessed and matters of MNES relating to advancement of the economic pillar of ecological sustainability are not addressed.	Consider holistic externality costs stemming from approval with a comprehensive cost benefit analysis necessary under the EPBC Act to demonstrate the producer surplus gained by Queensland offset externality costs to other Australian Communities.	N/A	No	Nil- Issue outside of scope	Assessment against sustainable mandates of SPA not required under TOR. Scope 2 emissions have been satisfactorily assessed and scope 3 emissions are not required to be assessed under the TOR.	No requirements	ToR addressed
17.4			Project-wide	Social impact assessment/SIA	Local/regional climate	**Appendix P** - Social impacts of global warming, climate change, extreme weather events, ocean acidification, rising sea levels on all Australian communities are not assessed and Appendix P is incomplete	Consider such social impacts and provide comprehensive mitigation measures and management strategies as necessary under the EPBC Act. Submitter has attached an article to be read in conjunction with this submission.	N/A	No	Nil- Issue outside of scope	Additional information not a requirement under TOR/EPBC Act	No requirements	ToR addressed
18.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
18.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community and no local employees. The mining companies need to remain committed to the long term sustainability to the Bowen basin.	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
18.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Local businesses are suffering and declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
18.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
18.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
18.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
18.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
18.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
18.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
18.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
19.1	Department of Transport and Main Roads	State Government	Project-wide	Dust emissions	Transport - rail	P11-20 Section 11 Air Quality 11.4 potential impacts 11.4.1.2 - Section fails to identify **coal loss and coal dust emissions during rail transport** to export as a source of dust emissions.	**Additional information** - last dot point on page 11-20 of Section 11 Air Quality - Section 11.4.1.2 should read - "train load out and coal loss and coal dust emissions during rail transport to export port".	N/A	Yes	Proponent to provide additional information to the EIS to inform CG	Section 11.4.1.2 of EIS	Proponent to provide response. Update EIS, as required.	Appendix T Section 13.5 Dust Emissions
19.2			Proposed Red Hill underground mine	Dust emissions	Transport - rail	Section 11.4.3 does not include measures to mitigate dust generation during rail-haul of coal to the export port.	It is a requirement for all mines transporting coal on the Aurizon coal network to implement measures contained in the **QR National Coal Dust Management Plan (CDMP)**. Engage with Aurizon to facilitate and implement the CDMP at the RHML rail load-out. Ensure the rail load-out handling will incorporate coal wagon veneering systems and associated support systems.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Section 11.4.3 of EIS	Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix T Section 13.5 Dust Emissions
20.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
20.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
20.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Local businesses are suffering and declining population in town due to FIFO policies results in housing costs decreased and affordable	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
20.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
20.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
20.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
20.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
20.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
20.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
20.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
21.1		Public Organisation	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
21.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
21.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
21.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4/17.5.1.6 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
21.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
21.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
21.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
21.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
21.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
21.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
22.1	Department of the Environment	Federal Government	Project-wide	Matters of National Environmental Significance	General Comment	**TOR Ch.5 - MNES** - Sufficient information needs to be provided. Where incomplete or insufficient information is provided, a worst case scenario will be used to assess potential impacts.	The documents provided have a number of areas where additional information and/or discussion are required to allow a reasonable assessment of potential project impacts to MNES.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 4.2 Matters of National Environmental Significance Appendix B, Section 4.1 Offsets Strategy
22.2			Project-wide	Matters of National Environmental Significance	Mitigation/management	**TOR Ch.5 - MNES** - The mitigation measures and monitoring programs identified in Chapter 5 (MNES) of the EIS should be used to develop impact management strategies for the project. There is a lack of certainty about what measures will be implemented, monitored and audited. Limited details regarding current operational policies and where they relate to the expansion.	The EIS needs to contain clear commitments to the mitigation and management methods to be employed on the RHMP site. These methods must be discussed in a level of detail for the Department to assess measures to reduce impacts to MNES. There is a lack of certainty about what measures will be implemented, monitored and audited. A detailed discussion is needed regarding how mitigation and management measures will build upon existing operations. More information is needed regarding the observed effectiveness of these plans in addressing impacts to MNES.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 5.10 Mitigation of Subsidence Impacts
22.3			Project-wide	Water impacts	General Comment	**Water Related Impacts** - The documents provide sufficient information to enable assessment of water impacts.		EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 5.5 Geomorphic Impacts of Subsidence Appendix T Section 5.6 Hydrological Impact of Subsidence Voids Appendix T Section 5.7 Water Quality Impacts of Subsidence Voids Appendix T Section 5.13 Water Quality Criteria
22.4			Proposed Red Hill underground mine	Subsidence	Mitigation/management	**Water Related Impacts** - Whilst a discussion of the proposed approach to mitigation of subsidence impacts is presented, clear commitments to mitigation of subsidence impacts are not provided.	clear commitments should be given	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 5.10 Mitigation of Subsidence Impacts
22.5			Proposed Red Hill underground mine	Subsidence	Mitigation/management	**Water Related Impacts** - The presented 'mitigated' and 'worst case' scenarios provide a significant level variation. Without clear commitments the Department would assess the potential impacts associated with subsidence against the 'worst case' scenario.	clear commitments should be given	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 3.2 Thick Seam Mining
22.6			Proposed Red Hill underground mine	Subsidence	General Comment	**Water Related Impacts** - the assessment of modelled subsidence impacts should refer to any available, local data regarding the observed levels of subsidence from underground/long wall operations.	need to reference relevant local data	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 5.3.1 Predicted versus Measured Subsidence Appendix T Section 5.5 Geomorphic Impacts of Subsidence Appendix T Section 5.6 Hydrological Impact of Subsidence Voids Appendix T Section 5.10 Mitigation of Subsidence Impacts
22.7			Proposed Red Hill underground mine	Groundwater	Stygofauna	**Water Related Impacts** - Appendix K4 recommends that a 2nd round of stygofauna sampling be carried out post 2012 wet season.	It is unclear if a second round of stygofauna sampling has been undertaken.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.12 Stygofauna Survey
22.8			Project-wide	Groundwater	Stygofauna	**Water Related Impacts** - Discrepancy whether there are groundwater dependent ecosystems - EIS Appendix Q3 - Regional groundwater system does not support groundwater dependent ecosystems - however (Appendix J) states otherwise.	Describe in detail the extent of the ecosystems that depend on the alluvial aquifers.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.13 Groundwater Dependent Ecosystems
22.9			Project-wide	Groundwater	Water balance	**Water Related Impacts** - The water balance presented does not identify all stores of water within the system.	The water balance presented needs to identify all the stores of water within the system together with estimated flows between these stores.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 7.2 Water Storage
22.10			Project-wide	Groundwater	General Comment	**Water Related Impacts** - One geological cross section has been provided.	An indication should be provided of the boreholes from which the cross section has been derived.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.3 Geological Cross-sections Appendix T Figure 6-2 Bore locations

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
22.11			Project-wide	Water impacts	General Comment	**Water Related Impacts** - The conceptualisation of the hydrogeological system should be provided.	A hydrogeological conceptual diagram should be provided, to clearly communicate the conceptualisation of the hydrogeological system.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.4 Adequacy of the Conceptual Model
22.12			Project-wide	Water impacts	Water Release	**Water Related Impacts** - Water management system - salinity/release parameters/compliance.	It is unclear what level, if any, of non-compliance with release parameters has been experienced with regard to the quality of mine discharge. Additionally, it is unclear how or if these compliance events have been addressed in the water management system.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 5.13 Water Quality Data Appendix T Section 5.14 Water Quality Data Appendix T Section 5.15 Water Discharges Appendix T Section 5.17 Cumulative Impacts Appendix T Section 5.18 Water Quality Monitoring Appendix T Section 5.20 Management Strategy
22.13			Project-wide	Offsets strategy	Offsets	**Water Related Impacts** - The EIS does not supply sufficient information regarding the proposed offsets for the project.	Offset information provided to the Department must meet the information requirements established in Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (October 2012) (the Offset Policy). The offset information must also include a reasonable, appropriately supported, description of the environmental values contained with the proposed offset area. In addition, habitat for a listed threatened species which does not meet the criteria for being a listed threatened community should be considered as part of the assessment of impacts and any subsequent discussion regarding the provisions of environmental offsets.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Appendix T Section 10.2 Development of an Offset Strategy
22.14			Proposed Red Hill underground mine	Aquatic Ecology	Impacts	**Water Related Impacts** - It is unclear if the Aquatic Ecology aspect of the EIS (Section 10.2) has provided an assessment of impacts to water resources consistent with the required definition.	The potential impacts to aquatic ecological features as a result of the development and operation of the RHMP need to be included in the assessment of impacts to water resources	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.5 Adequacy of the Numerical Model Appendix T Section 9.2 Context of Proposed Releases
22.15			Project-wide	Project Methodology	General Comment	**Water Related Impacts** - In the water sections of the EIS, the term permeability (units of length2) appears to have been used in some instances when hydraulic conductivity was reported (units of length/time).	Clarify and/or revise this apparent inconsistency.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.5 Adequacy of the Numerical Model
22.16			Project-wide	Project Methodology	General Comment	**Water Related Impacts** - The IESC Report (Appendix Q3) does not contain sufficient detail as a stand-alone document to be suitable for assessment under the EPBC Act; however, most of the detailed information required is provided in other chapters/appendices	It would aid the reader if the relevant sections of the EIS in which detailed information on water resources is provided were cross-referenced within the IESC Report.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 5 Surface Water Appendix T Section 6 Groundwater Appendix T Section 9 Aquatic Ecology
22.17			Project-wide	Cumulative Impacts	Offsets	**Water Related Impacts** - While the RHMP's EIS does nominates a number of operational projects and projects likely to be developed locally and regionally, it does not provide an adequate consideration of how the potential impacts to MNES from the RHMP will interact with the nominated projects. Additionally, as insufficient details have been provided regarding environmental offset the Department is unable to assume that the provision of an offset will address the contribution of the RHMP to cumulative impacts to MNES in the region.	Provide a suitable discussion of the spatial and temporal relationship of the RHMP to other likely developments in the region.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 6.9 Drwadown Predications Appendix T Section 6.16 Cumulative Impacts Appendix T Section 8.8 Cumulative Impacts
22.18			Project-wide	Water impacts	Mitigation/management	**Water Related Impacts** - The extent of threat (risk), impact and the benefits of any mitigation measures proposed should be addressed.	The extent of threat (risk), impact and the benefits of any mitigation measures proposed should be addressed.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Appendix T Section 4.2 Matters of National Environmental Significance

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
22.19			Project-wide	Matters of National Environmental Significance	Biodiversity loss	**Water Related Impacts** - It is unclear what the exact extent of project activities and their associated impacts will be. This includes all disturbances associated with project infrastructure and proposed management and rehabilitation activities. The EIS needs to present a clear and reasoned discussion of the potential impacts to all MNES which may be affected by the development of the RHEP. The discussion should include all species which are considered potential, likely or confirmed to be present, e.g. Squatter Pigeon, Ornamental Snake and Koala. There is no indication of the level of direct impact. The EIS has not explained why King Blue-grass, Eastern long-eared Bat, Yakka Skink and Dunmall's snake were excluded from consideration of potential impacts associated with the RHMP. Appendix Q2 defines the likely impact to Brigalow at 188 hectares while Section 9 defines the likely disturbance to 705.2 ha, with 270 ha being cleared and fragmented. The estimation of potential impacts should be consistent through the EIS, unless suitable explanation is provided.	Assess the impacts to the listed threatened species and ecological communities and any others that are found to be or may potentially be present in areas that may be impacted by the project.	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 8.4.2.1 Clarification of potential Impacts to the Brigalow (Acacia harpophylla dominant and co-dominant) Threatened Ecological Community
22.20			Project-wide	Matters of National Environmental Significance	Ecologically sustainable development	**Water Related Impacts** - Refer to preceding comments regarding the assessment of the impact to the listed threatened species and ecological communities and any other that are found or may potentially be present in areas that may be impacted by the project	Identify which component of the project is of relevance to each listed threatened species or ecological community or if the threat of impact relates to consequential actions from: - a decrease in the size of a population or a long-term adverse effect on an ecological community - reduction in the area of occupancy of the species or extent of occurrence of the ecological community - fragmentation of an existing population or ecological community - disturbance or destruction of habitat critical to the survival of the species or ecological community - disruption of the breeding cycle of a population - modification, destruction, removal, isolation or reduction of the availability or quality of habitat to the extent that the species is likely to decline - modification or destruction of abiotic (non-living) factors (such as water, nutrients or soil) necessary for the ecological community's survival - the introduction of invasive species that are harmful to the species or ecological community becoming established - interference with the recovery of the species or ecological community	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Appendix T Section 8.4 Matters of National Environmental Significance
22.21			Project-wide	Aquatic Ecology	Aquatic ecology impacts	**Water Related Impacts** - S9.6.3.3 - Insufficient detail regarding how the impacts of subsidence will be beneficial for the cotton pygmy goose and ornamental snake, noting that a number of the known threats to this species, such as ingestion of Cane Toads, are not discussed.	Identify and evaluate any positive impacts. Appropriate justification, discussion and quantification must be provided to clearly demonstrate how a positive benefit will be realised	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 8.4 Matters of National Environmental Significance
22.22			Project-wide	Aquatic Ecology	Assessment methodology	**Water Related Impacts** - As above	The following information must be provided when assessing impacts on listed threatened species and communities: - discuss the relevant species or community in respect of known threats and those threats posed by the proposed action - clearly describe the methodologies for presence/absence of the relevant species or community - quantify and discuss likely direct, indirect and downstream impacts from the proposed action, including subsidence - identify relevant matters on maps with locations of infrastructure proposed - describe and assess the effectiveness of avoidance and mitigation measures and the anticipated benefit of these measures - quantify and discuss residual impacts - assess the level of impact and its acceptability and provide a rationale - must propose offsets to compensate for any residual significant impacts in accordance with the *EPBC Act environment Offsets Polity* and associated *Offsets Assessment Guide*	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 and those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission including DOTE's offsets requirements as outlined in email correspondence from TL to BM dated 26 May 2014.	Appendix T Section 8.4 Matters of National Environmental Significance

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
22.23			Project-wide	Nature Conservation	Assessment methodology	**Water Related Impacts** - It is unclear how the ecological surveys presented meet the current survey requirements, noting that historical surveys may not be representative of the current flora and fauna diversity in the project area. Inconsistent description of the ecological values: the discussion of Amphibian diversity in the Fauna technical report addresses diversity of flora and fauna, but this discussion is missing from a number of key flora and fauna discussions. The EIS needs to either provide a supported discussion establishing the suitability of historic surveys, or address gaps in recent survey areas through additional, appropriately scoped and targeted surveys	Survey conducted for the project must demonstrate that they comply with relevant Commonwealth survey guidelines, unless adequate justification for alternative survey methodology can be provided	EPBC Act (controlled action)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the key actions outlined in meeting minutes from discussions held between DOTE, OCG and BMA on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Proponent to provide response as per the key actions outlined in meeting minutes from discussions held between DOTE, BMA and OCG on 20/21 March 2014 including those actions listed in the supporting EIS cross referencing spreadsheet for the relevant item in the DOTE submission.	Appendix T Section 8.2 Survey Methodology
23.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
23.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
23.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
23.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4/17.5.1.6 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
23.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
23.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
23.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
23.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
23.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
23.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
24.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
24.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
24.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
24.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
24.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
24.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
24.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
24.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
24.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
24.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
25.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
25.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
25.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
25.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
25.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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25.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
25.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
25.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
25.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
25.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
26.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
26.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
26.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
26.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
26.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
26.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
26.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
26.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
26.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted

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26.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
27.1	Powerlink	Public Organisation	Project-wide	General Comment	Legislation/Administering authorities	S1.13.1 - The regulations relating to electrical safety and working around live parts	Add the *Electrical Safety Regulation 2013* to the list of relevant legislation as it defines safety exclusion zones for working around electricity infrastructure	Electricity Act (various approvals for supplying electricity or for disturbing overhead powerlines)	Yes	Proponent to provide response		Proponent to note. Update EIS, as required	Appendix T Section 11.5 Power Infrastructure
27.2			Project-wide	Subsidence	Impacts	S3.7.7 - Subsidence impacts on Powerlink infrastructure	Note Powerlink's requirements for NO subsidence on a registered Powerlink easement. The proximity of which underground operations can occur surrounding these structures will need to be assessed based on relevant engineering and geological studies, which need to be submitted to Powerlink for review. Add Powerlink easements to any plan highlighting subsidence locations.	N/A	Yes	Proponent to provide response		Proponent to provide a response in EIS and update as required.	Appendix T Section 11.5 Power Infrastructure
27.3			Project-wide	Subsidence	Mitigation/management	S3.7.7, 5.1.9.1 - Line and substation realignments	Change wording to reflect that both the substation and line will be impacted by subsidence and will require relocation based on the current proposal. This will be subject to Powerlink's approval and at BMA's expense. BMA needs to work with Powerlink on the substation relocation and line realignment	N/A	Yes	Proponent to provide response		Proponent to note requirements and work with Powerlink on substation realignment, as required.	Appendix T Section 11.5 Power Infrastructure
27.4			Project-wide	Land	General Comment	F5.1-9 - Map shows affected power line although substation is missing	The affected substation is not shown. Powerlink requests the affected substation, located on Lot 172 of SP237593, be added to Figure 5.1-9	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, as required.	Appendix T Section 11.5 Power Infrastructure
27.5			Project-wide	Land	General Comment	Access requirements	Powerlink requires ongoing and unfettered access to its easements. The projects needs to avoid the need for lengthy inductions to gain access, e.g. placement of security gates, secure work areas etc., so as not to restrict Powerlink access under the Electricity Act.	N/A	Yes	Proponent to note		Proponent to note.	Appendix T Section 11.5 Power Infrastructure
28.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
28.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
28.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
28.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
28.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
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29.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
29.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
29.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
29.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
29.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
29.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
29.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
29.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
29.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
29.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
30.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
30.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
30.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
30.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
30.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
30.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
30.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
30.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
30.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
30.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 and 17.5.4.1 - Housing impacts - Increased vacancies in the area as well as Bushlark Grove Estate - affordable housing and land that can not be sold. Rental and land prices are affordable. 100% FIFO will not assist in housing workers in the community. Against the interest of the local community/not supporting the community	State Government to take account of the situation - do not approve 100% FIFO for Red Hill. Repeal 100% FIFO arrangement for Caval Ridge and Daunia. Mining companies to subsidise the rental accommodation to a value that is less than the total cost of flying workers	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.2				Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - Remote workforce - 100% FIFO - not allowing their workers to live in the local community unless they FIFO from the likes of Brisbane. Peabody has reduced its workforce by a significant number in favour of FIFO workers.	Reverse the 100% FIFO decision immediately. Listen to local Council and other stakeholders who have warned of the negative impacts on the local community.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.3				Social impact assessment/SIA	Social - Employment strategy	S17.5.1.3 - Declining population in town due to FIFO policies affecting local community and business	Reverse the 100% FIFO decision and provide incentives to employ local workers and allow them to live or rent accommodation Moranbah. Ensure all future policy takes the local community interests into account before providing such FIFO policy.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services. The situation in Moranbah has changed dramatically since the report with large vacancy rates	Provide choice for workers to reside either locally or at camp. Ensure all future policy takes the local community interests into account before providing such FIFO policy	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
31.5				Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - community values have been eroded and will continue to do so due to 100% FIFO policy and insufficient local employment opportunities	Reverse the 100% FIFO decision and provide incentives to employ local workers and allow them to live or rent accommodation Moranbah. Allow policy decisions effecting the local communities, not to be endorsed by large enterprise	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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31.6				Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	Better support from government to benefit the local community. Government to adapt to the needs of this mining community in times of rapid change such as the present	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
31.7				Transport	Cumulative Impacts	S17.5.1.9 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Additional overtaking lanes	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
31.8				Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. Provide equal opportunity to all workers to live within the local community. Tax incentives for abolishing mining camps	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
31.9				Social impact assessment/SIA	Social - Community values and change	S17.5.5.3 - Council representatives were concerned that Moranbah was beginning to turn into a town with a large population of non-residents, limiting opportunities for permanent population to grow	State Gov. should listen to Local Gov. and oppose 100% FIFO. Tax incentives for allowing employees to live in the local community.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.10				Social impact assessment/SIA	Social - Housing impacts	S18.3.2 and 18.4 - 3000 accommodation is proposed when there is currently adequate opportunity to house workers in Moranbah. No social or economic benefit for the local or regional community if people have to move to Brisbane or Cairns to get jobs.	Reduce the number of accommodation units in line with current vacancy and land availability. Allow local community workers to gain employment in BMA and other such mines	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.11				Social impact assessment/SIA	Social - Regional economies and businesses	S18.3.2 - Local and regional housing values have plummeted since an oversupply of land was endorsed by government. Local rental vacancy rates have reached excessively high levels	Reverse the 100% FIFO decision immediately. Cap the FIFO and camp accommodation. Withhold future land releases until the market stabilises	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.12				Social impact assessment/SIA	Social - Housing impacts	S18.18 - BMA instituted a rent control policy in 2011 followed up by the State government approval of 100% FIFO and has had disastrous impacts	Reverse the 100% FIFO decision immediately. Cap the FIFO and camp accommodation. Withhold future land releases until the market stabilises	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
31.13				Social impact assessment/SIA	Cumulative Impacts	S18.19 - the contribution of the GRM incremental expansion and RHM underground expansion options to cumulative impacts is expected to consist of negligible impact on cumulative impacts on housing access and affordability in Moranbah. This is incorrect	Do now allow RHM to be 100% FIFO. Reverse the current 100% FIFO policy and precedent before other mining companies take advantage of this failed and short sighted policy	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
32	Department of Housing and Public Works	State Government				No comment - there are no issues associated with the project related to the department							No response required
33.1	Private Submitter	Private Submitter - Landholder	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
33.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
33.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
33.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
33.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
33.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted

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33.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
33.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
33.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
33.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
34.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
34.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
34.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
34.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
34.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
34.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
34.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
34.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
34.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
34.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
35.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
35.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
35.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
35.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
35.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
35.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
35.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
35.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
35.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
35.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
36.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
36.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
36.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
36.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
36.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
36.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
36.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
36.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
36.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
36.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
37.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
37.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
37.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
37.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
37.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
37.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
37.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
37.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
37.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
37.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
38.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
38.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
38.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
38.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
38.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
38.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
38.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
38.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
38.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted

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38.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
39.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
39.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
39.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
39.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
39.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
39.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
39.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
39.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
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39.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
40.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
40.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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40.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
40.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
40.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
40.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
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40.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
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40.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
41.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
41.2			Project-wide	Social impact assessment/SIA	Social - Workforce	**S17.5.1.2** - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
41.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**S17.5.1.3** - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
41.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**S17.5.1.4** - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
41.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	**S17.5.1.6** - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
41.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**S17.5.1.8** - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
41.7			Project-wide	Transport	Transport - road	**S17.5.1.8** - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
41.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**S17.5.4.2** - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
41.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**S17.5.5.3** - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
41.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**S17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
42.1	Department of Natural Resources and Mines	State Government	Project-wide	General Comment	General Comment	**Cover letter** - NRM has identified a number of outstanding issues with the EIS in relation to Groundwater, Surface Water, Groundwater Dependent Ecosystems, Land Resources and Mining aspects and further information will be required from the proponent in order to assess project impacts and determine appropriate mitigation measures.	NRM has identified a number of outstanding issues with the EIS in relation to Groundwater, Surface Water, Groundwater Dependent Ecosystems, Land Resources and Mining aspects and further information will be required from the proponent in order to assess project impacts and determine appropriate mitigation measures.	N/A	No	Proponent to note		Proponent to note	Submission noted
42.2			Project-wide	Transport	Stock routes	**5.1.10.2 Stock Routes** - Shifting of stock routes - preference is for one major shift rather than several piecemeal realignments.	Continue negotiations between IRC, BMA, and DNRM to attempt to find a practical one stop solution for the Stock Route in the interests of economy and efficiencies for all organisations.	N/A	Yes	Proponent to provide response	As per discussion and agreed actions between OCG, NRM and BMA on 12 March 2014, NRM to contact Peter Klem to discuss in principle agreement of stock route along existing reserve/alignment	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014. Update EIS and Appendix S as required.	Appendix T Section 11.6 Stock Routes
42.3			Project-wide	Project description	Project proponent	**1.3 - The Proponent** - This section includes a brief explanation of the Central Queensland Coal Associates (CQCA).	This section should be expanded to advise if the new operation will be part of the CQCA and how the expansion relates to any legislation such as the CQCA Agreement Act 1968.	N/A	Yes	Proponent to provide response	As per the discussion held between NRM, OCG and BMA on 12 March 2014 add context to section 1.3	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 3.3 Central Queensland Coal Associates Agreement Act 1968
42.4			Project-wide	Stakeholder Consultation	Social - consultation	**2.3.3 Ecologically Sustainable Development Principles** - Despite the suggestion that stakeholder and community consultation and feedback has been collected and incorporated into the EIS (S2.3.3 Table 2-1), the approach appears to focus on gathering information for the proponent rather than establishing a dialogue with the community.	It is suggested that greater emphasis be placed on the emergent approaches to stakeholder engagement, as tabulated in Table 1 Generations of stakeholder engagement in the mining industry, in Community Engagement and Development, Leading Practice Sustainable Development Program for the Mining Industry, RET 2009.	N/A	Yes	Proponent to provide response	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide a cross reference to the relevant section in the EIS which provides the phone number that people can use to contact BMA about the project.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix U
42.5			Proposed Red Hill underground mine	Project Methodology	General Comment	**5.3.2.3 Project Specific Geological Setting -** There does not appear to be a commitment to use LTCC for maximum recovery for the GMS that is beyond the reach of conventional long wall shears. Actual data about the effectiveness of TSM in coal recovery and associated subsidence should be reported in this EIS rather than relying solely on modelling	Amend the EIS to address the effectiveness of TSM in coal recovery and associated subsidence, based on actual data.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide cross reference in the EIS to the sections which describe long wall top coal caving and its effectiveness over conventional long wall mining. Where necessary, BMA to provide further information.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 3.2 Thick Seam Mining
42.6			Proposed Red Hill underground mine	Project Methodology	Subsidence	**8.2.2.2 Additional Potential Impacts -** This section states "Underground mining using conventional long wall mining and thick seam mining methods (long wall top coal caving) will result in subsidence of the overlying strata in the mined-out areas behind the long wall …"	It is suggested to include more information about the increased recovery efficiency for the 10m coal seams expected using LTCC methods and how the increased extraction is balanced against the greater impacts of subsidence at the surface.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide cross reference in the EIS to the sections which describe long wall top coal caving and its effectiveness over conventional long wall mining. Where necessary, BMA to provide further information.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 3.2 Thick Seam Mining
42.7			Project-wide	Groundwater	Impacts	**8.2.2.2 Additional Potential Impacts -** The EIS states "The detailed design phase of the project will, however, consider shallow groundwater occurrence and include any necessary engineering solutions." Given the potential importance of shallow aquifers for stock watering, more detail should be provided in relation to the potential impacts to the parties who may be affected, and the mitigation strategies to inform discussion before the detail design stage.	Provide more detail in relation to the potential impacts to parties who may be affected, and the mitigation strategies to inform discussion before the detail design stage.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide more detail in relation to how potential waterlogging impacts could be avoided/mitigated during the infrastructure detailed design.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.7 Impacts on Shallow Aquifers
42.8			Project-wide	Project Methodology	General Comment	**3.13.7 - Quarry Material Requirements** - The draft EIS states that if suitable material is not available on site construction materials will be sourced from existing authorised quarry operations. It does not however, address any potential impact on the normal supply/demand of extractive resources in the regions impacted by the project, including any mitigation measures.	The draft EIS should be amended to highlight the estimated volume of extractive materials required for construction of the proposed mine and the potential impact on the normal supply/demand of extractive resources in the regions impacted by the project, including any mitigation measures.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014 - Proponent to provide commentary on local supply/demand.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 3.4 Supply of Construction Materials
42.9			Project-wide	Administrative/Other	General Comment	**Appendix F2 Appendices 1, 2 and 3** appear to be missing, DNRM has been unable to confirm methodology and interpretation of laboratory results.	Provide the missing Appendices.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Proponent to provide the missing Appendices (Laboratory Results and Field Assessment Techniques) to Soils and Land Suitability so NRM can complete assessment	Proponent to provide additional appendices.	Appendix T Section 11.2 Soils and Land Suitability Appendix T Appendix F Appendices to the Soil and Land Suitability Assessment

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42.10			Project-wide	Terrestrial Ecology	General Comment	**Appendix F2 Tables 15** - Inconsistency in Land Suitability Assessment with nearby Kilcummin assessment (Shields & Williams 1991). According to Shields & Williams soils with a Plant Available Water Capacity (PAWC) of > 100 mm are suitable (LSC 2, 3) for rainfed cropping. Six soil units (Table 16) should not have been downgraded to marginal or unsuitable as the Kilcummin Area has similar rainfall characteristics.	Reassess PAWC according to Shields & Williams 1991 Land Resource Survey of the Kilcummin Area, Queensland. Department of Primary Industries Land Resource Bulletin QV91001 and amend the EIS.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014 - Proponent to reassess PAWC and amend EIS as required.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 11.2 Soils and Land Suitability
42.11			Project-wide	Administrative/Other	General Comment	**Appendix F2** - Missing Figures 4A, 4B, 5A, 5B and 5C.	Provide the missing Figures.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG		Proponent to provide missing figures in Appendix F2	Appendix T Appendix G Figures from the Soil and Land Suitability Assessment
42.12			Project-wide	General Comment	General Comment	**Appendix F2** - There is no EAT Rating provided in table 10 to confirm the surface layer of the Shallow Vertosols (covering some 846 ha) are unsuitable for use as surface cover for rehabilitation.	Provide the EAT Rating for Shallow Vertosols.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide the EAT rating of Appendix F2	Appendix T Section 11.3 Emerson Aggregate Test (EAT) Rating of Shallow Vertosols
42.13			Project-wide	Land	Land - use and tenure	**5.1.4 – Existing Land Uses** - potential impacts on the resource, or entitlement of Quarry Material Allocation Notice (QMAN) holders along the Isaac River, and mitigation measures for any impacts on any QMAN holders were not addressed in the EIS.	Impacts on entitlements and mitigation measures in relation to potential impacts on the resource, or entitlement of Quarry Material Allocation Notice (QMAN) holders along the Isaac River should be identified within the EIS.	N/A	Yes	Proponent to provide response		Proponent to provide a response.	Appendix T Section 5.5 Geomorphic Impact of Subsidence
42.14			Project-wide	Administrative/Other	General Comment	**7.2.1.2 – Legislative and Policy Framework** - The EIS refers to guidelines and requirements that are now superseded.	The proponent should note the *NRM (2011a) Guideline – activities in a watercourse, lake or spring associated with mining operations* (WAM/2008/3435 – Version 2 2010) has been replaced by *DNRM (2013) Riverine protection permit exemption requirements* . The EIS should be amended to recognise that a Riverine protection permit will not be required to undertake remedial activities in a watercourse, lake or spring provided that the placement of fill or excavation within the watercourse is included in the Subsidence Management Plan approved under the conditions of the EA.	N/A	No	Proponent to note		Proponent to note.	Appendix T Section 4.4 Other Approvals
42.15			Project-wide	Compliance	General Comment	**7.2.1.2 – Legislative and Policy Framework** - The intent of the provision that allows the capture of overland flow as a requirement to meet the conditions of an EA (section 110 (d) of the Water Resource (Fitzroy Basin) Plan 2011 is associated with the capture of mine affected water, as defined under the Environmental Protection Act 1994.	To ensure consistent regulation of mine affected water through both the Water Act 2000 and the Environmental Protection Act 1994, demonstrate that the capture of overland flow is in accordance with the provisions of the Water Resource (Fitzroy Basin) Plan 2011.	Water Act (approvals required for various activities including water course diversions and interfering with groundwater)	Yes	Proponent to provide response	Further information is required	Proponent to provide a response.	Appendix T Section 5.9 Capture of Overland Flow
42.16			Proposed Red Hill underground mine	General Comment	General Comment	**7.3 – Potential Impacts and Mitigation Measures** - The flood hydrology, hydraulics and surface water quality have been based on the October 2011 mine plan, however a new mining plan and sequence has since been developed.	Amend the EIS to incorporate flood hydrology, hydraulics and surface water quality studies with the most recent mine plan to allow for a proper assessment by regulatory agencies.	N/A	Yes	Proponent to provide response	As per the discussion held between NRM, OCG and BMA on 12 March 2014 - Proponent has stated that the change in mine plan is not significant. A minor increase in panel 15 will have Negligible impact to flood hydrology. Proponent agreed to provide further information in this regard.	Proponent to provide a response.	Appendix T Section 5.2 Mine Plan and Sequence
42.17			Project-wide	Surface water	Impacts	**Appendix I7 – 4.5 Summary of Identified Subsidence Voids and 4.6 Significance for Impact Assessment** - The report concludes that the proposed worst case scenario for take associated with subsided long wall panels is 9500ML. Under the Water Resource (Fitzroy Basin) Plan 2011, overland flow can only be taken to satisfy the requirements of an environmental authority (EA) under the Environmental Protection Act 1994. The intent of this provision is associated with the capture of mine affected water, as defined under the Environmental Protection Act 1994.	To ensure consistent regulation of mine affected water through both the Water Act 2000 and the Environmental Protection Act 1994 the proponent will need to demonstrate that the capture of overland flow is in accordance with the Water Resource (Fitzroy Basin) Plan 2011. If not, then the proponent must provide alternative means to minimise and/or mitigate the capture of overland flow in subsided long wall panels to ensure compliance with the provisions of the Water Resource (Fitzroy Basin) Plan 2011.	Water Act (approvals required for various activities including water course diversions and interfering with groundwater)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014 - BMA to prepare a response which cites the Broadmeadow Subsidence Management Plan and detail how the objectives and mitigations contained in that plan will also apply to Red Hill. BMA to provide cross reference back to EIS on these items. Describe any significant differences between current Subsidence Management Plan and the needs of the Project. Provide further information on the parameters proposed for adaptive management approach, as above/Wedeena to liaise internally once BMA response received.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 5.9 Capture of Overland Flow
42.18			Project-wide	Administrative/Other	General Comment	**Executive Summary Section 1.13.3.4 –** The Executive Summary refers to obtaining an operational works approval under the Sustainable Planning Regulation 2009.	The proponent should note that the requirement for a development permit under the Sustainable Planning Act 2009 is not required if the proposed development is located on a mining lease and is considered to be an authorised activity under the Minerals Resources Act 1989.	SPA (Op works approval)	No	Proponent to note		Proponent to note	Submission noted
42.19			Project-wide	Approvals	Water - Waterway diversions	**Executive Summary Section 1.13.3.6 –** (section 1.13.1) page 22 of the EIS indicates there could be a requirement to apply for licences for watercourse diversions and the taking or interfering with surface water under the Water Act 2000.	The proponent should note that if there is a proposal for a diversion, the proponent would be required to meet the provisions of both the Water Act 2000 and the Water Resource (Fitzroy Basin) Plan 2011. DNRM recommend the proponent contact the department prior to the construction of any works that may interfere with the flow of water.	Water Act (approvals required for various activities including water course diversions and interfering with groundwater)	No	Proponent to note		Proponent to note	Appendix T Section 4.4 Other Approvals

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
42.20			Project-wide	Approvals	General Comment	**Executive Summary Section 6 -**Table 1 - Key Approvals Required for the Project identifies the need to obtain licences for bores constructed as part of the dewatering network and Riverine protection permits.	The proponent is required to meet the provisions of both the Water Act 2000 and the Water Resource (Fitzroy Basin) Plan 2011 to obtain approvals required for the project. DNRM recommend the proponent contact the department prior to undertaking riverine activities or the taking of water.	Water Act (approvals required for various activities including water course diversions and interfering with groundwater)	No	Proponent to note		Proponent to note	Submission noted
42.21			Project-wide	Administrative/Other	General Comment	**Appendix J - Section 2, and Section 01 -** It should be noted that a development permit under the Sustainable Planning Act 2009 is no longer required if the proposed works are located on a mining lease and if the proposed works are considered to be an authorised activity under the Minerals Resources Act 1989.	Amend the EIS to note that a development permit under the Sustainable Planning Act 2009 is no longer required if the proposed works are located on a mining lease and if the proposed works are considered to be an authorised activity under the Minerals Resources Act 1989.	MR Act (grant of a mining leases)	No	Proponent to note		Proponent to note	Submission noted
42.22			Project-wide	General Comment	General Comment	**Appendix J – Section 5 -** Geological structures such as fault lines are not clearly indicated on a Map and are necessary for assessment.	Provide a map of geological structures such as fault lines.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide a map of geological structures including fault lines.	Appendix T Section 6.6.1 Fault Details
42.23			Project-wide	General Comment	General Comment	**Appendix J – Section 6.1.1 -** Monitoring bore GW01 referred to in the report is not shown in Figure 6-2.	Update Figure 6-2 to include location of monitoring bore GW01.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to update Figure 6-2 to include location of monitoring bore GW01.	Appendix T Section 6.10 Drilling Data
42.24			Project-wide	General Comment	General Comment	**Appendix J – Section 6.1.1 -** The test data for GW01 and 43840 is not provided. Note that these would be more representative of the Isaac River alluvium.	Provide any test data associated with GW01 and 43840.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per a discussion between OCG, NRM and BMA on 12 March 2014 - URS to check if falling head tests were conducted at GW01	Proponent to provide any test data associated with GW01 and 43840.	Appendix T Section 6.10.5 Bore Data
42.25			Project-wide	General Comment	General Comment	**Appendix J – Section 6.1.4 -** confirm whether the bores used in this section and Chart 6-1 were only tapping the Permian formations, and not intersecting water from upper formations. A map showing the locations of the bores and their yields could identify whether the occurrence of water is sporadic, or whether it is limited to certain areas (for example – near any faulting etc.)	Provide confirmation whether the exploration bores used in this section were only tapping the Permian Formations. Provide a map showing the location and yields of the bores to identify any clustered areas of higher yield. This map should be overlain with location of any fault lines. The report should discuss any observations from that map.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per a discussion held between NRM, OCG and BMA on 12 March 2014, BMA stated that the other bore GW02 (2011 drilling program) was never commissioned. NRM suggested that the model and predictions be refined over time.	Proponent to provide additional information and update EIS as required	Appendix T Section 6.10 Drilling Data
42.26			Project-wide	General Comment	General Comment	**Appendix J – Section 6.2 –** The Goonyella Lower Seam shows an unusually low reading of 387µS/cm. Discussion about this reading/location would be helpful to identify whether it is an outlier or whether it indicates an area of recharge.	Provide some discussion on the low electrical conductivity value for the GLS.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide some discussion on the low electrical conductivity value for the GLS.	Appendix T Section 6.11 Hydrochemistry Data
42.27			Project-wide	General Comment	General Comment	**Appendix J – Section 6.3 -** Recent changes to the Water Act 2000 have changed the timeframes for submitting bore information. Records about each water bore are to be submitted within 60 days after the day drilling commences.	Note the advice and update the EIS where necessary: It is a requirement of the Water Act 2000 that a licensed water bore driller submit the records of the drilling and installation of a water well to NRM within 60 days after commencement of the well.	Water Act (approvals required for various activities including water course diversions and interfering with groundwater)	No	Proponent to note		Proponent to note	Appendix T Section 4.4 Other Approvals Appendix T Section 6.10 Drilling Data
42.28			Project-wide	General Comment	General Comment	**Appendix J – Section 6.3 page 35 -** The figures used do not seem to add up. There should be eleven (rather than seven) other private bores.	Clarification is required on the number of surrounding bores mentioned.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to clarify and amend EIS section in relation to the total number of private bores	Appendix T Section 6.10.3 Registered Bores
42.29			Project-wide	General Comment	General Comment	**Appendix J – Section 6.3 -** The text notes that the four bores found during the census are shown in Figure 6-4. It is not clear whether these (other than 81696) have been included in Figure 6-4.	Amend the Table 6-4 to include the location of the four surrounding bores (e.g. latitude/Longitude or Easting/Northing). The bores should also be identified in Figure 6-4.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to clarify and amend figure 6-4 and table 6-4 of the EIS as required.	Appendix T Section 6.10.4 Bore census details
42.30			Project-wide	General Comment	General Comment	**Appendix J – Section 7.3.3 -** The report notes that there is minor to moderate faulting within the groundwater survey area. There is no discussion on the location and nature of this faulting and whether it potentially provides a drawdown path to upper formations.	Amend the report to include discussion on the nature and location of faulting within the area, and discussion of potential effects on overlying water bearing beds and surface water interactions.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide general discussion about faulting in new section. Reiterate if there are any possible impacts associated with other mines in the area.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.6.2 Groundwater potential and faults
42.31			Project-wide	Surface water	Water balance	**Appendix J – Section 7.3.3 -** Potential groundwater/surface water interactions of surface water stream (e.g. Isaac River) have not been simulated in the model.	The model should include simulation of groundwater/surface water interactions of surface water streams.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide additional information and comment on water interaction, and reiterate commitment to future refinement of the model as new data comes in/put in the future monitoring program.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.8.1 Effect on surface flows
42.32			Project-wide	Surface water	Water - Watercourse impacts	**Appendix J – Section 7.3.7.1 -** The report does not give details on whether this fractured zone intersects upper tertiary/alluvial layers and what effect could occur from both additional water movements down from the Isaac River, and what the loss of water may have on stream flows. If the fracture zone is likely to pass through layers, the hydraulic conductivity should also be modified for those layers.	Amend the report to provide details on the extent of the fractures zone and whether it is likely to reach surface in some places. The modelling should reflect the likely extent of fracturing. (i.e. The hydraulic conductivity in layers above Layer 12 may need to modified to some extent).	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide general discussion about faulting in new section. Reiterate if there are any possible impacts associated with other mines in the area.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.6 Faulting
42.33			Project-wide	Project Methodology	Assessment methodology	**Appendix J – Section 7.5 Table 7-6 -** The same storage co-efficient has been used for all layers. The report does not give details on the rationale for the figure used. The figure adopted for the tertiary/Alluvium layer appears to be at the lower end of the range; however a conservative approach may have been adopted.	Amend the report to provide the rationale for the use of the same storage co-efficient for all layers.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussion between OCG, NRM and BMA on 12 March 2014, BMA to discuss why the storage vales were selected. Proponent to provide general discussion and amend the report to provide the rationale for the use of the same storage co-efficient for all layers.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.2 Modelling Methodology

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
42.34			Project-wide	General Comment	General Comment	**Appendix J – Section 7.5.2, Figure 7-8, 7-9, 7-10, 7-11** The modelled drawdown maps do not show other relevant detail such as location of bores, and surface water features. This makes it difficult to visually note which bores may be potentially affected.	Provide drawdown figures showing the drawdown contours in relation to location of surrounding bores and other relevant features.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per detailed discussion and agreed actions with NRM, OCG and BMA on 12 March 2014. Clarification on monitoring bore locations located on the eastern extent of the mining lease between the mining activity and bores and statement that this is an adequate control point to monitor potential impacts.. No generation of worst case drawdown cones based on sensitivity model runs are required. Provide commentary on sensitivity testing, including statistics where appropriate. In addition to the locations of the bores, DNRM would be interested in information on what formation the proposed bores will be monitoring to ensure a good spread.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.9 Drawdown Predictions
42.35			Project-wide	Groundwater	Water - Groundwater	**Appendix J – Section 7.5.4 -** This section reports on sensitivity runs undertaken on the model. There are no maps showing the extent of drawdowns for these scenarios.	Provide modelled drawdown maps to show the extent of some of the sensitivity cases (the one of most interest would be the worst case – case 8). The map should show drawdown contours in relation to surrounding bores and to relevant features.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation			Appendix T Section 6.9 Drawdown Predictions
42.36			Project-wide	Groundwater	Water - Groundwater	**Appendix J – Section 7.5.4 -** The reports states that the groundwater levels are expected to recover after closure. The report does not indicate the period of time this recovery will occur. This should be backed up by modelling.	The time-frame for the model should be extended to estimate recovery and likely long term recovery levels.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per a discussion with NRM, OCG and BMA on 12 March 2014. Proponent to provide some additional recovery commentary and update maps and figures. A new set of figures will be generated to include all missing and requested data including bores, faults, rivers and creeks as well as model predictions.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.15 Post-closure Recovery
42.37			Project-wide	Groundwater	Water - Groundwater	**Appendix J – Section 8.3.1 -** More detail on proposed monitoring locations is required. It is difficult to assess the effectiveness the proposed additional monitoring bores without having locations and aquifers The monitoring program should ensure that it adequately monitors a number of aquifers (e.g. alluvial, tertiary, Permian, coal measures) at a number of locations. Details of the a proposed monitoring program will need to be approved as acceptable prior to measurements being undertaken and prior to issuing of any water licence.	Provide details on the proposed additional monitoring bores, in regard to location and aquifer monitored.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per a discussion with NRM, OCG and BMA on 12 March 2014. Proponent to provide details on the proposed additional monitoring bores as discussed and agreed at the meeting on 12 March 2014.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.14.4 Baseline Groundwater Monitoring
42.38			Project-wide	Groundwater	Impacts	**Appendix J – Section 8.3.2** - The report states that there are not predicted to be any significant impacts on adjacent groundwater users. As per previous comments, a map showing the drawdowns and bore location is needed.	Provide drawdown figures showing the drawdown contours in relation to location of surrounding bores and other relevant features such as watercourses.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014. Proponent to provide further information as discussed and agreed at the meeting on 12 March 2014.	Proponent to provide response as per outcomes of discussion held between NRM, OCG and BMA on 12 March 2014.	Appendix T Section 6.9.1 Drawdown Contour Maps
42.39			Project-wide	Groundwater	Cumulative Impacts	**EIS Section 21.3.4 -** Quantify cumulative impacts on water levels from mines. Better estimates of cumulative drawdowns could be obtained.	Provide better estimates of cumulative drawdowns utilising information from nearby projects.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide additional information on estimates of cumulative drawdowns utilising information from nearby projects.	Appendix T Section 6.16 Cumulative Impacts
42.40			Project-wide	Groundwater	Water - GDEs	**GDE's Appendix K4: Stygofauna Technical Report -** Non compliance with the Western Australian Guidance for stygofaunal sampling as stated in the ToR.	Sample in accordance with the WA Guidance and as recommended by ALS (post-wet season, p19 – in the conclusions of the Stygofauna Technical Report), so that any conclusions about the presence of stygofauna in the project area are based on the outcomes of a robust pilot study. Ensure that the sampling method uses 50micron (not 150 micron) mesh and a solid framed net. A selection of 10 bores representative of be the full range of aquifer types may be chosen from bores GW1, GW2, GW3, GW6, GW7, GW9, GW10, GW11, GW12, 43841, 43841, 45318, 45319, 45320 for the pilot study. Provide the geographical location of the groundwater bores sampled in relation to both the EIS study area and the significant local and regional hydrogeological features. Provide a summary of overall compliance with the WA guidelines (2003 & 2007) including QA/QC protocols for sample collection.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per the discussion held between NRM, OCG and BMA on 12 March 2014, BMA believes that sampling has been carried out in accordance with the WA guideline and will provide further information in this regard.	Proponent to provide further information in relation to compliance with WA Guidelines.	Appendix T Section 6.12 Stygofauna Survey

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42.41			Project-wide	Approvals	Mitigation/management	**Executive Summary** – Page 12 - With reference to the statement on page 12 of the Executive Summary, any clearing of native vegetation is likely to be exempt from the provisions of the Vegetation Management Act 1999 (the VMA) since it will meet the criteria of a "resource activity" as defined in the Environmental Protection Act Section 107.	In the event that the project necessitates the clearing of Category B vegetation, (as defined in the VMA) and the clearing does not satisfy the criteria of a "resource activity", or another exemption listed under Schedule 24 of the Sustainable Planning Regulation 2009, an operational works permit assessed against Table 8.1.4 of State Development Assessment Provisions (SDAP) v 1.1 dated 22 November 2013 (or whichever SDAP provisions are applicable at the time of clearing), will be required before the clearing can occur. Currently there are no areas of Category A (as defined in the VMA) over the area subject the EIS. If, prior to the commencement of clearing operations associated with the project, any Category A areas subject to a Compliance Notice are created within the project footprint, any clearing of these areas will require the provision of an offset under the Biodiversity Offset Policy (BOP) or – in the event that assessment under the BOP does not include the Category A areas – the Policy for Vegetation Management Offsets (the current policy or as replaced from time to time) prior to clearing begin.	SPA (Op works approval)	No	Proponent to note		Proponent to note	Appendix T Section 10 Offsets Strategy Appendix T Appendix B Offsets Strategy
43.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**Section 17.1 and 17.2** - **Housing impacts** - Increased vacancies in the area as well as Bushlark Grove Estate - affordable housing and land that can not be sold. Rental and land prices are affordable. 100% FIFO will not assist in housing workers in the community. Against the interest of the local community/not supporting the community	State Government to take account of the situation - do not approve 100% FIFO for Red Hill. Repeal 100% FIFO arrangement for Caval Ridge and Daunia. Mining companies to subsidise the rental accommodation to a value that is less than the total cost of flying workers	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
43.2				Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.1 and 17.5.4.1 - Remote workforce** - 100% FIFO - not allowing their workers to live in the local community, nor enter the local community for fear of being sacked. 200 locals have been sacked by Peabody and jobs are now advertised as FIFO in Brisbane.	CG require BMA to formally respond to the housing/remote workforce situation. Restrict the % of FIFO workers that BMA can employ at the Red Hill mine e.g.. 80%	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
43.3				Social impact assessment/SIA	Social - Workforce	**Section 17.5.1.2 - Community concern on availability of local employment options.** No job opportunities in Moranbah. Moving to Cairns and Brisbane to get work. Sustaining Moranbah's population growth	Workers that reside in the Moranbah/Mackay areas need to be considered first for the jobs so that they don't have to move to get employment within their region.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
43.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.4** - Potential impact the proposed accommodation village would have on **demand for local health and emergency services**	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
43.5				Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.1.6 - Decreased feeling of community**	Introduce incentives to companies to live in the town or in a camp. BMA to maintain a % of employees that live in the local community for the Red Hill Mine. BMA to sponsor more local activities.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
43.6				Social impact assessment/SIA	Social - Demand on emergency /health service resources	**Section 17.5.1.8** - Some stakeholders voiced **dissatisfaction with various levels of government and government delivery** **of social infrastructure and services** to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
43.7				Transport	Transport - road	**Section 17.5.1.8** - Concerns regarding **traffic and transport impacts** were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
43.8				Social impact assessment/SIA	Social - Training and apprenticeships	**Section 17.5.4.2** - The project should bring **jobs, apprenticeships and trainee schemes to the community, employing local people first** before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
43.9				Social impact assessment/SIA	Social - Community values and change	**Section 17.5.5.3** - Council representatives were concerned that Moranbah was beginning to turn into a town with a large population of non-residents, limiting opportunities for permanent population to grow	State Gov. should listen to Local Gov. and oppose 100% FIFO. Tax incentives for allowing employees to live in the local community.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
43.10				Social impact assessment/SIA	Social - Housing impacts	**Section 17.5.5.3** - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for **BMA and was told she would lose her job if she signed a lease.**	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
43.11				Social impact assessment/SIA	Social - Regional economies and businesses	Section 18.3.2 and 18.4 - No social or economic benefit for the local or regional community if people have to move to Brisbane or Cairns to get jobs.	Introduce incentives to companies to live in the town or in a camp. BMA to maintain a % of employees that live in the local community for the Red Hill Mine.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
44	Department of Education, Training and Employment	State Government	Project-wide	Administrative/Other	Social - Employment strategy	An engineering, procurement and construction management (EPCM) contractor is likely to require liaison with Construction Skills Queensland and the Department of Education Training and Employment	BMA commit to reflect all skilling and training/employment strategies in contracting and sub-contracting arrangements. DETE notes that BMA's EPCM contractor will liaise with Construction Skills Queensland and DETE 12 months prior to commencement of construction. Initial contact with DETE should be with: Peter McDuff, Director Training, Central Queensland Region, DETE. Ph.: 07 4842 8376 Fax: 07 3220 6090 Email: peter.mcduff@dete.qld.gov.qu Web: www.training.qld.gov.au	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Update Appendix S - BMA Commitments, as required.	Appendix S Commitments Update
45.1	Isaac Regional Council	Local Government	Project-wide	Transport	Infrastructure	S3.10 - No off lease road upgrades are proposed	Traffic studies be carried out that consider and allow for ALL traffic movements (peak hour and non-peak hour) generated by the project. Slow vehicles & wide loads not allowed on this road between 5 AM & 7 AM 5 PM & 7 PM 7 days a week". This restriction effectively removes most construction and large vehicles from the peak hour study period.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to clarify and provide additional information about the survey methodology used with reference to IRC's concerns about slow vehicle and wide load exclusions from the study.	Appendix T Section 15.3 Traffic Movements
45.2				Project description	Infrastructure	S3.13.7 - Quarry materials for road construction and building / equipment foundation preparation are to be sourced from existing authorised quarry operations in the region. This activity alone should trigger road upgrade requirements for Goonyella Road and Moranbah Access Road and provision should be made for the upgrade of these roads.	Provision should be made for upgrade of these roads in any initial approval that may be given.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	OCG acknowledges Appendix S - BMA Commitments number 186 regarding intersection upgrades.	Amend EIS including Appendix S - BMA Commitments number 186 to reflect ongoing negotiations between IRC and operator for the upgrade of these roads.	Appendix T Section 15.3 Traffic Movements Appendix T Section 15.5 Mitigation
45.3				Surface water	Flooding impacts	S3.13.5/8 - Construction of levee will potentially cause damage to the riparian environment, erosion, reduction of floodplain waterway area	Extend flood modelling to downstream environment of the Isaac River and affected infrastructure. High priority gives to all weather resilience related flood prevention measures.	N/A	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of flood modelling in project study area	Proponent to provide response	Appendix T Section 5.11 Flooding
45.4				Waste	Waste - Waste management	S6.3.1 - Mined waste contribution to potential environmental harm is expected to be small	What is the proposed environmental solution to the generated acids, including the potential investment in basal materials to neutralise PAF and PAF-LC wastes?	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of environmental solution to the generated acids	Proponent to provide response	Appendix T Section 16.2 Mine Waste
45.5				Waste	Water Quality	S6.3.2 - No reference of guideline values regarding total metal concentrations	Clarify if the guidelines exist	N/A	Yes	Clarify issues with proponent/agencies prior to CG report		Proponent to clarify reference to guideline	Appendix T Section 5.13 Water Quality Criteria
45.6				Waste	Water Quality	S6.3.2 - The current EC (1:5) levels are within the salinity range (0 to 7463 microSiemens per centimetre (µS/cm)) recommended for livestock drinking water in Australia (ANZECC and ARMCANZ 2000).	Table 9.3.3 of the guidelines shows tolerances of livestock to total dissolved solids (salinity) in drinking water shows the peak level for salinity to be 5000 µS/cm, not as stated 7463 µS/cm. It is recommended that any controlled releases be monitored and the releases should not exceed 1000 µS/cm to ensure the downstream cumulative impact is low.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mine water release	Proponent to provide response	Appendix T Section 5.13 Water Quality Criteria Appendix T Section 5.18 Water Quality Monitoring
45.7				Waste	Waste - Waste management	S6.4 - The proposed mining strategy is to dispose all rejects and almost all overburden materials within the existing GRB mine complex waste storage facilities.	Recommend all rejects, waste rock and spoil to be deposited into "Final voids" of Goonyella and Riverside open cut mines and covered with sufficient overburden from stockpiles and topsoil prior to revegetation.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mine waste disposal	Proponent to provide response	Appendix T Section 16.2 Mine Waste
45.8				Waste	Waste - Waste management	S6.4 -The majority (78 per cent) of overburden, coal roof and coal floor, coarse reject and tailings samples tested have pH values greater than 9.0, which is regarded as very high and likely to have direct effects on plant growth if not appropriately managed (DERM 1995a and 1995b).	Although the overburden is very high pH, the topsoil, which is stockpiled on open cut facilities, is at an acceptable pH to permit revegetation with local species. Use of the topsoil stockpiles is recommended where the high pH overburden is used as fill.	EP Act (approvals of EA's and proposed plans for environmental impacts)	No	Proponent to note		Proponent to note	Submission noted
45.9				Subsidence	Water - Watercourse impacts	S7 - Subsidence of waterways will not be considered acceptable due to ephemeral regional waterways	It is therefore recommended that all long wall operations under waterways be carried out as board and pillar excavations with minimal subsidence accepted.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mitigation measures proposed to address impacts on waterways	Proponent to provide response	Appendix T Section 3.2 Thick Seam Mining
45.10				Surface water	Legislation/Administering authorities	S7.2.1.2 - No diversion of watercourses	Although there are no diversions required, the subsidence stated within the EIS are, in themselves, interference as the ponding caused by the subsided areas will reduce the natural flow during low flow periods. It is advised that BMA contact EHP, formerly DERM, for further clarification as IRC holds grave concerns for the waterways.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mitigation measures proposed to address impacts on waterways	Proponent to provide response	Appendix T Section 5.9 Capture of Overland Flow
45.11				Surface water	Water - Watercourse impacts	Surface water discharges from the project and the associated surface water monitoring are also regulated with EA conditions.	The Environmental Authority (EA) also extends to subsidence under waterways and, although the original EA may currently have no such conditions, IRC recommends that conditions requiring the use of board and pillar long wall operations are to be inserted in the amended EA conditions to ensure the continual flow of these ephemeral waterways.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mitigation measures proposed to address impacts on waterways	Proponent to provide response	Appendix T Section 3.2 Thick Seam Mining

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
45.12				Surface water	Water Release	S7.2.3.4 - Release criteria under flow conditions: – the salinity of mine affected water released from GS4A must not exceed an electrical conductivity (EC) level of 10,000 µS/cm; and – the salinity in the Isaac River at the downstream release point must not exceed an EC of 2,000 µS/cm.	The salinity of mine affected water released into this area of the Isaac River would increase the overall salinity of the Fitzroy basin, due to the downstream mining activities also discharging high saline mine affected waters. It is recommended that the releases at GS4A not exceed 2,000 µS/cm. Table 7.9 shows the median value of 220 µS/cm in the Isaac River. A release of 10,000 µS/cm would not be an acceptable increase. The EC of 2,000 µS/cm may be achieved via use of reverse osmosis technology.	EP Act (approvals of EA's and proposed plans for environmental impacts)	No	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of water release conditions	Proponent to provide response	Appendix T Section 5.13 Water Quality Criteria Appendix T Section 7.2 Water Storage
45.13				Hazard and Risk	H&R - Hazardous substances	S7.3.1 - Plant and equipment utilised during construction will contain diesel, oil and other hydrocarbons and it will also be necessary to store diesel and oil for use during construction.	Any storages of flammable or combustible liquids must be stored in accordance with AS 1940-2004 “The storage and handling of flammable and combustible liquids”, as stated in 20.6.2.6. Design plans of such storages must be submitted to EHP and to Council prior to commencement.	EP Act (approvals of EA's and proposed plans for environmental impacts)	No	Proponent to note	EA condition	Proponent to note	Appendix S Commitments Update
45.14				Surface water	Conditions	S7.3.2.1 - Mine water from the RHM will be managed by transferring it to the GRB mine water management network.	The EA for GRB must be amended to show the RHM waters entering and exiting. All operational changes must be assessed and approved by EHP prior to implementation to ensure all downstream impacts are factored in.	EP Act (approvals of EA's and proposed plans for environmental impacts)	No	Proponent to note	OCG to rely on advice from state agencies to determine adequacy of mine water management	Proponent to note	Submission noted
45.15				Surface water	Water Release	S 7.3.2.5 - The project will not adversely impact on the capability of the GRB mine water management system to comply with the current EA conditions for flow release limits applicable in the Isaac River downstream of the mine releases.	7.3.2.4 states that “there is a potential for the project to generate an average water surplus of approximately 640 ML/year...” Will this potentially have an adverse effect on the storage capabilities of the project, or will there be an increased volume of releases?	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mine water release	Proponent to provide response.	Appendix T Section 7.2 Water Storage
45.16				Subsidence	Water Quality	S7.3.4.2 - Subsidence will create ponds of varying depths and permanence	RHM is required to monitor any ponding from subsidence to ensure all mosquito breeding is controlled in the interests of public health.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	S20.6.2.10 of EIS - Should the ponds created through subsidence result in mosquito or midge breeding, eradication programs will be implemented in conjunction with Queensland Health and the local authority	Proponent to provide response. Update Appendix S as required.	Appendix T Section 17.4 Disease Vectors, Vermin and Pests
45.17				Subsidence	Land - Topography, geology and soils	S7.3.5.1 - Subsidence impacts are not determined to be significant in terms of instigating long term large scale geomorphological change	Use of board and pillar techniques under waterways will reduce the incidence of subsidence	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mitigation measures proposed to address impacts on waterways	Proponent to provide response.	Appendix T Section 3.2 Thick Seam Mining
45.18				Subsidence	Subsidence	S7.3.6.4 - Assuming that the voids in RH101 and RH102 (see Figure 7- 19) will be drained, the remaining total volume of the worst case subsidence voids would be approximately 7,400 ML.	If it is feasible to drain these two voids into the Isaac River, It should also be feasible to dig a drainage channel to link all voids with the river.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of mitigation measures proposed to address impacts on waterways	Proponent to provide response.	Appendix T Section 5.10 Mitigation of Subsidence Impacts
45.19				Groundwater	Water - Groundwater	S8.2.4 - Water scarcity during the lifetime of the project can be a significant issue and further discussed in the comment for S21.3.9.6	Consider contingency water supplies and BMA's long term capability to supply groundwater users	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, as required	Appendix T Section 3.5 Water Supply Appendix T Section 6.14.3 Groundwater Monitoring and Management Program Commitments
45.20				Groundwater	Water - Groundwater	S8.2.4.6 - Monitor groundwater levels to track recovery and validate predictive groundwater modelling when significant drawdown occurred	Clarify significant drawdown, monitor groundwater resource recovery post-project in collaboration with DNRM	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of groundwater monitoring	Proponent to provide response	Appendix T Section 6.9.1 Drawdown Contour Maps Appendix T Section 6.14 Monitoring Program
45.21				Groundwater	Impacts	Fig8-3 - This indicates a limited area used for groundwater studies, hence figure 8-6, 8-7, 8-8, and 8-9 of draw down modelling are likely to be inaccurate	The study area should be extended to include a greater area of the Isaac river basin for a more accurately measure	N/A	Yes	Proponent to provide response	OCG to rely on advice from state agencies to determine adequacy of groundwater modelling	Proponent to provide response.	Appendix T Section 6.2 Modelling Methodology
45.22				Terrestrial Ecology	Terrestrial Ecology - terrestrial fauna	S9.3.9.1 - North-south connectivity is provided by the Isaac River riparian corridor, which joins a large tract of vegetation at the Burton Range	Explain what will be done to improve habitat connectivity if natural North to South connectivity destroyed during mining and/or development	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, as required	Appendix T Section 8.6 Impacts on Riparian Vegetation
45.23				Terrestrial Ecology	Aquatic ecology impacts	S9.6.1.1 - The final footprint of the levee bank has not been determined and can be located to minimise impacts on good quality riparian vegetation	Outline the processes that will be put in place to minimise impacts on 'good quality riparian vegetation' (explain the classification of good quality)	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, as required	Appendix T Section 8.6 Impacts on Riparian Vegetation
45.24				Terrestrial Ecology	Terrestrial Ecology - terrestrial fauna	S9.6.2.4 - As the installation of the gas management infrastructure progresses, food and shelter resources will be diminished and density of fauna in the area man also diminish	Outline what will be done to minimise fauna entering camp areas in search of viable food sources or dwellings	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, as required	Appendix T Section 8.5.1 Introduced Fauna
45.25				Terrestrial Ecology	Terrestrial Ecology - terrestrial fauna	S9.6.4.1 - The loss or degradation of wildlife corridors will impact fauna dispersal and reducing fauna and important habitat	How to counter the loss of mobility of fauna via corridors by the project. Development of alternative wildlife corridors should be cooperated into planning for fauna management and post mining rehabilitation plans	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, as required	Appendix T Section 8.6 Impacts on Riparian Vegetation
45.26				Air quality	Coal dust management	S11.3.1.2 - The EIS states 'EHP has adopted a guideline for dust deposition of 120 mg/m2/day to nearby coal mining activities in relation to nuisance levels of dust'	Clarify where is this figure provided by EHP	Environmental Authority (EP Act)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response. Update EIS, as required	Appendix T Section 13.3 Air Quality Criteria
45.27				Air quality	Coal dust management	S11.3.3 - Current dust pollution should be from anthropogenic sources, including construction, resource extraction and denuding native vegetation rather than a combination of natural and anthropogenic sources as stated in the EIS	Recognise the fact that dust nuisances in the Moranbah area are primarily due to anthropogenic activities	N/A	No	Proponent to note		Proponent to note	Submission noted
45.28				Air quality	Coal dust management	S11.3.3.1 - Inappropriate location of the Moranbah airport provides inaccurate baseline data, and will skew assessments of RHM's dust emissions	Select an alternative site to conduct dust monitoring activities to determine a more accurate baseline level	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 13.4 Baseline Data
45.29				Greenhouse Gas Emissions	Hazard and risk - health and safety	S12.2.2 - No definitive schedules or plans provided for the greenhouse gas emission mitigation methods	Provide a definitive commitment to pursuing to minimise greenhouse gas emissions by the project	N/A	Yes	Proponent to provide response	OCG notes existing commitments to reduce GHG emissions in Appendix S - BMA Commitments	proponent to update response.	Appendix T Section 14.3 Mitigation
45.30				Noise and Vibration	General Comment	Inconsistency between S13.1.1.2 and S13.1.3.1 in terms of construction hours	Confirm that construction activities will adhere to the noise requirements under the EP Act	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Clarify issues with proponent/agencies prior to CG report		Proponent to provide response. Update EIS, as required	Appendix T Section 12.4 Construction Activities

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45.31				Noise and Vibration	Monitoring	S13.3.1.4 - Long-term noise impacts to residents and the surrounding environment in the proximity of the Moranbah township	Provide data from noise monitoring station/s to the council's Environmental Health team upon request to assist in planning and management activities to manage regional noise pollution	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 12.5 Monitoring
45.32				Noise and Vibration	Legislation/Administering authorities	S13.3.1.5 - Notify the Council and EHP if noise complaints from private residents is considered environmental harm under the EP Act	Insert sentence below "If the monitoring indicates exceedance of the nominated noise limits then further action will be taken as follows: "stating that IRC is notified of significant residential complaints and/or incidents involving noise pollution constituting environmental harm under the EP Act"	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix T Section 12.5 Monitoring
45.33				Transport	Transport - road	S14.2 - Traffic studies consistently refer to peak hour volumes only	Studies need to demonstrate and allow for total daily traffic volumes and not be limited to peak hour traffic	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS.	Appendix T Section 15.3 Traffic Movements
45.34				Transport	Transport - road	S14.4.1.3 - If the intersections of relevant roads have not been upgraded by the time the project starts how does the proponent propose to minimise the damages and ensure the sustainability of the roads from the additional load of traffic	Provide details on how the proponent proposes to minimise the damages and ensure the sustainability of the roads, when the additional load of traffic from the project begins	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix T Section 15.5 Mitigation
45.35				Transport	Airport	S14.4.6 - The project will result in approximately 30 additional round trips per week at the Moranbah Airport during operations	Provide details on how the additional 30 round trips will affect the public's access	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 15.4 Impact Assessment
45.36				Project description	Infrastructure	S14.4.7 - Impacts to existing infrastructure. Refers to S5.1 to detail the effects on existing infrastructure that only identifies homesteads in the locality	Does not consider or assess other infrastructure and is considered ambiguous and misleading	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS as required.	Appendix T Section 11.7 Land Use Impacts
45.37				Waste	Waste - Mine waste water	S15.5.1.1 - Sewage will be treated on site in package STPs and disposed of either by irrigation or reused for dust suppression	Under no circumstances will raw or treated sewerage wastes be permitted to be release within 50m of a waterway	EP Act (approvals of EA's and proposed plans for environmental impacts)	No	Proponent to note	OCG to rely on advice from state agencies to determine adequacy of sewage disposal/STPs	Proponent to note	Appendix T Section 16.3 General Waste
45.38				Waste	Waste - Waste management	S15.5.1.1 - Preferentially tyres will be reused for practical uses on site such as barriers, drainage and markers	The tyres for these purposes must be installed in a way which prevents water ponding for mosquito breeding, i.e. filled with dirt or drilled out	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS as required.	Appendix T Section 16.3 General Waste
45.39				Waste	Waste - Waste management	S15.5.1.1 - Burning of green wastes will only occur as a last resort, subject to obtaining necessary permits and approvals (table 15.1)	Provide further details on the definition of when and what would trigger a last resort burning of green waste on the site	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments as required.	
45.40				Waste	Waste - Waste management	S15.5.1.2 - Wet batteries will be stored in a central bundled facility	Storage area must be covered and protected from the elements	N/A	No	Proponent to note		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix T Section 16.3 General Waste
45.41				Cultural Heritage	Social - consultation	S16.1.4 - It does not state how much consultation with the relevant stakeholders for the best Cultural Heritage Management Plan (CHMP)	Ensure continued consultation with the appropriate stakeholders is achieved to ensure the best CHMP	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix U
45.42				Stakeholder Consultation	Social - consultation	S17.5.1.5 - The mention of BMA initiating an agreement with local medical centres to provide services to its non-residential workers for the Moranbah Hospital's ongoing issues	Funding for better equipment, more beds and staff, as the State does not include non-residential workers in their data	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix U
45.43				Cumulative Impacts	Water - Groundwater	S21.3.4 - Predictive groundwater modelling did not include consideration of future mine operations	Future mine operations should be considered in the predictive groundwater modelling	N/A	No	Proponent to note	OCG to rely on advice from state agencies to determine adequacy of groundwater modelling	Proponent to note	Appendix T Section 6.2 Modelling Methodology
45.44				Transport	Transport - road	S21.3.9.1 - The large number of transient workers accessing the road and highway between 2013 and 2020 exacerbates existing traffic congestion and road failure issues due to cumulative impact	Consider the potential to stagger shift changes to reduce traffic congestion during peak usage time apart from suggested intersection upgrades in the EIS	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 15.3 Traffic Movements
45.45				Transport	Transport - rail	S21.3.9.4 - No reference of cumulative impacts to air quality regarding aeolian coal deposition during rail transport	Consider the potential cumulative impacts to air quality regarding to aeolian coal dust deposition on the Moranbah - coal terminal routes	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 13.5 Dust Emissions
45.46				Project Methodology	Cumulative Impacts	S21.3.9.6 - Based on climate change projections by CSIRO that RHM will likely be operating in an increasingly dry region with increasing demand upon water resources due to mining activities	Clarify how BMA proposes that water availability will be able to expand to meeting the demand	N/A	Yes	Clarify issues with proponent/agencies prior to CG report		Proponent to provide response.	Appendix T Section 3.5 Water Supply
45.47				Waste	Waste - Waste management	S21.3.10 - Preferred disposal solution of the existing Moranbah landfill may cause strain on existing infrastructure and more rapid depletion of the landfill	Engage with IRC regarding additional strain which the project will have on the Moranbah Landfill site	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix T Section 16.4 Waste Disposal
45.48				Waste	Waste - Waste management	S21.3.10 - General wastes will be collected regularly and transported for disposal by a licensed contractor to licensed landfill	Engage with JJ Richards with regards to the Waste Management and Collection Strategy	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 16.4 Waste Disposal
45.49				Greenhouse Gas Emissions	Waste - Waste management	S21.3.10 - Will the greenhouse gas emissions associated with transport be incorporated into the greenhouse gas emissions plan if BMA pursues external contractors to remove waste to other disposal location?	Consider waste transport contributions in future emissions offset planning in an integrated waste management strategy	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 14.2 Methodology
45.50				General Comment	Economics - Business Opportunities	FIFO and DIDO workforce arrangement with the cumulative effect that spending in the local economy is limited or non-existent	Provide a comprehensive analysis of the long term effect of FIFO and DIDO workforce mining operations on the local economies in the IRC area, with specific reference to Moranbah	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix U
45.51				General Comment	Economics - Business Opportunities	Appx P 3.1.6 - The contribution to several of Moranbah's priorities do not cover the accumulative community impacts that are faced by IRC due to the increase in FIFO workers in the region	Further contributions of further social infrastructure will boost the incentives for people to choose to live and work within Moranbah and the Isaac region	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS as required.	Appendix U
45.52				General Comment	Economics - Business Opportunities	The proposed workforce does not satisfy the provisions of the ToR section 6.2. IRC does not support mandated FIFO workforce practices	The EIS response must address the ToR and provide the details to enable a formal response to be provided	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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45.53				General Comment	Economics - Employment	No consideration of a local recruitment strategy regarding total percentage of worker to be sourced remotely, which is not satisfy the provisions of the ToR	Respond to the ToR frame work	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
45.54				Nature Conservation	Pest and weeds	Concerns about natural resource management, particularly in relation to the spread of pests and weeds	Provide a defined strategy to manage the labour mobility impacts of weed spread	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide response	OCG to rely on advice from state agencies regarding the management of the Pest and Weeds Management Plan	Proponent to provide response.	Appendix T Section 8.5.1 Introduced Fauna Appendix T Section 8.5.2 Weeds
45.55				General Comment	Social - Employment strategy	100% remote workforces raise significant concern regarding the ongoing socio-economic viability of resource communities such as Moranbah	Address the meaningful consideration of diversified accommodation solutions and choices for workers to contribute in a positive way to a sustainable quadruple bottom line for the Isaac region	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
45.56				General Comment	General Comment	Increased incidences of irresponsible pet ownership with highly transient workers	Provide mitigation strategies to address irresponsible animal management behaviours in highly transient workforces	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix U
45.57				General Comment	General Comment	Particular forms of geographic labour mobility are promoted as the only workforce threatening long term sustainability of regional economies and communities	Concern for the removal of genuine choice from geographic labour mobility options	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response.	Appendix U
45.58				General Comment	Hazard and risk - health and safety	Highly mobile workforces pose concerns for infectious disease management	Detail a comprehensive model of disease management prior to any approval	N/A	No	Proponent to note	SIA (Appendix P contains measures to address public health impacts potentially arising from the project	Proponent to note	Submission noted
45.59				General Comment	Social - Employment strategy	No funds were committed towards operations or capital maintenance the costs for which are now borne by ratepayers.	Undertake meaningful EIS and integrated consultation in supporting on going community cost shifting	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required.	Appendix U
45.60				General Comment	Economics - Employment	Ensure the removal of the 1500 excess rooms at Red Hill Accommodation Village and further stipulate any application from BMA to retain the units	EIS needs to establish an integrated model of accommodation solutions that is inclusive of a triple bottom line outcome for regional residency	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
46.1	Private Submitter	Private Submitter - Other Individual	Project-wide	General Comment	General Comment	Lack of data and commitment to the project	Ensure BMA's commitment to the project	N/A	No	Proponent to note		N/A	Submission noted
46.2				Social impact assessment/SIA	Social - Housing impacts	Failed to provide figures that justify a camp of 3000 person scale, or the inevitable impact on surrounding communities	Undertake relevant workforce modelling, demonstrate genuine and reasonable need at local and state level	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required	Submission noted
46.3				Economics	Economics - Employment	Unnecessary high proportion and 100% FIFO workforces in established communities fail individuals, communities and Queensland- bad for business	Set conditions rejecting BMA's request for 100% FIFO workforce for the GRB and RHM mine complex	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Submission noted
46.4				Social impact assessment/SIA	Economics - Employment	100% FIFO arrangements do not increase employee flexibility and choice	Recruitment processes and high retention rates are best served by high residential proportion workforces to keep the regions and communities sustainable	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Submission noted
47	Regional Service Group, DSDIP	State Government	Project-wide	Economics	Social - Regional economies and businesses	Enhance strategies for business opportunities	To work with BMA regarding supply chain development programs	N/A	No	Proponent to provide response		Proponent to provide response. Update Appendix S - BMA Commitments, as required.	Appendix U
48.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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48.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
48.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
48.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
48.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
48.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
48.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
48.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
48.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
48.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
49.1	Department of Environment and Heritage Protection	State Government	Project-wide	General Comment	General Comment	**General** - EHP's review of the EIS material has identified a number of deficiencies that should be addressed within the EIS process. For example, additional information is required in relation to: the effects that the transfer of additional water (from the RHML Project) would have on the existing water balance for the GRB mine complex; flora and fauna impacts including appropriate offsets; contaminated land; air quality and noise and vibration assessments.	EHP's review of the EIS material has identified a number of deficiencies that should be addressed within the EIS process. For example, additional information is required in relation to: the effects that the transfer of additional water (from the RHML Project) would have on the existing water balance for the GRB mine complex; flora and fauna impacts including appropriate offsets; contaminated land; air quality and noise and vibration assessments	Environmental Authority (EP Act)	No	Proponent to note		Proponent to note (further details provided below)	Submission noted
49.2			Project-wide	General Comment	General Comment	**General** - Some sections of the EIS are incomplete and for some issues the proponent has sought to defer the provision of information to later stages in the assessment and approvals process (such as the development of receiving environment monitoring programs and mine rehabilitation requirements) therefore EHP may not be able to provide complete advice to the OCG on operating conditions for those aspects of the proposed mine.	DEHP may not be able to provide complete advice to the OCG on operating conditions for those aspects of the proposed mine. Nonetheless, model mining conditions would largely be applicable (nb. The EIS does not include an analysis of any changes likely to be required to the existing GRB EA for issues such as air emissions).	EP Act (approvals of EA's and proposed plans for environmental impacts)	No	Proponent to note		Proponent to note (further details provided below)	Submission noted

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
49.3			Proposed Red Hill underground mine	Approvals	Water Release	**Water Release** - EIS does not demonstrate that the existing GRB EA conditions would continue to be met under the proposed new water management regime.	**Recommendation:** That information in the EIS documentation be revised to: demonstrate that the operation of the RHM and addition of Red Hill mine water to the GRB mine water management system will still allow the combined GRB-Red Hill complex to meet the pre-requisites for continued participation in the enhanced release program, as per the relevant Operational Policy; describe the potential impacts of the proposed discharge regime on relevant environmental values downstream waterways, as per the requirements of the GRB EA; demonstrate that the combined water balance from both mines would not compromise the effective reduction of legacy water from the GRB water management system.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further discussion on the history of the Fitzroy Pilot release program and how the existing GRM water release EA conditions were established, including their effects on environmental values. Describe further (through cross referencing) how the RHM project will not impact on the capacity of GRM to manage water in accordance with its existing EA release conditions.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.13 Water Quality Criteria Appendix T Section 7.2 Water Storage
49.4			Proposed Red Hill underground mine	Surface water	subsidence	**Appendix 18 - Surface Water Quality sec 5.2.6 -** Sediment from subsidence does not appear to be included in the sediment generation model.	**Recommendation:** Estimate the volume of sediment likely to be lost as a result of bank erosion caused by subsidence and incorporate that additional input into sediment generation calculations.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide cross reference in the EIS to the proposed adaptive management measures proposed - both pre-emptive and reactive. BMA will also draw on the objectives and management measures described in the existing BRM Subsidence Management Plan.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.12 Sediment Generation
49.5			Project-wide	Surface water	Methodology	**Appendix 18 Surface Water sec 6** - The data set presented in the EIS does not span 12 months (August 2010 – April 2011) and includes only one reference site upstream (should be 3) on the Isaac River. More data should be used to encompass seasonal flow regimes. Sampling for the EIS was undertaken during periods of flow regime in which sampling was undertaken. Some parameters are significantly affected by the flow rate; as is the assimilative capacity of the receiving water. Background water quality descriptions should include separate data for high flow and low flow (baseline) conditions. No methodological information is provided for chemical analyses. The detection levels for water quality are also not provided.	**Recommendation:** That the EIS documentation be amended to a) define background water quality with the appropriate level of data, e.g. as per QWQG or relevant information gained under the GRB EA, b) present water quality data for high flow and low flow (base flow) conditions separately, c) discuss the timing of mine water releases during the period of sampling used to define background water quality and confirm whether the downstream site is an unaffected reference, d) describe analytical methodological approaches used for water chemistry and detection levels for water quality.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to cross reference the existing information contained in the EIS which describes the existing water management regime, water quality testing and compliance regime at GRM. Where necessary, BMA are to clarify existing management practices and describe how the release conditions and water quality parameters were established including through the Fitzroy Basin Release Pilot Program.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.14 Water Quality Data
49.6			Project-wide	Surface water	aquatic ecology impacts	**Appendix 18 Surface Water sec 6** - Subsidence is expected in the vicinity of Goonyella Creek and 12 Mile Gully. There is a need to describe how the receiving environment monitoring program will address possible impacts of subsidence on Goonyella Creek and 12 Mile Gully. Consequently, biological health monitoring should be included in the receiving environment monitoring program (REMP).	**Recommendation:** a) Describe how the receiving environment monitoring program will address possible impacts of subsidence on Goonyella Creek and 12 Mile Gully, b) Include biological health indicators in the receiving environment monitoring program, c) Confirm whether site RHSW2 is upstream or downstream of potential subsidence and other mine activities including the construction of roads and tracks, d) Identify site categories (i.e. upstream, control or downstream) in Table 6-2, Proposed Water Quality Monitoring Locations in Appendix 18.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information as described in EHP recommendation and expand on the proposed amendments to the REMP.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.17 Water Quality Monitoring
49.7			Project-wide	Aquatic Ecology	Salinity	**Appendix K3 Aquatic Ecology** - no risk assessment of the potential impacts to resident aquatic biota is provided.	**Recommendation:** That a) The EIS documentation include an impact statement about the proposed mine water releases including for example potential impacts of salinity >1,000 - 1,500 µS/cm, b) The source and nature of data given in Appendix E K3 be provided, c) The EIS documentation be amended to use consistent units for salinity throughout.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to expand/demonstrate compliance with the abovementioned document and Fitzroy River water release pilot and refer directly to the ACARP report adopted by the Government in establishing the release conditions.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 9.2 Context of Proposed Releases
49.8			Project-wide	Surface water	Aquatic ecology impacts	**Sec 7 Surface water, sec 7.2.6.1 -** The EIS omits aquatic ecosystem protection, farm water supply, drinking, primary and secondary recreation, human consumer and industrial use from the environmental values identified for protection of local creeks and rivers.	**Recommendation:** The EIS should predict impacts on all environmental values that may be adversely affected by the nature of the planned discharges. This would include at least aquatic ecosystem and use, raw water for drinking supply and farm water supply. Again, if the proponent considers that this information would be gleaned through the Fitzroy River coal mine water release pilot, this should be clearly stated in the EIS documentation**.**	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information on impacts to environmetnal values and how aquatic ecosystem protection relates to the water release pilot and refer directly to the ACARP report adopted by the Government in establishing the release conditions.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 9.3 Environmental Values
49.9			Project-wide	Surface water	Monitoring	**Sec 7 Surface water, Sec 7.2.6.2 -** sulphate results for several sites are in the thousands for consecutive days and then single digits for following consecutive days. Suspect that data entry errors have occurred or an imprecise analytical method have been chosen.	**Recommendation:** Provide a quality assurance assessment of the sulphate results. This should include checks for transcription errors and advice of the methods of analysis employed and practical limits of quantification for the analysis.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to explain sulphate results in more detail.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.19 Sulphate Monitoring Results
49.10			Project-wide	Surface water	Aquatic ecology impacts	**Sec 7, Surface Water, Section 7.2.6.1 -** Environmental values of aquatic ecosystem protection have been omitted. Where different objectives are proposed, it would be desirable to provide a detailed justification showing that those objectives not included are not present in the receiving system.	**Recommendation:** The EIS documentation should be amended to suitably describe all relevant environmental values including, but not limited to the potential impacts on aquatic ecosystems, farm water supply, drinking water, primary and secondary recreation, human consumer and industrial use, and the potential impacts on those values. Again, if the proponent considers that this information would be gleaned through the Fitzroy River coal mine water release pilot, this should be clearly stated in the EIS documentation.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information in relation to the Fitzroy Basin water release pilot program and how the water release parameters were established through the ACARP study and report in relation to management of potential impacts on environmental values. Explain how the environmental values differ from EPP (Water).	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.13 Water Quality Criteria Appendix T Section 9.3 Environmental Values
49.11			Project-wide	Surface water	Water Quality	**Appendix 18, Surface Water Quality Technical Report -** The water quality compliance limits proposed in the EIS differ from those scheduled under the EPP (Water) and the national and state water quality guidelines.	**Recommendation:** The EIS documentation should include a discussion about the proposed application of "enhanced" release conditions and provide a prediction of the potential impacts of such releases on the identified environmental values of the receiving environment. Again, if the proponent considers that this information would be gleaned through the Fitzroy River coal mine water release pilot, this should be clearly stated in the EIS documentation.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information in relation to the Fitzroy Basin water release pilot program and how the water release parameters were established through the ACARP study and report in relation to management of potential impacts on environmental values. Explain how the environmental values differ from EPP (Water).	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.13 Water Quality Criteria Appendix T Section 9.3 Environmental Values

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
49.12			Project-wide	Surface water	Water Quality	**Appendix 18, Surface Water Quality Technical Report -** water releases are expected to be non-compliant on occasions. There is also a need to include management options to avoid releasing water that will exceed 2000 µS/cm at the downstream compliance monitoring point including the ability to cease releases at short notice.	**Recommendation:** That the EIS documentation be amended to describe management options to ensure that water releases will be compliant with proposed EA conditions.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to cross reference the EIS to highlight sections which describe the management of water at GRM. Proponent to emphasise that the transfer of water from RHM to GRM will not impact on the current capacity to successfully manage water releases at GRM which have been managed in accordance with the aprpoved EA and associated conditions established under the water release pilot. Proponent to emphasise how the RHM will help to reduce the total GRM water inventory over the LOM.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.19 Management Strategy
49.13			Project-wide	Aquatic Ecology	Methodology	**Appendix K3, Aquatic Ecology Technical Report -** The SIGNAL 95 index has been updated with SIGNAL 2 (refer to Chessman 2003). The EIS variously uses the two indices throughout, it should apply the most recent (SIGNAL 2) - justify why both are used.	**Recommendation:** Amend the EIS documentation to consistently apply the most recent index (SIGNAL 2).	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to cross reference the EIS section which states why the two indices have been used and provide to EHP. If a further review necessitates further clarification, proponent will provide additional clarification to EHP.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 9.4 Methodology
49.14			Project-wide	Hazard and Risk	Mitigation/management	**Section 15, Waste Management -** Tables 15.1 and 15.2, page 15-8 to 15-11 - confirm if oil and greases will be generated outside of workshops (e.g. as part of field service activities). If so, add proposed mitigation for oil and greases generated at all locations on the mining lease.	**Recommendation:** Update Tables 15.1 and 15.2 to include waste collection and mitigation measures for waste oil and greases produced outside of workshops.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information as described. Where necessary, the proponent will expand on the detail already provided and confirm proposed commitments in relation to waste management.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 16.3 General Waste
49.15			Project-wide	General Comment	General Comment	**Appendix S, BMA Commitments -** The EIS includes a commitment to develop a mine rehabilitation management plan prior to the commencement of mining. It is a requirement, prior to granting of the EA, to have the rehabilitation requirements, in particular rehabilitation objectives, indicators and completion criteria.	**Recommendation:** The EIS documentation be amended to include the rehabilitation requirements, in particular but not limited to rehabilitation objectives, indicators and completion criteria, of the project must be provided in accordance with Guideline EM1122 Rehabilitation requirements for mining resource activities.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent will cite and spell out the objectives and management procedures as described in the approved BRM Subsidence Management Plan and GRB Rehabilitation Management Plan. The response will cross reference the EIS to identify any potential impacts of RHM infrastructure on GRB and gas drainage and surface infrastructure across the RHM underground footprint (including proposed river crossings for infrastructure) and define proposed management and rehabilitation objectives.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 18.2 Rehabilitation Management Plan
49.16			Project-wide	General Comment	Waste - Mine waste water	**Appendix 12, Mine Water Overview report -** The use of mine pits for mine water storage is not desirable, as the quality of water stored within mine pits on site is historically poor. The accumulation of legacy water has been a significant issue for water quality and mine production, and the planning for ongoing in-pit mine water storage, as proposed in the EIS, should only be relied if it can be demonstrated that wastewater discharges will be acceptable in the long-term.	**Recommendation:** The EIS documentation should not propose the use of mine pits on GRB for storage of mine affected water from the Red Hill project unless it can be demonstrated that such storage can be managed so as to protect relevant environmental values and achieve acceptable water quality in receiving water in the long term.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 7.2 Water Storage
49.17			Project-wide	Aquatic Ecology	Aquatic ecology impacts	**Section 10, Aquatic Ecology -** The EIS fails to address the potential impacts to aquatic ecosystems from proposed mine water releases and there is no statement about the overall impact of mine water releases.	**Recommendation:** That the EIS document be amended to adequately address the potential impacts on aquatic ecosystems from proposed water releases and, where relevant, propose appropriate mitigation and management measures to adequately address this section of the EIS. This should reference relevant commitments made as part of the Fitzroy River coal mine water release pilot.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 5.13 Water Quality Criteria Appendix T Section 9.2 Context of Proposed Releases
49.18			Project-wide	Project Methodology	Terrestrial Ecology - terrestrial flora	**Appendix K1, Flora Technical Report -** While the revised regional ecosystem mapping table of regional ecosystems and site data presented is likely to present the vegetation on the ground, the manner in which it has been presented does not allow an accurate assessment and confirmation of statements in the EIS.	**Recommendation:** That the proponent provide shape files of the survey sites, site survey data sheets, site photos and shape files (in particular of the same spatial projection) of the revised regional ecosystem polygons as per the Regional Ecosystem Assessment Kit produced by the Queensland Herbarium. This will allow for an accurate assessment of the regional ecosystem revision proposed by the proponent.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to meet with EHP to determine scope/format for additional shapefiles/data to be provided.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 8.3 Flora Survey Results Shape files submitted to EHP on 13 January 2014
49.19			Project-wide	Aquatic Ecology	Impacts	**Appendix K1, Flora Technical Report -** Residual impacts on watercourse vegetation are not quantified and no offsets are proposed for these watercourse impacts. This is especially important given the landscape connectivity values associated with these watercourses, and in particular the Isaac River.	**Recommendation:** That the EIS quantify the residual impacts, including of subsidence, on watercourse vegetation and, where relevant, propose adequate offset arrangements for this impact.	EP Act (approvals of EA's and proposed plans for environmental impacts)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to prepare a framework for the offsets approach for review and agreement with EHP/DOTE prior to drafting intial strategy.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 8.6 Impacts on Riparian Vegetation Appendix T Section 10.2 Development of an Offset Strategy
49.20			Project-wide	Matters of National Environmental Significance	Terrestrial Ecology - terrestrial fauna	**Appendix K2, Fauna Technical Report -** Habitat for threatened fauna species – the residual impacts on Brigalow scaly-foot, ornamental snake, little pied bat and koala habitats have not been quantified and no adequate offset arrangements have been presented.	**Recommendation:** The EIS be amended to quantify the residual surface and subsidence impacts on the habitat of the following threatened species: Brigalow scaly-foot, ornamental snake and koala. Adequate offset arrangements should be presented for these National and State significant environmental matters.		Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 8.7 Impacts on Fauna
49.21			Project-wide	Offsets strategy	Mitigation/management	**Appendix S, BMA commitments -** The EIS states that a biodiversity offset strategy and management plan will be developed for the project at least 6 months before disturbance. That time frame is inconsistent with the terms of reference for the EIS which states that the EIS should present proposals to offset impacts in accordance with the relevant Qld Government offset requirements.	**Recommendation:** The EIS documentation should include a Biodiversity Offset Strategy developed in accordance with relevant Queensland Government offset requirements.	Biodiversity Offset Policy (BOP)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 10.2 Development of an Offset Strategy
49.22			Project-wide	Offsets strategy	Mitigation/management	**Appendix S, BMA Commitments -** The offset strategy must be finalised in the EIS process. Undertaking of ecological equivalence assessment for areas to be disturbed by the project can be deferred to post EIS but must be completed prior to mining commencing.	**Recommendation:** That a completed Offset Strategy for all residual impacts of the project be included in the EIS documentation.	Biodiversity Offset Policy (BOP)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 10.2 Development of an Offset Strategy
49.23			Project-wide	Offsets strategy	Impacts	**Section 9, Terrestrial Ecology -** While staged offset delivery is an acceptable approach, the EIS must quantify all potential impacts of the proposal. The Offset Strategy should identify the proposed impacts for the entire project area. It should also detail and quantify those impacts that are likely to occur for each stage of mining.	**Recommendation:** Combine Tables 9-14 and 9-15 to present the total impact area of each State Significant Biodiversity Value. The new table should detail the impact area for each State Significant Biodiversity Value from each stage of mining.	Biodiversity Offset Policy (BOP)	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 10.2 Development of an Offset Strategy

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
49.24			Project-wide	Offsets strategy	Impacts	**Section 9, Terrestrial Ecology -** The EIS states that the riparian zone is difficult to offset. It is a value of state significance for bioregional connectivity and is required to be offset.	**Recommendation:** In planning to offset impacts on the riparian zone, seek to identify other sections of riparian vegetation on the Isaac River (or another river in the Fitzroy catchment), not impacted by mining disturbance, and negotiate land management arrangements (e.g. reduce/remove stock grazing, weed management) with landholder(s) to secure rehabilitation of the land and ongoing protection of riparian values.		Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to prepare framework for the offsets approach for review agreement with EHP/DOTE prior to drafting. Proponent does not propose to identify potential offset areas.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 8.6 Impacts on Riparian Vegetation
49.25			Project-wide	Project Methodology	General Comment	**Accuracy of revised of regional ecosystem mapping -** The locations of some survey sites were not within the polygons of the regional ecosystems to which they had been allocated in the Flora Survey Report, Table 3-6, Extent of Vegetation Communities mapped by URS within survey area. **see page 8 of submission for table of deficiencies	**Recommendation:** That the EIS documentation be amended to provide suitable mapping and evidence to address the relevant RE and refine impact assessments and offsets where relevant.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 8.3 Flora Survey Results
49.26			Proposed Red Hill underground mine	Air quality	Conditions	**Air Quality, Section 11.3.3.3 -** While the proposed RHM is predicted to make only a minor additional contribution to dust emissions at the mine complex, the assessment in the EIS of the existing mining operation indicates that the GRB Mine Complex would have difficulty meeting EHP's model mining condition for 24-hour average PM10. The air quality situation could deteriorate for the future mining and cumulative future mining scenarios, with 24-hour average PM10 predicted in the EIS to exceed the model mining condition level. it is not clear how the GRB Mine Complex would meet condition B4(b) for business-as-usual, or with the Red Hill projects contribution or under cumulative future mining scenarios. Should Condition B4 of EHP's Guideline Mining - Model mining conditions be adopted for the project EA's, it is not clear how the GRB mine complex would meet condition B4(b) for business-as-usual, or with the Red Hill projects contribution or under cumulative future mining scenarios.	**Recommendation:** Revise the EIS to demonstrate how the proposed project and including amended operations on GRB would comply with the model mining conditions including specifically model mining condition B4(b) 24-hour average PM10 level of 50 micrograms per cubic metre when measured at any sensitive or commercial place.		Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to cross reference the EIS to those sections which highlight that RHM has no meaningful impact on the existing operating air quality environment at GRB.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 13.3 Air Quality Criteria
49.27			Project-wide	Noise and Vibration	General Comment	**Section 13, Noise and Vibration** - The criterion considered in the EIS is an out of date guideline of 45dBA LAmax for 10 to 15 events of transient noise during a night. That old value is not appropriate as it has been reviewed and amended in the release of WHO 2009 Night Noise guideline for Europe.	**Recommendation:** The EIS should be amended to assess noise performance against the appropriate contemporary criterion. For example the criterion should be amended from 45dBA LAmax to 42 dBA LAmax and the appropriate reference of WHO 2009 - Night Noise guideline for Europe needs to be added so to reflect the latest research on sleep disturbance.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to provide further information in line with contemporary criterion.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 12.3 Noise Criteria
49.28			Project-wide	Land	Land - contaminated	**Appendix G, Contaminated Land** - The preliminary site investigation has identified that there is a risk of the proposed activity disturbing contaminated soils during construction. All areas of potential contamination concern require further investigation, the extent of any identified contamination should be adequately delineated, and strategies and methods for management of any identified contamination should be provided to ensure land contamination matters are adequately managed.	**Recommendation:** A Detailed Site Investigation Report and/or Validation Report undertaken in accordance with the National Environmental Protection (Assessment of site contamination) Measure 1999 (NEPM) and Guideline for Contaminated Land Professionals (EHP, 2012) is required to be undertaken to further investigate areas of potential contamination of concern as identified during the Preliminary Site Investigation.	N/A	Yes	Clarify issues with proponent/agencies prior to CG report	As per discussions held between EHP, OCG and BMA on 13 March 2014. Proponent to work with EHP to clarify if the detailed site investigation report can be conditioned or if it will be required as part of the EIS process.	Proponent to provide response as per the key actions documented in meeting minutes from discussions held on 13 March 2014 between EHP, OCG and BMA.	Appendix T Section 11.4 Contaminated Soils Appendix S Commitments Update
49.29			Project-wide	Administrative/Other	General Comment	**Editorial change** - First paragraph of page 7-54 uses an incorrect caption reference to Table 7-15.	**Recommendation:** This should reference Table 7-16, Proposed New Water Quality Monitoring Locations	N/A	Yes	Proponent to provide response		Proponent to note. Amend EIS, as required.	Submission noted
49.30			Project-wide	Administrative/Other	General Comment	**Editorial change** - Appendix I8, Page 23, delete the word that and insert than	**Recommendation:** "Figure 4-8 shows that, overall, dissolved aluminium concentrations were significantly lower *that* total aluminium concentrations	N/A	Yes	Proponent to provide response		Proponent to note. Amend EIS, as required.	Submission noted
49.31			Project-wide	Administrative/Other	General Comment	**Editorial change** - Appendix I8, Page 50, insert the word to	**Recommendation:** It is anticipated that the proposed expansion will initially be covered by the existing REMP, as that program is already required *to* define…	N/A	Yes	Proponent to provide response		Proponent to note. Amend EIS, as required.	Submission noted
49.32			Project-wide	Administrative/Other	General Comment	**Editorial change** - Appendix K3, Page 17 delete the word that	**Recommendation:** While a full comparison of taxonomic lists cannot be made, previous reports have indicated the presence of freshwater shrimps (Atyidae; Crustacea) and phantom midges (Chaorbidae: Diptera) *that* were absent from the current sampling."	N/A	Yes	Proponent to provide response		Proponent to note. Amend EIS, as required.	Submission noted
49.33			Project-wide	Administrative/Other	General Comment	**Editorial change** - Appendix K3, Section 4.2.4 refers to the term "suspendoids	**Recommendation:** this term should more appropriately be stated 'suspensoids'.	N/A	Yes	Proponent to provide response		Proponent to note. Amend EIS, as required.	Submission noted
50.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
50.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

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50.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
50.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
50.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
50.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
50.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
50.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
50.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
50.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
51.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
51.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
51.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
51.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U

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51.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
51.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
51.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
51.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
51.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
51.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
52.1	Department of Health	State Government	Project-wide	General Comment	Hazard and risk - health and safety	The EIS does not identify construction camps as sensitive receptors. The construction camps may be located in areas where the emissions from the project's construction may adversely affect the health and well-being of the workers and Qld Health is therefore unable to assess potential risks to workers.	The proponent should assess the acoustic and air environments at the construction camps and make recommendations as to appropriate mitigation measures to ensure compliance with relevant acoustic and air quality standards identified within the EIS.	N/A	Yes	Proponent to provide response		Proponent to provide response.	Appendix T Section 12.2 Sensitive Receptors Appendix T Section 13.2 Sensitive Receptors
52.2				Air quality	Mitigation/management	The proponent has not addressed the following issues relating to air quality: - Section 11.4.6.2 – summary of receptor locations at which relevant particulate matter air goals criteria is predicted to be exceeded - not all mitigation measures were able to be modelled. - Appendix S Commitments - The proponent has not assessed the increase in risk to human health at the surrounding sensitive receivers due to exceedance in air quality.	- Reassess the proposed mitigation strategies to ensure air quality goals are achieved at all sensitive receptors. - Provide further details/commitments (Appendix S) with respect to the proposed Dust/Coal Dust Management Plan highlighting how the proponent will adequately address any dust/coal complaints and or exceedance of the health and well-being goals to ensure human health is not adversely affected.	N/A	Yes	Proponent to provide response		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required	Appendix T Section 13.6 Mitigation Appendix S Commitments Update
52.3				Project commitments	Hazard and risk - health and safety	It is unclear how the proponent has addressed S8.2.1 of the TOR	The proponent needs to address S8.2.1 of the TOR, specifically describe how potable water will be treated, stored and tested and provide adequate commitments in Appendix S. The proponent also needs to describe how disease vectors, pests and vermin will be adequately treated as to ensure human health and well-being is maintained and provide adequate commitments in Appendix S.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation		Proponent to provide response. Update EIS, including Appendix S - BMA Commitments, as required	Appendix T Section 17.3 Potable Water Appendix T Section 17.4 Disease Vectors, Vermin and Pests
53.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	**S17.5.1.1 - Housing/Accommodation** - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
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53.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**S17.5.1.4** - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
53.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	**S17.5.1.6** - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
53.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	**S17.5.1.8** - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
53.7			Project-wide	Transport	Transport - road	**S17.5.1.8** - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
53.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	**S17.5.4.2** - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted
53.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	**S17.5.5.3** - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
53.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
54.1	Private Submitter	Private Submitter - Other Individual	Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.1 - Housing/Accommodation - Increased vacancy rates in Moranbah, available land developments and affordable purchase and rent prices. BMA and other companies are not allowed to live in the local community.	Give their workforce the choice for local subsidised rental accommodation or camp accommodation. Give mining companies some tax incentives for housing staff locally. Tax mining companies for building camps and FIFO.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
54.2			Project-wide	Social impact assessment/SIA	Social - Workforce	S17.5.1.2 - 100% FIFO provides no way that employees are able to live in the local community	Consider local workers in the Bowen Basin before a FIFO worker. A restriction on the % of FIFO workers that BMA can employ at the Red Hill Mine. Give all employees the option of subsidised housing, or the option to lease/buy a property in the local town of Moranbah	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
54.3			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.1.3 - Declining population in town due to FIFO policies results in housing costs decreased and affordable for lower income families	Maintain a % of employees that live in the local community. Give employees a choice between a flight allowance or a rental allowance to live in the town	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
54.4			Proposed Red Hill underground mine	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.4 - Potential impact the proposed accommodation village would have on demand for local health and emergency services	More funding given to the local communities hospitals and police to deal with the tens of thousands of people commuting into the area for work.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Proponent to update Appendix S - BMA Commitments to reflect current and proposed strategies in relation to local health and emergency services commitments.	Appendix U
54.5			Project-wide	Social impact assessment/SIA	Social - Community values and change	S17.5.1.6 - Decreased feeling of community in Moranbah. Over 200 rental properties that are available and much land available. Property owners are unable to get tenants due to 100% FIFO policies.	Restrict the % of FIFO workers that allows to at least facilitate people moving to the area. The money spend on flying people out of town can be used to support the local community instead. Tax incentives given to companies for accommodating staff locally and to tax mining camps and flights	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
54.6			Project-wide	Social impact assessment/SIA	Social - Demand on emergency /health service resources	S17.5.1.8 - Some stakeholders voiced dissatisfaction with various levels of government and government delivery of social infrastructure and services to Moranbah	More government funding into the local community for social infrastructure. The taxes from flights and mining camps could be filtered into the local community to fund infrastructure improvements.	N/A	No	Proponent to note	Section 18.11 of the EIS outlines BMA Strategies	Proponent to note	Submission noted
54.7			Project-wide	Transport	Transport - road	S17.5.1.8 - Concerns regarding traffic and transport impacts were also raised including driver behaviour and increased road traffic volumes and frequency, particularly along the Peak Downs Highway	Upgrade the peak downs highway to double lanes between Moranbah and Mackay. Need more overtaking lanes especially between Nebo and Moranbah. Restrictions on mining related traffic (big loads)	N/A	No	Proponent to note	BMA Commitments - (no.187) - BMA will liaise with TMR regarding required contributions.	Proponent to note.	Appendix T Section 15.5 Mitigation Appendix S Commitments Update
54.8			Project-wide	Social impact assessment/SIA	Social - Training and apprenticeships	S17.5.4.2 - The project should bring jobs, apprenticeships and trainee schemes to the community, employing local people first before utilising remote workforces.	BMA and all other mining companies to offer traineeships to local community members first. (note: Peabody at Moorevale are offering traineeships to those residing in Brisbane, is this fair?)	N/A	No	Proponent to note	Local based apprenticeships and trainee scheme strategies are included in the SIA/ Action Plan	Proponent to note	Submission noted

Sub. No.	Submitter	Submitter Type	Project component	Issue - Category	Issue - Topic	Issue - Details	Submitter Recommendations / Suggested Mitigation	Relevant approval	Action required? (Y/N)	Action details	OCG analysis/comments	OCG Direction to proponent	Cross-reference to final draft AEIS
54.9			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - There was concern by some stakeholders that mining companies, including BMA, were 'holding onto land' which could be released and used to develop affordable housing.	State government to abolish tax incentives for the mining camps and to introduce tax incentives for allowing employees to live in the local community. There is a large supply of land at the end of mills avenue, Moranbah that is owned by BMA and is not yet filled in. There is also large pockets of land available in the estate next door – of which some of the vacant land is owned by mining companies. A tax incentive could be given to the mining sector and private developers for building accommodation on their land.	N/A	No	Proponent to note		Proponent to note	Submission noted
54.10			Project-wide	Social impact assessment/SIA	Social - Housing impacts	S17.5.5.3 - An investor had interest from a couple to rent her unit and one partner refused to put her name on the lease because she worked for BMA and was told she would lose her job if she signed a lease.	EBA agreements to be looked at – give the choice for employees to reside in the local town or live in the camp. Abolish the bullying tactics that BMA resort to whereby employees at Caval Ridge and Daunia are not allowed to rent in the local community for fear of losing their jobs. Abolish 100% FIFO and give employees a choice between the camps and the local town. A good model is Peabody Mine at millennium that give their employees camp accommodation or $400pw LAFA.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U
55	Mackay Regional Council	Local Government	Project-wide	Economics	Social - Regional economies and businesses	Mackay Regional Council's areas of interest regarding direct and cumulative impacts of the RHML relates to: - Industrial land and services to support the expanding mining activity - Housing and accommodation of workers (permanent and temporary during construction and operational phase) -community services which include regional health facilities, regional education and training facilities and regional welfare and social facilities and - the impact on regional and local roads and rail infrastructure. The EIS addresses most of the areas of Council's interests listed above. Mackay Regional Council recognises the positive economic impacts from mining support services from Mackay if the proponent is going to use Mackay-based industries, construction equipment and material as well as related expertise. This construction services and maintenance services (as suggested in section 19 - Economic Assessment of the EIS). However section 19 - Economic Assessment of the EIS also acknowledges that 'The construction and operations workforce will reside in the project accommodation village, located on the mining lease. It is therefore assumed that workers will spend most of their income in their home region. The 100% FIFO workforce has a limiting factor on Mackay's local economic sustainability and future community development within the wider Mackay, Isaac and Whitsunday region. Council is not supportive of a proposed 100% FIFO workforce. Council submits that the proposal will be improved by reviewing the 100% FIFO arrangement and allowing greater flexibility in the place of residence for the workforce.	Review the 100% FIFO arrangement and allow greater flexibility for the workforce.	N/A	Yes	Proponent to provide additional information to the EIS to inform CG evaluation	Given the submissions regarding Housing Choice and Workforce Management issues, related to the potential for up to 100% FIFO workforce for this project, clarification is required. Proponent to submit work prior to CG Report	Proponent to provide response and clarification of the approach to be adopted by BMA in relation to their future Workforce Management and Housing and Accommodation Strategies for the project. Update EIS including Appendix S - BMA Commitments to reflect future workforce and accommodation commitments, as required.	Appendix U

Appendix B Offset Strategy

URS

Report

Red Hill
Mining Lease

AUSTRALIA

Offset Strategy

15 October 2014

42627373/01/0

Prepared for:
BHP Billiton Mitsubishi Alliance

Prepared by URS Australia Pty Ltd

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TABLE OF CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

Australian and Queensland government policies require the provision of environmental offsets for significant residual impacts to matters of national environmental significance (MNES) and residual impacts to matters of state environmental significance (MSES).

This offset strategy outlines the BHP Billiton Mitsubishi Alliance (BMA) strategy for providing environmental offsets for the Red Hill Mining Lease project (the project). The objective of this strategy is to outline BMA's proposed approach to the delivery of offsets as well as facilitate discussion between the Department of the Environment (DOTE) and the Queensland Government Department of Environment and Heritage Protection (EHP) on suitable offsets for unavoidable losses of biodiversity values incurred by the project.

BMA is seeking approval for up to 100 per cent disturbance of vegetation across the project footprint as a worst case due to the uncertainty regarding clearing works and design associated with incidental mine gas drainage. However, BMA is committed to avoiding and minimising impacts to biodiversity values where possible. This report details relevant commitments and mitigation measures that will be taken to avoid and minimise impacts, identifies potential maximum disturbance areas to biodiversity values and provides evidence that there are opportunities within the region to offset estimated losses.

It is proposed that offset delivery is undertaken in a staged approach similar to the staging of project construction components. BMA is committed to offset the potential maximum disturbance areas prior to project works and reconcile this with actual losses during post disturbance field surveys. This approach provides an incentive to avoid and minimise impacts wherever practical.

This offset strategy also provides guidance on the requirements that will be detailed in the offset management plan.

1 INTRODUCTION

1.1 The Red Hill Mining Lease project

The Red Hill Mining Lease project is located adjacent to the existing Goonyella, Riverside and Broadmeadow (GRB) mine complex in the Bowen Basin, approximately 20 km north of Moranbah and 135 km south-west from Mackay, central Queensland (Figure 1-1).

BHP Billiton Mitsubishi Alliance (BMA), through its joint venture manager, BM Alliance Coal Operations Pty Ltd, proposes to secure the Red Hill Mining Lease (currently MLA 70421) to enable mining operations. Specifically, the project includes:

- An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine (BRM);
- A future incremental expansion option of the existing Goonyella Riverside Mine (GRM); and
- A future Red Hill Mine (RHM) underground expansion option located to the east of the GRM.

The three project elements described above are collectively referred to as ‘the project’.

The Red Hill Mining Lease Project is a coordinated project under section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act), which required the proponent to prepare an Environmental Impact Statement (EIS). The project is also a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It will, therefore, require approval from the Commonwealth Minister for the Department of the Environment (DOTE).

BMA prepared an EIS for the project. The final EIS was submitted to the Office of the Coordinator-General in December 2013 and released for public review and comment from 14 December 2013 to 13 February 2014.

1.2 Project Components

The project includes the following components:

- **Extension of BRM** longwall panels 14, 15, and 16 into MLA 70421. Key elements include:
  - No new mining infrastructure is proposed other than infrastructure required for drainage of incidental mine gas (IMG) to enable safe and efficient mining;
  - Management of waste and water produced from drainage of IMG will be integrated with the existing BRM waste and water management systems;
  - The mining of the Broadmeadow extension is to sustain existing production rates of the BRM mine and will extend the life of mine by approximately one year; and
  - The existing BRM workforce will complete all work associated with the extensions.
- **Incremental expansion of the GRM** including:
  - underground mining associated with the RHM underground expansion option to target the GMS;

- a new mine industrial area (MIA);
- a CHPP adjacent to the Riverside MIA on MLA 1764 and ML 1900 − the Red Hill CHPP will consist of up to three 1,200 tonne per hour (tph) modules;
- construction of a drift for mine access;
- a conveyor system linking RHM to the Red Hill CHPP;
- associated coal handling infrastructure and stockpiles;
- a new conveyor linking product coal stockpiles to a new rail load-out facility located on ML 1900; and
- means for providing flood protection to the mine access and MIA, requiring a levee along the west bank of the Isaac River.

- **Potential new RHM underground expansion** option to the east of the GRB mine complex, to target the GMS on MLA 70421. Key aspects include:
  - the proposed mine layout consists of a main drive extending approximately west to east with longwall panels ranging to the north and south;
  - a network of bores and associated surface infrastructure over the underground mine footprint for mine gas pre-drainage (IMG) and management of goaf methane drainage to enable the safe extraction of coal;
  - a ventilation system for the underground workings;
  - a bridge across the Isaac River for all-weather access. This will be located above the main headings, and will also provide a crossing point for other mine related infrastructure including water pipelines and power supply;
  - a new accommodation village (Red Hill accommodation village) for the up to 100 per cent remote construction and operational workforces with capacity for up to 3,000 workers; and
  - potential production capacity of 14 mtpa of high quality hard coking coal over a life of 20 to 25 years.

1.3 Project Staging

The project components outlined above are currently scheduled to be delivered in three broad stages (Table 1-1). The current indicative staging for the project components is illustrated in Figure 1-2.

Table 1-1 Project Staging and Indicative Timing

Stage	Project Component	Indicative Timing
Stage 1	– Commencement of the BRM long wall panel extensions 14, 15 and 16	Commencing 2015
Stage 2:	– Commencement and completion of the incremental expansion of GRM – Potential initial work for the underground expansion of the RHM	Currently uncertain and no commencement date is nominated at this stage
Stage 3	– Completion of major works for the RHM underground expansion	Currently uncertain and no commencement date is nominated at this stage

The provision of offsets for the project will also be staged. BMA is seeking approval for up to 100 per cent disturbance of vegetation as a worst case due to the uncertainty regarding clearing works and design associated with IMG drainage. Offsets for of the disturbance area will be provided in advance of each stage. Site specific ground truthing surveys will be undertaken following clearance to determine the actual level of disturbance. Monitoring of subsided areas will be conducted on a periodic basis to determine and quantify impacts. An indicative timeframe for various subsidence-related impacts is presented in Table 1-2 (after Eco Logical Australia, 2010). Any discrepancy between projected and actual disturbance will be reconciled when the offset requirement is calculated for next stage of the project.

Table 1-2 Potential time frames for various impacts on vegetation

Time	Component of long wall mine subsidence	Potential Impacts to vegetation
1 month	Roof collapse	Sprouting & tree mortality: e.g. forest gap formation and loss of individual trees from slumping and cracking.
1 year	Panel extraction	Phenology: e.g. floristic and structural changes in forest canopy.
10 years	Panel succession	Seral stage: e.g. Longer term impacts such as water ponding, potentially leading to an altered progression of woodland community composition and structure.
100 years	Mine completion	Primary-secondary succession: e.g. multi-decade change in vegetation community boundaries, as a result of the above impacts and ongoing decommissioning and rehabilitation works.

The vegetation communities present within the areas potentially prone to subsidence will be most affected during the early stages of the project (roof collapse and panel extraction). A detailed monitoring schedule will be developed as part of the Offset Management Plan for the project with monitoring for timing based on the timing of these events.

1.4 Purpose of the Offset Strategy

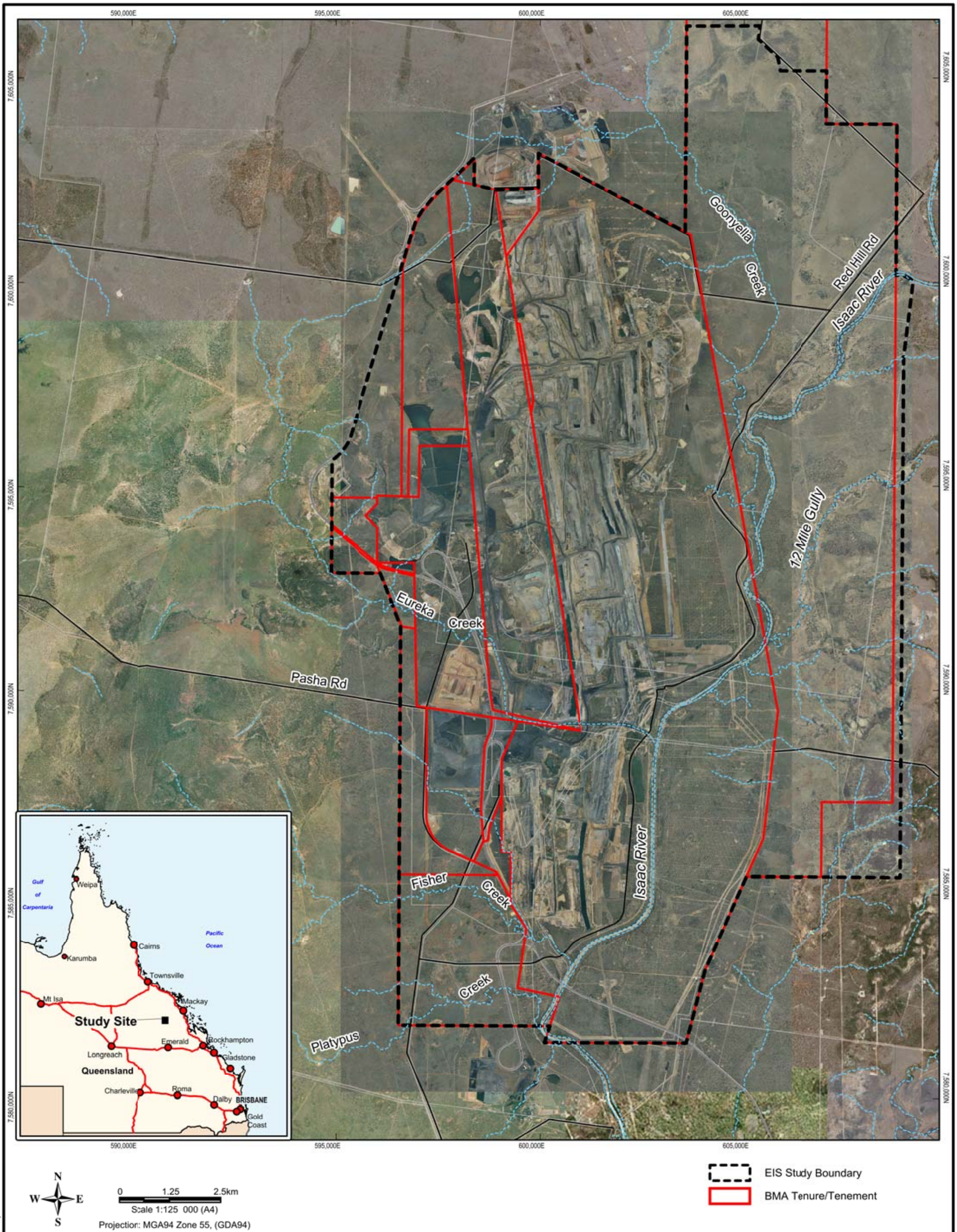
The purpose of this report is to outline the offset requirements for each project stage under the *Environmental Offsets Act 2014* (EO Act), and the Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.5 Document Structure

This offsets strategy is structured as follows:

- Section 1 – Introduction, background and purpose of the offsets strategy;
- Section 2 – Legislative framework to outline the offset policies which are applicable to the project;
- Section 3 – Overview and characterisation of the environmental values for the bioregion and project area. A detailed account of the baseline ecological values of the project is provided in the Terrestrial Ecology chapter (Section 9) of the EIS. Updated information is provided in Section 8 of Appendix T: Addendum to the EIS;

- Section 4 – Details on the proposed avoidance, mitigation and management of potential impacts to biodiversity values. A list of relevant mitigation commitments made by BMA for the project is also provided in this section;
- Section 5 – Summary of the potentially impacted environmental values on site likely to require environmental offsets, as described in terms of the definitions for Matters of National Environmental Significance (MNES) and Matters of State Environmental Significance (MSES);
- Section 6 – Potential area of maximum disturbance estimated for each of the project stages;
- Section 7 – Description of the approach to the provision of environmental offsets; and
- Section 8 – Preliminary assessment of the availability of environmental values.



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RED HILL MINING LEASE
OFFSET STRATEGY

RED HILL PROJECT AND REGIONAL LOCATION

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OFFSET STRATEGY

Figure: **1-1**

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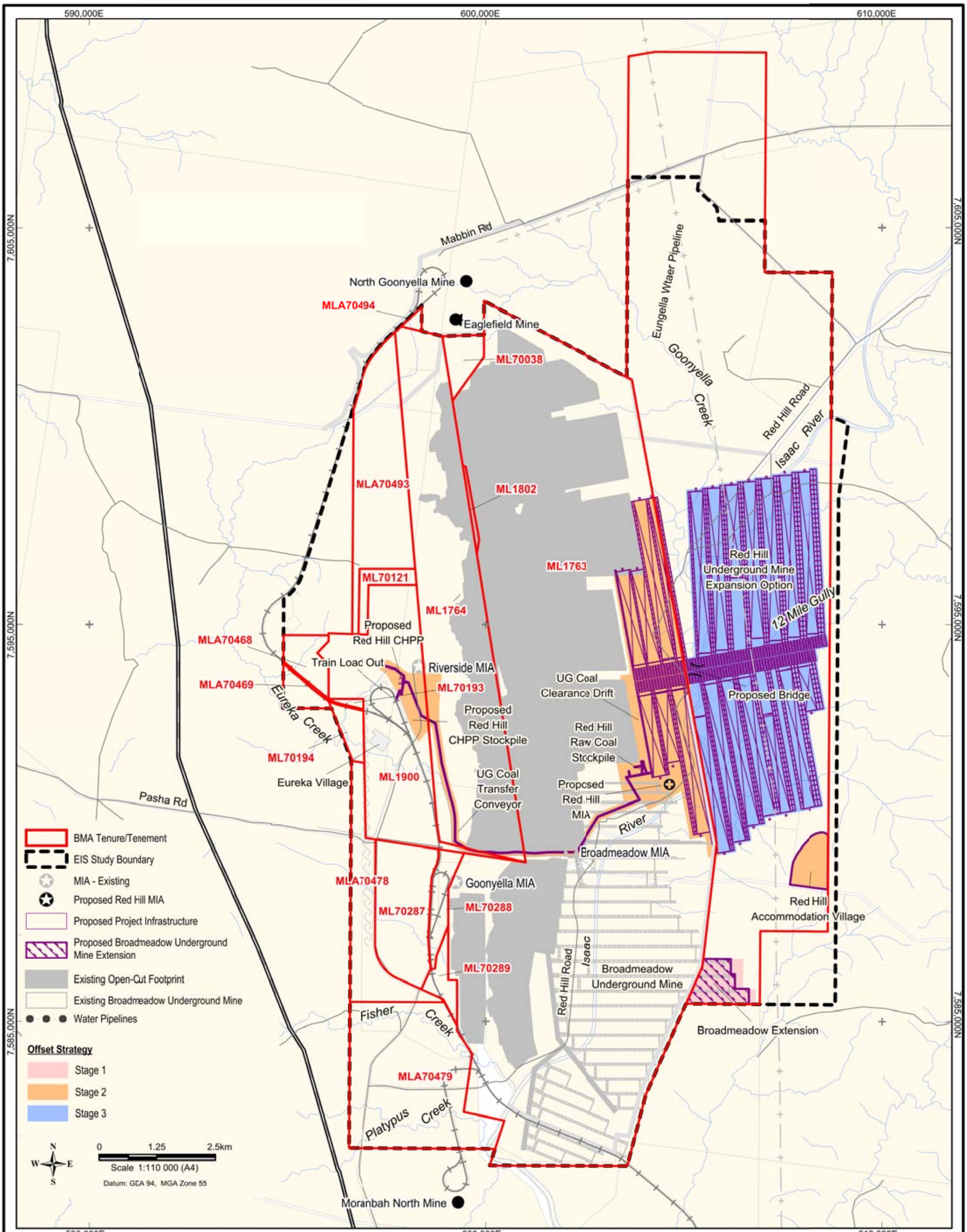

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RED HILL MINING LEASE
OFFSET STRATEGY

PROJECT OVERVIEW AND OFFSET STAGES

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OFFSET STRATEGY

Figure: **1-2**

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2 LEGISLATIVE FRAMEWORK

The offset policies which are relevant to the project under the Commonwealth and State government legislation are summarised below. The principles and applicability of each policy on the project is also provided.

2.1 Commonwealth Government Legislation and Policy

The project will be subject to the EPBC Act *Environmental Offsets Policy 2013*. There are five key aims of the policy including:

- Ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
- Provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
- Deliver improved environmental outcomes by consistently applying the policy;
- Outline the appropriate nature and scale of offsets and how they are determined; and
- Provide guidance on acceptable delivery mechanisms for offsets.

The EPBC Act *Environmental Offsets Policy 2013* identifies eight requirements for suitable offsets. These requirements include:

- Deliver an overall conservation outcome that improves or maintains the viability of the protected matter;
- Be built around direct offsets but may include other compensatory measures. Advanced offset will be considered;
- Be in proportion to the level of statutory protection that applies to the protected matter and be tailored specifically to the attribute of the protected matter that is impacted;
- Be of a size and scale proportionate to the residual impacts on the protected matter.
- Effectively account for and manage the risks of the offset not succeeding;
- Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs;
- Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable; and
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

Project offsets can comprise a combination of direct offsets and other compensatory measures. Offsets should align with conservation priorities for the impacted protected matter and be tailored specifically to the attribute of the protected matter that is impacted in order to deliver a conservation gain. For instance, if the proposed action is likely to have impacts on foraging habitat for a particular protected matter, then the offset should create, improve, protect and/or manage foraging habitat.

2.1.1 Applicability to the Project

Environmental offsets are required where significant residual impacts on MNES occur from the proposed project activities.

2.2 Queensland Government Legislation and Policy

2.2.1 Queensland Government Environmental Offset Framework

As of 1 July 2014, a new environmental offsets framework was introduced in Queensland. The new framework aims to streamline environmental offsets by providing an outcome-based approach to offsets by removing the complexities and duplication associated with the former offsets framework and aligning offsets across all three levels of government (commonwealth, state and local).

The new framework includes:

- *Environmental Offsets Act 2014*
  - Coordinates the delivery of environmental offsets across jurisdictions as well as providing a single point-of-truth for offsets in Queensland (EHP, 2014).
- Environmental Offsets Regulation 2014
  - Details the prescribed activities regulated under existing legislation and prescribed environmental matters to which the Act applies (EHP, 2014).
- Queensland Environmental Offsets Policy (version 1.0)
  - Outlines the government policy for the assessment of offset proposals provided by authority holders to satisfy offset conditions (EHP, 2014).

The Queensland Environmental Offsets Policy (QEOP) provides the supporting framework for environmental offsets in Queensland. The aim of the QEOP is to outline when offsets should and should not be used and to provide the over-arching principles and guidelines for using and implementing environmental offsets.

The QEOP outlines seven principles to guide the successful design and implementation of environmental offsets in Queensland:

- Principle 1: Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy.
- Principle 2: Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact.
- Principle 3: Offsets must achieve a conservation outcome that achieves an equivalent environmental outcome.
- Principle 4: Offsets must provide environmental values as similar as possible to those being lost.
- Principle 5: Offset provision must minimise the time-lag between the impact and delivery of the offset.

- Principle 6: Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values.
- Principle 7: Where legal security is required, offsets must be legally secured for the duration of the impact on the prescribed environmental matter.

The prescribed environmental matters of state significance (MSES) to which the EO Act applies:

- Regulated vegetation:
  - Endangered regional ecosystems (REs), including Endangered grassland REs;
  - Of Concern REs, including Of Concern grassland REs;
  - Wetlands shown on the vegetation management wetlands map;
  - Essential habitat;and
  - Watercourse vegetation.
- Vegetation required for connectivity;
- Wetlands and watercourses:
  - A wetland - in a wetland protection area; or of high ecological significance shown on the Map of referable wetlands;
  - A wetland or watercourse in high ecological value waters.
- High preservation areas of wild river areas;
- Protected wildlife habitat;
- Protected areas;
- Highly protected zones of State marine parks;
- Fish habitat areas;
- Waterway providing for fish passage;
- Marine plants; and
- Legally secured offset areas

Under the EO Act, offsets are only permitted following demonstration from the proponent that all practical and reasonable efforts have been taken to avoid and minimise impacts on MSES. The EO Act outlines the framework for a range of offset pathways for sourcing and securing offsets. Pathways include land-based offsets such as direct offsets and offset transfers or indirect offset options.

2.2.2 Ecological Equivalence

The QEOP requires ecological equivalence to be demonstrated between the offset area and the project disturbance area. The ecological equivalency methodology (EEM) is a process for assessing the ecological equivalence between a clearing area and an offset area through the determination of an ecological score for both areas based on ecological condition and presence of special features. This provides a transparent and repeatable methodology for the comparison of the clearing area and the offset area.

The ecological criteria used in the EEM are:

- Ecological condition – a measure of the ecological condition of a patch of vegetation using a number of field-based indicators and assessed against a defined benchmark. This measure also takes into account how the patch of vegetation relates, in terms of size and connectivity, to the surrounding landscape.
- Special features – a measure of significant ecological features important at either a site or landscape level. These areas are generally based on expert opinion informed by a range of ecological datasets, species distribution records and regional ecosystem mapping.

The ecological criteria are comprised of a total of 28 indicators, with 14 indicators in each criterion. These indicators are compared between impact and offset sites to determine whether the sites contain equivalent values.

2.2.3 Applicability to the Project

The terms of reference for the project require the discussion of environmental offset requirements in accordance the EO Act as well as to assess whether specific-issue offset policies are relevant. Consultation with the Office of the Coordinator-General and other state agencies has determined the requirement for offsets based on the principles outlined in the EO Act. As such, the project is required to be assessed using the EEM, as prescribed in the Ecological Equivalence Methodology Guideline, Version 1 (Department of Environment and Resource Management, 2011), (Section 2.2.2) and an assessment of MSES that occur within the impact area. Suitable offsets which meet the requirements outlined in the EO Act will need to be sourced and delivered for impacts on MSES associated with the project.

The proposed clearing areas and any proposed offset sites will need to be assessed using the EEM. These assessments will be completed and outlined in a project offset management plan to be developed subsequently to this offset strategy.

3 REGIONAL SETTING

3.1 Bioregion

Queensland's bioregions are based on landscape patterns that reflect geology and climate, as well as floral and faunal assemblages at a broad scale, and are used as the fundamental framework for the planning and conservation of biodiversity (Young *et al*., 1999).

The project area is located within the Brigalow Belt bioregion, which has experienced rapid and extensive loss of habitat. Major impacts upon vegetation of the Brigalow Belt include tree clearing, high grazing pressure, and the proliferation of exotic species such as *Opuntia* species (prickly pear). Additionally, the introduced pasture species *Pennisetum ciliare* (buffel grass), dominates much of the open landscape. As a consequence of habitat modification, many flora and fauna species in this bioregion have undergone severe range reductions, and localised extinctions have occurred for several fauna species (Young *et al.*, 1999).

Vegetation clearing has occurred on most of the lowland landscapes. Areas with more rugged topography associated with the sandstone and metamorphic ranges remain relatively undisturbed (Young *et al.*, 1999).

3.2 Sub-Region

The Brigalow Belt bioregion contains 36 sub-regions that delineate significant differences in geology and geomorphology (Young et al., 1999). The EIS study area is situated within the Northern Bowen Basin sub-region. The landscape of this province is predominantly undulating country dominated by *Acacia harpophylla* (brigalow) communities on clay soils and *Eucalyptus crebra* (narrow-leaved ironbark) and *E. populnea* (poplar box) open woodland communities on the shallower texture-contrast soils. Areas of sandstone are dominated by both narrow-leaved ironbark and bloodwoods (*Corymbia* spp.). Streams are often fringed by *E. raveretiana* (black ironbox) (Sattler and Williams, 1999).

3.3 Project Area Characteristics

The ecological values of the EIS study area are considered typical for the altered Isaac River sub-catchment, with large areas of land historically cleared for grazing and cropping. Although some areas of remnant vegetation remain intact, most have been modified to some extent by historical and current land management practices. The most common modification is the removal of the shrub and ground layers and replacement with pasture grass species.

The EIS study area features areas of habitat displaying north-south connectivity identified as state and regional importance. The remnant woodland vegetation in the south-east of the EIS study area represents significant habitat connectivity within the corridor system at a state scale. Contiguous tracts of vegetation within the EIS study area, representing local connectivity of habitat, are primarily linked by riparian corridors associated with the local creek and river systems. Connectivity in the east is primarily provided by the Isaac River riparian corridor. The Isaac River corridor connects with a large significant tract of vegetation along the Burton Range, approximately 10 km to the north-west of the project. The Burton Range represents a contiguous extent of woodland approximately 18 km long, varying in width from 1 to 5 km.

The majority of the EIS study area is located on relatively flat or slightly undulating lands at elevations between 250 and 325 m above sea level. Woodlands dominated by eucalyptus or acacia species cover part of the area with the remainder vegetated by non-remnant grasslands (as pasture) and shrubby regrowth. Areas of native grassland are present. In the drier areas *Eucalyptus populnea* (poplar box), *E. cambageana* (Dawson gum), *Corymbia tessellaris* (Moreton Bay ash) and *Acacia harpophylla* (brigalow) generally dominate the canopy, with a sparse mid layer and ground cover of tussocky introduced grasses. Black soil grassland areas with *Lysiphyllum* species occur, while other areas are dominated by sandy, clayey or stony soils. Isolated low laterite hills vegetated with Acacia species occur in the south-east and west of the EIS study area.

Natural waterways on the site include the Isaac River and its tributaries, including Goonyella, Eureka, Fisher, and Platypus creeks and 12 Mile Gully. All streams on the site are ephemeral with flow only evident following significant rain events. The Isaac River is a significant watercourse in the region, flowing south to enter the Fitzroy River system.

The primary existing land use within the EIS study area is cattle grazing. As a result, the general ecology of the area has been significantly modified. Modifications include the proliferation of the exotic *Pennisetum ciliare* (buffel grass) to the general exclusion of native groundcover species; impacts from cattle (trampling of ground cover vegetation); loss of mid-story vegetation shrubby diversity; soil erosion; compaction; and disturbance and fouling of natural water bodies. The presence of artificial water supplies, such as dams, provides habitat and resources for fauna groups including waterbirds and frogs, and enhances the conditions for exotic fauna such as cane toads and feral pigs.

4 AVOIDANCE AND MITIGATION

4.1 Overview

Under the current state and Commonwealth offset legislation, proponents must demonstrate that actions have been taken to avoid, minimise and mitigate impacts to ecological values prior to proposing offsets. BMA's proposed avoidance, minimisation, mitigation and management measures to achieve the identified environmental protection objectives have been presented in the Flora Survey and Terrestrial Fauna Technical Report (EIS Appendices K1 and K2 respectively) of the EIS. Relevant management measures are listed in the commitments section (Appendix S) of the EIS, and summarised in Table 4-1 below.

The implementation of the management measures listed below will aim to avoid adverse impacts from project activities, or reduce the severity of their magnitude on species and communities in the project area.

Table 4-1 Summary of relevant Project Mitigation Commitments

Commitment Number	Overview of Commitment	Relevant EIS Sections	Project Component
7	Wherever practicable, maintain existing vegetation cover.	Section 5.2 – Scenic Amenity and Lighting	GRM RHM
10	Prior to any surface disturbance, develop and implement erosion and sediment control plans for all land disturbing activities that may cause mobilisation of topsoil to surface waters as well as for works in and adjacent to streams. Erosion and sediment control plans should be based on minimising exposed soils, managing overland and concentrated flows and using appropriate devices to capture sediment if required. Conduct regular inspections of disturbed areas, including subsided areas for erosion and undertake actions to stabilise eroded surfaces as soon as practicable.	Section 5.3 – Topography, Geology and Soils Section 7 – Surface Water Section 10 – Aquatic Ecology	BRM GRM RHM
58	Some initial and progressive revegetation (pasture grassland) will take place over areas disturbed by the IMG management infrastructure. Enhancement of riparian areas at high risk of avulsion or bank instability will also be undertaken in advance of planned subsidence. Otherwise, revegetation will occur progressively after subsidence and in response to changes induced by subsidence. Revegetation of areas such as the MIA, accommodation village and other non-gas related infrastructure will take place on removal of these facilities.	Section 5.5 – Rehabilitation and Decommissioning	BRM GRM RHM
64	Riverine areas requiring pre-subsidence enhancement or rehabilitation following subsidence will be seeded or planted with selected species identified as preferred and locally endemic. Lower seeding rates may be possible in optimal conditions.	Section 5.5 – Rehabilitation and Decommissioning	GRM RHM
77	Avoid and/or minimise earthworks to be undertaken within *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) threatened ecological community (TEC) Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (of concern RE 11.8.11).	Section 9 – Terrestrial Ecology	BRM GRM RHM
78	When clearing vegetation for any of the surface facilities: – Clearly delineate areas for clearing to avoid inadvertent clearing. – Identify and clearly mark habitat trees that can be retained without compromising safety. – Consider habitat features such as felled trees and logs for relocation to other areas where practical to provide microhabitat.	Section 9 – Terrestrial Ecology	BRM GRM RHM

Commitment Number	Overview of Commitment	Relevant EIS Sections	Project Component
86	Seek to avoid and/or minimise placement of IMG extraction wells and infrastructure within RE11.8.11/TEC (Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin) where practical. Where unavoidable, offsets will be required. If this community is to be traversed, the topsoil and roots will not be disturbed. This area may be slashed.	Section 9 – Terrestrial Ecology	BRM GRM RHM
87	If clearing in the area of RE11.8.11/TEC (Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin) is required, conduct pre-clearing surveys for *Dichanthium setosum*, *Dichanthium queenslandicum* and *Digitaria porrecta*. If these grasses are identified, clearing should be avoided in these areas wherever possible, with slashing preferred to gain access. If clearing is required, individual plants may be collected and relocated, and topsoil removed and set aside to protect seed banks. Topsoil will be replaced over pipelines as quickly as possible.	Section 9 – Terrestrial Ecology	BRM GRM RHM
88	When selecting locations for wells, tracks and other infrastructure during the detailed design, already disturbed areas will be used wherever practicable, particularly in riparian and woodland vegetation.	Section 9 – Terrestrial Ecology	BRM GRM RHM
89	Placement of IMG extraction wells and other infrastructure will seek to avoid the following areas wherever practicable: – endangered REs 11.4.7, 11.4.8 and 11.4.9; and – riparian zones along Isaac River and 12 Mile Gully, particularly native vegetation within 100 m of the bank. Where these areas cannot be avoided, offsets will be required.	Section 9 – Terrestrial Ecology	BRM GRM RHM
90	River and creek crossings will be selected where natural or anthropogenic breaks in vegetation occur wherever possible, recognising that crossing locations must align with the pillars between each longwall panel.	Section 9 – Terrestrial Ecology	GRM RHM
96	Repair cracks in areas of native vegetation as they occur. Where works are required to repair surface cracks from subsidence, this will be done with minimal clearing or damage to vegetation. Suitable machinery will be used to minimise disturbance. Grasses and other groundcover will be slashed rather than cleared to allow access.	Section 9 – Terrestrial Ecology	BRM GRM RHM

Commitment Number	Overview of Commitment	Relevant EIS Sections	Project Component
99	Weed and pest monitoring will be undertaken as follows: – annual observations by site personnel for weeds and pests of management concern; – a post-construction weed audit of the surface facilities, well sites, pipeline routes and access tracks at the end of the first wet season after completion of construction activities in each area; – monitoring for pest plants and fauna within subsided areas where ponding occurs; and – maintenance of monitoring records for a period of at least five years to aid in the assessment of the long term success of the project's weed management program.	Section 9 – Terrestrial Ecology	BRM GRM RHM
103	Implement impact mitigation measures for design, construction, installation of IMG management infrastructure and operation phases to minimise disturbance to identified biodiversity values wherever practicable and safe. Biodiversity values include TECs listed under the EPBC Act, endangered and of concern regional ecosystems and riparian zones along the Isaac River, 12 Mile Gully and Goonyella Creek.	Section 9 – Terrestrial Ecology	BRM GRM RHM
110	When selecting bridge location and locations for IMG drainage infrastructure stream crossings, consider maximising use of already disturbed areas and avoiding areas with intact remnant riparian vegetation.	Section 10 – Aquatic Ecology	GRM RHM
126	Implement proactive measures, such as bank stabilisation works, in advance of subsidence.	Section 7 – Surface Water	GRM RHM
127	Where works are required to repair surface cracks from subsidence or erosion, techniques that minimise impacts on remnant native vegetation will be used.	Section 7 – Surface Water Section 9 – Terrestrial Ecology	BRM GRM RHM

225	Subsidence management and monitoring for the Broadmeadow extensions will be integrated with existing BRM subsidence management plan for operations.
	Prior to the commencement of operations for GRM and RHM, a subsidence management plan will be prepared. The plan will be consistent with the BRM subsidence management plan and adopt measures that have been successful for BRM operations, covering:
	– a description of the pre-subsidence landscape including:
	  – ecological values;
	  – land use and agricultural land suitability;
	  – topography;
	  – geology;
		Section 7 – Surface Water
		Appendix I6 – Geomorphology
		Appendix I7 – Subsidence Hydrology Assessment
			BRM
			GRM
			RHM

Commitment Number	Overview of Commitment	Relevant EIS Sections	Project Component
	– soil types and constraints; – watercourses, including cross sectional and longitudinal profiles; – surface water quality; – groundwater resources; – infrastructure; and – cultural heritage.		
	– environmental, social and economic values and environmental quality objectives;		
	– impacts of subsidence: – predicted subsidence effects (first order effects) including: o likely depth of subsidence; o post subsidence topography and formation of subsidence ponds; and o timing of subsidence. – geomorphic response (second order effects): o areas of increase channel erosion risk; o areas of avulsion risk; o hydraulic impacts; and o sediment transport impacts. – water quality and quantity (third order effects): o in-channel ponding; o overland flow capture and storage; o surface water quality; and o groundwater. – vegetation and habitat (fourth order effects): o trees and shrubs; and o grasses and pasture. – effects on infrastructure.		
	– management approach: – proactive and preventative works; – responsive works and adaptive management based on observed outcomes; – rehabilitation; and		

Commitment Number	Overview of Commitment	Relevant EIS Sections	Project Component
	– monitoring and corrective action. – reporting. Proactive measures, such as bank stabilisation works, will be undertaken. These works will be conducted within areas to be subsided in early years of mining.		
227	Based on experience managing subsidence at the BRM, the following controls are expected to be implemented: – Proactive works as required to stabilise streams prior to subsidence, potentially including: – installing timber groynes/pile field retards or other toe of bank protection measures at the base of the channel banks (extending into the channel) to mitigate erosion undercutting the channel banks and to facilitate creation of in-channel benches; – implementing toe of bank protection measures near upstream limit of subsidence on the Isaac River - these measures will most likely also be in the form of timber groynes or pile fields; and – maintaining and enhancing high density vegetation cover on the Isaac River and other tributaries where potential for avulsion or cut-off is identified. – Where surface cracks do not self-seal, or are large enough and located such as to pose a safety risk, repair of surface cracking. This may include ripping the surface surrounding the cracks, regrading to a smooth surface profile, and revegetating the cracked areas. Techniques will minimise disturbance to healthy vegetation. Grasses and other groundcover will be slashed rather than cleared to allow access and if vegetation is to be cleared, it will be cleared to ground level only. – Repair of erosion wherever this may result in loss of topsoil resources or degradation of downstream water quality. – Management of stock access prior to and during subsidence and until a stable landform is achieved. – Signage and fencing to restrict human and vehicle access to subsided areas where a hazard exists, or where this is necessary to allow vegetation to re-establish. For more substantial cracks (predicted up to 0.5 m wide): – topsoil will be stripped and stockpiled; – clay material will be imported to fill and seal cracks; – topsoil will be respread once cracks have sealed; and – the area will be seeded with appropriate plant species.	Section 7 – Surface Water Appendix I6 – Geomorphology Appendix I7 – Subsidence Hydrology Assessment	BRM GRM

Commitment Number	Overview of Commitment	Relevant EIS Sections	Project Component
230	Subsidence management will be closely integrated with management of soils, terrestrial ecology and rehabilitation.	Section 7 – Surface Water Appendix I6 – Geomorphology Appendix I7 – Subsidence Hydrology Assessment	BRM GRM RHM
233	Where monitoring indicates that performance outcomes are not being achieved in relation to subsidence or related areas of terrestrial ecology, aquatic ecology, soil management and rehabilitation, corrective actions will be undertaken and incorporated into the adaptive management approach to subsidence.	Section 7 – Surface Water Appendix I6 – Geomorphology Appendix I7 – Subsidence Hydrology Assessment	BRM GRM RHM
254 (amended from EIS commitment 107)	Develop and implement a strategy to offset state significant biodiversity values where destruction cannot be avoided. Strategy is to comply with the Queensland Government *Environmental Offsets Act 2014*.	Appendix T Section 10 – Offset Strategy	BRM GRM RHM

4.2 Avoidance

BMA is seeking approval for up to 100 per cent disturbance of vegetation as a worst case maximum disturbance scenario due to the uncertainty regarding clearing works and design associated with IMG drainage. However it should be noted as per the project mitigation commitments, BMA will apply sensitive design and site selection, to avoid high-value environmental areas for the protection of MSES and MNES wherever possible. The main impact areas of the project are anticipated to be predominantly within the non-remnant grazing lands of the project area. Direct impacts to riparian vegetation associated with the Isaac River will also be avoided wherever possible.

4.3 Mitigation

4.3.1 Mitigation Measures Specific to Surface Facilities

4.3.1.1 Flora and Vegetation Communities

When clearing vegetation for any of the surface facilities, the following mitigation measures will be utilised:

- Areas for clearing will be clearly delineated to avoid inadvertent clearing;
- If habitat trees can be retained without compromising safety, these will be identified and clearly marked;
- Habitat features such as felled trees and logs will be considered for relocation to other areas where practical to provide microhabitat;
- Vehicles and equipment will be cleaned to remove weed seeds before being brought to the site; and
- Workers will be made aware of management requirements in induction training and through work instructions.

The construction of the Red Hill accommodation village will directly impact vegetation through clearing. One record for *Cerbera dumicola* was identified within the accommodation village footprint. Targeted surveys for this species will be undertaken prior to construction. These surveys will determine:

- if the species is still present within the accommodation village footprint;
- if present, determine its extent of occurrence; and
- if present, develop suitable mitigation strategies based on extent of occurrence.

Throughout construction, the following mitigation measures will be utilised to manage impacts from construction activities:

- vehicles and equipment will be cleaned to remove weed seeds before being brought to the site;
- topsoil will be removed and used to rehabilitate existing disturbed areas;
- erosion and sediment control measures will be installed and maintained; and

- dust suppression measures, where practical, will be utilised to minimise deposition of dust on adjacent vegetation.

Following construction in each area, disturbed areas not required will be stabilised and rehabilitated consistent with the rehabilitation plan. For the bridge across the Isaac River, this will include rehabilitation of riparian vegetation. Otherwise, revegetation around surface infrastructure will generally involve establishing pasture grass as it is unlikely to be appropriate to establish native woodland or shrub land very close to surface facilities.

Weed monitoring and management and dust suppression will be ongoing throughout construction and operation.

As it will not be possible to avoid all impacts on vegetation communities of conservation significance, offsets may be required to mitigate residual impacts.

4.3.1.2 Fauna

Measures set out above to minimise impacts on flora and vegetation communities will also assist to some extent in minimising impacts on fauna. Offsets will also assist in providing habitat for species. Other measures which will be undertaken include:

- Spotter/catchers will be required when clearing woodland vegetation with high likelihood of arboreal animals;
- Spotter/catchers will hold appropriate permits under the NC Act;
- When working in other areas, workers will be provided with contact details in the event that fauna is present and needs to be removed, or fauna are accidentally injured. This will be covered in induction training and work instructions. Vehicles will not be allowed to traverse vegetated areas outside designated construction zones, but will be required to remain on existing tracks;
- During detailed design, lighting will be designed such that light spill into adjacent habitat areas is minimised. This will be particularly important for the proposed Red Hill accommodation village; and
- A speed limit of 60 km/hr will be observed for the access road to the accommodation village.

If fauna are injured by vehicles during operations, the RSPCA or local wildlife carers will be contacted for assistance. Fauna killed on roads within the mining lease areas will be dragged to the side immediately, and then removed and disposed of on a regular basis to prevent carrion eaters from also being exposed to vehicle strike.

4.3.2 Mitigation Measures Specific to the Gas Drainage Network

4.3.2.1 *Flora and Vegetation Communities*

While the extent of infrastructure required for IMG drainage will mean that impacts on significant vegetation communities and plants are unavoidable, there are a range of measures that will be taken to potentially reduce the level of impact of clearing and manage associated impacts. These include:

- Avoiding placement of IMG extraction wells and infrastructure within RE11.8.11/TEC Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin where practical. Where unavoidable, offsets will be sourced.
- Avoiding placement of IMG extraction wells and infrastructure within Endangered REs 11.4.7, 11.4.8 and 11.4.9 (and analogous TEC) where practical. Where unavoidable, offsets will be sourced.
- If clearing in the area of RE11.8.11/TEC Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin is required, conducting pre-clearing surveys for *Dichanthium setosum*, *Dichanthium queenslandicum* and *Digitaria porrecta*.
- If these grasses are identified, clearing should be avoided in these areas wherever possible, with slashing preferred to gain access. Slashing to be undertaken as per suitable guidelines for managing native pastures, such as Henry *et al.* (2004).
- If clearing is required, individual plants may be collected and relocated and topsoil will be carefully removed and set aside to protect seed banks. Topsoil will be replaced over pipelines as soon as practicable.
- Designing and constructing IMG management infrastructure to minimise disturbance to riparian zones along the Isaac River and 12 Mile Gully and avoiding placement of wells within 50 m of these waterways wherever possible.
- Wherever practical, locating infrastructure alignments and gas drainage wells to avoid remnant vegetation.
- Minimise river crossings, relying on the Isaac River bridge.
- Selecting river and creek crossings where natural breaks in vegetation occur wherever possible, recognising that crossing locations must align with the pillars between each longwall panel.
- Clearly delineating clearing areas so that inadvertent clearing of additional areas does not occur. This will be covered in induction training and work instructions to crews undertaken vegetation clearing.
- Cleaning of vehicles and equipment to remove weed seeds before equipment and vehicles are brought to the site. Weed wash downs of vehicles and equipment will also be undertaken when leaving a known weed infested area.
- Monitoring weed levels and actively managing weeds around the edges of vegetation fragments.
- Dust suppression measures will be undertaken to minimise dust deposition on vegetation adjacent to tracks and construction areas. Frequently trafficked surfaces will be gravelled to reduce dust generation, otherwise water trucks will be used to suppress dust.

- Utilising erosion and sediment control measures as set out in the Land Resources Chapter (Section 5.3.3) of the EIS for all ground disturbance activities and stream crossings.
- Rehabilitating buried pipeline alignments consistent with the EIS Rehabilitation Plan.
- Rehabilitating drill pads once wells are installed consistent with the Rehabilitation Plan.

Even with these mitigation measures, the ecological function of most vegetation communities within the proposed underground mine footprint will be severely affected due to the extent of fragmentation, and offsets are expected to be required to mitigate any residual impact after taking into account potential effectiveness of rehabilitation.

4.3.2.2 Fauna

The primary impacts on fauna during construction of the gas drainage network are the loss of habitat and potential risk of mortality associated with the works.

Measures to reduce habitat impacts will include:

- Restricting crossings of the Isaac River to a bridge crossing on the main headings, and one to two pipeline crossings, unless detailed design indicates that additional crossings cannot be avoided for safety reasons;
- Selecting already disturbed areas for crossings of creeks and drainage lines wherever possible;
- Minimising the width of clearing required for crossing, and particularly retaining tall trees on either side of crossing locations wherever this is safe to do so; and
- Minimising placement of gas wells in riparian and woodland areas wherever possible.

Mitigation measures proposed for flora and vegetation communities will address loss and degradation of habitat to some extent, however as noted above, offsets will also be sourced as required.

When clearing woodland vegetation with high likelihood of arboreal animals BMA will use spotter/catchers to inspect area for presence of fauna immediately prior to clearing, and then remove any fauna in situ. Spotter/catchers will hold appropriate permits under the NC Act. When working remote to the spotter/catchers, workers will be provided with contact details for the spotter/catchers in the event that fauna is present and needs to be removed, or are accidentally injured. This will be covered in the induction training and work instructions. Vehicles will not be allowed to traverse vegetated areas but will be required to remain on existing tracks. BMA will impose a speed limit on all roads and tracks associated with the IMG management network. Forty kilometres per hour is likely to be appropriate for most roads and tracks. If lighting is required, it will be directed away from vegetated areas where practical.

4.3.3 Mitigation Measures Specific to Mining of the RHM and BRM

Adaptive management will be incorporated into management strategies, which will include lessons learnt from the adjacent Broadmeadow subsidence monitoring results.

4.3.3.1 *Flora and Vegetation Communities*

Where works are required to repair surface cracks from subsidence, this will be done with minimal clearing or damage to vegetation. Use of smaller machinery will be preferred. Grasses and other groundcover will be slashed rather than cleared to allow access.

Where machinery is required to repair cracks or construct subsidence pond drainage channels, vehicles and equipment will be cleaned of all weed seeds and other potential contaminants before entering the site.

Weed monitoring and management programs will be ongoing throughout the mining period.

Rehabilitation will be undertaken as soon as practical as detailed in the Land Resources chapter (Section 5.5) the EIS

4.3.3.2 *Fauna*

No particular mitigation measures are required to address impacts of subsidence on fauna. Management of vegetation and rehabilitation along the Isaac River and 12 Mile Gully corridors will assist with minimising impacts of habitat loss on fauna.

Progressive rehabilitation of impacted areas as the RHM progresses will reduce long term impacts on fauna. In areas where subsidence causes permanent ponds, rehabilitation efforts should be tailored toward developing sustainable wetland habitats.

4.3.4 Mitigation Measures Specific to Conservation Significant Fauna Species

As detailed within the Ecology Technical Report (Appendix K) of the EIS, the majority of conservation significant fauna will not experience direct impacts. Due to the availability of suitable habitat elsewhere in the EIS study area or surrounding region, the loss of suitable habitat from the project is not expected to have a significant impact on the regional population of any conservation significant fauna species. Additionally, the adoption of the mitigation strategies identified from the above project activities should reduce the potential for adverse impacts on these fauna.

Of the seventeen fauna species of conservation significance identified as occurring or potentially occurring within the EIS study area, two have been the subject of a recovery plan, these being the brigalow scaly-foot (*Paradelma orientalis*) and ornamental snake (*Denisonia maculata*), as covered under the draft Queensland Brigalow Belt Reptile Recovery Plan 2008 – 2012. Mitigation measures presented in the EIS are consistent with the objectives of the recovery plan for these two species.

Habitat in which the ornamental snake (*Denisonia maculata*) was recorded could potentially be altered as a result of subsidence. A targeted field survey of this location and adjacent habitat will be undertaken 12 months prior to the commencement of construction of the RHM underground expansion option to determine the presence and extent of the ornamental snake habitat within this area.

If any areas within the disturbance footprint are deemed as significant habitat, a threatened species management plan will be developed. This plan will outline:

- The level of activity that the habitat can sustain;
- The remediation procedures if tension cracking or vegetation loss occurs; and
- Further monitoring requirements.

The threatened species management plan will aim to mitigate the long term impacts on this species within the EIS study area.

5 ENVIRONMENTAL VALUES TO BE OFFSET

5.1 EPBC Act Biodiversity Values Summary

The EPBC Act and EO Act outline specific environmental values that require offsetting if significant impacts to those values occur. MNES are listed in Table 5-1 below, and MSES are listed in Table 5-2.

Table 5-1 Matters of National Environmental Significance and their Applicability to the Project

MNES	Description	Applicability to Red Hill Project
World Heritage Properties	Australian heritage places that are of outstanding universal value and have been included on the United Nations Educational, Scientific and Cultural Organisation (UNESCO) managed list.	Not applicable
Ramsar Wetlands	A 'declared Ramsar wetland' is an area that has been designated under Article 2 of the Ramsar Convention or declared by the Minister to be a declared Ramsar wetland under the EPBC Act.	Not applicable
Nationally listed threatened species and ecological communities	Species or communities listed under the EPBC Act.	Nationally listed threatened species including the koala and ornamental snake will be impacted by the project. Threatened ecological communities including Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin and Brigalow (*Acacia harpophylla* dominant and co-dominant) will be impacted by the project.
Listed Migratory Species	Many migratory species listed under the international conventions and agreements Australia is party to, are protected under the EPBC Act.	Listed migratory species occurring within the project area are listed in the MNES Report (Appendix J) of the EIS. Impacts to listed migratory species are discussed in the MNES Report (Appendix J) and are expected to be insignificant, and therefore will not require offsetting.
Activities related to nuclear energy, including uranium mining	Activities related to nuclear energy, including uranium mining. Includes nuclear actions as defined in the EPBC Act.	Not applicable
The Commonwealth marine environment	Marine areas as defined by the EPBC Act and broadly grouped into South-west, North-west, North and Temperate East marine zones.	Not applicable

MNES	Description	Applicability to Red Hill Project
National Heritage Places	A list of natural, historic and Indigenous places of heritage significance.	Not applicable
Great Barrier Reef Marine Park	The Great Barrier Reef Marine Park managed by The Great Barrier Reef Marine Park Authority (GBRMPA).	Not applicable

5.2 Matters of State Environmental Significance Summary

Table 5-2 Matters of State Environmental Significance and their Applicability to the Project

MSES	Description	Applicability to Red Hill Project
Endangered REs	Regional ecosystems which: – are listed in schedule 1 of the Vegetation Management Regulation 2012 – are mapped as a Category B area on the regulated vegetation management map – fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	Remnant endangered REs within the project area include REs 11.3.1, 11.4.7, 11.4.8, 11.4.9, 11.5.16 and 11.9.1. An estimate of availability of these REs as suitable areas for offset sites is presented in Section 7.2.
Endangered grassland REs	Regional ecosystems which: – are listed in Appendix 4 of this Policy – are mapped as a Category B area on the regulated vegetation management map – fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	No endangered grassland REs occur within the project area.
Of concern REs	Regional ecosystems which: are listed in schedule 2 of the Vegetation Management Regulation 2012 – are mapped as a Category B area on the regulated vegetation – management map – fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	Remnant of concern REs within the project area includes REs 11.3.2, 11.3.3, 11.3.4, 11.3.4a, 11.3.36 and 11.4.2.
Of concern grassland REs	Regional ecosystems which: are listed in Appendix 4 of this Policy – are mapped as a Category B area on the regulated vegetation management map – fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	One of concern grassland RE occurs within the project area: RE 11.8.11 The availability of this RE as a suitable offset area within the region is presented in Section 7.2.
Essential habitat	Regional ecosystems which: – are mapped as a Category B area on the regulated vegetation management map – identified as essential habitat on the essential habitat map.	Essential habitat for *Dichanthium setosum* is mapped within the project area.

MSES	Description	Applicability to Red Hill Project
Wetland (*Vegetation Management Act 1999*)	Regional ecosystems which: – are mapped as a Category B area on the regulated vegetation management map – identified as a wetland on the vegetation management wetlands map	Wetlands as per the MSES description are mapped within the project area. However, field surveys have discounted the presence of this wetland RE.
Watercourses	Regional ecosystems which: – are mapped as a Category B area on the regulated vegetation management map – identified as a watercourse on the vegetation management watercourse map	Watercourses as per the MSES description occur within the project including Isaac River and 12 Mile Gully
Connectivity	Areas which consist of vegetation mapped as a category B area on the regulated vegetation management map where the proposed impact area: – contains State significant biodiversity values; or – is within 500 meters of a State significant biodiversity value; and – forms an important link or stepping stone in the landscape; or – forms part of a patch which is five ha or greater; and – will compromise the function of State significant biodiversity values	Connectivity occurs within the project area as per the MSES description.
Protected plants and animals	Extinct in the wild, endangered or vulnerable protected plants under the *Nature Conservation Act 1992*. Endangered, vulnerable and special least concern animals under the *Nature Conservation Act 1992*.	Estimated areas for protected plants and animals have been undertaken through habitat mapping where applicable.
Legally secured offset area under State legislation	An offset area approved by the administering authority associated with a legislative or policy requirement for the provision of an offset.	No legally secured offset areas are present within the project area.
Wetland protection areas	Means an area shown as a wetland protection area on the Map of Referrable Wetlands	No wetland protection areas occur within the project area.

6 POTENTIAL AREA OF DISTURBANCE

6.1 Overview

BMA will use sensitive design and site selection to avoid high-value environmental areas for the protection of MSES and MNES wherever possible, and anticipates that the area of disturbance will be less than 100 per cent of the project footprint. Due to current uncertainty in final design and potential clearing works for the IMG drainage, BMA are presenting a worst case scenario of 100 per cent disturbance.

The maximum estimated disturbance area for each project stage under the worst case scenario is outlined in Table 6-1, Table 6-2 and Table 6-3 below.

Ecological equivalence surveys for Stage 1 are currently being engaged, with the results and identified offset areas to be presented to regulatory agencies following these initial ground truthing investigations.

Offsets for Stage 1 are being calculated using the current *EPBC Act Environmental Offsets Policy* 2013 (EOP) and the Queensland Government EO Act. Offsets for Stages 2 and 3 will be calculated using the applicable offset policies and mechanisms available at those times.

6.2 Stage 1

The maximum estimated disturbance area for Stage 1 includes MNES potential habitat and an Of Concern RE. Potential impacts from Stage 1 include clearing of vegetation for IMG and subsidence associated with the Broadmeadow expansion. No surface infrastructure impacts are planned in Stage 1. Potential synergies exist between the EPBC Act EOP and offset policies administered by the Queensland Government. The EPBC Act EOP and EO Act support the development of complementary offset packages. These are not being considered during Stage 1 as no overlapping values have been identified with the potential impacts for Stage 1. A further analysis of potential overlapping values will be undertaken in Stages 2 and 3.

Table 6-1 Stage 1 proposed disturbance areas

Biodiversity Value	Description	Maximum Impact Area (ha)
MNES		
Ornamental snake habitat	High potential habitat	25.76
MSES		
Of Concern RE	11.4.2	25.76
Connectivity	State significant	71.90

6.3 Stage 2

The biodiversity values which will potentially be impacted during Stage 2 include TECs, protected fauna potential habitat and state protected vegetation communities. Watercourse and connectivity MSES also have potential to be impacted. The estimated worst case disturbance impacts to the values associated with Stage 2 are presented in Table 6-2.

It should be noted that the estimated worst case disturbance impact areas for MNES generally comprise MSES (for example TECs are comprised of analogous REs). Offset delivery for Stage 2 impacts will preferentially secure offset areas which satisfy MNES values and MSES.

Table 6-2 Stage 2 proposed disturbance areas

Biodiversity Value	Description	Maximum Impact Area (ha)
MNES		
Threatened Ecological Community	Brigalow	298.14
	Native grasslands	81.89
Koala habitat	High potential habitat	29.31
Ornamental snake habitat	High potential Habitat	352.67
MSES		
Endangered REs	11.3.1	10.56
	11.4.7	57.63
	11.4.8	49.78
	11.4.9	120.76
	11.5.16	28.09
	11.9.1	0.64
Of Concern REs	11.3.2	44.91
	11.3.3	7.01
	11.3.4	7.83
	11.4.2	32.71
Of Concern grassland REs	11.8.11	117.54
High value regrowth containing endangered REs	11.4.8/11.4.9 HVR	30.67
Essential habitat	*Dichanthium setosum*	117.54
Watercourses	Stream Order 1	21.45
	Stream Order 2	8.77
	Stream Order 3	8.87
	Stream Order 5	49.64
Connectivity	Local or Other significance	300.40
	Regional	175.82
	State	335.55

6.4 Stage 3

The majority of the disturbance area associated with the project will potentially occur during Stage 3; however, fewer RE types are associated with the clearing during this stage of the project. The estimated worst case disturbance impacts associated with Stage 3 are presented in Table 6-3.

It should be noted that the estimated worst case disturbance impact areas for MNES generally comprise MSES (for example TECs are comprised of analogous REs). Offset delivery for Stage 3 impacts will preferentially secure offset areas which satisfy MNES values and MSES.

Table 6-3 Stage 3 proposed disturbance areas

Biodiversity Value	Description	Maximum Impact Area (ha)
MNES		
Threatened Ecological Community	Brigalow	70.62
Koala habitat	High potential habitat	105.80
Ornamental snake habitat	High potential Habitat	692.08
MSES		
Endangered REs	11.3.1	52.99
	11.4.8	6.02
	11.4.9	4.77
Of concern	11.3.2	129.59
	11.3.4	127.25
	11.4.2	333.54
High value regrowth containing endangered REs	11.4.8/11.4.9 HVR	6.84
Watercourses	Stream Order 1	4.07
	Stream Order 2	13.47
	Stream Order 3	71.33
	Stream Order 5	266.80
Connectivity	Local or Other significance	75.50
	Regional	296.65
	State	517.46

7 APPROACH TO PROVISION OF OFFSETS

7.1 Overview

This offsets strategy provides an estimation of maximum disturbance to biodiversity values for each stage of the project. State and Commonwealth government polices allow a range of options for offsets including direct and indirect offsets, funding arrangements for research and managing offsets obtained by brokerage or banking services. These options have been considered in determining BMA's preferred hierarchy in delivering offsets.

As outlined above in Section 4, BMA is committed to reducing potential impacts on biodiversity values through avoidance and mitigation measures, with offsets employed as a secondary measure to ameliorate residual impacts. Due to uncertainties associated with IMG design and the degree of subsidence impacts on vegetation, BMA has developed a staged offset approach that will account for actual losses, manages unavoidable losses and incentivises avoidance to protect environmental values.

Prior to the start of each stage, an assessment of offset requirements and associated ecological equivalence surveys will be carried out. The offsets approach for each project stage includes the following steps:

- Refine the estimate disturbance and undertake ecological equivalence – Quantify the area of disturbance on biodiversity values. Undertake site specific ecological equivalence assessments of potentially impacted biodiversity values.
- Prepare Offset Management Plan – Suitable offset areas which meet criteria for the specific environmental value will be identified. Offset areas will be sought for the maximum disturbance area pertaining to the relevant project stage.
- Deliver offsets and reconcile impacts – Offset areas are to be delivered following approval of Offset Management Plan from Commonwealth and State regulators within the agreed timeframe. Actual on site impacts associated with the clearing and subsidence for previous stages will be determined and reconciled against estimated disturbances and the balance accrued against the overall values actually offset in the next stage.

These steps are further detailed below.

7.2 Estimate Disturbance and Undertake Ecological Equivalence

The estimated disturbance areas represent a maximum disturbance area and are a conservative estimate of the likely actual losses. Ecological equivalence assessments of disturbance areas will be undertaken prior to any works as site specific surveys utilising EEM to verify the baseline condition of the biodiversity values for the site (as outlined in Section 2.2.2), and inform the requirements for offsets in the Offset Management Plan.

7.3 Offset Management Plan

During this stage, the results of the ecological equivalence assessments within the project area will be presented and the offset areas identified within an Offset Management Plan. The plan will:

- Finalise the offset mechanism to be used for the project;
- Identify opportunities for offsetting complementary values (e.g. brigalow TEC and ornamental snake habitat);
- Identify any BMA lands that will be secured as offsets, their locations and contribution towards offset requirements;
- Identify those offset requirements that will be secured through the provision of other offset lands;
- Identify offset requirements that will be secured through an offset transfer or offset payment; and
- Identify any indirect offset proposals.

Where direct offsets are proposed, a risk assessment of future land use will be completed. This will go towards ensuring that any direct offset proposed by the project is not subject to future non-compatible land uses such as mining.

Consultation is conducted with Commonwealth and State agencies during the development of an Offset Management Plan to ensure all offset issues are identified and discussed before the package is finalised.

7.4 Delivery of Offsets

The delivery of an offset is defined for the project as entering in agreements to establish an offset with the relevant landholder or organisation.

Following approval of the Offset Management Plan, the measures and mechanisms identified will be secured. This includes conducting ecological assessments of offset sites, legally securing the offset sites and the preparation of appropriate offset site management plans. Where offsets are to be secured through brokers and offset payments, contracts are to be in place (and payments made) to satisfy these offsets requirements. Finally, all funding for indirect offsets are to be in-place with the appropriate institution or department.

Offset site management plans will be prepared where required to outline ongoing management actions required at each area, such as:

- Management of grazing;
- Weed suppression and control;
- Pest control;
- Management of fire;
- Fencing to restrict informal access; and
- Revegetation and supplementary planting (for areas of non-remnant vegetation).

These offset site management plans will also include details such as the duration of active management, reporting, monitoring and measures to achieve condition improvement requirements. Annual reporting may be required to be undertaken to assess the progress of the offset area against biodiversity objectives.

Offsets selected will be managed to deliver a net benefit, particularly in regards to an improvement in condition and context of the protected offset area. With improved and active management of the offset site it is anticipated that an improvement in both the condition and the context of the offset can be achieved in a relatively short timeframe (5-10 years).

Key elements of management that can deliver improvement are:

- Active weed management;
- Fire management;
- Rotation and control of grazing pressure;
- Maintain a connection to other vegetation/offset/protected areas and application of consistent and complimentary management measures across a larger area focused on conservation; and
- Control of pest animals (particularly wild dogs and pigs) that have the potential to destroy habitat and displace or prey on native fauna.

Context improvement will be achieved through the management of the broader property as a whole. This will reduce the likelihood of edge effects, weed invasion and provides security to the habitat connectivity in place.

Grazing management in particular requires a balanced approach in order to deliver positive improvement outcomes. A controlled grazing regime will be introduced as part of the Offset Management Plan, this regime will be based on local conditions and knowledge and conform to the published science on grazing in native woodlands and grasslands.

Through active management it is anticipated that the selected offset area will provide continued and improved fauna colonisation, particularly through the management of grazing pressure and the control of feral animals.

7.5 Staging of Offsets

An estimation of initial maximum predicted impacts associated with each project stage is presented within this report (Section 6). As the timing of stages 2 and 3 of the project is uncertain, the necessary offsets for each project stage will be sourced and secured at the appropriate time in advance of each stages development. Before stages 2 and 3 begin, BMA will:

- Calculate any credits from previous stage(s), based on post-impact surveys;
- Calculate the offset area required for the potential maximum disturbance area;
- Identify and evaluate suitable offset area(s);
- Conduct landholder negotiation;
- Conduct management planning; and
- Secure the offset(s).

The staged approach will allow for the refinement of potential impacts to be updated for each stage to incorporate any future project design changes and efficiencies that may result in a reduction of the disturbance footprint.

The staged approach relies on offsets to be obtained for the estimated maximum area of disturbance for each project stage, with subsequent site surveys to then quantify the actual impacts. The timing of site surveys will be detailed within the offsets management plan. The scheduling of surveys will be based on predicted timing of key impacts, as outlined in project timing (Section 1.3), and Table 1-2, including:

- Post-clearing;
- Roof collapse; and
- Panel extraction.

It is proposed that where the actual resulting impacts from development are less than the initial estimated maximum disturbance area (as is expected to be likely), then the difference between the area of values offset, but not impacted, is then utilised as an offset 'credit'.

Any offset credits resulting from areas that were not actually impacted, will then be attributed to the offset area for the impacts from subsequent project stages.

The timeframe for proposed offset staging is outlined below in Table 7-1.

Table 7-1 Offset Staging Timeframe

Project Stage	Timing	Offsets Delivered Per Stage[1]
1	Prior to stage 1	Stage 1 offsets acquired for 100 % of projected disturbance
2	Prior to stage 2	Stage 2 offsets acquired for 100 % of projected disturbance minus any Stage 1 credits
3	Prior to stage 3	Stage 3 offsets procured for 100 % of projected disturbance minus any Stage 1 or 2 credits

It is proposed that any offset credits resulting from the reconciliation of actual impacts for Stage 3 of the project could potentially also be applied to BMA's interests elsewhere in the region where suitable. This process incentivises the avoidance and/or minimisation of impact on biodiversity values.

[1] Offsets will have been identified and acquired within these timeframes. However, due to potential time constraints, secured covenants and other legal mechanisms may not have been completed.

7.6 Proposed Offset Options

The proposed offset approach may use a series of offset options available. The proposed approach by BMA involves the following offset options in order of preference:

1. Use of lands owned by BMA.
2. Purchase other offset properties.
3. Use of offset brokers to source and secure the required offsets from the landscape on behalf of BMA. An offset broker may be used to secure an offset through a third party, or through an offset transfer.
4. Use of offset payments to allow government bodies to secure the required offsets. This option requires negotiation and consultation with government bodies.
5. Use of indirect offsets should the options above fulfil a significant proportion of the offset requirement.

An assessment of potential offset availability for land based offsets has been undertaken using a spatial analysis. The methodology and results of this assessment are outlined in Section 8 below.

8 OFFSET AVAILABILITY

An estimation of the offset availability within the Bioregion was undertaken and is presented below. Given the recent offset legislation changes, this estimation was initially undertaken on ‘compliant’ regrowth vegetation within the bioregion (as per superseded offset policies). This estimate is relevant to current legislative requirements and has therefore been retained within this strategy. However, it is recognised that additional options are now available to BMA with regards to offset delivery and may be incorporated into future offset management plans. All offsets delivered by BMA will be compliant with the EO Act.

8.1 Offsets for Stage 1

Ecological equivalence surveys for Stage 1 impacts are currently being scoped, with surveys scheduled to be undertaken following finalisation of this offset strategy.

8.2 Offset Availability Identification Methodology

An estimation of potential offset availability within the bioregion for each impacted MSES was undertaken using desktop analysis. The desktop assessment assessed available regrowth within the brigalow belt bioregion with a foliage projective cover (FPC) greater than or equal to six per cent (≥ 6 %).

8.2.1 Vegetation Offset Area Identification

Possible offset areas were based on lot and plans, rather than properties which may comprise more than one lot. The potential offset areas were identified where all of the following criteria apply:

- lot size is greater than 2 ha;
- lot tenure is lands lease or freehold – using the Queensland Digital Cadastral Database;
- contain suitable mapped environmental values as those potential impacted by the project;
- contain areas mapped as non-remnant, compliant high value regrowth vegetation or category X on a property map of assessable vegetation; and
- mapped with FPC ≥ 6 % (except for grassland REs).

Potential offset areas identified in this analysis do not include areas that are:

- High value regrowth (HVR) that is an Endangered RE on freehold or indigenous land;
- HVR that is an Endangered or Of Concern REs on leasehold land;
- Essential regrowth habitat;
- Wetland protection areas;
- Lots mapped as Queensland Estate,
- Lots declared as nature refuges,
- Strategic cropping trigger areas; and
- Lots containing existing mining leases.

8.2.2 Watercourse Vegetation and Connectivity Offset Identification

As outlined in the EO Act, offset requirements for watercourses must be:

- Located within the same bioregion;
- The same or higher stream order as the proposed impacted watercourse; and
- An RE associated with a watercourse. That is, the offset area must assist with maintaining bank stability, water quality, aquatic habitat and terrestrial habitat.

Given the above, the offset availability for watercourse vegetation was determined using two methods:

- The total length of streams of suitable stream order in the bioregion was calculated; and
- Potential vegetation offset areas were identified using REs on landzone 3 (Quaternary alluvial systems), as these REs are by definition associated with river and creek flats.

Offset availability for connectivity was determined by calculating potential vegetation offset areas (as outlined in Section 0) within the Biodiversity Planning Assessment State and Regional corridor mapping within the bioregion.

8.2.3 Limitations of the Desktop Assessment

The desktop assessment outlined above has a number of limitations, including:

- All desktop identified areas require ground truthing of environmental values;
- Potential conflicts may exist between land use areas;
- Identified areas may have been cleared or partially cleared since the release of the most current FPC dataset;
- Further site specific ecological equivalence assessments are required to determine the suitability of the offset and the size of the offset required for each impact; and
- Landholders who own the potential offset areas may not wish their land to be the subject of environmental offsets.

8.3 Offset Availability within the Region

The analysis of potential offset availability for impacts to MSES including vegetation (REs), watercourses and connectivity within the Brigalow Belt Bioregion is presented below. The proposed maximum disturbance area for the project is provided for each environmental value for ease of comparison.

8.3.1 Regional Ecosystems

The offset requirements for REs as determined from the maximum disturbance scenario for Stages 1, 2 & 3 combined are presented in Table 8-1 below. The table outlines the conservation status and maximum disturbance area for impacts to each RE, as well as detailing the potential offset availability of the RE within the bioregion.

In many circumstances, under Queensland offset policies, vegetation within the same broad vegetation group (BVG) are able to be provided as an offset. This allows the use of multiple REs to be used as an offset for an impact to a particular RE.

Table 8-1 Potential offset availability for impacts to vegetation

BVG	Impacted RE	Status	Maximum Area of Project Disturbance (ha)	Compliant REs	Potential Offset Areas, FPC ≥6% (ha)	Total Number of Lots
25a	11.3.1	E	63.56	11.4.10, 11.11.14, 11.12.21, 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.5.16, 11.9.1, 11.9.5, 11.9.6	124,770	6,100
25a	11.4.7	E	57.63			
25a	11.4.8	E	55.80			
25a	11.4.9	E	125.53			
25a	11.5.16	E	28.09			
17a	11.4.2	OC	392.01	11.12.17, 11.4.2, 11.4.12, 11.3.2, 11.5.13, 11.8.15, 11.9.7	143,631	4,747
17a	11.3.2	OC	174.5			
16c	11.3.3	OC	7.01	11.3.15 11.3.28, 11.3.3 11.3.38, 11.3.4	153,571	8,096
16c	11.3.4	OC	135.18			
30b	11.8.11[1]	OC	117.54	11.11.17, 11.4.11 11.8.11, 11.9.12	36,806	758

[1] FPC data has not been considered when calculating potential offset availability of grassland Res

E – endangered, OC – Of concern

8.3.2 *Watercourses and Connectivity*

The offset requirements for watercourses and connectivity as determined from the maximum disturbance scenario for Stages 1, 2 & 3 combined are presented in Table 8-2 and Table 8-3 below. The table outlines the potential offset availability within the bioregion.

Table 8-2 Potential offset availability for impacts to watercourses

Impacted Value: Stream Order	Estimated Maximum Area of Project Disturbance (ha)	Available Total Stream Length in Bioregion (km)	Potential Offset Areas, FPC ≥6% (ha)	Total Number of Lots
Order 1	25.52	341,305	Landzone 3 REs 261,940 ha	15,676
Order 2	22.24	148,659		
Order 3	80.20	83,982		
Order 5	316.4	26,577		

Table 8-3 Potential offset availability for impacts to connectivity

Impacted Value	Significance	Maximum Project Impact Area (ha)	Potential Offset Areas (ha)	Total Number of Lots
Connectivity	State (including State habitat for EVR)	407	15,779	4,703
	Regional	176	8,936	3,206
	Local	301	1,015	572

8.4 Offset Availability within BMA Properties

BMA holds a number of properties within the Brigalow Belt that could be used as offset areas. One such property, "Terang", has been assessed for suitability against a number of BMA's interests for Stage 1. This assessment has identified the following:

- The property is located near Blackwater within the Brigalow Belt Bioregion;
- The property is confirmed to support 85.5 ha of RE11.3.2 (BVG17a); and
- The property supports known ornamental snake habitat.

Based on this assessment, the values within the Terang property have potential to be used as an offset for REs of BVG 17a within the project area.

The RE values present within the Terang property (BVG 17a) are analogous to a number of potentially impacted REs for the project, including the Stage 1 estimated disturbance of 25.76 ha to RE 11.4.2.

The results of the ecological equivalence surveys and an analysis of potential offset sites within other BMA properties (if deemed suitable) will be utilised for inclusion in the subsequent Offset Management Plan.

8.5 Offset Site Prioritisation

Whilst all proposed offset areas will meet the intent of Commonwealth and State offset policies, prioritisation will be given to those areas that contain multiple offset values and are strategically located. Offsets which contain connectivity values, such as those within regional wildlife corridors, will be prioritised to provide a greater enhancement of biodiversity and long term conservation outcomes.

While it is recognised that the final availability and ecological suitability is dependent on both landholder engagement and ecological equivalence, the results of the above potential offset analysis show that large areas of potentially suitable vegetation occur.

9 CONCLUSION

The potential maximum estimated disturbance area of the project has been determined (Section 6) and the potential availability of offset values within the Brigalow Belt Bioregion for has been assessed (Section 8). The results of this desktop assessment have been presented for each value potentially impacted, with total available offset area (hectares) and number of lots outlined in Section 8.3.

The results of this assessment have indicated that all potentially impacted values have analogous areas that could serve as offsets within the region. The available area of values and number of lots potentially present (as determined from the desktop assessment) to offset each impacted value, are sufficient for use as environmental offsets. However, these areas are still subject to field verification of their condition and suitability as offsets.

As well as disturbance estimates and associated offset availability, BMA's approach to the provision of offsets is outlined within Section 7 and details the offset staging process. The staged approach allows offsets to be sought for the maximum area of disturbance, with reconciliation of actual impacts to be carried through into the following stages as offset credits.

10 REFERENCES

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11 LIMITATIONS

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Appendix C BSTEM Model Assumptions and Results

Attachment E
Bank Stability and Toe Erosion Model (BSTEM)

The Bank Stability and Toe Erosion Model (BSTEM) is a tool that is freely available via the United States Department of Agriculture's (USDA) Agricultural Research Service. BSTEM is an Excel-based model that simulates the hydraulic and geotechnical processes that contribute to mass failure (the bank stability model) and fluvial scour (the toe erosion model) in stream banks. Inputs into the model include:

- Bank geometry (bank and toe extent), reach slope, soil layers, flow conditions and water table depth.
- Bank material for each soil layer, consisting of either default or measured values for cohesion, friction angle, saturated unit weight and nutrient concentration.
- Bank top vegetation.
- Bank and/or bank-toe protection.

The bank stability model and the toe erosion model can then be run and the output of these models (failed or eroded bank profile geometry) can be fed back into the input geometry to form an iterative procedure.

Model setup

BSTEM was applied to a typical bank on the Isaac River susceptible to instability and accelerated erosion as a result of subsidence. The selected bank is located on the left bank (looking downstream) of the Isaac River on the pillar zone between longwall panels RH208 and RH209. The geometry of the bank was input into the model as shown in Figure 20 below. The shear emergence elevation was set at the top of the toe of bank at a height of 1.93m.

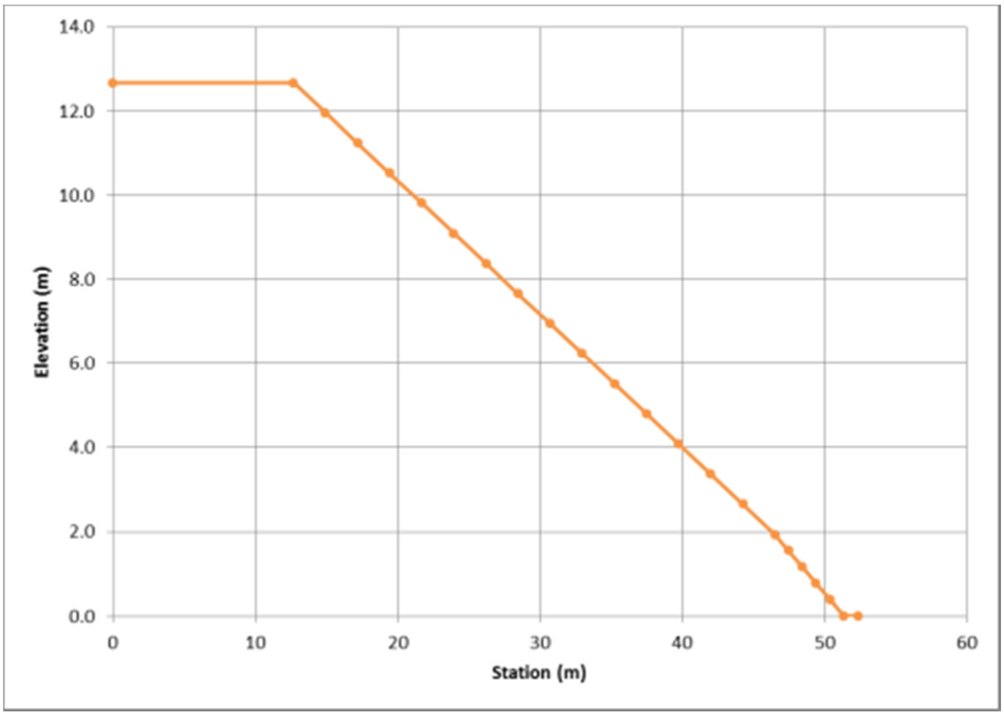

Figure 20. ***Representation of bank geometry used in BSTEM***

The bank was assumed to be comprised of a single material type, due to the lack of any sediment data to confirm otherwise. A material type of erodible silt was selected for the bank and toe material (conservative assumption) and the default bank and toe parameters adopted that are provided within the BSTEM. The mud drape, which is densely populated by plant roots, which covers the channel banks is not adequately represented in BSTEM.

The water surface elevation for flow rates of 2,000 m^3/s and 500 m^3/s was extracted from the HEC-RAS modelling of the Isaac River at the bank location. These flow rates were selected as they represent a bank-full event and a half bank-full event respectively at this location. Event durations of 12, 24, 36, 48 and 60 hours were modelled to provide results for a range of possible flow events.

The pre-subsidence scenario was modelled with an average reach slope of 0.0007 m/m, whilst an average reach slope of 0.033 m/m was used for the post-subsidence scenario. These bed grades were measured from the pre-subsidence and post-subsidence DTM respectively, with a reach length of 150m. The effects of bank top vegetation or bank/toe protection were not initially modelled.

BSTEM results

The BSTEM modelling found that for both pre-subsidence and post-subsidence scenarios, the bank was stable in terms of mass failure with a factor of safety of 6.2 for the 500 m^3/s flow rate and 3.3 for the 2,000 m^3/s flow rate, where a factor of safety greater than 1.3 indicates the bank is stable.

In contrast to this, the estimated toe erosion impacts were determined to be much more significant for the post-subsidence scenario compared to the pre-subsidence scenario for both of the flow rates as shown in Table 6 below. A visual representation of the estimated impacts upon the bank are shown for both the pre-subsidence and post-subsidence scenarios following a single 2,000 m^3/s flow event in Figure 21 below. Prior to subsidence occurring, the estimated toe erosion is minimal given the magnitude of the event modelled. Following subsidence, the toe erosion is significant, with an estimate of up to 25m of toe erosion from the single large-scale event, illustrating the need for toe erosion mitigation measures.

Table 6. BSTEM toe erosion outputs for 500 and 2,000 m^3/s flow rates

	Total Eroded Volume for 500 m^3/s flow rate		Total eroded volume for 2000 m^3/s flow rate	
Event Duration (hr)	**Pre-subsidence (m^3)**	**Post-subsidence (m^3)**	**Pre-subsidence (m^3)**	**Post-subsidence (m^3)**
12	480	5,372	1,691	17,910
24	899	6,134	3,128	20,118
36	1,254	6,506	4,385	21,101
48	1,565	6,759	5,513	21,681
60	1,838	6,933	6,507	22,085

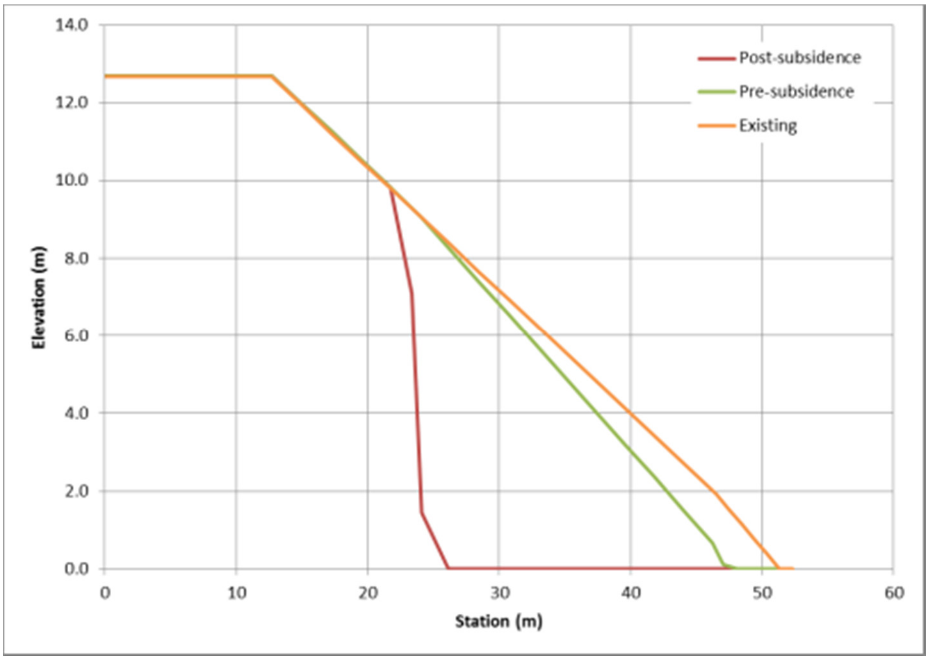

Figure 21. ***Resultant bank profile after a single toe-erosion model run for a 2,000 m^3/s flow rate and 24 hour duration for the pre-subsidence and post-subsidence scenarios***

BSTEM results with pile field mitigation

The proposed toe-erosion mitigation measures are a series of timber pile fields that aim to reduce flow velocity against the toe of the bank to a level below that of the entrainment of sand size particles at the toe of bank. These pile fields would be situated over and just upstream of the pillar zone between longwall panels. The pile fields will ensure a bench is maintained over the pillar zone against the toe of the bank, hence minimizing the risk of toe erosion when the sand bed is stripped over the pillar zone following the effects of deepening instigated by cumulative subsidence over a number of years.

The intent of the pile fields is to perform the required function of bank stabilization but also provide conditions whereby vegetation can be established and perform the same role as the structural works once their design life is exceeded. Timber piles will be subject to degrading processes such as wetting and drying, borer attack and impact loading, hence a design life of 10 to 20 years is assumed. During this time toe of bank vegetation and in-filling of the subsidence voids can be established that will supersede the function of the pile fields.

The design of pile fields generally use the shear stress approach to pile field design, which uses relative shear stress factors to estimate the shear stress experienced a given distance downstream of a pile field retard as a function of pile field retard porosity, height and distance from bank (Table 7). Based on previous experience in the Isaac River, a retard porosity of 40% has been utilised with spacing between subsequent pile field retards of up to 20m and a maximum pile height of 2m, resulting in a maximum relative shear stress factor at the toe of bank of 0.30 between subsequent pile field retards.

Table 7. Downstream relative shear stress as a function of retard porosity, height and distance from bank (adapted from DSE 2007)

	Distance from bank (as multiples of retard length L)			
	40% porosity			
Downstream distance as a multiple of pile height (where pile height is the lessor of depth of flow and pile height H)	**0.2L**	**0.4L**	**0.6L**	**0.8L**
2H	0.25	0.25	0.25	0.25
5H	0.25	0.25	0.25	0.25
10H	0.30	0.36	0.42	0.49
20H	0.49	0.56	0.72	0.90
30H	0.64	0.72	0.81	1.00
40H	0.72	0.81	0.90	1.10

In order to account for the reduction in shear stress at the toe of bank as a result of the incorporation of pile fields, the reach slope input in the BSTEM was modified based on the relative shear stress factor.

Shear stress is a function of channel slope and discharge.

Shear Stress (τ) $=(\rho g d s)$

ρ = density of water (kg/m^3)

g = gravitational acceleration constant (m^2/s)

d = depth of water (m)

s = water surface slope (m/m)

In this scenario, the density of water, gravitational acceleration constant and depth of water are all constant, which results in a directly proportional relationship between shear stress and water surface slope, where the water surface slope can be approximated by the reach slope in the BSTEM. Thus the shear stress reduction factors can be applied directly to the reach slope input in the BSTEM to simulate the mitigation of pile fields upon toe erosion.

The reach slopes input into the BSTEM were modified to account for pile field mitigation measures. The cumulative impact of pile fields consisting of up to six pile field retards was investigated for the 24-hour duration with the resultant erosion outputs for both the 500 and 2,000 m^3/s events shown in Table 8. The toe erosion model outputs indicate that a pile field consisting of four pile field retards will be sufficient to reduce total toe erosion volumes to the levels estimated for the pre-subsidence scenario, whilst a pile field consisting of six pile field retards will reduce total toe erosion volumes to a negligible level for both flow-rates.

Table 8. BSTEM toe erosion outputs for 500 and 2,000 m^3/s flow rates for a 24-hour duration for the post-subsidence scenario with and without pile field mitigation for a pile field of varying retard number

	Total Eroded Volume for 500 m^3/s flow rate		**Total eroded volume for 2000 m^3/s flow rate**	
No. of pile field retards	**Post-subsidence (m^3)**	**Post-subsidence with pile field mitigation (m^3)**	**Post-subsidence (m^3)**	**Post-subsidence with pile field mitigation (m^3)**
1	6,134	4,571	20,118	15,621
2	6,134	2,600	20,118	9,194
3	6,134	1,091	20,118	3,822
4	6,134	371	20,118	1,301
5	6,134	107	20,118	390
6	6,134	28	20,118	110

Model limitations and recommendations

A limitation of applying the BSTEM to an Australian waterway results from BSTEM's catalogue of riparian vegetation being currently limited to European and American species. Whilst applying these species in the Australian context would provide a reasonable estimate of the additional bank cohesion provided by tree roots, there are notable differences between Australian tree species and their US and UK counterparts. In this particular scenario that has been modelled, however, the bank has been found to be stable in terms of mass failure until multiple iterations of toe erosion have occurred. This means that the impact of vegetation upon bank stability has not been a major factor. If a further investigation of bank stability following multiple events of toe-erosion is required, data pertaining to Australian tree species and their impact upon bank stability will be required.

In order to more accurately predict bank stability and toe erosion, a geotechnical investigation should be conducted to determine the composition of the bank and its soil properties. The internal shear strength properties of the banks can be determined by undertaking testing with an in-situ borehole shear test device. The resistance properties of the bank-toe are also required and can be tested in-situ on cohesive materials by a submerged jet-test as developed by the USDA Agricultural Research Service (Brooks et. al., 2013).

In addition to this, calibration of the BSTEM should be conducted with aerial imagery and repeat LiDAR datasets over time as a measure for erosion that has occurred. The magnitude of flow events will also be required for this calibration.

Appendix D Red Hill Surface Water Quality Technical Report Appendix A

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010
Aluminium (µg/L)	7530	9330	10100	54300	8520	10600	8440	9500	6060	36000	14000	7200	18000	11000	23000	16000	12000
Ammonia as N (µg/L)	10	5	5	30	5	10	10	5	5	40	5	5	5	10	30	5	5
Antimony (µg/L)																	
Arsenic (µg/L)	2.5	2.5	2.5	7	2.5	2.5	2.5	2.5	5	4	2.5	2.5	2.5	2.5	5	2.5	5
Barium (µg/L)																	
Beryllium (µg/L)															2.5		
Boron (µg/L)	70	70	70	160	120	90	130	60	80	80	60	80	60	50	80	50	50
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																	
Chloride (µg/L)																	
Chromium (µg/L)	35	36	24	86	15	12	15	16	8	52	15	15	35	15	67	19	34
Copper (µg/L)											11	12	31	12	67	20	9
Cyanide (µg/L)																	
Fluoride (µg/L)	200	300	100	200	100	100	200	100	100	300	50	100	100	100	100	100	100
Iron (µg/L)	24800	18700	12300	71400	7800	8080	7400	13100	7040	55000	10400	11000	25600	12600	50000	18400	6530
Lead (µg/L)	12	6	5	32	2.5	5	2.5	7	2.5	21	5	5	18	8	26	12	2.5
Magnesium (µg/L)											273						
Manganese (µg/L)	464	253	171	1730	181	326	182	390	186	690		249	1200	416	1060	650	135
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.1
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	41	28	22	97	22	19	22	18	13	59	21	20	40	21	109	26	10
Nitrate as NO3 (µg/L)	650	220	5	190	60	70	140	50	150	280	40	10	60	50	150	20	50
Nitrite as NO2- (µg/L)																	
Oxygen (µg/L)																	
pH (units)	7.2	7.2	7.1	9.3	7.7	7.9	7.9	7.7	7.7	7.5	7.3	7.5	7.7	7.8	8	7.5	7.8
Potassium (µg/L)																	
Selenium (µg/L)	2.5	2.5	2.5	6	7	5	6	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sodium (µg/L)																	
Sulfate (mg/L)	78	20	32	33	19	18	37	10	25	74	8	25	5	8	14	2	2
Zinc (µg/L)	47	31	33	119	18	20	29	34	12	58	20	22	62	25	148	39	8
Ammonium (NH4+) (µg/L)																	
Chlorophyll α (µg/L)																	
Dissolved Oxygen (µg/L)																	
Filterable Reactive Phosphate (FRP) (µg/L)	967	322	387	490	333	338	611	246	473	969							
NOx (µg/L)																	
Electrical Conductivity (µS/cm)											213	475	198	242	299	164	149
Total Nitrogen as N (µg/L)																	
Total Phosphorus as P (µg/L)																	
Total Dissolved Solids (mg/L)	485	455	454	372	201	162	314	189	316	494	269	371	444	224	318	254	354
Total Solids (mg/L)																	

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010
Total Suspended Solids (mg/L)	632	362	130	604	251	222	77	160	280	1830	644	330	127	293	40	437	1300
Turbidity (NTU)	4840	1270	758	5780	219	460	322	1020	415	2750	1280	476	2390	1030	5830	1100	801
Cobalt (µg/L)	18	10	8	47	7	8	7	7	5	26	9	8	24	10	48	14	2.5
Dissolved Aluminium (µg/L)											6700	4100	7300	5300	3200	220	3000
Dissolved Antimony (µg/L)																	
Dissolved Arsenic (µg/L)											1	1	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)															2.5		
Dissolved Boron (µg/L)	60	40	50	100	80	50	90	60	70	80	50	70	40	50	50	40	40
Dissolved Cadmium (µg/L)											0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																	
Dissolved Chromium (µg/L)	0.5	1	2	0.5	1	0.5	1	0.5	0.5	2	8	5	0.5	0.5	1	0.5	1
Dissolved Copper (µg/L)	2	3	3	4	3	2	3	3	2	2	11	2	2	3	2	2	5
Dissolved Iron (µg/L)	110	90	80	25	210	70	270	260	80	670	720	680	1030	510	300	260	100
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																	
Dissolved Manganese (µg/L)	3	1	1	0.5	1	0.5	2	2	0.5	2.5	12	5	6	8	6	5	0.5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	3	1	2	6	4	2	5	1	2	2.5	1	2	0.5	0.5	1	0.5	0.5
Dissolved Nickel (µg/L)	4	4	4	6	6	3	6	3	3	6	6	4	2	2	4	2	2
Dissolved Potassium (µg/L)																	
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5
Oil and Grease (mg/L)																	
MBAS (mg/L)																	
Chemical Oxygen Demand (mg/L)											48	26	45	33	284	44	47
Bicarbonate Alkalinity (mg/L)																	
Total Alkalinity (mg/L)																	
C6-C9 (µg/L)											25	25	25	25	25	25	25
C10-C14 (µg/L)											25	25	25	25	25	25	25
C15-C28 (µg/L)											100	100	100	100	100	100	100
C29-C36 (µg/L)											25	100	25	25	130	25	60
BOD (lab) (mg/L)											3	1	2	1	2	1	2
C10 - C36 Fraction (sum) (µg/L)												100			130		60
NO2 + NO3 (µg/L)																	
Orthophosphate as P (ug/L)																	
Dissolved Cobalt (ug/L)											0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)											0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)											0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)											0.2	0.2	0.1	0.1	0.1	0.1	0.05
Total Uranium (ug/L)											0.25	0.5	1.1	0.5	1.5	0.7	0.25
Dissolved Vanadium (ug/L)											10	7	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)											30	30	70	30	100	60	130

ND - No data

ORANGE — Parameters discussed in surface water quality assessment

Lower Isaac River

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Aluminium (µg/L)	19000	15000	48000	17300	14300	31000	2100	2600	2200	3600	4300	4600	2000	2600	7300	3600
Ammonia as N (µg/L)	5	50	5	5	5	30	50	20	20	20	30	20	50	30	20	40
Antimony (µg/L)																
Arsenic (µg/L)	2.5	2.5	23	2.5	2.5	2.5	2.5	2.5	2.5	6	1	1	1	1	1	5
Barium (µg/L)																
Beryllium (µg/L)																
Boron (µg/L)	40	50	30	50	50	60	40	40	40	30	25	25	25	25	50	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																
Chloride (µg/L)																
Chromium (µg/L)	22	2.5	27	31	22	34	7	10	9	15	17	18	9	10	13	23
Copper (µg/L)	17	2.5	6	23	20	22	7	9	7	11	11	13	7	7	9	11
Cyanide (µg/L)																
Fluoride (µg/L)	100	100	50	50	100	50	50	50	50	50	50	50	50	100	50	50
Iron (µg/L)	14400	6150	6600	20000	15200	34000	2900	3900	3200	5200	16000	15000	4000	7800	8600	6500
Lead (µg/L)	10	5	2.5	12	7	16	2.5	5	2.5	6	7	8	4	4	5	5
Magnesium (µg/L)																
Manganese (µg/L)	616	127	83	751	340	700	220	300	170	340	290	300	140	150	190	240
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5	5	5	5	5	2.5
Nickel (µg/L)	24	9	7	39	22	34	9	12	9	16	17	18	9	10	12	20
Nitrate as NO3 (µg/L)	30	50	50	30	80	20	50	10	20	5	40	20	20	40	20	70
Nitrite as NO2- (µg/L)																
Oxygen (µg/L)																
pH (units)	7.9	7.8	7.2	7	7.6	8.5	8.6	8.4	8.5	8.2	7.8	8.3	7.8	8	7.7	7.5
Potassium (µg/L)																
Selenium (µg/L)	5	6	2.5	2.5	2.5	2.5	11	9	7	11	1	1	1	1	1	7
Sodium (µg/L)																
Sulfate (mg/L)	4	7	2	5	13	1	2	1	26	1	2.3	1	2.2	3.1	1	3.1
Zinc (µg/L)	31	10	6	41	36	43	6	21	17	24	120	39	41	60	33	28
Ammonium (NH4+) (µg/L)																
Chlorophyll α (µg/L)																
Dissolved Oxygen (µg/L)																
Filterable Reactive Phosphate (FRP) (µg/L)																
NOx (µg/L)																
Electrical Conductivity (µS/cm)	161	226	107	143	301	140	180	160	190	130	200	170	190	230	180	200
Total Nitrogen as N (µg/L)																
Total Phosphorus as P (µg/L)																
Total Dissolved Solids (mg/L)	344	358	110	274	262	95	88	110	130	92	120	80	140	130	150	240
Total Solids (mg/L)																

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Total Suspended Solids (mg/L)	1070	338	1180	280	202	610	490	670	490	810	510	450	310	290	290	510
Turbidity (NTU)	1040	767	2950	1190	597	470	260	360	280	500	290	360	170	160	600	1000
Cobalt (µg/L)	11	2.5	2.5	20	8	17	2.5	6	2.5	8	7	7	3	4	4	8
Dissolved Aluminium (µg/L)	3400	360	6300	30	160	25	60	2600	2200	3600	310	350	440	470	170	3600
Dissolved Antimony (µg/L)																
Dissolved Arsenic (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	0.5
Dissolved Beryllium (µg/L)																
Dissolved Boron (µg/L)	30	40	20	40	40	40	30	40	40	30	20	40	40	50	40	40
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																
Dissolved Chromium (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Copper (µg/L)	10	7	4	8	5	2	1	2	4	5	1	2	4	5	6	5
Dissolved Iron (µg/L)	90	170	240	25	25	25	2900	3900	3200	5200	200	230	310	300	170	6500
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																
Dissolved Manganese (µg/L)	0.5	1	1	0.5	1	2	3	3	2	1	2	4	0.5	2	0.5	0.5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	1	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	2	3	2	2	2	1	2	2	2	0.5	2	2	2	1	2
Dissolved Potassium (µg/L)																
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	7	7	5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																
MBAS (mg/L)																
Chemical Oxygen Demand (mg/L)	56	29	44	38	26	35	29	40	28	41	23	30	17	20	28	32
Bicarbonate Alkalinity (mg/L)																
Total Alkalinity (mg/L)																
C6-C9 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C29-C36 (µg/L)	160	25	80	25	25	25	25	25	120	25	100	25	60	70	120	90
BOD (lab) (mg/L)	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3.1
C10 - C36 Fraction (sum) (µg/L)	160		80			100	100	100	120	100	100	100	60	70	120	90
NO2 + NO3 (µg/L)																
Orthophosphate as P (ug/L)																
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	5	5	5	5	5	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.05	0.05	0.05	0.05	0.1	0.2	0.05	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.05
Total Uranium (ug/L)	0.6	0.25	0.25	0.8	0.6	0.25	0.25	0.25	0.25	0.5	2.5	2.5	2.5	2.5	2.5	0.5
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)	60	20	70	50	30	50	20	20	20	30	26	28	14	17	20	30

Lower Isaac River

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Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Aluminium (µg/L)	4200	6200	2900	53000	12000	2900	15000	5800	6100	17000	15000	15000	11000	120	90	6200	2800	5500
Ammonia as N (µg/L)	30	20	20	25	30	5	40	10	5	5	5	5	5	5	5	10	10	10
Antimony (µg/L)																		
Arsenic (µg/L)	1	2.5	2.5	2.5	1	1	0.5	0.5	0.5	2	2.5	0.5	2.5	2.5	2.5	6	2.5	2.5
Barium (µg/L)																		
Beryllium (µg/L)																		
Boron (µg/L)	50	50	60	125	25	70	60	25	25	50	60	70	50	50	70	30	50	60
Cadmium (µg/L)	0.25	0.25	0.25	0.5	0.1	0.1	0.3	0.2	0.2	0.1	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																		
Chloride (µg/L)																		
Chromium (µg/L)	18	52	15	78	13	7	16	9	9	12	24	28	37	16	14	11	8	8
Copper (µg/L)	9	18	8	51	10	3	12	8	4	16	14	14	18	11	12	9	7	8
Cyanide (µg/L)																		
Fluoride (µg/L)	50	10	10	10	10	10	10	100	200	100	200	200	100	100	100	100	100	50
Iron (µg/L)	14000	30000	10000	77000	17000	5100	23000	8400	9900	21000	21000	20000	14000	90	5900	6900	3400	6700
Lead (µg/L)	5	7	2.5	33	9	1	10	5	6	11	2.5	7	2.5	2.5	2.5	2.5	2.5	2.5
Magnesium (µg/L)																		
Manganese (µg/L)	190	550	190	1200	270	43	350	170	170	460	260	230	180	360	130	240	180	240
Mercury (µg/L)	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	5	2.5	2.5	2.5	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	14	50	16	92	17	9	17	12	11	26	22	33	34	20	18	12	9	11
Nitrate as NO3 (µg/L)	120	10	100	100	30	100	10	90	170	270	30	5	30	20	320	90	170	10
Nitrite as NO2- (µg/L)		5	5					10	10									
Oxygen (µg/L)																		
pH (units)	7.6	8.1	8.4	7.7	7.6	7.4	7.4	7.5	7.3	7.4	7.3	7.9	7.8	8.1	8	7.9	7.8	7.8
Potassium (µg/L)																		
Selenium (µg/L)	1	2.5	2.5	2.5	0.5	3	7	11	0.5	2	1	2	1	0.5	1	2.5	2.5	6
Sodium (µg/L)																		
Sulfate (mg/L)	3.8	2.5	6.3	9.3	5.4	21	6.4	3.7	7.8	4.1	3.8	4.7	1	1	4.7	1	4.3	4.8
Zinc (µg/L)	37	37	30	110	23	6	25	36	43	37	17	41	30	21	20	17	10	14
Ammonium (NH4+) (µg/L)																		
Chlorophyll α (µg/L)																		
Dissolved Oxygen (µg/L)																		
Filterable Reactive Phosphate (FRP) (µg/L)																		
NOx (µg/L)																		
Electrical Conductivity (µS/cm)	270	190	400	220	220	610	210	280	440	330	260	420	270	210	400	270	350	390
Total Nitrogen as N (µg/L)																		
Total Phosphorus as P (µg/L)																		
Total Dissolved Solids (mg/L)	270	230	210	330	110	270	180	180	370	310	390	440	340	170	240	210	240	300
Total Solids (mg/L)																		

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Total Suspended Solids (mg/L)	330	730	220	3700	340	36	640	410	360	900	650	570	1000	590	380	350	310	220
Turbidity (NTU)	670	190	370	4700	510	100	710	160	290	1600	1000	2100	1100	320	510	180	210	440
Cobalt (µg/L)	5	16	2.5	42	6	2	8	4	4	10	10	12	7	8	4	5	2.5	2.5
Dissolved Aluminium (µg/L)	390	250	780	120	160	420	350	760	520	1600	25	1300	1400	120	70	50	90	30
Dissolved Antimony (µg/L)																		
Dissolved Arsenic (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)																		
Dissolved Boron (µg/L)	50	40	50	25	25	80	25	25	25	25	50	70	25	25	25	50	50	60
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																		
Dissolved Chromium (µg/L)	0.5	0.5	0.5	0.5	4	2	1	1	0.5	1	2	2	3	0.5	0.5	2	1	6
Dissolved Copper (µg/L)	6	2	2	1	2	1	2	5	2	2	2	2	2	3	3	3	4	1
Dissolved Iron (µg/L)	290	210	420	110	190	360	330	570	340	900	25	510	810	90	90	60	100	70
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																		
Dissolved Manganese (µg/L)	0.5	2	2	2.5	2.5	2.5	5	2.5	2.5	2.5	4	2.5	2.5	2.5	2.5	4	2	0.5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	1	0.5	1	2.5	2.5	6	2.5	2.5	2.5	2.5	1	2.5	2.5	2.5	2.5	0.5	2	2
Dissolved Nickel (µg/L)	2	3	3	1	1	5	1	3	2	2	3	3	3	3	3	2	3	2
Dissolved Potassium (µg/L)																		
Dissolved Selenium (µg/L)	2.5	2.5	2.5	0.5	0.5	2	0.5	11	0.5	0.5	2.5	0.5	0.5	0.5	0.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5	0.5	0.5	0.5	0.5	3	0.5	2	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																		
MBAS (mg/L)																		
Chemical Oxygen Demand (mg/L)	34	39	36	81	75	36	77	30	23	26	27	28	33	24	30	34	28	28
Bicarbonate Alkalinity (mg/L)																		
Total Alkalinity (mg/L)																		
C6-C9 (µg/L)	25	25		10	25	25	10	25	25	25	25	25	25	25	25	10	10	10
C10-C14 (µg/L)	25	25		25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100		50	100	100	50	100	100	100	100	100	100	100	100	50	50	50
C29-C36 (µg/L)	90	25		50	25	25	50	25	25	25	60	25	70	25	25	50	50	100
BOD (lab) (mg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5	1	1	1	1	1	1	1	1	1	1	2
C10 - C36 Fraction (sum) (µg/L)	90	100		50	100	100	50	100	100	100	100	100	100	100	100	50	50	100
NO2 + NO3 (µg/L)								100	180									
Orthophosphate as P (ug/L)																		
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	5	0.25	0.25	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.25	0.25	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.05	2.5	2.5	2.5	2.5	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.2	0.2	0.3	50	0.1	0.1	0.05	0.2	0.3	0.1	0.05	0.3	0.2	0.2	0.3	0.3	0.3	0.1
Total Uranium (ug/L)	2.5	0.25	0.25	50	1	1	0.2	0.5	0.6	0.25	0.5	0.7	0.5	0.25	0.6	0.25	0.25	0.6
Dissolved Vanadium (ug/L)	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	10
Total Vanadium (ug/L)	24	40	20	100	22	8	29	17	18	33	30	35	25	26	16	40	20	10

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	51.0	12193.9	8520	4250	15000	90	54300
Ammonia as N (µg/L)	51.0	16.4	10.0	5.0	27.5	5.0	50.0
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	51.0	3.0	2.5	2.3	2.5	0.5	23.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	51	58	50	40	70	25	160
Cadmium (µg/L)	51.0	0.2	0.3	0.3	0.3	0.1	0.5
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	51.0	22.4	16.0	11.5	27.5	2.5	86.0
Copper (µg/L)	41.0	14.1	11.0	8.0	16.0	2.5	67.0
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	51.0	94.3	100.0	50.0	100.0	10.0	300.0
Iron (µg/L)	51	16137	11000	6650	19350	90	77000
Lead (µg/L)	51.0	7.6	5.0	2.5	8.5	1.0	33.0
Magnesium (µg/L)	1	273	273	273	273	273	273
Manganese (µg/L)	50.0	373.1	251.0	180.3	409.5	43.0	1730.0
Mercury (µg/L)	51.0	0.1	0.1	0.1	0.1	0.1	0.2
Molybdenum (µg/L)	51.0	2.9	2.5	2.5	2.5	2.5	6.0
Nickel (µg/L)	51	25	19	12	26	7	109
Nitrate as NO3 (µg/L)	51	86.8	50	20	100	5	650
Nitrite as NO2- (µg/L)	4	7.5	7.5	5	10	5	10
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	51.0	7.8	7.8	7.5	8.0	7.0	9.3
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	51.0	3.5	2.5	2.0	5.0	0.5	11.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	51.0	11.4	4.8	2.3	13.5	1.0	78.0
Zinc (µg/L)	51	36	30	20	40	6	148
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	10.0	513.6	430.0	334.3	580.8	246.0	969.0
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	41	253.4	220	180	299	107	610
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	51	259	254	166	342	80	494
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Total Suspended Solids (mg/L)	51	548	380	285	636	36	3700
Turbidity (NTU)	51	1116	597	321	1100	100	5830
Cobalt (µg/L)	51	10	7	4	10	2	48
Dissolved Aluminium (µg/L)	41.0	1520.2	420.0	160.0	2600.0	25.0	7300.0
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	41.0	0.6	0.5	0.5	0.5	0.5	1.0
Dissolved Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	51.0	45.6	40.0	30.0	50.0	20.0	100.0
Dissolved Cadmium (µg/L)	41	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	51	1.2	0.5	0.5	1.0	0.5	8.0
Dissolved Copper (µg/L)	51	3.3	3.0	2.0	4.0	1.0	11.0
Dissolved Iron (µg/L)	51	675.0	240.0	90.0	510.0	25.0	6500.0
Dissolved Lead (µg/L)	51	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	51	2.5	2.0	1.0	2.8	0.5	12.0
Dissolved Mercury (µg/L)	51	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	51	1.6	1.0	0.5	2.5	0.5	6.0
Dissolved Nickel (µg/L)	51	2.8	2.0	2.0	3.0	0.5	6.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	51	2.5	2.5	2.5	2.5	0.5	11.0
Dissolved Zinc (µg/L)	51	3.3	2.5	2.5	5.0	0.5	5.0
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	0	42	33	28	41	17	284
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	0	23.1	25	25	25	10	25
C10-C14 (µg/L)	40	23.1	25	25	25	25	25
C15-C28 (µg/L)	40	25.0	100	100	100	50	100
C29-C36 (µg/L)	40	93.8	25	25	73	25	160
BOD (lab) (mg/L)	40	53.4	1	1	2	1.0	3.1
C10 - C36 Fraction (sum) (µg/L)	41	1.4	100	90	100	50	160
NO2 + NO3 (µg/L)	33	93.3	140	120	160	100	180
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	0	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	41	0.5	0.3	0.3	2.5	0.3	5.0
Dissolved Silver (ug/L)	41	1.6	0.1	0.1	2.5	0.1	2.5
Dissolved Uranium (ug/L)	40	0.7	0.2	0.1	0.2	0.1	50.0
Total Uranium (ug/L)	41	1.4	0.5	0.3	1.0	0.2	50.0
Dissolved Vanadium (ug/L)	41	2.0	2.5	2.5	2.5	2.5	10.0
Total Vanadium (ug/L)	41	3.1	29.0	20.0	40.0	8.0	130.0

Upper Isaac River

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010	13/12/2010	14/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010
Aluminium (µg/L)	37800	9630	16100	10700	10200	6450	16000	13000	7500	15000	12000	10000	14000	35000	18000	24000	9530	31000	2300	3100
Ammonia as N (µg/L)	30	10	40	10	5	5	70	10	5	10	20	10	5	5	5	90	1460	20	50	20
Antimony (µg/L)																				
Arsenic (µg/L)	5	2.5	2.5	2.5	2.5	5	2	2.5	2.5	2.5	2.5	2.5	2.5	5	2.5	2.5	2.5	2.5	2.5	2.5
Barium (µg/L)																				
Beryllium (µg/L)												2.5								
Boron (µg/L)	120	120	90	110	60	60	25	60	70	40	50	60	60	60	30	40	40	60	30	30
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																				
Chloride (µg/L)																				
Chromium (µg/L)	47	17	20	25	14	7	20	24	14	31	17	20	14	29	26	2.5	17	31	7	11
Copper (µg/L)								16	12	25	12	13	13	11	18	2.5	13	19	7	9
Cyanide (µg/L)																				
Fluoride (µg/L)	200	200	100	200	100	100	200	100	100	100	100	100	100	100	100	100	50	50	50	50
Iron (µg/L)	38600	8250	13000	14100	12300	7080	18000	12200	12200	22800	14000	13300	13300	7230	16000	5980	8890	30000	3100	4400
Lead (µg/L)	16	2.5	7	7	8	2.5	5	8	6	16	6	7	8	2.5	11	2.5	5	14	2.5	6
Magnesium (µg/L)								407												
Manganese (µg/L)	994	188	494	351	462	184	270		263	957	262	350	381	164	695	112	194	550	210	290
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	64	23	26	31	17	10	20	28	17	33	14	17	17	13	28	8	15	29	9	12
Nitrate as NO3 (µg/L)	110	5	5	5	40	60	40	10	60	40	30	40	30	30	20	20	30	10	20	5
Nitrite as NO2- (µg/L)																				
Oxygen (µg/L)																				
pH (units)	9.1	7.9	7.8	7.9	7.8	7.7	5.4	7.2	7.5	7.6	7.8	7.7	7.5	7.7	7.8	7.6	7.8	8.5	8.6	8.1
Potassium (µg/L)																				
Selenium (µg/L)	2.5	2.5	6	6	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	5	2.5	2.5	7	8
Sodium (µg/L)																				
Sulfate (mg/L)	23	22	6	26	3	4	55	5	6	2	2	4	1	2	1	2	3	1	1	1
Zinc (µg/L)	76	18	38	27	31	9	34	34	22	11	18	27	26	8	33	8	24	39	5	22
Ammonium (NH4+) (µg/L)																				
Chlorophyll α (µg/L)																				
Dissolved Oxygen (µg/L)																				
Filterable Reactive Phosphate (FRP) (µg/L)	399	392	185	465	186	226	294													
NOx (µg/L)																				
Electrical Conductivity (µS/cm)								208	238	157	157	185	144	157	131	158	162	140	140	140
Total Nitrogen as N (µg/L)																				
Total Phosphorus as P (µg/L)																				
Total Dissolved Solids (mg/L)	411	222	124	264	212	242	178	255	260	210	18	360	238	280	324	362	214	97	89	95
Total Solids (mg/L)																				
Total Suspended Solids (mg/L)	340	209	139	305	62	190	456	594	307	486	450	31	343	1670	1020	236	158	480	480	630

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010	13/12/2010	14/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010
Turbidity (NTU)	2380	305	352	470	453	420	776	1340	610	1930	987	856	491	2120	1210	650	590	440	200	260
Cobalt (µg/L)	29	7	12	11	8	2.5	8	12	7	19	6	7	8	5	12	2.5	5	13	2.5	6
Dissolved Aluminium (µg/L)								5900	4400	6500	4700	4900	230	3600	3000	380	120	110	2300	3100
Dissolved Antimony (µg/L)																				
Dissolved Arsenic (µg/L)								1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)												2.5								
Dissolved Boron (µg/L)	80	40	30	100	60	60	25	60	60	30	40	50	40	40	40	40	40	40	40	40
Dissolved Cadmium (µg/L)								0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																				
Dissolved Chromium (µg/L)	0.5	0.5	0.5	1	0.5	0.5	1	6	4	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Copper (µg/L)	4	1	2	3	3	2	2	3	3	2	2	2	2	7	6	5	8	2	4	2
Dissolved Iron (µg/L)	25	80	25	310	150	100	600	880	850	840	610	210	260	80	60	260	25	100	3100	4400
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																				
Dissolved Manganese (µg/L)	0.5	0.5	0.5	2	0.5	0.5	2.5	12	6	6	6	6	6	0.5	0.5	2	0.5	3	5	4
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	5	2	0.5	7	0.5	1	2.5	1	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	5	2	2	7	2	2	2	4	3	2	2	2	2	2	2	2	1	2	2	2
Dissolved Potassium (µg/L)																				
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	5	0.5	5	5	5	5	5	5	5	5	5	5	2.5	2.5	2.5
Oil and Grease (mg/L)																				
MBAS (mg/L)																				
Chemical Oxygen Demand (mg/L)								40	26	37	33	29	32	64	50	34	23	34	32	37
Bicarbonate Alkalinity (mg/L)																				
Total Alkalinity (mg/L)																				
C6-C9 (µg/L)								25	25	25	25	25	25	25	25	25	25	25	25	25
C10-C14 (µg/L)								25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)								100	100	100	100	100	100	100	100	100	100	100	100	100
C29-C36 (µg/L)								25	70	25	80	25	25	25	140	25	25	25	25	25
BOD (lab) (mg/L)								2	1	2	1	1	1	3	2	1	1	1	1	1
C10 - C36 Fraction (sum) (µg/L)									70		80				140			100	100	100
NO2 + NO3 (µg/L)																				
Orthophosphate as P (ug/L)																				
Dissolved Cobalt (ug/L)								0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)								0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)								0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)								0.1	0.2	0.1	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.2	0.2	0.2
Total Uranium (ug/L)								0.5	0.5	0.9	0.25	0.5	0.5	0.25	0.7	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)								10	8	2.5	2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	5	2.5
Total Vanadium (ug/L)								40	30	70	30	50	50	90	60	20	20	50	20	30

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Data Source	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	27/12/2010	28/12/2010	29/12/2010
Aluminium (µg/L)	2000	3900	6500
Ammonia as N (µg/L)	50	20	20
Antimony (µg/L)			
Arsenic (µg/L)	2.5	2.5	1
Barium (µg/L)			
Beryllium (µg/L)			
Boron (µg/L)	30	30	25
Cadmium (µg/L)	0.25	0.25	0.25
Calcium (µg/L)			
Chloride (µg/L)			
Chromium (µg/L)	9	14	18
Copper (µg/L)	6	11	13
Cyanide (µg/L)			
Fluoride (µg/L)	50	50	50
Iron (µg/L)	2900	5300	19000
Lead (µg/L)	2.5	6	8
Magnesium (µg/L)			
Manganese (µg/L)	160	330	300
Mercury (µg/L)	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	5
Nickel (µg/L)	8	15	18
Nitrate as NO3 (µg/L)	5	5	5
Nitrite as NO2- (µg/L)			
Oxygen (µg/L)			
pH (units)	8.1	8.2	7.9
Potassium (µg/L)			
Selenium (µg/L)	7	2.5	1
Sodium (µg/L)			
Sulfate (mg/L)	1	1	1
Zinc (µg/L)	15	24	95
Ammonium (NH4+) (µg/L)			
Chlorophyll α (µg/L)			
Dissolved Oxygen (µg/L)			
Filterable Reactive Phosphate (FRP) (µg/L)			
NOx (µg/L)			
Electrical Conductivity (µS/cm)	140	120	190
Total Nitrogen as N (µg/L)			
Total Phosphorus as P (µg/L)			
Total Dissolved Solids (mg/L)	92	83	73
Total Solids (mg/L)			
Total Suspended Solids (mg/L)	380	370	490

Data Source	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	27/12/2010	28/12/2010	29/12/2010
Turbidity (NTU)	300	540	300
Cobalt (µg/L)	2.5	7	7
Dissolved Aluminium (µg/L)	70	3900	420
Dissolved Antimony (µg/L)			
Dissolved Arsenic (µg/L)	0.5	0.5	1
Dissolved Beryllium (µg/L)			
Dissolved Boron (µg/L)	40	30	30
Dissolved Cadmium (µg/L)	0.05	0.05	0.05
Dissolved Calcium (µg/L)			
Dissolved Chromium (µg/L)	0.5	0.5	0.5
Dissolved Copper (µg/L)	4	2	3
Dissolved Iron (µg/L)	2900	5300	260
Dissolved Lead (µg/L)	0.5	0.5	0.5
Dissolved Magnesium (µg/L)			
Dissolved Manganese (µg/L)	3	0.5	2
Dissolved Mercury (µg/L)	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	1	2
Dissolved Potassium (µg/L)			
Dissolved Selenium (µg/L)	2.5	2.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5
Oil and Grease (mg/L)			
MBAS (mg/L)			
Chemical Oxygen Demand (mg/L)	35	40	21
Bicarbonate Alkalinity (mg/L)			
Total Alkalinity (mg/L)			
C6-C9 (µg/L)	25	25	25
C10-C14 (µg/L)	25	25	25
C15-C28 (µg/L)	100	100	100
C29-C36 (µg/L)	60	25	60
BOD (lab) (mg/L)	1	1	1
C10 - C36 Fraction (sum) (µg/L)	60	100	60
NO2 + NO3 (µg/L)			
Orthophosphate as P (ug/L)			
Dissolved Cobalt (ug/L)	0.5	0.5	0.5
Total Silver (ug/L)	0.25	0.25	5
Dissolved Silver (ug/L)	0.05	0.05	
Dissolved Uranium (ug/L)	0.2	0.2	0.2
Total Uranium (ug/L)	0.25	0.5	2.5
Dissolved Vanadium (ug/L)	2.5	2.5	2.5
Total Vanadium (ug/L)	20	40	28

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	30/12/2010	31/12/2010	1/01/2011	3/01/2011	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011
Aluminium (µg/L)	3200	3900	3300	3200	4500	7500	2300	46000	12000	8500	16000	19000	6100	9300	23000	5400	6700	100	140	7300
Ammonia as N (µg/L)	20	30	20	80	40	20	10	25	50	30	20	20	5	20	5	5		5	5	5
Antimony (µg/L)																				
Arsenic (µg/L)	1	1	1	5	1	2.5	2.5	2.5	1	1	1200	1	0.5	2	2.5	1	2.5	2.5	2.5	2.5
Barium (µg/L)																				
Beryllium (µg/L)																				
Boron (µg/L)	25	25	25	50	50	50	70	125	25	50	50	25	25	60	70	70	60	50	70	50
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.1	0.1	69	0.1	0.1	0.1	0.25	0.1	0.25	0.25	0.25	0.25
Calcium (µg/L)																				
Chloride (µg/L)																				
Chromium (µg/L)	15	11	10	13	11	48	9	70	11	9	6600	17	8	16	45	9	41	18	0.25	12
Copper (µg/L)	10	8	8	9	7	16	6	41	9	7	5500	12	4	6	19	7	21	11	2.5	11
Cyanide (µg/L)																				
Fluoride (µg/L)	50	50	100	50	400	10	10	10	10	10	10	100	100	50	200	200	100	50	50	100
Iron (µg/L)	15000	4500	7500	4600	11000	28000	6100	59000	16000	12000	23000	22000	9600	9300	34000	6500	7000	90	5700	8200
Lead (µg/L)	7	5	5	2.5	5	6	2.5	27	8	6	24000	13	6	5	2.5	4	7	2.5	2.5	6
Magnesium (µg/L)																				
Manganese (µg/L)	240	190	180	210	180	480	130	1300	260	190	60000	350	160	72	340	89	100	300	120	390
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	5	5	5	2.5	5	2.5	2.5	2.5	2.5	2.5	210	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	14	11	10	11	10	45	10	78	13	12	8100	17	10	9	37	9	42	19	2.5	16
Nitrate as NO3 (µg/L)	5	5	5	10	10	10	30	10	80	80	10	120	10	590	20	10	20	30	40	100
Nitrite as NO2- (µg/L)						5	5					10	50							
Oxygen (µg/L)																				
pH (units)	8.2	8.1	7.9	7.8	7.5	7.9	8.3	7.8	7.6	7.7	7.6	7.6	7.6	7.4	7.3	7.9	7.9	8.2	8	8.1
Potassium (µg/L)																				
Selenium (µg/L)	1	1	1	6	1	2.5	2.5	2.5	0.5	1	0.5	0.5	0.5	0.5	2.5	0.5	0.5	2	1	2.5
Sodium (µg/L)																				
Sulfate (mg/L)	1	1	1	1	1	2.5	5	2.5	2.5	11	2.5	1	1	1	2.1	3	1	1	1	1
Zinc (µg/L)	29	35	61	22	24	37	20	89	23	18	20000	37	35	14	29	14	37	19	2.5	23
Ammonium (NH4+) (µg/L)																				
Chlorophyll α (µg/L)																				
Dissolved Oxygen (µg/L)																				
Filterable Reactive Phosphate (FRP) (µg/L)																				
NOx (µg/L)																				
Electrical Conductivity (µS/cm)	140	110	150	190	190	180	330	150	160	380	140	170	180	170	210	510	270	170	260	250
Total Nitrogen as N (µg/L)																				
Total Phosphorus as P (µg/L)																				
Total Dissolved Solids (mg/L)	100	110	110	200	170	200	200	280	48	190	190	120	210	380	380	310	270	160	190	170
Total Solids (mg/L)																				
Total Suspended Solids (mg/L)	320	220	290	270	210	430	120	1800	330	260	610	430	340	250	1000	380	1300	530	280	400

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	30/12/2010	31/12/2010	1/01/2011	3/01/2011	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011
Turbidity (NTU)	320	120	190	400	410	230	170	2400	600	450	690	210	180	770	1800	600	900	180	340	180
Cobalt (µg/L)	6	4	4	2.5	4	14	2.5	36	6	4	1700	7	4	3	15	3	3	3	3	8
Dissolved Aluminium (µg/L)	370	280	400	3200	480	290	530	170	160	410	340	1500	380	9300	25	1900	1400	100	70	30
Dissolved Antimony (µg/L)																				
Dissolved Arsenic (µg/L)	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)																				
Dissolved Boron (µg/L)	40	30	40	50	40	40	60	25	25	60	25	25	25	60	50	60	25	50	25	50
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.1	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																				
Dissolved Chromium (µg/L)	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	4	1	0.5	2	0.5	8	2	2	2	0.5	0.5	1
Dissolved Copper (µg/L)	2	1	2	7	8	2	1	2	2	1	2	2	2	2	2	3	3	3	3	2
Dissolved Iron (µg/L)	240	190	260	4600	350	220	290	150	190	320	320	800	250	3500	25	1100	850	90	90	60
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																				
Dissolved Manganese (µg/L)	3	1	2	0.5	1	2	2	6	2.5	2.5	5	2.5	2.5	10	2.5	5	6	2.5	2.5	2
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	2.5	2.5	2.5	2.5	0.5
Dissolved Nickel (µg/L)	2	1	1	1	2	2	3	1	0.5	2	1	2	2	5	3	3	3	3	2	2
Dissolved Potassium (µg/L)																				
Dissolved Selenium (µg/L)	2.5	2.5	5	2.5	2.5	2.5	2.5	0.5	0.5	1	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.5	0.5	0.5	0.5	3	0.5	5	2.5	2	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																				
MBAS (mg/L)																				
Chemical Oxygen Demand (mg/L)	34	23	19	27	28	78	100	33	18	30	40	2.5	23	32	31	26	33	27	20	31
Bicarbonate Alkalinity (mg/L)																				
Total Alkalinity (mg/L)																				
C6-C9 (µg/L)	25	25	25	25	25	25	25	10	25	25	10	25	25	25	25	25	25	25	25	10
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	3200	25	25	25
C15-C28 (µg/L)	100	100	100	100	100	100	100	50	100	100	50	100	100	100	100	100	5800	100	2800	50
C29-C36 (µg/L)	25	80	70	25	60	25	25	50	25	25	50	25	25	25	70	25	6100	25	25	50
BOD (lab) (mg/L)	1	1	1	2	1	2.5	2.5	2.5	2.5	2.5	2.5	2.8	1	2.5	2.1	1	2.8	1	1	1
C10 - C36 Fraction (sum) (µg/L)	100	80	70	100	60	100	100	50	100	100	50	100	100	100	100	100	15000	100	2800	50
NO2 + NO3 (µg/L)												120	50							
Orthophosphate as P (ug/L)																				
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	5	5	5	0.25	5	0.25	0.25	2.5	2.5	2.5	75	2.5	2.5	2.5	0.25	2.5	2.5	2.5	2.5	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.05	2.5	2.5	2.5	2.5	0.05
Dissolved Uranium (ug/L)	0.2	0.1	0.2	0.05	0.2	0.2	0.3	50	0.1	0.05	0.05	0.2	0.2	0.05	0.05	0.3	0.2	0.2	0.3	0.2
Total Uranium (ug/L)	2.5	2.5	2.5	0.5	2.5	0.25	0.25	50	1	0.6	0.4	0.4	0.5	0.25	0.5	0.7	0.6	0.25	0.25	0.5
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	9	2.5	6	6	2.5	2.5	2.5
Total Vanadium (ug/L)	24	19	18	40	19	40	20	89	21	18	10000	29	16	17	30	15	16	25	15	40

Data Source	BMA	BMA
Site ID	Upper Isaac	Upper Isaac
Sample Date	3/04/2011	4/04/2011
Aluminium (µg/L)	3200	5700
Ammonia as N (µg/L)	5	20
Antimony (µg/L)		
Arsenic (µg/L)	2.5	2.5
Barium (µg/L)		
Beryllium (µg/L)		
Boron (µg/L)	50	50
Cadmium (µg/L)	0.25	0.25
Calcium (µg/L)		
Chloride (µg/L)		
Chromium (µg/L)	7	13
Copper (µg/L)	7	9
Cyanide (µg/L)		
Fluoride (µg/L)	100	50
Iron (µg/L)	3600	6500
Lead (µg/L)	2.5	2.5
Magnesium (µg/L)		
Manganese (µg/L)	190	210
Mercury (µg/L)	0.05	0.05
Molybdenum (µg/L)	2.5	2.5
Nickel (µg/L)	9	11
Nitrate as NO3 (µg/L)	60	170
Nitrite as NO2- (µg/L)		
Oxygen (µg/L)		
pH (units)	7.5	8
Potassium (µg/L)		
Selenium (µg/L)	2.5	2.5
Sodium (µg/L)		
Sulfate (mg/L)	1	1
Zinc (µg/L)	14	18
Ammonium (NH4+) (µg/L)		
Chlorophyll α (µg/L)		
Dissolved Oxygen (µg/L)		
Filterable Reactive Phosphate (FRP) (µg/L)		
NOx (µg/L)		
Electrical Conductivity (µS/cm)	260	260
Total Nitrogen as N (µg/L)		
Total Phosphorus as P (µg/L)		
Total Dissolved Solids (mg/L)	210	230
Total Solids (mg/L)		
Total Suspended Solids (mg/L)	270	200

Data Source	BMA	BMA
Site ID	Upper Isaac	Upper Isaac
Sample Date	3/04/2011	4/04/2011
Turbidity (NTU)	140	450
Cobalt (µg/L)	2.5	2.5
Dissolved Aluminium (µg/L)	140	20
Dissolved Antimony (µg/L)		
Dissolved Arsenic (µg/L)	0.5	0.5
Dissolved Beryllium (µg/L)		
Dissolved Boron (µg/L)	50	50
Dissolved Cadmium (µg/L)	0.05	0.05
Dissolved Calcium (µg/L)		
Dissolved Chromium (µg/L)	0.5	5
Dissolved Copper (µg/L)	3	2
Dissolved Iron (µg/L)	100	25
Dissolved Lead (µg/L)	0.5	0.5
Dissolved Magnesium (µg/L)		
Dissolved Manganese (µg/L)	2	0.5
Dissolved Mercury (µg/L)	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5
Dissolved Nickel (µg/L)	2	1
Dissolved Potassium (µg/L)		
Dissolved Selenium (µg/L)	2.5	2.5
Dissolved Zinc (µg/L)	2.5	6
Oil and Grease (mg/L)		
MBAS (mg/L)		
Chemical Oxygen Demand (mg/L)	26	26
Bicarbonate Alkalinity (mg/L)		
Total Alkalinity (mg/L)		
C6-C9 (µg/L)	10	10
C10-C14 (µg/L)	25	25
C15-C28 (µg/L)	50	50
C29-C36 (µg/L)	50	100
BOD (lab) (mg/L)	1	2.1
C10 - C36 Fraction (sum) (µg/L)	50	100
NO2 + NO3 (µg/L)		
Orthophosphate as P (ug/L)		
Dissolved Cobalt (ug/L)	0.5	0.5
Total Silver (ug/L)	0.25	0.25
Dissolved Silver (ug/L)	0.05	0.05
Dissolved Uranium (ug/L)	0.2	0.1
Total Uranium (ug/L)	0.25	0.5
Dissolved Vanadium (ug/L)	2.5	12
Total Vanadium (ug/L)	5	10

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	45.0	11334	8500	3900	15000	100	46000
Ammonia as N (µg/L)	44.0	54.8	20.0	5.0	30.0	5.0	1460.0
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	45.0	29.0	2.5	2.0	2.5	0.5	1200.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	45	54	50	30	60	25	125
Cadmium (µg/L)	45.0	1.8	0.3	0.3	0.3	0.1	69.0
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	45.0	165.1	15.0	11.0	24.0	0.3	6600.0
Copper (µg/L)	38.0	156.1	11.0	7.0	13.0	2.5	5500.0
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	45.0	92.4	100.0	50.0	100.0	10.0	400.0
Iron (µg/L)	45	13358	11000	6500	16000	90	59000
Lead (µg/L)	45.0	539.7	6.0	2.5	8.0	2.5	24000.0
Magnesium (µg/L)	1	407	407	407	407	407	407
Manganese (µg/L)	44.0	1678.2	261.0	183.0	358.5	72.0	60000.0
Mercury (µg/L)	45.0	0.1	0.1	0.1	0.1	0.1	0.2
Molybdenum (µg/L)	45.0	7.4	2.5	2.5	2.5	2.5	210.0
Nickel (µg/L)	45	199	15	10	26	3	8100
Nitrate as NO3 (µg/L)	45	45.6	20	10	40	5	590
Nitrite as NO2- (µg/L)	4	17.5	7.5	5	20	5	50
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	45.0	7.8	7.8	7.6	8.0	5.4	9.1
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	45.0	2.6	2.5	1.0	2.5	0.5	8.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	45.0	4.8	2.0	1.0	3.0	1.0	55.0
Zinc (µg/L)	45	472	24	18	35	3	20000
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	7.0	306.7	294.0	206.0	395.5	185.0	465.0
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	38	194.7	170	146	210	110	510
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	45	203	200	120	260	18	411
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	45	446	340	250	480	31	1800

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Turbidity (NTU)	45	660	450	300	770	120	2400
Cobalt (µg/L)	45	45	6	3	8	3	1700
Dissolved Aluminium (µg/L)	38.0	1713.8	405.0	162.5	3075.0	20.0	9300.0
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	38.0	0.6	0.5	0.5	0.5	0.5	1.0
Dissolved Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	45.0	43.6	40.0	30.0	50.0	25.0	100.0
Dissolved Cadmium (µg/L)	38	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	45	1.2	0.5	0.5	1.0	0.5	8.0
Dissolved Copper (µg/L)	45	2.9	2.0	2.0	3.0	1.0	8.0
Dissolved Iron (µg/L)	45	787.7	260.0	100.0	800.0	25.0	5300.0
Dissolved Lead (µg/L)	45	0.5	0.5	0.5	0.5	0.5	2.0
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	45	3.0	2.5	1.0	5.0	0.5	12.0
Dissolved Mercury (µg/L)	45	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	45	1.4	0.5	0.5	2.5	0.5	7.0
Dissolved Nickel (µg/L)	45	2.2	2.0	2.0	2.0	0.5	7.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	45	2.0	2.5	1.0	2.5	0.5	5.0
Dissolved Zinc (µg/L)	45	3.3	2.5	2.5	5.0	0.5	6.0
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	38	34	32	26	35	3	100
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	38	23.0	25	25	25	10	25
C10-C14 (µg/L)	38	108.6	25	25	25	25	3200
C15-C28 (µg/L)	38	314.5	100	100	100	50	5800
C29-C36 (µg/L)	38	201.7	25	25	60	25	6100
BOD (lab) (mg/L)	38	1.6	1	1	2	1.0	3.0
C10 - C36 Fraction (sum) (µg/L)	31	655.5	100	70	100	50	15000
NO2 + NO3 (µg/L)	2	85.0	85	68	103	50	120
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	38	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	38	3.4	0.3	0.3	2.5	0.3	75.0
Dissolved Silver (ug/L)	37	0.8	0.1	0.1	2.5	0.1	2.5
Dissolved Uranium (ug/L)	38	1.5	0.2	0.1	0.2	0.1	50.0
Total Uranium (ug/L)	38	2.0	0.5	0.3	0.7	0.3	50.0
Dissolved Vanadium (ug/L)	38	3.7	2.5	2.5	2.5	2.5	12.0
Total Vanadium (ug/L)	38	294.1	26.5	19.0	40.0	5.0	10000.0

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010
Aluminium (µg/L)	7780	9220	8280	15000	3900	2860	4100	4290	14000	6100	5500	7700	5500	6300	8500
Ammonia as N (µg/L)	10	10	5	30	10	5	10	10	40	10	10	20	20	10	20
Antimony (µg/L)															
Arsenic (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	2	2.5	2.5	2.5	2.5	2.5	2.5
Barium (µg/L)															
Beryllium (µg/L)														2.5	
Boron (µg/L)	40	50	40	50	60	70	80	60	25	40	50	40	50	50	60
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)															
Chloride (µg/L)															
Chromium (µg/L)	32	36	18	27	9	18	13	13	26	15	11	31	12	19	19
Copper (µg/L)										7	6	11	6	5	8
Cyanide (µg/L)															
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	19100	19000	9010	19800	4420	8110	5530	9740	17000	9410	7190	13600	5280	6570	11400
Lead (µg/L)	7	6	2.5	10	2.5	2.5	2.5	2.5	4	2.5	2.5	5	2.5	2.5	2.5
Magnesium (µg/L)										150					
Manganese (µg/L)	455	393	134	422	66	110	85	56	150		106	278	138	56	100
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	24	24	13	22	9	15	11	11	14	13	10	17	10	11	13
Nitrate as NO3 (µg/L)	70	100	300	250	5	5	5	90	50	30	5	5	10	10	20
Nitrite as NO2- (µg/L)															
Oxygen (µg/L)															
pH (units)	7.5	7.3	7.3	10.7	7.4	7.4	7.4	7.8	6.5	7.1	7.3	7.2	7.4	7.4	7.5
Potassium (µg/L)															
Selenium (µg/L)	2.5	2.5	2.5	6	5	2.5	5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Sodium (µg/L)															
Sulfate (mg/L)	3	2	3	2	2	3	4	4	1	7	4	1	2	3	4
Zinc (µg/L)	22	20	14	20	6	19	16	20	28	15	5	19	10	9	10
Ammonium (NH4+) (µg/L)															
Chlorophyll α (µg/L)															
Dissolved Oxygen (µg/L)															
Filterable Reactive Phosphate (FRP) (µg/L)	100	99	88	70	97	112	131	181	59						
NOx (µg/L)															
Electrical Conductivity (µS/cm)										151	131	103	128	157	150
Total Nitrogen as N (µg/L)															
Total Phosphorus as P (µg/L)															
Total Dissolved Solids (mg/L)	72	363	222	266	52	56	84	263	237	238	265	163	214	266	321
Total Solids (mg/L)															
Total Suspended Solids (mg/L)	658	538	86	490	287	92	85	29	244	183	203	353	60	2.5	172
Turbidity (NTU)	1030	1740	509	1850	213	148	180	192	818	463	377	650	265	158	321
Cobalt (µg/L)	12	12	2.5	14	2.5	2.5	2.5	2.5	5	5	2.5	8	2.5	2.5	2.5

Upper Eureka Creek

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010
Dissolved Aluminium (µg/L)										5800	4300	5800	4600	4600	270
Dissolved Antimony (µg/L)															
Dissolved Arsenic (µg/L)										1	0.5	0.5	0.5	0.5	1
Dissolved Beryllium (µg/L)														2.5	
Dissolved Boron (µg/L)	30	60	30	30	40	40	50	60	25	40	50	30	40	60	50
Dissolved Cadmium (µg/L)										0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)															
Dissolved Chromium (µg/L)	3	2	1	0.5	1	2	2	2	2	6	6	0.5	1	2	0.5
Dissolved Copper (µg/L)	3	4	3	2	2	3	3	3	2	2	2	2	3	2	2
Dissolved Iron (µg/L)	390	280	150	180	220	280	250	260	730	720	580	960	760	550	450
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)															
Dissolved Manganese (µg/L)	4	5	3	0.5	2	3	3	4	6	7	6	6	6	5	5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	4	3	3	2	3	4	4	4	3	4	4	3	4	4	4
Dissolved Potassium (µg/L)															
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	5	5	5	2	5	5	5	5	5	5
Oil and Grease (mg/L)															
MBAS (mg/L)															
Chemical Oxygen Demand (mg/L)										35	31	45	45	39	42
Bicarbonate Alkalinity (mg/L)															
Total Alkalinity (mg/L)															
C6-C9 (µg/L)										25	25	25	25	25	25
C10-C14 (µg/L)										25	25	25	25	25	25
C15-C28 (µg/L)										100	100	100	100	100	100
C29-C36 (µg/L)										25	50	25	25	25	25
BOD (lab) (mg/L)										2	1	3	1	1	2
C10 - C36 Fraction (sum) (µg/L)											50				
NO2 + NO3 (µg/L)															
Orthophosphate as P (ug/L)															
Dissolved Cobalt (ug/L)										0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)										0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)										0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)										0.1	0.1	0.05	0.05	0.05	0.1
Total Uranium (ug/L)										0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)										6	6	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)										20	20	40	20	20	40

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Upper Eureka Creek

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	12/12/2010	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Aluminium (µg/L)	6800	4600	4500	6700	3180	5560	14000	940	470	240	310	1800	600	540	270	3700	850
Ammonia as N (µg/L)	5	5	40	5	20	5	40	50	50	20	30	30	30	40	30	50	100
Antimony (µg/L)																	
Arsenic (µg/L)	15	2.5	2.5	20	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	1	1	1	1	2.5
Barium (µg/L)																	
Beryllium (µg/L)																	
Boron (µg/L)	70	40	50	30	40	50	70	50	40	40	30	60	70	50	25	25	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																	
Chloride (µg/L)																	
Chromium (µg/L)	40	18	2.5	26	8	16	35	7	2.5	2.5	2.5	12	11	7	3	13	9
Copper (µg/L)	23	5	2.5	2.5	5	7	10	2.5	2.5	2.5	2.5	4	4	4	2	5	2.5
Cyanide (µg/L)																	
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	4210	8250	3760	4100	3530	5670	21000	2500	1700	1000	620	5700	5500	5200	1900	7300	2100
Lead (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	1	2	1	3	2.5
Magnesium (µg/L)																	
Manganese (µg/L)	25	99	19	15	51	79	200	73	46	32	17	75	67	77	38	120	81
Mercury (µg/L)	0.1	0.05	0.05	0.05	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5	5	5	5	5	2.5
Nickel (µg/L)	7	11	7	2.5	7	11	20	6	2.5	2.5	2.5	9	10	6	4	9	7
Nitrate as NO3 (µg/L)	110	5	5	10	5	50	140	30	20	5	5	60	130	5	10	5	5
Nitrite as NO2- (µg/L)																	
Oxygen (µg/L)																	
pH (units)	7.6	7.5	7.3	6.9	7.3	7.1	7.8	8	8.2	8.3	8.2	7.8	7.7	7.6	7.8	7.4	7.3
Potassium (µg/L)																	
Selenium (µg/L)	2.5	6	7	2.5	2.5	2.5	2.5	12	8	7	9	1	1	1	1	1	2.5
Sodium (µg/L)																	
Sulfate (mg/L)	3	2	2	1	2	14	7.4	1	2.7	1	1	4.9	13	1	2.2	1	1
Zinc (µg/L)	7	6	2.5	2.5	2.5	10	22	2.5	9	2.5	6	65	33	44	14	79	7
Ammonium (NH4+) (µg/L)																	
Chlorophyll α (µg/L)																	
Dissolved Oxygen (µg/L)																	
Filterable Reactive Phosphate (FRP) (µg/L)																	
NOx (µg/L)																	
Electrical Conductivity (µS/cm)	168	156	172	53	82	261	370	210	230	210	88	300	590	160	250	150	150
Total Nitrogen as N (µg/L)																	
Total Phosphorus as P (µg/L)																	
Total Dissolved Solids (mg/L)	294	238	311	122	209	232	200	160	150	150	99	180	270	140	170	160	150
Total Solids (mg/L)																	
Total Suspended Solids (mg/L)	94	220	42	36	38	60	340	340	200	100	110	150	88	270	48	390	250
Turbidity (NTU)	549	238	138	126	302	173	290	120	83	33	73	330	56	89	37	110	210
Cobalt (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	7	2.5	2.5	2.5	2.5	3	3	3	1	4	2.5

Upper Eureka Creek

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	12/12/2010	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Dissolved Aluminium (µg/L)	4900	4000	420	6500	2650	790	90	90	60	25	230	130	140	110	50	1900	590
Dissolved Antimony (µg/L)																	
Dissolved Arsenic (µg/L)	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	1	1	0.5
Dissolved Beryllium (µg/L)																	
Dissolved Boron (µg/L)	70	50	60	120	100	50	50	50	50	50	30	30	50	50	50	40	40
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																	
Dissolved Chromium (µg/L)	2	2	2	0.5	3	0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2
Dissolved Copper (µg/L)	7	6	5	0.5	3	6	2	3	4	2	1	4	4	2	4	4	2
Dissolved Iron (µg/L)	520	720	810	820	980	220	120	2500	170	130	200	150	160	250	170	1600	2100
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																	
Dissolved Manganese (µg/L)	2	4	5	160	4	0.5	5	5	4	8	2	6	14	2	17	4	3
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	4	5	5	7	3	3	4	3	3	3	2	2	5	3	3	3	3
Dissolved Potassium (µg/L)																	
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	7	6	6	6	2.5	2.5
Dissolved Zinc (µg/L)	5	5	10	5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	2.5
Oil and Grease (mg/L)																	
MBAS (mg/L)																	
Chemical Oxygen Demand (mg/L)	38	54	45	38	44	38	33	38	39	41	42	29	38	43	33	50	42
Bicarbonate Alkalinity (mg/L)																	
Total Alkalinity (mg/L)																	
C6-C9 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C29-C36 (µg/L)	25	170	60	80	25	25	25	25	60	70	25	90	80	110	90	100	70
BOD (lab) (mg/L)	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3.5	2.1
C10 - C36 Fraction (sum) (µg/L)		170	60	80			100	100	60	70	100	90	80	110	90	100	70
NO2 + NO3 (µg/L)																	
Orthophosphate as P (ug/L)																	
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	5	5	5	5	5	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total Uranium (ug/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2.5	2.5	2.5	2.5	2.5	0.25
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)	210	30	10	50	20	5	30	20	20	10	10	12	12	10	5	15	10

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Aluminium (µg/L)	3900	2700	1500	1900	6200	11000	6000	1900	2600	9200	6200	7600	7400	180	420	5000	2900	4600
Ammonia as N (µg/L)	30	20	20	50	60	70	30	10	5	5	30	20	20	20	5	20	20	5
Antimony (µg/L)																		
Arsenic (µg/L)	1	2.5	2.5	2.5	1	2	0.5	0.5	0.5	1	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5
Barium (µg/L)																		
Beryllium (µg/L)																		
Boron (µg/L)	25	40	60	125	25	50	80	70	50	50	90	80	60	80	80	90	50	60
Cadmium (µg/L)	0.25	0.25	0.25	0.5	0.1	0.1	0.3	0.1	0.2	0.1	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																		
Chloride (µg/L)																		
Chromium (µg/L)	18	30	12	2.5	14	10	15	9	8	13	11	10	19	21	0.25	23	12	15
Copper (µg/L)	6	9	5	2.5	5	8	6	5	0.5	9	6	6	8	11	8	9	7	8
Cyanide (µg/L)																		
Fluoride (µg/L)	50	10	10	10	10	10	10	50	100	100	100	100	50	50	50	50	50	50
Iron (µg/L)	11000	19000	6400	3300	11000	14000	11000	4300	4400	11000	9700	9700	8800	130	8700	8200	4700	7100
Lead (µg/L)	3	2.5	2.5	2.5	3	7	3	0.5	0.5	6	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5
Magnesium (µg/L)																		
Manganese (µg/L)	120	210	71	63	89	200	69	41	34	260	45	56	82	240	67	240	130	86
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	12	18	9	2.5	10	12	10	9	7	11	9	10	15	16	13	17	11	13
Nitrate as NO3 (µg/L)	20	10	70	220	10	10	50	90	130	130	100	470	10	40	10	30	20	50
Nitrite as NO2- (µg/L)		5	5					10	10									
Oxygen (µg/L)																		
pH (units)	7.1	7.7	7.9	7.2	7.2	7.6	7.2	7.3	7.2	7.7	7.2	7.2	7.3	7.7	7.6	7.8	7.6	7.5
Potassium (µg/L)																		
Selenium (µg/L)	1	2.5	2.5	2.5	0.5	1	9	12	1	0.5	2.5	0.5	1	0.5	0.5	2.5	2.5	6
Sodium (µg/L)																		
Sulfate (mg/L)	1	2.5	13	2.5	6.2	2.5	13	7.9	22	1	1	2.3	2.6	1	1	1	1	1
Zinc (µg/L)	14	16	7	3	9	21	11	15	10	21	12	34	13	11	6	11	9	13
Ammonium (NH4+) (µg/L)																		
Chlorophyll α (µg/L)																		
Dissolved Oxygen (µg/L)																		
Filterable Reactive Phosphate (FRP) (µg/L)																		
NOx (µg/L)																		
Electrical Conductivity (µS/cm)	170	120	460	84	170	170	280	400	830	260	240	210	160	180	140	190	180	180
Total Nitrogen as N (µg/L)																		
Total Phosphorus as P (µg/L)																		
Total Dissolved Solids (mg/L)	170	140	250	210	180	110	340	230	470	300	500	500	290	180	120	180	160	330
Total Solids (mg/L)																		
Total Suspended Solids (mg/L)	180	440	84	130	43	280	120	100	130	390	240	320	280	650	480	600	590	66
Turbidity (NTU)	290	210	87	130	240	470	770	140	49	630	810	700	380	240	320	140	170	230
Cobalt (µg/L)	4	7	2.5	2.5	3	5	3	2	1	4	2	3	3	4	3	7	2.5	2.5

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Dissolved Aluminium (µg/L)	510	770	730	250	210	430	320	210	330	2000	25	1100	670	180	240	250	370	480
Dissolved Antimony (µg/L)																		
Dissolved Arsenic (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1
Dissolved Beryllium (µg/L)																		
Dissolved Boron (µg/L)	30	30	50	25	25	60	60	60	25	25	80	80	50	60	25	50	50	60
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																		
Dissolved Chromium (µg/L)	0.5	1	0.5	0.5	5	1	1	1	0.5	1	1	1	1	0.5	0.5	2	0.5	7
Dissolved Copper (µg/L)	6	2	1	0.5	2	1	1	5	1	2	1	2	3	3	4	3	4	3
Dissolved Iron (µg/L)	440	460	410	330	250	330	380	280	270	1100	25	530	490	130	230	300	350	510
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																		
Dissolved Manganese (µg/L)	2	2	5	2.5	2.5	2.5	2.5	7	13	5	3	5	2.5	2.5	2.5	3	3	4
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	3	3	3	1	2	1	3	4	4	2	4	4	4	5	5	5	5	5
Dissolved Potassium (µg/L)																		
Dissolved Selenium (µg/L)	5	2.5	2.5	0.5	0.5	0.5	0.5	11	0.5	0.5	2.5	0.5	0.5	0.5	0.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5	1	0.5	0.5	0.5	2	0.5	2	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																		
MBAS (mg/L)																		
Chemical Oxygen Demand (mg/L)	31	130	72	30	30	36	37	23	35	20	29	36	35	32	28	52	53	53
Bicarbonate Alkalinity (mg/L)																		
Total Alkalinity (mg/L)																		
C6-C9 (µg/L)	25	25	25	10	25	130	10	25	25	25	25	25	25	25	25	10	10	10
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100	100	50	100	100	50	100	100	100	100	100	100	100	100	50	50	100
C29-C36 (µg/L)	110	25	25	50	150	25	50	70	25	25	80	70	90	25	25	100	100	200
BOD (lab) (mg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5	2.1	1	1	1	1	3.7	1	1	1	1	2.5
C10 - C36 Fraction (sum) (µg/L)	110	100	100	50	100	100	50	100	100	100	100	100	100	100	100	100	100	300
NO2 + NO3 (µg/L)								90	130									
Orthophosphate as P (ug/L)																		
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	5	0.25	0.25	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.25	2.5	2.5	2.5	2.5	0.25	0.25	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.05	2.5	2.5	2.5	2.5	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.05	0.05	0.05	50	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total Uranium (ug/L)	2.5	0.25	0.25	50	0.4	0.3	0.2	0.2	0.2	0.7	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	11
Total Vanadium (ug/L)	18	30	10	8	16	20	17	9	8	20	10	17	17	21	17	10	10	10

URS

Data Source	BMA
Site ID	Upper Eureka
Sample Date	11/08/2010
Aluminium (µg/L)	29000
Ammonia as N (µg/L)	60
Antimony (µg/L)	
Arsenic (µg/L)	2.5
Barium (µg/L)	
Beryllium (µg/L)	
Boron (µg/L)	45
Cadmium (µg/L)	0.1
Calcium (µg/L)	
Chloride (µg/L)	
Chromium (µg/L)	26
Copper (µg/L)	
Cyanide (µg/L)	
Fluoride (µg/L)	50
Iron (µg/L)	32900
Lead (µg/L)	8
Magnesium (µg/L)	
Manganese (µg/L)	400
Mercury (µg/L)	
Molybdenum (µg/L)	2.5
Nickel (µg/L)	18
Nitrate as NO3 (µg/L)	350
Nitrite as NO2- (µg/L)	
Oxygen (µg/L)	
pH (units)	8.2
Potassium (µg/L)	
Selenium (µg/L)	2.5
Sodium (µg/L)	
Sulfate (mg/L)	2
Zinc (µg/L)	33
Ammonium (NH4+) (µg/L)	
Chlorophyll α (µg/L)	
Dissolved Oxygen (µg/L)	
Filterable Reactive Phosphate (FRP) (µg/L)	107
NOx (µg/L)	
Electrical Conductivity (µS/cm)	
Total Nitrogen as N (µg/L)	
Total Phosphorus as P (µg/L)	
Total Dissolved Solids (mg/L)	520
Total Solids (mg/L)	
Total Suspended Solids (mg/L)	1370
Turbidity (NTU)	2140
Cobalt (µg/L)	11

URS

Data Source	BMA
Site ID	Upper Eureka
Sample Date	11/08/2010
Dissolved Aluminium (µg/L)	
Dissolved Antimony (µg/L)	
Dissolved Arsenic (µg/L)	
Dissolved Beryllium (µg/L)	
Dissolved Boron (µg/L)	37
Dissolved Cadmium (µg/L)	
Dissolved Calcium (µg/L)	
Dissolved Chromium (µg/L)	2.5
Dissolved Copper (µg/L)	2.5
Dissolved Iron (µg/L)	1270
Dissolved Lead (µg/L)	2.5
Dissolved Magnesium (µg/L)	
Dissolved Manganese (µg/L)	22
Dissolved Mercury (µg/L)	0.05
Dissolved Molybdenum (µg/L)	2.5
Dissolved Nickel (µg/L)	5
Dissolved Potassium (µg/L)	
Dissolved Selenium (µg/L)	2.5
Dissolved Zinc (µg/L)	9
Oil and Grease (mg/L)	
MBAS (mg/L)	
Chemical Oxygen Demand (mg/L)	
Bicarbonate Alkalinity (mg/L)	
Total Alkalinity (mg/L)	
C6-C9 (µg/L)	
C10-C14 (µg/L)	
C15-C28 (µg/L)	
C29-C36 (µg/L)	
BOD (lab) (mg/L)	
C10 - C36 Fraction (sum) (µg/L)	
NO2 + NO3 (µg/L)	
Orthophosphate as P (ug/L)	
Dissolved Cobalt (ug/L)	
Total Silver (ug/L)	
Dissolved Silver (ug/L)	
Dissolved Uranium (ug/L)	
Total Uranium (ug/L)	
Dissolved Vanadium (ug/L)	
Total Vanadium (ug/L)	

Data Source Site ID	Summary Statistics						
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	51	5378.2	4600	1900	7100	180	29000
Ammonia as N (µg/L)	51	25	20	10	30	5	100
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	51	2.8	2.5	2.0	2.5	0.5	20.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	51	54	50	40	65	25	125
Cadmium (µg/L)	51	0.2	0.3	0.3	0.3	0.1	0.5
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	51	15.3	13	9	19	0.3	40
Copper (µg/L)	41	6.1	6	4	8	0.5	23
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	51	49.2	50	50	50	10	100
Iron (µg/L)	51	8520	7190	4350	11000	130	32900
Lead (µg/L)	51	3.1	2.5	2.5	2.8	0.5	10
Magnesium (µg/L)	1	150	150	150	150	150	150
Manganese (µg/L)	50	123.3	81.5	56	137	15	455
Mercury (µg/L)	50	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum (µg/L)	51	2.8	2.5	2.5	2.5	2.5	5.0
Nickel (µg/L)	51	11	11	8	13	2.5	24
Nitrate as NO3 (µg/L)	51	66.2	20	7.5	90	5	470
Nitrite as NO2- (µg/L)	4	7.5	7.5	5	10	5	10
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	51	7.6	7.4	7.3	7.7	6.5	10.7
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	51	3.2	2.5	1	2.5	0.5	12
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	51	4	2.2	1.0	4.0	1.0	22
Zinc (µg/L)	51	16	12	7	20	2.5	79
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	10	104.4	99.5	90.3	110.8	59	181
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	41	215.7	170	150	240	53	830
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	51	225.4	210	155	268	52	520
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	51	250	183	87	340	2.5	1370
Turbidity (NTU)	51	392.5	238	139	466.5	33	2140
Cobalt (µg/L)	51	3.9	2.5	2.5	4.0	1.0	14.0

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Dissolved Aluminium (µg/L)	41	1393.2	420	210	1900	25	6500
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	41	0.6	0.5	0.5	0.5	0.5	1.0
Dissolved Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	51	48.2	50	30	60	25	120
Dissolved Cadmium (µg/L)	41	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	51	1.5	1.0	0.5	2.0	0.5	7.0
Dissolved Copper (µg/L)	51	2.8	3.0	2.0	4.0	0.5	7.0
Dissolved Iron (µg/L)	51	518.9	350	225	650	25	2500
Dissolved Lead (µg/L)	51	0.5	0.5	0.5	0.5	0.5	2.5
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	51	7.9	4	2.5	5.5	0.5	160
Dissolved Mercury (µg/L)	51	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	51	1.1	0.5	0.5	2.3	0.5	2.5
Dissolved Nickel (µg/L)	51	3.6	4	3	4	1	7
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	51	2.6	2.5	2.5	2.5	0.5	11
Dissolved Zinc (µg/L)	51	3.6	2.5	2.5	5	0.5	10
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	41	41.1	38	33	44	20	130
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	41	25.7	25	25	25	10	130
C10-C14 (µg/L)	41	25	25	25	25	25	25
C15-C28 (µg/L)	41	95.1	100	100	100	50	100
C29-C36 (µg/L)	41	62.2	50	25	90	25	200
BOD (lab) (mg/L)	41	1.6	1.0	1.0	2.5	1.0	3.7
C10 - C36 Fraction (sum) (µg/L)	33	98.2	100	80	100	50	300
NO2 + NO3 (µg/L)	2	110	110	100	120	90	130
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	41	0.7	0.5	0.5	0.5	0.5	7
Total Silver (ug/L)	41	1.5	0.3	0.3	2.5	0.3	5
Dissolved Silver (ug/L)	40	0.7	0.1	0.1	2.5	0.1	2.5
Dissolved Uranium (ug/L)	41	1.3	0.1	0.1	0.1	0.1	50
Total Uranium (ug/L)	41	1.8	0.3	0.3	0.3	0.2	50
Dissolved Vanadium (ug/L)	41	2.9	2.5	2.5	2.5	2.5	11
Total Vanadium (ug/L)	41	22	17	10	20	5	210

Fisher Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	12/12/2010	20/12/2010
Aluminium (µg/L)	38800	7140	7260	5340	20000	12000	11000	11000	6500	8100	5400	5550
Ammonia as N (µg/L)	20	10	10	5	50	10	5	20	10	5	5	5
Antimony (µg/L)												
Arsenic (µg/L)	7	2.5	2.5	2.5	1	2.5	2.5	2.5	2.5	2.5	13	2.5
Barium (µg/L)												
Beryllium (µg/L)										2.5		
Boron (µg/L)	50	70	90	90	25	60	70	50	60	90	60	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)												
Chloride (µg/L)												
Chromium (µg/L)	36	17	18	19	27	12	8	21	7	14	35	11
Copper (µg/L)						5	2.5	10	2.5	2.5	2.5	7
Cyanide (µg/L)												
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	19900	7760	7430	8040	20000	7850	5710	9020	3610	4510	3530	7190
Lead (µg/L)	6	2.5	23	2.5	6	2.5	2.5	6	2.5	2.5	2.5	2.5
Magnesium (µg/L)						86						
Manganese (µg/L)	194	96	94	132	100		43	106	41	36	32	92
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	19	9	11	13	12	8	7	10	7	8	6	9
Nitrate as NO3 (µg/L)	40	30	10	100	60	10	10	20	10	10	30	30
Nitrite as NO2- (µg/L)												
Oxygen (µg/L)												
pH (units)	9.2	7.2	7.3	7.1	6.8	7.1	7.2	7.2	7.4	7.6	7.7	7.3
Potassium (µg/L)												
Selenium (µg/L)	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	6
Sodium (µg/L)												
Sulfate (mg/L)	1	1	1	2	1	1	2	1	1	2	1	1
Zinc (µg/L)	14	13	19	16	24	5	2.5	11	5	6	2.5	2.5
Ammonium (NH4+) (µg/L)												
Chlorophyll α (µg/L)												
Dissolved Oxygen (µg/L)												
Filterable Reactive Phosphate (FRP) (µg/L)	53	70	91	103	81							
NOx (µg/L)												
Electrical Conductivity (µS/cm)						92	129	103	143	178	92	60
Total Nitrogen as N (µg/L)												
Total Phosphorus as P (µg/L)												
Total Dissolved Solids (mg/L)	534	40	48	74	298	99	236	244	226	245	188	205
Total Solids (mg/L)												
Total Suspended Solids (mg/L)	54	99	96	61	354	218	70	238	26	10	436	196
Turbidity (NTU)	3060	480	249	310	1200	411	266	646	165	123	482	331
Cobalt (µg/L)	10	5	2.5	6	6	2.5	2.5	2.5	2.5	2.5	2.5	5
Dissolved Aluminium (µg/L)						11000	9100	6300	3900	3600	4200	1590
Dissolved Antimony (µg/L)												
Dissolved Arsenic (µg/L)						0.5	0.5	0.5	0.5	0.5	1	0.5

Fisher Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	12/12/2010	20/12/2010
Dissolved Beryllium (µg/L)										2.5		
Dissolved Boron (µg/L)	40	40	50	60	25	50	60	40	60	80	60	40
Dissolved Cadmium (µg/L)						0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)												
Dissolved Chromium (µg/L)	0.5	2	4	2	1	9	6	0.5	1	2	1	2
Dissolved Copper (µg/L)	2	2	2	2	2	2	2	2	2	6	4	6
Dissolved Iron (µg/L)	310	600	630	350	680	970	880	1130	1270	830	1130	700
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	3	0.5	0.5
Dissolved Magnesium (µg/L)												
Dissolved Manganese (µg/L)	0.5	2	3	2	6	8	6	5	6	4	3	2
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	3	3	3	3	5	4	3	4	4	3	2
Dissolved Potassium (µg/L)												
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	0.5	5	5	5	5	5	5	5
Oil and Grease (mg/L)												
MBAS (mg/L)												
Chemical Oxygen Demand (mg/L)						36	35	47	45	37	48	33
Bicarbonate Alkalinity (mg/L)												
Total Alkalinity (mg/L)												
C6-C9 (µg/L)						25	25	25	25	25	25	25
C10-C14 (µg/L)						25	25	25	25	25	25	25
C15-C28 (µg/L)						100	100	100	100	100	100	100
C29-C36 (µg/L)						70	70	25	25	25	90	25
BOD (lab) (mg/L)						2	1	2	1	1	4	1
C10 - C36 Fraction (sum) (µg/L)						70	70				90	
NO2 + NO3 (µg/L)												
Orthophosphate as P (ug/L)												
Dissolved Cobalt (ug/L)						0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)						0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)						0.1	0.05	0.1	0.05	0.05	0.05	0.05
Total Uranium (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)						9	7	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)						20	10	30	5	20	160	30

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	12	11508	7680	6263	11250	5340	38800
Ammonia as N (µg/L)	12	12.9	10	5	12.5	5	50
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	12	3.6	2.5	2.5	2.5	1.0	13.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	12	62.9	60	50	75	25	90
Cadmium (µg/L)	12	0.2	0.3	0.3	0.3	0.1	0.3
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	12	18.8	17.5	11.8	22.5	7	36
Copper (µg/L)	7	4.6	2.5	2.5	6.0	2.5	10
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	12	50	50	50	50	50	50
Iron (µg/L)	12	8713	7595	5410	8285	3530	20000
Lead (µg/L)	12	5.1	2.5	2.5	6.0	2.5	23
Magnesium (µg/L)	1	86	86	86	86	86	86
Manganese (µg/L)	11	87.8	94	42	103	32	194
Mercury (µg/L)	12	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum (µg/L)	12	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	12	9.9	9	7.8	11.3	6	19
Nitrate as NO3 (µg/L)	12	30	25	10	33	10	100
Nitrite as NO2- (µg/L)	ND	ND	ND	ND	ND	ND	ND
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	12	7.4	7.3	7.2	7.5	6.8	9.2
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	12	2.6	2.5	2.5	2.5	0.5	6.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	12	1.3	1.0	1.0	1.3	1.0	2.0
Zinc (µg/L)	12	10.0	8.5	4.4	14.5	2.5	24
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	5	79.6	81	70	91	53	103
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	7	113.9	103	92	136	60	178
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	12	203.1	215.5	92.8	244.3	40	534
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	12	154.8	97.5	59.3	223	10	436
Turbidity (NTU)	12	643.6	371	261.8	523	123	3060
Cobalt (µg/L)	12	4.1	2.5	2.5	5.3	2.5	10
Dissolved Aluminium (µg/L)	7	5670	4200	3750	7700	1590	11000
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	7	0.6	0.5	0.5	0.5	0.5	1.0

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Dissolved Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	12	50.4	50.0	40.0	60.0	25.0	80.0
Dissolved Cadmium (µg/L)	7	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	12	2.6	2.0	1.0	2.5	0.5	9.0
Dissolved Copper (µg/L)	12	2.8	2.0	2.0	2.5	2.0	6.0
Dissolved Iron (µg/L)	12	790	765	623	1010	310	1270
Dissolved Lead (µg/L)	12	0.8	0.5	0.5	0.5	0.5	3.0
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	12	4.0	3.5	2.0	6.0	0.5	8.0
Dissolved Mercury (µg/L)	12	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	12	0.7	0.5	0.5	0.5	0.5	2.5
Dissolved Nickel (µg/L)	12	3.3	3.0	3.0	4.0	2.0	5.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	12	2.3	2.5	2.5	2.5	0.5	2.5
Dissolved Zinc (µg/L)	12	4.6	5.0	5.0	5.0	0.5	5.0
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	7	40.1	37	35.5	46	33	48
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	7	25	25	25	25	25	25
C10-C14 (µg/L)	7	25	25	25	25	25	25
C15-C28 (µg/L)	7	100	100	100	100	100	100
C29-C36 (µg/L)	7	47	25	25	70	25	90
BOD (lab) (mg/L)	7	1.7	1.0	1.0	2.0	1.0	4.0
C10 - C36 Fraction (sum) (µg/L)	3	76.7	70	70	80	70	90
NO2 + NO3 (µg/L)	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	7	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	7	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Silver (ug/L)	7	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Uranium (ug/L)	7	0.1	0.1	0.1	0.1	0.1	0.1
Total Uranium (ug/L)	7	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Vanadium (ug/L)	7	4.1	2.5	2.5	4.8	2.5	9.0
Total Vanadium (ug/L)	7	39.3	20	15	30	5	160

Platypus Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	12/12/2010	20/12/2010
Aluminium (µg/L)	11100	5080	5170	4070	8200	7200	12000	8600	6400	3600	5240
Ammonia as N (µg/L)	30	20	10	60	40	10	5	20	10	5	5
Antimony (µg/L)											
Arsenic (µg/L)	10	2.5	2.5	2.5	0.5	2.5	2.5	2.5	10	2.5	2.5
Barium (µg/L)											
Beryllium (µg/L)											
Boron (µg/L)	30	60	70	70	25	40	50	40	40	40	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)											
Chloride (µg/L)											
Chromium (µg/L)	44	16	16	23	30	11	13	30	10	13	28
Copper (µg/L)						2.5	2.5	6	2.5	6	5
Cyanide (µg/L)											
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	20000	6560	5940	7340	14000	5240	6010	8370	3890	3400	9710
Lead (µg/L)	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5
Magnesium (µg/L)						47					
Manganese (µg/L)	182	55	41	76	98		38	74	31	24	75
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	10	7	6	7	7	2.5	6	8	6	2.5	7
Nitrate as NO3 (µg/L)	120	5	5	430	30	5	5	5	10	5	50
Nitrite as NO2- (µg/L)											
Oxygen (µg/L)											
pH (units)	9.2	7	7.1	7	6.9	7.1	7.2	7.2	7.6	7.6	7.3
Potassium (µg/L)											
Selenium (µg/L)	5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Sodium (µg/L)											
Sulfate (mg/L)	1	1	2	2	1	1	1	1	1	1	1
Zinc (µg/L)	14	10	13	16	15	2.5	5	9	5	11	10
Ammonium (NH4+) (µg/L)											
Chlorophyll α (µg/L)											
Dissolved Oxygen (µg/L)											
Filterable Reactive Phosphate (FRP) (µg/L)	55	68	84	87	63						
NOx (µg/L)											
Electrical Conductivity (µS/cm)						65	83	93	106	70	56
Total Nitrogen as N (µg/L)											
Total Phosphorus as P (µg/L)											
Total Dissolved Solids (mg/L)	244	46	48	48	134	134	197	171	190	146	132
Total Solids (mg/L)											
Total Suspended Solids (mg/L)	132	138	133	39	222	116	53	116	38	260	26

Platypus Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	12/12/2010	20/12/2010
Turbidity (NTU)	1080	284	218	240	382	291	204	262	141	325	86
Cobalt (µg/L)	5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Aluminium (µg/L)						6800	7200	5900	4200	3300	1900
Dissolved Antimony (µg/L)											
Dissolved Arsenic (µg/L)						0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)											
Dissolved Boron (µg/L)	30	40	40	40	25	30	40	30	40	40	30
Dissolved Cadmium (µg/L)						0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)											
Dissolved Chromium (µg/L)	1	3	2	3	2	10	7	0.5	2	4	3
Dissolved Copper (µg/L)	2	2	2	2	2	2	2	2	3	6	7
Dissolved Iron (µg/L)	760	630	350	320	680	840	800	1390	1050	1120	790
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)											
Dissolved Manganese (µg/L)	1	3	2	2	2.5	8	6	5	6	4	3
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	3	2	2	2	3	3	2	3	3	2
Dissolved Potassium (µg/L)											
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	0.5	5	5	5	5	5	5
Oil and Grease (mg/L)											
MBAS (mg/L)											
Chemical Oxygen Demand (mg/L)						35	38	49	50	43	31
Bicarbonate Alkalinity (mg/L)											
Total Alkalinity (mg/L)											
C6-C9 (µg/L)						25	25	25	25	25	25
C10-C14 (µg/L)						25	25	25	25	25	25
C15-C28 (µg/L)						100	100	100	100	100	100
C29-C36 (µg/L)						80	80	60	25	80	60
BOD (lab) (mg/L)						2	1	3	2	3	1
C10 - C36 Fraction (sum) (µg/L)						80	80	60		80	60
NO2 + NO3 (µg/L)											
Orthophosphate as P (ug/L)											
Dissolved Cobalt (ug/L)						0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)						0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)						0.05	0.05	0.05	0.05	0.05	0.05
Total Uranium (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)						6	6	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)						10	20	20	5	40	20

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	11	6969	6400	5125	8400	3600	12000
Ammonia as N (µg/L)	11	19.5	10.0	7.5	25.0	5.0	60.0
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	11	3.7	2.5	2.5	2.5	0.5	10.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Boron (µg/L)	11	45.9	40	40	55	25	70
Cadmium (µg/L)	11	0.2	0.3	0.3	0.3	0.1	0.3
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	11	21.3	16.0	13.0	29.0	10.0	44.0
Copper (µg/L)	6	4.1	3.8	2.5	5.8	2.5	6.0
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	11	50	50	50	50	50	50
Iron (µg/L)	11	8224	6560	5590	9040	3400	20000
Lead (µg/L)	11	2.5	2.5	2.5	2.5	2.0	2.5
Magnesium (µg/L)	1	47	47	47	47	47	47
Manganese (µg/L)	10	69.4	64.5	38.8	75.8	24	182
Mercury (µg/L)	11	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum (µg/L)	11	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	11	6.3	7.0	6.0	7.0	2.5	10
Nitrate as NO3 (µg/L)	11	61	5.0	5.0	40	5.0	430
Nitrite as NO2- (µg/L)	ND	ND	ND	ND	ND	ND	ND
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	11	7.4	7.2	7.1	7.5	6.9	9.2
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	11	2.5	2.5	2.5	2.5	0.5	5.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	11	1.2	1.0	1.0	1.0	1.0	2
Zinc (µg/L)	11	10	10	7.0	13.5	2.5	16
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	5	71.4	68	63	84	55	87
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	6	78.8	76.5	66.3	90.5	56	106
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	11	135	134	90	181	46	244
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	11	116	116	46	136	26	260

Data Source Site ID	Summary Statistics						
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Turbidity (NTU)	11	319	262	211	308	86	1080
Cobalt (µg/L)	11	2.8	2.5	2.5	2.5	2.5	5.0
Dissolved Aluminium (µg/L)	6	4883	5050	3525	6575	1900	7200
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	6	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Boron (µg/L)	11	35	40	30	40	25	40
Dissolved Cadmium (µg/L)	6	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	11	3.4	3.0	2.0	3.5	0.5	10
Dissolved Copper (µg/L)	11	2.9	2	2	2.5	2	7
Dissolved Iron (µg/L)	11	794	790	655	945	320	1390
Dissolved Lead (µg/L)	11	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	11	3.9	3.0	2.3	5.5	1.0	8.0
Dissolved Mercury (µg/L)	11	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	11	0.7	0.5	0.5	0.5	0.5	2.5
Dissolved Nickel (µg/L)	11	2.5	2.0	2.0	3.0	2.0	3.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	11	2.3	2.5	2.5	2.5	0.5	2.5
Dissolved Zinc (µg/L)	11	4.6	5	5	5	1	5
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	6	41	40.5	35.8	47.5	31	50
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	6	25	25	25	25	25	25
C10-C14 (µg/L)	6	25	25	25	25	25	25
C15-C28 (µg/L)	6	100	100	100	100	100	100
C29-C36 (µg/L)	6	64.2	70	60	80	25	80
BOD (lab) (mg/L)	6	2.0	2.0	1.3	2.8	1.0	3.0
C10 - C36 Fraction (sum) (µg/L)	5	72	80	60	80	60	80
NO2 + NO3 (µg/L)	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	6	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	6	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Silver (ug/L)	6	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Uranium (ug/L)	6	0.1	0.1	0.1	0.1	0.1	0.1
Total Uranium (ug/L)	6	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Vanadium (ug/L)	6	3.7	2.5	2.5	5.1	2.5	6.0
Total Vanadium (ug/L)	6	19.2	20	12.5	20	5.0	40

Appendix E Bore Logs

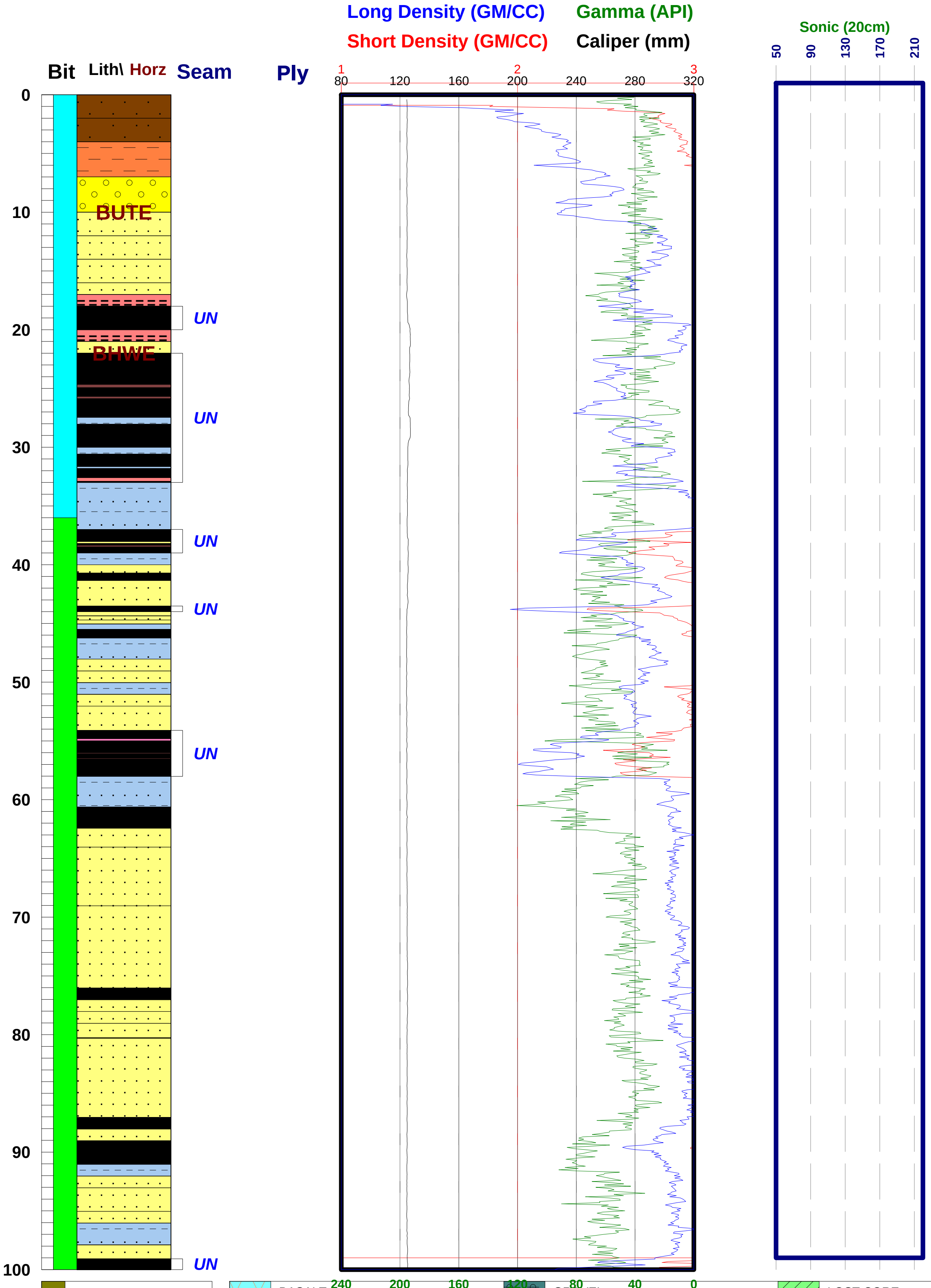
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114010

Easting :	607814.40 m	Elevation :	263.28 m
Northing :	7594515.21 m	Final Depth :	522.34 m



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

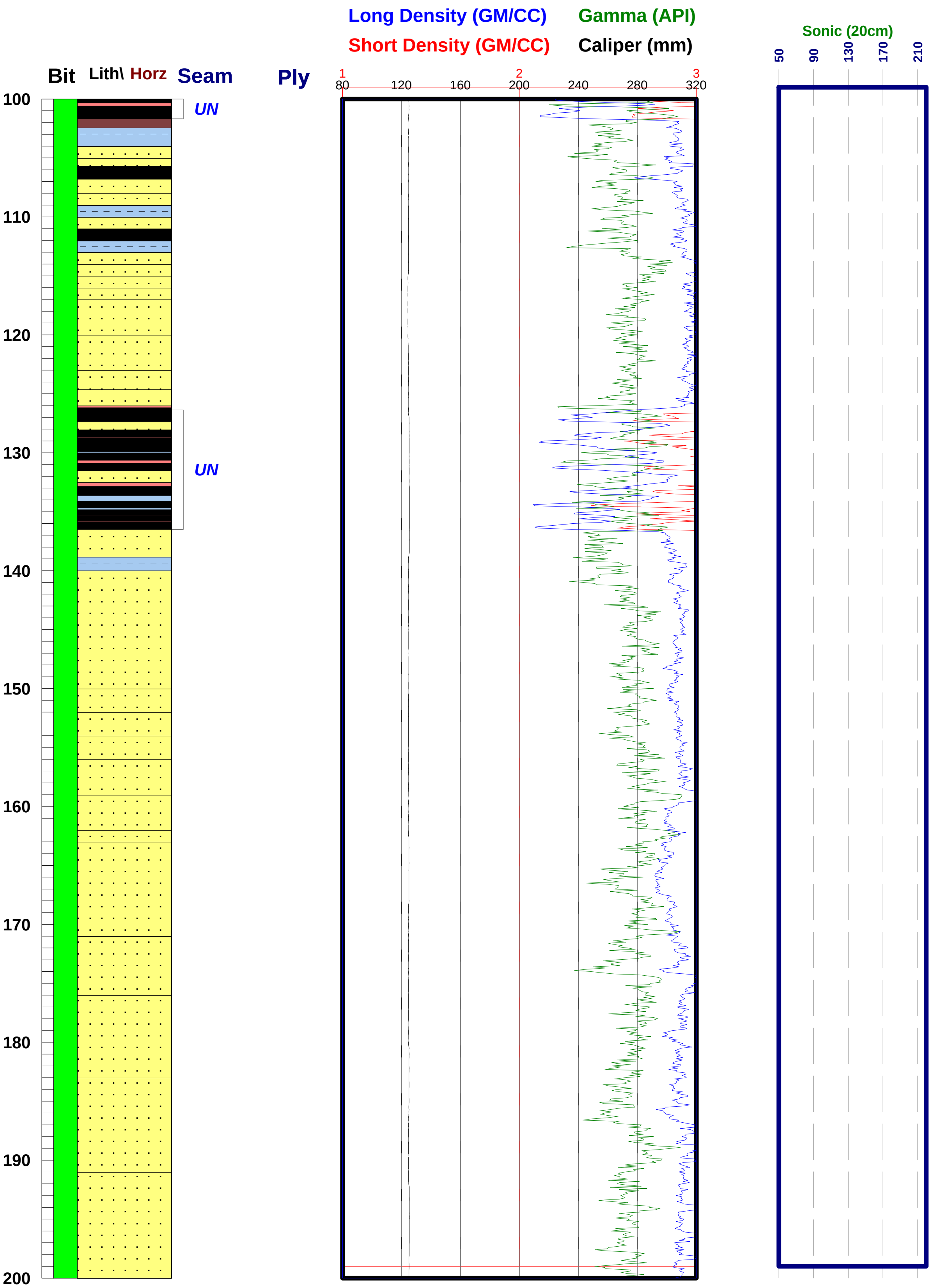
Goonyella

Lithological Log

DRILLHOLE : 114010

Easting :	607814.40 m	**Elevation :**	263.28 m
Northing :	7594515.21 m	**Final Depth :**	522.34 m

BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

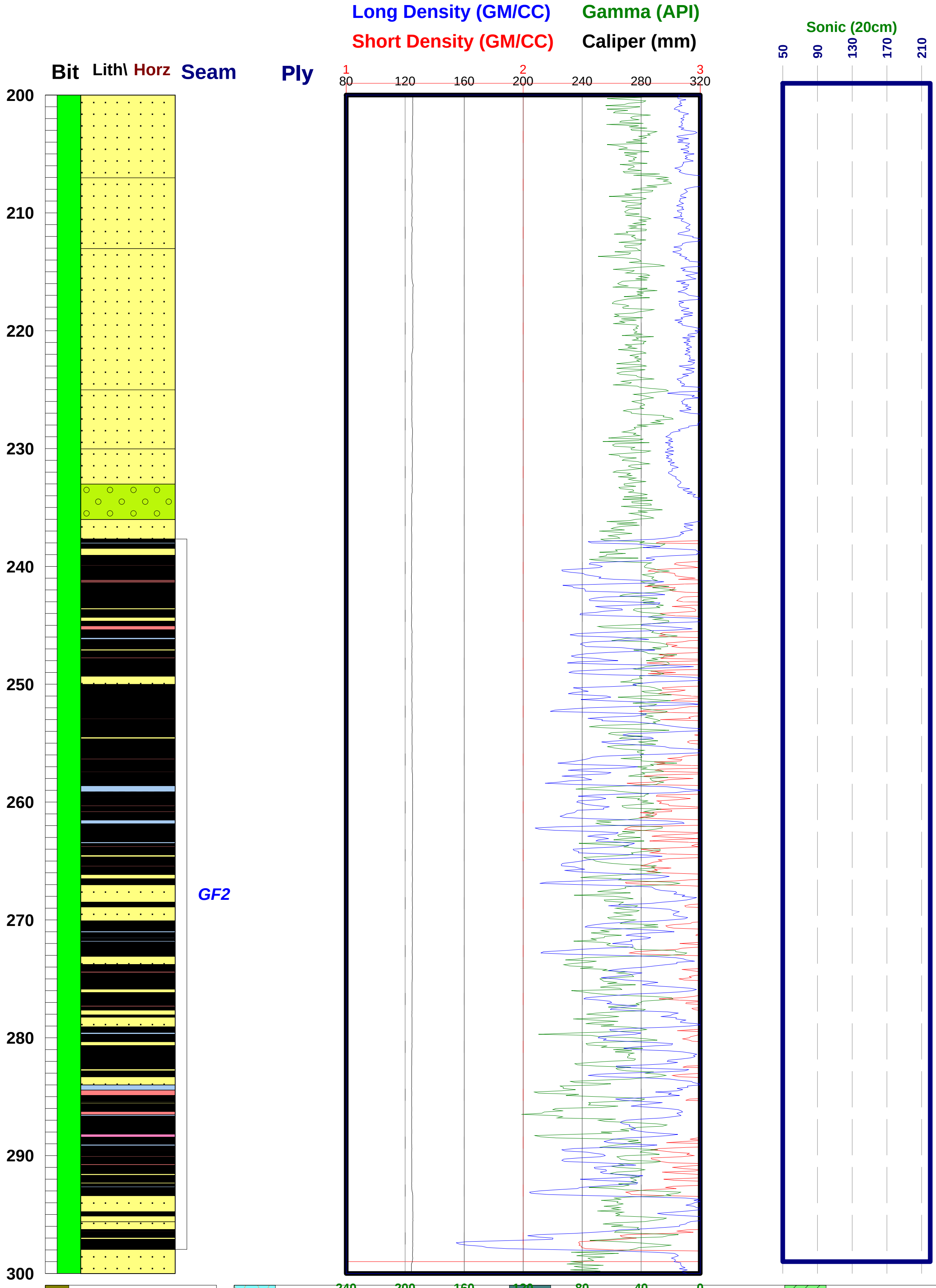
Goonyella

Lithological Log

DRILLHOLE : 114010

Easting :	607814.40 m	Elevation :	263.28 m
Northing :	7594515.21 m	Final Depth :	522.34 m

BHP Billiton Mitsubishi Alliance



Bit	
	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

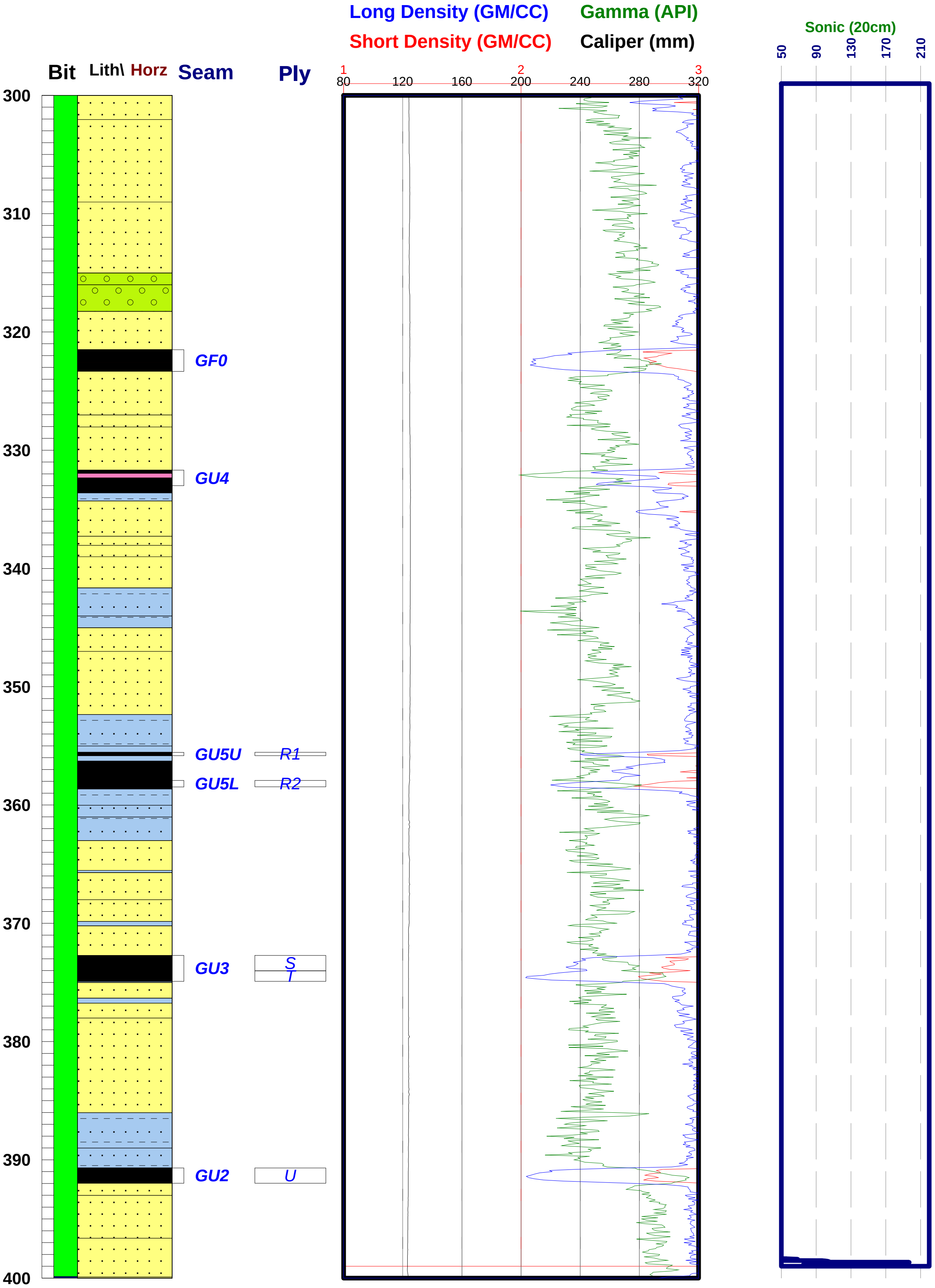
Goonyella

Lithological Log

DRILLHOLE : 114010

Easting :	607814.40 m	Elevation :	263.28 m
Northing :	7594515.21 m	Final Depth :	522.34 m

BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE		PYRITE
	SILT		CARB SANDSTONE		SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

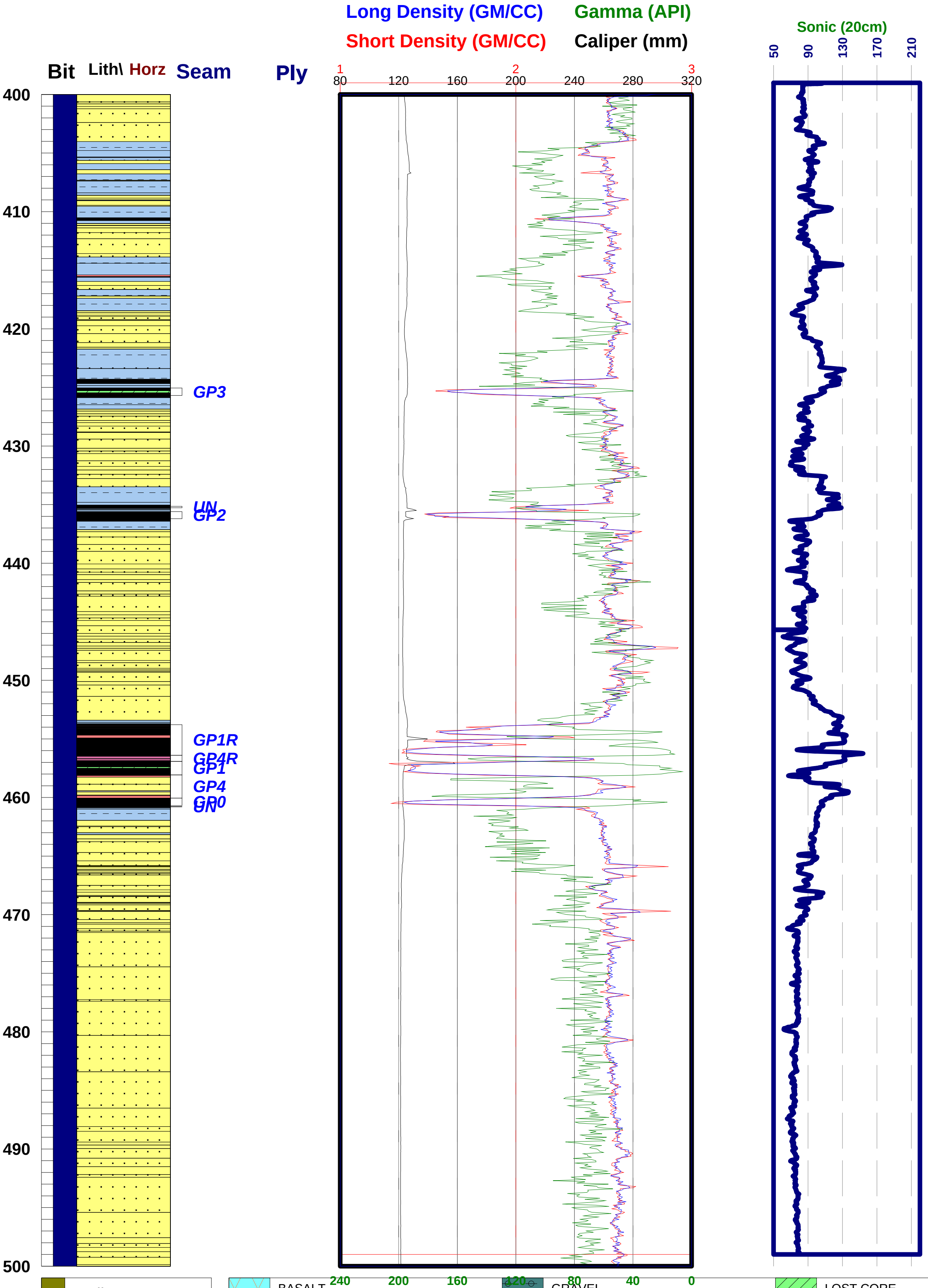
Goonyella

Lithological Log

DRILLHOLE : 114010

Easting :	607814.40 m	**Elevation :**	263.28 m
Northing :	7594515.21 m	**Final Depth :**	522.34 m

BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE	
IGNEOUS ROCK	SHALE	FAULT ZONE	
COAL	CARB SHALE	CALCITE	
COAL Heat affected	SILTSTONE	CHERT	
COAL WEATHERED	FINE SANDSTONE	TUFF	J
CLAY	>MED SANDSTONE	PYRITE	K
SILT	CARB SANDSTONE	SIDERITE	L
CLAYEY SAND	CONGLOMERATE	ALLUVIAL	M
SAND	SEDIMENTARY, undiff		

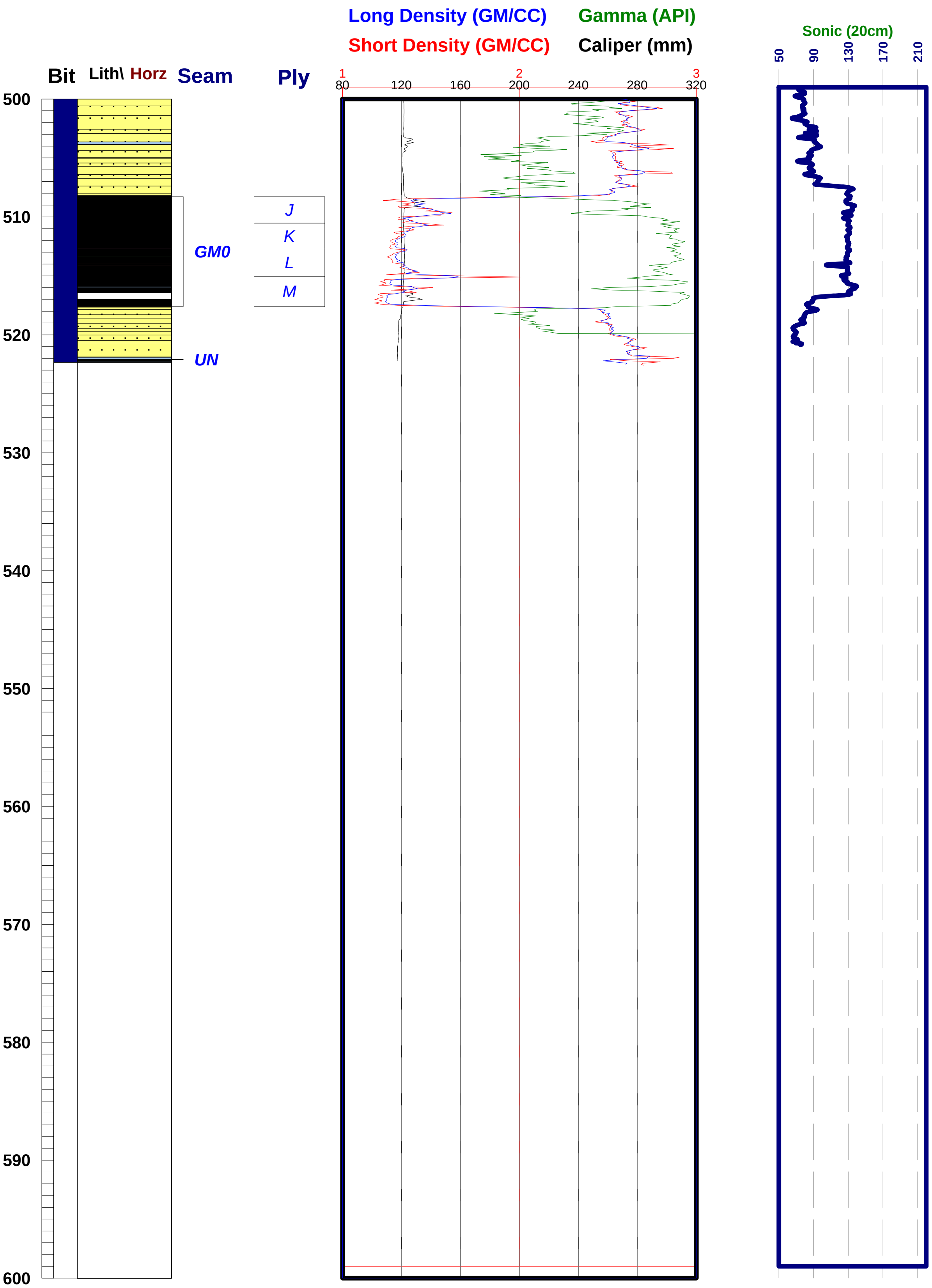
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114010

Easting :	607814.40 m	**Elevation :**	263.28 m
Northing :	7594515.21 m	**Final Depth :**	522.34 m



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

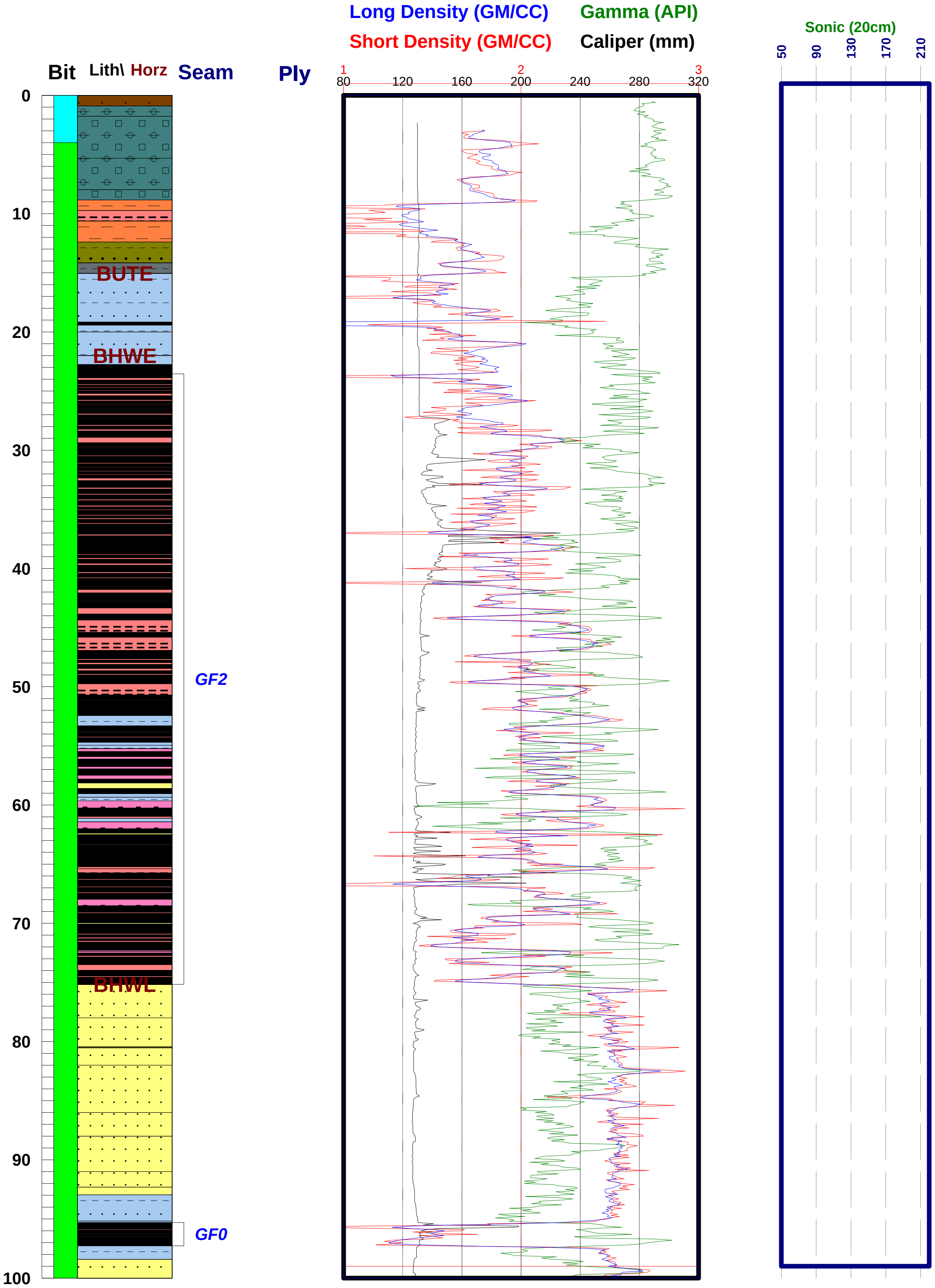
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114012

Easting :	604249.90 m	Elevation :	263.88 m
Northing :	7594421.93 m	Final Depth :	358.57 m

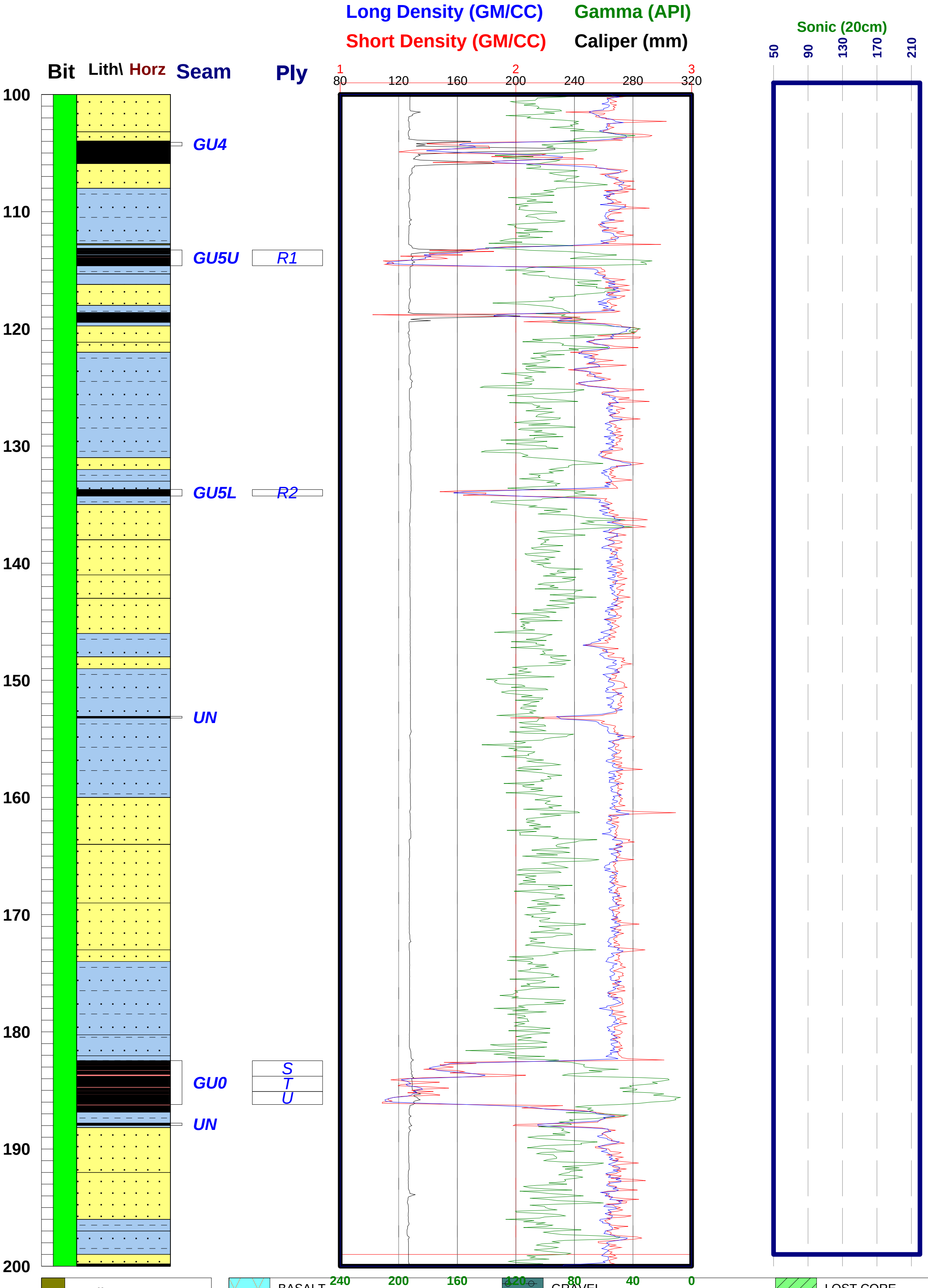


	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE	P y	PYRITE
	SILT		CARB SANDSTONE	S d	SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

Goonyella | **Lithological Log** | **BMA** — BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114012	**Easting :** 604249.90 m	**Elevation :** 263.88 m	
	Northing : 7594421.93 m	**Final Depth :** 358.57 m	



Bit	
	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

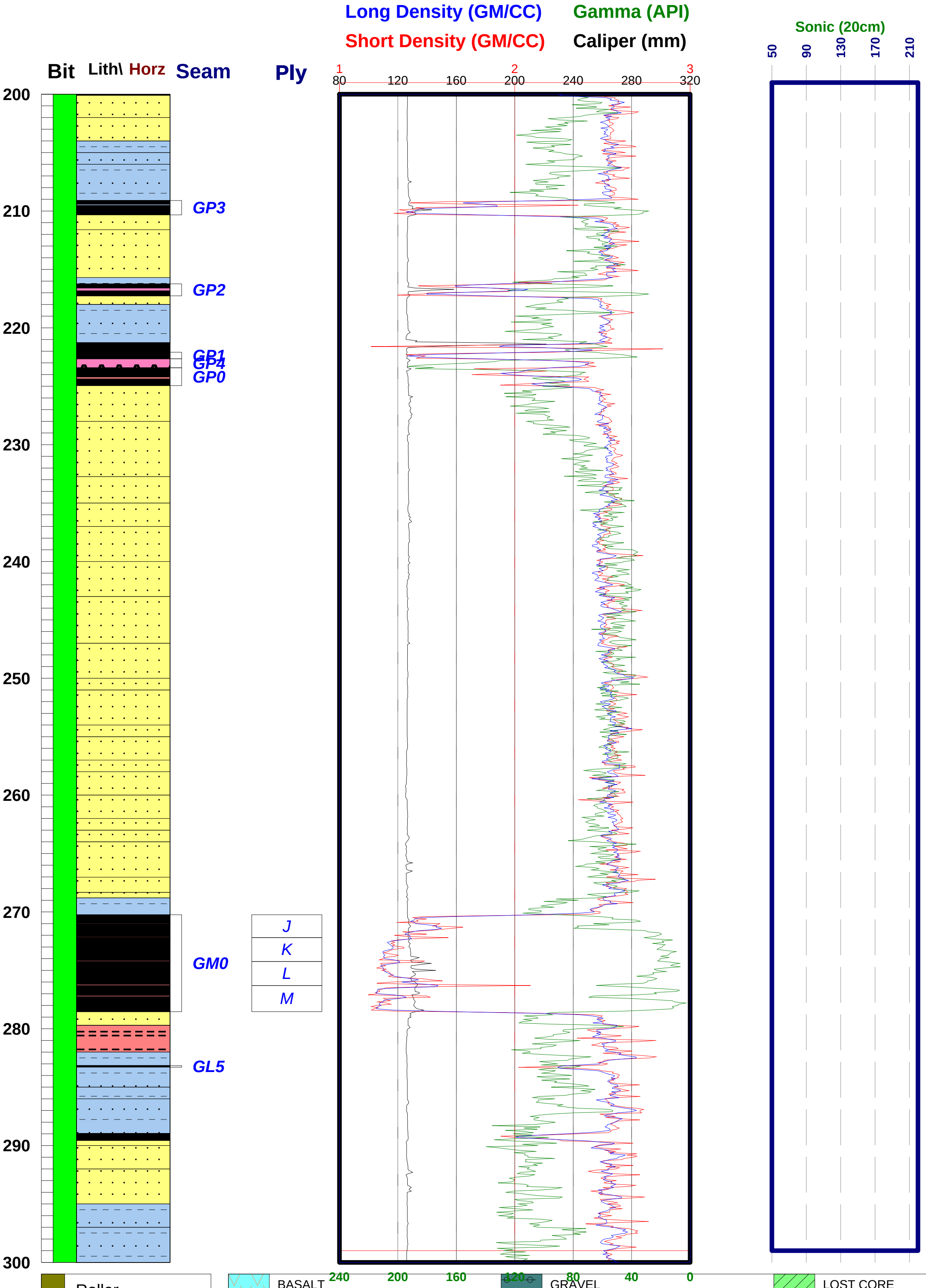
Goonyella

Lithological Log

DRILLHOLE : 114012

Easting :	604249.90 m	**Elevation :**	263.88 m
Northing :	7594421.93 m	**Final Depth :**	358.57 m

BMA
BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE	P y	PYRITE
	SILT		CARB SANDSTONE	S d	SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

Goonyella

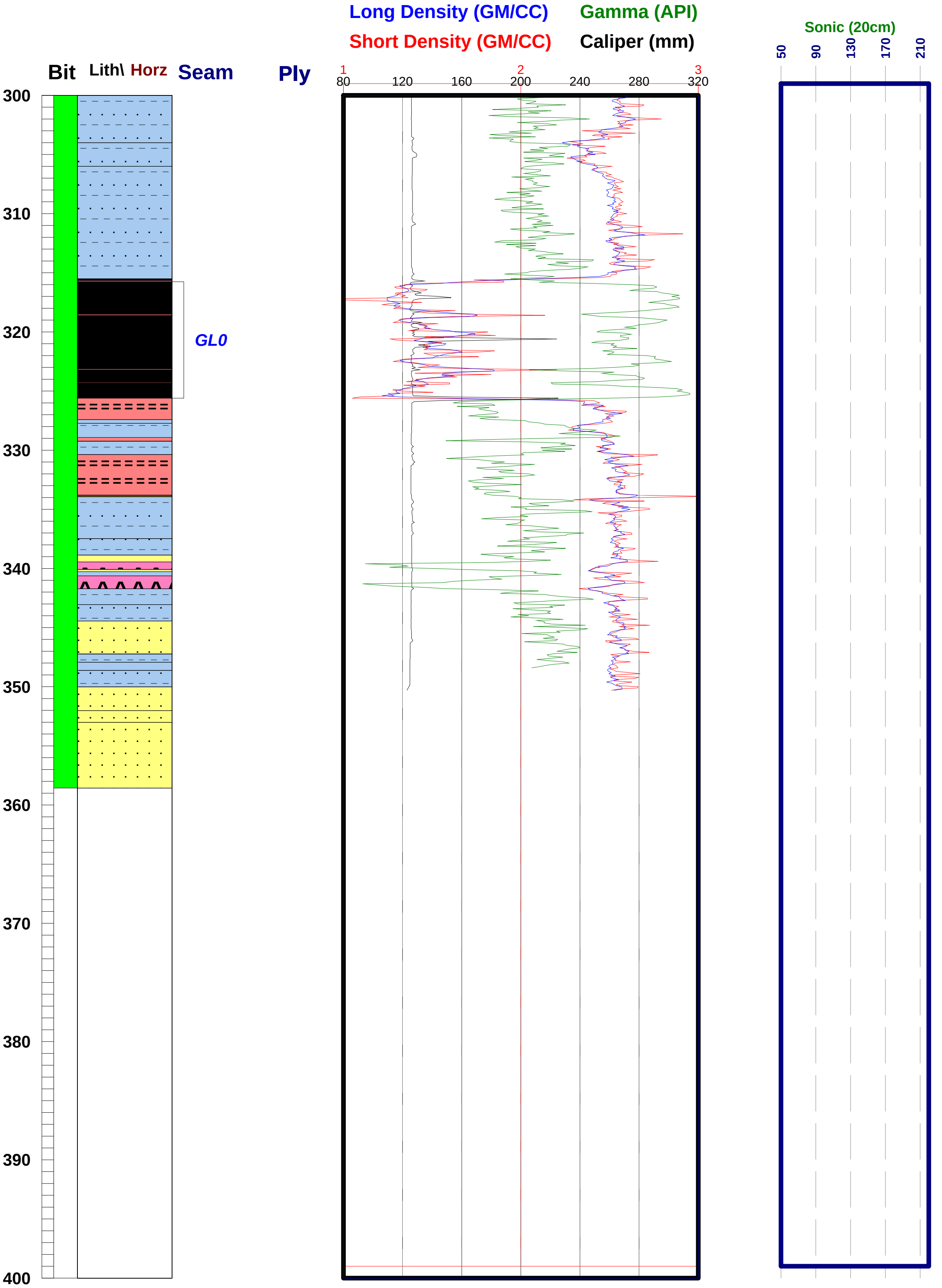
Lithological Log

DRILLHOLE : 114012

Easting : 604249.90 m **Elevation :** 263.88 m

Northing : 7594421.93 m **Final Depth :** 358.57 m

BHP Billiton Mitsubishi Alliance



Roller	
Blade	
Tungsten	
Diamond	
Hammer	
Polycrystalline	

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

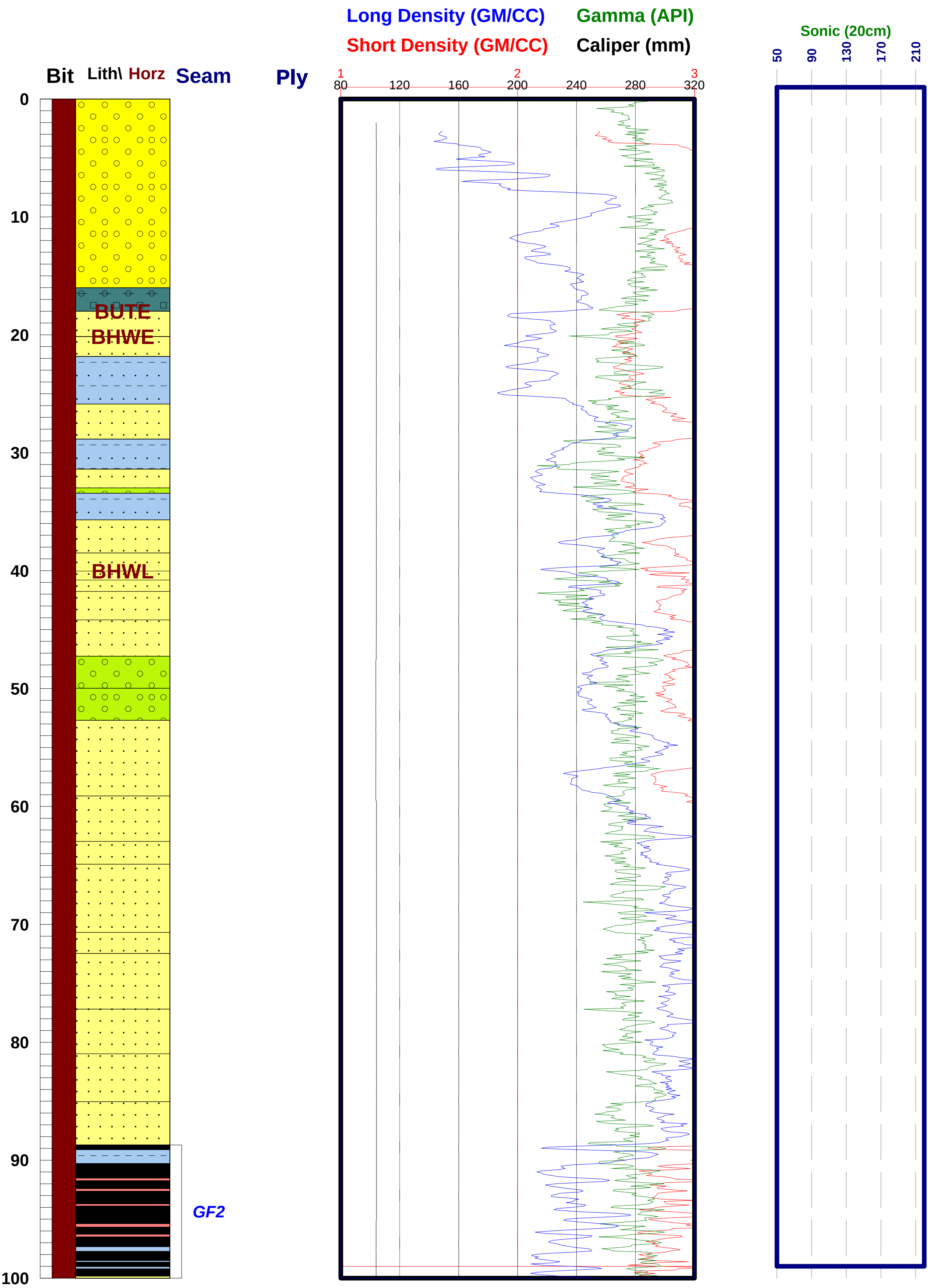
Goonyella

Lithological Log

DRILLHOLE : 114033

Easting :	605721.12 m	**Elevation :**	260.41 m
Northing :	7594235.39 m	**Final Depth :**	462.49 m

BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

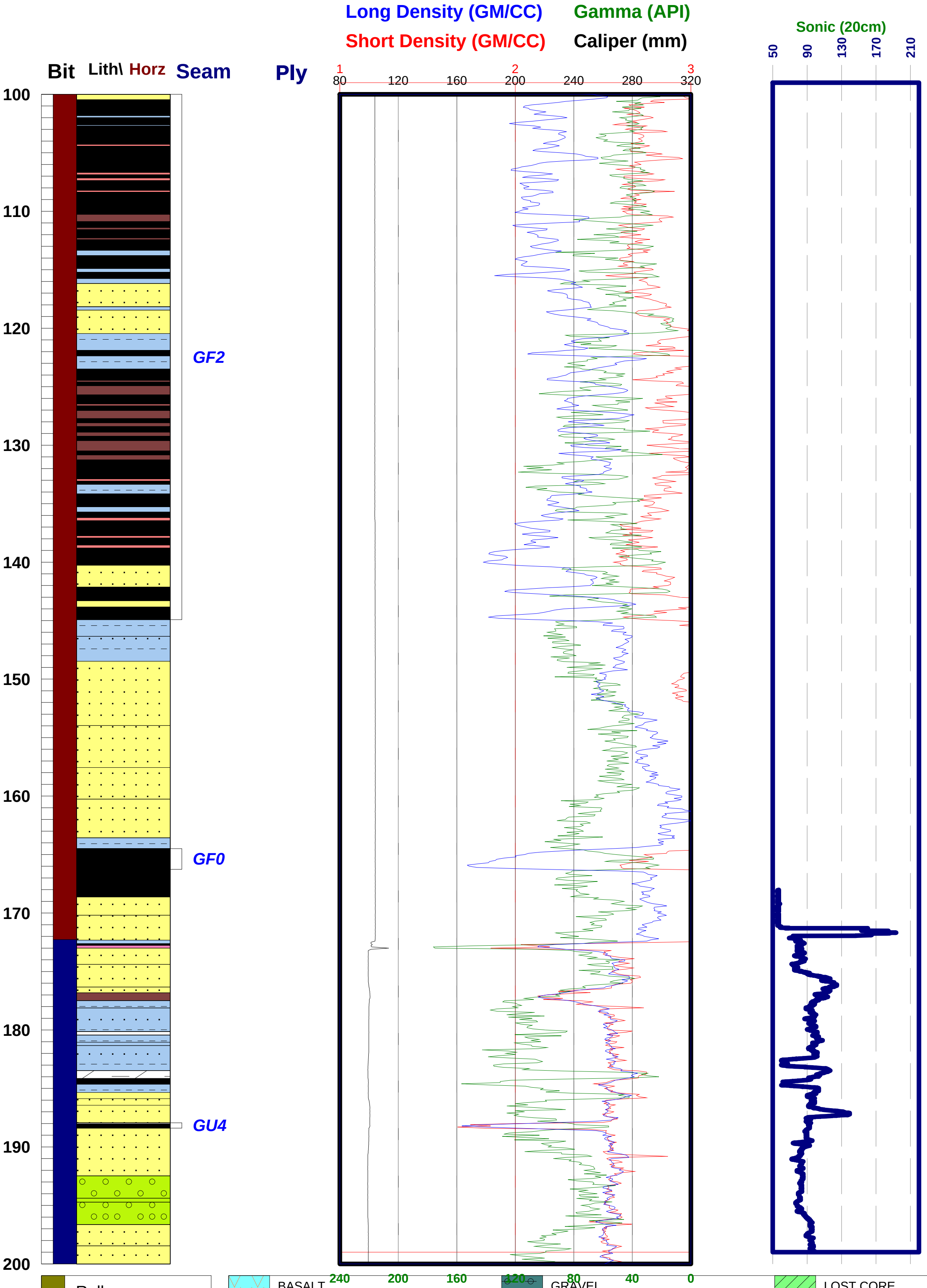
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114033

Easting :	605721.12 m	**Elevation :**	260.41 m
Northing :	7594235.39 m	**Final Depth :**	462.49 m



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

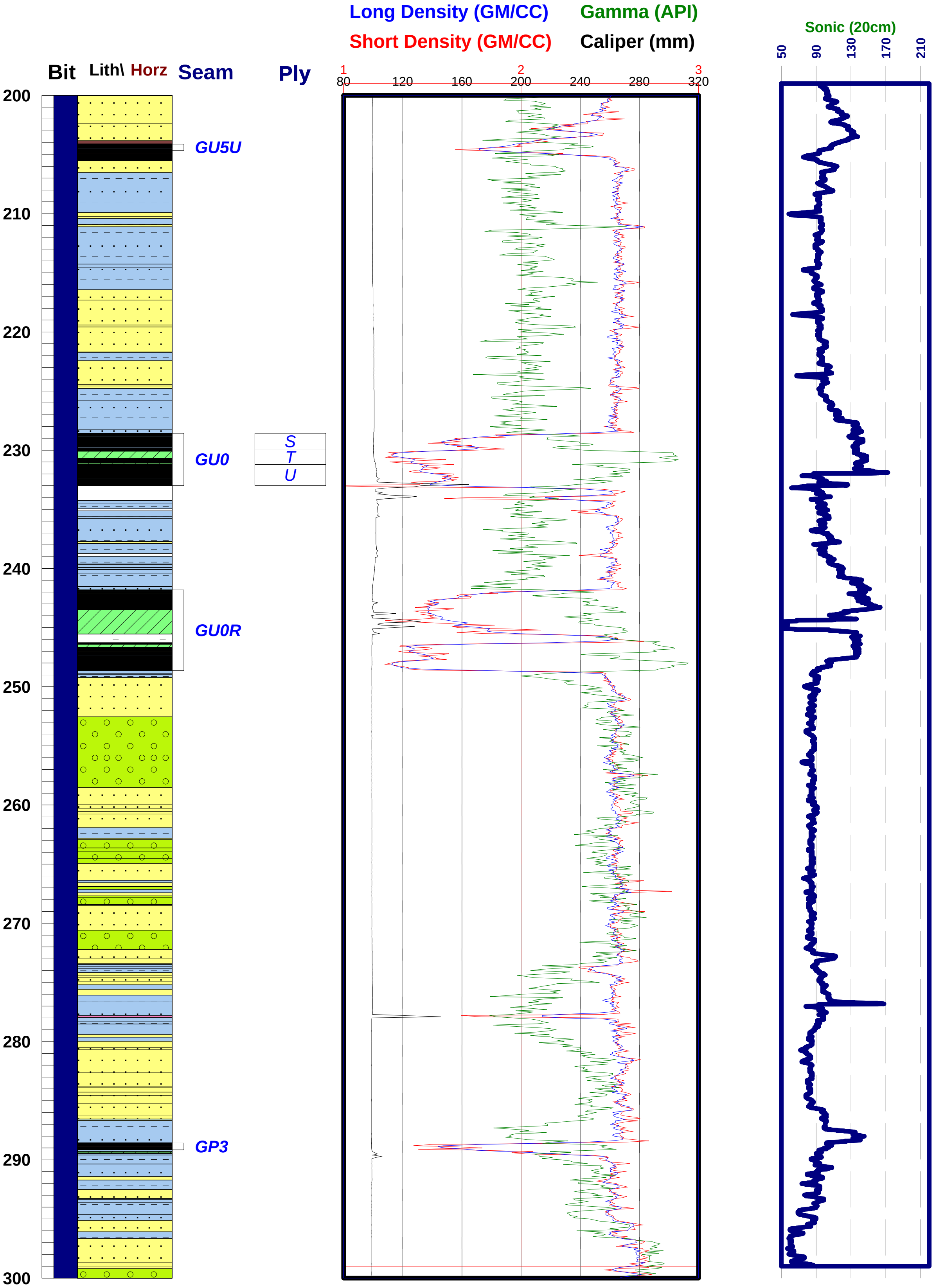
Goonyella

Lithological Log

DRILLHOLE : 114033

Easting :	605721.12 m	**Elevation :**	260.41 m
Northing :	7594235.39 m	**Final Depth :**	462.49 m

BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

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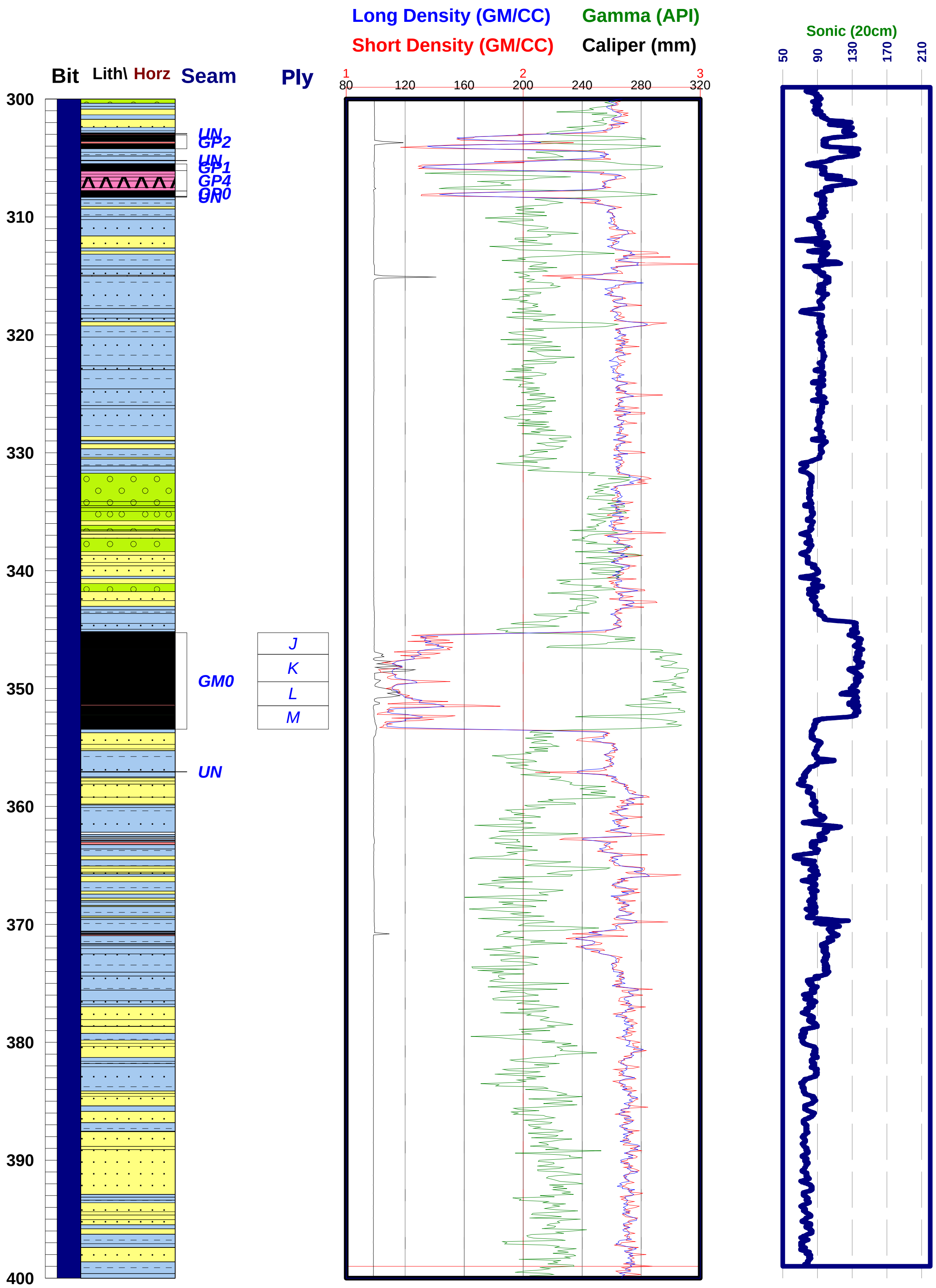
Easting :	605721.12 m	**Elevation :**	260.41 m
Northing :	7594235.39 m	**Final Depth :**	462.49 m

BHP Billiton Mitsubishi Alliance



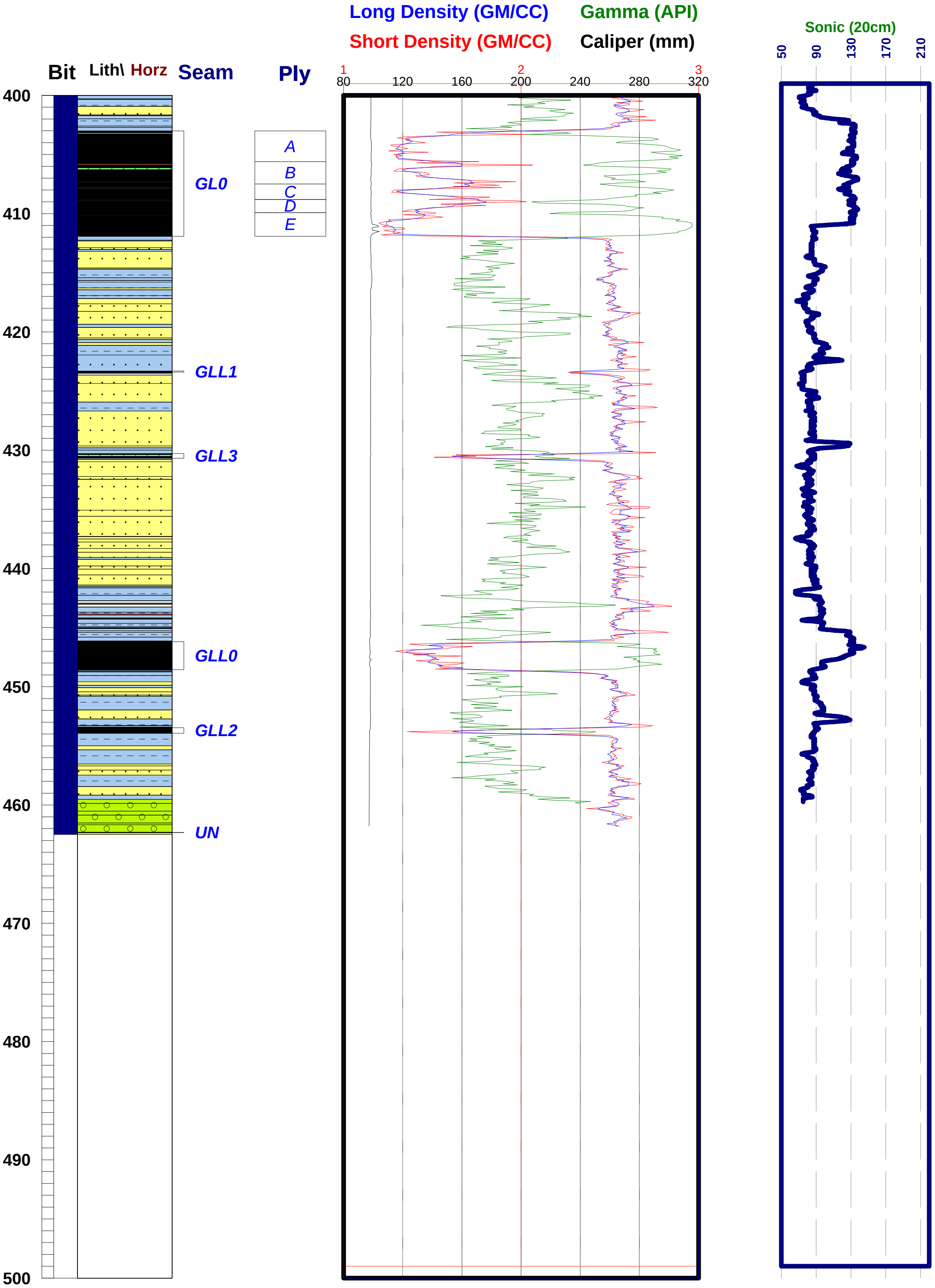
Bit
Roller
Blade
Tungsten
Diamond
Hammer
Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella | **Lithological Log** | BMA BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114033

Easting :	605721.12 m	**Elevation :**	260.41 m
Northing :	7594235.39 m	**Final Depth :**	462.49 m



Bit	
	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

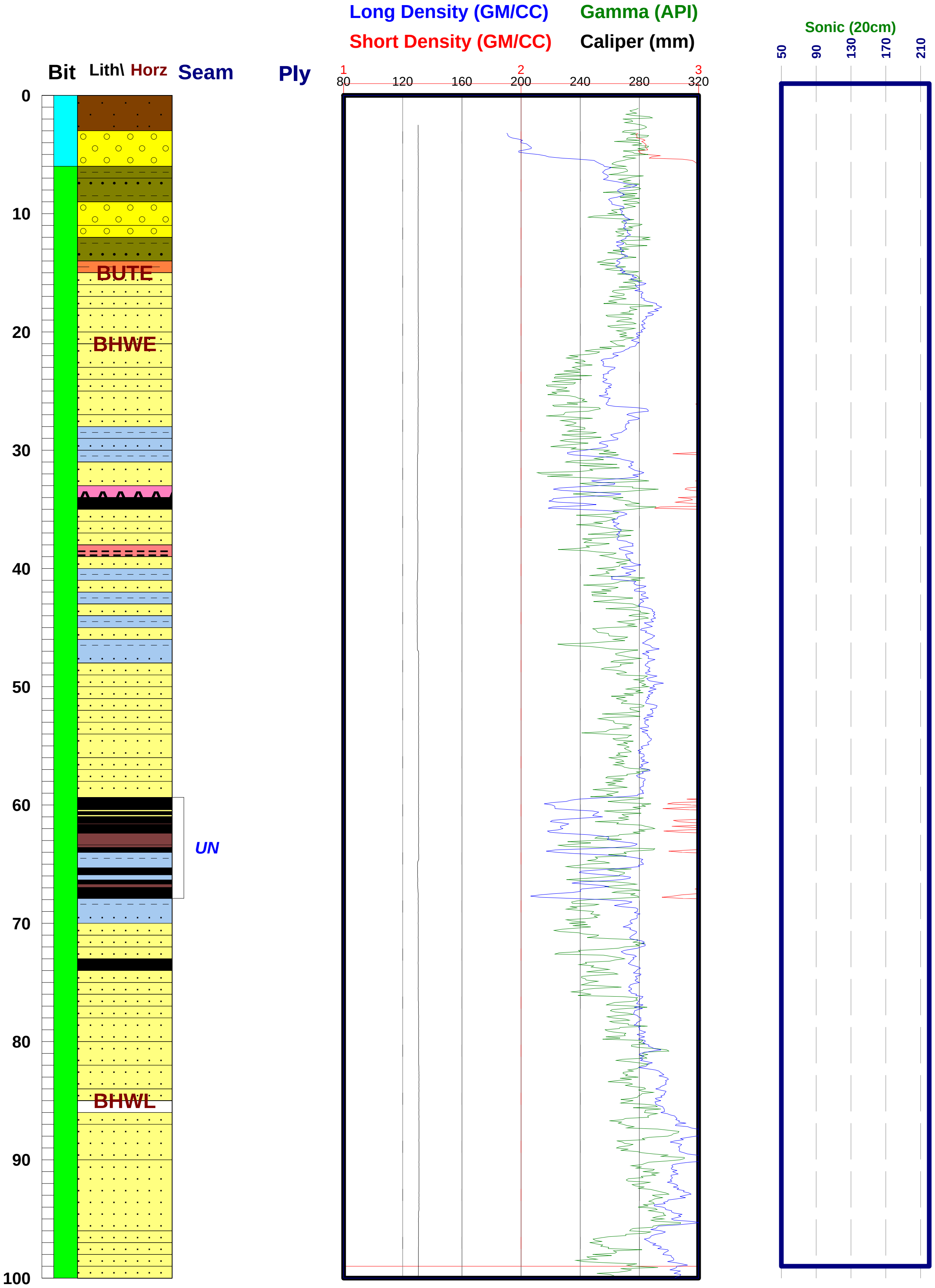
Lithological Log

DRILLHOLE : 114121

Easting : 607307.80 m **Elevation :** 264.33 m

Northing : 7593720.93 m **Final Depth :** 522.16 m

BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE		PYRITE
	SILT		CARB SANDSTONE		SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

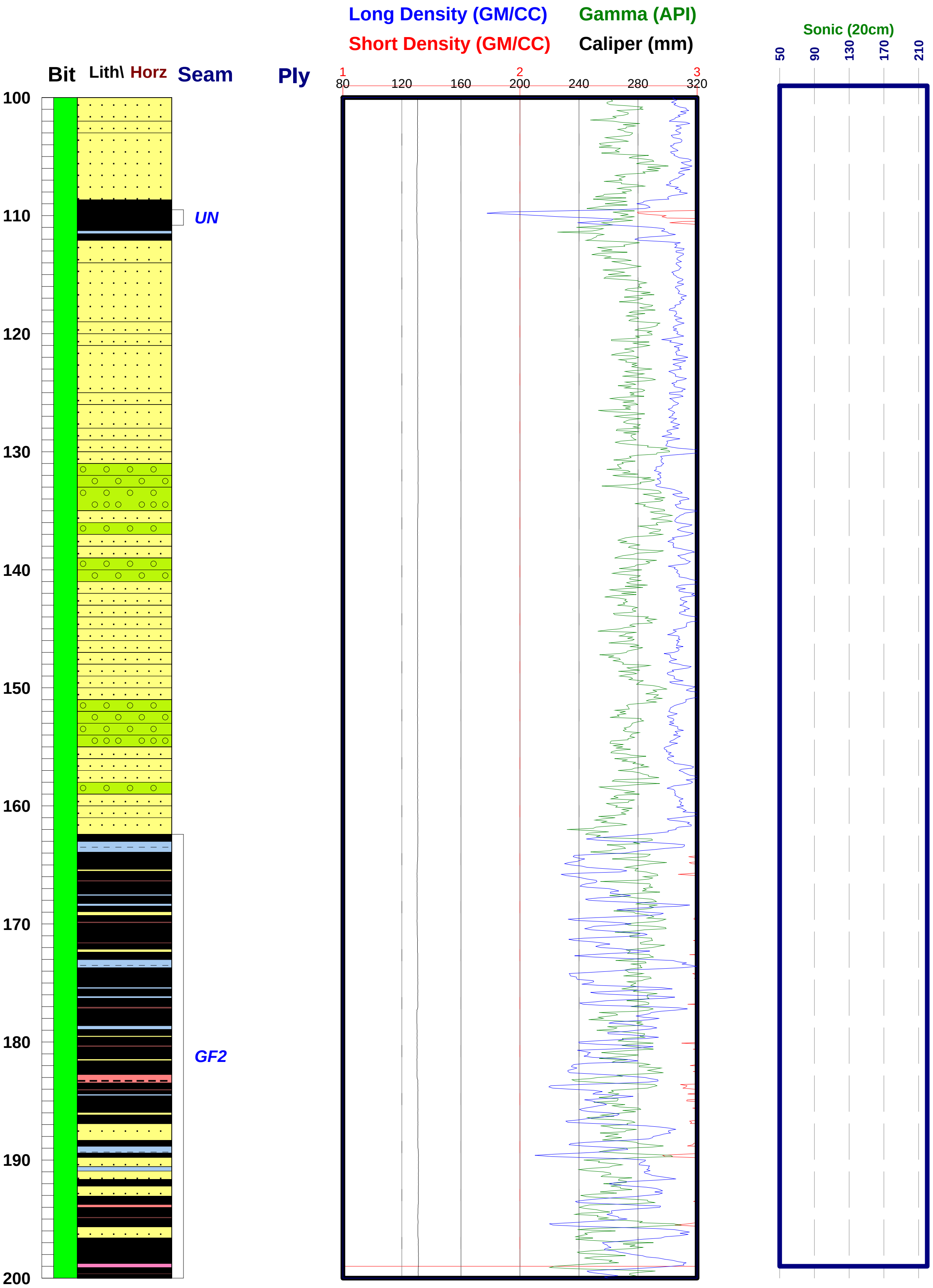
Goonyella

Lithological Log

BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114121

Easting : 607307.80 m
Northing : 7593720.93 m
Elevation : 264.33 m
Final Depth : 522.16 m



Roller	BASALT	GRAVEL	LOST CORE
Blade	IGNEOUS ROCK	SHALE	FAULT ZONE
Tungsten	COAL	CARB SHALE	CALCITE
Diamond	COAL Heat affected	SILTSTONE	CHERT
Hammer	COAL WEATHERED	FINE SANDSTONE	TUFF
Polycrystalline	CLAY	>MED SANDSTONE	PYRITE
	SILT	CARB SANDSTONE	SIDERITE
	CLAYEY SAND	CONGLOMERATE	ALLUVIAL
	SAND	SEDIMENTARY, undiff	

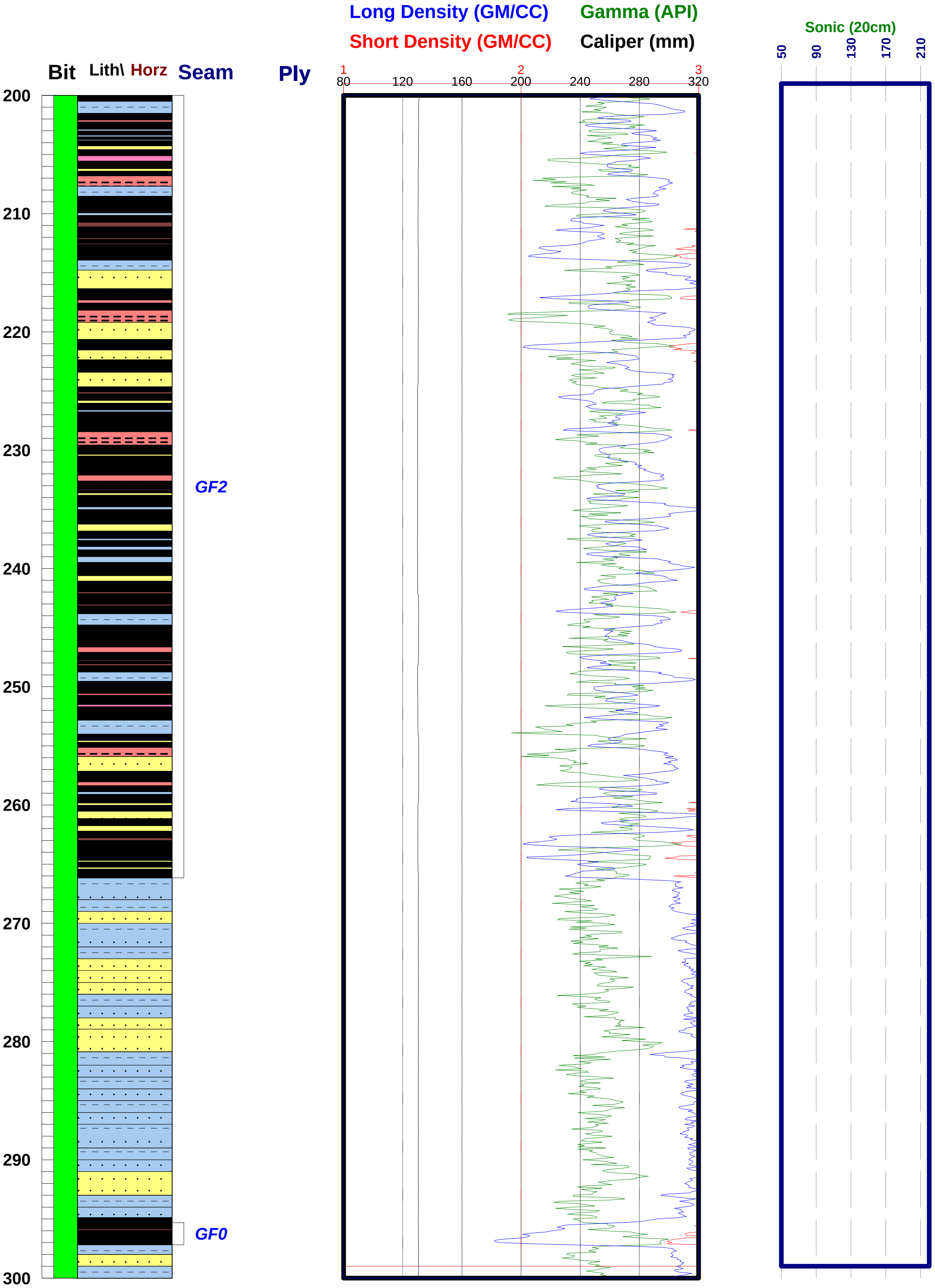
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114121

Easting :	607307.80 m	Elevation :	264.33 m
Northing :	7593720.93 m	Final Depth :	522.16 m



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE	
IGNEOUS ROCK	SHALE	FAULT ZONE	
COAL	CARB SHALE	CALCITE	
COAL Heat affected	SILTSTONE	CHERT	
COAL WEATHERED	FINE SANDSTONE	TUFF	
CLAY	>MED SANDSTONE	PYRITE	
SILT	CARB SANDSTONE	SIDERITE	
CLAYEY SAND	CONGLOMERATE	ALLUVIAL	
SAND	SEDIMENTARY, undiff		

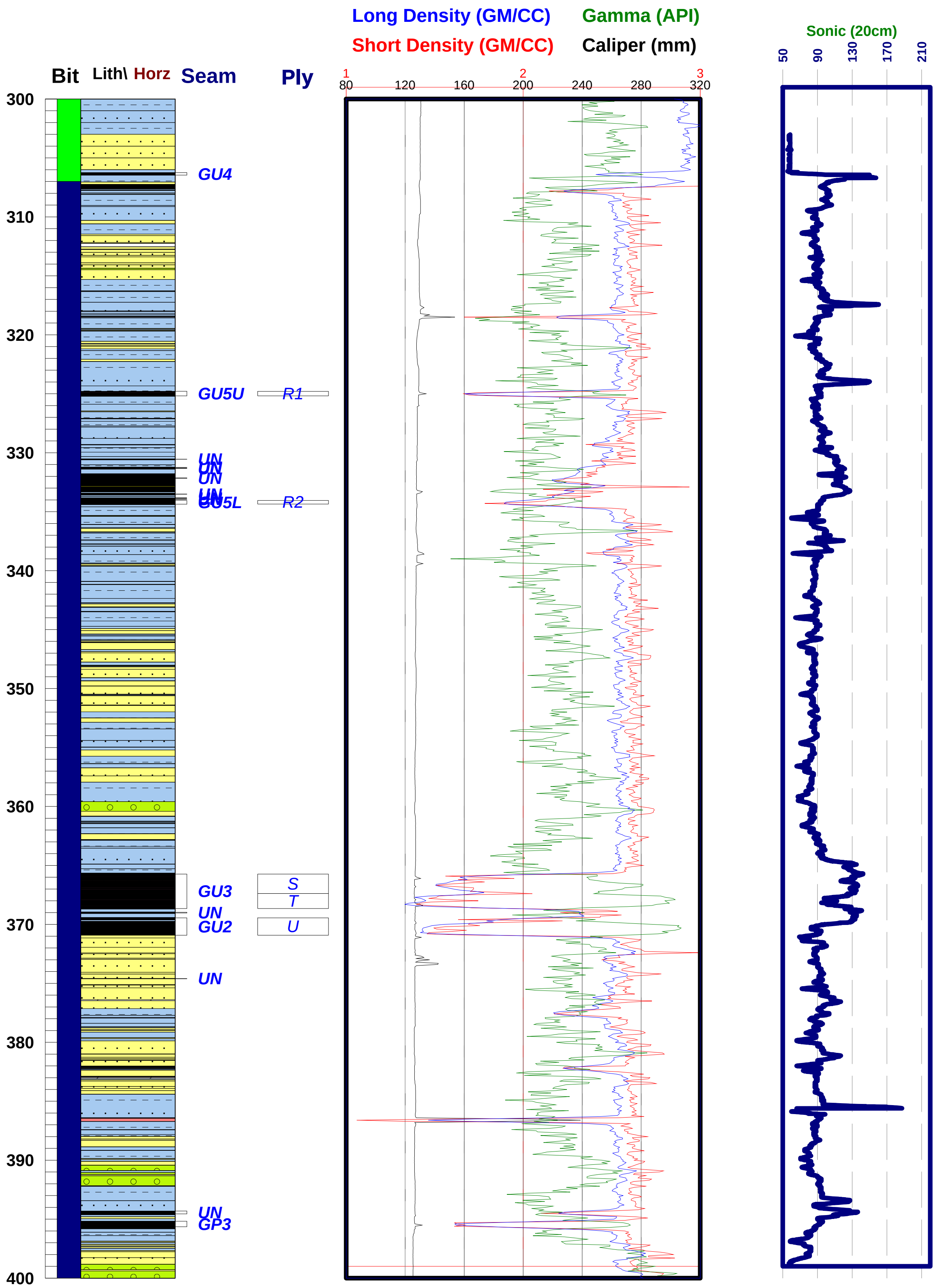
Goonyella

Lithological Log

DRILLHOLE : 114121

Easting : 607307.80 m **Elevation :** 264.33 m

Northing : 7593720.93 m **Final Depth :** 522.16 m



Roller	BASALT	GRAVEL	LOST CORE		
Blade	IGNEOUS ROCK	SHALE	FAULT ZONE		
Tungsten	COAL	CARB SHALE	CALCITE		
Diamond	COAL Heat affected	SILTSTONE	CHERT		
Hammer	COAL WEATHERED	FINE SANDSTONE	TUFF		
Polycrystalline	CLAY	>MED SANDSTONE	PYRITE		
	SILT	CARB SANDSTONE	SIDERITE		
	CLAYEY SAND	CONGLOMERATE	ALLUVIAL		
	SAND	SEDIMENTARY, undiff			

Goonyella

Lithological Log

DRILLHOLE : 114121

Easting : 607307.80 m **Elevation :** 264.33 m

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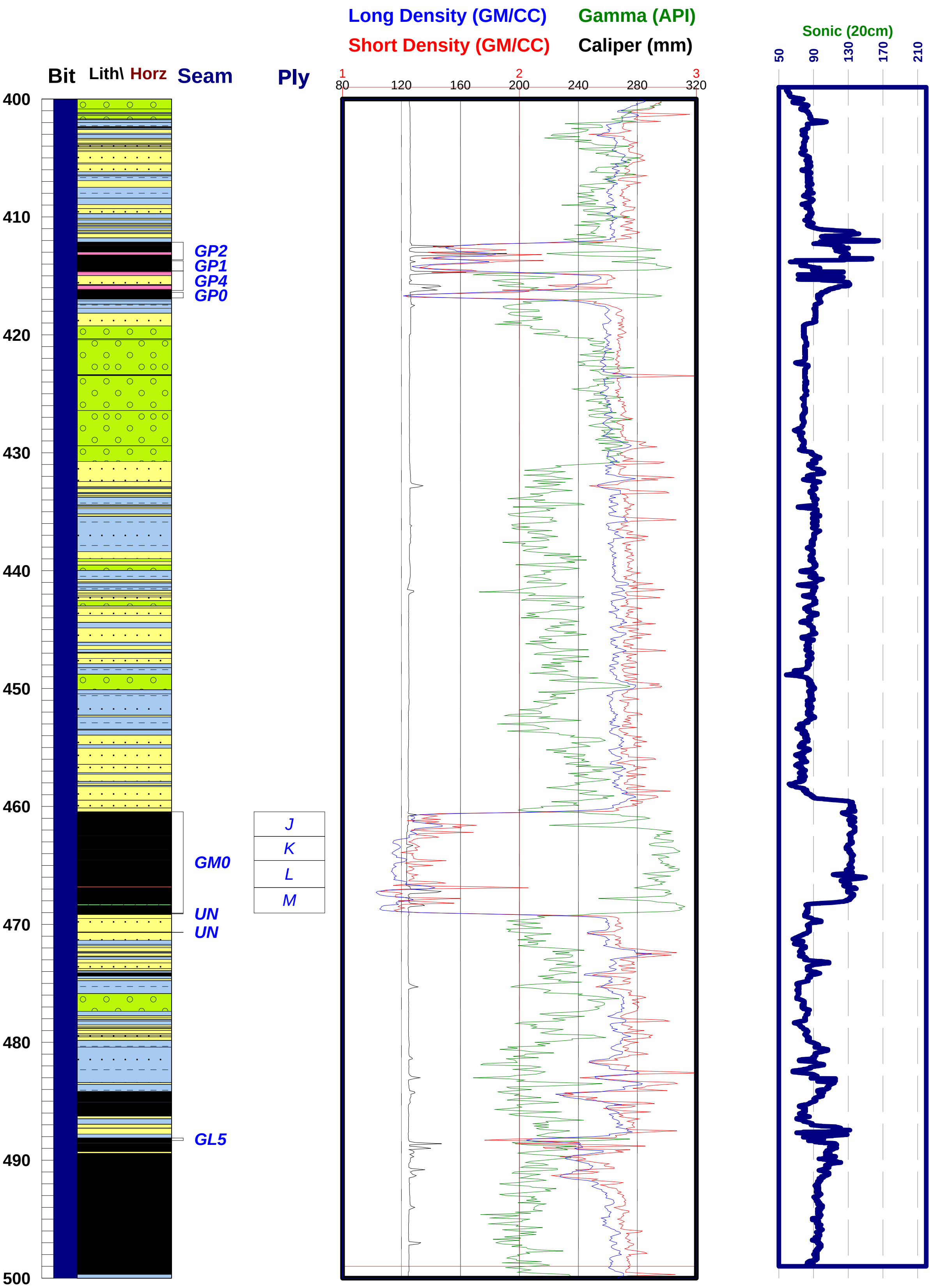
BMA BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE		PYRITE
	SILT		CARB SANDSTONE		SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

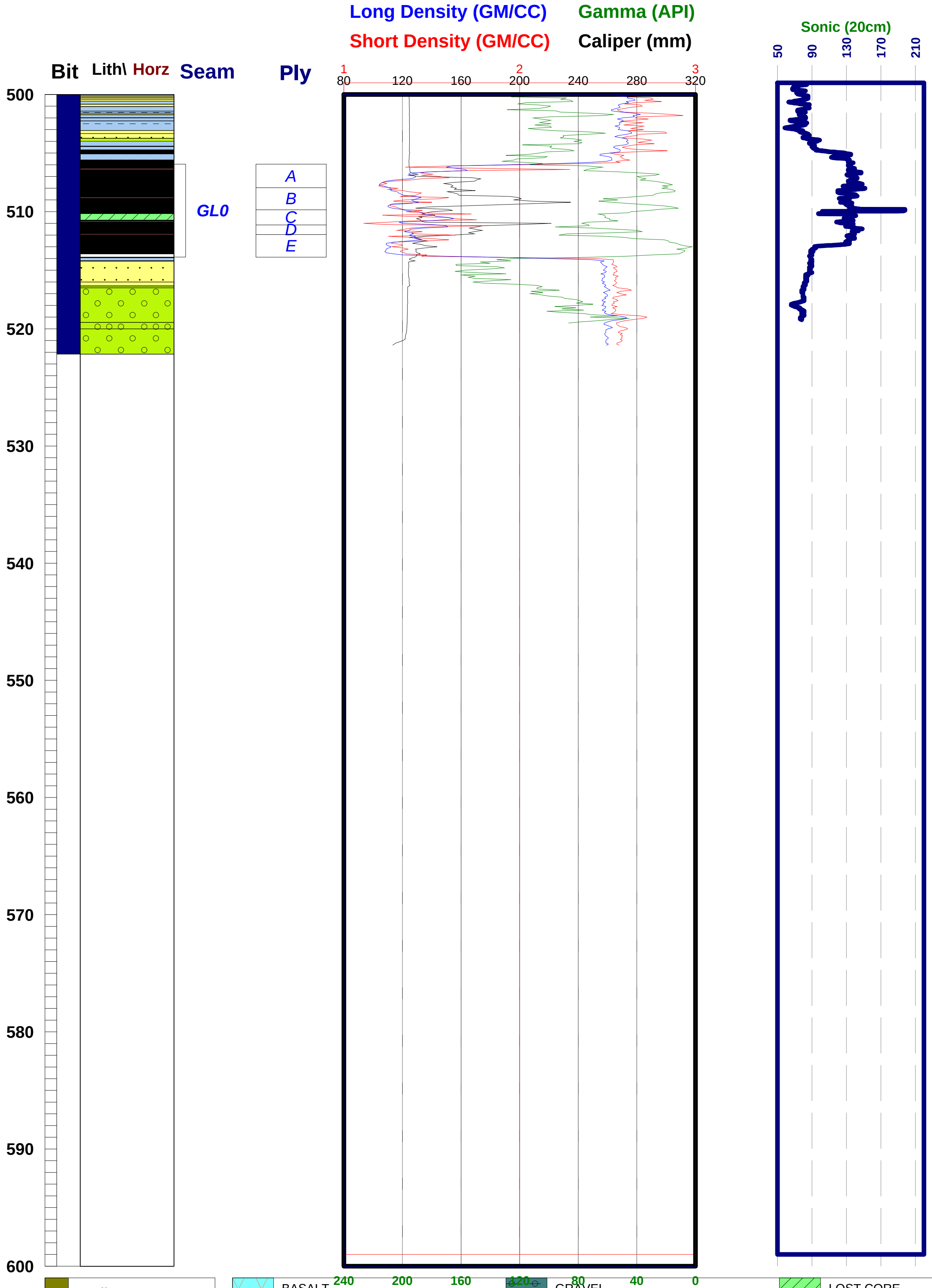
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 114121

Easting : 607307.80 m
Northing : 7593720.93 m
Elevation : 264.33 m
Final Depth : 522.16 m



Bit	
	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE	P y	PYRITE
	SILT		CARB SANDSTONE	S d	SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

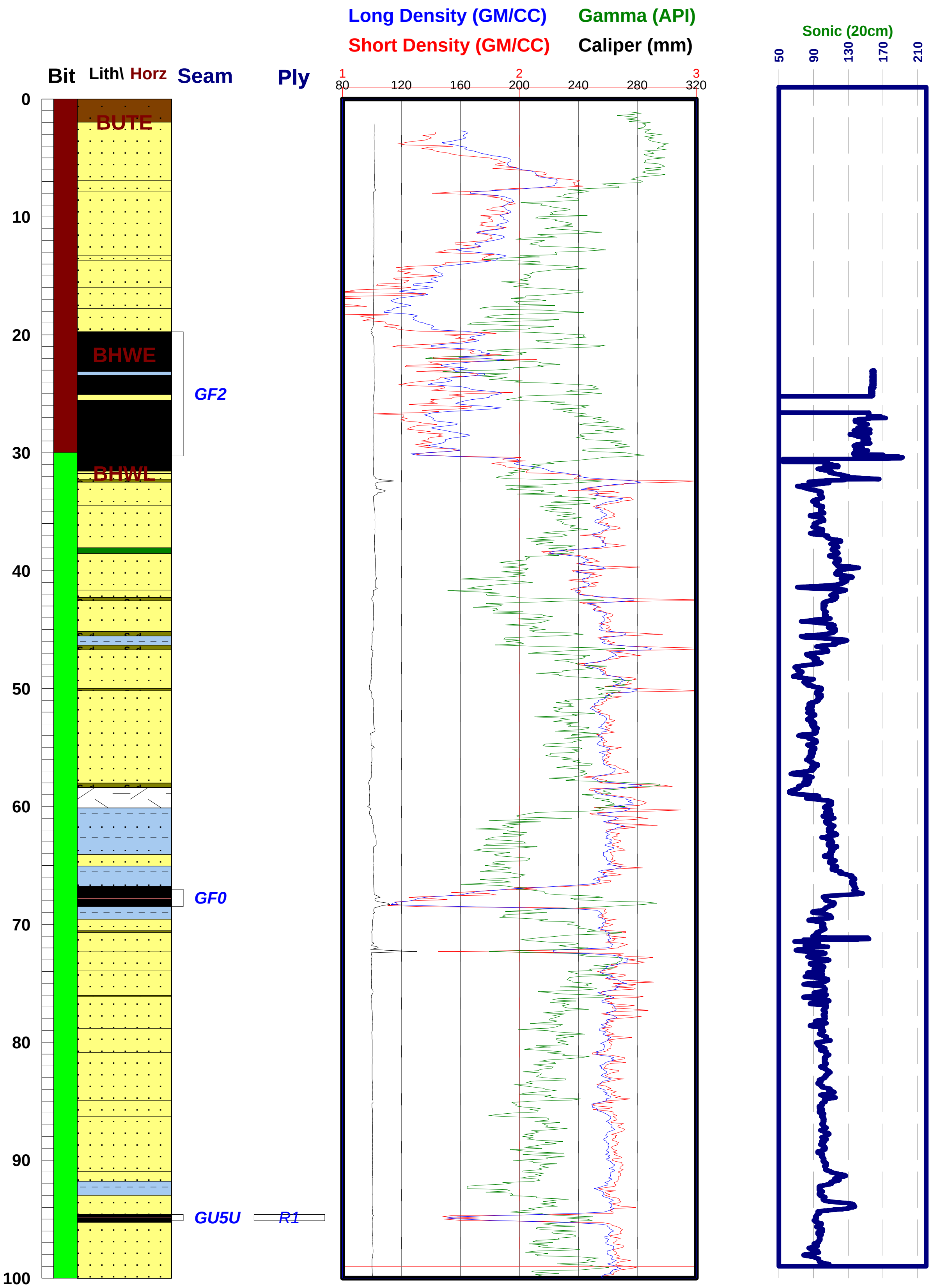
Goonyella

Lithological Log

DRILLHOLE : 114174

Easting :	603650.73 m	**Elevation :**	268.63 m
Northing :	7594386.97 m	**Final Depth :**	252.49 m

BHP Billiton Mitsubishi Alliance



Roller		BASALT		GRAVEL		LOST CORE	
Blade		IGNEOUS ROCK		SHALE		FAULT ZONE	
Tungsten		COAL		CARB SHALE		CALCITE	
Diamond		COAL Heat affected		SILTSTONE		CHERT	
Hammer		COAL WEATHERED		FINE SANDSTONE		TUFF	
Polycrystalline		CLAY		>MED SANDSTONE		PYRITE	
		SILT		CARB SANDSTONE		SIDERITE	
		CLAYEY SAND		CONGLOMERATE		ALLUVIAL	
		SAND		SEDIMENTARY, undiff			

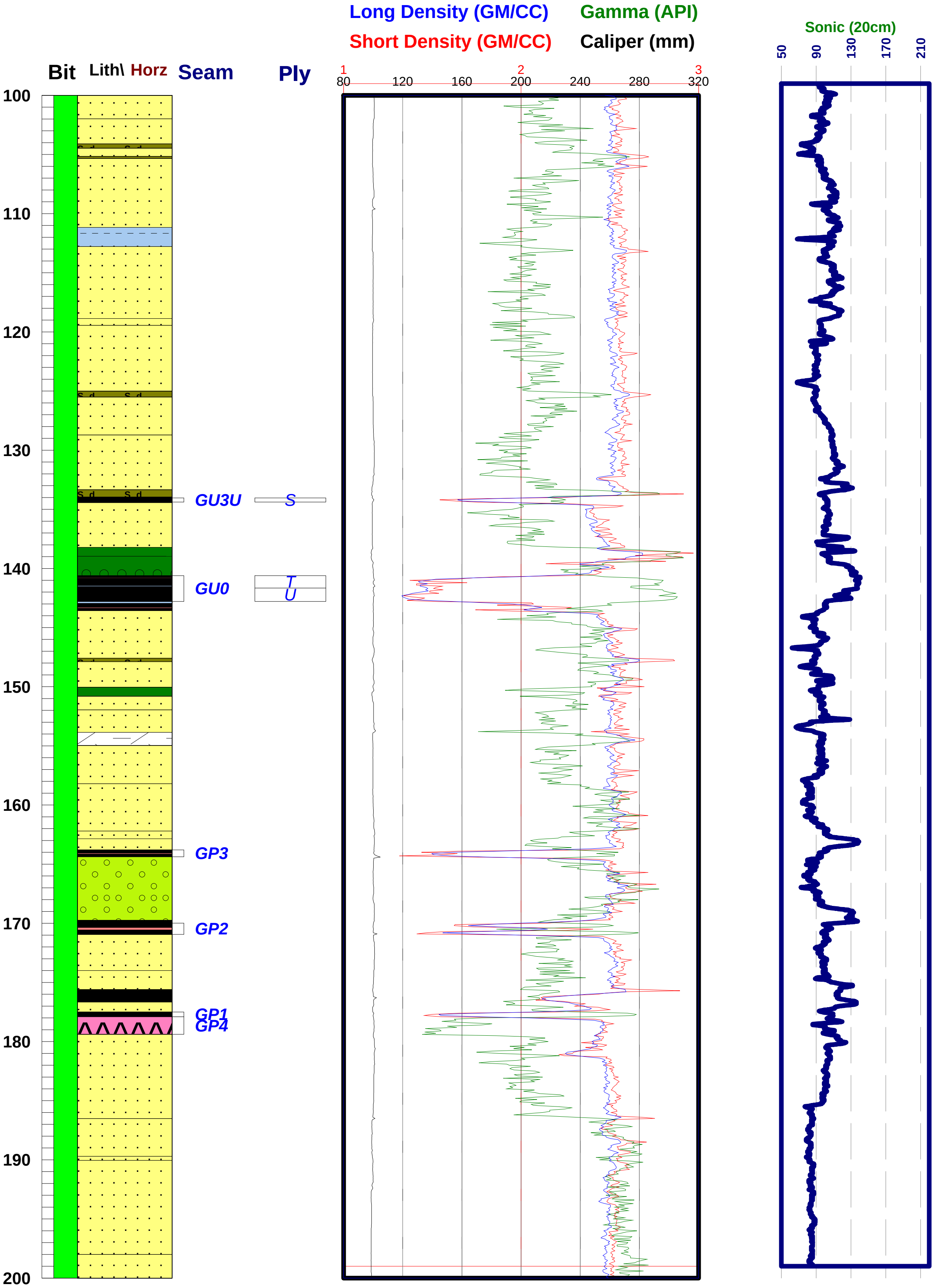
Goonyella

Lithological Log

DRILLHOLE : 114174

Easting :	603650.73 m	**Elevation :**	268.63 m
Northing :	7594386.97 m	**Final Depth :**	252.49 m

BHP Billiton Mitsubishi Alliance



Roller	
Blade	
Tungsten	
Diamond	
Hammer	
Polycrystalline	

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

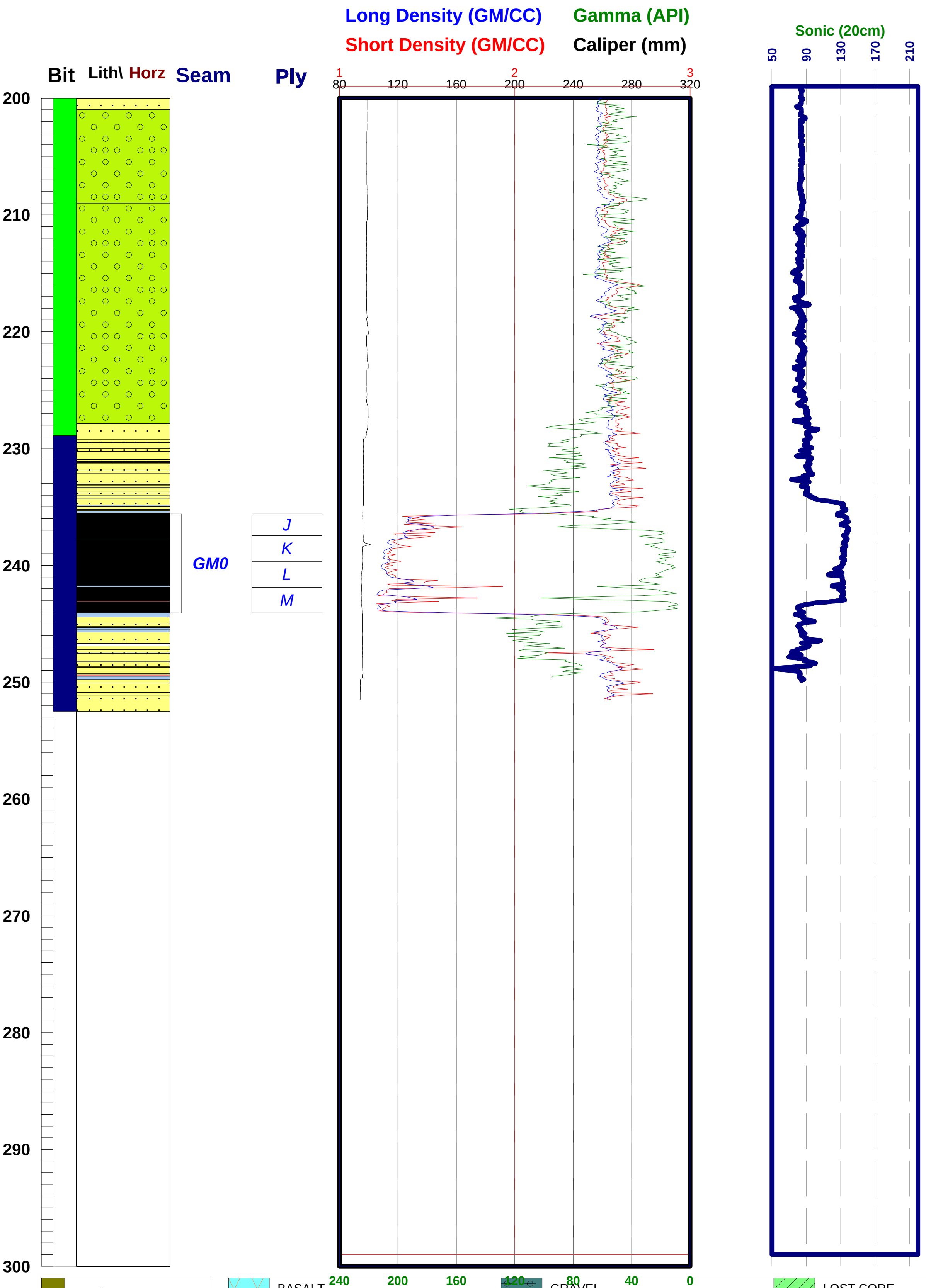
Lithological Log

DRILLHOLE : 114174

Easting : 603650.73 m **Elevation :** 268.63 m

Northing : 7594386.97 m **Final Depth :** 252.49 m

BMA
BHP Billiton Mitsubishi Alliance



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

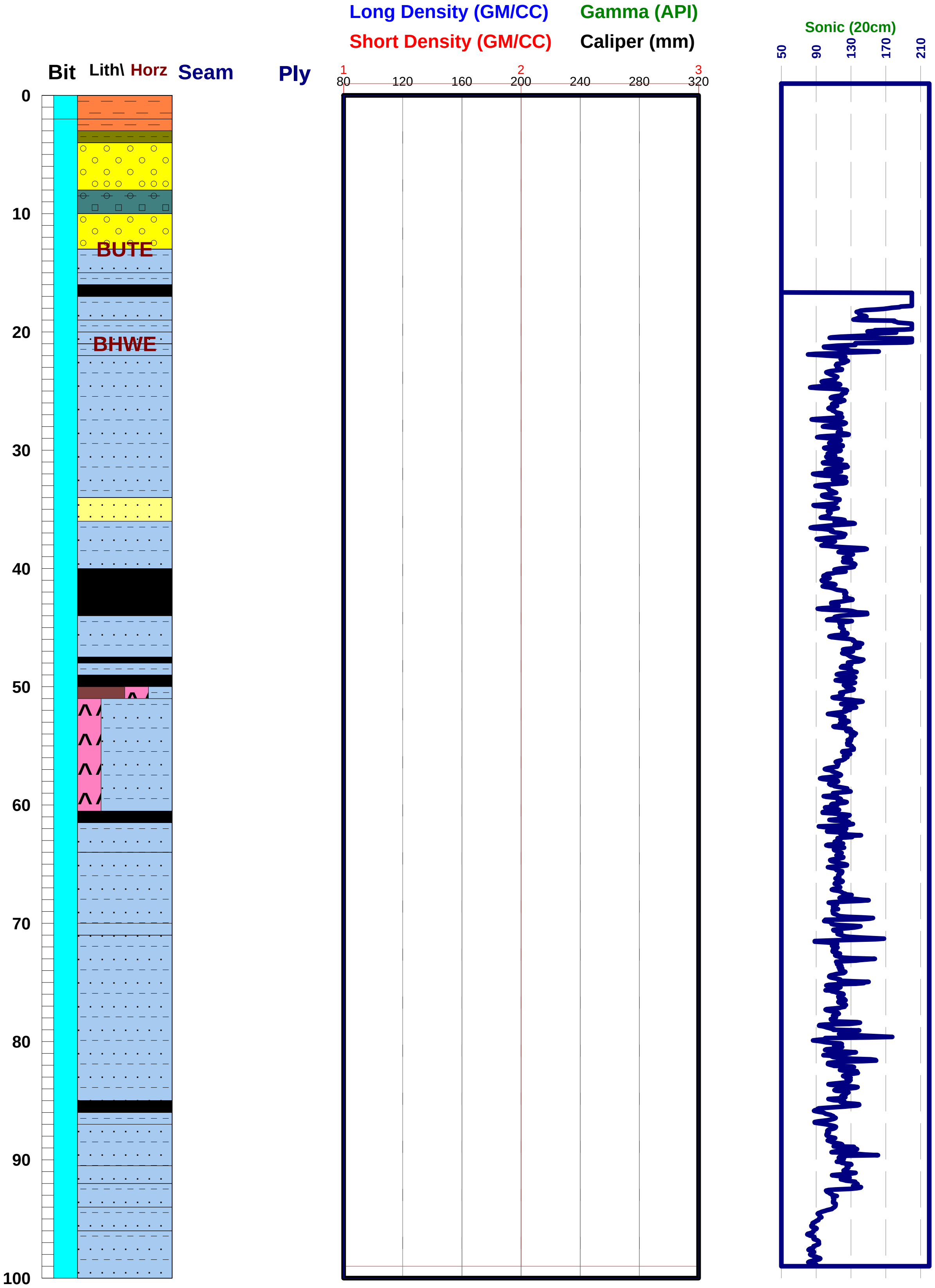
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 40247

Easting :	606499.21 m	Elevation :	259.14 m
Northing :	7594227.35 m	Final Depth :	480.00 m



	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

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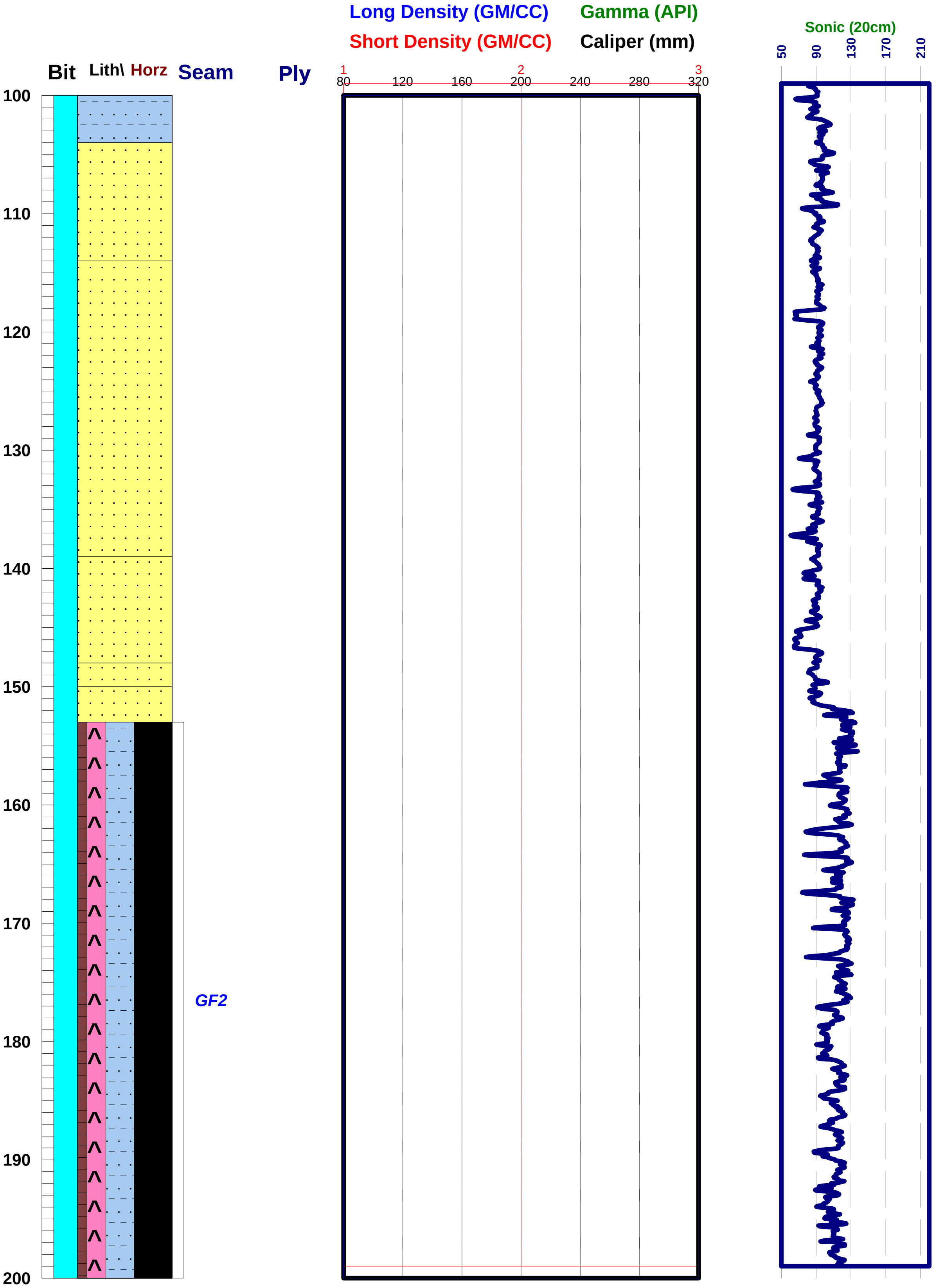
BHP Billiton Mitsubishi Alliance



Bit	
	Roller
	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

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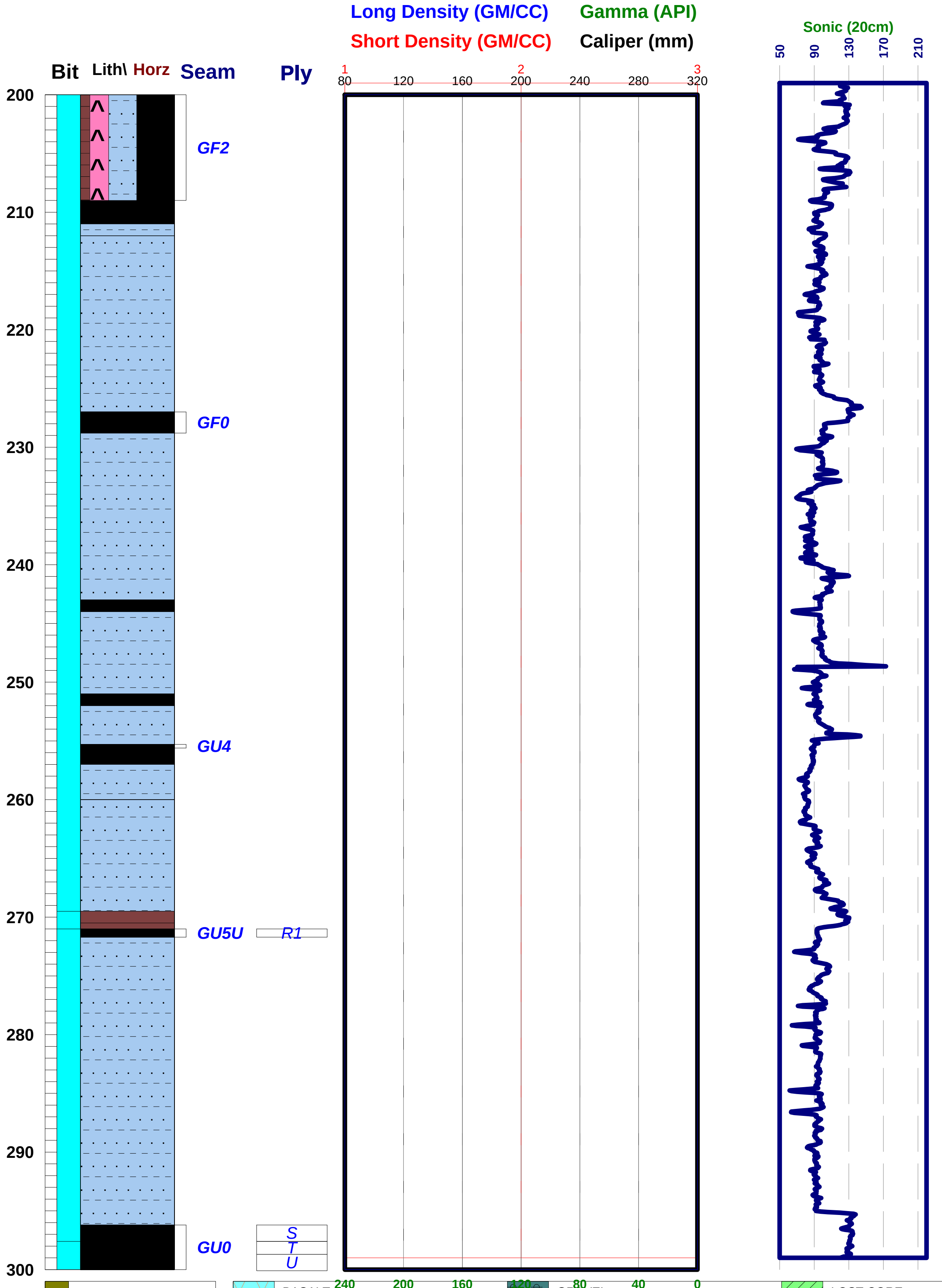
BHP Billiton Mitsubishi Alliance



Bit	
Roller	
Blade	
Tungsten	
Diamond	
Hammer	
Polycrystalline	

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
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Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

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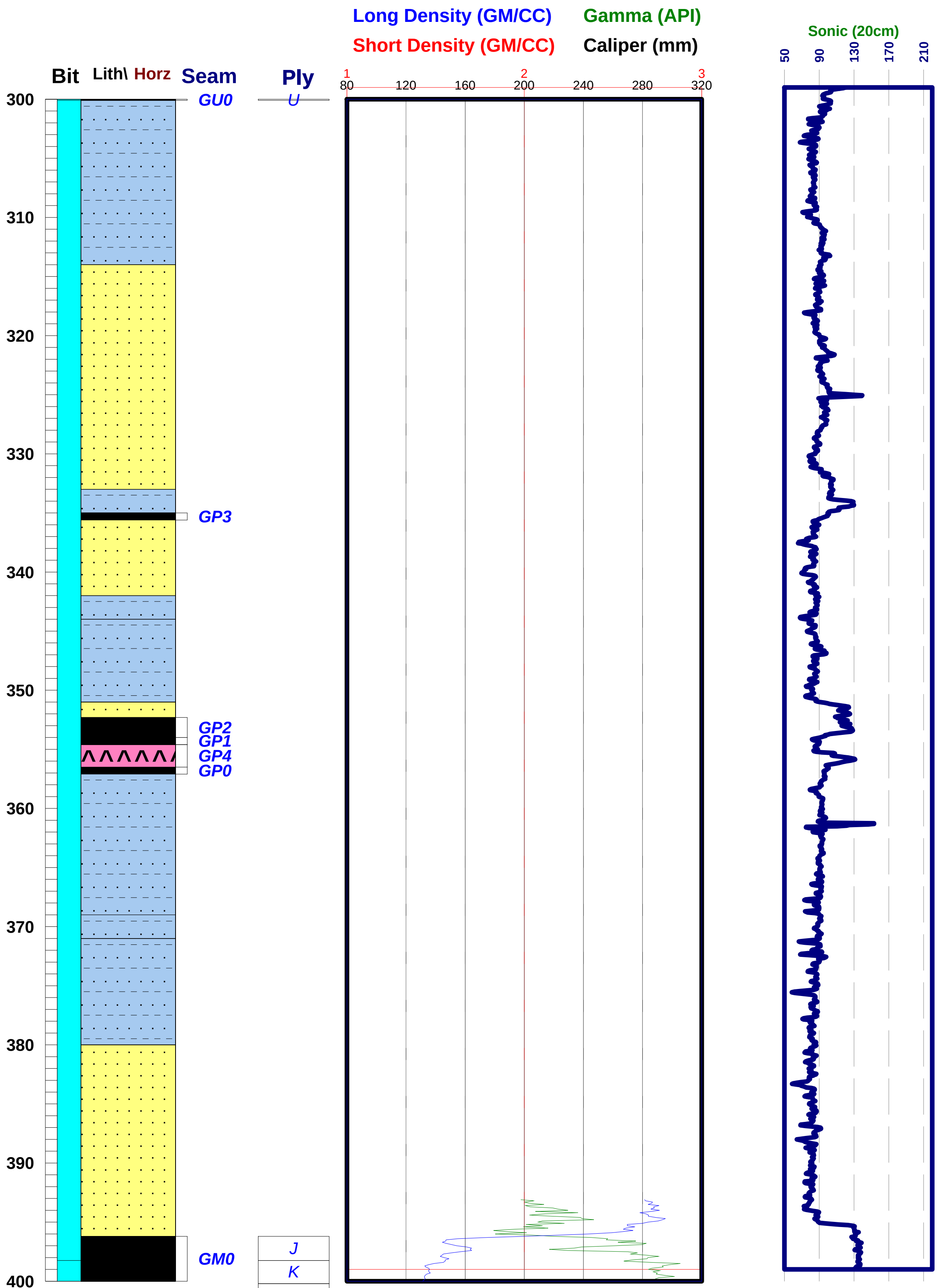

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	Tungsten		COAL		CARB SHALE		CALCITE
	Diamond		COAL Heat affected		SILTSTONE		CHERT
	Hammer		COAL WEATHERED		FINE SANDSTONE		TUFF
	Polycrystalline		CLAY		>MED SANDSTONE	P y	PYRITE
			SILT		CARB SANDSTONE	S d	SIDERITE
			CLAYEY SAND		CONGLOMERATE		ALLUVIAL
			SAND		SEDIMENTARY, undiff		

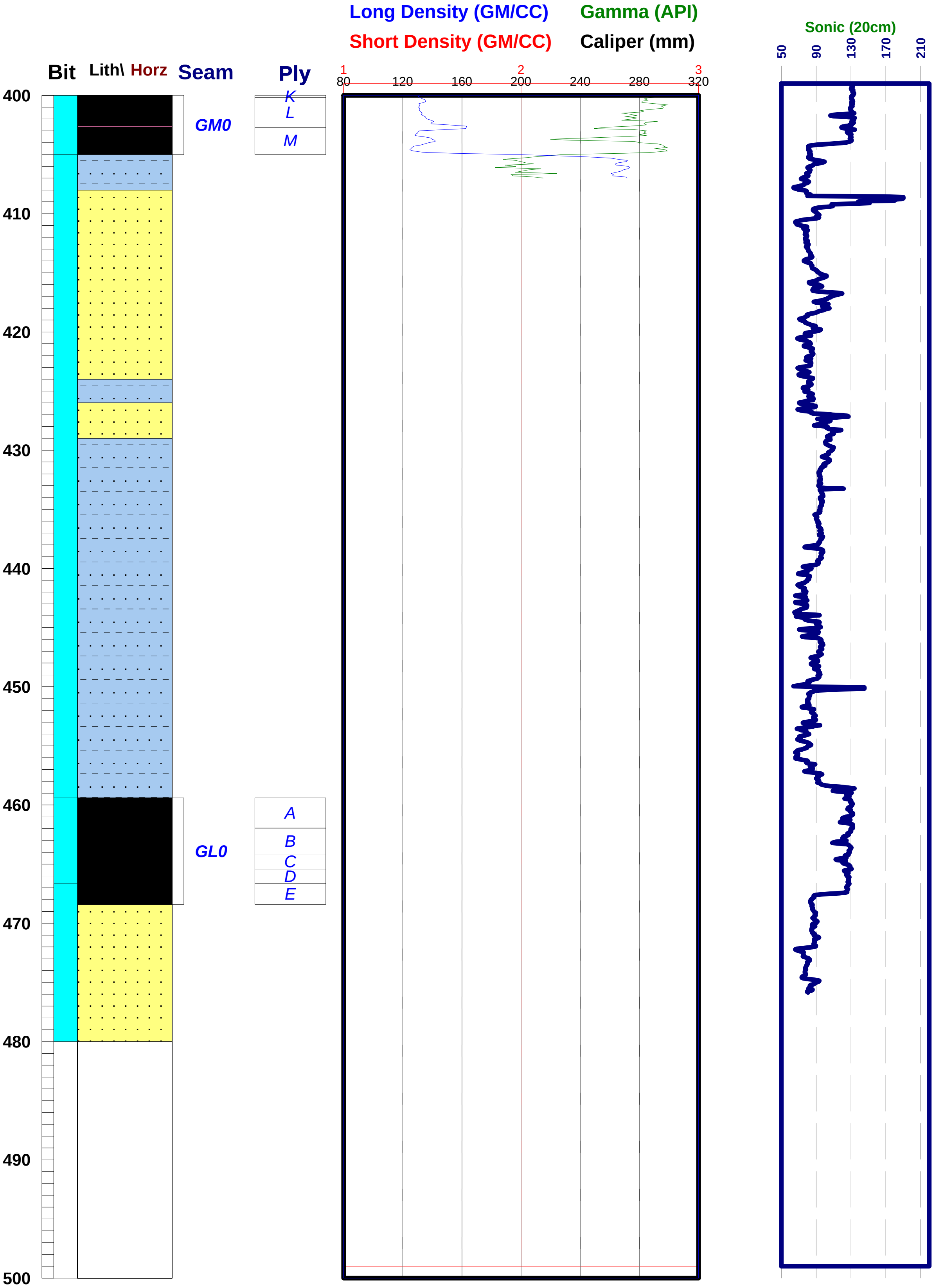
Goonyella

Lithological Log

DRILLHOLE : 40247

Easting :	606499.21 m	**Elevation :**	259.14 m
Northing :	7594227.35 m	**Final Depth :**	480.00 m

BHP Billiton Mitsubishi Alliance



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	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE		PYRITE
	SILT		CARB SANDSTONE		SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

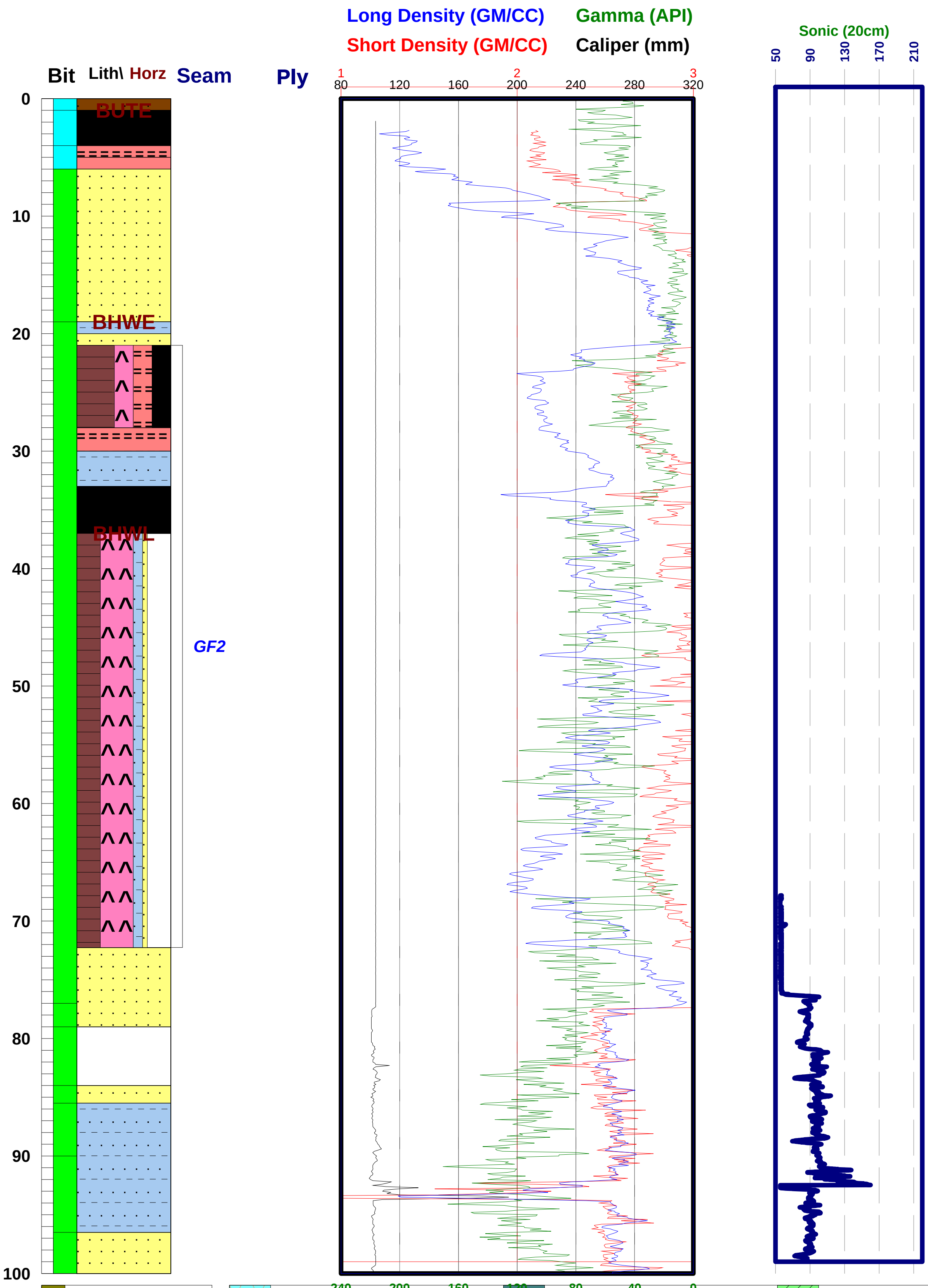
Goonyella

Lithological Log

DRILLHOLE : 43717

Easting : 604491.11 m
Northing : 7594505.54 m
Elevation : 258.49 m
Final Depth : 340.78 m

BHP Billiton Mitsubishi Alliance



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	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE	Py	PYRITE
	SILT		CARB SANDSTONE	Sd	SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

Goonyella

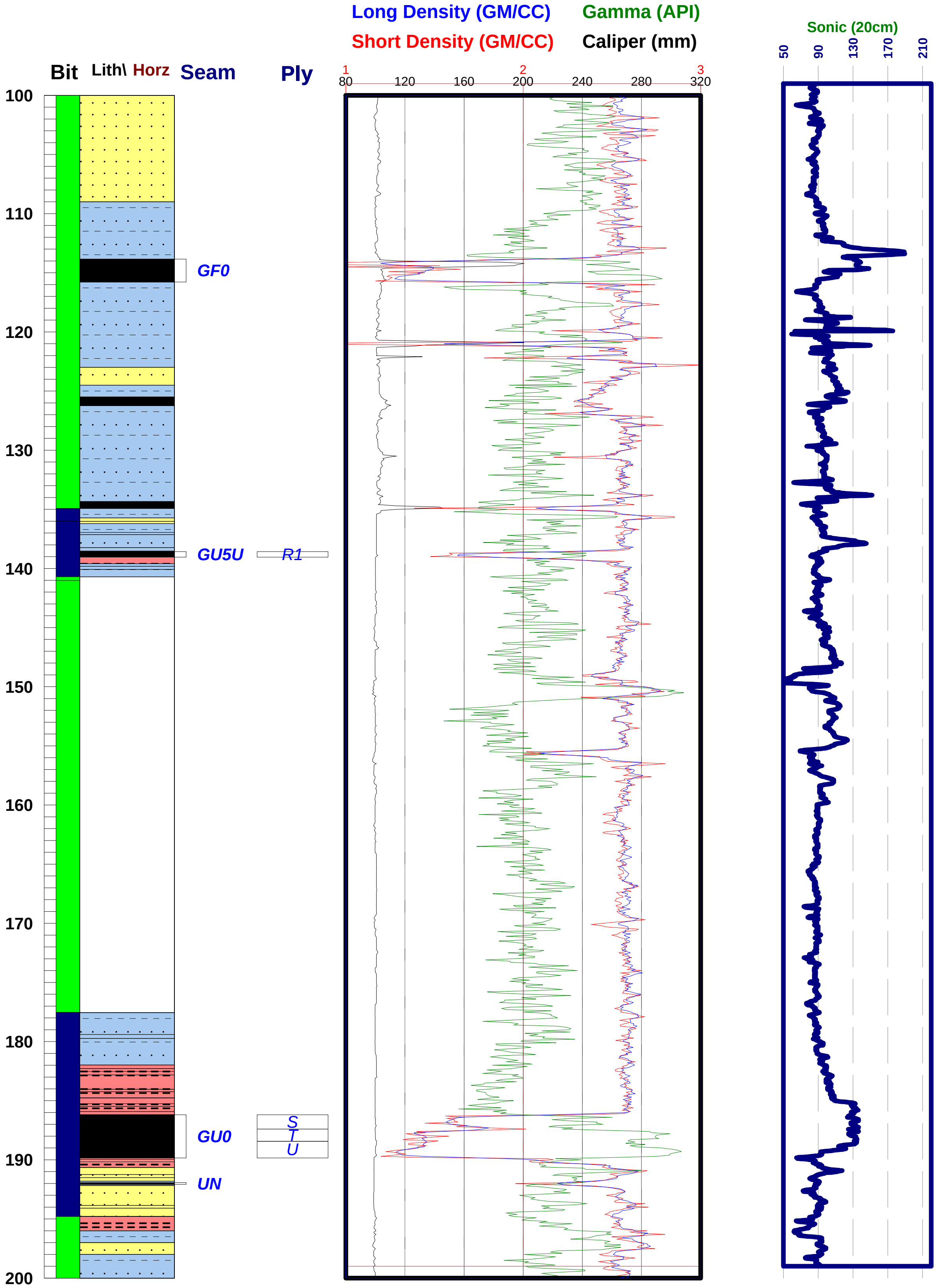
Lithological Log

DRILLHOLE : 43717

Easting : 604491.11 m **Elevation :** 258.49 m

Northing : 7594505.54 m **Final Depth :** 340.78 m

BHP Billiton Mitsubishi Alliance



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	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

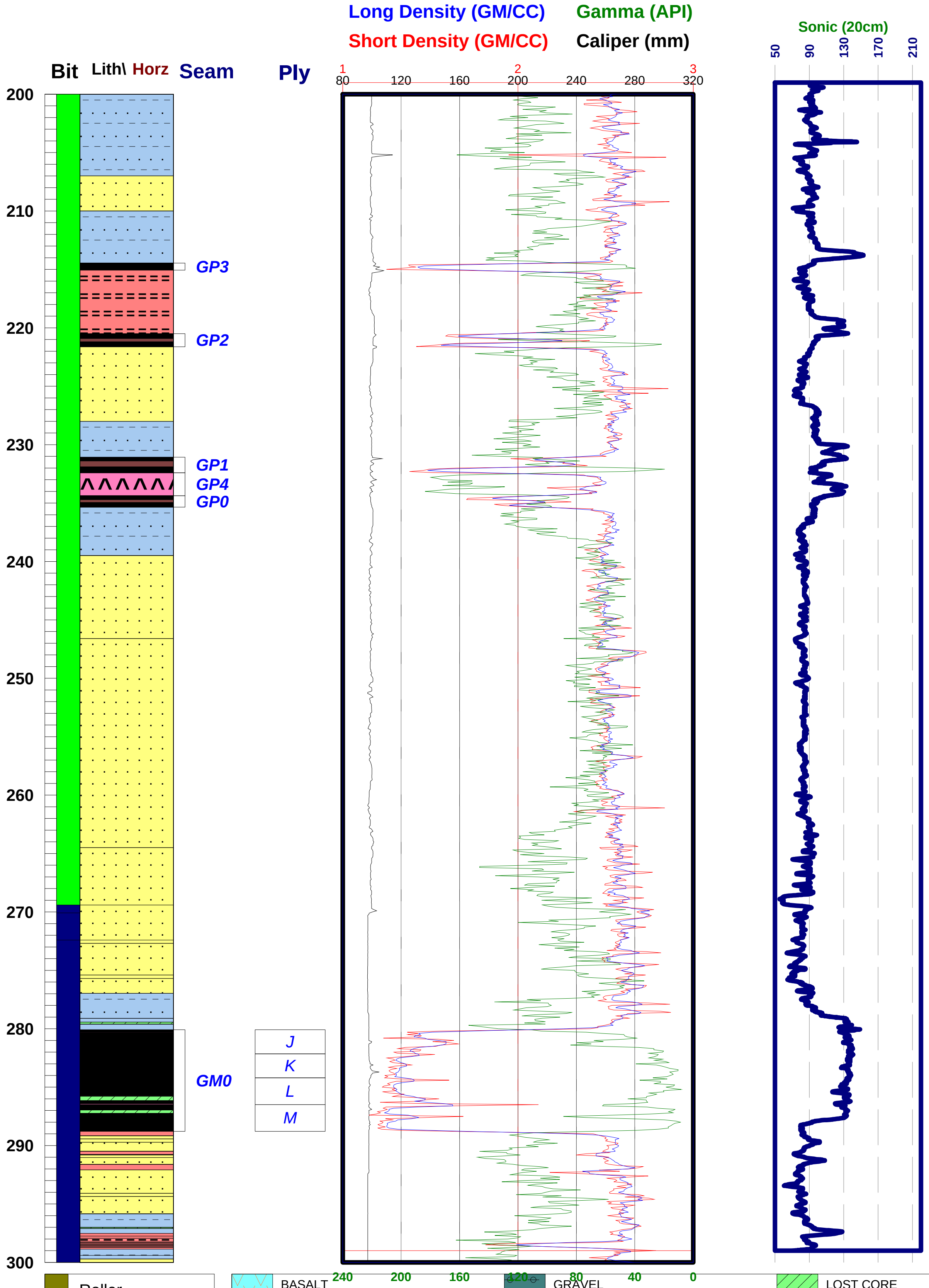
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 43717

Easting :	604491.11 m	**Elevation :**	258.49 m
Northing :	7594505.54 m	**Final Depth :**	340.78 m



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	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
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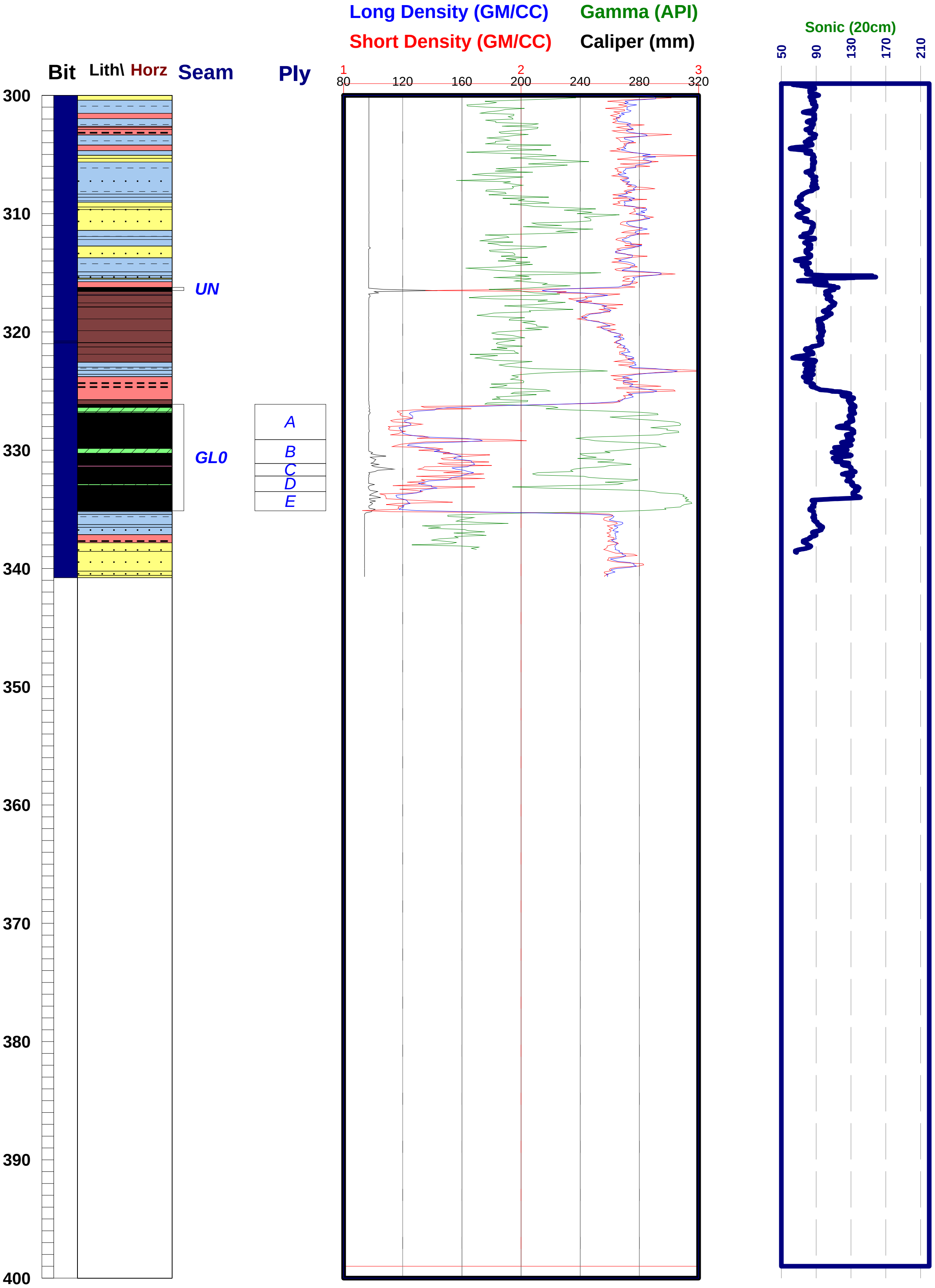
BHP Billiton Mitsubishi Alliance



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	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE		PYRITE
	SILT		CARB SANDSTONE		SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

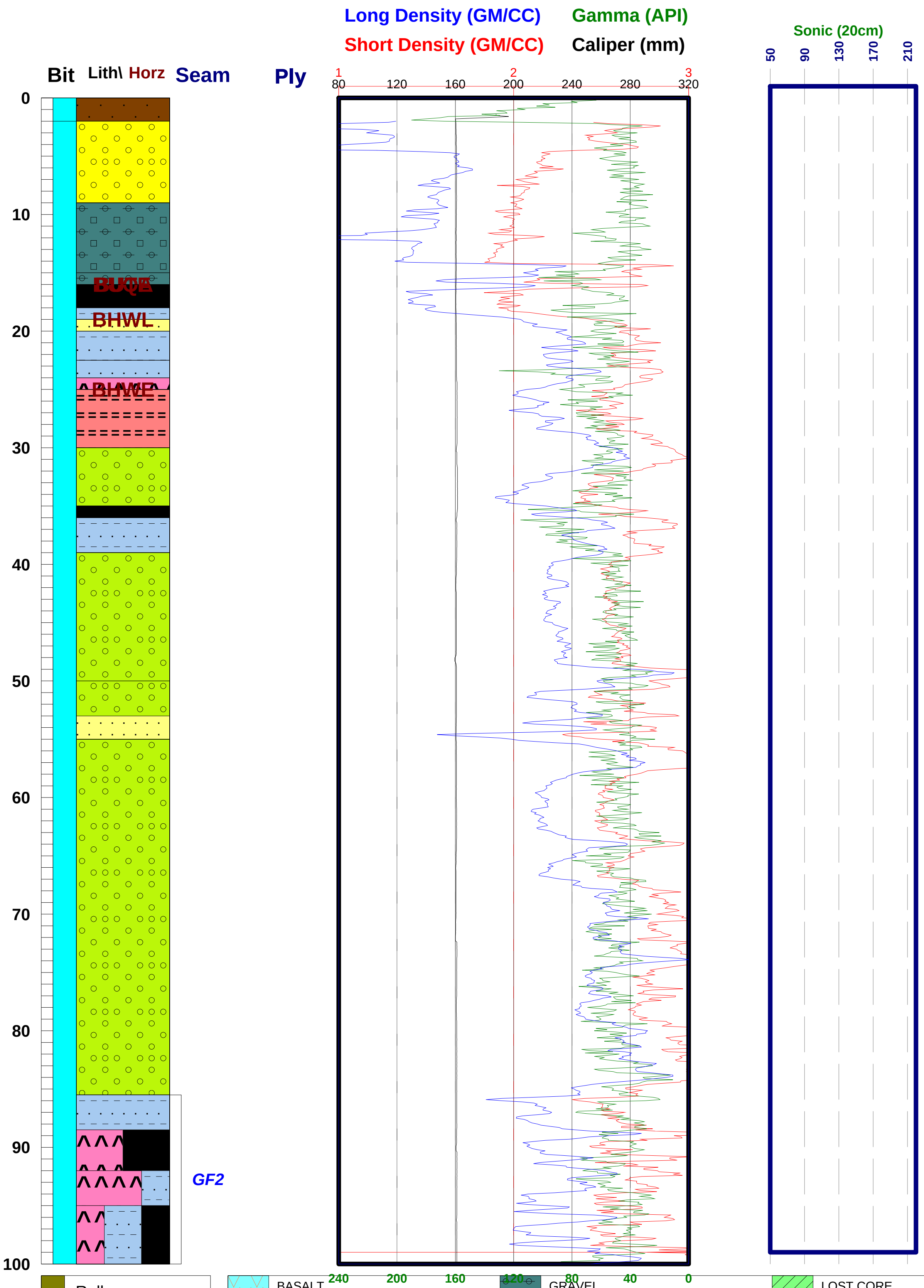
Goonyella

Lithological Log

DRILLHOLE : 43758

Easting :	605592.67 m	**Elevation :**	261.53 m
Northing :	7594454.72 m	**Final Depth :**	429.00 m

BMA
BHP Billiton Mitsubishi Alliance



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	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

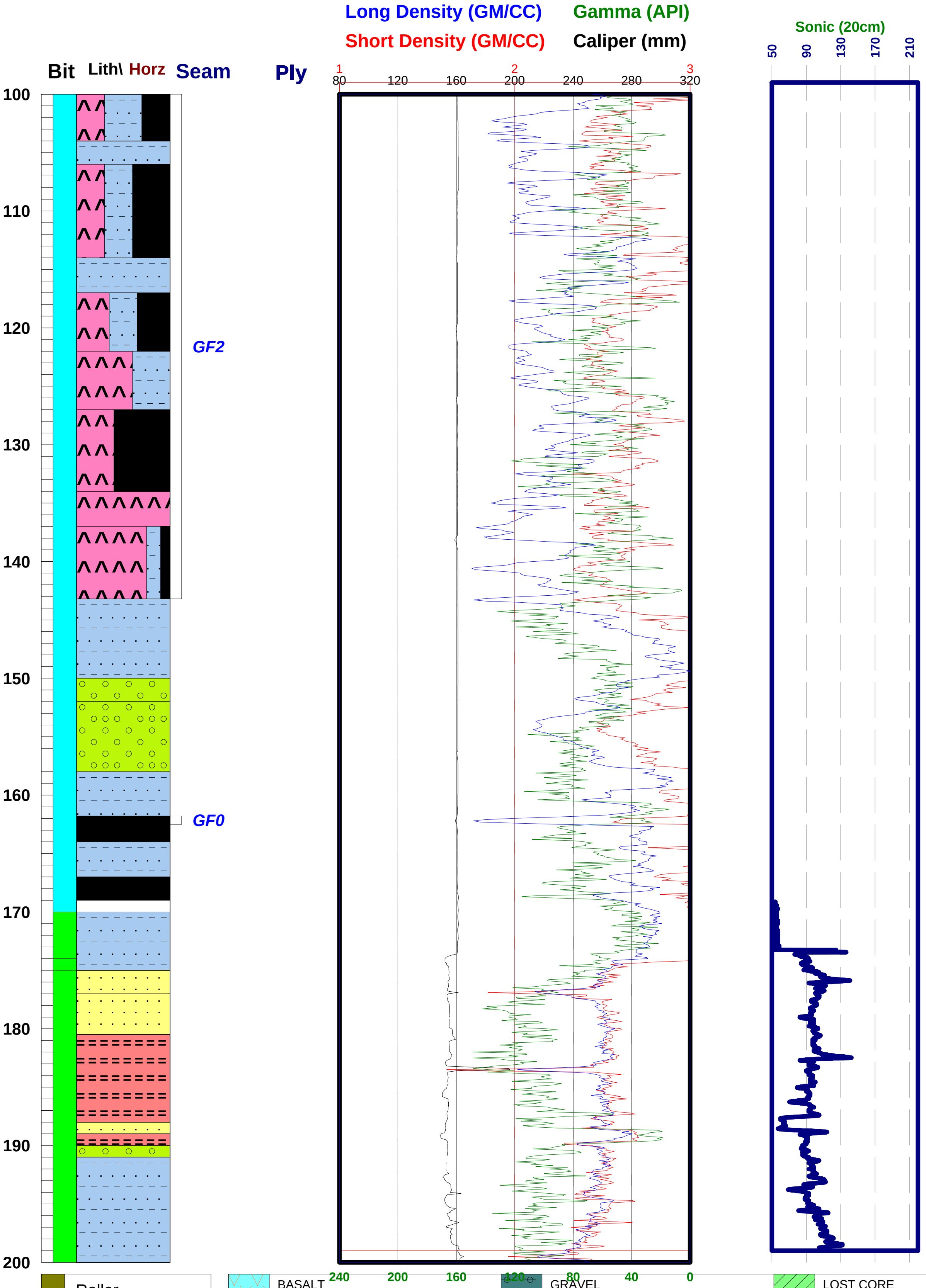
Goonyella

Lithological Log

DRILLHOLE : 43758

Easting : 605592.67 m
Northing : 7594454.72 m
Elevation : 261.53 m
Final Depth : 429.00 m

BHP Billiton Mitsubishi Alliance



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Tungsten		COAL		CARB SHALE		CALCITE	
Diamond		COAL Heat affected		SILTSTONE		CHERT	
Hammer		COAL WEATHERED		FINE SANDSTONE		TUFF	
Polycrystalline		CLAY		>MED SANDSTONE		PYRITE	
		SILT		CARB SANDSTONE		SIDERITE	
		CLAYEY SAND		CONGLOMERATE		ALLUVIAL	
		SAND		SEDIMENTARY, undiff			

R1

Goonyella

Lithological Log

DRILLHOLE : 43758

Easting :	605592.67 m	**Elevation :**	261.53 m
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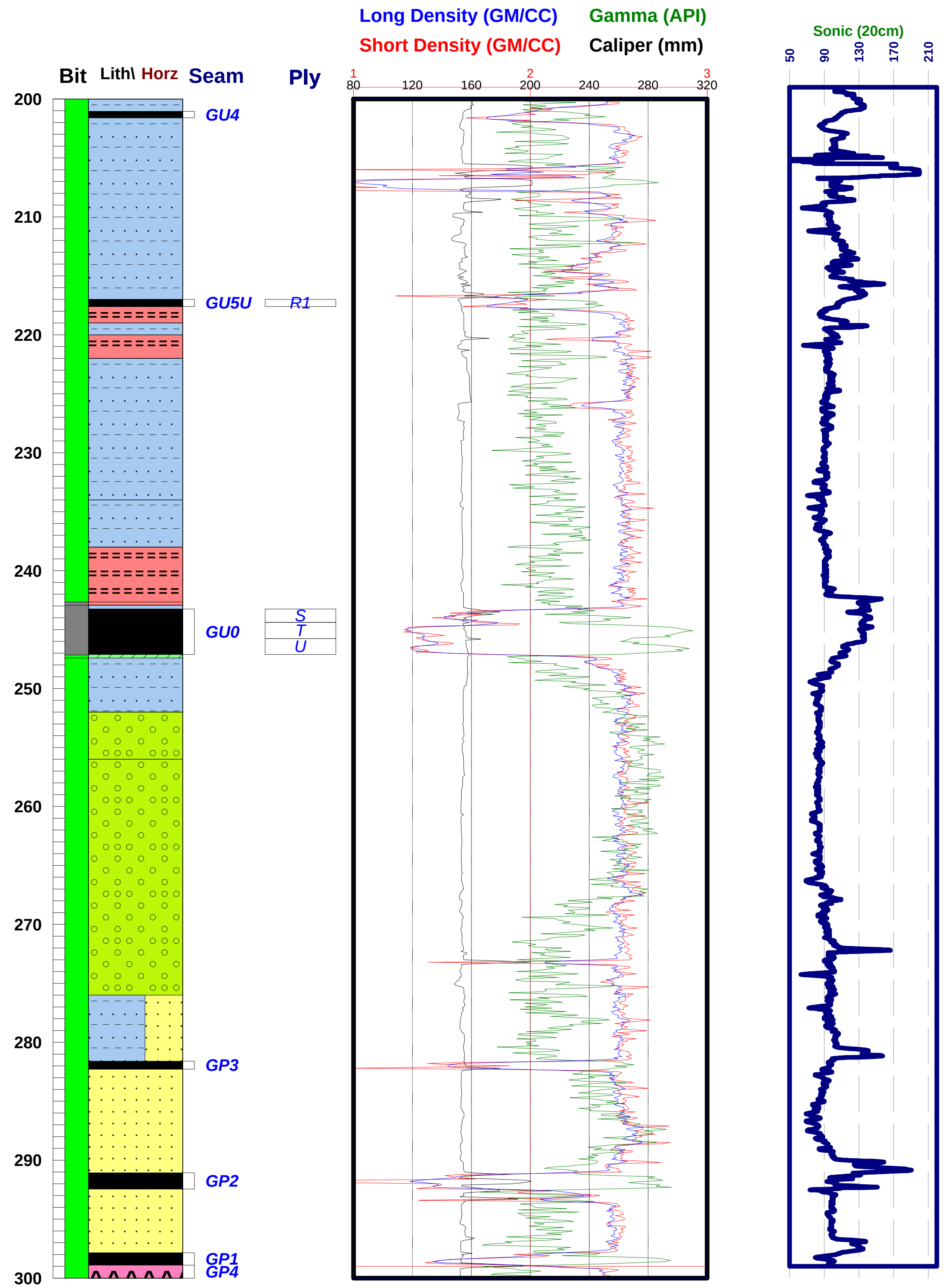
BHP Billiton Mitsubishi Alliance



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	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

Lithological Log

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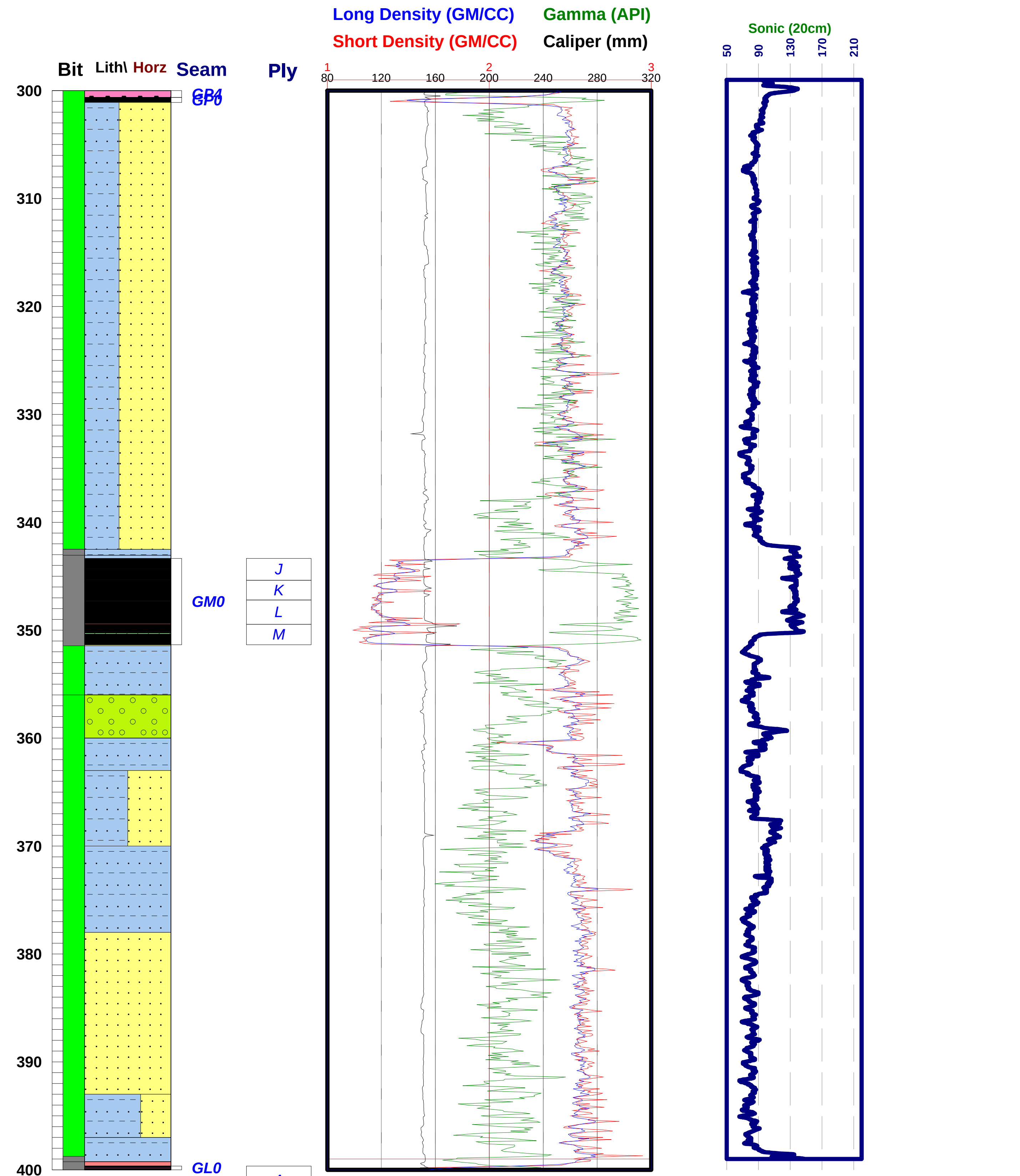
BHP Billiton Mitsubishi Alliance



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	Tungsten
	Diamond
	Hammer
	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

Goonyella

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DRILLHOLE : 43758

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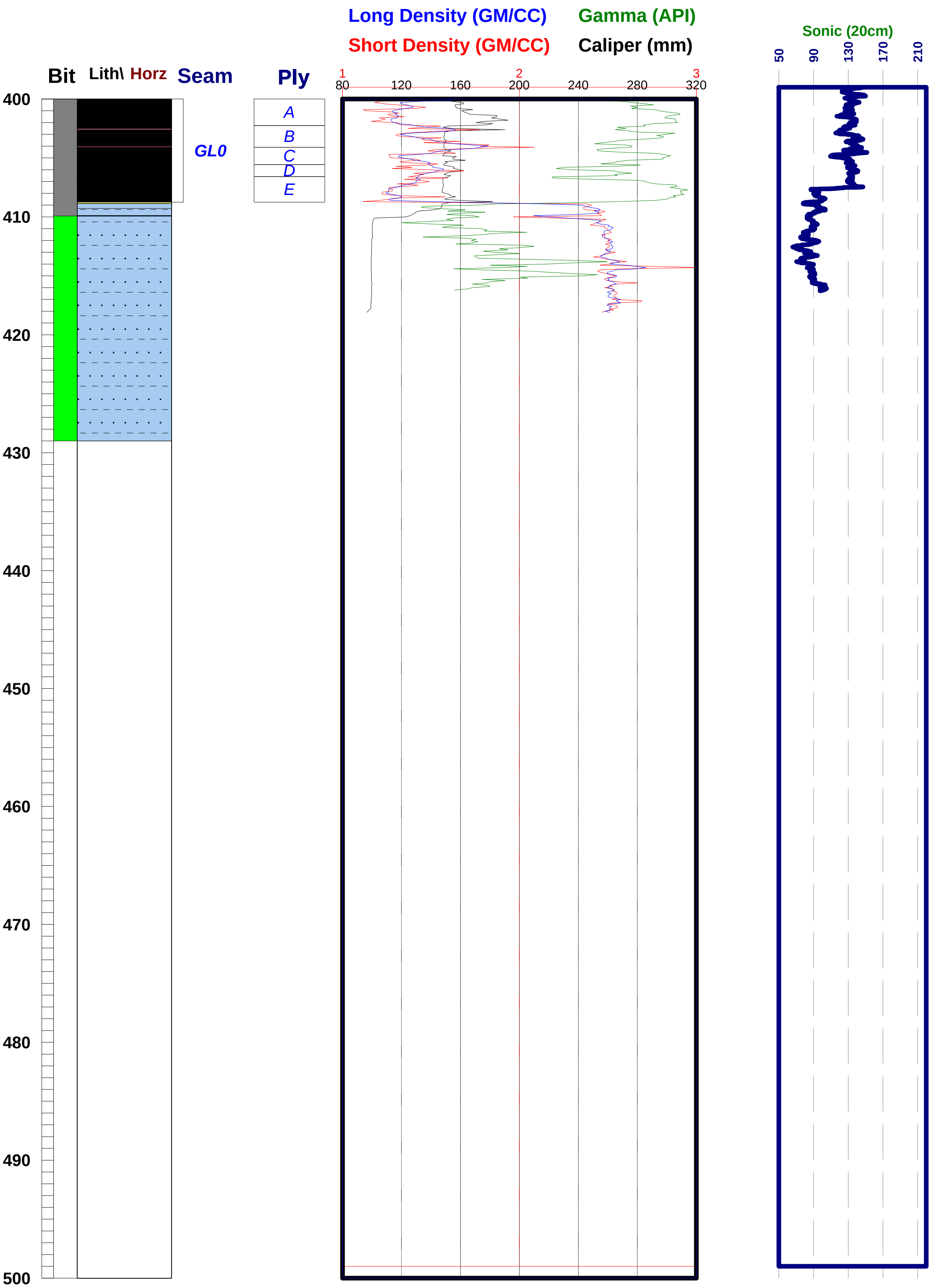

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Blade	IGNEOUS ROCK	SHALE	FAULT ZONE		
Tungsten	COAL	CARB SHALE	CALCITE		
Diamond	COAL Heat affected	SILTSTONE	CHERT		
Hammer	COAL WEATHERED	FINE SANDSTONE	TUFF		
Polycrystalline	CLAY	>MED SANDSTONE	PYRITE		
	SILT	CARB SANDSTONE	SIDERITE		
	CLAYEY SAND	CONGLOMERATE	ALLUVIAL		
	SAND	SEDIMENTARY, undiff			

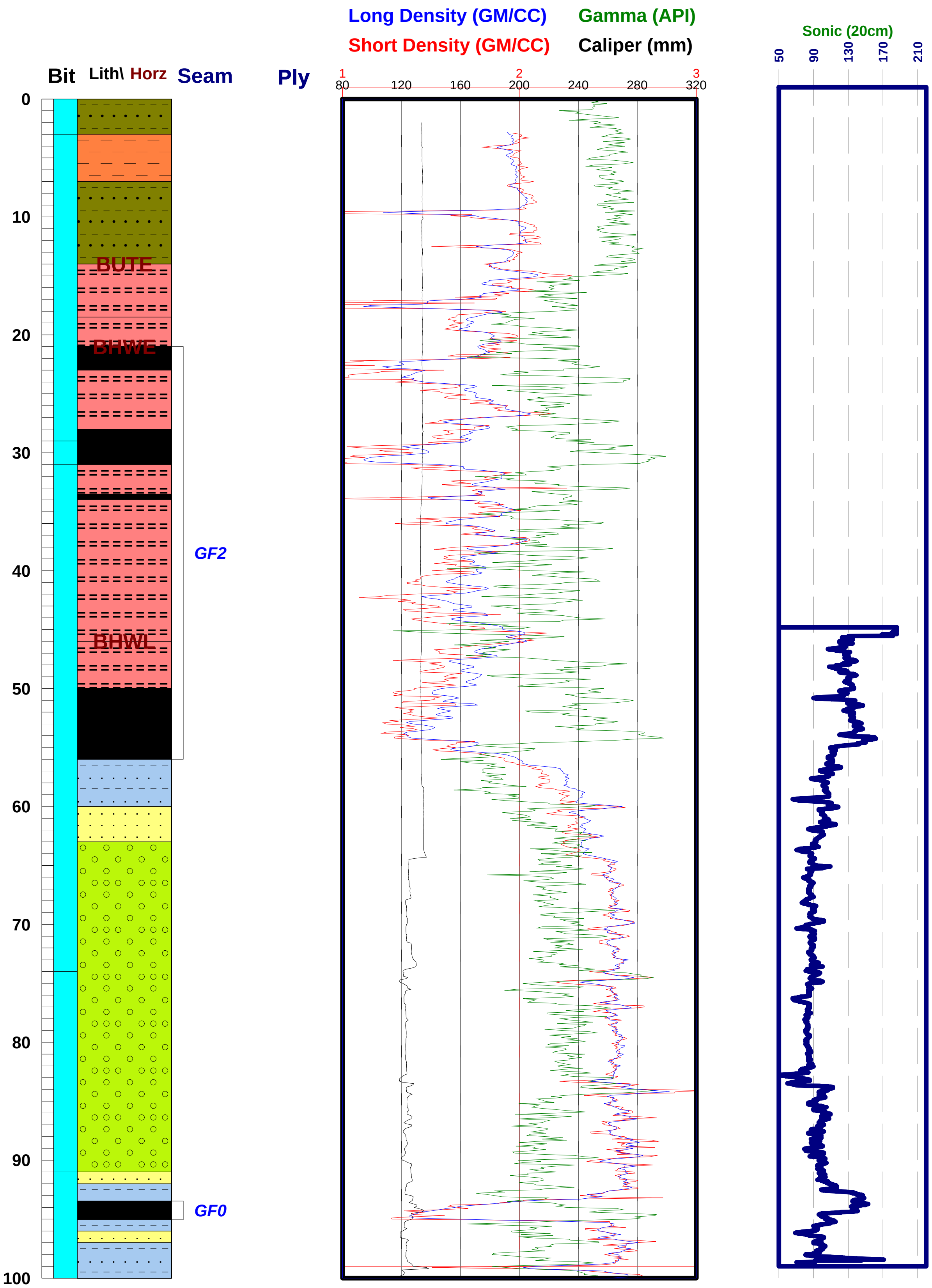
Goonyella

Lithological Log

DRILLHOLE : 45569

Easting :	603985.58 m	Elevation :	266.09 m
Northing :	7594357.39 m	Final Depth :	325.00 m

BHP Billiton Mitsubishi Alliance



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Blade	IGNEOUS ROCK	SHALE	FAULT ZONE		
Tungsten	COAL	CARB SHALE	CALCITE		
Diamond	COAL Heat affected	SILTSTONE	CHERT		
Hammer	COAL WEATHERED	FINE SANDSTONE	TUFF		
Polycrystalline	CLAY	>MED SANDSTONE	PYRITE		
	SILT	CARB SANDSTONE	SIDERITE		
	CLAYEY SAND	CONGLOMERATE	ALLUVIAL		
	SAND	SEDIMENTARY, undiff			

R1

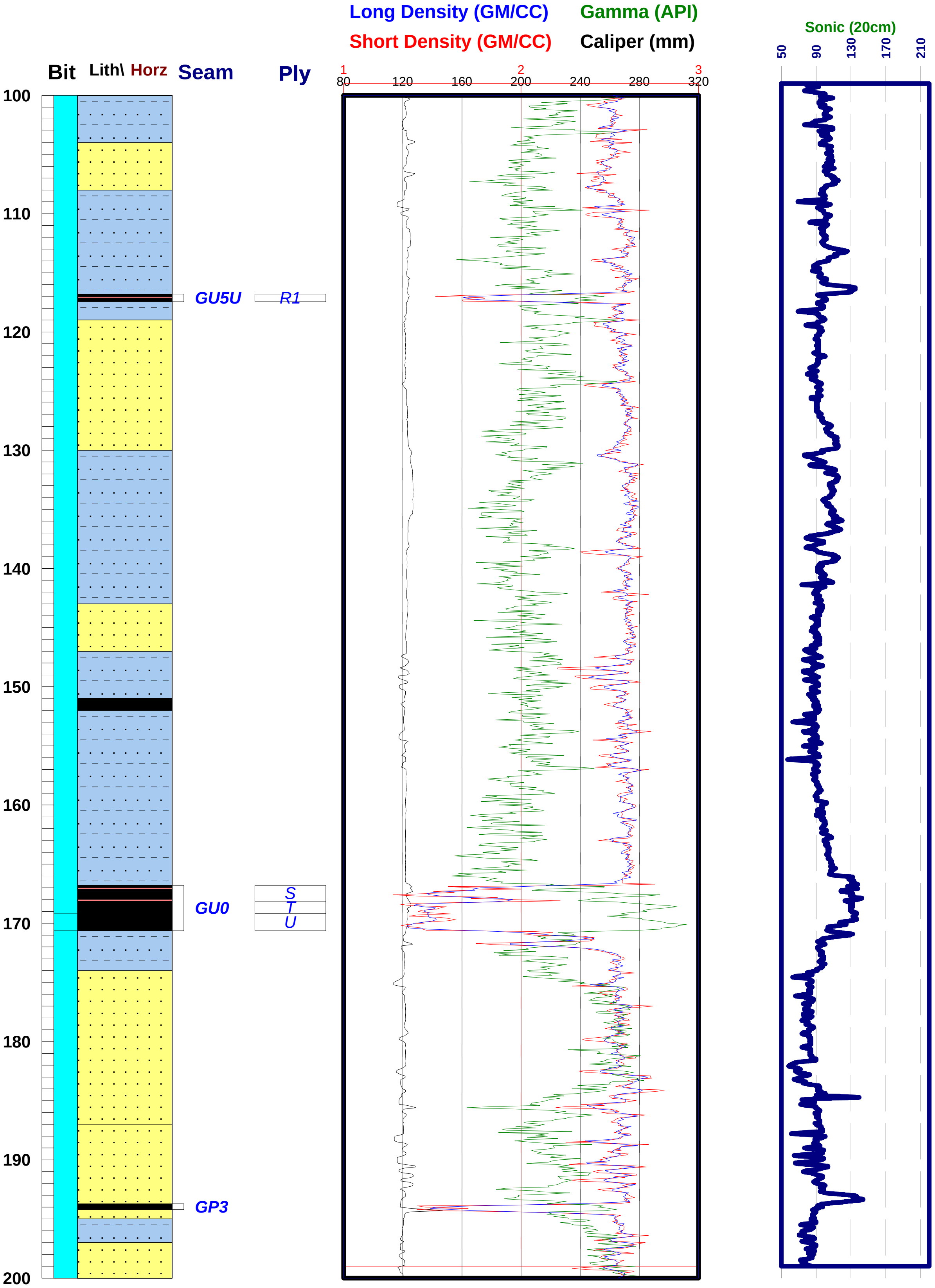
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 45569

Easting :	603985.58 m	**Elevation :**	266.09 m
Northing :	7594357.39 m	**Final Depth :**	325.00 m



	Roller
	Blade
	Tungsten
	Diamond
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	Polycrystalline

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
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SAND	SEDIMENTARY, undiff	

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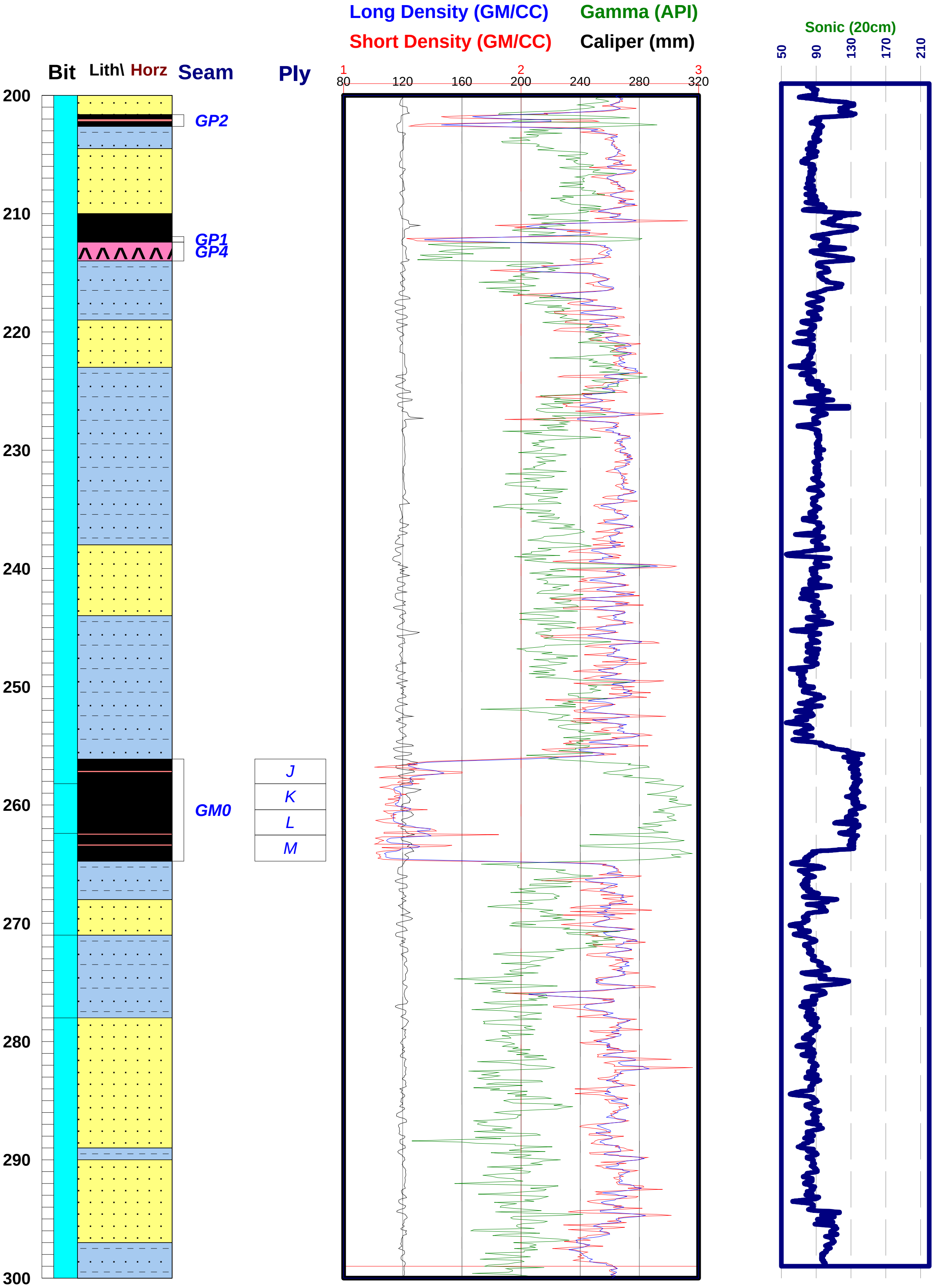

Roller	
Blade	
Tungsten	
Diamond	
Hammer	
Polycrystalline	

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

A B C D E

Goonyella

Lithological Log

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BHP Billiton Mitsubishi Alliance

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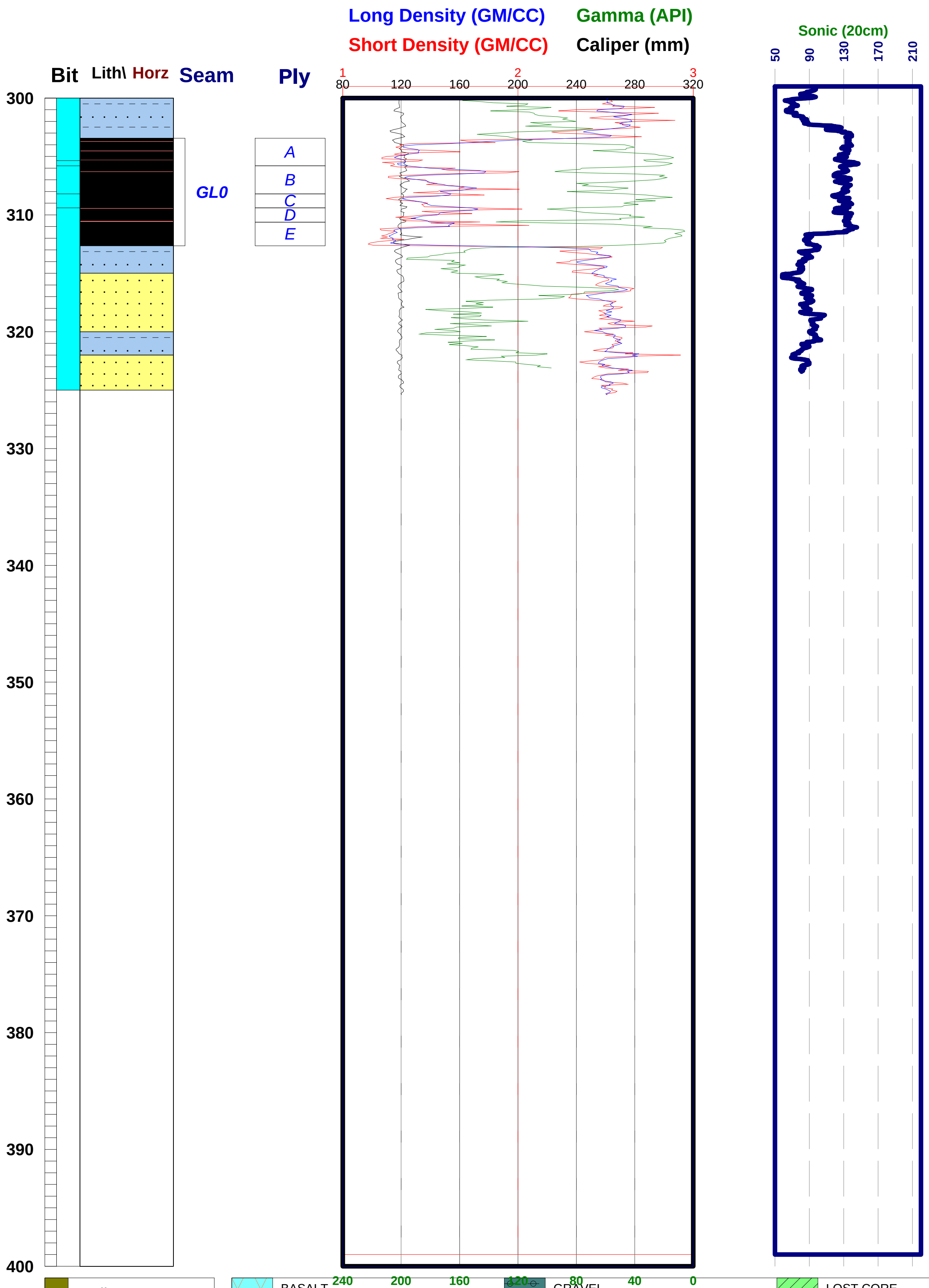

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	Blade
	Tungsten
	Diamond
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	Polycrystalline

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IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

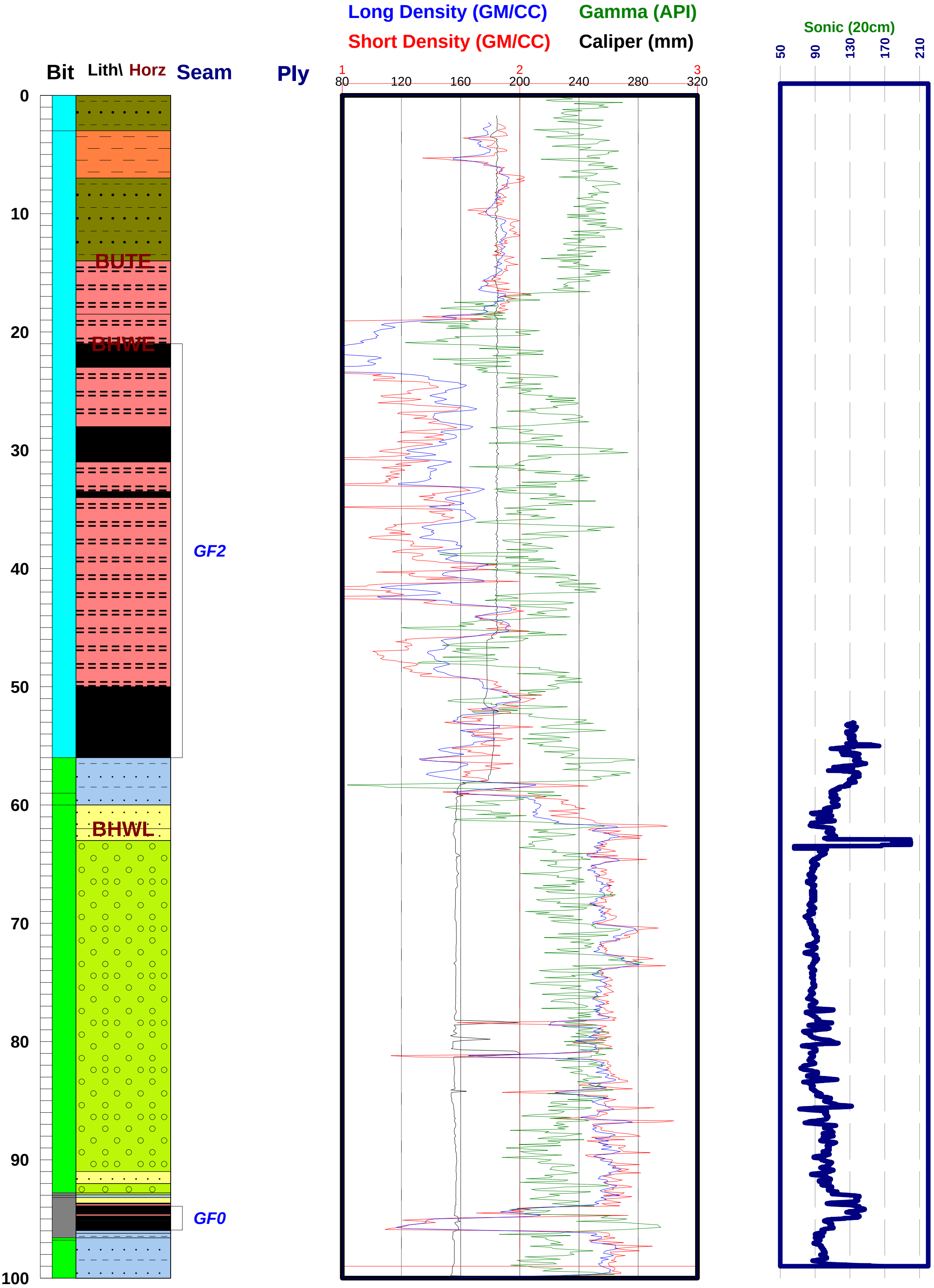
Goonyella

Lithological Log

BMA
BHP Billiton Mitsubishi Alliance

DRILLHOLE : 45586

Easting :	604008.80 m	**Elevation :**	265.92 m
Northing :	7594355.96 m	**Final Depth :**	325.00 m



Bit	
Roller	
Blade	
Tungsten	
Diamond	
Hammer	
Polycrystalline	

BASALT	GRAVEL	LOST CORE
IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
SAND	SEDIMENTARY, undiff	

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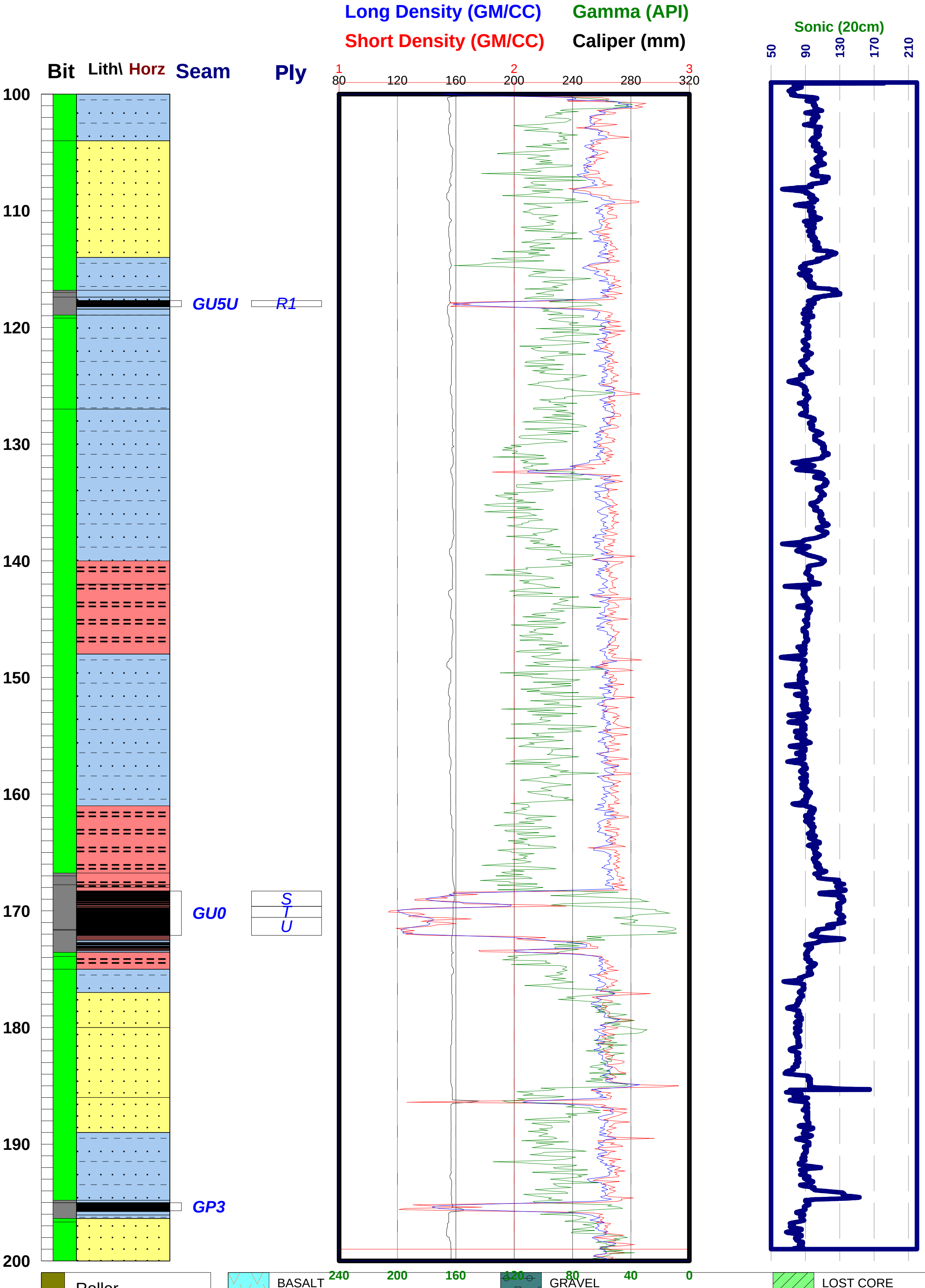
Goonyella

Lithological Log

DRILLHOLE : 45586

Easting :	604008.80 m	Elevation :	265.92 m
Northing :	7594355.96 m	Final Depth :	325.00 m

BHP Billiton Mitsubishi Alliance



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	Tungsten
	Diamond
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IGNEOUS ROCK	SHALE	FAULT ZONE
COAL	CARB SHALE	CALCITE
COAL Heat affected	SILTSTONE	CHERT
COAL WEATHERED	FINE SANDSTONE	TUFF
CLAY	>MED SANDSTONE	PYRITE
SILT	CARB SANDSTONE	SIDERITE
CLAYEY SAND	CONGLOMERATE	ALLUVIAL
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Goonyella

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BMA
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DRILLHOLE : 45586

Easting :	604008.80 m	Elevation :	265.92 m
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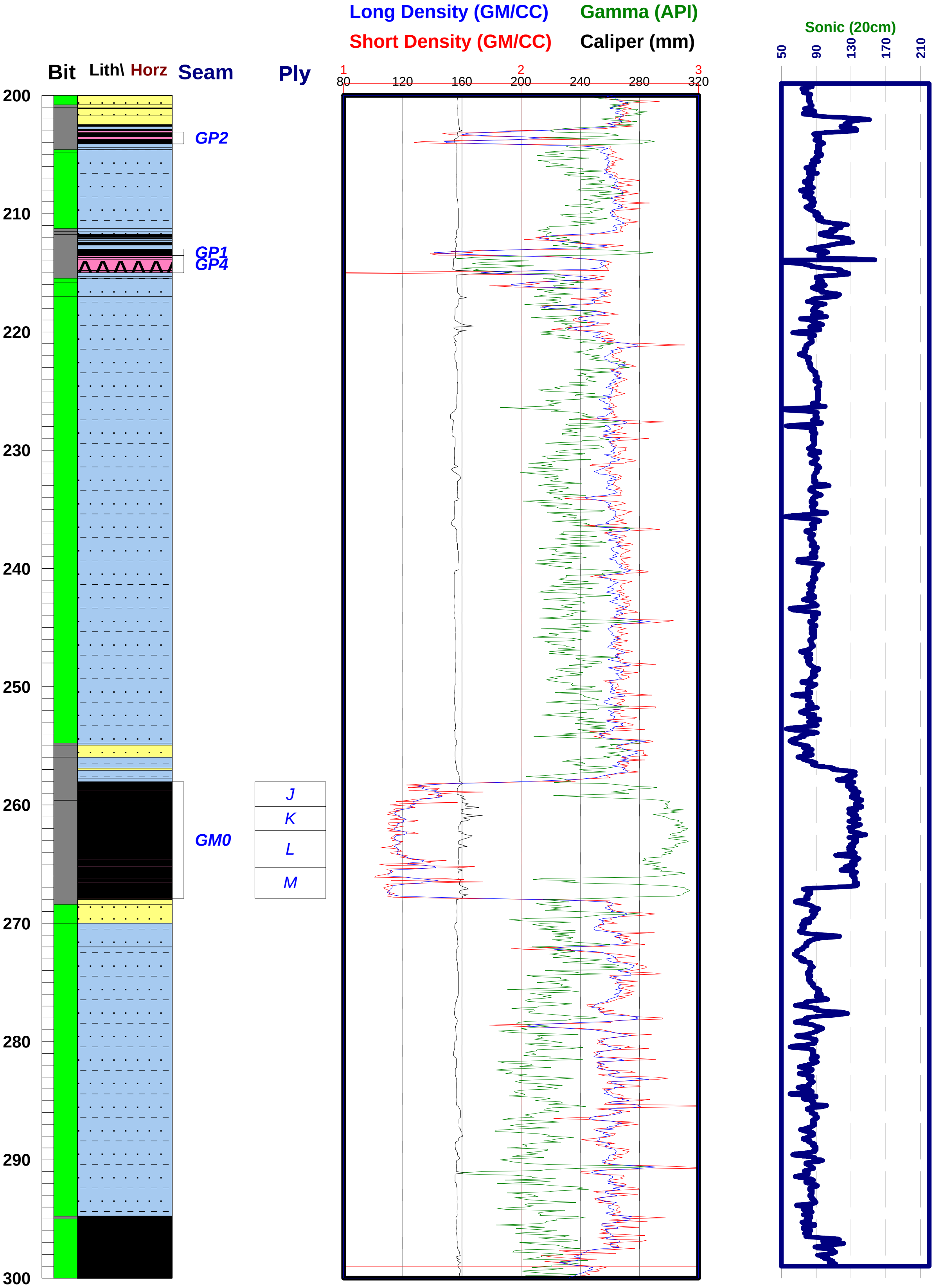

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	Blade
	Tungsten
	Diamond
	Hammer
	Polycrystalline

	BASALT		GRAVEL		LOST CORE
	IGNEOUS ROCK		SHALE		FAULT ZONE
	COAL		CARB SHALE		CALCITE
	COAL Heat affected		SILTSTONE		CHERT
	COAL WEATHERED		FINE SANDSTONE		TUFF
	CLAY		>MED SANDSTONE	Py	PYRITE
	SILT		CARB SANDSTONE	Sd	SIDERITE
	CLAYEY SAND		CONGLOMERATE		ALLUVIAL
	SAND		SEDIMENTARY, undiff		

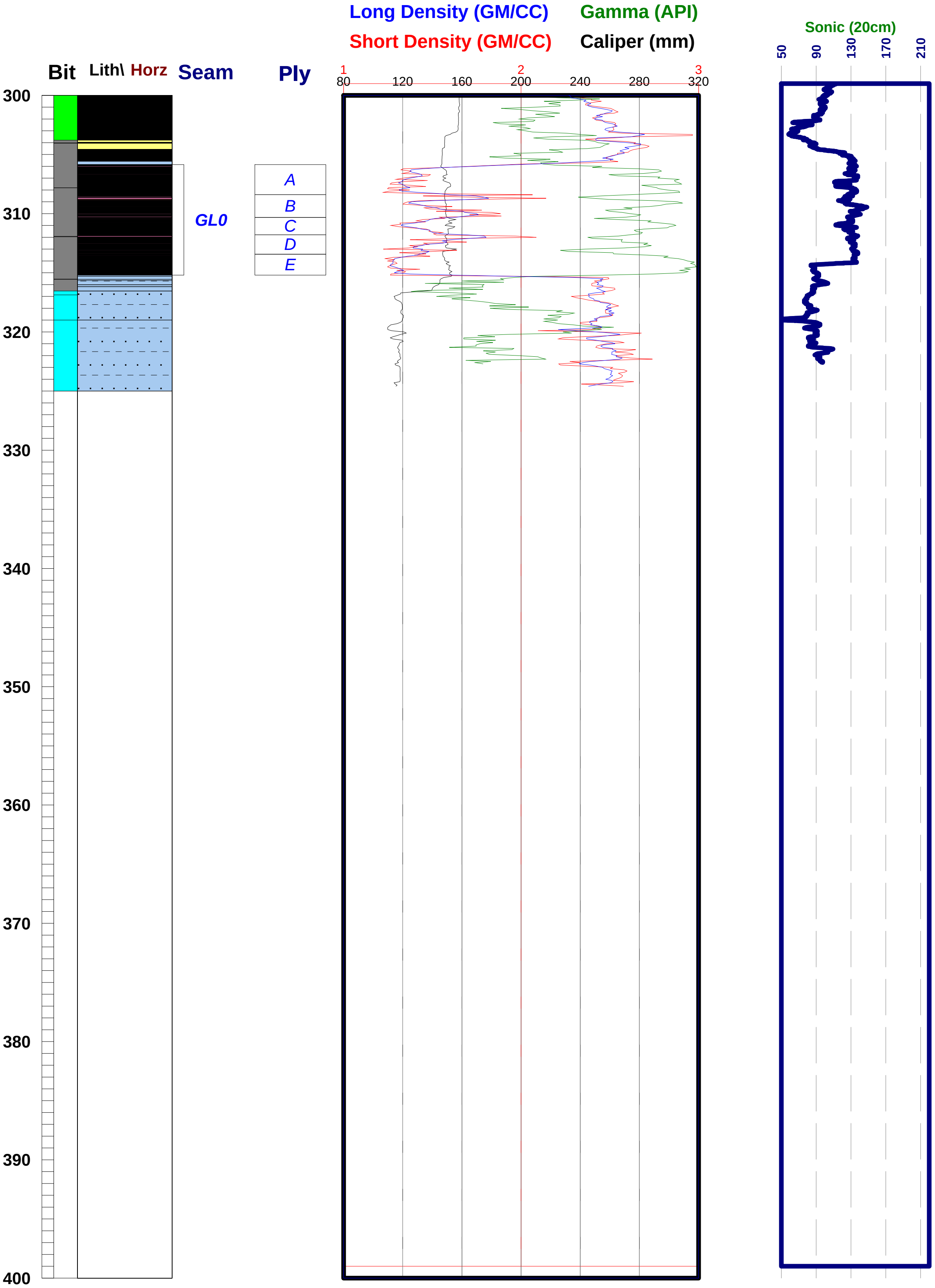
Goonyella

Lithological Log

DRILLHOLE : 45586

Easting : 604008.80 m
Northing : 7594355.96 m
Elevation : 265.92 m
Final Depth : 325.00 m

BHP Billiton Mitsubishi Alliance



Roller	BASALT	GRAVEL	LOST CORE		
Blade	IGNEOUS ROCK	SHALE	FAULT ZONE		
Tungsten	COAL	CARB SHALE	CALCITE		
Diamond	COAL Heat affected	SILTSTONE	CHERT		
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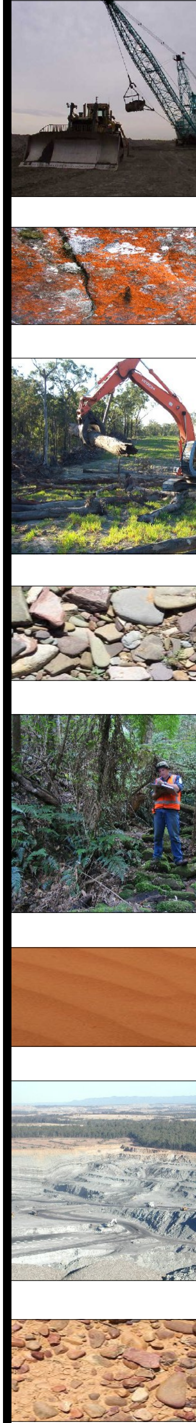
	SILT	CARB SANDSTONE	SIDERITE		
	CLAYEY SAND	CONGLOMERATE	ALLUVIAL		
	SAND	SEDIMENTARY, undiff			

Appendix F Appendices to the Soil and Land Suitability Assessment



GLOSSARY

APPENDIX 1

GLOSSARY

Term	Definition
Acidity	A property expressed by the pH value when this is below 7.0 in a soil/water suspension.
Aggregate	A unit of soil structure usually formed by natural processes in contrast with natural processes, and generally <10mm in diameter.
Alkalinity	A property expressed by the pH value when this exceeds 7.0 in a soil/water suspension.
Andesite	Very fine crystalline extrusive rock of volcanic origins composed largely of plagioclase feldspar with smaller amounts of dark collared minerals.
Availability	Refers to the ease with which plants can absorb a particular nutrient form the soil.
Available Water Capacity	The amount of water in the soil, generally available to plants, that can be held between field capacity and the moisture content at which plant growth ceases. Sometimes also known as the *Plant Available Water Capacity*.
Cation	An element with a positive charge.
Cation Exchange	Process whereby cations interchange between the soil solution and the clay or organic matter complexes in the soil.
Cation Exchange Capacity	The total amount of exchangeable cations that a soil can adsorb, expressed in centimoles of positive charge per kilogram of soil.
Clay	A soil separate consisting of particles <0.002mm in equivalent diameter.
Crumb	A soft, porous, more or less rounded soil aggregate 1mm to 5mm in diameter.
Consistence Force	The strength of cohesion and adhesion in the soil.
Deflocculated	The process by which masses of colloidal, or very fine, clay particles or ‘flocs’ separate in water into their constituent particles, which go into suspension. It depends on the balance between exchangeable cations on the clay and in solution, and on the overall ionic strength of the solution. Clays high in sodium deflocculate readily. The antonym is flocculation.
Electrical Conductivity	A measure of the conduction of electricity through water or a water extract of soil. It can be used to determine the soluble salts in the extract and hence soil salinity. The unit of electrical conductivity is the Siemens and soil salinity is normally expressed as decisiemens per meter at 25 °C (dS/m).
Emerson Aggregate Test	A classification of soil aggregates based on their coherence in water.
Exchangeable Cation	A positively charged ion held on or near the surface of a solid particle by a negative surface charge of a colloid and which may be replaced by other positively charged ions in the soil solution.
Exchangeable Sodium Percentage	Exchangeable sodium fraction expressed as a percentage.
Field Texture Grade	Field texture is a measure of the behaviour of a small handful of soil when moistened and kneaded into a ball and then passed out between thumb and forefinger. The recommended field texture grades are characterized by the behaviour of the moist bolus.
Field Colour	The colour of soil material is determined by comparison with a standard Munsell colour chart.
Gilgai	Surface microrelief associated with clayey soils, consisting of hummocks (mounds) and hollows (depressions) of varying size, shape and frequency. This phenomenon is a continuing long-term process due to the shrinking and swelling of deep subsoils with changes in moisture content. It is usually associated with the occurrence of expansive (or shrink-swell) soils.
Gravel	A mixture of coarse mineral particles larger than 2mm but less than 75mm in diameter.

Term	Definition
Hydraulic Conductivity	The flow of water through soil per unit of energy gradient. For practical purposes it may be taken as the steady state of percolation rate of a soil when infiltration and internal drainage are equal, measured as depth per unit time.
Infiltration	The downward entry of water into the soil through the soil surface.
Massive	Refers to that condition of a soil layer (horizon) in which the layer appears as a coherent or solid mass, which is largely devoid of peds and is more than 6mm thick.
Mottles	Spots, blotches or streaks of subdominant colors different from the matrix colour and also different from the color of the ped surface.
Organic Carbon	An estimate of the amount of organic matter in a soil as a percentage by weight.
Organic Matter	The sum of all natural and thermally altered biologically derived organic materials found in the soil. These materials, in various states of decay, include leaf litter, plant roots, branches, living, and dead organism, and excreta.
pH (soil)	A measure of the acidity or alkalinity of a soil. It represents the negative logarithm of the hydrogen ion concentration in a specified soil/water suspension on a scale of 0 to 14.
Parent Material	The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed by pedogenic processes.
Particle Size Analysis	The laboratory determination of the amounts of the different separates in a soil sample such as clay, silt, fine sand, coarse sand, and gravel. The amounts are normally expressed as percentages by weight of dry soil.
Ped	A unit of soil structure – such as an aggregate, crumb, prism, block or granule – formed by natural processes (in contrast to a clod, which is artificially formed).
Permeability (soil)	The ease with which gases, liquids or plant roots penetrate or pass through a bulk mass of soil or layer of soil.
Pores	The part of the bulk volume of the soil not occupied by soil particles.
Regolith	The entire unconsolidated or secondary recemented cover that overlies more coherent bedrock that has been formed by weathering, erosion, transport and/or deposition of the older material. The regolith thus includes fractured and weathered basement rocks, saprolites, soils, organic accumulations, colluviums, alluvium, aeolian deposits and groundwater; also referred to as ‘everything from fresh rock to fresh air’.
Sampling Site	A georeferenced point within a monitoring unit where one or more samples are taken for analysis.
Sand	A soil particle that in the USDA soil texture system is of size 0.05mm to 2.0mm in diameter.
Shrink-swell	The capacity of soil material to change volume with changes in moisture content, frequently measured by a laboratory assessment of the soil’s linear shrinkage.
Silt	A soil particle that in the USDA soil texture system is of size 0.002mm to 0.05mm in diameter.
Slake	The partial breakdown of soil aggregated in water due to swelling of clay and the expulsion of air from pore spaces. It is a component, along with soil dispersion and soil detachment, of the process whereby soil structure is broken down in the field.
Slickenside	A surface that is polished and smoothly striated and results from slippage along fault plane.
Sodicity	A property expressed by the amount of exchangeable sodium present relative to the cation capacity of a soil horizon.
Soil Classification	The systematic arrangement of soils into groups or categories on the basis of similarities and differences in their characteristics.

Term	Definition
Soil Coherence	The degree to which soil material is held together at different moisture levels. If two-thirds or more of the soil material, whether composed of peds or not, remain united at a given moisture level then the soil is described as coherent.
Soil Consistence	The resistance of soil material to deformation or rupture.
Soil Erodibility	The susceptibility of a soil to the detachment and transportation of soil particles by erosive agents.
Soil Horizon	A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties such as color structure, texture, consistency, kinds and number of organisms present, degrees or acidity or alkalinity.
Soil Profile	A vertical section of the soil through all its horizons.
Soil Salinity	The amount of soluble salts in a soil. The convention measure of soil salinity is the electrical conductivity of a saturation extract.
Soil Structure	Refers to the way soil particles are arranged and bound together to form aggregates or peds.
Soil Texture	The relative proportions of the various soil separates in a soil as described by the classes of soil texture. It is the general coarseness or fineness of soil material as it affects the behaviour of a moist ball (bolus) when pressed between the thumb and forefinger.
Solum	The upper part of a soil profile, above the parent material, in which current processes of soil formation are active. The solum consists of either the A and B horizons or the A horizon alone when no B is present.
Structure Pedality Grade	The degree of development and distinction of ped.
Structure Ped and Size	Refers to the distinctness, size and shape of peds.
Subsoil	Refers to B soil horizon.
Topsoil	Refers to A1 and A2 soil horizons.
Source: Charman & Murphy, 1991; Peverill et al., 1999; McKenzie et al., 2004; NCST, 2009; NSW EPA, 1997; *Dictionary of Geology & Mineralogy*, 2003.	








Lab and Field Assessment Techniques

APPENDIX 2

TEST SIGNIFICANCE AND TYPICAL VALUES

Particle Size Analysis

Particle size analysis measures the size of the soil particles in terms of grainsize fractions, and expresses the proportions of these fractions as a percentage of the sample. The grainsize fractions are:

clay	<0.002mm
silt	0.002 to 0.02mm
fine sand	0.02 to 0.2mm
medium & coarse sand	0.2 to 2mm

Particles greater than 2mm, that is gravel and coarser material, are not included in the analysis.

Emerson Aggregate Test

Emerson aggregate test measures the susceptibility to dispersion of the soil in water. Dispersion describes the tendency for the clay fraction of a soil to go into colloidal suspension in water. The test indicates the credibility and structural stability if the soil and its susceptibility to surface sealing under irrigation and rainfall. Soils are divided into eight classes on the basis of the coherence of soil aggregates in water. The eight classes and their properties are:

Class 1:	Very dispersible soils with susceptibility to high tunnel erosion.
Class 2:	Moderately dispersible soils with some susceptibility to tunnel erosion.
Class 3:	Slightly or non-dispersive soils which are generally stable and suitable for soil conservation earthworks.
Class 4-6:	More highly aggregated materials which are less likely to hold water. Special compactive efforts are required in the construction of earthworks.
Class 7-8:	Highly aggregated materials exhibiting low dispersion characteristics.

The following subdivisions within Emerson classes may be applied:

(1) Slight milkiness, immediately adjacent to the aggregate.
(2) Obvious milkiness, less than 50% of the aggregate affected.
(3) Obvious milkiness, more than 50% of the aggregate affected.
(4) Total dispersion, leaving only sand grains.

Salinity

Salinity is measured as electrical conductivity on a 1:5 soil:water suspension to give EC (1:5). The effects of salinity levels expressed as EC at 25^{o} (dS/cm), on plants are:

0 to 1:	Very low salinity, effects on plants mostly negligible.
1 to 2:	Low salinity, only yields of very sensitive crops are restricted.
Greater than 2:	Saline soils, yields of many crops restricted.

pH

The pH is a measure of acidity and alkalinity. For 1:5 soil:water suspensions, soils having pH values less than 4.5 are regarded as strongly acid, 4.5 to 5.0 moderately acidic, and values greater than 7.0 are regarded as alkaline. Most plants grow best in slightly acidic soils.

LABORATORY TEST METHODS

Particle Size Analysis

Determination by sieving and hydrometer of percentage, by weight, of particle size classes: Gravel >2mm, Coarse Sand 0.2-2mm, Fine Sand 0.02-0.2mm, Silt 0.002-0.2mm and Clay <0.002mm; SCS standard method (Bond et al., 1990)

Emerson Aggregate Test

An eight class classification of soil aggregate coherence (slaking and dispersion) in water. SCS standard method closely related to Australian Standard AS1289. The degree of dispersion is included in brackets for class 2 and class 3 aggregates (Bond et al., 1990).

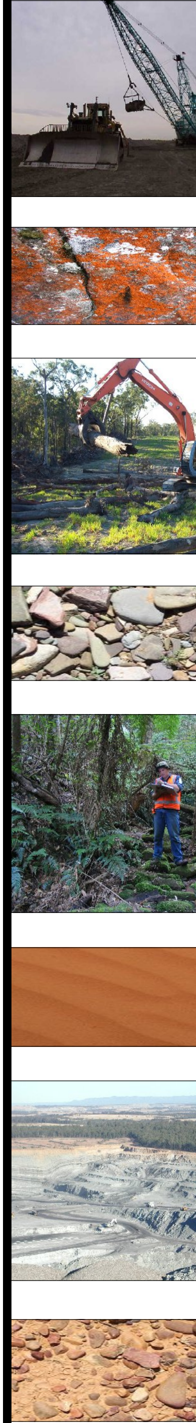
EC

Electrical Conductivity determined on a 1:5 soil:water suspension. Prepared from the sample's fine earth fraction (Bond et al., 1990).

pH

Determined on a 1:5 soil:water suspension, Prepared from the sample's fine earth fraction (Bond et al., 1990).

Laboratory Results



APPENDIX 3

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1112025**	Page	: 1 of 12
Client	: **GSS ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
Contact	: MR CLAYTON RICHARDS	Contact	: Customer Services
Address	: LEVEL 1, 241 DENISON ST BROADMEADOW NSW, AUSTRALIA 2292	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: richards@gssenvironmental.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: 02 49203000	Telephone	: +61 7 3243 7222
Facsimile	: ----	Facsimile	: +61 7 3243 7218
Project	: URS03-018	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: URS03-018		
C-O-C number	: ----	Date Samples Received	: 22-JUN-2011
Sampler	: ----	Issue Date	: 06-JUL-2011
Site	: Goonyella		
		No. of samples received	: 35
Quote number	: BN/372/11	No. of samples analysed	: 23

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Dianne Blane	Laboratory Supervisor	Newcastle
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ED021 - (Bicarbonate Extractable K (Colwell)) -The LOR for samples EB1112025 -001 (17 (1), 0-15), -003 (29 (1), 0-35) , -013 (76 (1), 0-15), -022 (122 (1), 0-10) have been raised due to matrix interference.**
- **ED045G - Chloride Soluble : Sample 17 (2) shows poor duplicate results due to sample heterogeneity. Confirmed by re-extraction and re-analysis.**
- **ED045G (Chloride Soluble): The LOR for sample 80 (1) 0-30 has been raised due to matrix interference.**

Analytical Results

Sub-Matrix: **SOIL**			Client sample ID	17 (1) 0-15	17 (2) 15-45	29 (1) 0-35	29 (2) 35-60	36 (1) 0-15
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
Compound	CAS Number	LOR	Unit	EB1112025-001	EB1112025-002	EB1112025-003	EB1112025-004	EB1112025-005
EA150: Particle Sizing								
+75µm	----	1	%	56	27	68	47	41
+150µm	----	1	%	39	17	30	21	27
+300µm	----	1	%	27	11	12	18	16
+425µm	----	1	%	23	9	6	17	12
+600µm	----	1	%	21	8	4	17	10
+1180µm	----	1	%	18	6	2	16	7
+2.36mm	----	1	%	14	3	<1	15	3
+4.75mm	----	1	%	4	<1	<1	13	<1
+9.5mm	----	1	%	<1	<1	<1	7	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.5	7.8	5.2	8.3	6.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	29	126	75	198	63
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	2.3	7.8	1.4	4.1	4.0
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	44	73	32	53	59
Sand (>75 µm)	----	1	%	42	24	67	32	38
Gravel (>2mm)	----	1	%	14	3	1	15	3
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	3.5	2.8	0.4	1.3	3.2
^ Exchangeable Magnesium	----	0.1	meq/100g	1.6	7.0	0.5	4.6	1.7
^ Exchangeable Potassium	----	0.1	meq/100g	0.5	0.1	0.3	0.2	0.8
^ Exchangeable Sodium	----	0.1	meq/100g	0.3	2.6	0.4	3.0	0.2
^ Cation Exchange Capacity	----	0.1	meq/100g	6.0	12.6	1.6	9.1	5.8
ED021: Bicarbonate Extractable Potassium (Colwell)								
^ Bicarbonate Extractable K (Colwell)	----	10	mg/kg	<200	----	<200	----	310
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	----	10	----	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	<0.01	<0.01	0.01
ED045G: Chloride Discrete analyser								

Analytical Results

Sub-Matrix: **SOIL**

			Client sample ID	17 (1) 0-15	17 (2) 15-45	29 (1) 0-35	29 (2) 35-60	36 (1) 0-15
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112025-001**	**EB1112025-002**	**EB1112025-003**	**EB1112025-004**	**EB1112025-005**
ED045G: Chloride Discrete analyser - Continued								
Chloride	16887-00-6	10	mg/kg	**70**	**1380**	**110**	**640**	**180**
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10	**40**	**20**	**10**	**30**
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**7990**	----	**4470**	----	**8850**
Iron	7439-89-6	50	mg/kg	**53200**	----	**16100**	----	**57000**
EK060G-F: Dissolved Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
^ Organic Nitrogen as N	----	20	mg/kg	**640**	----	**350**	----	**410**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**303**	**176**	**167**	**102**	**258**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.83**	----	**0.42**	----	**0.88**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	36 (2) 15-30	36 (3) 30-60	40 (1) 0-10	40 (2) 10-40	40 (3) 40-80
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
Compound	CAS Number	LOR	Unit	EB1112025-006	EB1112025-007	EB1112025-008	EB1112025-009	EB1112025-010
EA150: Particle Sizing								
+75µm	----	1	%	40	51	50	37	27
+150µm	----	1	%	34	51	34	26	20
+300µm	----	1	%	31	50	19	16	15
+425µm	----	1	%	30	50	11	11	13
+600µm	----	1	%	29	50	6	8	12
+1180µm	----	1	%	28	49	3	6	10
+2.36mm	----	1	%	23	45	<1	3	7
+4.75mm	----	1	%	18	32	<1	1	4
+9.5mm	----	1	%	6	12	<1	<1	3
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.7	6.3	6.3	6.3	6.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	79	25	28	34	28
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	7.3	5.7	3.2	5.5	8.9
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	60	49	50	63	73
Sand (>75 µm)	----	1	%	17	6	50	34	20
Gravel (>2mm)	----	1	%	23	45	1	3	7
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	1.8	1.5	1.9	2.4	2.3
^ Exchangeable Magnesium	----	0.1	meq/100g	1.7	1.6	1.0	1.5	1.9
^ Exchangeable Potassium	----	0.1	meq/100g	0.6	0.4	0.7	0.7	0.4
^ Exchangeable Sodium	----	0.1	meq/100g	0.2	0.2	<0.1	<0.1	<0.1
^ Cation Exchange Capacity	----	0.1	meq/100g	4.4	3.6	3.7	4.6	4.7
ED021: Bicarbonate Extractable Potassium (Colwell)								
^ Bicarbonate Extractable K (Colwell)	----	10	mg/kg	----	----	280	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	10	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	0.02	0.01	0.01	0.01
ED045G: Chloride Discrete analyser								

Analytical Results

Sub-Matrix: **SOIL**			Client sample ID	36 (2) 15-30	36 (3) 30-60	40 (1) 0-10	40 (2) 10-40	40 (3) 40-80
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112025-006**	**EB1112025-007**	**EB1112025-008**	**EB1112025-009**	**EB1112025-010**
ED045G: Chloride Discrete analyser - Continued								
Chloride	16887-00-6	10	mg/kg	**120**	**30**	**110**	**190**	**40**
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	**20**	<10	**30**	**20**	**10**
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	**6760**	----	----
Iron	7439-89-6	50	mg/kg	----	----	**32500**	----	----
EK060G-F: Dissolved Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
^ Organic Nitrogen as N	----	20	mg/kg	----	----	**550**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**160**	**205**	**144**	**130**	**96**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	**0.85**	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	54 (1) 0-20	54 (2) 20-40	76 (1) 0-15	76 (2) 15-45	76 (3) 45-60
Client sampling date / time				[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
				EB1112025-011	EB1112025-012	EB1112025-013	EB1112025-014	EB1112025-015
EA150: Particle Sizing								
+75µm	----	1	%	16	15	62	49	41
+150µm	----	1	%	10	10	46	37	32
+300µm	----	1	%	6	5	24	20	19
+425µm	----	1	%	4	3	15	13	14
+600µm	----	1	%	3	2	11	10	12
+1180µm	----	1	%	2	2	7	7	9
+2.36mm	----	1	%	1	<1	5	3	6
+4.75mm	----	1	%	<1	<1	2	<1	3
+9.5mm	----	1	%	<1	<1	<1	<1	3
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.2	8.5	8.4	8.8	9.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	96	177	100	135	301
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	7.9	8.0	3.2	6.0	5.0
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	84	85	38	51	59
Sand (>75 µm)	----	1	%	15	15	57	46	35
Gravel (>2mm)	----	1	%	1	1	5	3	6
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	30.8	34.0	12.5	24.8	32.5
^ Exchangeable Magnesium	----	0.1	meq/100g	6.1	6.8	1.7	5.1	10.4
^ Exchangeable Potassium	----	0.1	meq/100g	1.0	0.6	0.4	0.4	0.3
^ Exchangeable Sodium	----	0.1	meq/100g	0.5	1.8	0.2	0.9	2.8
^ Cation Exchange Capacity	----	0.1	meq/100g	38.5	43.3	14.8	31.2	46.0
ED021: Bicarbonate Extractable Potassium (Colwell)								
^ Bicarbonate Extractable K (Colwell)	----	10	mg/kg	250	----	<200	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	----	<10	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	0.01	0.01	0.05
ED045G: Chloride Discrete analyser								

Analytical Results

Sub-Matrix: SOIL			Client sample ID	54 (1) 0-20	54 (2) 20-40	76 (1) 0-15	76 (2) 15-45	76 (3) 45-60
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
Compound	CAS Number	LOR	Unit	EB1112025-011	EB1112025-012	EB1112025-013	EB1112025-014	EB1112025-015
ED045G: Chloride Discrete analyser - Continued								
Chloride	16887-00-6	10	mg/kg	10	60	10	<10	40
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	20400	----	8790	----	----
Iron	7439-89-6	50	mg/kg	18200	----	39300	----	----
EK060G-F: Dissolved Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
^ Organic Nitrogen as N	----	20	mg/kg	840	----	1080	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	119	118	277	223	87
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	1.00	----	1.07	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	80 (1) 0-30	80 (2) 30-60	80 (3) 60-80	82 (1) 0-30	82 (2) 30-50
Client sampling date / time				[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
				EB1112025-016	EB1112025-017	EB1112025-018	EB1112025-019	EB1112025-020
EA150: Particle Sizing								
+75µm	----	1	%	77	44	77	60	47
+150µm	----	1	%	60	34	59	47	36
+300µm	----	1	%	35	20	36	24	19
+425µm	----	1	%	21	11	24	11	9
+600µm	----	1	%	11	6	16	5	5
+1180µm	----	1	%	5	2	12	2	2
+2.36mm	----	1	%	3	2	11	<1	1
+4.75mm	----	1	%	2	1	7	<1	<1
+9.5mm	----	1	%	<1	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.0	8.5	8.2	7.0	7.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	23	175	21	71	34
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	<1.0	5.0	<1.0	2.8	4.2
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	23	56	23	40	53
Sand (>75 µm)	----	1	%	73	42	66	59	46
Gravel (>2mm)	----	1	%	3	2	11	<1	1
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	1.5	6.9	1.3	9.7	7.8
^ Exchangeable Magnesium	----	0.1	meq/100g	0.4	5.4	0.4	1.5	2.3
^ Exchangeable Potassium	----	0.1	meq/100g	0.5	1.0	0.4	0.7	0.6
^ Exchangeable Sodium	----	0.1	meq/100g	0.3	0.6	0.2	<0.1	<0.1
^ Cation Exchange Capacity	----	0.1	meq/100g	2.7	14.0	2.3	12.0	10.8
ED021: Bicarbonate Extractable Potassium (Colwell)								
^ Bicarbonate Extractable K (Colwell)	----	10	mg/kg	230	----	----	300	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	----	----	<10	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	0.01	<0.01
ED045G: Chloride Discrete analyser								

Analytical Results

Sub-Matrix: SOIL			Client sample ID	80 (1) 0-30	80 (2) 30-60	80 (3) 60-80	82 (1) 0-30	82 (2) 30-50
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]
Compound	*CAS Number*	*LOR*	*Unit*	**EB1112025-016**	**EB1112025-017**	**EB1112025-018**	**EB1112025-019**	**EB1112025-020**
ED045G: Chloride Discrete analyser - Continued								
Chloride	16887-00-6	10	mg/kg	<50	**20**	**30**	**20**	**60**
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	**20**	**30**	**10**	**30**	**10**
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**2650**	----	----	**7350**	----
Iron	7439-89-6	50	mg/kg	**7320**	----	----	**14400**	----
EK060G-F: Dissolved Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
^ Organic Nitrogen as N	----	20	mg/kg	**230**	----	----	**1130**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**92**	**48**	**69**	**202**	**115**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.24**	----	----	**2.31**	----

Analytical Results

Sub-Matrix: SOIL			Client sample ID	82 (3) 50-70	122 (1) 0-10	122 (2) 10-20	----	----
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	----	----
Compound	CAS Number	LOR	Unit	EB1112025-021	EB1112025-022	EB1112025-023	----	----
EA150: Particle Sizing								
+75µm	----	1	%	37	63	24	----	----
+150µm	----	1	%	27	56	20	----	----
+300µm	----	1	%	13	51	15	----	----
+425µm	----	1	%	6	49	12	----	----
+600µm	----	1	%	3	47	11	----	----
+1180µm	----	1	%	<1	45	8	----	----
+2.36mm	----	1	%	<1	41	5	----	----
+4.75mm	----	1	%	<1	32	3	----	----
+9.5mm	----	1	%	<1	9	<1	----	----
+19.0mm	----	1	%	<1	<1	<1	----	----
+37.5mm	----	1	%	<1	<1	<1	----	----
+75.0mm	----	1	%	<1	<1	<1	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.0	9.6	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	131	49	578	----	----
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	5.6	2.4	5.2	----	----
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	63	37	76	----	----
Sand (>75 µm)	----	1	%	36	22	18	----	----
Gravel (>2mm)	----	1	%	<1	41	5	----	----
Cobbles (>6cm)	----	1	%	<1	<1	<1	----	----
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	7.6	3.9	25.5	----	----
^ Exchangeable Magnesium	----	0.1	meq/100g	5.4	4.4	17.2	----	----
^ Exchangeable Potassium	----	0.1	meq/100g	0.5	0.2	0.2	----	----
^ Exchangeable Sodium	----	0.1	meq/100g	0.4	0.4	5.2	----	----
^ Cation Exchange Capacity	----	0.1	meq/100g	13.8	9.0	48.1	----	----
ED021: Bicarbonate Extractable Potassium (Colwell)								
^ Bicarbonate Extractable K (Colwell)	----	10	mg/kg	----	<200	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	10	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.02	0.03	----	----
ED045G: Chloride Discrete analyser								

Analytical Results

Sub-Matrix: SOIL			Client sample ID	82 (3) 50-70	122 (1) 0-10	122 (2) 10-20	----	----
			Client sampling date / time	[24-JUN-2011]	[24-JUN-2011]	[24-JUN-2011]	----	----
Compound	CAS Number	LOR	Unit	EB1112025-021	EB1112025-022	EB1112025-023	----	----
ED045G: Chloride Discrete analyser - Continued								
Chloride	16887-00-6	10	mg/kg	<10	**20**	**480**	----	----
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	**4420**	----	----	----
Iron	7439-89-6	50	mg/kg	----	**112000**	----	----	----
EK060G-F: Dissolved Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
^ Organic Nitrogen as N	----	20	mg/kg	----	**300**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**70**	**411**	**316**	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	**0.51**	----	----	----

Soil Conservation Service

Experienced people protecting your resources

709 Gundy Road, Scone NSW 2337
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Australian Laboratory Services Pty Ltd
32 Shand Street
Stafford Qld 4053

19 July 2011 SCO11/198

Dear Sir/Madam

Soil erodibility (K) factor – EB1112025

The Soil Conservation Service has completed the analysis of twenty three soil sample (Soil test report SCO11/198R1). These samples were analysed for: particle size analysis-mechanical dispersion (clay, silt, fine sand, coarse sand and gravel) and organic carbon (OC). The soil erodibility factor (K factor) has been determined (as described by Rosewell 1993) using the particle size analysis-mechanical dispersion and the organic carbon (Table 1). The surface soil structure was assumed to be medium granular and the profile permeability was assumed to be slow to moderate.

Table 1. Soil erodibility (K) factors and rating.

Lab No	Sample Id	K factor	Rating
1	EB1112025-001	0.031	Moderate
2	EB1112025-002	0.014	Low
3	EB1112025-003	0.058	High
4	EB1112025-004	0.027	Moderate
5	EB1112025-005	0.032	Moderate
6	EB1112025-006	0.027	Moderate
7	EB1112025-007	0.019	Low
8	EB1112025-008	0.034	Moderate
9	EB1112025-009	0.026	Moderate
10	EB1112025-010	0.035	Moderate
11	EB1112025-011	0.037	Moderate
12	EB1112025-012	0.034	Moderate
13	EB1112025-013	0.032	Moderate
14	EB1112025-014	0.025	Moderate
15	EB1112025-015	0.029	Moderate
16	EB1112025-016	0.035	Moderate
17	EB1112025-017	0.020	Low
18	EB1112025-018	0.034	Moderate
19	EB1112025-019	0.033	Moderate
20	EB1112025-020	0.030	Moderate
21	EB1112025-021	0.021	Moderate
22	EB1112025-022	0.017	Low
23	EB1112025-023	0.029	Moderate

This interpretation was based on the soil samples being representative, and literature guidelines.

If you have any queries, please contact me on (02) 6545 1666.

Yours faithfully

SR Young

SR Young

References

Rosewell CJ (1993) Soiloss – A program to assist in the selection of management practices to reduce erosion. Department of Conservation and Land Management.

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO11/198R2
REPORT TO:	Australian Laboratory Services Pty Ltd 32 Shand Street Stafford Qld 4053
REPORT ON:	Four soil samples Ref: EB1112025
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	25 July 2011
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED
THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

SR Young
(Laboratory Manager)

SOIL CONSERVATION SERVICE
Scone Research Service Centre

Report No: SCO11/198R2
Client Reference: Australian Laboratory Services Pty Ltd
32 Shand Street
Stafford Qld 4053

Lab No	Method	P7B/2 Particle Size Analysis (%)				
	Sample Id	clay	silt	f sand	c sand	gravel
11	EB1112025-011	49	28	15	7	1
12	EB1112025-012	49	29	13	8	1
22	EB1112025-022	11	5	11	18	55
23	EB1112025-023	44	28	7	11	10

S R Young

END OF TEST REPORT

Department of Lands

Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO09/138R1
REPORT TO:	Clayton Richards GSS Environmental PO Box 907 Hamilton NSW 2303
REPORT ON:	Forty seven soil samples Goonyella Riverside Mine Expansion Area
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	29 May 2009
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED
THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

SR Young

SR Young
(Laboratory Manager)

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No: SCO09/138R1
Client Reference: Clayton Richards
GSS Environmental
PO Box 907
Hamilton NSW 2303

Lab No	Method	P7B/1 Particle Size Analysis (%)					P9B/2	C1A/4	C2A/3	Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	EAT	EC (dS/m)	pH	Dry	Moist
1	1-1	35	12	27	25	1	3(1)	0.01	6.5	10YR4/4	10YR3/3
2	1-2	36	4	23	16	21	2(1)	0.07	8.6	10YR4/4	10YR3/4
3	3-1	20	6	55	19	0	6	0.33	5.2	7.5YR4/6	7.5YR3/4
4	3-2	44	2	38	15	1	5	0.03	6.3	5YR5/8	5YR4/6
5	3-3	37	4	30	12	17	5	0.03	6.6	7.5YR6/8	7.5YR5/8
6	4-1	40	3	30	26	1	3(2)	0.03	6.3	7.5YR4/6	7.5YR3/4
7	4-2	31	1	9	9	50	5	0.04	6.0	5YR4/6	5YR3/4
8	6-1	55	8	20	14	3	5	0.01	6.3	10YR5/6	10YR3/6
9	7-1	31	4	45	20	0	3(2)	0.01	6.6	5YR4/6	5YR3/4
10	7-2	40	3	34	18	5	5	0.01	7.1	5YR5/6	5YR3/4
11	10-1	60	5	23	10	2	4	0.92	8.7	5YR4/4	5YR3/4
12	13-1	17	3	52	28	0	3(1)	0.01	6.9	7.5YR4/6	7.5YR3/4
13	13-2	15	2	54	28	1	3(1)	<0.01	6.9	7.5YR5/6	7.5YR3/4
14	13-3	49	2	31	17	1	3(2)	0.06	8.0	10YR5/6	10YR4/6
15	14-1	46	4	26	23	1	2(1)	0.20	8.0	7.5YR4/3	7.5YR3/3
16	14-2	40	5	30	24	1	2(1)	1.00	8.0	7.5YR5/6	7.5YR4/6

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No: SCO09/138R1
Client Reference: Clayton Richards
GSS Environmental
PO Box 907
Hamilton NSW 2303

Lab No	Method	P7B/1 Particle Size Analysis (%)					P9B/2	C1A/4	C2A/3	Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	EAT	EC (dS/m)	pH	Dry	Moist
17	15-1	16	5	40	39	<1	8/3(2)	0.04	6.5	10YR4/4	10YR3/4
18	15-2	26	2	36	35	0	2(3)	0.11	7.7	10YR4/4	10YR3/6
19	17-1	33	3	31	32	1	3(3)	0.04	7.2	7.5YR4/2	7.5YR3/2
20	17-2	33	3	30	34	0	1	0.76	6.5	10YR4/4	10YR3/4
21	18-1	39	6	29	24	2	2(1)	0.50	9.2	7.5YR4/4	7.5YR3/4
22	18-2	37	6	30	27	<1	2(2)	1.11	5.4	5YR4/4	5YR3/3
23	19-1	39	8	23	30	<1	3(1)	0.17	9.1	7.5YR4/3	7.5YR3/3
24	19-2	36	9	25	30	<1	2(3)	0.55	8.4	7.5YR5/3	7.5YR4/3
25	20-1	8	4	45	43	<1	3(2)	0.01	6.4	7.5YR5/3	7.5YR3/2
26	20-2	45	4	22	26	3	5	0.01	6.0	5YR5/4	5YR4/4
27	21-1	16	7	37	29	11	3(2)	0.01	6.5	7.5YR5/3	7.5YR4/3
28	21-2	38	11	33	18	0	2(3)	0.90	8.8	7.5YR6/4	7.5YR5/6
29	22-1	32	8	32	28	<1	3(2)	0.03	7.4	10YR4/4	10YR3/4
30	22-2	44	5	28	23	<1	2(3)	0.38	9.5	7.5YR5/4	7.5YR4/4
31	23-1	51	7	22	19	1	2(1)	0.34	9.5	7.5YR4/3	7.5YR3/3
32	23-2	62	9	18	11	<1	1	1.50	5.3	7.5YR5/3	7.5YR4/4

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No: SCO09/138R1
Client Reference: Clayton Richards
GSS Environmental
PO Box 907
Hamilton NSW 2303

Lab No	Method	P7B/1 Particle Size Analysis (%)					P9B/2	C1A/4	C2A/3	Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	EAT	EC (dS/m)	pH	Dry	Moist
33	24-1	13	8	41	38	<1	8/3(1)	<0.01	6.8	10YR4/4	10YR3/4
34	24-2	18	8	36	38	<1	3(2)	<0.01	7.8	10YR5/4	10YR4/4
35	33-1	15	5	54	25	1	8/3(1)	0.01	5.8	2.5YR4/4	2.5YR3/4
36	33-2	26	2	51	19	2	5	0.01	5.8	2.5YR4/6	2.5YR3/6
37	35-1	27	26	32	15	0	3(3)	0.01	7.6	10YR5/4	10YR4/4
38	35-2	51	19	20	10	0	1	0.66	8.6	10YR5/4	10YR4/4
39	39-1	21	2	26	20	31	3(1)	0.02	6.8	5YR5/6	5YR4/6
40	40-1	13	6	40	41	<1	3(2)	<0.01	7.0	10YR5/4	10YR4/4
41	40-2	16	3	41	39	1	3(1)	<0.01	7.2	10YR4/4	10YR3/4
42	40-3	35	3	28	33	1	2(3)	0.01	8.0	10YR6/4	10YR5/4
43	41-1	7	6	36	49	2	8/3(1)	0.08	7.7	10YR5/3	10YR3/3
44	41-2	7	6	37	48	2	3(1)	<0.01	7.2	10YR5/4	10YR4/4
45	41-3	6	6	40	43	5	3(1)	0.01	7.2	7.5YR6/4	7.5YR5/3
46	41-4	39	4	22	33	2	2(3)	0.07	7.8	10YR5/6	10YR4/6
47	Eureka Creek	11	6	58	25	0	3(1)	0.01	6.9	7.5YR4/6	7.5YR3/4

END OF TEST REPORT

LABORATORY ANALYTICAL DATA – SUMMARY

Analysis	Lab No.												
	Site No.	G/R#2	G/R#2	G/R#2	G/R#2	G/R#2	G/R#4	G/R#4	G/R#4	G/R#4	G/R#10	G/R#10	G/R#10
	Depth (m)	0-0.2	0.2-0.4	0.6-0.8	1.0-1.2	1.5-1.6	0-0.2	0.3-0.5	0.8-1.0	1.1-1.7	0-0.2	0.2-0.6	0.6-1.0
	Land Units												
pH (1:5 H_2O)	Unit-	7.76	8.19	7.98	7.97	7.41	8.45	8.24	7.85	4.80	7.06	7.45	8.10
EC (1:5 H_2O)	dS/m	0.29	0.22	0.97	1.16	1.20	0.25	1.51	1.78	1.54	0.05	0.14	0.09
Chloride	mg/kg	275	206	1137	1396	1520	178	2065	2522	2244	14	58	41
Nitrate Nitrogen	mg/kg	<1	1	1	2	4	1	1	1	<1	2	23	4
Phosphorus)	mg/kg	5	4	4	3	3	13	12	11	14	10	3	3
Organic Carbon	%	3.2	2.9	1.8	1.7	1.2	3.5	2.3	2.0	0.9	3.0	2.3	1.9
Sulfur	mg/kg	17.1	9.5	92.9	112.4	95.7	4.5	105.7	141.6	57.8	3.9	5.5	4.7
Calcium (Ca)	mg/kg	4800	4506.08	3543.95	3600	3100	5000	3300	2400	1500	8000	8400	8500
Magnesium Mg)	mg/kg	1600	1600	1900	2100	2100	1500	1900	1900	1700	2600	2700	2800
Sodium (Na)	mg/kg	485.65	660	1556.08	1765.49	1840.76	360.86	1924.62	2078.34	1900	71.83	210	300
Potassium (K)	mg/kg	98	75	77	93	120	330	220	200	160	130	60	40
CEC - (ECEC)	meq/100g	39.47	39.22	40.43	43.19	41.52	40.21	37.6	37.6	31.01	62.01	65.48	66.85
Ex. Sodium	meq/100g	5.3	2.85	6.77	17.8	8.00	1.57	20.3	24.0	8.35	0.31	0.90	1.32
Ex. Potassium	meq/100g	0.6	0.5	0.20	0.6	0.7	2.1	0.58	1.4	0.41	0.5	0.15	0.10
Ex. Calcium	meq/100g	24.19	57.4	43.8	41.4	36.9	62.7	16.33	11.86	7.31	40.6	42.13	42.38
Ex. Magnesium	meq/100g	12.92	34.8	15.74	40.3	17.88	12.58	16.04	43.1	14.52	21.30	22.30	23.05
ESP	%												
Ca/Mg	Ratio	1.9	1.7	1.1	0.9	0.9	2.0	1.0	0.7	0.5	1.9	1.9	1.8
Copper (Cu)	mg/kg	1.2	1.0	0.9	0.9	0.8	1.9	1.8	1.5	2.5	1.4	1.2	1.0
Zinc (Zn)	mg/kg	0.3	0.2	0.3	0.3	0.3	0.6	0.4	0.4	1.2	0.4	0.3	0.2
Manganese (Mn)	mg/kg	14	9	7	6	4	8	6	5	10	27	10	6
Iron (Fe)	mg/kg	21	25	19	18	20	21	15	12	32	18	18	17
Boron (B)	mg/kg3	1.2	1.4	3.2	1.7	3.0	2.4	6.0	5.1	2.0	0.8	1.1	1.6

Analysis	**Lab No.**												
	Site No.	G/R#10	G/R#16	G/R#16	G/R#16	G/R#16	G/R#18	G/R#18	G/R#18	G/R#18	G/R#20	G/R#20	G/R#20
	Depth (m)	1.0-1.3	0-0.15	0.3-0.5	0.7-0.9	1.0-1.2	0-0.15	0.2-0.3	0.6-0.7	1.2-1.3	0-0.1	0.4-0.5	0.8-1.0
	Land Units												
pH (1:5 H_2O)	**Unit-**	8.12	7.65	7.86	8.11	8.06	7.12	7.08	7.41	7.28	6.63	6.54	6.90
EC (1:5 H_2O)	dS/m	0.22	0.07	0.54	1.01	1.16	0.03	0.02	0.01	0.03	0.05	0.02	0.01
Chloride	mg/kg	156	47	645	1095	1251	15	18	20	24	16	24	19
Nitrate Nitrogen	mg/kg	1	1	12	9	1	1	<1	<1	<1	7	<1	<1
Phosphorus)	mg/kg	3	13	7	7	7	7	3	3	3	42	52	28
Organic Carbon	%	1.5	2.5	2.0	2.0	0.9	3.2	1.2	0.7	<0.6	3.0	1.3	1.5
Sulfur	mg/kg	3.4	2.2	18.2	122.9	158.5	2.4	1.0	<1.0	1.9	1.6	<1.0	1.2
Calcium (Ca)	mg/kg	8800	3800	4000	3700	3000	430	470	270	340	430	1100	1100
Magnesium Mg)	mg/kg	2800	1300	1400	1800	1800	99	66	56	100	97	270	260
Sodium (Na)	mg/kg	394.29	344.76	1010.39	1629.95	1902.53	7.8	8.00	2.94	8.6	3.9	5.1	16
Potassium (K)	mg/kg	38	180	120	110	130	170	120	89	150	320	170	140
CEC - (ECEC)	meq/100g	69.34	32.04	36.52	40.43	38.40	3.47	3.22	2.08	3.02	3.79	8.11	8.15
Ex. Sodium	meq/100g	1.71	1.50	4.39	7.09	8.27	0.03	0.03	0.01	0.04	0.02	0.02	0.07
Ex. Potassium	meq/100g	0.10	0.46	0.31	0.29	0.32	0.44	0.31	0.23	0.39	0.82	0.42	0.37
Ex. Calcium	meq/100g	43.83	19.10	19.89	18.45	14.78	2.17	2.33	1.37	1.72	2.14	5.41	5.51
Ex. Magnesium	meq/100g	23.70	10.98	11.93	14.60	15.03	0.83	0.55	0.47	0.87	0.81	2.26	2.20
ESP	%												
Ca/Mg	Ratio	1.8	1.7	1.7	1.3	1.0	2.6	4.2	2.9	2.0	2.6	2.4	2.5
Copper (Cu)	mg/kg	1.0	1.6	1.2	1.3	0.8	0.3	0.4	0.3	0.3	0.4	1.0	0.7
Zinc (Zn)	mg/kg	0.3	0.6	0.4	0.5	0.4	0.8	0.4	0.5	0.5	1.2	0.6	0.6
Manganese (Mn)	mg/kg	5	28	11	9	5	16	14	8	5	16	22	20
Iron (Fe)	mg/kg	14	21	19	16	19	44	17	8	12	21	22	17
Boron (B)	mg/kg3	2.5	0.9	1.0	2.4	3.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Analysis	Lab No.												
	Site No.	G/R#20	G/R#21	G/R#21	G/R#21	G/R21	G/R#46	G/R#46	G/R#46	G/R#46	G/R#49	G/R#49	G/R#49
	Depth (m)	1.3-1.5	0-0.2	0.7-0.9	1.2-1.4	0.2-0.5	0-0.2	0.2-0.4	0.5-0.6	1.0-1.1	0-0.15	0.15-0.4	06.-0.7
	Land Units												
pH (1:5 H_2O)	**Unit-**	7.57	8.35	8.65	8.60	8.62	6.50	6.44	7.13	8.04	5.79	7.31	8.58
EC (1:5 H_2O)	dS/m	0.01	0.20	1.07	1.28	0.79	0.03	0.02	0.03	0.09	0.07	0.03	0.08
Chloride	mg/kg	19	91	1070	1313	886	15	16	16	23	17	18	23
Nitrate Nitrogen	mg/kg	<1	20	1	1	3	2	1	2	1	15	2	2
Phosphorus)	mg/kg	9	19	3	3	3	25	11	4	7	66	23	5
Organic Carbon	%	1.5	3.8	1.4	2.1	1.7	5.7	3.4	2.4	1.8	3.6	2.4	1.0
Sulfur	mg/kg	2.1	5.6	126.3	176.4	50.8	2.3	<1.0	1.9	2.5	10.9	4.4	7.4
Calcium (Ca)	mg/kg	1600	5000	4200	3700	4300	2000	900	1900	2600	2100	1900	1800
Magnesium Mg)	mg/kg	390	510	1300	1300	1200	240	130	440	750	490	490	860
Sodium (Na)	mg/kg	39	120	1400	1700	980	13	2.1	21	61	14	19	260
Potassium (K)	mg/kg	220	460	420	290	360	220	110	200	220	330	190	140
CEC - (ECEC)	meq/100g	12.14	30.90	38.50	37.56	36.48	12.78	5.87	13.88	20.26	15.36	14.10	17.62
Ex. Sodium	meq/100g	0.17	0.51	6.10	7.5	4.24	0.06	0.01	0.09	0.27	0.6	0.08	1.13
Ex. Potassium	meq/100g	0.57	1.18	1.09	0.75	0.93	0.56	0.28	0.52	0.57	0.85	0.49	0.36
Ex. Calcium	meq/100g	8.17	24.93	20.85	18.55	21.57	10.18	4.50	9.62	13.14	10.33	9.44	8.94
Ex. Magnesium	meq/100g	3.23	4.28	10.46	10.76	9.74	1.98	1.08	3.65	6.28	4.12	4.09	7.19
ESP	%												
Ca/Mg	Ratio	2.5	5.8	2.0	1.7	2.2	5.1	4.2	2.6	2.1	2.5	2.3	1.2
Copper (Cu)	mg/kg	0.7	1.1	0.8	0.8	1.0	1.6	0.9	1.5	2.2	2.6	1.8	0.9
Zinc (Zn)	mg/kg	0.9	0.9	0.5	2.9	1.7	2.9	0.5	0.5	0.5	1.3	0.6	0.3
Manganese (Mn)	mg/kg	11	6	5	4	4	30	9	10	11	90	38	10
Iron (Fe)	mg/kg	21	11	17	11	13	53	32	23	26	135	38	13
Boron (B)	mg/kg3	0.6	1.5	7.4	5.8	6.5	0.6	<0.5	0.5	0.8	1.0	0.8	1.5

Analysis	Lab No.												
	Site No.	G/R#49	G/R#58	G/R#58	G/R#58	G/R#61	G/R#61	G/R#61	G/R#61	G/R#63	G/R#63	G/R#63	G/R#63
	Depth (m)	0.9-1.0	0-0.2	0.2-0.4	0.5-0.7	0-0.15	0.15-0.3	0.5-0.6	0.9-1.0	0-0.2	0.4-0.6	0.8-1.0	1.3-1.5
	Land Units												
pH (1:5 H_2O)	Unit-	9.04	5.80	6.13	6.78	7.55	7.59	7.49	7.83	6.26	7.38	7.74	8.23
EC (1:5 H_2O)	dS/m	0.23	0.49	0.16	0.08	0.09	0.04	0.03	0.03	0.02	0.03	0.05	0.12
Chloride	mg/kg	87	346	93	71	20	22	18	19	16	19	33	112
Nitrate Nitrogen	mg/kg	2	102	43	13	2	4	2	1	3	2	2	1
Phosphorus)	mg/kg	4	14	8	4	12	6	4	5	6	4	2	2
Organic Carbon	%	0.8	4.3	3.3	1.6	6.0	2.9	1.4	0.8	3.7	1.5	0.9	0.7
Sulfur	mg/kg	9.5	15.9	5.2	1.7	2.5	2.9	1.4	2.0	2.9	1.5	4.7	7.1
Calcium (Ca)	mg/kg	2100	1500	1600	1200	2400	1600	1000	850	640	730	450	630
Magnesium Mg)	mg/kg	930	140	120	160	210	180	210	300	110	210	440	970
Sodium (Na)	mg/kg	500	18	9.1	7.6	3.1	2.4	11	15	2.7	17	100	460
Potassium (K)	mg/kg	120	450	220	110	370	170	120	44	140	120	130	170
CEC - (ECEC)	meq/100g	20.59	10.11	9.54	7.55	14.71	10.07	7.15	6.93	4.51	5.78	6.65	13.64
Ex. Sodium	meq/100g	2.16	0.08	0.04	0.03	0.01	0.01	0.05	0.07	0.01	0.07	0.45	2.02
Ex. Potassium	meq/100g	0.30	1.17	0.57	0.29	0.94	0.44	0.30	0.11	0.36	0.30	0.34	0.43
Ex. Calcium	meq/100g	10.39	7.67	7.97	5.89	12.04	8.16	5.01	4.26	3.20	3.64	2.23	3.14
Ex. Magnesium	meq/100g	7.74	1.19	0.96	1.34	1.72	1.46	1.79	2.49	0.94	1.77	3.63	8.05
ESP	%												
Ca/Mg	Ratio	1.3	6.4	8.3	4.4	7.0	5.6	2.8	1.7	3.4	2.1	0.6	0.4
Copper (Cu)	mg/kg	0.8	1.5	1.3	0.6	0.7	0.8	0.5	0.3	0.7	0.5	0.3	0.4
Zinc (Zn)	mg/kg	0.4	1.7	0.9	0.4	1.4	0.5	0.3	0.3	0.9	0.6	0.5	0.6
Manganese (Mn)	mg/kg	7	62	28	5	19	17	4	1	32	9	3	1
Iron (Fe)	mg/kg	9	18	17	7	16	11	7	5	30	11	8	8
Boron (B)	mg/kg3	1.7	0.9	1.2	1.8	1.3	0.9	1.1	2.3	0.7	1.8	1.7	2.6

Analysis	Lab No.												
	Site No.	G/R#66	G/R#66	G/R#66	G/R#66	G/R#66	G/R#70	G/R#70	G/R#70	G/R#70	G/R#76	G/R#76	G/R#76
	Depth (m)	0-0.2	0.2-0.4	0.6-0.8	0.9-1.1	1.4-.1.5	0-0.15	0.15-0.4	0.7-0.9	1.3-1.4	0-0.15	0.15-0.4	0.7-0.8
	Land Units												
pH (1:5 H_2O)	**Unit-**	6.37	6.37	7.52	7.97	7.91	6.79	7.52	8.49	6.83	5.16	4.77	5.86
EC (1:5 H_2O)	dS/m	0.11	0.19	0.46	0.62	0.68	0.09	0.08	0.15	0.22	0.05	0.04	0.03
Chloride	mg/kg	77	225	623	832	887	31	27	109	215	16	15	15
Nitrate Nitrogen	mg/kg	23	8	2	2	2	18	14	2	4	16	7	9
Phosphorus)	mg/kg	23	9	5	7	12	34	5	4	11	7	2	2
Organic Carbon	%	2.3	1.9	1.7	1.6	1.7	3.9	1.7	1.1	1.8	3.2	1.3	1.3
Sulfur	mg/kg	8.1	5.8	17.1	28.3	39.5	9.4	9.3	9.7	17.2	6.1	10.4	8.0
Calcium (Ca)	mg/kg	1400	1200	940	730	480	1800	1500	570	250	240	160	340
Magnesium Mg)	mg/kg	510	800	910	950	890	550	700	730	560	83	50	88
Sodium (Na)	mg/kg	130	340	890	1200	1400	110	180	870	950	12	1.8	0
Potassium (K)	mg/kg	130	39	30	98	25	240	83	58	52	240	110	33
CEC - (ECEC)	meq/100g	12.12	14.45	16.25	17.24	16.05	14.59	14.50	12.92	10.19	2.89	2.03	2.52
Ex. Sodium	meq/100g	0.55	1.48	3.88	5.43	6.17	0.49	0.78	3.79	4.12	0.05	0.01	0.00
Ex. Potassium	meq/100g	0.34	0.10	0.08	0.25	0.06	0.61	0.21	0.15	0.13	0.61	0.29	0.08
Ex. Calcium	meq/100g	7.02	6.24	4.69	3.65	2.41	8.94	7.67	2.86	1.26	1.21	0.78	1.71
Ex. Magnesium	meq/100g	4.21	6.63	7.60	7.91	7.41	4.55	5.84	6.12	4.68	0.69	0.42	0.73
ESP	%												
Ca/Mg	Ratio	1.7	0.9	0.6	0.5	0.3	2.0	1.3	0.5	0.3	1.8	2.03	2.3
Copper (Cu)	mg/kg	1.6	1.9	1.4	1.2	1.2	3.0	1.7	1.4	2.7	0.6	0.6	0.5
Zinc (Zn)	mg/kg	1.2	0.9	0.8	0.6	0.9	1.1	0.8	0.5	1.8	0.7	0.4	0.7
Manganese (Mn)	mg/kg	20	24	11	6	6	107	37	7	147	20	13	4
Iron (Fe)	mg/kg	29	51	20	12	13	49	33	20	55	52	16	14
Boron (B)	mg/kg3	0.8	0.5	1.3	2.4	3.0	1.3	<0.5	1.8	0.8	0.5	<0.5	<0.5

Analysis	Lab No.												
	Site No.	G/R#77	G/R#77	G/R#77	G/R#77	G/R#86	G/R#86	G/R#86	G/R#86	G/R#86	G/R#88	G/R#88	G/R#88
	Depth (m)	0-0.15	0.15-0.3	0.6-0.8	1.0-11	0-0.15	0.15-0.3	0.3-0.6	0.6-1.2	1.4-1.5	0-0.2	0.2-0.4	0.4-0.7
	Land Units												
pH (1:5 H_2O)	**Unit-**	7.19	7.51	8.4	4.73	6.19	5.59	5.94	7.78	7.94	6.51	6.4	6.73
EC (1:5 H_2O)	dS/m	0.04	0.38	1.00	1.25	0.02	0.04	0.05	0.2	0.2	0.02	0.01	0.03
Chloride	mg/kg	20	489	1350	1863	18	22	45	164	216	18	18	22
Nitrate Nitrogen	mg/kg	3	17	2	<1	18	<1	6	1	2	<1	<1	<1
Phosphorus)	mg/kg	40	12	3	7	14	10	8	5	17	8	7	1
Organic Carbon	%	3.1	2.2	1.1	1.9	0.5	0.3	0.3	0.4	0.3	0.6	0.3	0.3
Sulfur	mg/kg	3.4	3.9	30.9	40.1	1.9	4.6	2.8	9.9	10.7	<1	1.4	<1
Calcium (Ca)	mg/kg	2000	1700	1100	600	620	470	800	2300	1300	630	570	1300
Magnesium Mg)	mg/kg	490	1300	1600	1300	170	180	300	850	560	110	150	660
Sodium (Na)	mg/kg	47	750	1900	2100	4.9	32	80	320	270	0	0	59
Potassium (K)	mg/kg	280	74	54	47	95	46	55	120	92	170	100	210
CEC - (ECEC)	meq/100g	14.79	22.48	27.37	23.39	4.74	4.09	6.97	20.25	12.65	4.5	4.36	12.95
Ex. Sodium	meq/100g	0.20	3.27	8.24	9.02	0.02	0.14	0.35	1.37	1.2	0	0	0.26
Ex. Potassium	meq/100g	0.72	0.19	0.14	0.12	0.24	0.12	0.14	0.31	0.24	0.44	0.27	0.50.53
Ex. Calcium	meq/100g	9.81	8.49	5.46	3.00	3.09	2.37	3.98	11.46	6.57	3.16	2.86	6.66
Ex. Magnesium	meq/100g	4.06	10.53	13.53	10.63	1.39	1.46	2.50	7.11	4.64	0.9	150	5.50
ESP	%												
Ca/Mg	Ratio	2.4	0.8	0.4	0.3	2.2	1.6	1.6	1.6	1.4	3.5	2.3	1.2
Copper (Cu)	mg/kg	1.5	1.2	0.8	0.9	0.7	0.9	1.4	1.4	0.7	0.8	0.8	1
Zinc (Zn)	mg/kg	0.9	0.6	0.5	0.6	0.4	0.2	0.2	0.2	0.2	0.5	0.2	<0.1
Manganese (Mn)	mg/kg	42	36	11	7	20	28	28	12	9	44	29	22
Iron (Fe)	mg/kg	25	36	21	45	28	34	37	14	14	28	29	20
Boron (B)	mg/kg3	1.5	1.9	4.6	2.5	0.5	0.6	0.6	2	2.1	0.6	0.6	1.4

Analysis	Lab No.												
	Site No.	G/R#88	G/R#88	G/R#91	G/R#91	G/R#91	G/R#91	G/R#91	G/R#95	G/R#95	G/R#95	G/R#95	G/R#95
	Depth (m)	0.7-1.1	1.4-1.5	0-0.05	0.05-0.15	0.15-0.5	0.5-0.7	1.3-1.4	0-0.1	0.1-0.3	0.3-0.6	0.6-1.1	1.1-1.5
	Land Units												
pH (1:5 H_2O)	Unit-	7.71	8.54	6.84	6.85	6.97	7.48	7.97	8.16	8.1	8.34	8.48	8.41
EC (1:5 H_2O)	dS/m	0.05	0.39	0.04	0.03	0.01	0.02	0.07	0.42	0.97	1.22	1.41	1.54
Chloride	mg/kg	37	366	18	15	20	24	51	268	525	1444	1653	1918
Nitrate Nitrogen	mg/kg	<1	<1	1	3	<1	<1	<1	52	84	50	9	2
Phosphorus)	mg/kg	1	3	16	9	4	2	<5	21	9	3	2	3
Organic Carbon	%	<0.3	<0.3	2	1	0.3	0.3	<0.3	2.4	1.3	0.7	0.4	0.3
Sulfur	mg/kg	1.7	36.4	2.1	<1	<1	1	8.9	25.5	49.7	101.4	142.5	154.5
Calcium (Ca)	mg/kg	1200	1900	1300	920	560	610	580	6100	5400	3800	3000	2700
Magnesium Mg)	mg/kg	680	970	160	92	110	240	410	720	950	1200	1200	1200
Sodium (Na)	mg/kg	110	400	2.1	<1	1.2	22	220	220	680	1300	1800	2000
Potassium (K)	mg/kg	200	190	200	100	37	68	110	250	230	140	160	180
CEC - (ECEC)	meq/100g	12.59	19.85	8.47	5.62	3.80	5.34	7.56	37.93	38.64	35.05	33.45	32.83
Ex. Sodium	meq/100g	0.46	1.75	0.01	0	0.01	0.1	0.97	0.94	2.94	5.62	7.98	8.71
Ex. Potassium	meq/100g	0.5	0.49	0.51	0.27	0.09	0.17	0.27	0.65	0.6	0.37	0.41	0.45
Ex. Calcium	meq/100g	6	9.5	6.59	4.58	2.80	3.07	2.90	30.38	27.14	18.99	14.79	13.33
Ex. Magnesium	meq/100g	5.63	8.11	1.36	0.77	0.9	2	3.42	5.96	7.96	10.07	10.27	10.34
ESP	%												
Ca/Mg	Ratio	1.1	1.2	4.8	5.9	3.1	1.5	0.8	5.1	3.4	1.9	1.4	1.3
Copper (Cu)	mg/kg	0.7	0.5	0.6	0.7	0.7	0.5	0.2	1.1	1.1	1	1	1
Zinc (Zn)	mg/kg	0.2	0.2	2.1	0.9	0.2	<0.1	<0.1	0.5	0.4	0.2	0.2	0.2
Manganese (Mn)	mg/kg	10	3	31	30	11	6	3	17	9	9	7	7
Iron (Fe)	mg/kg	18	8	28	23	18	10	7	12	13	13	17	20
Boron (B)	mg/kg3	2	3.2	0.9	0.7	0.6	1.2	2.1	2.3	1.6	3.9	6.4	6

Analysis	Lab No.												
	Site No.	G/R#105	G/R#105	G/R#105	G/R#105	G/R#109	G/R#109	G/R#109	G/R#109	G/R#111	G/R#111	G/R#111	G/R#111
	Depth (m)	0-0.2	0.2-0.6	0.6-0.9	1.1-1.5	0-0.35	0.5-0.7	0.7-1.0	1.0-1.4	0-0.15	0.15-0.6	0.6-1.2	1.4-1.5
	Land Units												
pH (1:5 H_2O)	**Unit-**	5.0	7.5	9.5	9.0	5.6	6.5	7.4	7.7	6.7	6.8	7.3	7.2
EC (1:5 H_2O)	dS/m	0.02	0.29	0.77	0.49	0.04	0.02	0.02	0.04	0.03	0.01	0.02	0.02
Chloride	mg/kg	73	339	634	545	18	13	19	23	13	14	21	15
Nitrate Nitrogen	mg/kg	2	<1	<1	<1	12	2	<1	<1	<1	<1	<1	<1
Phosphorus (P)	mg/kg	7	2	<1	1	4	1	4	3	25	13	7	3
Organic Carbon	%	1.4	0.9	<0.6	<0.1	1.3	0.6	<0.6	<0.1	0.4	0.2	<0.1	<0.1
Sulfur	mg/kg	3.1	7.1	43	27.6	2.3	1.9	2	<1.0	1.0	<1	<1.0	1.4
Calcium (Ca)	mg/kg	620	730	2800	190	510	720	750	1000	240	310	920	1400
Magnesium (Mg)	mg/kg	240	900	1300	580	120	250	340	650	63	87	310	490
Sodium (Na)	mg/kg	<1	670	1400	1000	<1	1	12	66	0	<1	<1	31
Potassium (K)	mg/kg	45	15	15	4	180	120	91	120	260	110	74	94
CEC - (ECEC)	meq/100g	5.51	14.06	31.30	10.14	4.03	5.99	6.91	11.15	2.37	2.54	7.37	11.38
Ex. Sodium	meq/100g	0.00	2.92	5.99	4.38	0.00	0.01	0.05	0.29	0.00	0.00	0.02	0.14
Ex. Potassium	meq/100g	0.12	0.04	0.04	0.01	0.46	0.3	0.23	0.3	0.66	0.29	0.19	0.24
Ex. Calcium	meq/100g	3.11	3.63	14.05	0.93	2.53	3.58	3.77	5.11	1.19	1.53	4.58	6.88
Ex. Magnesium	meq/100g	2.02	7.47	11.22	4.82	1.04	2.10	2.86	5.45	0.52	0.72	2.58	4.12
ESP	%												
Ca/Mg	Ratio	1.5	0.5	0.3	0.2	2.4	1.7	1.3	0.9	2.3	2.1	1.8	1.7
Copper (Cu)	mg/kg	1.1	0.9	0.3	0.2	1.1	0.6	0.3	0.2	0.2	0.4	0.3	0.4
Zinc (Zn)	mg/kg	0.5	0.2	0.2	<0.1	0.4	0.2	<0.1	<0.1	0.3	<0.1	<0.1	<0.1
Manganese (Mn)	mg/kg	12	0.6	1	<1	42	9	4	3	11	23	11	11
Iron (Fe)	mg/kg	61	18	7	6	33	12	84	8	18	14	8	9
Boron (B)	mg/kg3	<0.5	1.5	4.6	2.9	0.5	1.3	2.4	1.8	<0.5	<0.5	<0.5	<0.5

Analysis	Lab No.												
	Site No.	G/R#113	G/R#113	G/R#113	G/R#115	G/R#115	G/R#115	G/R#121	G/R#121	G/R#121	G/R#121	G/R#123	G/R#123
	Depth (m)	0-0.1	0.1-0.3	0.3-1.4	0-0.25	0.25-0.5	0.5-0.9	0-0.15	0.15-0.4	0.4-0.7	1.0+	0-0.15	0.15-0.4
	Land Units												
pH (1:5 H_2O)	**Unit-**	8.3	9.1	8.5	7.0	7.4	8.0	6.4	6.5	7.1	9.0	7.1	8.4
EC (1:5 H_2O)	dS/m	0.09	0.59	1.03	0.04	0.07	0.13	0.02	0.01	0.08	0.27	0.10	0.24
Chloride	mg/kg	14	489	1168	21	26	53	16	22	54	158	48	164
Nitrate Nitrogen	mg/kg	3	1	1	10	10	5	<1	<1	<1	<1	22	8
Phosphorus)	mg/kg	5	<1	2	8	2	<1	7	<1	<1	<1	15	7
Organic Carbon	%	2	0.5	0.3	1.3	0.8	0.4	0.8	<0.1	0.3	<0.1	2.6	1.9
Sulfur	mg/kg	1.4	17.2	65.7	2.2	3.4	6.1	<1.0	<1.0	10.5	7.5	6.1	4.3
Calcium (Ca)	mg/kg	2800	2400	710	1400	1700	1400	230	160	950	1800	3000	5700
Magnesium Mg)	mg/kg	730	1200	980	160	430	800	46	25	670	890	720	1000
Sodium (Na)	mg/kg	74	1200	2200	1	190	440	<1	<1	180	440	24	200
Potassium (K)	mg/kg	140	67	59	57	51	55	110	54	250	230	320	260
CEC - (ECEC)	meq/100g	20.57	27.24	21.27	8.52	12.83	15.60	1.79	1.13	11.73	19.13	21.84	38.57
Ex. Sodium	meq/100g	0.32	5.27	9.44	0.01	0.85	1.91	0.00	0.00	0.80	1.92	0.11	0.85
Ex. Potassium	meq/100g	0.35	0.17	0.15	0.15	0.13	0.14	0.28	0.14	0.64	0.58	0.82	0.68
Ex. Calcium	meq/100g	13.82	11.97	3.53	7.04	8.31	6.92	1.13	0.79	4.73	9.18	14.89	28.34
Ex. Magnesium	meq/100g	6.08	9.83	8.15	1.32	3.54	6.63	0.38	0.20	5.56	7.45	6.02	8.70
ESP	%												
Ca/Mg	Ratio	2.3	1.2	0.4	5.3	2.3	1.0	3.0	4.0	0.9	1.2	2.5	3.3
Copper (Cu)	mg/kg	1.6	0.7	0.6	1.6	1.5	1.5	0.3	0.2	0.5	0.4	1.5	1.4
Zinc (Zn)	mg/kg	1.4	0.3	0.2	0.6	<0.1	0.2	0.2	0.2	0.3	<0.1	0.5	0.3
Manganese (Mn)	mg/kg	8	3	3	12	4	3	5	3	5	2	35	9
Iron (Fe)	mg/kg	13	3	11	13	23	11	23	9	10	5	14	10
Boron (B)	mg/kg3	0.9	6.1	5.7	0.8	1.1	1.4	<0.5	<0.1	1.5	2.3	0.9	1.3

Analysis	Lab No.												
	Site No.	G/R#123	G/R#88	G/R#91	G/R#91	G/R91	G/R91	G/R91	G/R95	G/R95	GR/95	GR/95	GR/95
	Depth (m)	0.4-0.9	1.4-1.5	0-0.05	0.05-0.15	0.15-0.5	0.5-0.7	1.3-1.4	0-0.1	0.1-0.3	0.3-0.6	0.6-1.1	1.1-1.5
	Land Units												
pH (1:5 H_2O)	**Unit-**	8.4											
EC (1:5 H_2O)	dS/m	0.61											
Chloride	mg/kg	577											
Nitrate Nitrogen	mg/kg	3											
Phosphorus)	mg/kg	3											
Organic Carbon	%	1.3											
Sulfur	mg/kg	58.2											
Calcium (Ca)	mg/kg	4400											
Magnesium Mg)	mg/kg	1500											
Sodium (Na)	mg/kg	650											
Potassium (K)	mg/kg	320											
CEC - (ECEC)	meq/100g	37.82											
Ex. Sodium	meq/100g	2.81											
Ex. Potassium	meq/100g	0.82											
Ex. Calcium	meq/100g	21.86											
Ex. Magnesium	meq/100g	12.33											
ESP	%												
Ca/Mg	Ratio	1.8											
Copper (Cu)	mg/kg	1.3											
Zinc (Zn)	mg/kg	<0.1											
Manganese (Mn)	mg/kg	5											
Iron (Fe)	mg/kg	11											
Boron (B)	mg/kg3	3.1											

Analysis	Lab No.												
	Site No.	G/R#88	G/R#88	G/R#91	G/R#91	G/R91	G/R91	G/R91	G/R95	G/R95	GR/95	GR/95	GR/95
	Depth (m)	0.7-1.1	1.4-1.5	0-0.05	0.05-0.15	0.15-0.5	0.5-0.7	1.3-1.4	0-0.1	0.1-0.3	0.3-0.6	0.6-1.1	1.1-1.5
	Land Units												
pH (1:5 H_2O)	**Unit-**	7.71	8.54	6.84	6.85	6.97	7.48	7.97	8.16	8.1	8.34	8.48	8.41
EC (1:5 H_2O)	dS/m	0.05	0.39	0.04	0.03	0.01	0.02	0.07	0.42	0.97	1.22	1.41	1.54
Chloride	mg/kg	37	366	18	15	20	24	51	268	525	1444	1653	1918
Nitrate Nitrogen	mg/kg	<1	<1	1	3	<1	<1	<1	52	84	50	9	2
Phosphorus)	mg/kg	1	3	16	9	4	2	<5	21	9	3	2	3
Organic Carbon	%	<0.3	<0.3	2	1	0.3	0.3	<0.3	2.4	1.3	0.7	0.4	0.3
Sulfur	mg/kg	1.7	36.4	2.1	<1	<1	1	8.9	25.5	49.7	101.4	142.5	154.5
Calcium (Ca)	mg/kg	1200	1900	1300	920	560	610	580	6100	5400	3800	3000	2700
Magnesium Mg)	mg/kg	680	970	160	92	110	240	410	720	950	1200	1200	1200
Sodium (Na)	mg/kg	110	400	2.1	<1	1.2	22	220	220	680	1300	1800	2000
Potassium (K)	mg/kg	200	190	200	100	37	68	110	250	230	140	160	180
CEC - (ECEC)	meq/100g	12.59	19.85	8.47	5.62	3.80	5.34	7.56	37.93	38.64	35.05	33.45	32.83
Ex. Sodium	meq/100g	0.46	1.75	0.01	0	0.01	0.1	0.97	0.94	2.94	5.62	7.98	8.71
Ex. Potassium	meq/100g	0.5	0.49	0.51	0.27	0.09	0.17	0.27	0.65	0.6	0.37	0.41	0.45
Ex. Calcium	meq/100g	6	9.5	6.59	4.58	2.80	3.07	2.90	30.38	27.14	18.99	14.79	13.33
Ex. Magnesium	meq/100g	5.63	8.11	1.36	0.77	0.9	2	3.42	5.96	7.96	10.07	10.27	10.34
ESP	%												
Ca/Mg	Ratio	1.1	1.2	4.8	5.9	3.1	1.5	0.8	5.1	3.4	1.9	1.4	1.3
Copper (Cu)	mg/kg	0.7	0.5	0.6	0.7	0.7	0.5	0.2	1.1	1.1	1	1	1
Zinc (Zn)	mg/kg	0.2	0.2	2.1	0.9	0.2	<0.1	<0.1	0.5	0.4	0.2	0.2	0.2
Manganese (Mn)	mg/kg	10	3	31	30	11	6	3	17	9	9	7	7
Iron (Fe)	mg/kg	18	8	28	23	18	10	7	12	13	13	17	20
Boron (B)	mg/kg3	2	3.2	0.9	0.7	0.6	1.2	2.1	2.3	1.6	3.9	6.4	6

Analysis	Lab No.												
	Site No.	G/R#88	G/R#88	G/R#91	G/R#91	G/R91	G/R91	G/R91	G/R95	G/R95	GR/95	GR/95	GR/95
	Depth (m)	0.7-1.1	1.4-1.5	0-0.05	0.05-0.15	0.15-0.5	0.5-0.7	1.3-1.4	0-0.1	0.1-0.3	0.3-0.6	0.6-1.1	1.1-1.5
	Land Units												
pH (1:5 H_2O)	**Unit-**	7.71	8.54	6.84	6.85	6.97	7.48	7.97	8.16	8.1	8.34	8.48	8.41
EC (1:5 H_2O)	dS/m	0.05	0.39	0.04	0.03	0.01	0.02	0.07	0.42	0.97	1.22	1.41	1.54
Chloride	mg/kg	37	366	18	15	20	24	51	268	525	1444	1653	1918
Nitrate Nitrogen	mg/kg	<1	<1	1	3	<1	<1	<1	52	84	50	9	2
Phosphorus)	mg/kg	1	3	16	9	4	2	<5	21	9	3	2	3
Organic Carbon	%	<0.3	<0.3	2	1	0.3	0.3	<0.3	2.4	1.3	0.7	0.4	0.3
Sulfur	mg/kg	1.7	36.4	2.1	<1	<1	1	8.9	25.5	49.7	101.4	142.5	154.5
Calcium (Ca)	mg/kg	1200	1900	1300	920	560	610	580	6100	5400	3800	3000	2700
Magnesium Mg)	mg/kg	680	970	160	92	110	240	410	720	950	1200	1200	1200
Sodium (Na)	mg/kg	110	400	2.1	<1	1.2	22	220	220	680	1300	1800	2000
Potassium (K)	mg/kg	200	190	200	100	37	68	110	250	230	140	160	180
CEC - (ECEC)	meq/100g	12.59	19.85	8.47	5.62	3.80	5.34	7.56	37.93	38.64	35.05	33.45	32.83
Ex. Sodium	meq/100g	0.46	1.75	0.01	0	0.01	0.1	0.97	0.94	2.94	5.62	7.98	8.71
Ex. Potassium	meq/100g	0.5	0.49	0.51	0.27	0.09	0.17	0.27	0.65	0.6	0.37	0.41	0.45
Ex. Calcium	meq/100g	6	9.5	6.59	4.58	2.80	3.07	2.90	30.38	27.14	18.99	14.79	13.33
Ex. Magnesium	meq/100g	5.63	8.11	1.36	0.77	0.9	2	3.42	5.96	7.96	10.07	10.27	10.34
ESP	%												
Ca/Mg	Ratio	1.1	1.2	4.8	5.9	3.1	1.5	0.8	5.1	3.4	1.9	1.4	1.3
Copper (Cu)	mg/kg	0.7	0.5	0.6	0.7	0.7	0.5	0.2	1.1	1.1	1	1	1
Zinc (Zn)	mg/kg	0.2	0.2	2.1	0.9	0.2	<0.1	<0.1	0.5	0.4	0.2	0.2	0.2
Manganese (Mn)	mg/kg	10	3	31	30	11	6	3	17	9	9	7	7
Iron (Fe)	mg/kg	18	8	28	23	18	10	7	12	13	13	17	20
Boron (B)	mg/kg3	2	3.2	0.9	0.7	0.6	1.2	2.1	2.3	1.6	3.9	6.4	6

Analysis	Lab No.												
	Site No.	G/R#88	G/R#88	G/R#91	G/R#91	G/R91	G/R91	G/R91	G/R95	G/R95	GR/95	GR/95	GR/95
	Depth (m)	0.7-1.1	1.4-1.5	0-0.05	0.05-0.15	0.15-0.5	0.5-0.7	1.3-1.4	0-0.1	0.1-0.3	0.3-0.6	0.6-1.1	1.1-1.5
	Land Units												
pH (1:5 H_2O)	**Unit-**	7.71	8.54	6.84	6.85	6.97	7.48	7.97	8.16	8.1	8.34	8.48	8.41
EC (1:5 H_2O)	dS/m	0.05	0.39	0.04	0.03	0.01	0.02	0.07	0.42	0.97	1.22	1.41	1.54
Chloride	mg/kg	37	366	18	15	20	24	51	268	525	1444	1653	1918
Nitrate Nitrogen	mg/kg	<1	<1	1	3	<1	<1	<1	52	84	50	9	2
Phosphorus)	mg/kg	1	3	16	9	4	2	<5	21	9	3	2	3
Organic Carbon	%	<0.3	<0.3	2	1	0.3	0.3	<0.3	2.4	1.3	0.7	0.4	0.3
Sulfur	mg/kg	1.7	36.4	2.1	<1	<1	1	8.9	25.5	49.7	101.4	142.5	154.5
Calcium (Ca)	mg/kg	1200	1900	1300	920	560	610	580	6100	5400	3800	3000	2700
Magnesium Mg)	mg/kg	680	970	160	92	110	240	410	720	950	1200	1200	1200
Sodium (Na)	mg/kg	110	400	2.1	<1	1.2	22	220	220	680	1300	1800	2000
Potassium (K)	mg/kg	200	190	200	100	37	68	110	250	230	140	160	180
CEC - (ECEC)	meq/100g	12.59	19.85	8.47	5.62	3.80	5.34	7.56	37.93	38.64	35.05	33.45	32.83
Ex. Sodium	meq/100g	0.46	1.75	0.01	0	0.01	0.1	0.97	0.94	2.94	5.62	7.98	8.71
Ex. Potassium	meq/100g	0.5	0.49	0.51	0.27	0.09	0.17	0.27	0.65	0.6	0.37	0.41	0.45
Ex. Calcium	meq/100g	6	9.5	6.59	4.58	2.80	3.07	2.90	30.38	27.14	18.99	14.79	13.33
Ex. Magnesium	meq/100g	5.63	8.11	1.36	0.77	0.9	2	3.42	5.96	7.96	10.07	10.27	10.34
ESP	%												
Ca/Mg	Ratio	1.1	1.2	4.8	5.9	3.1	1.5	0.8	5.1	3.4	1.9	1.4	1.3
Copper (Cu)	mg/kg	0.7	0.5	0.6	0.7	0.7	0.5	0.2	1.1	1.1	1	1	1
Zinc (Zn)	mg/kg	0.2	0.2	2.1	0.9	0.2	<0.1	<0.1	0.5	0.4	0.2	0.2	0.2
Manganese (Mn)	mg/kg	10	3	31	30	11	6	3	17	9	9	7	7
Iron (Fe)	mg/kg	18	8	28	23	18	10	7	12	13	13	17	20
Boron (B)	mg/kg3	2	3.2	0.9	0.7	0.6	1.2	2.1	2.3	1.6	3.9	6.4	6

Analysis	Lab No.												
	Site No.	G/R#88	G/R#88	G/R#91	G/R#91	G/R91	G/R91	G/R91	G/R95	G/R95	GR/95	GR/95	GR/95
	Depth (m)	0.7-1.1	1.4-1.5	0-0.05	0.05-0.15	0.15-0.5	0.5-0.7	1.3-1.4	0-0.1	0.1-0.3	0.3-0.6	0.6-1.1	1.1-1.5
	Land Units												
pH (1:5 H_2O)	**Unit-**	7.71	8.54	6.84	6.85	6.97	7.48	7.97	8.16	8.1	8.34	8.48	8.41
EC (1:5 H_2O)	dS/m	0.05	0.39	0.04	0.03	0.01	0.02	0.07	0.42	0.97	1.22	1.41	1.54
Chloride	mg/kg	37	366	18	15	20	24	51	268	525	1444	1653	1918
Nitrate Nitrogen	mg/kg	<1	<1	1	3	<1	<1	<1	52	84	50	9	2
Phosphorus)	mg/kg	1	3	16	9	4	2	<5	21	9	3	2	3
Organic Carbon	%	<0.3	<0.3	2	1	0.3	0.3	<0.3	2.4	1.3	0.7	0.4	0.3
Sulfur	mg/kg	1.7	36.4	2.1	<1	<1	1	8.9	25.5	49.7	101.4	142.5	154.5
Calcium (Ca)	mg/kg	1200	1900	1300	920	560	610	580	6100	5400	3800	3000	2700
Magnesium Mg)	mg/kg	680	970	160	92	110	240	410	720	950	1200	1200	1200
Sodium (Na)	mg/kg	110	400	2.1	<1	1.2	22	220	220	680	1300	1800	2000
Potassium (K)	mg/kg	200	190	200	100	37	68	110	250	230	140	160	180
CEC - (ECEC)	meq/100g	12.59	19.85	8.47	5.62	3.80	5.34	7.56	37.93	38.64	35.05	33.45	32.83
Ex. Sodium	meq/100g	0.46	1.75	0.01	0	0.01	0.1	0.97	0.94	2.94	5.62	7.98	8.71
Ex. Potassium	meq/100g	0.5	0.49	0.51	0.27	0.09	0.17	0.27	0.65	0.6	0.37	0.41	0.45
Ex. Calcium	meq/100g	6	9.5	6.59	4.58	2.80	3.07	2.90	30.38	27.14	18.99	14.79	13.33
Ex. Magnesium	meq/100g	5.63	8.11	1.36	0.77	0.9	2	3.42	5.96	7.96	10.07	10.27	10.34
ESP	%												
Ca/Mg	Ratio	1.1	1.2	4.8	5.9	3.1	1.5	0.8	5.1	3.4	1.9	1.4	1.3
Copper (Cu)	mg/kg	0.7	0.5	0.6	0.7	0.7	0.5	0.2	1.1	1.1	1	1	1
Zinc (Zn)	mg/kg	0.2	0.2	2.1	0.9	0.2	<0.1	<0.1	0.5	0.4	0.2	0.2	0.2
Manganese (Mn)	mg/kg	10	3	31	30	11	6	3	17	9	9	7	7
Iron (Fe)	mg/kg	18	8	28	23	18	10	7	12	13	13	17	20
Boron (B)	mg/kg3	2	3.2	0.9	0.7	0.6	1.2	2.1	2.3	1.6	3.9	6.4	6

Appendix G Figures from the Soil and Land Suitability Assessment

1.1.1 Soil Group 4 – Brown Kurosols

Description: The Brown Kurosol is comprised of a deep loamy surface duplex soil with a pale gravelly clay sub-surface horizon, an acidic to strongly acidic dark brown heavy clay subsoil horizon, underlain by mottled reddish-brown and grey heavy clay lower subsoil where approaching the (very strongly acidic) weathered rock substrate. The topsoil is moderately dispersive and slightly to moderately saline with a neutral pH. The subsoil's were strongly dispersive, highly saline and highly acidic. The analytical information of the representative site for this soil type is presented in **Table 6** below.

Location: This soil type occurs on gently to moderately inclined foot slopes in a small area to the north west of the EIS study area, encompassing an area of 186.7 hectares, or 1.5 per cent of the EIS study area as shown in **Figure 3**. This soil type is represented by site A77.

Landuse: The land overlying these soils is currently used for extensive grazing, having been largely cleared of trees, cultivated and improved with native and exotic pasture species.

Management: Generally the topsoil does not display any specific management risk related to potential disturbance during stripping. The topsoil layer exhibits structure and chemical characteristics that would be suitable as surface cover in rehabilitation. However, where stone content becomes prohibitive to re-use on rehabilitation, material should not be salvaged for that purpose. The subsoil is strongly dispersive, highly saline and highly acidic and are therefore not suitable for use as a topdressing in rehabilitation. Furthermore, erosion control measures should be implemented during the exposure of this soil. The recommended stripping depth of this soil is 0.30 metres.

Plate 9: Kurosol Soil Profile

Plate 10: Kurosol Landscape setting

Table 6 – Brown Kurosol Laboratory Results

Depth	Colour	pH		ECe		CEC		ESP		EAT	
cm	Munsell	#	Rating	%	Rating	#	Rating	%	Rating	#	Rating
0 -15	Dark brown	7.2	Neutral	0.34	Non saline	14.8	Moderate	9	Marginally sodic	3(3)	Moderate
15 - 30	Dark brown	7.5	Mildly alkaline	3.27	Slightly saline	22.5	Moderate	65	Strongly sodic	3(4)	Moderate
60 - 80	Dark brown	8.4	Moderately alkaline	8.6	Highly saline	27.4	High	110	Strongly sodic	2(2)	High
100 - 110	Strong brown	4.7	Very strongly acid	10.8	Highly saline	23.4	Moderate	165	Strongly sodic	2(2)	High

The Brown Kandosol profile is represented by: **Figure 4A**, which shows the ECe and pH trend with depth, and **Figure 4B**, which shows the trend of exchangeable cations with depth. The entire data collection for this soil type, which includes laboratory results from the 2007 study, can be found in **Appendix 3**.

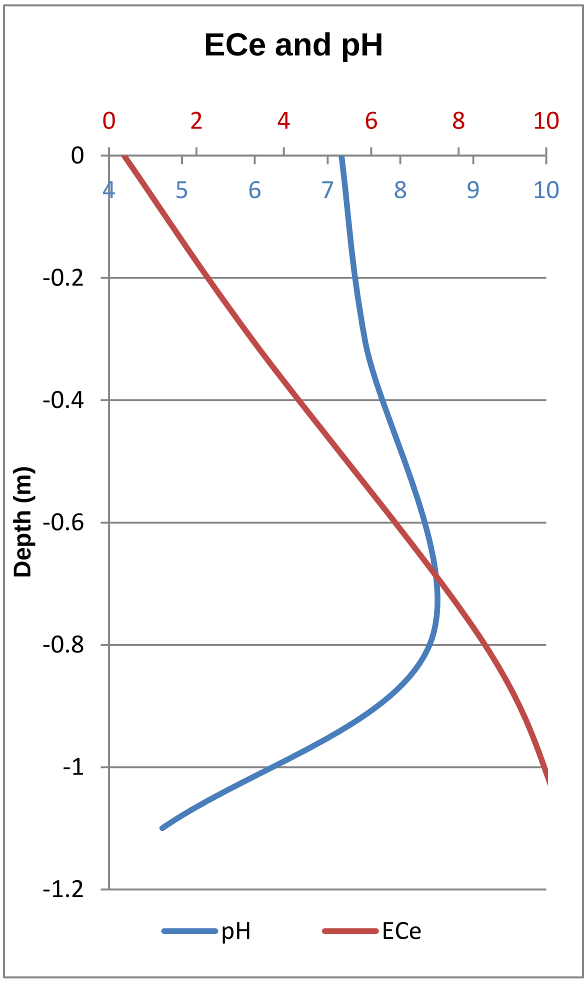

Figure 4A: ECe and pH profile trends

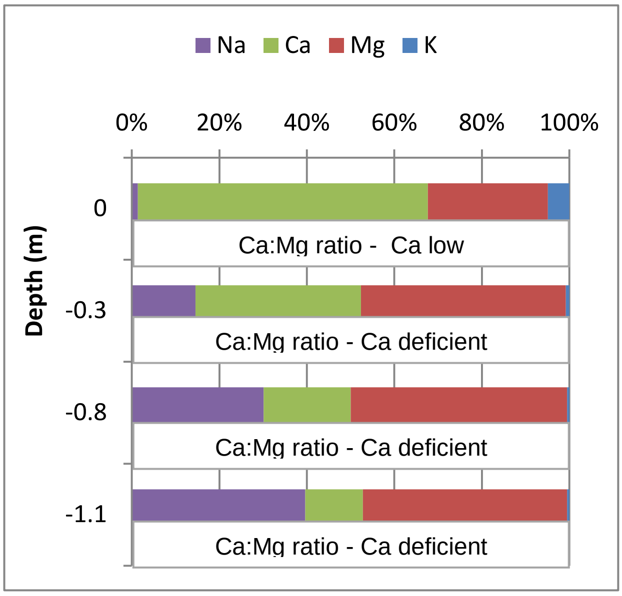

Figure 4B: Exchangeable Cations

1.1.2 Soil Group 5 – Brown Chromosol

Description: The Brown Chromosol includes deep (>1 metre) mostly thick sandy and loamy surface duplex soils generally with a pale (A2) horizon over brown or yellow-brown, sometimes diffusely mottled non-sodic to marginally sodic, non-saline sandy clay or medium to heavy clay subsoils. The topsoil is structurally stable with a low potential for dispersion. The majority of topsoil is non-saline although can be slightly saline and is slightly acidic to moderately alkaline. The subsoil varies from slightly dispersive to strongly dispersive, is generally slightly to non-saline, although occasionally moderately saline, and is neutral to slightly alkaline pH value. The analytical information of the representative site for this soil type is presented in **Table 7** below.

Location: These soils occur on alluvial terraces and on broadly rounded rises and dissection slope interfluves, common throughout the eastern areas of the EIS study area, encompassing an area of 1861.2 hectares, or 15.1 per cent of the EIS study area as shown in **Figure 3**. This soil type is represented by C82 and C121.

Landuse: The land overlying these soils is currently used for extensive grazing, having been previously cleared of trees, cultivated and improved with native and exotic pasture species.

Management: Generally the topsoil of this soil unit does not display any specific management risk related to potential disturbance during stripping. The clay subsoils should not be recovered or used as a surface cover in rehabilitation due to high clay content, massive structure and alkalinity. The sandy loam topsoil is considered generally suitable as a surface cover during rehabilitation. The topsoil is suitable for stripping to a depth of 0.4 metres.

Plate 11: Chromosol Soil Profile

Plate 12: Chromosol Landscape Setting

Table 7 – Brown Chromosol Laboratory Results

Depth	Colour	pH		ECe		CEC		ESP		EAT	
cm	Munsell	#	Rating	%	Rating	#	Rating	%	Rating	#	Rating
0 - 15	Dark brown	6.4	Slightly acid	0.5	Non saline	1.79	Very low	0	Non sodic	5	Slight
15 - 40	Dark brown	6.5	Slightly acid	0.2	Non saline	1.13	Very low	0	Non sodic	5	Slight
40 - 100	Dark yellowish brown	7.1	Neutral	0.7	Non saline	11.7	Low	7	Marginally sodic	5	Slight

The Brown Kandosol profile is represented by: **Figure 5A**, which shows the ECe and pH trend with depth, **Figure 5B**, which shows the soil texture throughout the profile, and **Figure 5C**, which shows the trend of exchangeable cations with depth. The entire data collection for this soil type, which includes laboratory results from the 2007, 2009 and 2011 studies, can be found in **Appendix 3**.

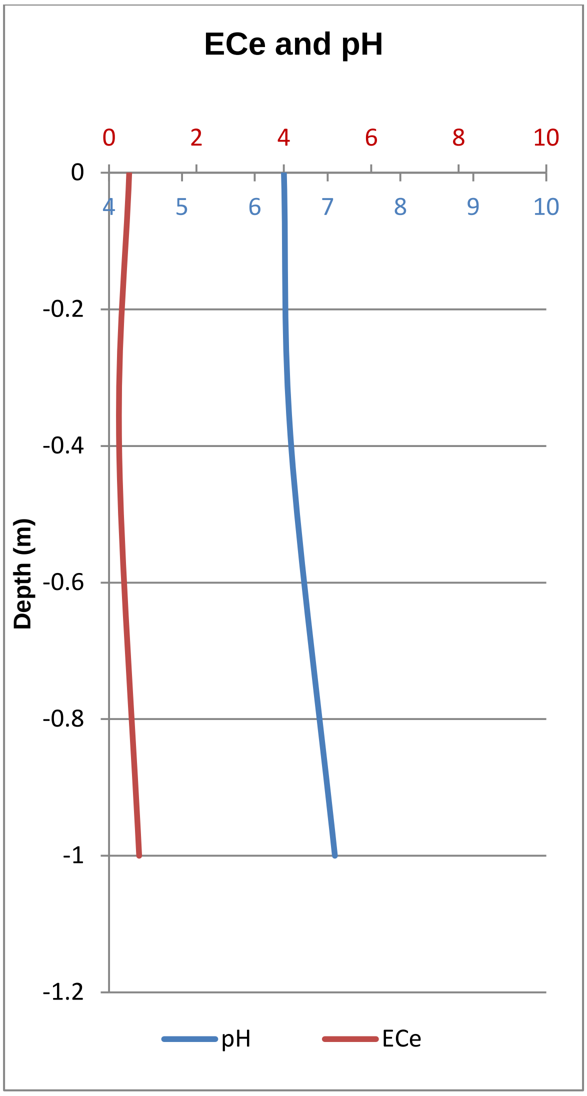

Figure 5A: ECe and pH profile trends

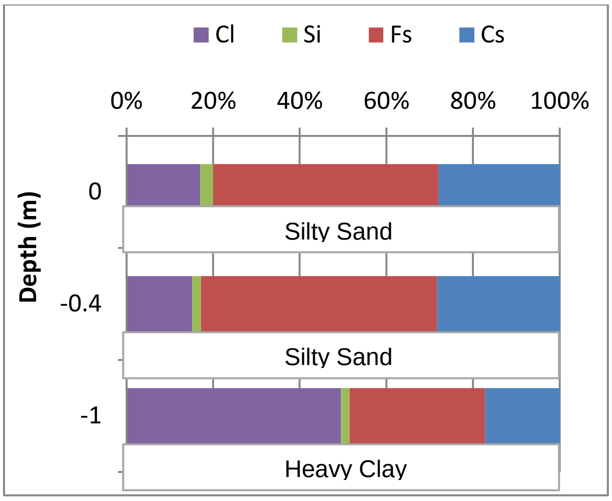

Figure 5B: Particle Size Analysis

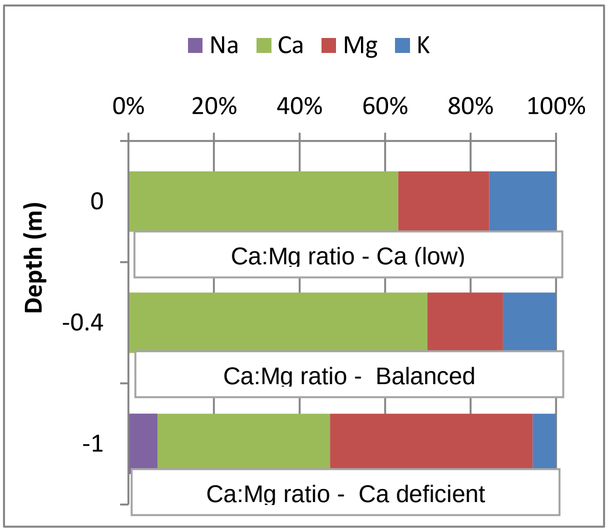

Figure 5C: Exchangeable Cations

Appendix H Acronyms

Acronym	Definition
AAMC	Anglo American Metallurgical Coal
ACARP	Australian Coal Association Research Program
AEP	Annual exceedance probability
AGE	Australian Groundwater and Environmental Consultants
AHD	Australian Height Datum
AMD	Acid mine drainage
AMIRA	Australian Mineral Industries Research Association
ANZECC	Australian and New Zealand Environment and Conservation Council
ARD	Acid rock drainage
AWC	Available water capacity
BMA	BHP Billiton Mitsubishi Alliance
BOP	Biodiversity Offset Policy
BRM	Broadmeadow underground mine
BSTEM	Bank Stability and Toe Erosion Model
CAESAR	Cellular Automation Evolutionary Slope and River
CQCA	Central Queensland Coal Associates
CQCA JV	Central Queensland Coal Associates Joint Venture
CHPP	Coal Handling and Preparation Plant
CSG	Coal seam gas
CSR	Crown separation ratio
DAFF	Department of Agriculture, Fisheries and Forestry
DCCEE	Department of Climate Change and Energy Efficiency
DEC	Department of Environment and Conservation
DERM	Department of Natural Resources and Mines
DEWHA	Department of the Environment, Water, Heritage and the Arts
DITR	Department of Industry, Tourism and Resources
DOTE	Department of the Environment
DSDIP	Department of State Development, Infrastructure and Planning
DSITIA	Department of Science, Information Technology, Innovation and the Arts
EA	Environmental Authority
EC	Electrical conductivity
EFO	Environmental Flow Objective
EHP	Environment and Heritage Protection
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
EPP	Environmental Protection (Water) Policy
ERD	Effective Rooting Depth
ESP	Exchange sodium percentage
EV	Environmental Value
FPC	Foliage protection cover
GARD	Global Acid Rock Drainage Guide
GCE	Goonyella Coal Extension
GIS	Geographic Information Systems
GL	Gigalitre
GLS	Goonyella Lower Seam
GMS	Goonyella Middle Seam
GPR	Ground penetrating radar
GPS	Global positioning system
GRB	Goonyella Riverside Broadmeadow
GRM	Goonyella Riverside Mine
HEC-RAS	Hydrologic Engineering Centre River Analysis System

Acronym	Definition
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
IMC	International Mining Consultants
IMG	Incidental mine gas
INAP	International Network for Acid Prevention
IQQM	Integrated Quantity Quality Model
IRCIA	Isaac River Cumulative Impact Assessment
LFA	Landscape Function Analysis
LOM	Life of mine
LOR	Limit of reporting
LTCC	Longwall top coal caving
MDFRC	Murray Darling Freshwater Research Centre
MIA	Mine infrastructure area
ML	Megalitre
MLA	Mining Lease Application
MNES	Matters of national environmental significance
NAPP	Net acid generating potential
NAPPCRS	Net acid generating potential chromium reducible sulphur
NATA	National Association of Testing Authorities
NEPC	National Environmental Protection Measures
NRM	Natural Resources and Mines
NSW	New South Wales
NTU	Nephelometric turbidity units
PAF	Potentially acid forming
PAWC	Plant available water capacity
PEST	Parameter estimation program
PMP	Pest management plan
QLD	Queensland
QMAN	Quarry Material Allocation Notice
QWQG	Queensland Water Quality Guidelines
RACQ	Royal Automobile Club of Queensland
RE	Regional ecosystem
REDD	Regional Ecosystem Description Database
REMP	Receiving Environment Monitoring Program
RHM	Red Hill Mine
ROM	Run of mine
RORB	Runoff routing model
SDPWO	State Development and Public Works Organisation Act 1971
SLR	Soil loss ratio
TDS	Total dissolved solids
TEC	Threatened ecological community
TEOM	Tapered Element Oscillating Microbalance
TMR	Transport and Main Roads
TSS	Total suspended solids
URS	URS Australia Pty Ltd
VWP	Vibrating wire piezometer
WDS	Water distribution system
WHO	World Health Organisation