BHP

South Walker Creek Mulgrave Resource Access: Stage 2C (MRA2C)

EPBC 2017-7957

Preliminary Documentation

30 January 2019

Contents

1. Proponent

Entity: BHP Billiton Mitsui Coal Pty Ltd

ABN: 34 009 713 875

Registered Address: Level 14, 480 Queen Street, Brisbane Qld 4000

2. Environmental record of the person proposing to take the action

BHP Billiton Mitsui Coal Pty Ltd (BMC) has an excellent record of responsible environmental management and a strong commitment to continual improvement of environmental performance.

BMC has been the sole manager of South Walker Creek Mine since 2010 and no significant non-conformance of its Environmental Authority has occurred in that time, nor has the mine performed any unauthorised activities.

Between 1996 and 2010 the mine was managed by BM Alliance Coal Operations Pty Ltd, during which time only one non-compliant environmental incident is known to have occurred, being that of a tailings pipeline failure which was remedied in accordance with Government and community expectations.

BHP Billiton as a whole has an overriding commitment to environmental responsibility. We strive to achieve the efficient use of resources, including reducing and preventing pollution, and enhancing biodiversity protection by assessing ecological values and land use in our activities. Our stewardship approach is designed to ensure that the lifecycle health, safety, environment and community impacts associated with resources, materials, processes and products related to our businesses are minimised and managed.

BMC has not been subject to any environmental related proceedings in any of the following courts: High Court, Federal Court, Supreme Court, District Court, and Planning and Environment Court.

To the best of our knowledge and enquiries, BMC has not been involved in any proceedings within the various Queensland Magistrates Courts.

South Walker Creek Mine currently operates under an Environmental Management System that provides the framework for environmental management and details the management plans to be created and implemented and also stipulates the legal aspects to be considered in all actions.

The project will be conducted in accordance with the:

- South Walker Creek Environmental Management System
- BHP Billiton Charter - https://www.bhp.com/our-approach/our-company/our-charter
- BHP Environment and Climate Change standard - https://www.bhp.com/-/media/documents/ourapproach/governance/180529_environmentclimatechange.pdf?la=en
- BHP Code of Business Conduct - https://www.bhp.com/-/media/bhp/documents/aboutus/ourcompany/code-of-business-conduct/160310_codeofbusinessconduct_english.pdf?la=en

BHP Billiton's approach to environmental management is incorporated in the Charter, which states that we have 'an overriding commitment to health, safety, environmental responsibility and sustainable development'.

Other BMC referred projects include:

- Wards Well Exploration Program (EPBC 2011/5820)
- Poitrel Coal Mine Project (EPBC 2004/1770)
- Kemmis II, South Walker Creek Mine (EPBC 2013/7025)
- South Walker Creek Mulgrave Pit Extension (EPBC 2014/7272)
- Goonyella Riverside Mine to South Walker Creek Mine Dragline Move (EPBC 2016/7788)

3. Preliminary Documentation Requirements

The delegate of the Commonwealth Minister for the Environment and Energy determined that the proposed action is likely to have a significant impact on the following controlling provisions which are protected under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act):

- Listed threatened species and communities (section 18 & section 18A); and
- Protection of water resources from coal seam gas development and large coal mining development (section 24D & section 24E).

The Minister's delegate determined that the proposed action will be assessed by Preliminary Documentation. The information required for the Preliminary Documentation assessment was provided by the Minister's delegate and is reproduced at Appendix A. The table below indicates where in the documentation key elements can be found.

Information Requested	Preliminary Documentation	Supporting Documentation
Project description	Section 5	Referral
Listed threatened species and communities, including: A discussion of the survey effort undertaken to determine the presence of the species and community listed above and/or habitat for the above species and ecological community, including reference to relevant departmental survey guidelines; Detailed mapping of the known and potential suitable habitat for each species within the project site; A habitat assessment of the quality and likely use of known and potential suitable habitat for the above species and ecological community in relation to the project's disturbance footprint; Discussion of the impacts - direct, indirect, facilitated and residual - to the above species and their habitat as a result of this action; Consideration of the vegetation to be cleared as habitat in a regional context.	Section 7	Appendix E and G
Water resource impacts from coal seam gas development and large coal mining development	Section 6	Appendix C, D, F, H, I and J
Surface Water Details and results of studies of the predicted groundwater and surface water interactions that are likely to result from the creek diversion; Information and monitoring results of previous stream diversions that may provide details of the effectiveness of the 'proposed diversion or potential impacts; Details of the diversion design and how it adheres to the Queensland Guidelines on watercourse diversions; Details on the baseline data and modelling to appropriately identify, quantify and therefore manage likely impacts to surface and groundwater resources; Discussion of cumulative impacts to surface waters including Bee Creek and Walker Creek; An assessment of the likely impacts of mine affected water on surface water as a result of proposed treated water management measures; An assessment of the likely impacts of the proposed action on groundwater dependent species and ecosystems within the project site, including from groundwater drawdown and the creek diversion; Detailed mapping of the known and potential suitable habitat for Black Ironbox (*Eucalyptus raveretiana*) within and downstream of the project site to determine possible impacts from the proposed action, including removal of the alluvial aquifer, changes to the availability of groundwater and impacts associated with the final void; Details of the mitigation and monitoring measures that will be implemented to ensure that the impacts of the proposed action on species and ecosystems are appropriately managed.	Section 6.1	Appendix C, F, H and J

Information Requested	Preliminary Documentation	Supporting Documentation
Groundwater Details and results of modelling of the drawdown as a result of all the pits associated with the South Walker Creek Mine to determine the extent of impacts; An assessment of the likely impacts of the proposed action on groundwater resources, including from groundwater drawdown; Details and results of modelling of the cumulative drawdown associated with proposed action and other pits in the area, including Carborough, Walker and Toolah pits; Detailed modelling of all aquifers in the region, including the alluvial aquifers that are likely to be entirely removed due to mining operations; Detailed descriptions of what structures are likely to remain post operation. Details on the infrastructure, long term stability, and potential interactions with surface and groundwater from the dams and final void are required.	Section 6.2	Appendix D, H and I
Cumulative impacts to water resources	Section 6.3	Appendix D
Water related mitigation measures Details of thresholds or triggers for the implementation of management responses; An assessment of the expected or predicted effectiveness of the mitigation measures; Details of the mitigation and monitoring measures that will be implemented to ensure that impacts from mine affected water on receiving waters are appropriately managed.	Section 6.5 (water)	Appendix B – D, G and H
Avoidance, safeguards and mitigation measures	Section 8	Appendix B - E
Risk Assessment	Section 9	-
Environmental Offsets	Section 10	-
Environmental Outcomes	Section 11	-
Environmental Record of Person(s) Proposing to take the Action	Section 2	-
Economic and Social Matters	Section 12	-
Ecological Sustainability	Section 13	-
Conclusion	Section 14	-
Information Contributions	Section 15	-
References	Section 16	-

4. Location and Context

The South Walker Creek Mine is an open cut coal mining operation owned and managed by BHP Billiton Mitsui Coal. The mine is located in the northern Bowen Basin, approximately 25 km west-south west of the township of Nebo in Queensland.

The mine includes a number of mining pits including the Mulgrave Pit. The Mulgrave Resource Access (MRA) project is a multi-stage progression of open cut mining of the Mulgrave Pit. Previous stages have been assessed and approved separately (ref: EPBC 2014/7272). The current project relates to MRA Stage 2C (MRA2C) that involves a progression of the Mulgrave Pit in a south-westerly direction to access coal resources within the current mining lease (ML4750).

The pit progression will intersect an ephemeral creek system (Walker Creek) requiring the diversion of the watercourse. Two new water storage dams will be constructed to replace an existing mine water storage (F Pit) that is in the path of the pit progression. One dam will be located to the north of the pit and one to the south. These dams will hold mine affected water that will be pumped directly from the mine into these dams.

This report provides a summary of the assessment undertaken to understand potential impacts on matters of National Environmental Significance (MNES) in line with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

South Walker Creek Mine

The South Walker Creek Mine (SWC Mine) is located approximately 25 km west-south west of Nebo, Queensland, in the Bowen Basin (Figure 1). The SWC Mine is an open cut coal mining operation owned by BHP Billiton Mitsui Coal (BMC) and has been in operation for more than 20 years, with construction works commencing in 1996.

The SWC Mine currently consists of five open cut coal mining pits: Toolah, Walker, Carborough, Mulgrave, and Kemmis (Figure 2). All pits are located within mining lease ML4750. The mine operates under Queensland an Environmental Authority (**EPML00712313**) (Appendix B).

The SWC Mine commenced construction and operation prior to the 2000 enactment of the EPBC Act. Subsequently, BMC has obtained EPBC Act approvals relating to specific projects at SWC Mine including:

- Kemmis II pit development (EPBC 2013/7025, approval granted on 16 January 2015)
- Mulgrave Resource Access Project 2A (EPBC 2014/7272, approval granted on 16 January 2015)
- Dragline relocation, Goonyella Riverside Mine to SWC Mine (EPBC 2016/7788, approval granted 2 May 2017)

BMC proposes to continue mining via the progression of the existing pits at SWC Mine. Figure 3 shows the current life-of-asset plan for the SWC Mine, which extends until 2072. The proposed MRA2C project, which is the focus of this study, includes the “F Pit” and “G Pit” areas in the life-of-asset plan. Future pit extensions and approvals will be sought as mining and market drivers require.

Mining associated with the MRA2C project is expected to start between 2019 and 2022 (pending approval) and continue through to 2067. As part of the project, a section of the ephemeral Walker Creek would be diverted to the south around the mining operations.

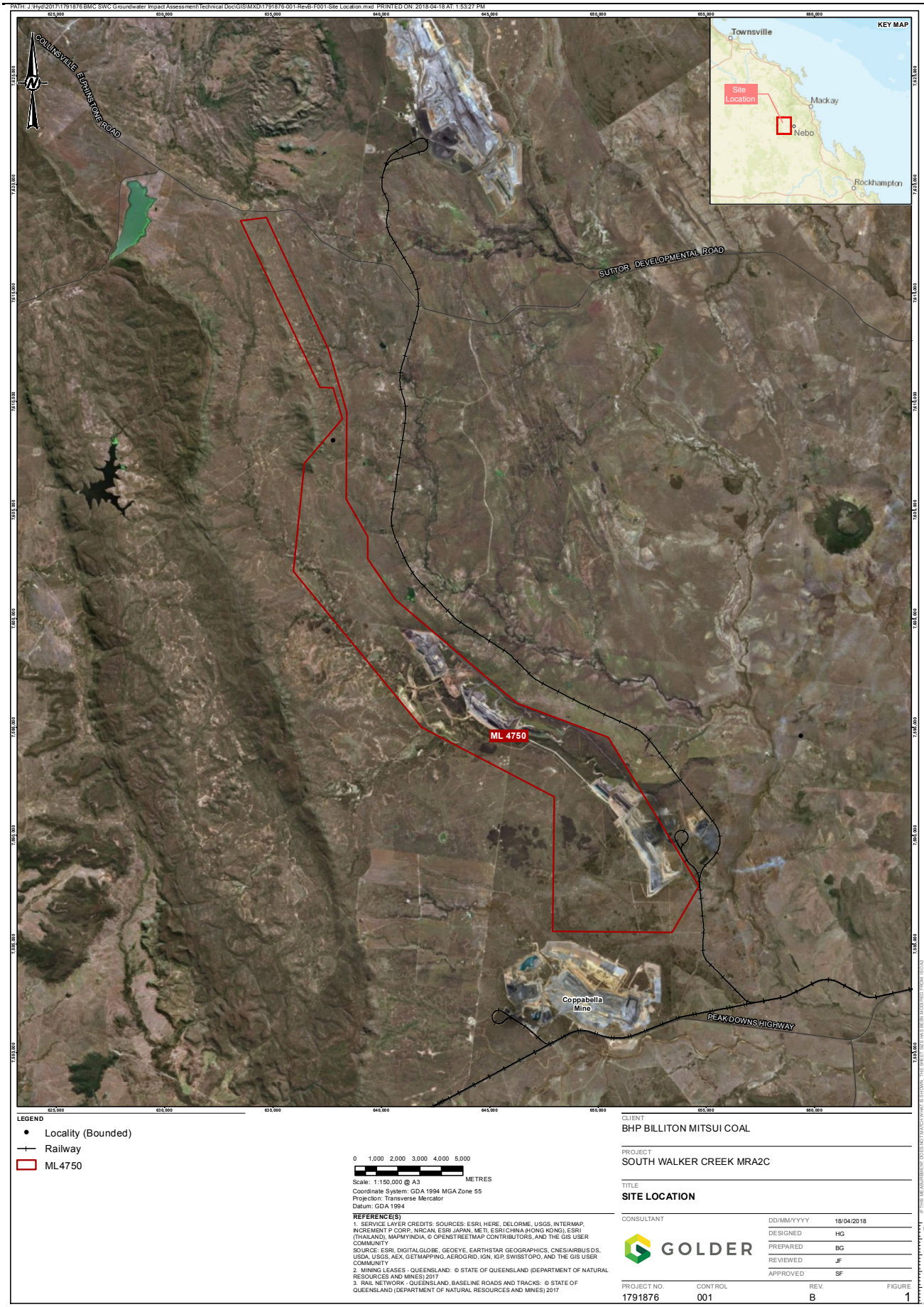


Figure 1: SWC Mine location

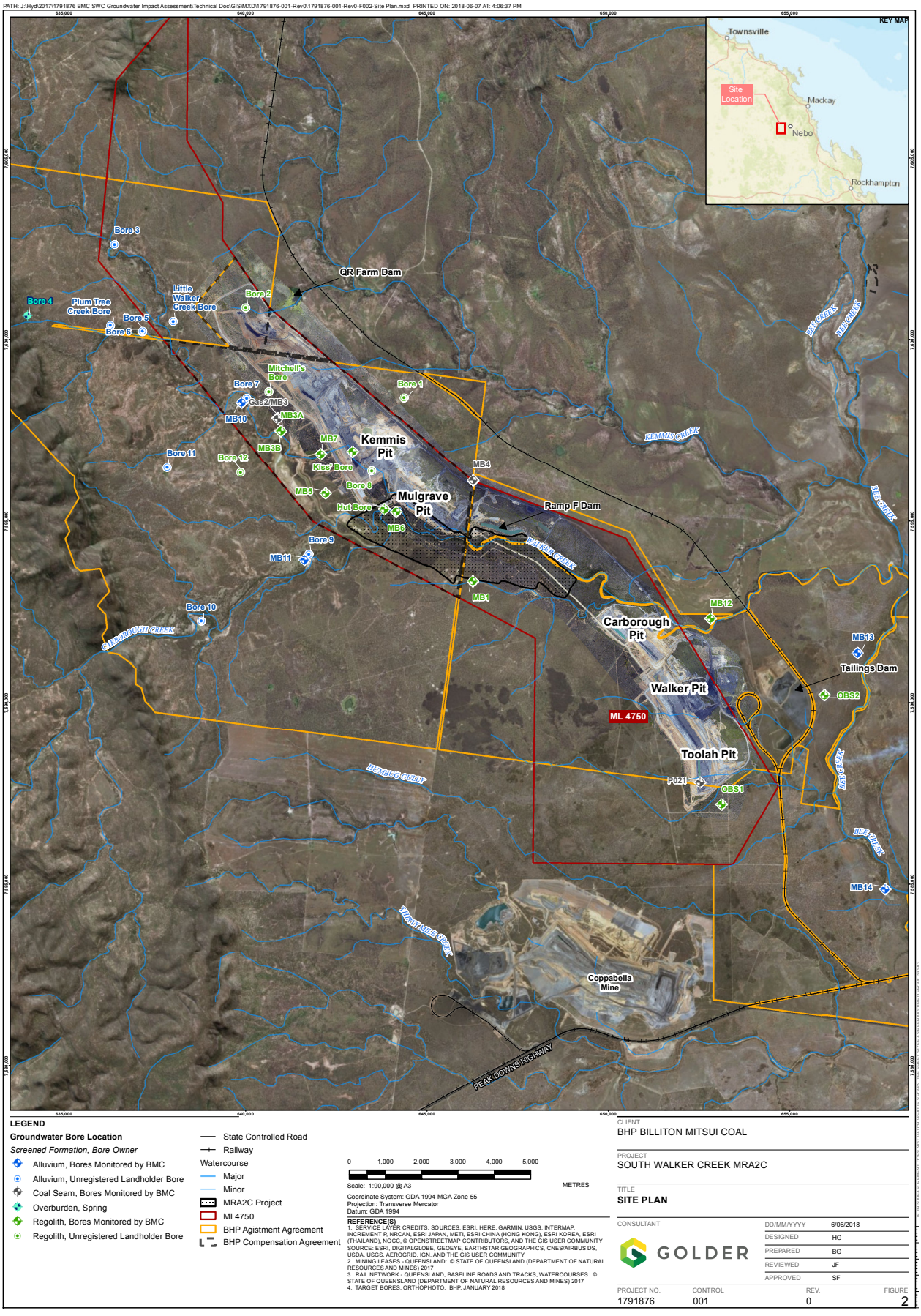


Figure 2: SWC Mine layout

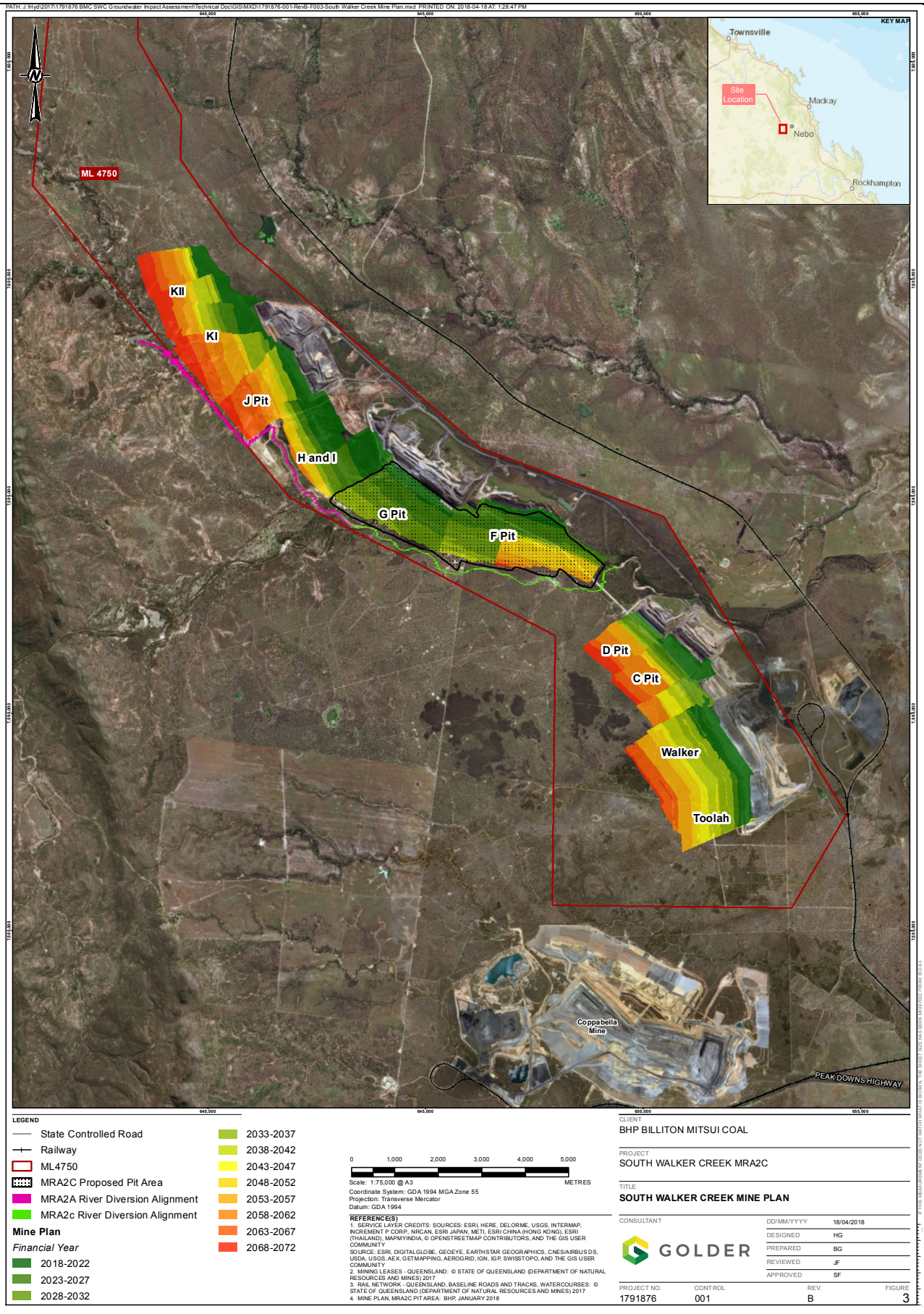


Figure 3: SWC Mine life-of-asset plan

5. The MRA2C Project

The MRA2C project component of the Mulgrave Pit has two distinct phases:

Phase 1: Preparation Phase

This phase involves the following works:

- fencing and stock removal
- clearing of vegetation and top soil removal for infrastructure items
- installation of supporting infrastructure including roads, powerline relocation
- geotechnical investigations, cultural heritage survey and artefact salvage
- construction of a water course diversion and water management facilities, including two new dams.

Fencing and stock removal will occur to enable safe operation of equipment.

Clearing of vegetation and topsoil salvage will occur only in areas required for installation of infrastructure or facilities, including the water course diversion. Vegetation clearance will include spotter catching and capture/relocation programs. Topsoil will be salvaged and stockpiled or immediately replaced elsewhere as part of rehabilitation works.

A diversion of Walker Creek is required to enable progression of mining activities in Mulgrave Pit. The diversion channel will be located on the far western flank of the mine lease and as such the diversion will be permanent. Studies have been conducted on the watercourse diversion for Walker Creek, which has resulted in the preferred option of utilising an existing tributary of Walker Creek to divert water flows. The diversion is ~8 km long and has been designed to be a functioning and sustainable diversion that meets regulatory requirements. The creek diversion will connect to Carborough Creek, directly adjacent to a previously constructed diversion associated with MRA Stage 2A and make the new confluence with Walker Creek ~6.4 km downstream from its current confluence. An overland flow bund will be constructed along the south-western length of the diversion channel with associated batter drains to receive overland flow runoff. Levees will be required at sections along the north-eastern length of the diversion channel to retain functionality of the diversion.

Phase 2: Continuance of mining in the Mulgrave Pit

This phase involves the continuation of mining activities in the Mulgrave Pit in a south-west direction from the existing highwall. The rate of advancement of the pit will vary in accordance with resource characteristics and the best practice of maintaining a uniform high wall/pit face. It is anticipated that the mining activity will disturb an area of 753 ha however, with infrastructure, spoil and overburden placement areas and creek diversion works, disturbance of 1,279 ha is being allowed for. Mining will continue in a westerly direction until the economical coal resource has been recovered.

The mining activity will only include activities authorised by the existing Environmental Authority and will follow the methodology outlined in the approved Plan of Operations. The South Walker Creek Plan of Operations is a statutory plan approved annually by the Queensland Department of Environment & Science (DES). The Plan of Operations details mining disturbance and rehabilitation 12 months in advance of the activity occurring. The Plan of Operations will detail the annual vegetation clearing overburden removal and mining activities necessary for the advancement of the existing Mulgrave Pit.

Topsoil stripping will be performed prior to mining of overburden for the coal resource. The pit will be progressively backfilled and spoil dumps will be rehabilitated as per the current practice and in-line with the approved Plan of Operations.

The project will be regulated by:

- the existing Environmental Authority issued under the *Environmental Protection Act 1994* (Qld)
- a Water Licence to Interfere by Diverting the Course of Flow issued under the *Water Act 2000* (Qld)

The project will be performed as part of mining activity authorised by Environmental Authority (EPML00712313), the Plan of Operations and the Surface Area Rights granted over Mine Lease 4750.

The *Environmental Protection Act 1994* (Qld) (EP Act) requires that the mine hold an Environmental Authority (EA) to conduct mining activities. The EA stipulates conditions relating to the mining activities that must be complied with to minimise environmental harm. The EA will be a key document controlling the activities associated with the project. Additionally, the EP Act requires that a Plan of Operations be submitted and approved which outlines the proposed mining activities to occur during the period of the Plan of Operations and describes the measures that will be taken to minimise environmental harm and remain compliant with conditions in the EA. A copy of the current EA is provided at Appendix B.

For the diversion component of the action, the *Water Act 2000* (Qld) requires that a Water Licence to Interfere with the Course of Flow be obtained from the Queensland Department of Natural Resources, Mines and Energy (DNRME). Approval requires that the design, construction, operation and monitoring of the diversion are consistent with Queensland Government and community expectations and will be regulated by DNRME. The licence conditions will require creating a waterway channel that resembles and functions like the natural system it replaces. The diversion has been hydraulically designed using both existing design guidelines adopted by the Queensland Government and the outcomes of the latest research undertaken by the Australian Coal Association Research Program (ACARP) in a report titled 'Criteria for functioning river landscape units in mining and post mining landscapes' (ACARP, 2014).

Figure 4 shows the surface area extent of the MRA2C project as well as the previously approved disturbance area for MRA2A. There is an approximate 99 ha overlap between the projects.

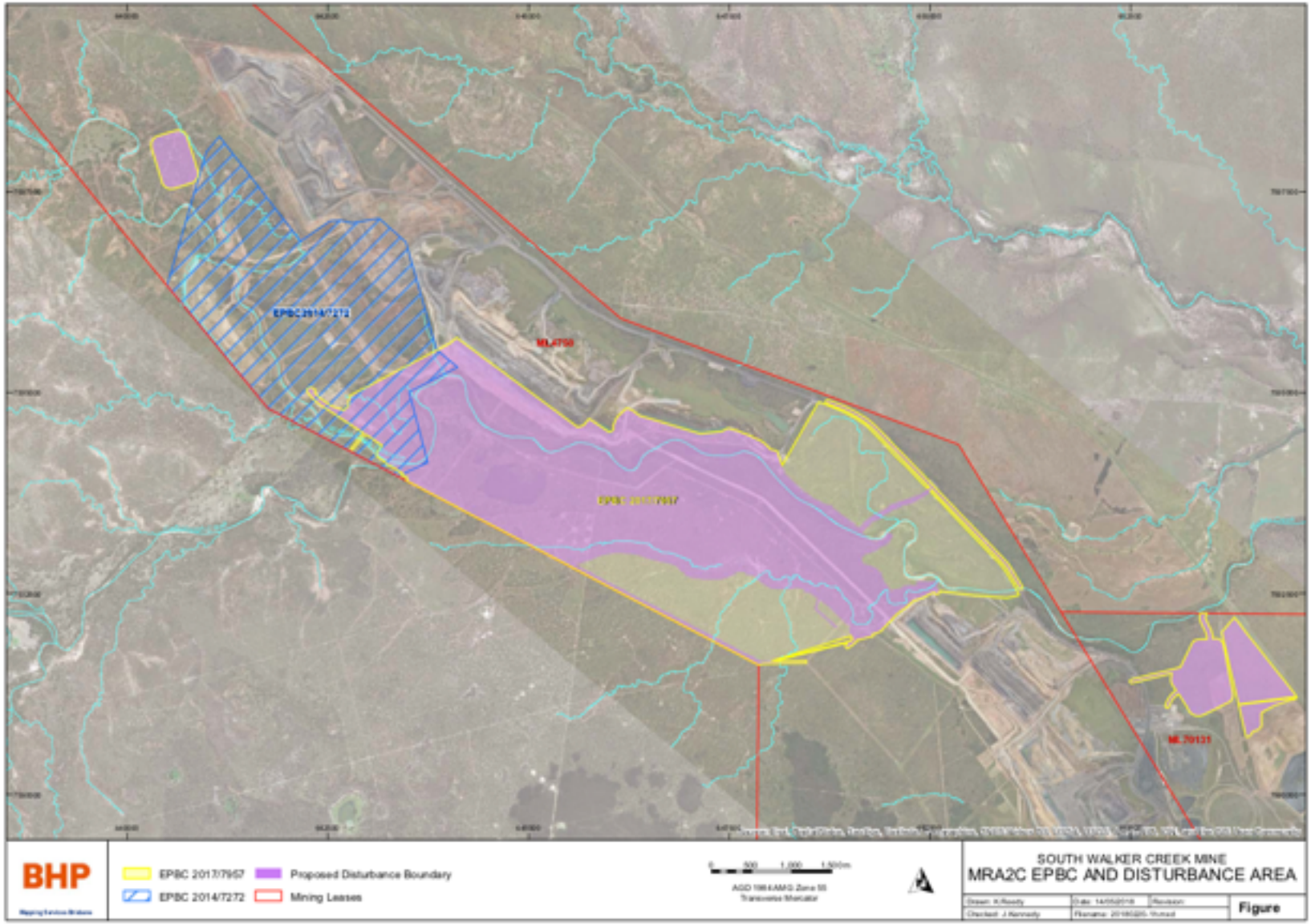


Figure 4: MRA2C project area

6. Water Resources

This section summarises the findings of an assessment of impacts on water resources. It identifies and qualifies impacts from the MRA2C project to water resource users, including third parties and the environment.

The EPBC Act Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources (Commonwealth of Australia 2013) set out the relevant criteria for assessment of large coal mining operations. The criteria are focussed on changes in hydrological characteristics, water quality, cumulative impacts. The criteria refer specifically to the utility of the water resource, therefore, it is imperative that any assessment of impacts is undertaken with a focus on third party uses of the water resource, including human and natural environmental users.

Specifically the criteria are:

5.2 General criteria

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.

5.2.1. Value of a water resource

It is important to consider the value of the water resource in determining whether the impacts of a proposed action on a water resource are likely to be significant. The key factor that will be relevant in determining the value of a water resource will be its utility for all third party uses, including environmental and other public benefit outcomes. Such outcomes include:

- provisioning services (e.g. use by other industries and use as drinking water)
- regulating services (such as the climate regulation or the stabilisation of coastal systems)
- cultural services (including recreation and tourism, science and education)
- supporting services (e.g. maintenance of ecosystem function).

The ecosystem function of a water resource includes the ecosystem components, processes and benefits or services that characterise the water resource, including support for the biological diversity or species composition of the water resource.

If there is evidence, based on data, modelling and engagement with potentially affected stakeholders, that the action would not materially affect (either by increasing or decreasing) the availability and quality of water for all third party users, including environmental and other public benefit outcomes and including at a future time or in another place, then that would reduce the likelihood of the action having a significant impact.

Criteria 5.3. Guidance on changes to hydrological characteristics

A significant impact on the hydrological characteristics of a water resource may occur where there are, as a result of the action:

a) changes in the water quantity, including the timing of variations in water quantity

b) changes in the integrity of hydrological or hydrogeological connections, including substantial structural damage (e.g. large scale subsidence)

c) changes in the area or extent of a water resource

where these changes are of sufficient scale or intensity as to significantly reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes.

Criteria 5.4. Guidance on changes to water quality

A significant impact on a water resource may occur where, as a result of the action:

a) there is a risk that the ability to achieve relevant local or regional water quality objectives would be materially compromised, and as a result the action:

   I. creates risks to human or animal health or to the condition of the natural environment as a result of the change in water quality

   II. substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality

   III. causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment

   IV. seriously affects the habitat or lifecycle of a native species dependent on a water resource, or

   V. causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource, or

b) there is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives), or

c) high quality water is released into an ecosystem which is adapted to a lower quality of water.

Criteria 5.5.1. Cumulative impacts

With regard to cumulative impacts the guidelines provide the following advice:

> The definitions of CSG development and large coal mining development refer to the action having a significant impact 'when considered with other developments, whether past, present or reasonably foreseeable developments'. This means that a significant impact on water resources may be caused by one CSG development or large coal mining development, or the cumulative impact of other developments in the area.

6.1. Surface Water

The following chapter provides a summary of surface water values and potential impacts, the full assessment undertaken by Alluvium (2018) is contained in Appendix C.

The SWC Mine operation interacts with the Walker and Carborough Creek systems which overlie low strip ratio coal measures. Previous creek diversions have been constructed at SWC Mine to provide access to these coal measures. The Mulgrave Pit now has three strips of coal left before being constrained from further mining by these creek systems. The mine planning process has identified the need for progression of the Mulgrave Pit, which will add significant value to the SWC Mine operation.

BMC has conducted a study on creek diversion options for the Mulgrave Resource area, which has resulted in preferred options known as Stage 2A and Stage 2C and shown in Figure 4.

Stage 2A of the project became operational in 2016 (ref: EPBC 2014/7272). Stage 2C, the focus of this surface water study, has been subject to functional and detailed design and impact assessment and is scheduled to commence construction in 2019, subject to receipt of all approvals. The impact assessment is based on the MRA2C project disturbance footprint identified in Figure 4.

Progression of mining

Understanding the current mine layout and the progression of mining under the MRA2C project development is key to understanding the potential impacts. The existing mine layout has an existing disturbance footprint (the base case). This assessment is aimed at understanding what the additional disturbance and associated impacts may be over the base case as a result of the MRA2C project development.

The current mine plan progression of mining strips for MRA2C project from 2016 to 2065 is shown in Figure 5 together with current sub-catchments and water management system storages relevant to the MRA2C project. Over that period, four areas of interest to the study are identified as follows:

- Active pit – the area between the top of the high wall and the toe of the low wall – the area where direct rainfall and potential groundwater seepage will drain to. This includes pre-strip areas.
- Spoil areas – the area of spoil from the crest of the low wall to the toe of the low wall – the unrehabilitated, active spoil area, where water runoff drains to the pit.
- Rehabilitated area – the area draining away from the crest of the low wall and pit where the spoil is rehabilitated to final landform or is in the process of rehabilitation. Runoff from this area is considered to be clean water runoff as it is sourced from either fully rehabilitated areas or has been treated by sediment control structures prior to discharge.
- Unmined areas – where clean water runoff drains directly or via drainage to Walker Creek. This includes all areas between the high wall and the western lease boundary, which may include capture and drainage (or pumping) of runoff between the highwall and diversion levees (referred to hereafter as the highwall drain catchments). All runoff from this area is assumed to be non-mine affected and will be directed to Walker Creek and not to the pit.

From the base case, advancement of the pits has been considered in logical blocks of years rather than annually due to scale of the project and minor variations at the annual scale. The following blocks provide the basis of a fit for purpose analysis of potential impacts and are based on mine planning as it is currently known.

- 2016-19 - The base case with existing pit, spoil and rehabilitation areas. This also includes the first pre-strips prior to interception with the MRA2C project study area.
- 2019-24 - This 5 year period is the first time that mining will intercept the MRA2C project study area.
- 2025-29 - This 5 year block is the first major advancement into the MRA2C project study area.
- 2030-34 - The 2nd 5 year block.
- 2035-39 - The 3rd 5 year block.
- 2040-49 - A ten year block.
- 2050-65 - The final block, 15 years. This will be the final configuration at pit closure.

For each of these blocks of time, areas have been calculated for each of the four areas of interest: active pit; spoil; rehabilitated areas; and unmined areas and for each of the catchments of F Pit; G & H Pit; and H & I Pit. From 2025 the rehabilitated areas are included with the natural (unmined) areas as all runoff from those areas is directed away from the pits, treated as clean water, and discharged as per EA conditions.

By the end of the 2050-65 block, the final pit void and spoil areas reduce as the area of rehabilitation, which drains external to the pit, is finalised. At that point the highwall catchments are minimal and remaining highwall drain catchments topography can be graded and/or built up to prevent ponding behind levees. As is shown in the table

below the total area of internally draining catchment increases from the base case of 412 ha in 2019 to a maximum of 579 ha in 2049 before declining at closure to 395 ha in 2065, a decrease of 20 ha over the base case.

Land use and catchment areas for F Pit; G & H Pit; and H & I Pit 2016 to 2065

Years	Pit (ha)	Rehab/natural (ha)	Spoil (ha)	TOTAL (ha)	% of Base Case
2016	100.6	73.1	241.0	414.7	
2016-19	91.8	50.8	269.5	412.0	99.3
2020-24	105.8	27.4	188.5	321.7	77.6
2025-29	130.6		256.4	387.0	93.3
2030-34	156.3		263.9	420.2	101.3
2035-39	199.9		360.5	560.5	135.1
2040-49	174.9		404.5	579.4	139.7
2050-65	101.6		293.	394.6	95.1

Site water storage and water management

The base case site water management system utilises the inactive void of F Pit as a water storage. Water from F Pit is periodically pumped to C Dam or F Dam from where it is used for site water requirements or released to Walker Creek under current EA conditions. Once the MRA projects are developed, F Pit will no longer be available as a water storage. A number of alternative arrangements have been considered for water storage. The selected option is to replace F Pit as a storage by constructing two new dams: a 500 ML Northern Dam and 2 GL Southern Dam (Figure 5). These dams will then act as water storage with sufficient capacity to hold mine affected water for site water use and/or for release to Walker Creek under EA conditions.

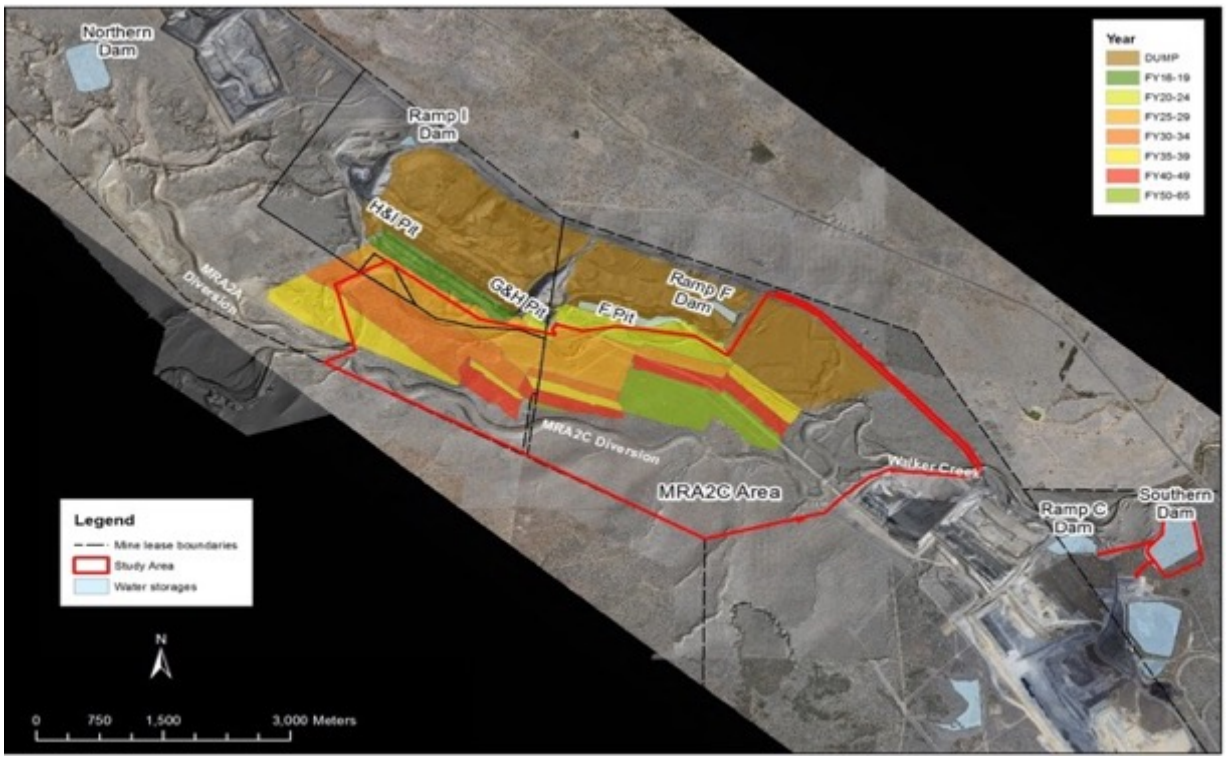


Figure 5: MRA2C Mine Plan 2016-65

Hydrology

Surface Water Resources

The location of the MRA2C project study area within the Walker Creek catchment, Bee Creek catchment and broader Fitzroy River catchment is shown in Figure 6.

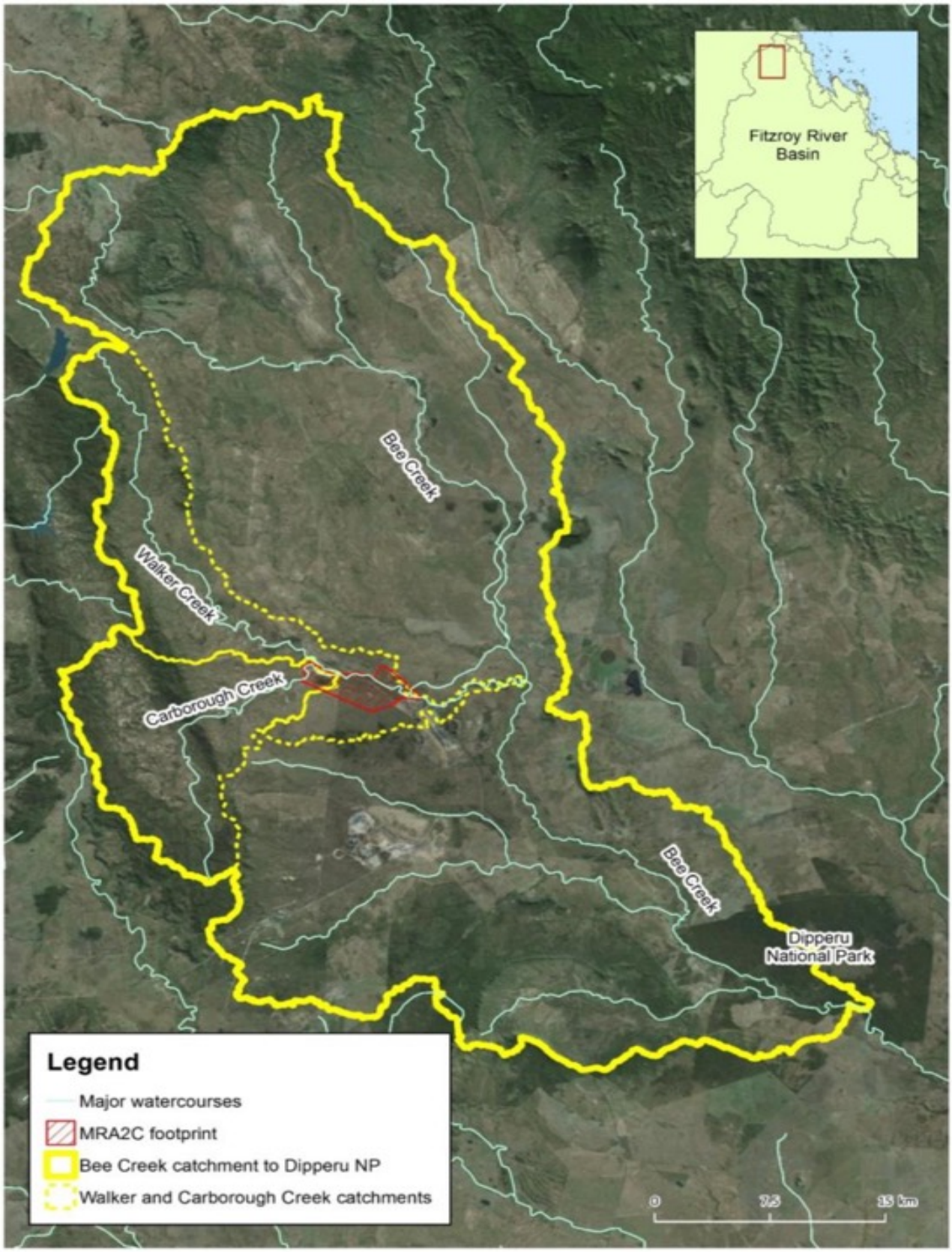


Figure 6: Location of MRA2C study area within local and regional catchments

Bee Creek extends from its headwaters, located approximately 40 km north of SWC Mine, to Funnel Creek, which eventually flows into the Connors River.

At a waterway distance of approximately 39 km south-east of SWC Mine, Bee Creek forms the western border of Dipperu National Park. The left bank of Bee Creek forms the boundary of Dipperu National Park with the right bank being an operational grazing property. Both banks were identified in 2011 as being disturbed by cattle access tracks to a similar extent of the banks observed farther upstream, beyond the National Park. Based on the instream and riparian habitat conditions, Bee Creek is considered to be in a slightly to moderately disturbed condition (BMT WBM 2011).

The headwaters of Walker Creek begin approximately 25 km north-west of SWC Mine. Within the mine site, reaches of Walker Creek have previously been diverted to accommodate mining activities, the most recent being MRA stage 2A, which creates a new confluence with Carborough Creek and became operational in 2016.

Under strict flow and quality conditions as set out the EA, SWC Mine may release mine-affected discharge into Walker Creek via controlled release processes from C-dam or F dam. The distance from the release points to Walkers Creeks' confluence with Bee Creek is 8.1 km. Based on the degree of modification to its catchment, quality of aquatic habitat, and overall stream condition, Walker Creek is considered to be in slightly to moderately disturbed condition (BMT WBM 2011).

BMT WBM (2011) stated that "based on the likely regularity of inundation, modification to its catchment, quality of aquatic habitat and overall stream condition, Carborough Creek is considered to be in a moderately disturbed condition". With the completion of the MRA2A project diversion of Walker Creek, the confluence with Carborough Creek was moved upstream, just outside the MRA2C project area. Consequently impacts to Carborough Creek are restricted to limited changes in flood extents and depths.

Human and Environmental Uses

Surface water uses in the SWC Mine area have been identified as:

- Ecosystem function
- Stock watering

Waterways may provide temporary habitat and aquatic fauna movement corridors during flow events. Deeper waterholes, if present, may persist for extended periods into the dry season but there are no permanent waterholes on Walker Creek between the mine and the Bee Creek confluence, approximately 10 km waterway length from the MRA2C project.

The catchment area of Walker Creek (including Carborough Creek) is approximately 349.5 km^2. The deep scours at bends in Bee Creek are likely to approach permanency in wetter years, but probably dry out in periods of drought (BMT WBM 2011). The first observable waterholes that may approach permanency are on Bee Creek downstream of the mine at Dipperu National Park, approximately 39 km waterway length downstream of the MRA2C project.

Changes to Hydrology

Hydrological analysis has been undertaken for previous studies conducted by Alluvium (2014 and 2015) and the functional design of the MRA2C diversion, refer Attachment C to Appendix C (Alluvium 2016). Peak discharge estimates for 2 year and 50 year ARI events for Walker Creek and Carborough Creek upstream and downstream of the confluence used in hydraulic modelling to assess existing conditions are presented below.

Peak discharge estimates and catchment areas for Walker and Carborough Creeks

	Walker Creek upstream (excludes that component of Walker Creek catchment downstream from the start of the diversion)	Carborough Creek upstream	Confluence
Catchment area (km^2)	~130km^2	~160km^2	~300km^2
2 year ARI peak discharge (m^3/s)	100	121	217
50 year ARI peak discharge (m^3/s)	442	554	998

The maximum impact on flows in Walker Creek as a direct result of the increasing catchment areas of F, G & H and H & I Pits is a decrease of 0.47% and 0.08% of the Bee Creek catchment at Dipperu National Park by 2049. This is a conservative estimate that does not consider any flows released from storage under EA conditions. It is reasonable to consider the conservative scenario as at pit closure the catchments of F, G & H and H & I Pits will become terminal (i.e. there will be no pumping from the pits and they will not contribute any runoff to Walker Creek).

In addition to altered flows there will also be changes to the extent of floodplain inundation as a result of the development of the MRA2C project. The primary change is the result of the replacement of a reach of Walker Creek channel with a diversion. This will result in the loss of channel and floodplain in one area and its replacement in another. Changes have been modelled as part of the MRA2C Diversion Functional Design, refer Attachment C to Appendix C (Alluvium 2016).

Water Quality

There are two sources of water that will be discharged from site: stormwater released after treatment in accordance with an Erosion and Sediment Control Plan (ESCP); and mine water collected from the catchments of F, G & H and H & I Pits, which are currently collected in F Pit.

The controlled release of mine-affected water from site is only permissible in accordance with strict conditions outlined in the EA. These release conditions have been carefully and scientifically determined, and are in accordance with Qld Government requirements, so as to protect downstream environmental values. The release conditions are based on the ability to dilute discharges with natural flow rates to ensure that the constituent concentrations of dissolved salts are not likely to produce a downstream environmental impact. These have been determined in relation to typical runoff flow rates experienced at the discharge points.

Under the EA conditions, monitoring is required of the quality of receiving waters at specific locations, and for various parameters, different frequencies. All monitoring is undertaken under the umbrella of the site Receiving Environment Monitoring Program (REMP). The design of the REMP was completed in 2012 and the most recent reporting was in 2017 (FRC Environmental, 2017), which concluded that:

> "As there was no evidence of an impact on the macroinvertebrate communities, it is considered very unlikely that any changes in water quality associated with the discharge of mine-affected water resulted in environmental harm. Based on these results, the current discharge limits appear suitable to protect downstream environmental values. However, the limits for some parameters were often exceeded at reference sites in 2016–2017, which suggests they may be more stringent than required. Recommendations based on the outcomes of the 2016–2017 REMP (FRC Environmental 2017) include: reviewing all water quality data collected from reference sites to set more applicable local guidelines for water quality and macroinvertebrates."

Impacts to Surface Water Resources

Human and Environmental Uses

DERM (2010) set out Draft Environmental Values (EVs) for the Fitzroy River Basin, which were refined by WBM (BTM WBM, 2011) based on more detailed site-specific information. For Walker Creek and Bee Creek the users identified in the EVs are:

- Aquatic and riparian ecosystem
- Farms (for water supply) (however, it should be noted that there are no identified extraction points directly from Bee or Walker Creek downstream from the MRA2C project)
- Stock (drinking water) (It should also be noted that there are no identified stock watering points directly from Walker Creek downstream from the MRA2C project and that alternative off stream stock watering is used, which is supplied with water by SWC Mine from the Braeside borefield, approximately 60 km distant)
- General public (visual recreation)
- Limited local drinking water supply (none known on Walker Creek or Bee Creek in the study area to Dipperu National Park)
- Industrial use (mining) (Whilst this is theoretically possible, there is however no known mining extractive use from Bee or Walker Creeks)
- Cultural custodians/users (including traditional owners).

The assessment in this chapter considers to what extent any "significant" impacts to users may be expected.

Hydrological Impacts

The maximum impact on flows in Walker Creek as a direct result of the increasing catchment areas of F, G & H and H & I Pits is a decrease of 0.08% of the Bee Creek catchment at Dipperu National Park by 2049. This is considered to be a conservative estimate as it does not include any flows returned to the natural system from storages (in F Pit and/or the new Northern and Southern Dams) under EA conditions. It is reasonable to consider the conservative scenario as at pit closure the catchments of F, G & H and H & I Pits will become terminal i.e. there is no pumping planned from the pits and they will not contribute any runoff to Walker Creek.

This percentage reduction in catchment area and flows is well within any margin of error in calculations and is not considered to represent any significant impact on the hydrology of Walker and Carborough Creeks and is therefore considered to have no significant impacts to users.

There will be changes to flood flows and extents, however, those changes are localised to the diversion and the immediate reaches of Walker and Carborough Creeks upstream and downstream from the diversion on the SWC Mine lease and adjacent BMC owned land. There are no identified significant impacts to users.

The catchment areas of the pits comprising the MRA2C project have been identified and how they are predicted to change over the mine life. From commencement of mining in 2019 until 2034 there is predicted to be very little change in the catchment areas and land use (spoil and pit void) compared to the current base case. The site's water management system, including release of mine affected water, operates effectively under current EA conditions. Given that the catchment areas of the pits changes little over the period 2019 to 2034 it can be expected that it can continue to operate effectively under the current EA without the need for amended water quality release conditions.

From 2034 to 2049 the catchment area increases by 163.4 ha (40% greater than the current base case), which will result in a greater volume of water being required to be removed from the pits to alternative storage dam/s prior to discharge. SWC Mine will need to ensure that appropriate storage and discharge infrastructure is constructed to enable discharges to continue to be undertaken in line with EA conditions. This will require periodic reviews of the mine water management system and water balance model.

Water Quality Impacts

The maximum change in catchment area to Walker Creek as a result of the MRA2C project development is 1.65km^2, which is 0.47% of the 349.54km^2 Walker Creek catchment (Walker Creek including Carborough Creek) and 0.08% of the 1,945.39 km^2 Bee Creek catchment to Dipperu National Park.

Potential changes to water quality over current conditions are considered to be very limited due to the limited increase in the scale of the project. As the MRA2C project develops the land previously mined will be progressively rehabilitated resulting in a limited overall increase in disturbed ground or pit extent. Consequently, the potential for significant changes to water quality over the current mining configuration is considered to be very low given that the 2017 REMP report (FRC, 2017) has not identified any evidence impacts from mine water releases (including releases from F Pit dam) under current EA conditions and states that "it is considered very unlikely that any changes in water quality associated with the discharge of mine-affected water resulted in environmental harm. Based on these results, the current discharge limits appear suitable to protect downstream environmental values".

Aquatic biota

Waterways of the SWC Mine area are 'perched alluvial' streams, using the definition of Datry et al. (2017); thus, flows are brief in response to rainfall and there is no baseflow (i.e. the streams 'lose' water to underlying groundwaters rather than gain water from adjacent shallow groundwater systems). Flows in Bee Creek occur approximately 22% of the time as discrete short duration events (Figure 7), with Kennard et al. (2010) classifying flow regimes of the region as 'unpredictable summer highly intermittent' and 'variable summer extremely intermittent'.

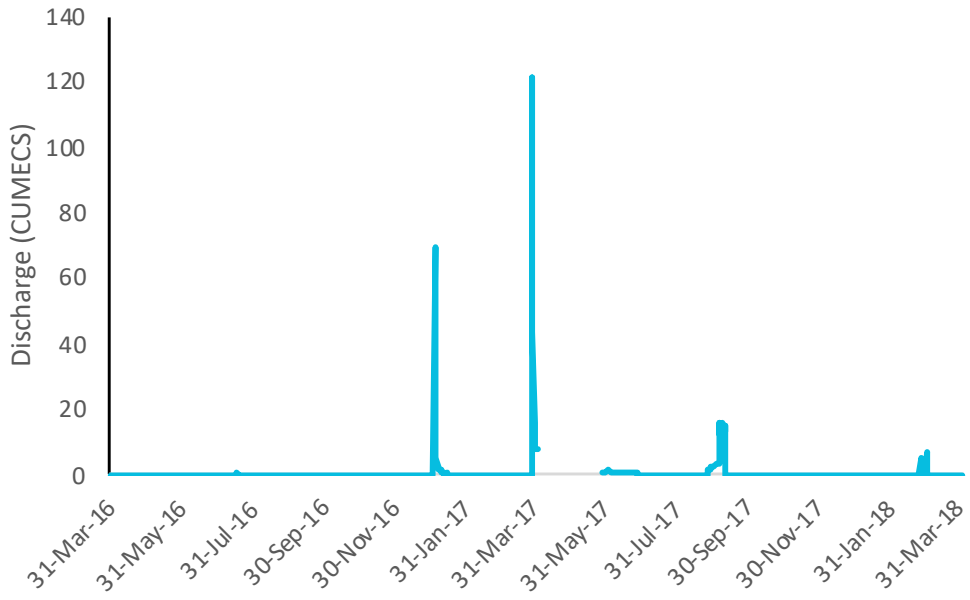


Figure 7: Stream flow at BMC gauging station on Bee Creek 31 March 2016 to 4 April 2018.

While the ephemeral flow regime of waterways of the region do not support species that require greater perenniality of flow (such as white-throated snapping turtle (*Elseya albagula*) or Fitzroy River turtle (*Rheodytes leukops*), both of which are listed threated species under the EPBC Act), they support a range of common species that are tolerant of ephemeral flow regimes, including aquatic invertebrates (Stubbington et al. 2017), aquatic and terrestrial vertebrates (Kerezsy et al. 2017; Sanchez-Montoya et al. 2017), terrestrial and semi-aquatic invertebrates (Steward et al. 2017) and aquatic plants (Sabater et al. 2017).

Aquatic invertebrates are routinely assessed within the scope of the SWC Mine Receiving Environment Monitoring Program (REMP) using conventional AUSRIVAS sampling methods, as required by applicable standards set by the regulator (DES 2018a). While standard aquatic bioassessment methods are reported to be unsuitable for highly ephemeral streams (Chiu et al. 2017), current compliance monitoring requirements are based on standard bioassessment methodologies. Aquatic macroinvertebrate data collected for the SWC REMP in recent years is presented below.

Aquatic vertebrates (turtles and fish) have been assessed within the scope of other SWC projects, and are described below. Terrestrial vertebrates (e.g. amphibians, reptiles, birds, mammals) that may utilise the ephemeral flows of waterways of the SWC Mine area have been assessed within the scope of terrestrial ecology studies and are not described here.

Terrestrial and semi-aquatic invertebrates (TSAI) is a relatively new area of research (e.g. Steward et al. 2011). As assessment of this biotic group is not currently recognised by DES (2018a), primary data is not available. However, a brief literature review is provided below. While the use of TSAI for assessing the ecological health of the ephemeral waterways (e.g. for REMPs) may be theoretically superior compared to the use of aquatic macroinvertebrates in such systems, there are many knowledge gaps about the diversity and ecology of TSAIs (Steward et al. 2017, 2018) that currently limit their utility in the development of a defensible ecological monitoring program. Furthermore, no region-specific baseline studies at ‘reference’ sites have been implemented; thus, there is no benchmark regarding the diversity or taxonomic composition of TSAI communities of ‘healthy’ ephemeral systems of the region.

Aquatic plants are assessed in the context of ‘habitat features’ for the REMP, and are described below.

Aquatic Invertebrates

Macroinvertebrate communities of edge habitat of watercourses in and surrounding the SWC Mine area vary spatially and temporally in diversity and composition, with taxonomic diversity overall typically being lower than the default biological guideline (QWQ trigger range). The recorded macroinvertebrates were dominated by insects; for example, the 2017 REMP survey recorded:

- beetles (Coleoptera) – nine families
- flies and midges (Diptera) – eight families
- bugs (Hemiptera) – nine families
- dragonflies and damselflies (Odonata) – five families

- mayflies (Ephemeroptera) – three families (sensitive taxa), and
- caddisflies (Trichoptera) – two families (sensitive taxa).

Other macroinvertebrate taxa recorded in the 2017 REMP included (amongst other taxa):

- mussels and clams (Bivalvia) – one family
- snails (Gastropoda) – two families
- macrocrustacea (Decapoda) – four families:
- long-armed river prawn (Palaemonidae)
- glass shrimp (Atyidae)
- crayfish (Parastacidae, genus Cherax) (with crayfish burrows recorded at a number of sites), and
- freshwater crabs (Parathelphusidae).

Most sites were dry for the 2018 REMP, although a sub-set of the macroinvertebrate taxa caught in 2017 was present at the two sites that held water in 2018.

All recorded macroinvertebrate taxa are common and widespread in Queensland. All crayfish recorded were of the genus *Cherax*. None of the macroinvertebrate taxa recorded are listed threatened species under the EPBC Act or *Nature Conservation Act 1992* (NC Act).

Aquatic Vertebrates

Turtles

Two species of turtle are reported from within 50 km of the SWC Mine study area: eastern long-necked turtle (*Chelodina longicolis*) and Krefft's river turtle (*Emydura macquarii krefftii*) (DES 2018b). It is possible that broad-shelled river turtle (*Chelodina expansa*) also occurs near the SWC Mine area. The nearest populations of white-throated snapping turtle and Fitzroy River turtle are likely to be over 80 km downstream from the SWC Mine area.

None of the known or possibly occurring species of turtle in or surrounding the SWC Mine area are listed as threatened species under the Commonwealth's EPBC Act or Queensland's NC Act.

Fish

Five native species of fish are recorded within 50 km of the SWC Mine area (DES 2018b), with four of them known from the SWC Mine area and surrounds (i.e. all but purple spotted gudgeon) (frc environmental 2015):

- common gudgeons (*Hypseleotris* spp.)
- spangled perch (Leiopotherapon unicolor)
- Agassiz's glassfish (*Ambassis agassizii*)
- eastern rainbowfish (*Melanotaenia splendida*), and
- purple spotted gudgeon (*Mogurnda adspersa*)

The following species may also occur periodically near the SWC Mine area:

- sleepy cod (*Oxyeleotris lineolata*)
- fly-specked hardyhead (*Craterocephalus stercusmuscarum*)
- Hyrtl's tandan (*Neosilurus hyrtlii*), and
- bony bream (*Nematolosa erebi*).

These are all common species that are tolerant of harsh environmental conditions (e.g. variable flow, fluctuating water quality) (Pusey et al. 2004) that are typical of ephemeral watercourses of the region. All species are potadromous (i.e. migrate to various extents within freshwaters and do not migrate between freshwater and estuarine waters). None of these species are listed as threatened species under the Commonwealth's EPBC Act or Queensland's NC Act.

Terrestrial and Semi-Aquatic Invertebrates

Dry river beds have diverse TSAI communities that differ significantly from invertebrate communities in adjacent riparian areas, although the riparian fauna is more diverse than that of dry stream beds (Steward et al. 2011). While most TSAI taxa are shared between dry stream beds and adjacent riparian areas, approximately 20% of morpho-species appear to be unique to dry stream beds (Steward et al. 2011).

Commonly encountered TSAI taxa include ants (Formicidae), beetles (Coleoptera), springtails (Collembola), mites (Acarina), flies (Diptera), bugs (Hemiptera), cockroaches (Blattodea), spiders (Lycosidae), etc (Steward et al. 2011), although shortly after drying the taxa present may also include a range of semi-aquatic taxa, such as some types of tolerant semi-aquatic insect, snails and crustacean (Steward et al. 2012, 2017).

First flush flows of high velocity may entrain some TSAI taxa, which can be catastrophic for them if flows are not rapidly followed by drying (Steward et al. 2017), although resistance traits to flows used by other TSAIs include flotation, swimming, flight, climbing and novel respiration mechanisms (Steward et al. 2017).

TSAIs likely play key ecological roles temporarily during dry phases between wet phases, and spatial between wet and dry areas of a drying stream (Steward et al. 2017). TSAIs may be vulnerable to disturbances such as hydrological alteration, sedimentation and weed infestation (Chiu et al., 2017; Steward et al. 2017). However, they have a range of resilience traits that allow persistence between wet and dry phases, and many have highly developed abilities of dispersal (Steward et al. 2017), indicating that the may have relatively large geographical distributions. Consequently, it is likely that TSAIs, including those that appear to be restricted to dry river beds, have regional-scale or inter-regional scale distributions (i.e. are not narrow range endemics). No TSAI species is currently listed as threatened at Commonwealth or State levels.

Aquatic Plants

Aquatic plant diversity is low, with many sites not having any aquatic plants recorded. Those species that were recorded always had low percentage cover, and all were of an emergent growth form (i.e. submerged and floating aquatic plants not present). Recorded taxa include (frc environmental 2018):

- sedges (*Cyperus* spp.)
- nardoo (*Marsilea drummondii*)
- rushes (*Juncus usitatus*), and
- matt rushes (*Lomandra* sp.).

These are all common species, and none are listed as threatened species under the Commonwealth's EPBC Act or Queensland's NC Act.

6.2. Groundwater

This chapter summarises the findings of an assessment of impacts on ground water resources. It presents an overview of groundwater conditions with a focus on the environmental values of groundwater, the potential impacts to those values, and plans for impact mitigation and management.

The assessment addresses concerns about groundwater drawdown and depressurisation, groundwater contamination from mining activities and changes to surface water and groundwater quality and quantity from the mining activities.

The full assessment report by Golders (2018) is contained in Appendix D.

Groundwater Resources

The following chapter provides a summary of groundwater values and potential impacts, the full assessment undertaken by Golders (2018) is contained in Appendix D. A supplementary memorandum provided by AQ2 (2018) is at Appendix I.

The hydrogeology of the SWC Mine has been characterized through several previous studies, field investigations, monitoring programs, and groundwater modelling studies. More than 15 studies and several years' worth of monitoring data were considered during development of the groundwater impact assessment.

The conceptualisation of the groundwater system at the SWC Mine and the MRA2C project expansion project is shown in Figure 8. This figure is a schematic cross-section, generally aligned from west to east, that illustrates the processes and pathways of groundwater movement including recharge and discharge, vertical and lateral flow, and flow around the active mine pit.

There are two identified aquifers at the SWC Mine: the unconfined or "water table" aquifer and the confined coal seam aquifer. These are described below.

Water Table Aquifer

The unconfined or 'water table' aquifer occurs in two hydrostratigraphic units that are in hydraulic connection: the alluvium and regolith.

Alluvium consists of Quaternary and Pleistocene age sediments deposited along the major ephemeral creek systems. The alluvium is less than 20 m thick in the project area and has a limited distribution along present creek channels and nearby paleochannels associated with Walker and Carborough Creeks. The localised zones of saturated alluvium are disconnected from one another by bedrock outcrops and high points between stream channels. Where alluvium occurs, it may be locally saturated or unsaturated.

At most locations, saturated thickness of the alluvium generally varies from 5 to 10 m based on the groundwater levels measured in monitoring bores. In the project area, the greatest saturated thickness of alluvium occurs in the southeast along Bee Creek.

While the alluvium and regolith together comprise the water table aquifer, the distribution of the alluvium is quite limited and localised to stream courses, and the regolith is the main water-bearing unit for the water table aquifer.

The water table aquifer is recharged via direct precipitation to outcropping regolith and by ephemeral stream recharge to alluvium during the wet season. Water levels and groundwater chemistry indicate that water in the alluvium and regolith are in connection, although groundwater in the water table aquifer underlying streams may be fresher during and after the wet season due to direct recharge. Groundwater from the water table aquifer does not exit to surface water in the project area. Inflows from ephemeral streams will seep into the alluvium, then drain to the underlying regolith or be rapidly lost to evaporation.

Confined Coal Seam Aquifer

The confined coal seam aquifer is a regional, low-permeability aquifer that occurs within the Rangal Coal Measures associated with the Leichhardt coal seams. The Rangal Coal Measures outcrop along the footprint of the current SWC Mine and dip gently to the west where they are overlain by increasing thickness of the Rewan Formation. The confined coal seam aquifer extends beyond the study area into other parts of the Nebo Synclinorium.

Groundwater at depth within the Rangal Coal Measures preferentially flows via coal seams, along fractures and cleats. At depth, the buried coal seams are interpreted as confined aquifers and the adjoining interbeds are interpreted as aquitards. There are downward gradients between the water table and coal seam aquifer, as illustrated graphically in Figure 8.

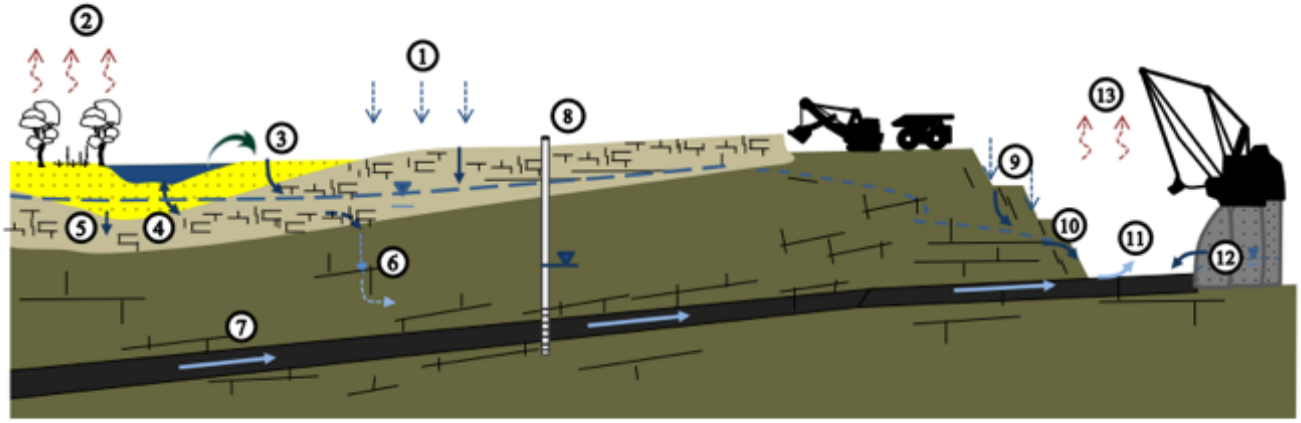
Background Water Quality

The major ion chemistry of groundwater within the study area shows Na-K cations are dominant, and major anions can be classified as HCO_3-Cl type with sulphate almost complete lacking. The water table aquifer is more variable in composition with greater amounts of Ca + Mg, while the confined coal seam aquifer does not contain these cations.

Monitoring data indicate that concentrations of aluminium, arsenic, boron, cadmium, copper, iron, lead, manganese, molybdenum, nickel, selenium and zinc were detected above the ANZECC guideline values for aquatic ecosystems with 95% protection level and/or the ADWG guideline.

According to the ANZECC/ARMCANZ (2000) guideline values, the groundwater salinity is suitable for most stock watering requirements; the Total Dissolved Solids (TDS) concentrations are within the salinity tolerance of most livestock (2000 – 5000 mg/L; some animals may adapt to higher salinity without loss of production).

At a few locations, TDS concentrations are within Australian Drinking Water Guidelines - aesthetic values for “good quality” drinking water (<600 mg/L) or “fair quality” drinking water (600-900 mg/L), but water quality at most bores exceed these aesthetic guidelines and would not be suitable for human consumption.



1. Seasonal rainfall infiltration through ground surface and percolation to the water table aquifer (alluvium and regolith)
2. Evapotranspiration from vegetated areas, including fringing riparian vegetation: upwards movement of capillary pore water in the soil cover, evaporation from ponding water in surface depressions
3. Infiltration of overbank flood waters from ephemeral creeks during storm events to recharge alluvium
4. Ephemeral creek discharge to water table aquifer at times when creeks are flowing in the wet season (creek levels are always above groundwater levels in the water table aquifer)
5. Recharge of groundwater in the interconnected network of fissures, joints and bedding parings (secondary porosity) of the regolith.
6. Locally, slow vertical groundwater leakage through low permeability overburden towards confined aquifer
7. Lateral transport of groundwater along confined coal seam aquifer from regional recharge areas due to hydraulic head differential
8. Confined coal seam aquifer bores have hydraulic heads above the elevation of the aquifer, but below the water table aquifer level, indicating downward vertical gradients
9. Infiltration and percolation of rainfall and pit wall runoff into open fractures of the stress release and blast induce fringe behind the pit slope face
10. Groundwater daylighting along open bedding partings, faults, fissure zones and joint-bedding parting intersection
11. Groundwater seepage from intersected coal seams in the highwall and pit floor
12. Groundwater seepage flow from low wall spoil dumps with groundwater recharged during wet seasons and heavy rainfalls
13. Evaporation of groundwater seepage and pit water accumulated in pit floor depressions and low points

GOLDER

CLIENT: BHP Billiton Mitsui Coal		PROJECT: South Walker Creek MRA2C	
DRAWN: JF	DATE: 7 March 2018	TITLE: Conceptualisation of the Groundwater System	
CHECKED: -	DATE: -		
SCALE: N/A	SHEET SIZE: A4	PROJECT No: 1791876	REVISION: 0 / FIGURE No: FIGURE 10

Figure 8: Conceptualisation of the Groundwater System

Figure 9: Generalized contour map of hydraulic head in the water table aquifer

Groundwater Values

Water Table Aquifer Values

The water table aquifer is considered a groundwater resource, with 15 unregistered landholder bores present within the project site and surrounding areas. All identified bores are presently or were formerly used for stock watering purposes. There are no identified groundwater bores in the area used for human consumption or agricultural purposes.

Stock Watering

A census of existing groundwater facilities at and within the vicinity of the SWC Mine was undertaken, in consultation with the surrounding landholders (CDM 2016). A total of fifteen unregistered bores were verified in the field: Bores 1 to 12, Mitchell's Bore, Little Walker Creek Bore, and Plum Tree Creek Bore. Kiss' Bore and Hut Bore are unregistered landholder bores owned by BMC and the latter has been decommissioned. Neither will be used as a water source. AGE (2014) indicates that 10 of the unregistered bores are active and used for stock watering purposes.

A search of the Queensland Government database indicates that the groundwater use over the broader area is limited, the nearest bore registered for water supply is located more than 18 km from the MRA2C project mining area.

Unregistered Landholder Bores

Bore ID	Northing	Easting	Surface Elevation	Depth to Water	Total Depth	HSU
Bore 1	644260	7598204	243.6	15.5	39.5	Regolith
Bore 2	639895	7600690	253.9	19	31.98	Regolith
Bore 3	636279	7602437	257.9	NA	NA	Alluvium
Bore 4	633882	7600475	311.4	NA	NA	Overburden
Bore 5	637044	7600028	253.5	NA	NA	Alluvium
Bore 6	637045	7600039	253.2	NA	NA	Alluvium
Bore 7	639925	7598198	237.9	5.41	9.85	Alluvium
Bore 8	643363	7596208	222.8	10.95	33.21	Regolith
Bore 9	641636	7593910	232.1	5.61	7.57	Alluvium
Bore 10	638672	7592054	242.2	NA	NA	Alluvium
Bore 11	637726	7596291	270.2	NA	NA	Alluvium
Bore 12	639752	7596163	254.9	23.78	90.5	Regolith / Overburden
Mitchell's Bore	640530	7598384	241.4	13.9	43	Regolith
Little Walker Creek Bore	640530	7598384	241.4	13.9	43	Regolith
Plum Tree Creek Bore	636278	7600384	259.4	NA	NA	Alluvium

Groundwater Dependent Ecosystems

Groundwater-dependent ecosystems (GDEs) are defined as ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide (Richardson et al., 2011).

The GDE Atlas maps GDEs as three broad types:

Type 1 GDEs

Stygofauna are aquatic animals that live in groundwater and have been documented in limestone and fractured rock aquifers but are most abundant in alluvial aquifers (Hancock *et al*, 2005).

The potential for stygofauna habitat in the project area is limited by the following factors:

- the lack of limestone formations or karstic features within the project study area;
- the lack of surface expression of groundwater in the project area.

A field investigation for the possible presence of stygofauna has not been undertaken. The site hydrogeology at the project site is typical of similar sites in the region, and there is a significant extent of alluvial aquifer along other creeks in the area including Kemmis Creek, Bee Creek, and Walker Creek that are beyond any potential impacts of the project. It is therefore unlikely that any stygofauna, if present in the alluvial aquifer, are endemic to the project site.

To further understand if stygofauna are present, BMC will implement a stygofauna pilot study, as described in the Queensland *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (the guideline; DSITI 2015) and referenced in the *Monitoring and Sampling Manual* (DES 2018). Further details are presented in the proposed monitoring section.

Type 2 GDEs

Type 2 GDEs are those dependent on the surface expression of groundwater.

Several areas of the project are classified as 1-50% wetland in the GDE Atlas. A high potential for groundwater discharge to surface water is indicated as occurring along Walker Creek, Carborough Creek and in a palustrine wetland to the immediate south west of the proposed expansion area. However, water level data from monitoring bores indicates that groundwater is at least several meters below ground surface throughout the study area. This includes data from bores screened along Bee Creek (MB13), Walker Creek (Bore 7, MB10, and others) and Carborough Creek (MB11). Throughout the study area, the base of ephemeral streams and other surface water features are elevated several meters above groundwater, and surface water features are losing streams when flowing. The groundwater level never comes close to the surface, and discharge to surface water (i.e. springs) has not been observed or documented in the project area.

Thus, there is no evidence for the presence of Type 2 GDEs, and the likelihood is extremely unlikely in the study area.

Type 3 GDEs

Type 3 GDEs represent vegetation that depends on groundwater below the surface.

Eco Logical Australia (2018) completed a detailed ecological assessment for the MRA2C project including surveys for Matters of National Environmental Significance. Five major habitat types were identified in the project area:

1. Fringing riparian forest occurs on the stream banks of Walker and Carborough Creek;
2. Floodplain Eucalypt forest occurs on the active floodplains adjacent to Walker and Carborough Creek;
3. Dry Eucalypt Forest occurs in the majority of the study area and occurs outside of the extent of the currently active floodplain (e.g. on older alluvial terraces);
4. Brigalow Woodland occurs in discrete patches (e.g. towards the southern extent of the proposed expansion area) associated with clay plans; and
5. Wetlands occur in discrete patches and include a palustrine wetland fringed by *Eucalyptus camaldulensis* (river red gum) that occurs to the immediate south west of the proposed expansion area.

Based on available monitoring bore data across the SWC Mine, habitats where vegetation could potentially access groundwater (i.e. < 10 m depth to water) (Canadell et al., 1996) is limited to fringing riparian forest and portions of the floodplain Eucalypt forest within the western portion of the MRA2C project footprint along Walker Creek. In the broader area across the SWC Mine where shallow groundwater has also been identified, the habitats present are also limited to these two types. This includes areas within the upper branches of Walker Creek and along Carborough Creek.

For these habitat types, the groundwater that may potentially be accessed would be contained within the water table aquifer. This aquifer system does have limitations as a reliable and consistent groundwater source for vegetation as it is seasonally influenced. During dry periods when vegetation would be more reliant on this source

of water, recharge rates and the influx of fresh water decreases, which impacts on water quality and water levels within the aquifer.

Nonetheless, these limitations would not necessarily discount the potential use of groundwater by these habitat types. Particularly for the habitat types that occur within the upper reaches of Walker Creek and along Carborough Creek where depth to water has been recorded at less than 5 m. Species composition within these habitat types consists of native canopy species that have been recorded to access groundwater between depths of 6 to 10 m (i.e. *Eucalyptus calmedulensis* and *Corymbia clarksoniana*) (Orellana et al. 2011).

However, not all areas of these two habitat types occur in areas of shallow groundwater and not all are of similar environmental value. The fringing riparian forest and floodplain Eucalypt forest habitat extends along and adjacent to Walker Creek and Bee Creek where depth to water within the water table aquifer is greater than 10m. Furthermore, some portions of the fringing riparian forest were identified during field surveys to support Black Ironbox (*Eucalyptus raveretiana*), which is listed as vulnerable under the EPBC Act. The species was located along sections of Walker Creek and Bee Creek within the SWC Mine mining lease. However, Black Ironbox was found to be absent from upstream fringing riparian habitat areas of Walker Creek and Carborough Creek.

The density of Black Ironbox along Walker and Bee Creek within the SWC Mine mining lease area was also found to vary, but generally increased as the creeks progress downstream. Within the project footprint of the MRA2C project, the density of Black Ironbox along Walker Creek was found to be approximately 7.6 individuals / 100m^2. This progresses to 8.27 individuals / 100m^2 further downstream along Walker Creek within the mining lease. Along Bee Creek the density of Black Ironbox is substantially greater at 16.5 individuals / 100m^2.

The occurrence of Black Ironbox across the SWC Mine occurs within the fringing riparian forest habitat where depth to water within the water table aquifer has been recorded to range from 10 – 15 m from adjacent monitoring bores (MB6, MB12, MB13 and MB14). While the species is within areas of habitat that have access to shallow groundwater (i.e. 10 m), it also occurs outside of these areas and increases in density as groundwater becomes deeper and is therefore less accessible. The species is highly restricted to the riparian zone of watercourses, indicating a strong level of dependency on surface water within these watercourses.

The rooting depth or depth to water table range has not been studied for Black Ironbox so the ability of the species to tap into the groundwater across SWC Mine cannot be negated. However, the level of dependency that the species has on groundwater sources at SWC Mine is not considered to be high. The interaction with groundwater is likely to be intermittent, seasonal and situationally dependent at best. This concept is supported by other examples of the species persistence without groundwater sources, including along watercourse in Collinsville, Queensland where the underlying metamorphic geology prevents access to groundwater and in plantings in non-riparian environments in Biloela, Queensland (Queensland Herbarium, personal communication, 8 August 2017).

Other vegetation values across the SWC Mine recognised as a MNES under the EPBC Act include the Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community (TEC). Areas of Brigalow TEC both within the MRA2C project footprint and across the SWC Mine occur where depth to groundwater is much greater (i.e. > 15m). The community is also situated on cracking clay soils and in such scenarios is generally found to rely on trapped surface water or water stored in the unsaturated zone rather than groundwater (IESC, 2018). As such the Brigalow TEC is not considered to be a GDE.

In summary, the SWC Mine may potentially support Type 3 GDEs in areas where shallow groundwater is present. This includes areas of fringing riparian forest and floodplain Eucalypt forest along the upper reaches of Walker Creek and Carborough Creek (Figure 10). The likelihood that these habitat types are Type 3 GDEs is lower along the downstream portions of Walker Creek, as well as along Bee Creek and with increasing distance from the alluvial channels. This is due to the increase in depth to water within the water table aquifer. Significant vegetation values recognised as MNES under the EPBC Act generally occur within such areas. For Black Ironbox, a number of other influencing factors for persistence suggests a lower dependency on groundwater. Brigalow TEC within the SWC Mine is not considered a GDE.

Wetlands

All wetlands are surface fed (not groundwater) and there is no impact mechanisms associated with the project that would extend to this area. Refer to new map (Figure 11).

Confined Coal Seam Aquifer Values

Groundwater quality in the confined coal seam aquifer is similar to the water table aquifer, with salinity averaging 1,970 to 2,800 mg/L for bores screened in the main seam aquifer. This aquifer has limited environmental value due to its low permeability, low saturated thickness, greater depth, and salinity. It is beyond the reach of terrestrial vegetation and has insufficient production potential for stock watering.

There are no identified groundwater users of the confined coal seam aquifer in the project vicinity. No environmental values have been identified.

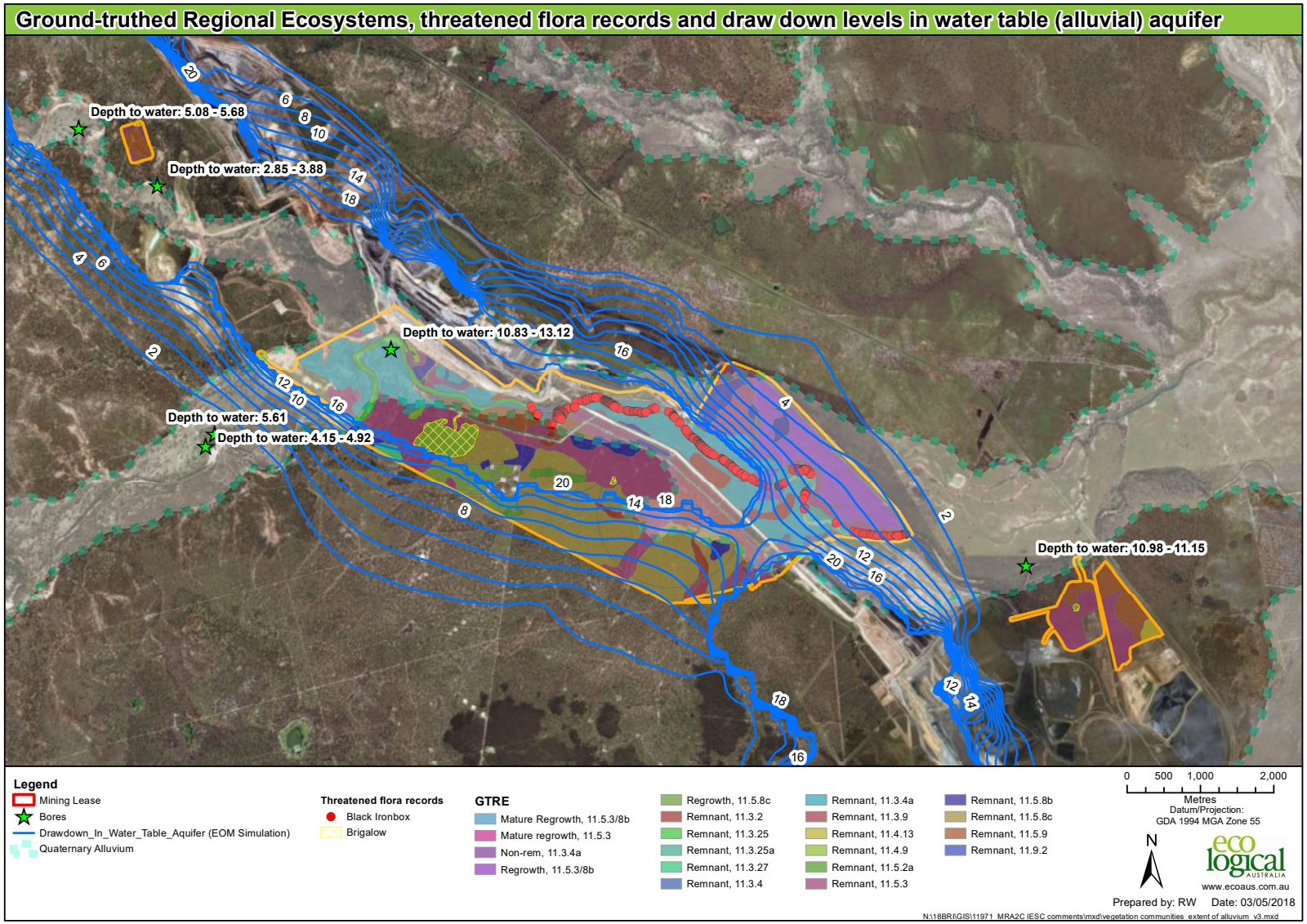


Figure 10: Vegetation communities overlain on alluvial water table and drawdown predictions

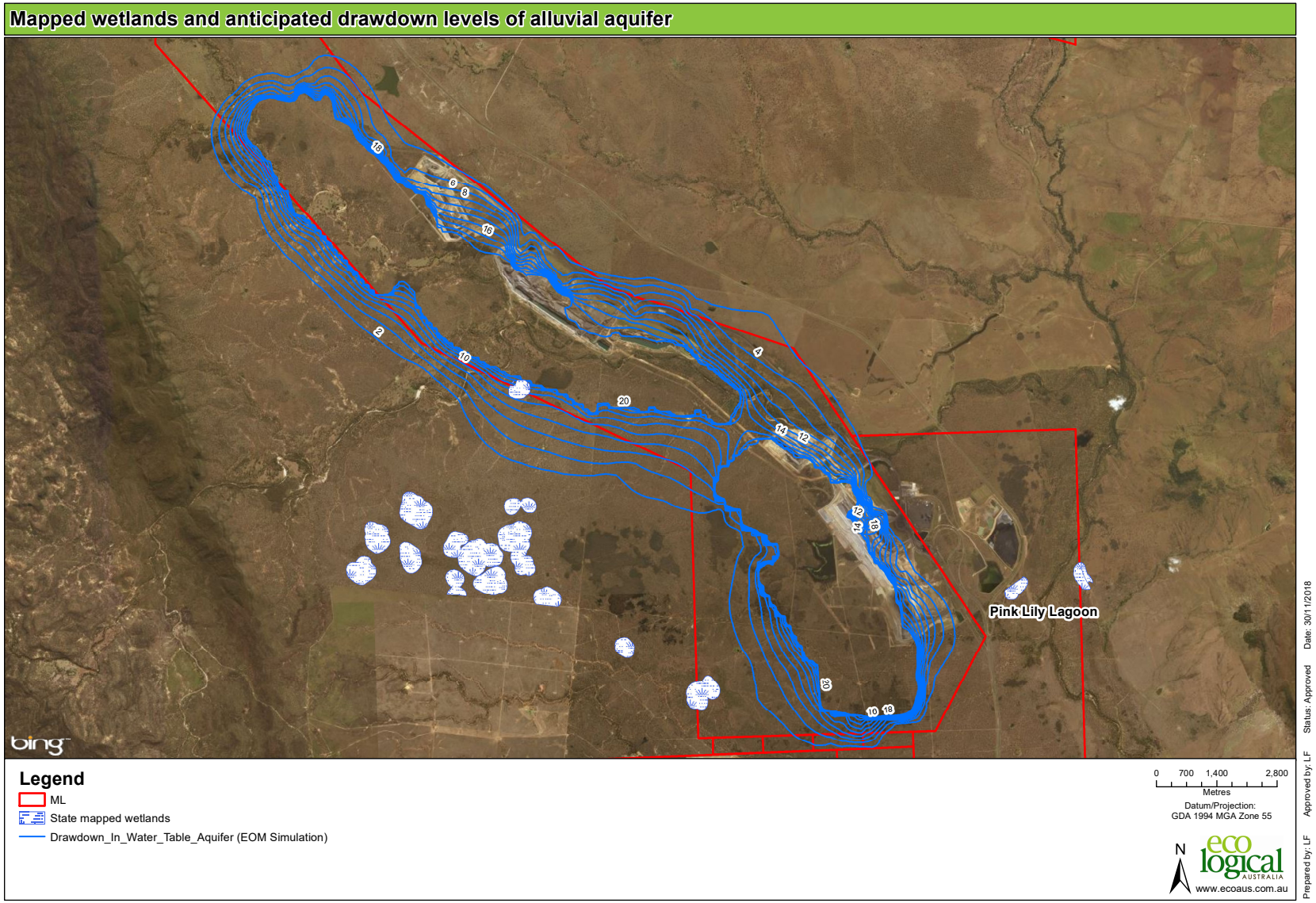


Figure 11: Mapped wetlands overlain with alluvial water table drawdown

Groundwater Modelling

Open cut mining involves the removal of overburden and coal seams, creating a void that is progressively backfilled by spoil as mining progresses. During the mining and recovery period, the water level in the final voids is lower than the surrounding aquifers, and groundwater flows inwards towards the mining operations. Groundwater seepage together with any surface water runoff is typically pumped out of the mined voids to allow mining to continue. At the SWC Mine, evaporation greatly exceeds groundwater inflow to the open pits, and pumping is not required in many years. After mining ceases, pumping is not maintained, and groundwater and surface water will accumulate in the voids if inflow volumes are sufficient.

These mining operations result in localised changes to groundwater flow patterns, and a depression in the water table. A groundwater model was developed to assess these changes, and the associated potential impacts to environmental values of groundwater. To fully account for cumulative impacts, the model was developed using the full mining plan for the SWC Mine, including areas planned for mining that are outside of the MRA2C project. The nearby Coppabella Mine was also included in model calibration and simulations.

A three-dimensional (3D) numerical groundwater flow model was developed using available site-specific information on geology, hydrogeology, hydraulic properties, and climate data. Site-specific data was supplemented by regional data, similar studies from the Bowen Basin, and literature values. The groundwater modelling has been undertaken in a manner consistent with the Australian Groundwater Modelling Guidelines (Barnett *et al.,* 2012), and is described in detail in the Groundwater Impact Assessment (Golders 2018) attached at Appendix D to this report. The groundwater model was calibrated to site-specific observational (field) data collected from 2000 to 2018.

The calibrated groundwater model was used to estimate future groundwater conditions through forward, predictive simulations. The predictive simulation for the life-of-mine period is based on the planned 50-year mining sequence for the SWC Mine. This includes the MRA2C project and all other planned mining activities at the SWC Mine. In addition to life-of-mine simulations, post-operational simulations were undertaken to assess changes to water levels in the water table and confined coal seam aquifers after mining ceases, and to assess the amount of groundwater that is lost to evaporation from the final pit voids.

Groundwater Quantity

Figure 12 presents contours of maximum predicted drawdown of the water table aquifer at the ending of mining activities. In the water table aquifer, the extent of the drawdown is limited to the active mining area surrounding the pits. It extends about 2 km away from the void to the southwest, which is about 1.5 km past the mining lease boundary. Mining operations have a noticeable effect on localised groundwater contours where open cut pits intersect the regolith, resulting in flow from the water table aquifer towards the mine voids and open pits.

The project includes diversion of part of the ephemeral Walker Creek to the south. Leakage from the diverted section of the creek is predicted to partially offset drawdown to the south of the MRA2C project. The change in the alignment of Walker Creek does not materially affect groundwater contours due to two reasons:

1. Creek leakage is episodic and limited to wet periods.
2. The re-aligned creek is unlined, and losing water to the same general section of the alluvial aquifer, albeit slightly to the south of the original location.

Figure 13 presents the contours of maximum predicted drawdown (change in hydraulic head) for the confined coal seam aquifer. Drawdown is greater where the coal seam is deeper, with relatively steep hydraulic gradients along the edge of the pit. The predicted drawdown extends approximately 6 km from the active mine areas and overlaps with drawdown from the Coppabella Mine to the south. The larger drawdown distance in the confined aquifer is due to its lower hydraulic conductivity and thickness, which results in significantly lower overall transmissivity compared to the water table aquifer. However, this aquifer is not subject to beneficial uses.

During the post-closure period, it is likely that the water level in the final voids will be lower than the surrounding aquifers and therefore the voids will act as an evaporative sink which maintains groundwater flow towards the final voids resulting in long term residual drawdown in both the water table and alluvium aquifer.

The groundwater model was subjected to sensitivity and uncertainty analyses to evaluate how changes in model parameters affect predictions of drawdown and potential impacts to sensitive receptors. Results indicate that, for reasonable parameter ranges, predicted changes to groundwater drawdown are similar.

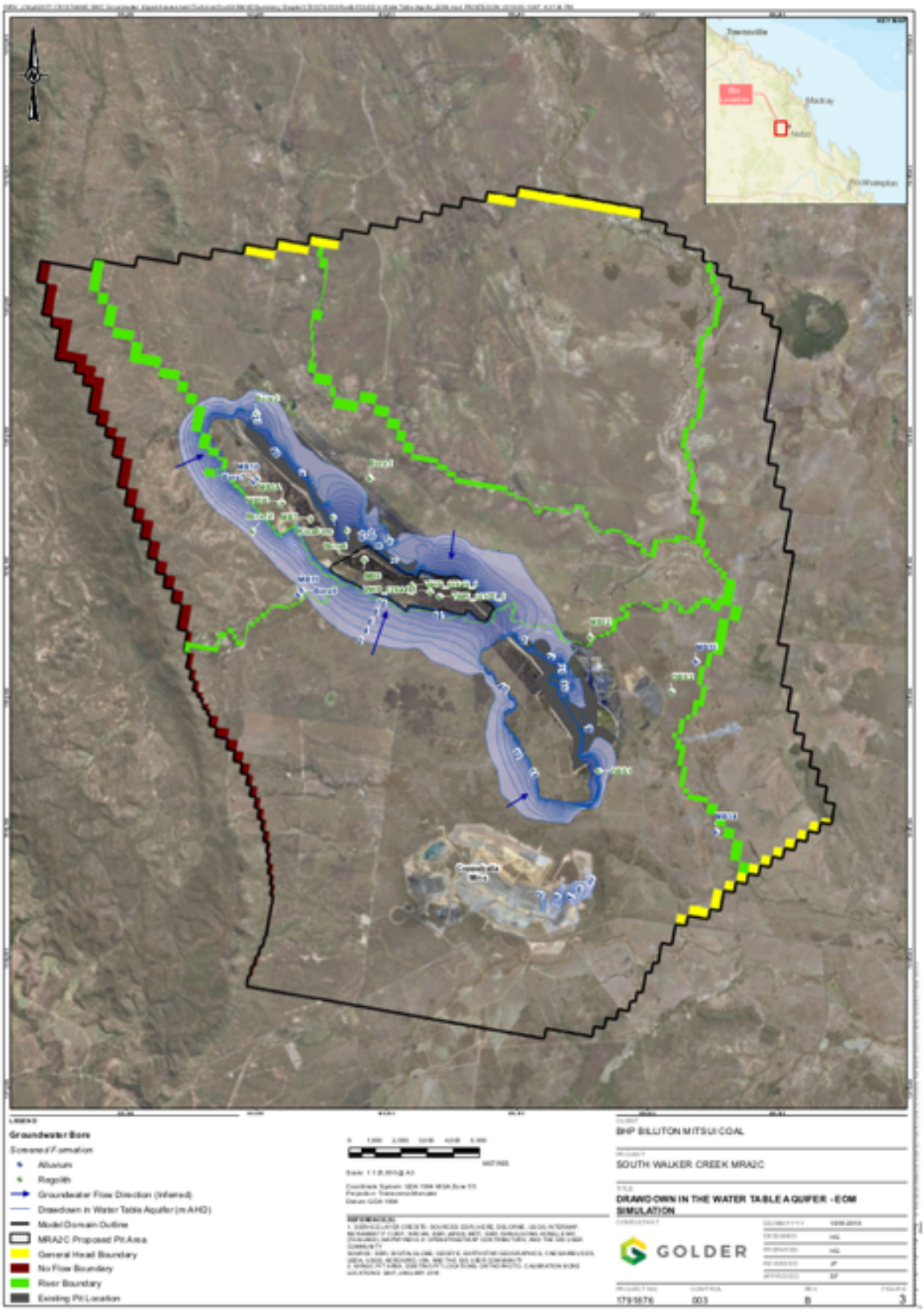


Figure 12: Maximum predicted drawdown in the water table aquifer

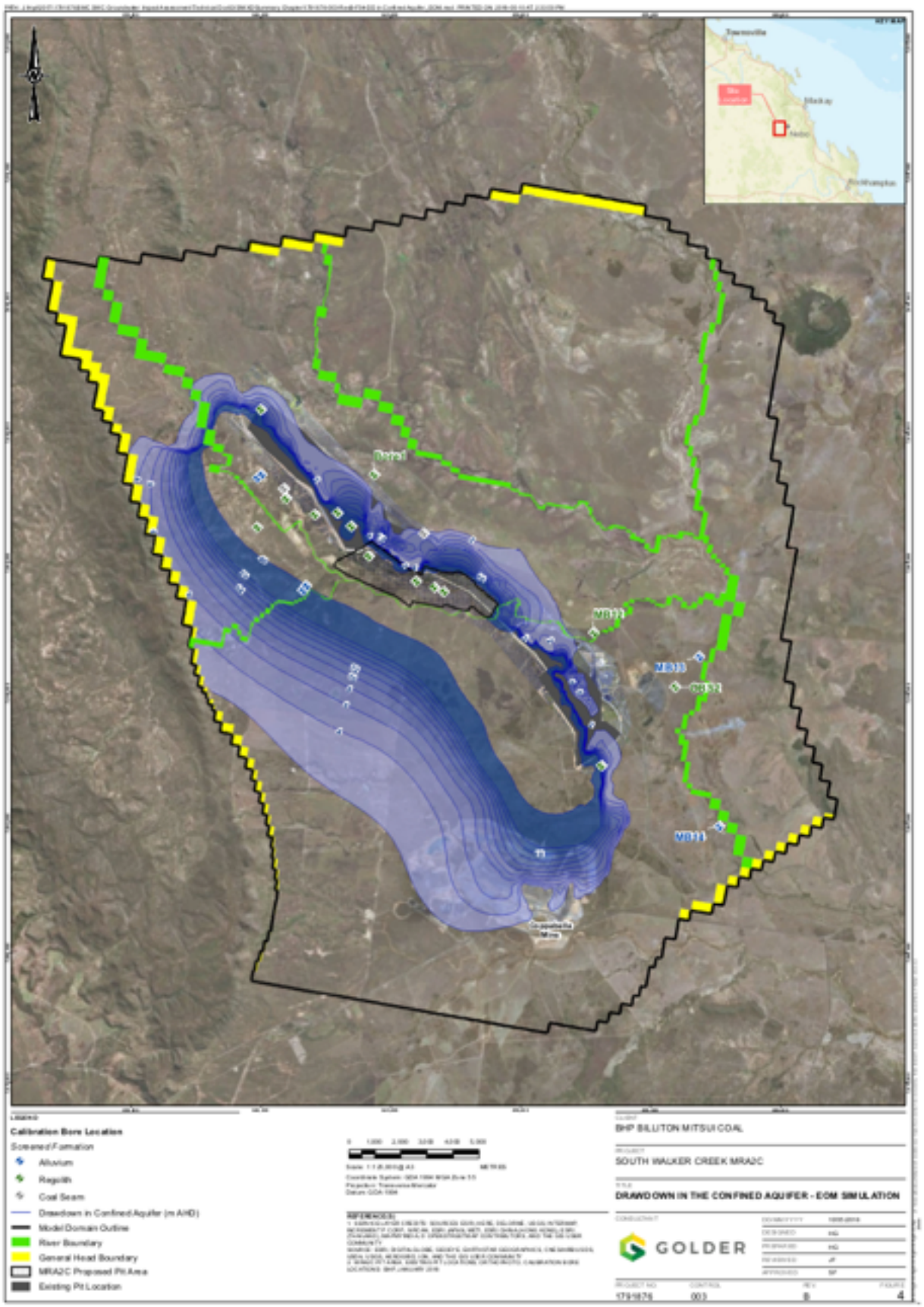


Figure 13: Maximum predicted drawdown in the confined aquifer

Groundwater Quality

Impacts to groundwater quality will be limited to the potential development of saline pit lakes in final voids during closure timeframes. It's likely that the voids will act as long term sinks due to outflows (evaporation) significantly exceeding inflows (groundwater inflow, direct rainfall, and runoff) which would inhibit migration of the saline water from the pit void.

The position of the planned Walker Creek diversion relative to the overall water table aquifer is not significantly different to the current alignment, and changes in the shallow groundwater level is not expected. Ephemeral leakage from Walker Creek to shallow groundwater during the wet season will be maintained along the proposed creek diversion and may lead to a local "freshening" of groundwater in the water table aquifer along the diversion alignment, which is a positive impact to the environmental values of the shallow aquifer as it may locally reduce salinity.

The proposed project will make use of the existing operational and storage facilities at the SWC Mine currently used for tailings, storage of fuels and oils, refuelling stations, etc. Additional facilities are not proposed as part of the MRA2C project expansion. Any unplanned or uncontrolled release of substances from operational and storage facilities could potentially impact the water table aquifer quality, if the release is of sufficient volume and duration.

Final Void water balance modelling

An assessment of the water balance and water quality conditions in the final void likely to remain in F pit has been examined through hydrologic modelling (Alluvium 2018, Appendix J). A water balance model was created by considering rainfall, evaporation, contributing catchment area and hydrogeologic characteristics of the area.

In undertaking this assessment, the assumption is that the current disturbance areas are indicative of the final form of the site, albeit with rehabilitation and some internal reconfiguration of the drainage (Refer Appendix F, Final Void Planning Study). Ultimately, the form of the final void post mining is therefore likely to be similar to the existing void and we have used the characteristics of the existing void and surrounding catchment to develop the model. The model was developed with the following inputs:

- Daily rainfall - Nebo Station 033054 from 01/01/1900 – 31/12/2017
- Mean monthly pan evaporation – Nebo Station 33054
- F Pit Catchment area – 54.23 ha (measured through GIS of final proposed pit area)
- F Pit final void area – 13.45 ha (measured through GIS based on existing pit area to void area ratio)
- Volumetric runoff coefficient for surface waters 0.35
- Depth 175m (from Golders 2018)
- Recharge rate 0.5% of rainfall (from Golders 2018)

The model was run over the 117 year climatic period available to gauge the trends of water balance and water quality from these ranges of inputs. It was assumed that the pit would be full at the commencement of the analysis to view the overall trend in the results. Given that the workings are likely to be active immediately prior to closure, this is a conservative assumption, as the void would likely be dry, but this wouldn't show trends easily.

Over the period modelled, the general trend is for the water volume to reduce to less than 50% of the current volume, with a consequential increase in salinity to an end concentration of 2.5 times the existing concentration. This is expected given that the evaporation rate is significantly greater than the rainfall rate, such that even with recharge, the inflows never exceed the losses from the system and it is therefore expected that the final void, if similar in characteristics to the current F pit void in area, depth and contributing catchment, will never overtop, but continue to concentrate salt and other associated water quality criteria.

This analysis shows is that the results are relatively insensitive to recharge rate, and salt concentrations, with some sensitivity to runoff coefficients and high sensitivity to leakage/infiltration loss. In all cases however, the model shows a decreasing trend in volume and increasing trend in salt concentration, suggesting that the likely condition of the void post closure is that volumes are not ever likely to overtop but water quality concentrations will increase over time. This means that the default condition of the final void is one that would tend to dry out or be completely dry most of the time, depending on the starting level of the void.

This result shows that it may be possible to achieve a relatively stable waterbody by increasing the catchment area to void area ratio, but this is based on the assumption of a full void at the time of closure. This is typical of most waterbodies in that there is an optimal size (depending on climate) where inflows can match losses and outflows to achieve consistent volumes and levels.

All of this analysis shows that the catchment area draining to the final void is one of the most influential factors on whether a waterbody would exist post closure, as all modelling demonstrates that the most likely scenario is a void where the losses significantly exceed the inflows and hence the system would tend to dryness or be completely dry if the starting condition was also an empty void.

Impacts to Groundwater resources

The main impact to groundwater resources as a result of the MRA2C project will be the reduction of water levels in the water table and confined aquifers.

As outlined below, under the definitions detailed in “Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources”, the development of the MRA2C project will not result in any significant impacts to groundwater resources.

Groundwater Users

Water for stock purposes is sourced from the water table aquifer and there is potential to impact some stock bores.

All identified stock bores located within the estimated area of drawdown are located on BMC owned land. All land agistment arrangements include compensation agreements that ensure alternative water supply arrangements are put in place should a bore be impacted. Such arrangements have already been put in place for Bores 9 and 12 where an alternate water supply has been established for these locations from the BMC owned Braeside Borefield.

There are no identified groundwater users of the confined coal seam aquifer in the project vicinity nor have any environmental values been identified. This is due primarily to the aquifer’s relatively poor water quality but also due to its greater depth, making extraction costly.

Further impacts to groundwater uses are therefore not expected.

Groundwater Quality

The proposed MRA2C project will result in localized lowering of the water table, which causes groundwater to flow toward the final void from the surrounding confined aquifer and locally from the water table aquifer, possibly leading to a mixing of groundwaters with slightly different water quality in the mine void.

Furthermore water balance modelling of F pit final void conducted by Alluvium (2018) indicated that that any water in the final void will have likely have elevated salinity due to evapoconcentration. However, there is no predicted discharge from the mine void to the surrounding aquifers as the void is expected to act as a sink for groundwater as is typical for a final void in the Bowen Basin in which there is limited groundwater inflows (i.e. no basalt aquifers) and where overtopping from flood waters is unlikely.

Ephemeral leakage from Walker Creek to shallow groundwater will be maintained along the proposed creek diversion and may lead to a local “freshening” of groundwater in the water table aquifer along the diversion alignment, relative to the conditions currently along the alignment of the diversion. The position of the diversion relative to the overall aquifer is not significantly different to the current alignment, and any changes because of the relocation of the creek will not have a significant impact on beneficial uses of groundwater in the shallow aquifer.

Impacts to groundwater quality will be limited to the potential development of saline pit lakes in final voids during closure timeframes. It’s likely that the voids will act as long term sinks due to outflows (evaporation) significantly exceeding inflows (groundwater inflow, direct rainfall, and runoff) which would inhibit migration of the saline water from the pit void.

Groundwater Dependent Ecosystems

There are no identified Type 1 or Type 2 groundwater dependent ecosystems within the estimated drawdown extent.

Fringing riparian forest and floodplain Eucalypt forest in the upper reaches of Walker Creek and along Carborough Creek may utilise the shallower groundwater in this area. In these areas groundwater is predicted to drawdown between 2 to 20 m. Severity of threat on habitats where drawdown is predicted to be 2 – 4m is considered to be low; however, where drawdown is greater than 4 m the severity is potentially higher. These habitats are in moderate to good ecological condition and provide ecosystem functions including bank stabilisation, habitat connectivity and fauna habitat. The fringing vegetation is considered to be of moderate value only and occurs widely in the region, the vegetation types in these areas is not listed as threatened under Commonwealth or State law. The vulnerable Black Ironbox does not occur within these portions of the riparian system. But does occur downstream of the proposed creek diversion. In this area the water table aquifer is 15-20m deep and beyond reach of surface vegetation. Significant impacts to listed and non-listed vegetation is not expected.

6.3. Cumulative Water Impacts

The wider land uses and activities that could affect the quantity and quality of water within the Bee Creek catchment above Dipperu National Park are:

- Grazing - the predominant landuse, which contributes to land disturbance and the generation of sediment via reduced vegetation cover, particularly in riparian zones.
- Mining at Hail Creek - located in the upper catchment of Bee Creek.
- Mining at Coppabella mine – located on Harrybrandt Creek, which discharges to Bee Creek immediately upstream from Dipperu National Park.
- Mining at SWC Mine.

Given the existing catchment wide disturbance from grazing and the existing mines of Hail Creek, Copabella and South Walker Creek, the MRA2C project will have a very minor additional potential cumulative effect.

As has been stated previously, the limited additional increase in disturbed surface catchment and the ongoing management of water discharges under existing EA conditions will not result in a notable change to the hydrology or quality of water in surface waterways, significant impacts to users will not result.

The results presented above for groundwater are a cumulative assessment. The groundwater modelling undertaken included the full current mine plan, which nominally extends until fiscal year 2071-2072, meaning that impacts predicted by the model are cumulative impacts for the entire SWC Mine during the life-of-asset period, and are not limited to impacts from the proposed MRA2C project. Additionally, the Copabella Mine was also included, with the mining operations simulated by applying the maximum depth of mining from operations to date across the entire footprint of the mine. This simplification results in a conservative estimate of the pit shape that may be present during our simulation period. This approach does not account for potential future expansions (if any) outside of the current mine footprint.

The approach adopted is designed to meet IESC recommendations for consideration of “all relevant past, present, and reasonably foreseeable actions, programmes, and policies that are likely to impact on water resources”.

Ground water disturbances within the water table aquifer are localized and primarily occur within the mining lease, limited to around a 2km radius from the SWC Mine pits and do not overlap or combine with drawdown from Copabella Mine.

6.4. Summary of Water Resource Impacts

The proposed activity will not cause a significant depletion or quality change to any surface or groundwater resources, nor will it have an impact on the way a critical water system operates.

One ephemeral local watercourse, Walker Creek, will be impacted by the project directly through the construction of a diversion around proposed mining activities. This change will be carefully managed and regulated to ensure water leaving the site is in similar quantities and quality to that occurring currently.

SWC Mine’s water management system including release of mine affected water operates effectively under current EA conditions – given that the catchment areas of the pits changes little over the proposed mining period (2019 to 2065) it can be expected that the mine can continue to operate effectively without the need for changed EA conditions or alterations to water flows and quality.

There is also a high level of confidence that the project activity will not substantially change the quality or quantity of groundwater in the vicinity of the project. Drawdown effects are localised and the risk of water quality changes or contamination are low and correspond to those in place currently for the SWC Mine. There are limited current known uses of groundwater within the area affected, alternative water source arrangements have been made for stock on affected land owned by BMC.

Under the definitions detailed in “Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources”, the development of the MRA2C project will not result in any significant impacts to water resources or users:

- The environmental values of groundwater at the project site are limited, primarily to use of the water table aquifer for stock watering.
- Impacts to water resource values are minor and can be sufficiently mitigated through make good agreements, and plans are already in place to do so, backed by a more than 20-year successful history of impact mitigation at the SWC Mine.

A robust and expanded groundwater monitoring network is planned to increase understanding of the water table aquifer and reduce any uncertainty associated with ongoing water management.

6.5. Water Resources Mitigation and Monitoring

The impact of the project upon the hydrology and water quality of water resources is not expected to be significant. However, BMC is committed to ongoing compliance with the Environmental Authority and Water Licence conditions that will minimise any harm to the receiving environment. As part of remaining in compliance with the Environmental Authority, BMC will undertake or maintain the following water management and monitoring requirements.

Water Management Plan

SWC Mine has developed and implements a Water Management Plan (Appendix H), that:

- provides overarching information about the water resource and the receiving environment
- identifies the management tools and strategies that have been developed to minimise impact
- set trigger levels to identify if activities are potentially impacting the water resource
- identifies the monitoring and reporting requirements.

The current water management plan will be updated to incorporate the MRA2C project and related water infrastructure once the project is approved.

Receiving Environment Monitoring Program

SWC Mine has developed and implements a Receiving Environment Monitoring Program (REMP) that makes an assessment of the condition of the receiving environment and any mine derived impacts. This includes:

- predicted impacts to the regional and site water balance
- changes to hydrology
- water quality
- toxicant movement
- risks to ecological assets and receptors.

Key components of the REMP include:

- identification of the surface and aquatic systems to be monitored and their environmental values
- water quality parameters
- environmental and ecological characteristics and values and the rationale
- the frequency of the monitoring and rationale for the frequency
- baseline data for each monitoring site for comparison of monitoring results over the life of the project.

Sediment and Erosion Management Plan

SWC Mine has developed and implements a Sediment and Erosion Management Plan (SEMP) to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.

Drawdown

Groundwater drawdown predictions indicate that receptor exposure will be limited to two existing stock watering bores as described above.

As part of ongoing operations at the SWC Mine, BMC has established compensation agreements with holders of agistment licences should stock watering bores be impacted.

Groundwater Quality

Strict management and control measures of potential pollutants and contaminant sources will be maintained to prevent uncontrolled discharge to groundwater, consistent with the existing management strategy. These include provision of appropriate spill control materials at refuelling facilities to contain spills and established procedures to ensure safe and effective storage and handling of fuel, oil and chemicals.

All uncontrolled discharges will be reported to the relevant regulatory authorities in accordance with legislative requirements. If any groundwater quality impacts are identified, mitigation measures will include rectifying any damages caused to the integrity of the storage unit and, if practical, intercepting the impacted groundwater/pollutant source.

Water Resource Monitoring

Diversion monitoring

A monitoring program has formed part of licence conditions for diversions for over a decade in Queensland and is common practice across all diversions in the area. The monitoring program includes a semi-quantitative condition assessment scoring system known as Index of Diversion Condition. This is made up of geomorphic and riparian vegetation indices. The geomorphic index will assess erosion and/or sedimentation of the watercourse.

This monitoring program has been in place on the diversions at SWC Mine for 10 years and will be further adapted to suit the MRA2C project as per *Monitoring Program: Mulgrave Resource Access Walker Creek Diversion Stage 2C* (Alluvium, 2017) (refer Attachment E to Appendix C) .

Monitoring sites are already established on Walker and Carborough Creeks upstream and downstream of the diversions that reflect the condition of the waterway as influenced by agricultural activity in the area that has produced very high sediment loads in the waterways.

As part of the diversion monitoring an additional component is planned to measure any indirect impacts on riparian vegetation from either the diversion or from groundwater drawdown. Riparian vegetation monitoring will occur upstream of the diversion where the alluvium water table is at its shallowest point (refer Figure 10). Monitoring sites will also be established in areas outside of predicted drawdown as control points and to assist in attribution of cause should changes in vegetation condition or structure be detected. Monitoring will incorporate:

- vegetation condition and structure twice yearly (pre and post wet season)
- groundwater levels

This monitoring will commence at completion of the diversion construction. The diversion monitoring plan will be updated to include this riparian vegetation monitoring component.

BMC will also examine the possible use of leaf water potential measurements to determine tree-water-source / groundwater use. Pre-dawn leaf water potential is a particularly powerful approach and can help determine whether riparian monitoring is actually required for the life of mine or can be stopped once groundwater independence is confirmed. Pre-dawn leaf-water potential is one of the measures outlined in the Australian GDE tool box referenced by the IESC.

Pre-dawn leaf water potential provides an integrative measure of water availability in the root zone of the measured tree (through the proxy of vadose-matric-pressure). Thus, with pre-dawn leaf water potential measurements, it should be possible to relate changes in tree-health to both groundwater levels and soil-moisture.

Tree-health measures can be complimented with both pre-dawn and midday leaf water potential measurements. Pre-dawn leaf water potential provides information as above and the midday leaf water potential provides an indication of transpiration gradient (i.e. tree-water use). A function of the ratio of the two leaf-water potential measurements provides an indicator or tree-water stress. Changes in the ratio occur before they are visible in health monitoring and changes in the ratio can be directly correlated with climate and / or mining drivers of tree-water-availability.

Water quality monitoring

For water quality, monitoring is required under the EA conditions and is undertaken under the umbrella of the REMP, which requires:

- monitoring of stream flow, water quality, sediment quality, aquatic habitat and macroinvertebrates) during natural flow conditions and when mine-affected water is being discharged
- an assessment of monitoring components at potentially impacted (i.e. receiving environment) sites and background sites (i.e. sites that are not affected by the release of mine-affected water), and comparison of monitoring results against guidelines levels as defined in the REMP, and
- an assessment of the potential impact of releases of mine-affected water on the environmental values of the receiving environment, including discussion regarding the suitability of current discharge limits for protecting the environmental values of the receiving environment.

Groundwater monitoring

The existing monitoring network includes monitoring bores located within and outside of the predicted area of influence of the proposed MRA2C project (Figure 14). Ongoing monthly monitoring of water levels in these bores will enable drawdown effects to be isolated from background influences associated with seasonal recharge and leakage. Although there are expected to be no significant impacts to groundwater resources as a result of the project, there are areas in which additional information or studies could assist with validating and improving the

conceptual and numerical models for the SWC Mine and to more accurately monitor the drawdown extent as the mine progresses.

BMC has already initiated several projects to help improve in these areas, including:

- Installation of data-logging pressure transducers in 11 boreholes across the site; this was completed in mid-April 2018. This will allow higher frequency measurements of groundwater levels to better understand rates of recharge and drawdown.
- Installation of 3 vibrating wire piezometers (VWP) near Walker Creek with sensors located within the regolith, overburden, and coal seams. These VWP's will help with understanding vertical gradients between hydrostratigraphic units, rainfall/runoff/recharge relationships, and rates of drawdown.

Additional monitoring bores are also being considered in more distal areas to the west of the MRA2C project area and to the west of the existing southern pits (Carborough, Walker, and Toolah) to allow more accurate measurements of the drawdown extent (Figure 15).

Stygofauna study

A stygofauna study will be undertaken that includes:

1. A desktop review of stygofauna of the region, and their habitat requirements (i.e. groundwater quality, hydrological units, depth to water table, overlying vegetation types, etc), will be implemented. Key references will include relevant hydrogeological studies (e.g. Golder 2018) to describe groundwater habitat characteristics, but also published literature relating to stygofauna of the broader region, including Hancock and Boulton (2008), Cook et al. (2012), Hose et al. (2015), Glanville et al. (2016) and Little et al. (2016). Relevant literature relating to stygofauna more broadly will also be referenced, including Tomlinson & Boulton (2008), Eberhard et al. (2009) and Halse et al. (2014), amongst others.
2. A pilot study will include field sampling of stygofauna at a minimum of 10 bores, as described in the guideline, including bore 4. The timing of the survey will be the post-wet season in early 2019 (notionally mid-March). At each bore, six replicate hauls using a weighted phreatobiological net of mesh size 50 µm will be taken, with the contents of the six hauls combined to give a single composite stygofaunal sample for each bore. Samples will be preserved in ethanol and transported to a biological laboratory for processing.

Stygofauna specimens will be identified to morpho-species by a suitably qualified and experienced aquatic ecologist with considerable experience in stygofauna studies.

Stygofauna taxa are grouped into one of several classes based on the degree of their requirement for subterranean life. For the purpose of this assessment, stygofauna species will be assigned to one of these two stygofauna classes to facilitate detailed assessment of Environmental Values of groundwater ecosystems:

- stygobites: obligate groundwater aquatic fauna that have specialised adaptations to underground life and that live within groundwater systems for their entire life, and
- stygoxenes: aquatic fauna that facultatively use groundwater ecosystems, but are not dependent on groundwater to complete their life cycle.

Notionally, five bores will be located in the predicted zone of groundwater drawdown ('impact' bores), and 5 will be 'reference' bores and located in areas that are not currently impacted, nor in areas potentially to be developed in the future. The reference bores will target the same hydrogeological units as the 'impact' bores, which includes alluvium along waterways and regolith, interburden (dominated by mudstone), and the Rangal coal measures (which are the target unit of mining activities) (Golder 2018). Sampling effort will be greater in alluvium as the rate of occurrence of stygofauna in alluvium is greater than for coal (Glanville et al. 2016), but regolith and coal seams will each be represented by at least one bore in each of the test and reference areas. Mudstone units will be low priority for the survey design, as stygofauna have not been reported from mudstone to date (Glanville et al. 2016).

The stygofauna pilot study report will fully describe the literature review, sampling methods and results, and discuss the potential impacts of the MRA2C project on stygofauna. The report will also provide recommendations for management of stygofauna, including implementing a comprehensive stygofauna survey, as described in the guideline, if the pilot study detects stygofauna.

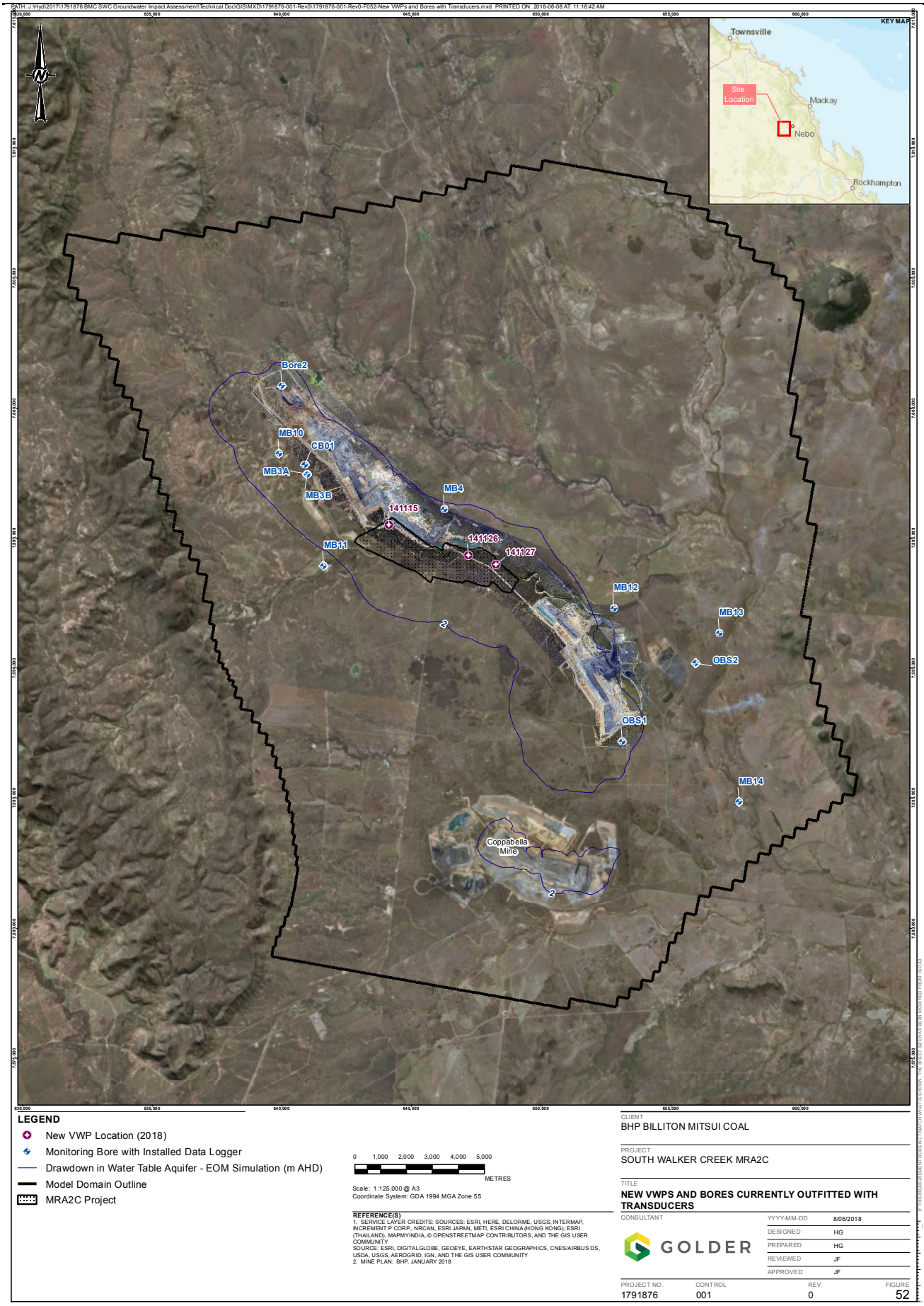


Figure 14: Current monitoring bores

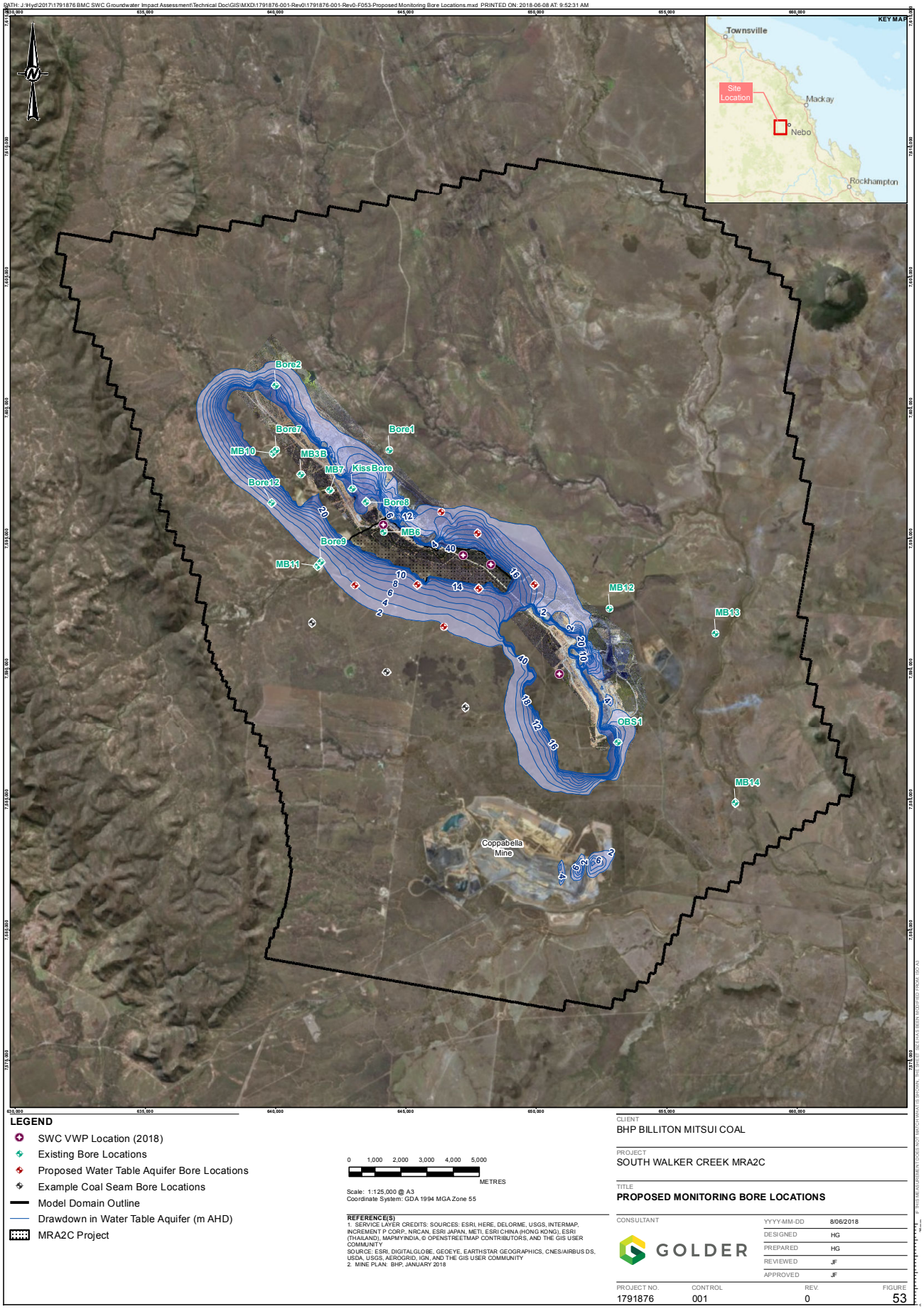


Figure 15: Proposed monitoring bores

7. Threatened Species and Ecological Communities

This chapter summarises the findings of an assessment of impacts on threatened species and ecological communities under the requirements and definitions of the *Environment Protection and Biodiversity Conservation Act 1999*. The assessment considers the Australian Government's Significant Impact Guidelines 1.1: Matters of National Environmental Significance.

MNES values of Brigalow TEC, Black Ironbox and potential habitat for Koala, Ornamental Snake, Greater Glider and Squatter Pigeon are identified and the impacts assessed.

Over many years BMC has commissioned a considerable amount of work to more accurately define the presence/absence of threatened species and ecological communities within and adjacent to the SWC Mine, including the area proposed for disturbance. The latest study specific to the MRA2C project is a technical assessment of ecology issues that has been undertaken and reported in Eco Logical Australia (2018) Mulgrave Stage 2C Ecological Impact Study. It includes review of the previous field assessments undertaken within and around the study area. Three field surveys have also been undertaken in 2016, 2017 and 2018 to specifically investigate particular aspects of the ecology of the study area. The full assessment report is contained in Appendix E.

7.1. Impacts to Ecological MNES

Based on field validation surveys in 2016, 2017 and 2018, the following ecological MNES values were confirmed within the project disturbance footprint of the MRA2C project:

- Brigalow threatened ecological community (TEC)
- Black Ironbox
- Potential habitat for threatened fauna: Ornamental Snake, Koala, Squatter Pigeon and Greater Glider.

Threatened Ecological Communities

Brigalow TEC

Four patches of Brigalow (dominant or co-dominant) TEC were identified within the project site, comprising of a total area of approximately 32.7 ha. Three of the Brigalow TEC patches within the study area are only small occurrences encompassing a total area of less than 1.5 ha. The majority of Brigalow TEC occurs in one large patch located in the western portion of the project site. Refer Figure 16.

All Brigalow TEC (32.7 ha) within the MRA2C project area will be removed. Across the broader SWC Mine the amount of Brigalow dominated communities remaining outside of currently planned mining areas is approximately 524.8 ha.

Project impacts are likely to be significant on this MNES value as shown by the assessment against the significant impact criteria outlined in the table below.

Brigalow TEC – Assessment against Significant Impact Criteria

Significant Impact Criteria	Assessment	Response to Criteria
Reduce the extent of an ecological community	No	The extent of occurrence for Brigalow TEC across the region will remain unchanged following the development of the project.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	No	Clearing for the project will not fragment any patches of Brigalow TEC. Connectivity between remaining Brigalow TEC patches will remain following the development of the project.

Significant Impact Criteria	Assessment	Response to Criteria
Adversely affect habitat critical to the survival of an ecological community	Yes	Approximately 32.7 ha of Brigalow TEC habitat will be lost as a result of the project.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	Yes	The progression of the Mulgrave pit and construction of associated infrastructure will ultimately remove 32.7 ha of Brigalow TEC and associated habitat.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	No	The progression of the Mulgrave pit and construction of associated infrastructure will ultimately remove 32.7 ha of Brigalow TEC rather than cause a substantial change in species composition.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	No	The progression of the Mulgrave pit and construction of associated infrastructure will ultimately remove 32.7 ha of Brigalow TEC rather than cause a substantial reduction in the quality or integrity.
Interfere with the recovery of an ecological community	No	The project will result in 32.7 ha of Brigalow TEC being impacted. This equates to 0.2% of the mapped Brigalow TEC extent (based on RE associations) occurring within the Northern Bowen Basin (subregion).

Figure 16: Recorded presence of ecological MNES

Threatened species habitat

Black Ironbox

Within the project site there is 16.8 ha of suitable riparian habitat supporting Black Ironbox that will be impacted by the project (refer Figure 16). This habitat has been assessed as not critical for the survival of the species and the occurrence of Black Ironbox within the study area is not considered to be part of an important population.

The extent of impacts is anticipated to be limited to the direct removal of the species and habitat within the project disturbance footprint. Indirect impacts downstream or from ground water alterations are not expected. The average depth to groundwater sources is approximately 10 m below the surface (CDM Smith, 2016). The depth is consistent across the entire study area, including the Walker Creek riparian zone. The fact that Black Ironbox is limited to the riparian zone suggests it is not highly dependent on the groundwater but rather reliant on the riparian saturation zone that is replenished by seasonal flooding. As such there is a low risk that downstream populations will be negatively affected by any potential groundwater drawdowns associated with the construction of the Mulgrave Pit.

As it is highly likely that Black Ironbox requires water from the riparian saturation zone, the maintenance of the current hydrological flows along Walker Creek is of importance. The constructed diversion channel will divert the current catchment area associated with Walker Creek. Connectivity of subsurface flows will remain through deliberate design of the diversion channel. As such, water flow and volume to downstream areas will be equivalent to current conditions, which will reduce the likelihood of indirect impacts to downstream populations.

In addition, it is proposed to use Black Ironbox in the revegetation of the constructed diversion channel to assist in mitigating impacts associated with the removal of mature individuals within the project disturbance footprint. Species planting along the diversion channel will substantially mitigate any impacts. Overall an increase in Black Ironbox individuals is expected.

As outlined in the table below, project impacts are not considered to be significant on this MNES value.

Black Ironbox (*Eucalyptus raveretiana*) – Assessment against Significant Impact Criteria

Significant Impact Criteria	Assessment	Response to Criteria
Lead to a long-term decrease in the size of an important population of a species	No	The occurrence of Black Ironbox is not considered to be part of an important population. Larger more densely populated occurrences occur in the region and immediate surrounding areas (e.g. Bee Creek). Revegetation of the creek diversion utilising the species would mitigate the long-term decrease of Black Ironbox within the impact area.
Reduce the area of occupancy of an important population	No	The occurrence of Black Ironbox is not considered to be part of an important population. Larger more densely populated occurrences occur in the region and immediate surrounding areas (e.g. Bee Creek). Impacts are expected on 16.8 ha. Nearby important populations downstream on Bee Creek will not be impacted by this project. Revegetation of the creek diversion utilising the species would mitigate the reduction of area of occupancy of Black Ironbox within the impact area.
Fragment an existing important population into two or more populations	No	Project clearing will not fragment habitat supporting an important population.
Adversely affect habitat critical to the survival of the species	No	Habitat within the study area is not considered critical to the survival of the species due to there being good quality habitat still occurring downstream of the study area. Loss equates to 0.04 % of potential Black Ironbox habitat modelled within the region.

Significant Impact Criteria	Assessment	Response to Criteria
Disrupt the breeding cycle of an important population	No	The occurrence of Black Ironbox is not considered to be part of an important population. Larger more densely populated occurrences occur in the region and immediate surrounding areas (e.g. Bee Creek). This population would have a greater reproductive output (pollen) in comparison to the population within the study area.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	Habitat within the study area is not considered critical to the survival of the species due good quality habitat occurring downstream of the study area and in numerous other large watercourse systems in the nearby region. The loss equates to 0.04% of potential Black Ironbox habitat modelled within the region. It is unlikely that this will result in a decline of the species. Rubber Vine is a threat to the species and has the potential to cause extensive degradation. No Rubber Vine infestations were located along Walker Creek. Current mining operations have not introduced this species and it is unlikely that this will occur as a result of the expansion project. Exotic grasses were prevalent along Walker Creek and likely a result of previous grazing land use rather than current mining activities. Management of diversion rehabilitation will include weed and exotic grass control that are identified as threatening processes.
Introduce disease that may cause the species to decline	No	No diseases are listed as a threat to the species.
Interfere substantially with the recovery of the species	No	Based on the percentage of potential modelled habitat impacted, the project is not considered to substantially interfere with the recovery of the species. Rehabilitation of creek diversion will include Black Ironbox to mitigate impacts.

Ornamental Snake

Approximately 33.7 ha of Ornamental Snake habitat will be impacted by the project. The project site is considered to be an area potentially supporting an important population of Ornamental Snake. As outlined in the table below, project impacts are likely to be significant for this MNES value.

Ornamental Snake (*Denisonia maculata*) – Assessment against Significant Impact Criteria

Significant Impact Criteria	Assessment	Response to Criteria
Lead to a long-term decrease in the size of an important population of a species	Yes	Habitat within the study area is considered to support an important population due to the presence of important habitat (gilgai habitat in good condition). The determination of important habitat is supported by species records 2 – 5 km south-east of the study area. The project will impact on 33.7 ha of Ornamental Snake habitat. No undisturbed Ornamental Snake habitat will remain within the study area following the development of the project.
Reduce the area of occupancy of an important population	Yes	Habitat within the study area is considered to support an important population due to the presence of high quality habitat. The project will impact on 33.7 ha of Ornamental Snake habitat.
Fragment an existing important population into two or more populations	No	Project clearing will not fragment Ornamental Snake habitat supporting an important population.
Adversely affect habitat critical to the survival of the species	Yes	The project will impact on 33.7 ha of Ornamental Snake habitat. No undisturbed Ornamental Snake habitat will remain within the study area following the development of the project.
Disrupt the breeding cycle of an important population	No	The project will not specifically disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The species is also known to persist in disturbed environments as long as key microhabitat features are present (gilgai, soil cracks).
Introduce disease that may cause the species to decline	No	There are no known diseases that threatened the species.
Interfere substantially with the recovery of the species	No	The project does not interfere with the recovery actions outlined in the Draft Recovery Plan for Queensland Brigalow Belt Reptiles.

Koala

Koalas have been observed previously in nearby areas to SWC Mine, however until 2018 numerous surveys had found only limited evidence of Koalas on the mine site. During surveys undertaken in February 2018 three Koalas were recorded within the floodplain and fringing riparian forest habitats in the study area. All recordings and sightings have been in riparian vegetation along waterways.

Based on ecological surveys of habitat a maximum of 212.2 ha of Koala habitat will be impacted by the project (Figure 16).

As per the EPBC Act referral guidelines for the vulnerable Koala, Koala habitat value is categorised by five primary habitat attributes – vegetation composition, occurrence, recovery value, key existing threats and connectivity. An analysis of these five primary Koala habitat attributes has been undertaken and combined with the latest regional data, previous ecological assessment results for the study area and the recent results of the targeted habitat assessments the habitat.

The habitat has been assessed as critical for the survival of the species and is considered to support an important population.

The diversion channel has been designed to maintain the hydrology of Walker Creek and indirect impacts on habitat further downstream along Walker Creek are unlikely. The inclusion of Koala food trees in the revegetation of the constructed diversion channel is proposed to assist in mitigating impacts on habitat within the project site.

Project impacts are likely to adversely affect habitat critical to the survival of the species.

Vegetation composition

Based on targeted habitat assessments across the study area, Koala food trees were confirmed within the floodplain of Walker and Carborough Creek. The entirety of the fringing riparian forest habitat was found to contain known Koala food species; however only portions (approximately 45%) of the floodplain Eucalypt forest habitat was found to contain Koala food trees dominating the canopy layer (>50% coverage). Koala food trees identified within these habitat types include:

- Poplar Box
- Narrow-leaved Ironbox
- Queensland Blue Gum
- River Red Gum

Suitable vegetation composition, structure and condition to support Koalas was therefore only identified within two habitat areas within the study area – the fringing riparian forest and portions of the floodplain Eucalypt forest habitat.

Occurrence

While food trees are present across the study area, koala occurrence is very low. Surveys conducted in 2018 identified three Koalas within the study area, all restricted to the riparian and fringing floodplain Eucalypt forests.

Targeted searches for Koalas across suitable habitat within and adjacent to the study area in 2013 and 2014 found no evidence of Koala utilisation. This involved targeted searches (including spotlighting nocturnal searches) along fringing riparian forest and Eucalypt floodplain habitat along Carborough and Walker Creek. Only one form of indirect evidence has been recorded, which was during surveys in 2006 where potential scratch marks were identified on a Eucalypt tree located along Walker Creek.

Whilst inland Koala populations naturally occur in low densities (0.01 Koala / ha), given the extent of suitable habitat both within and surrounding the study area the evidence of species utilisation should be higher for a typical inland population. As such all evidence collected to date suggests that Koalas are present; however use of suitable habitat is infrequent and that Koalas are likely to utilise the study area on a transient basis only.

Key existing threats

The study area has historically been utilised for grazing purposes. Key threats to the species such as dog attacks and vehicle strikes would have been low. Operational mining activities do not currently extend into the study area although wild dog eradication has occurred in nearby areas. Vehicle traffic associated with mining activities are infrequent and occur as part of routine maintenance and inspection checks across the lease. Clearing or construction of infrastructure within the study area has not occurred to the extent that it would create a barrier to Koala movement.

Connectivity

The study area forms the eastern edge of a large vegetation tract that extends toward the west of the South Walker mining lease. Connectivity to the west and south of the study area is therefore high. The large vegetation tract provides a landscape linkage between the Carborough Ranges and Dipperu National Park.

The operational mining area fragments the study area from areas to the north and east, creating a significant barrier to fauna movement. However, Walker Creek does provide a corridor that links to other eastern areas of habitat along Bee Creek.

Koala (*Phascolarctos cinereus*) – Assessment against Significant Impact Criteria

Significant Impact Criteria	Assessment	Response to Criteria
Lead to a long-term decrease in the size of an important population of a species	No	Three Koala individuals were confirmed within the study area during the 2018 survey. Based on current information and concentrations of species records, important populations are likely to occur in the Conor Ranges, Carborough Ranges, Dipperu National Park and the Funnel Creek riparian habitat, as well as Blair Athol State Forest Park. The study area is highly connected to these areas enabling a contiguous population. The project is unlikely to lead to a long-term decrease in the size of the population. The connectivity with surrounding habitat will remain following the creek diversion project, allowing for breeding males to still disperse across the area. Whilst some connectivity along the riparian corridor will be lost until rehabilitation of the creek diversion is established, the species will be able to utilise adjacent eucalypt woodland habitats to disperse. The existing hydrology of Walker Creek will also be maintained within the diversion channel, which will retain habitat values within the study area. Rehabilitation of the creek diversion will include Koala food trees to mitigate impacts.
Reduce the area of occupancy of an important population	No	The project is unlikely to lead to a reduction in area occupancy of the population. The connectivity with surrounding habitat will remain following the creek diversion project, allowing for breeding males to still disperse across the area. Whilst some connectivity along the riparian corridor will be lost until rehabilitation of the creek diversion is established, the species will be able to utilise adjacent eucalypt woodland habitats to disperse. The existing hydrology of Walker Creek will also be maintained within the diversion channel, which will retain habitat values within the study area. Rehabilitation of the creek diversion will include Koala food trees to mitigate impacts.
Fragment an existing important population into two or more populations	No	The project is unlikely to fragment an existing population into two or more populations. The study area is well connected to large tracts of surrounding habitat within the Conor Ranges, Carborough

Significant Impact Criteria	Assessment	Response to Criteria
		Ranges, Dipperu National Park and the Funnel Creek riparian habitat, as well as Blair Athol State Forest Park. The connectivity with surrounding habitat will remain following the construction of the project. Whilst some connectivity along the riparian corridor will be lost until rehabilitation of the creek diversion is established, the species will be able to utilise adjacent eucalypt woodland habitats to disperse.
Adversely affect habitat critical to the survival of the species	Yes	Habitat within the study area is considered critical to the survival of the species. This is in accordance with the Koala referral guidelines (habitat score 9). Two key considerations are outlined in referral guidelines as to whether a proposed action will have or is likely to have a significant impact on the koala. These include: • Adversely affecting habitat critical to the survival of the species (specifically, > 20 ha with a habitat score of >8), and/or • Interfering substantially with the recovery of the species through the introduction or exacerbation of key threats in areas of habitat critical to the survival of the species A total of 212.2 ha of habitat (habitat score of 9) will be impacted by the project, as such the project is likely to have a significant impact on the Koala.
Disrupt the breeding cycle of an important population	No	Based on current information and concentrations of species records, important populations are likely to occur in the Conor Ranges, Carborough Ranges, Dipperu National Park and the Funnel Creek riparian habitat, as well as Blair Athol State Forest Park. The study area is highly connected to these areas enabling a contiguous population. The project is unlikely to disrupt the breeding cycle of the population. The connectivity with surrounding habitat will remain following the creek diversion project, allowing for breeding males to still disperse across the area. Whilst some connectivity along the riparian corridor will be lost until rehabilitation of the creek diversion is established, the species will be able to utilise adjacent eucalypt woodland habitats to disperse.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of the habitat. A total of 212.2 ha of Koala habitat will be impacted by the project. The area provides suitable foraging resources for the species. However, the connectivity with surrounding habitat will remain

Significant Impact Criteria	Assessment	Response to Criteria
		following the creek diversion project, allowing for breeding males to still disperse across the area. Whilst some connectivity along the riparian corridor will be lost until rehabilitation of the creek diversion is established, the species will be able to utilise adjacent eucalypt woodland habitats to disperse.
Introduce disease that may cause the species to decline	No	It is unlikely that the project will facilitate the introduction or spread of diseases specific to the species such as Chlamydia, or diseases that can significantly degrade critical habitat such as root rot (*Phytophthora cinnamomi*). Whilst dieback was noted to occur in the study area, this was highly localised and not to the extent that occurs as a result of root rot. No other signs of root rot such as yellow and wilting of the leaves was observed across the vegetation communities within the study area.
Interfere substantially with the recovery of the species	No	The project will not increase Koala fatalities due to dog attacks, vehicle strike or introduced pathogens. Mining activities are limited to operational land and will not encroach into remaining habitat areas. The retention of vegetation within undisturbed portions of the study area will retain connectivity across the landscape, allowing Koalas to continue to disperse to surrounding areas of suitable habitat. Maintaining existing hydrology of Walker Creek within the diversion channel will also retain refuge habitat values within the study area. Rehabilitation of the creek diversion will include Koala food trees to mitigate impacts.

Squatter Pigeon

A maximum of approximately 295.3 ha of Squatter Pigeon habitat will be potentially impacted by the project. This habitat has been assessed as not critical for the survival of the species and is not considered to support an important population. As outlined in the table below, project impacts are not considered to be significant on Squatter Pigeon.

Squatter Pigeon (*Geophaps scripta scripta*) – Assessment against Significant Impact Criteria

Significant Impact Criteria	Assessment	Response to Criteria
Lead to a long-term decrease in the size of an important population of a species	No	Not considered an important population as current occurrence not considered to be part of a source population and playing a critical role in maintaining genetic diversity.
Reduce the area of occupancy of an important population	No	Not considered an important population as current occurrence not considered to be part of a source population and playing a critical role in maintaining genetic diversity.
Fragment an existing important population into two or more populations	No	Project clearing will not fragment Squatter Pigeon habitat supporting an important population.
Adversely affect habitat critical to the survival of the species	No	Habitat within the study area is not considered critical to the survival of the species due to the abundance of habitat (including breeding) that occurs in the region. The diversion will result in the relocation of a suitable water source for the species further south. Following the construction of the project, including the diversion, critical water resources will be available to the surrounding suitable foraging habitat for the species.
Disrupt the breeding cycle of an important population	No	Not considered an important population as current occurrence not considered to be part of a source population and playing a critical role in maintaining genetic diversity.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	The project will result in the potential loss of 295.3 ha of Squatter Pigeon habitat. This equates to only 0.3% of potential Squatter Pigeon habitat modelled within the region (1:500,000). It is unlikely that this will result in a decline of the species.
Introduce disease that may cause the species to decline	No	No diseases are listed as a threat to the species.
Interfere substantially with the recovery of the species	No	Based on the percentage of potential modelled habitat impacted, the project is not considered to substantially interfere with the recovery of the species. Rehabilitation of creek diversion to ensure the catchment size and volume of water flow through the diversion is similar to that of Walker Creek will assist in mitigating impacts on breeding habitat.

Greater Glider

A total of 149.3 ha of Greater Glider habitat will be potentially impacted by the project.

The project will result in the removal of habitat containing a high density of breeding resources. Riparian corridors along Walker Creek provide high quality connectivity for the Greater Glider to Carborough Range in the west, Conor Range and Dipperu National Park in the east. The project is therefore likely to have a significant impact on the Greater Glider.

Greater Glider (*Petauroides volans*) – Assessment against Significant Impact Criteria

Significant Impact Criteria	Assessment	Response to Criteria
Lead to a long-term decrease in the size of an important population of a species	Yes –within the study area	The study area is considered to contain an important population of Greater Glider. 22 individuals were identified across five nights of survey within 153.2 ha of suitable habitat. 149.3 ha of habitat will be removed for the project, including trees with high densities of hollows, which are a key resource for the species. It is considered likely that this impact will reduce the size of the population with in the study area.
Reduce the area of occupancy of an important population	Yes	The study area is considered to contain an important population of Greater Glider and 149.3 ha of habitat will be removed for the project. This will reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations	Yes	The study area is considered to contain an important population of Greater Glider. 22 individuals were identified across five nights of survey within 153.2 ha of suitable habitat. This population is likely to form part of a larger source population to the west in the Carborough Ranges. Riparian habitat with old growth forest provide connectivity corridors between suitable habitat areas and Walker Creek is likely to provide connection to larger habitat areas in the east, such as Dipperu National Park. Removal of old growth forest within the riparian corridor of Walker Creek may reduce Greater Glider movement between habitat areas and fragment populations east and west of the study area. Greater Glider is known to be sensitive to even small levels of fragmentation and this is therefore considered to be significant.
Adversely affect habitat critical to the survival of the species	Yes	The study area is considered to contain habitat critical to the survival of the Greater Glider. 149.3 ha of habitat will be removed for the project and this is considered to be significant.
Disrupt the breeding cycle of an important population	Yes	The study area contains a high density of tree hollows which is a key breeding resource for Greater Gliders. It is likely the removal of this resource would have some disruptive effected on the important population of Greater Glider in the study area.

Significant Impact Criteria	Assessment	Response to Criteria
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Yes – within the local area	The study are is considered to contain habitat critical to the survival of the Greater Glider. High density suitable hollows were identified within Walker Creek that are known to be utilised by the species. Riparian habitat with old growth forest provide connectivity corridors between suitable habitat areas and Walker Creek is likely to provide connection to larger habitat areas east and west of the study area. Greater Glider are considered particularly sensitive to removal of old growth forests containing hollows and have little dispersal ability between cleared areas. The project will result in the potential impact on 149.3 ha of riparian habitat containing the essential breeding resource of hollow-bearing trees. As hollow-bearing trees are a limited resource with density concentrated along Walker Creek, the removal of this riparian habitat will reduce the carrying capacity of the area. This is likely to result in localised population decline.
Introduce disease that may cause the species to decline	No	There are no known diseases that threaten the species.
Interfere substantially with the recovery of the species	Yes	The project is likely to interfere with the primary conservation action listed in the species conservation advice (TSSC 2016), specifically; • Protect and retain hollow-bearing trees, suitable habitat and habitat connectivity Greater Glider are considered particularly sensitive to removal of old growth forests containing hollows and have little dispersal ability between cleared areas. Removal of old growth forest within the riparian corridor of Walker Creek may reduce movement between east and west habitat areas and diminish the availability of suitable hollow-bearing trees. These actions may interfere with the recovery of the species in the area.

7.2. Summary of Significant Ecological Impacts

Based on the above assessment and field surveys undertaken (ELA 2018) a total of five (5) MNES will be significantly impacted by the project. The implementation of mitigation measures will limit the severity and magnitude of significant impacts; however residual impacts particularly from direct clearing of vegetation will remain significant.

Significant residual impacts associated with the MRA2C project are:

- Clearing of Brigalow TEC – 32.7 ha
- Ornamental Snake habitat clearing – 33.7 ha
- Koala habitat clearing – 212.2 ha
- Greater Glider habitat clearing – 149.3 ha
- Clearing of 16.8 ha of Black Ironbox habitat

In accordance with the EPBC Act, the residual significant impacts for these protected matters will be offset as per the EPBC Act Environmental Offset Policy.

8. Avoidance, safeguards and mitigation measures

Mitigation of Impacts on Species and TECs

Avoidance and minimisation

The diversion channel alignment has been chosen to predominantly traverse an existing drainage line, which will reduce the extent of excavation and clearing required. In doing so the pit will be limited to the available area north of the diversion. Whilst clearing impacts will occur to develop the pit and establish the diversion and associated water management infrastructure, further disturbance to surrounding MNES values within the study area will be minimised.

Mitigation and management

The proposed diversion channel presents an opportunity to rehabilitate in consideration of MNES values impacted by the MRA2C project. The diversion channel has been specifically designed to provide features that are characteristic of incised alluvial streams within the Bowen Basin with the purpose of creating a riparian environment close to natural conditions. The design includes a lower bench that is inundated by flows around the 2 year ARI events, and a higher bench that is inundated by flows around the 50 year ARI events in the downstream sections of the diversion (Figure 17). The benches will act as an inset floodplain, providing a suitable environment to facilitate ongoing riparian zone regeneration and long term vegetation cover and stability of the channel.

A hyporheic zone will develop over time as the sand bed level accumulates, which will provide a similar saturation zone present along the existing Walker Creek. The saturation zone will provide a source of soil moisture for surrounding vegetation (including planted Koala food trees and Black Ironbox) as well as retaining sub-surface flow connectivity to downstream environments.

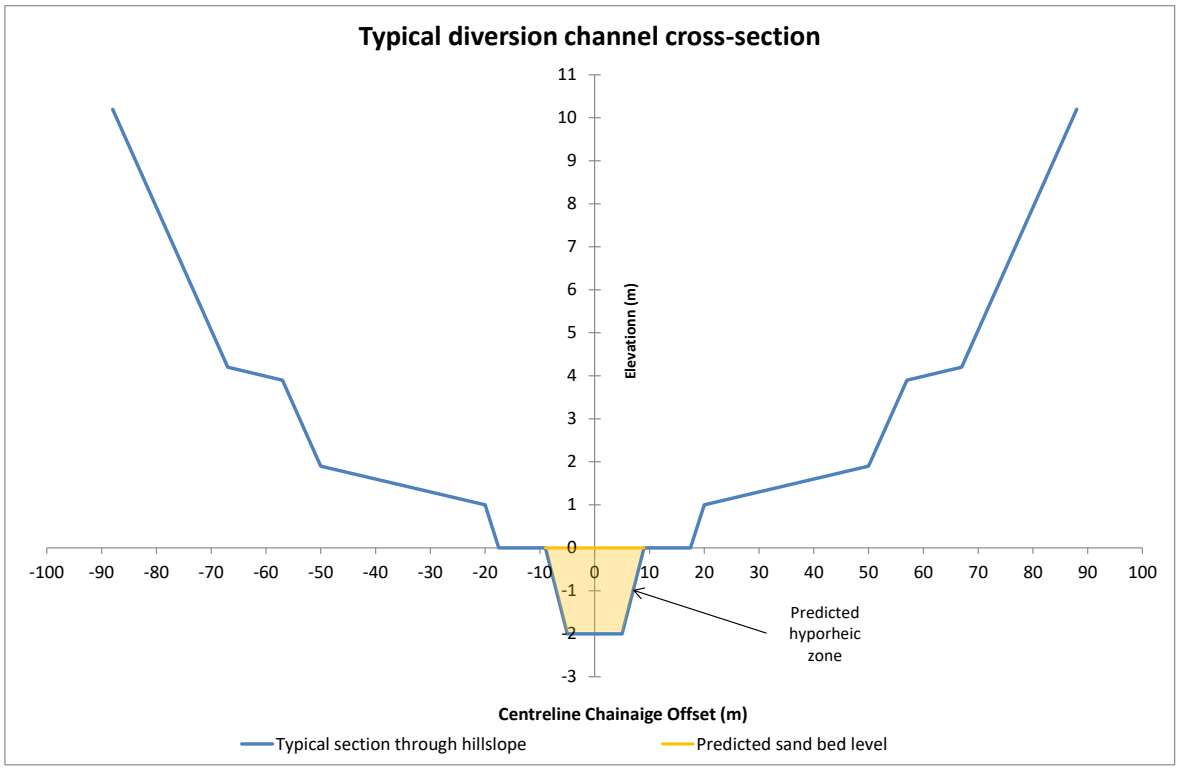


Figure 17: Generalised cross section of proposed diversion channel

A revegetation plan (refer Appendix G) has been prepared for the constructed channel that specifies the use of Koala food tree species as well as the threatened Black Ironbox in the planting mix along the channel. The area available for revegetation along the diversion channel is estimated to be 157.5 ha for Koala habitat and 46.3 ha for Black Ironbox.

The preparation of a revegetation plan specific for the diversion channel ensures appropriate planning, site preparation and maintenance, which in turn increases the rate of rehabilitation success. A number of risks to revegetation failure have been specifically identified for the diversion channel, which have been addressed through the proposed implementation of the following key strategies:

- Permian bedrock to be deeply ripped and left with a surface layer of rock rubble to provide armouring for topsoil, and allow for suitable rooting depth and water retention in sub-soils
- Addition of topsoil to provide an appropriate growth medium for seeding and compensate for deficiencies associated with current weathered soils
- Further testing to determine geo-chemical properties of Permian bedrock as well as nutrient content and structure of weathered soils
- Addition of soil ameliorants to supplement tested deficiencies
- On-site seed sourcing to ensure local provenance and adaptability to local conditions
- Follow up monitoring and maintenance, including additional planting of Black Ironbox if initial seeding fails.

The establishment of the diversion channel for MRA2A has provided insight into the conditions of the area, which has been considered in the design and planning of the diversion channel for Stage 2C. Black Ironbox was not utilised in Stage 2A plantings due to expected hydrological differences between MRA2A and MRA2C (i.e. inclusion of Carborough Creek); however consultation with the former Biloela district group of Landcare Australia has revealed that the species has been successfully utilised in revegetation projects and plantings across the Central Queensland township. Black Ironbox seed has been successfully propagated into tube stock, planted and has since matured to large fertile trees across the Biloela area. The establishment of Black Ironbox along the diversion channel for the MRA2C project is therefore considered a viable mitigation strategy.

Further, the construction and progression of the Mulgrave pit will occur over a period of 30+ years allowing a considerable amount of time for habitat to be regenerated in the diversion, its riparian zone and any land based offset location.

Other management measures to be incorporated pre- and post-construction to assist in mitigating impacts on MNES include:

- Weed management including controlling infestations of Restricted Matters (as classified under the *Biosecurity Act 2014*) or Weed of National Significance (WoNS), (i.e. *Parthenium hysterophorus* or *Harrisia* spp.) as well as regular wash downs for vehicle and equipment, particularly for those that have been operating in an area of known weed infestation
- Fauna management during construction such as key habitat identification (nesting trees) and spotter-catchers to remove fauna and relocate to surrounding areas prior to clearing
- Sensitive vegetation clearing techniques i.e. targeted, staged and sequential clearing
- Standard fire, waste water management, pest, sediment, dust and noise control implemented as part of the mine's environmental management system
- Topsoil salvage, stockpiling and rehabilitation of disturbed mine areas to be undertaken in accordance with the mine's Plan of Operation, topsoil management and rehabilitation plans.

9. Risk Assessment

A risk assessment of the MRA2C project been undertaken to assess the risk of increased environmental harm / impacts on environmental values associated with the Project and to determine the requirement for additional mitigation in order to:

- Minimise / reduce the risks to as low as reasonably practicable
- Ensure that MRA2C management and operational controls are able to achieve environmental performance outcomes, as governed by the existing EA conditions.

Risk assessment approach

Changes to mining operations as a result of the project have been considered in terms of their potential to impact on environmental values. Aspects of the program with potential to affect the level of impact have been identified and potentially affected environmental values listed.

For each aspect / environmental value combination:

- the potential impacts on associated environmental values has been detailed giving consideration to the findings of the comprehensive environmental assessments included as Appendices to this report.
- the existing controls and mitigation measures in place have been identified
- The severity or consequence level for the likely change in impact level has been assessed, giving consideration to the controls already in place
- the likelihood of the assessed change in impact level occurring has been assessed
- the risk level has been determined as a product of the severity and likelihood, as shown in the table below.
- the requirement for additional risk management measures has been assessed.

Environmental Risk Assessment Matrix

BHP SWC Improvement Program - Risk Rating Matrix		Severity level and factor						
		Low 1	Minor 3	Moderate 10	Major 30	Serious 100	Severe 300	Permanent severe 1000
Uncertainty level and factor	Almost certain 10	10 Moderate	30 Medium	100 High	300 High	1000 High	3000 High	10000 High
	Likely 3	3 Moderate	9 Moderate	30 Medium	90 High	300 High	900 High	3000 High
	Possible 1	1 Low	3 Moderate	10 Moderate	30 Medium	100 High	300 High	1000 High
	Unlikely 0.3	0.3 Low	0.6 Low	3 Moderate	9 Moderate	30 Medium	900 High	300 High
	Rare 0.1	0.1 Low	0.3 Low	1 Low	3 Moderate	10 Moderate	30 Medium	100 High
	Very rare 0.03	0.03 Low	0.09 Low	0.3 Low	0.9 Low	3 Moderate	9 Moderate	30 Medium

Risk assessment results

The risk assessment results are presented in the tables on the following pages. Based on these results, it can be concluded that the Project poses low to moderate risk of increased impact on environmental values. Management and mitigation of impacts and the continued achievement of environmental performance objectives is able to be effectively managed using the existing site mitigation and control measures and by application of management measures outlined in this preliminary documentation.

Risk Assessment

No.	Risk description and controls				Risk level (existing controls)			Risk treatment plan
	Aspect / Event/ Activity	Environmental Value impacted	Impact description	Existing controls	Severity	Likelihood	Risk Level	Risk treatment plan
1	Vegetation clearance	Land	Direct impacts of the project relate to a change in the progression of the MRA pit and creek diversion resulting in removal of vegetation. *Refer detailed terrestrial ecology assessment report (Ecological Australia, 2018)*	Vegetation rehabilitation Vegetation offsets	Low	Possible	Low	Proposed controls are sufficient to manage risk. No additional mitigation required.
2	Hydrological changes	Land (Ecology)	Indirect impacts to Black Ironbox from changes in surface or groundwater hydrology.	Black Ironbox occurs downstream of the proposed creek diversion, in this area the water table aquifer is 15-20 m deep and beyond reach of surface vegetation. Surface water flows and water quality is closely monitored; water releases occur only in accordance with EA conditions.	Low	Possible	Low	Proposed controls are sufficient to manage risk. Monitoring is in line with REMP.
3	Mining progression	Surface water	Alteration of surface water quality from mine water discharge	Release and monitoring of mine water is controlled by EA conditions. This includes: - monitoring of stream flow, water quality, sediment quality, aquatic habitat and macroinvertebrates) during natural flow conditions when mine-affected water is being discharged - an assessment at potentially impacted	Low	Possible		Proposed controls are sufficient to manage risk. Monitoring is in line with REMP.

No.	Risk description and controls				Risk level (existing controls)			Risk treatment plan
	Aspect / Event/ Activity	Environmental Value impacted	Impact description	Existing controls	Severity	Likelihood	Risk Level	Risk treatment plan
				(i.e. receiving environment) sites and background sites (i.e. sites that are not affected by the release of mine-affected water), and comparison of monitoring results against guideline levels				
4	Pit development / mining progression	Groundwater	Water for stock purposes is sourced from the water table aquifer and there is potential to impact some stock bores. All identified stock bores located within the estimated area of drawdown are located on BMC owned land. All land agistment arrangements include compensation agreements that ensure alternative water supply arrangements are put in place should a bore be impacted. Such arrangements have already been put in place for Bores 9 and 12. There are no identified groundwater users of the confined coal seam aquifer in the project vicinity nor have any environmental values been identified. This is due primarily to the aquifer's relatively poor water quality but also due to its greater depth, making extraction costly. The SWC Mine may potentially support Type 3 GDEs in areas where shallow groundwater is present (Riparian vegetation along Walker and Carborough Creeks). The program is not expected to change the level of impact to these GDEs. Precautionary detection monitoring is panned.	1. Groundwater Monitoring Program 2. Existing "make-good" arrangements with affected water users 3. Riparian vegetation monitoring	Low	Likely	Moderate	Proposed and existing controls are sufficient to manage risk to groundwater and surface water. Additional riparian vegetation monitoring has been proposed to detect any change as a result of unpredicted alterations to the water table aquifer in higher risk locations.

No.	Risk description and controls				Risk level (existing controls)			Risk treatment plan
	Aspect / Event/ Activity	Environmental Value impacted	Impact description	Existing controls	Severity	Likelihood	Risk Level	Risk treatment plan
5	Dust generation: Material handling (overburden / coal product) and vehicle movements	Land (Ecology)	Ecology: Indirect (dust) impacts to remaining vegetation. The extent of dust deposition increases is considered to be minimal due to the low rate of dust deposition in these areas compared to rates known to adversely affect vegetation.	1. Watering of haul/vehicle roads 2. Vehicle speed limits (Note: instigated for mine safety)	Low	Almost certain	Moderate	Existing EA conditions / management practices are sufficient to manage risk. No additional mitigation required
6	Site water releases (MAW)	Water	Changes to site discharge have potential to impact receiving environment hydrology, geomorphology and ecosystem. However there is very low likelihood that MRA2C will result in any significant change to current mine affect water quantity/quality parameters.	Release of water will continue to comply with the EA and monitoring of water quality and aquatic ecology will continue in accordance with EA conditions, the Mine Water Plan and the Receiving Environment Monitoring Program.	Moderate	Rare	Low	Existing EA conditions / management practices are sufficient to manage risk. No additional mitigation required.
7	Spills	Groundwater	Pollutant discharge into surface or groundwater	Mine management and control measures of potential pollutants and contaminant sources will be maintained to prevent uncontrolled discharge. These include provision of appropriate spill control materials at refuelling facilities, established procedures to ensure safe and effective storage and handling of fuel, oil and chemicals	Low	Possible	Low	Existing management practices are sufficient to manage risk. No additional mitigation required

10. Environmental Offsets

Project impacts

As discussed above there are a number of MNES that will be impacted by the project. The implementation of mitigation measures will limit the severity and magnitude of significant impacts; however residual impacts will remain significant. Significant residual impacts associated with the MRA2C project are:

- Clearing of Brigalow TEC – 32.7 ha
- Ornamental Snake habitat clearing – 33.7 ha
- Koala habitat clearing – 212.2 ha
- Greater Glider habitat clearing – 149.3 ha
- Clearing of Black Ironbox habitat – 16.8 ha

Offset Strategy

The following Offset Strategy provides proposed compensatory measures for residual significant impacts to MNES. Further analysis and planning, in conjunction with DoEE, will be undertaken to refine offset areas and plan for potential staged offset delivery.

Offsets for the MNES listed above will be delivered across three properties. The Myuna property which is owned and managed by BHP and the Clive and Brigalow properties which are owned and managed by third parties with whom BMC has entered into formal offset arrangements.

The Clive and Brigalow properties are adjacent to each other and this is where the majority of offsets will be delivered. *Eucalyptus raveretiana* has specialised habitat requirements, which are not present on the Clive and Brigalow properties. Offsets for this species will be delivered on the Myuna property.

Properties' contribution to offset requirements

Protected matter	Contribution to offset requirement		
	Clive Property	Brigalow Property	Myuna Property
Brigalow TEC	100 %	-	-
Ornamental Snake habitat	100 %	-	-
Koala habitat	87%	13%	-
Greater Glider habitat	87%	13%	-
Eucalyptus raveretiana	-	-	100 %

Clive & Brigalow Property

The Clive and Brigalow properties are adjacent to each other, with the Brigalow Property directly to the north of Clive. The collective values present on these properties are discussed below.

Property location & regional context

The properties are located 140 km south of the SWC Mine in the Northern Brigalow Belt Bioregion. The properties encompass 7,730 ha (Brigalow – 3,914 ha; Clive 3,816 ha). They are located in the Isaac Local Government Area, approximately 140 km north-west of Rockhampton (Figure 18).

The majority of both properties are cleared. However, both also contain a mixture of remnant and regrowth vegetation, predominantly located in the western parts of the properties and along drainage lines and watercourses. The Isaac River and its anabranches form the western boundary of the Brigalow Property and bisects the western parts of the Clive Property. Smaller watercourses to the east and west of both properties flow into the Isaac River providing a corridor between the properties and Junee State Forest and National Park (5 km west of the properties) and the Nebo-Connors Ranges (6.5 km east of the properties) (Figure 18).

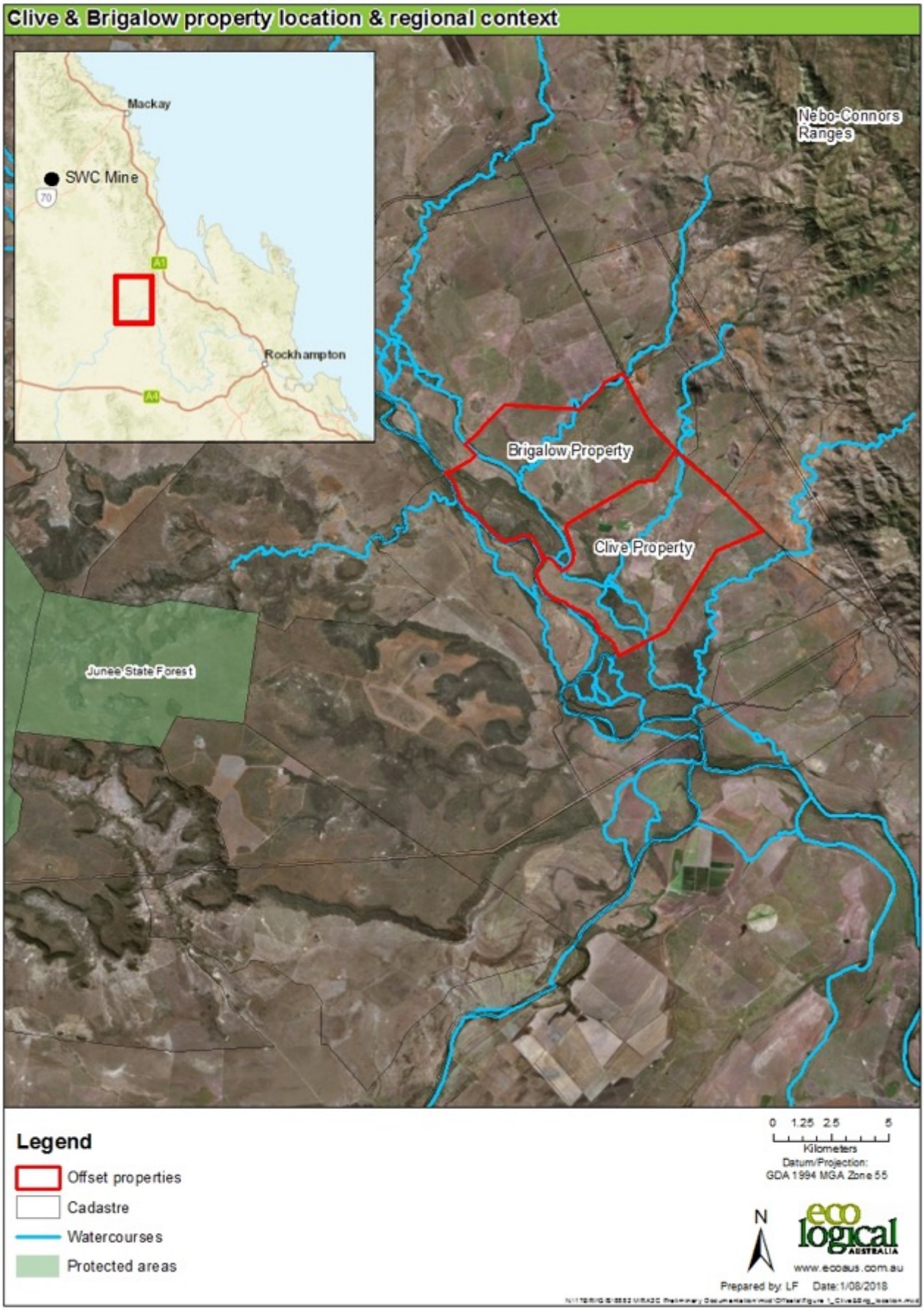


Figure 18: Clive & Brigalow Property location & regional context

Tenure & ownership

Both properties are third party owned properties on freehold land, with no mining or petroleum leases over the properties. They are both currently used predominantly for grazing purposes, with areas of the Clive Property also under cultivation.

Brigalow offset area

The proposed offset area, herein referred to as the 'Brigalow offset area', comprises 49.8 ha in the south-western corner of the Brigalow property (Figure 19). The offset area is part of a large contiguous tract of remnant vegetation that is associated with the Isaac River and anabranches. The area forms a corridor of vegetation connecting habitat in the north to habitat areas in the south. The vegetation within the offset area is predominately floodplain Eucalypt woodlands and fringing riparian vegetation analogous to RE11.3.3 and RE11.3.25, respectively. The areas to the east and south-west of the offset area have historically undergone extensive clearing and now comprise predominantly cleared land with scattered young regrowth.

Clive offset area

The proposed offset area, herein referred to as the 'Clive offset area', comprises 336.7 ha in the south-western portion of the Clive property (Figure 20). An anabranch of the Isaac River bisects the offset area from north to south. The offset area directly connects to the Brigalow offset area, contributing to the corridor of vegetation connecting habitat in the north to habitat areas in the south. The offset area also includes patches of regrowth vegetation that link the area to the main riparian channel of the Isaac River to the west of the offset area.

The vegetation within the offset area is both in remnant and regrowth condition and comprises predominately floodplain Eucalypt woodlands and fringing riparian vegetation analogous to RE11.3.2, RE11.3.3, RE11.3.4 and 11.3.25. Areas of regrowth vegetation analogous to RE11.3.1 (Brigalow woodland) is also present throughout the offset area. The areas to the east and west of the offset area have historically undergone extensive clearing and now comprise predominantly cleared land with scattered young regrowth.

Offset values & existing condition

Field surveys to ground-truth and validate the ecological values and condition of the offset area were undertaken in January 2018. The surveys were undertaken across five days and included:

- Tertiary and quaternary surveys to validate vegetation and habitat type, condition, extent and RE classification
- Targeted habitat assessments to identify areas that have the required resources and capacity to support threatened species, including Koala, Greater Glider and Ornamental Snake
- TEC assessments to determine the presence of potentially occurring TECs in accordance with Commonwealth listed diagnostic and condition threshold criteria
- BioCondition surveys to determine site condition of ecological values

The following sections provide a description of the ground-truthed ecological values, including the relevant Commonwealth offset values.

Figure 19: Brigalow Offset Area

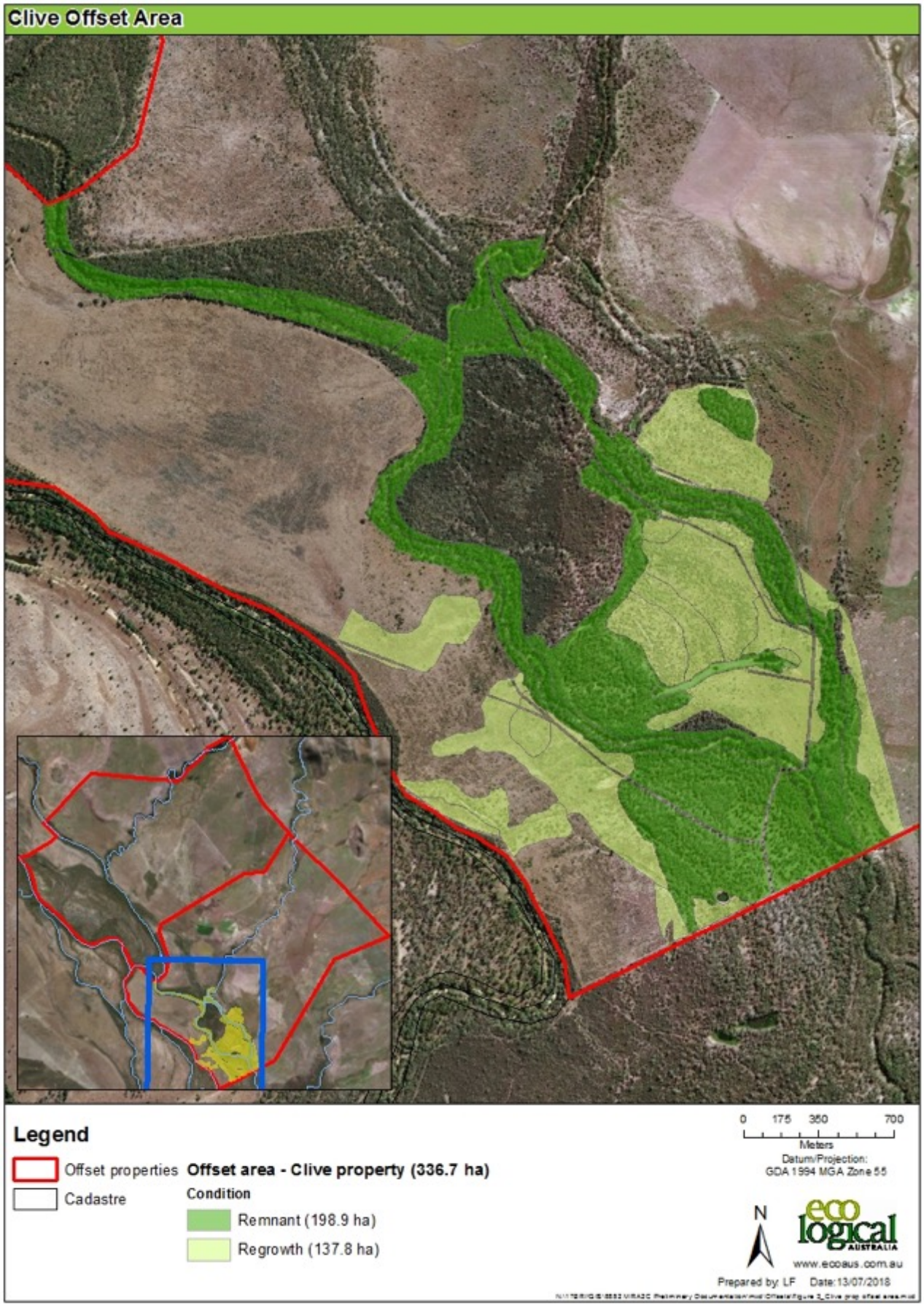


Figure 20: Clive Offset Area

Vegetation communities

The Brigalow offset area comprises entirely of remnant vegetation, classified into two REs – RE11.3.25 and RE11.3.3. Vegetation consisted of a woodland community dominated by *Eucalyptus calmedulensis* (River Red Gum), *Eucalyptus tereticornis* (Queensland Blue Gum) and *Eucalyptus coolabah* (Coolibah) along the riparian zone of the Isaac River.

The Clive offset area comprises a mixture of remnant and regrowth vegetation interspersed by cleared and disturbed areas. Remnant and regrowth vegetation within the area was classified into a total of five REs. Remnant woodland communities dominated by River Red Gum, Queensland Blue Gum and Coolibah encompass the majority of the offset area including along the riparian zone of the Isaac River. Patches of Brigalow, *Eucalyptus populnea* (Poplar Box) and Coolibah regrowth also occur throughout the offset area.

Regional Ecosystems present within the Brigalow and Clive offset areas

RE	Description	Condition	VM Act Status	Offset area
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Regrowth	Endangered	Clive
11.3.25	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Remnant	Least concern	Brigalow & Clive
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Remnant & Regrowth	Of concern	Brigalow & Clive
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus spp*. woodland on alluvial plains	Remnant	Of concern	Clive
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Regrowth	Of concern	Clive

Commonwealth offset values

Brigalow TEC

Vegetation community classification and TEC assessments undertaken during the field survey identified 43.27 ha of vegetation that is consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC diagnostic characteristics as outlined in the Commonwealth conservation advice. Vegetation was confirmed to meet the diagnostic criteria if Brigalow was determined to be dominant or co-dominant in the treey layer and the community was found to be analogous to one of the 12 Brigalow TEC listed REs for the Brigalow Belt region. Ground-truthed potential Brigalow TEC areas can be described as regrowth communities with a canopy layer dominated by Brigalow and analogous to Brigalow listed RE11.3.1.

The Brigalow regrowth communities occur only within the Clive offset area and were found to comprise a disturbed canopy layer with an understorey predominantly invaded by exotic perennial grass species. Due to the state of regrowth, large trees and a complex ground layer of leaf litter and logs is absent from the community. However, species diversity and recruitment levels indicate that the community is in a progressive state of recovery. The areas of regrowth were found to form large patches of habitat, adjacent to other areas of regrowth and remnant vegetation. Habitat quality assessments found these communities to be in moderate condition.

Ornamental Snake

Field surveys involving targeted habitat assessments ground-truthed 35.5 ha of Ornamental Snake habitat within the Clive offset area. Habitat areas were validated based on the presence of the preferred habitat structure, resources and essential microhabitat features that are species requirements outlined in the Commonwealth species profile and threat database, including:

- Gilgais and other aquatic habitat (wetlands, lake and river margins) that can support preferred prey i.e. frogs
- Deep cracking clays, including alluvial clays

Ground-truthed habitat within the offset area can be described as regrowth communities analogous to RE11.3.1, containing soil cracks and gilgais. The areas of regrowth were found to form large patches of habitat, adjacent to other areas of regrowth and remnant vegetation. Regrowth was found to contain suitable ephemeral aquatic habitat

and therefore foraging resources for Ornamental Snake, and deep soils cracks were present throughout regrowth areas. Habitat quality assessments found regrowth habitat to be in moderate condition.

The presence of Ornamental Snake within the offset area was not confirmed during the field assessment, however is considered likely. The species has been confirmed with high species counts (20 sightings over 3 nights) on the Isaac River floodplain at the Croydon Property (Eco Logical Australia 2018a), ~ 50 km to the north of the Clive offset area and within the broader region.

Koala

Field surveys involving targeted habitat assessments ground-truthed 343.21 ha of Koala habitat within the Clive and Brigalow offset areas. Habitat areas were validated based on the presence of preferred habitat structure and preferred food tree species that are the species habitat requirements outlined in the Commonwealth EPBC Act referral guidelines for the vulnerable Koala (DoE, 2014).

The Commonwealth referral guideline also describes the species refugia habitat, which was also utilised to identify potential habitat refuges for the species within the offset area. Refugia habitat is suitable habitat in riparian environments and other areas with reliable soil moisture and fertility, including a permanent aquifer, in a riparian zone, on upper or mid-slopes, on a fertile alluvial plain or where soil moisture / rainfall is reliable (DoE, 2014).

Ground-truthed habitat within the offset area can be described as Eucalypt dominated woodland and regrowth communities containing habitat food trees, namely Red River Gum, Queensland Blue Gum, Poplar Box and Coolibah. On both the Clive and Brigalow offset areas this includes habitat analogous to RE11.3.2, RE11.3.3, RE11.3.25 and RE11.3.4.

The woodland communities comprise 248.69 ha of habitat within the offset area. These areas were found to be in remnant condition, with good structural complexity and species recruitment. The majority of remnant habitat was associated with a fully connected patch of vegetation associated with the Isaac River riparian area and floodplain. It extends across both offset areas. This vegetation is consider to provide refugia habitat for the species. This vegetation is expected to have reliable year round access to high soil moisture and provides an important refuge for Koala in during droughts and in periods of extreme heat. Habitat quality assessments found remnant habitat areas to be in moderate to high condition.

The regrowth communities comprise 94.52 ha of the offset area and were found to comprise a disturbed canopy layer with high weed incursion in the understorey. Connectivity to the surrounding landscape was found to be moderate, with some habitat patches disconnected from remnant vegetation by cleared land. These areas also occur on the alluvial plain of the Isaac River and therefore have potential refugia habitat values. Habitat quality assessments found regrowth habitat to be in moderate to poor condition.

Koala presence was confirmed directly during field surveys, with scats located at three locations in the Clive offset area. These were located in remnant vegetation (RE11.3.25 and 11.3.3) along the Isaac River. As this vegetation is well connected across both the properties, Koala presence at the Brigalow offset area is considered very likely.

Greater Glider

Field surveys involving targeted habitat assessments ground-truthed 343.21 ha of Greater Glider habitat within the Clive and Brigalow offset areas. Habitat areas were validated based on the presence of preferred habitat structure, habitat patch size and connectivity, as well as the presence or future potential presence of tree hollows, as described as the species' habitat requirements outlined in the Approved Conservation Advice for the species (Threatened Species Scientific Committee (TSSC), 2016).

Ground-truthed habitat within the offset area can be described as Eucalypt dominated woodland and regrowth communities connecting to the Isaac River. On both the Clive and Brigalow offset areas this includes habitat analogous to RE11.3.2, RE11.3.3, RE11.3.25 and RE11.3.4. This represents the same vegetation as described for Koala above. Throughout the Clive offset area, tree hollows were found within the remnant riparian vegetation communities in densities of between 2 and 5 per hectare and we mostly of medium size (10-60 cm).

The presence of Greater Glider within the offset area was not confirmed during the field assessment, however is considered likely. There is suitable habitat throughout the offset areas and known records in the broader region.

Threatening processes

Field assessment of the offset areas identified numerous threatening processes present within the properties. These include habitat clearing, heavy livestock grazing, pest fauna and weeds.

Summary of threatening processes

Value	Threat
Brigalow TEC	• Clearing of regrowth areas • Clearing of understory and recruitment trees • Cattle grazing resulting in reduced ground layer diversity and structure, and encouraging exotic perennial grass cover • Spread of declared weed species (incl. Parthenium & Parkinsonia)
Ornamental Snake	• Clearing of regrowth habitat • Thinning and burning of remnant communities, removing understorey structure and microhabitat features i.e. logs, leaf litter • Ongoing cattle grazing compacting soils, reducing soil cracks and degrading aquatic habitat • Ongoing pest incursion reducing habitat condition and prey abundance
Koala & Greater Glider	• Clearing of regrowth habitat • Clearing of refuge remnant habitat not currently mapped as regulated vegetation by State Government • Clearing of understory and recruitment trees • Ongoing pest incursion • Potential predation of Koala by pest species • Fragmentation of habitat by infrastructure such as roads, fence lines, fire breaks, etc.

Myuna Property

Property location & regional context

The Myuna Property is located 145 km north-west of the SWC Mine in the Northern Brigalow Belt Bioregion. The property encompass 9,293 ha. It is located in the Whitsundays Local Government Area, approximately 165 km north-west of Mackay (Figure 21).

The Myuna Property is located at the confluence of the Bowen River and Pelican Creek. The majority of the property is mapped as remnant vegetation, with the western portion of the property consisting of well vegetated escarpments and ridgelines that form part of the Leichhardt Ranges (Figure 21). The eastern portion of the property is of a lower relief and comprises extensive floodplain woodlands, natural grasslands and Eucalypt and Acacia open forests on undulating low hills. Smaller areas that have been cleared for cultivation also occur within the floodplain areas on the eastern portion of the property. Field verification surveys identified areas of mature regrowth in the south-western parts of the property.

Tenure & ownership

The Myuna Property comprises 14 individual lots, with all but one of these being freehold land. Lot 18 DK17 is leasehold land administered by the Department of Natural Resources, Mines and Energy, and in this instance is reserved for community or public purposes.

There are no mining or petroleum leases over the property, however both the Collinsville and Sonoma Coal Mines (and associated MLs) are located immediately to the east of Myuna. A proposed rail line corridor bisects through the central portion of the property.

Offset area overview

The proposed offset area, herein referred to as the 'Myuna offset area', comprises 35.57 ha in a number of areas along both the Bowen River and Pelican Creek (**Figure 22**). These areas are comprised of *Eucalyptus raveretiana* fringing riparian open forest analogous to RE11.3.25a. More broadly, the offset areas are adjacent to large patches of remnant and regrowth vegetation.

Offset values & existing condition

Field surveys to ground-truth and validate the ecological values and condition of the offset area were undertaken in January 2018. The surveys were undertaken across five days and included:

- Tertiary and quaternary surveys to validate vegetation and habitat type, condition, extent and RE classification
- BioCondition surveys to determine site condition of ecological values
- Targeted threatened flora surveys to determine presence of *Eucalyptus raveretiana*

Eucalyptus raveretiana was present in remnant vegetation within the riparian zone of both the Bowen River and Pelican Creek. Suitable habitat for this species occurred in a number of patches of RE11.3.25a where a sufficient sandy substrate had formed on the rocky river bed. These ranged in size from 5 to 19 ha. Connectivity between patches varied, however generally there was good connectivity, with the largest patch extending along ~3.5 km of riverbank. The condition of the offset area was found to be moderate due to the extensive weed incursion including the invasion of Rubber Vine (*Cryptostegia grandiflora*) both in the understorey and canopy layers of the community.

Threatening processes

Threatening processes relevant to the Myuna offset area are cattle grazing and the presence of weeds, in particular Rubber Vine. More broadly, the offset area is adjacent to areas of mature regrowth that are not currently mapped on state mapping. Removal of these areas, which currently provide a buffer to the offset area, presents a secondary threat such as stream bank instability.

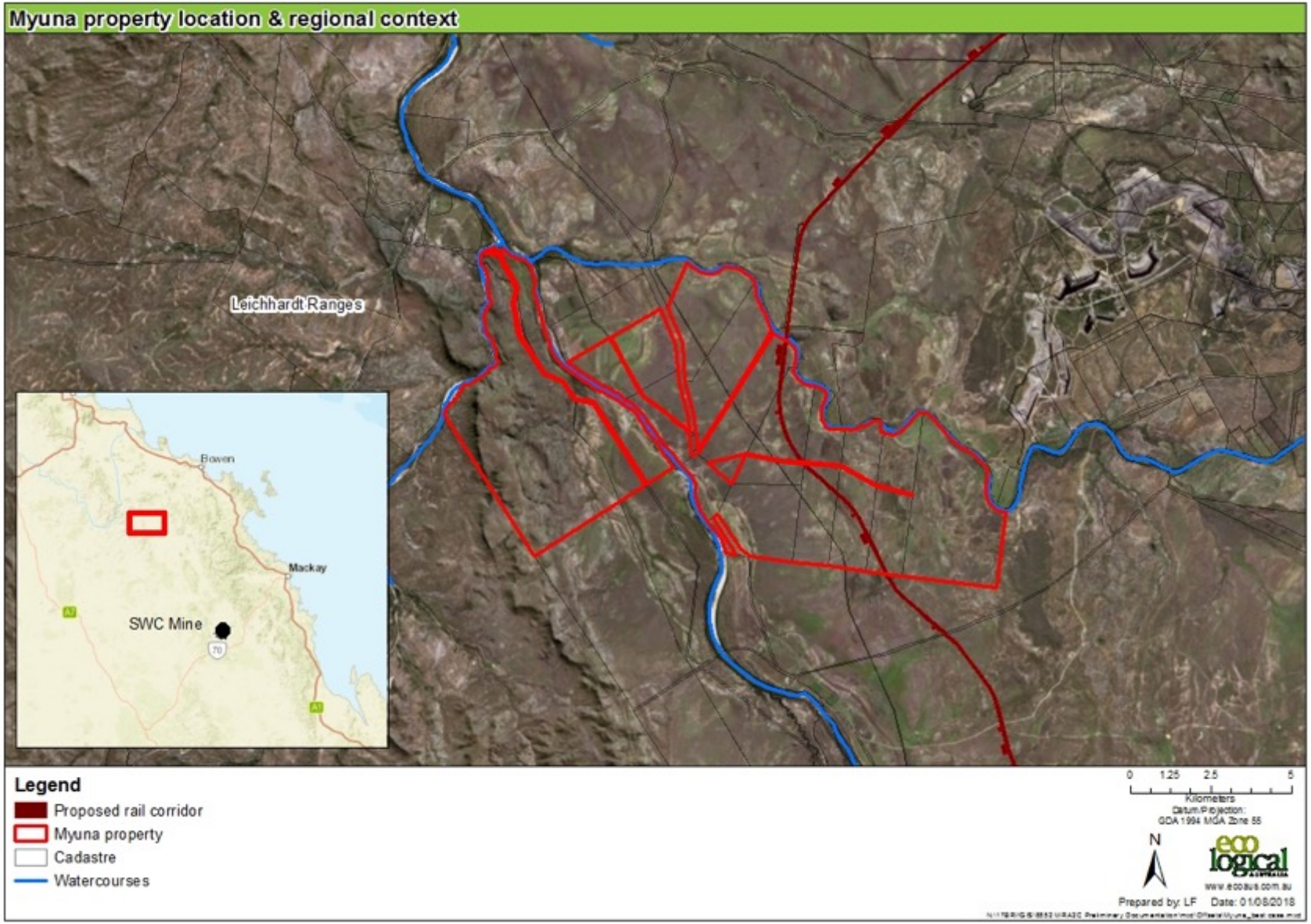


Figure 21: Myuna Property location & regional context

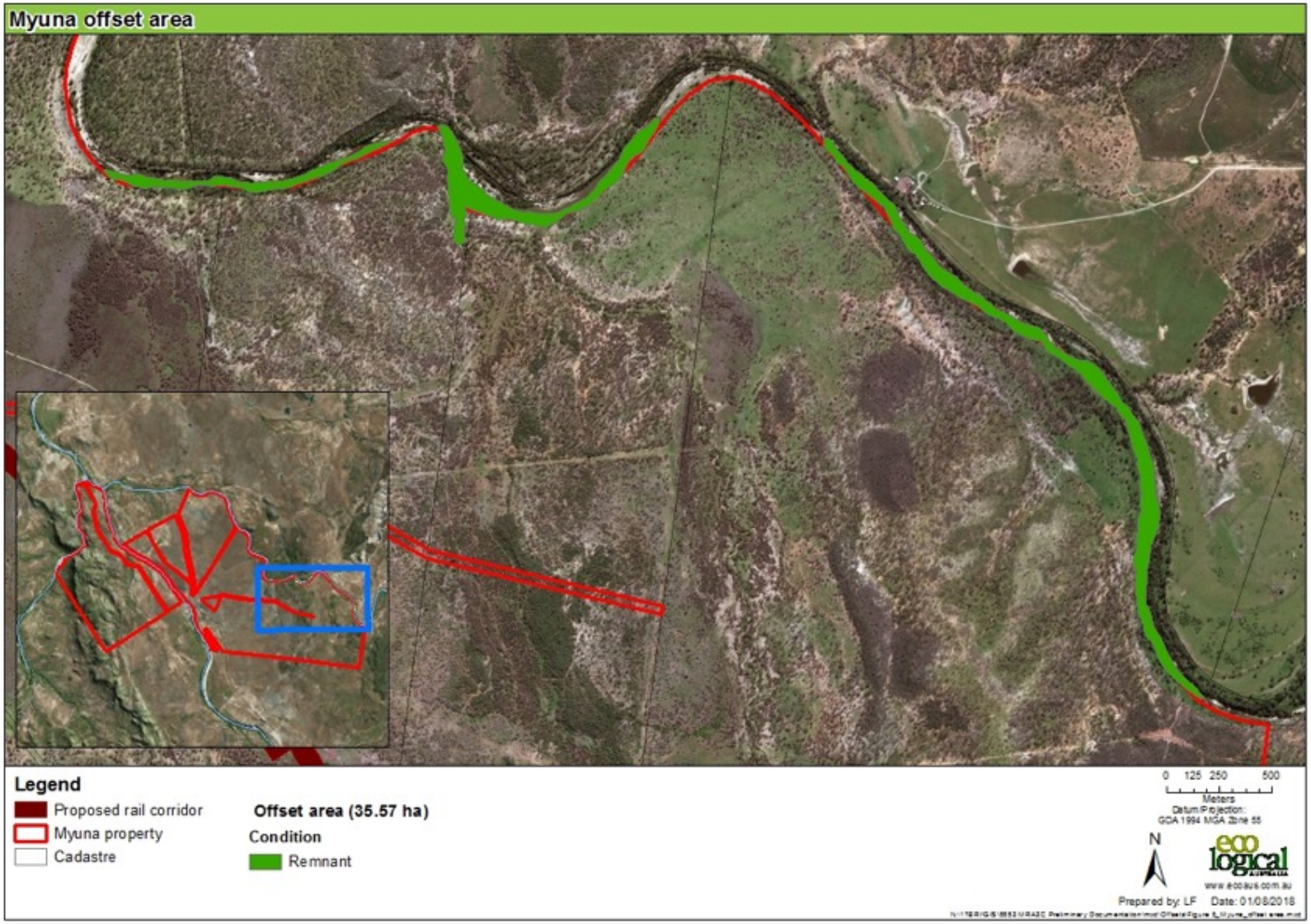


Figure 22: Myuna offset area

Offset suitability

The offset areas have been assessed against the Commonwealth's Offset Assessment Guidelines (OAG) for each MNES value impacted by the project. Attributes associated with the offset areas and impact area start quality (site condition, site context and species stocking rate) have been determined by utilising the methodology outlined in the Queensland Guide to Determining Terrestrial Habitat Quality.

Clive offsets area – Brigalow TEC

Suggested attribute values for use in the OAG have been generated and are provided below. These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

As demonstrated in the calculations below, the proposed offset area directly offsets approximately 100% of authorised significant residual impacts on Brigalow TEC from the project. The offset provides a net conservation gain by improving both current condition and protected extent of the TEC. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the affected TEC.

OAG values for Brigalow TEC at the impact site

Attribute	Score	Rationale
Area (ha)	32.75 ha	Significant residual impact as discussed above (refer to project Impact section)
Condition	7	Overall habitat quality calculations based on site condition and context assessments determined the condition of Brigalow TEC within the impact site to be seven out of ten.
Total quantum of impact to be offset	22.93	As per OAG

OAG values for Brigalow TEC within proposed offset area

Attribute	Score	Rationale
Area (ha)	43.27 ha	Area verified in field assessments conducted by ELA (2018)
Quality		
Start quality	6	Site condition is moderate due to high weed incursion, disturbed canopy layer, the lack of large mature trees and native groundcover. However, species diversity and recruitment levels indicate that the community is in a progressive state of regrowth. Site context is generally moderate due to reduced connectivity to surrounding vegetation as a result of previous clearing activities. However, all areas are generally situated adjacent to existing vegetated areas in remnant condition that area well connected. Overall habitat quality calculations based on site condition and context assessments determined the start quality of regrowth areas to be six out of ten.
Future quality without offsets	3	Regrowth communities are generally on a trajectory of improvement, which can be expected to continue if no clearing activities are undertaken within the offset area. However, the continued clearing cycle and the presence of cattle grazing will cause a significant degradation in the site condition. Clearing and grazing activities result in the removal of vegetation layers, disturbance of soil and subsequent increase in exotic grass cover. This leads to a decrease in site condition and habitat feature parameters including vegetation structure complexity, native species abundance and diversity. The current condition of the offset area is moderate as clearing activities have not been implemented for several years and condition has been allowed to improve, however, the condition will be significantly reduced when scheduled clearing is undertaken. Ongoing maintenance clearing will also reduce site context through reduced patch sizes and connectivity.
Future quality with offsets	8	Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing, weed management and selective thinning, this improvement can be accelerated. Removal of stock will limit vegetation trampling and in turn allow native shrubs and

Attribute	Score	Rationale
		ground covers to regenerate reducing the abundance of exotic pasture species. This can be further supplemented with weed management. Selective thinning can reduce Brigalow thickets and promote understorey growth and diversity. Protection from clearing will also allow for continued natural regeneration, increase canopy height and cover. Patch size and connectivity will also increase. Due to these factors it is anticipated that this can improve that start quality of regrowth Brigalow TEC by an order of two points.
Time until ecological benefit	20	Estimated time for native species to regenerate, canopy layer to mature and shade out exotic pasture species.
Confidence in quality scores	90%	Improvement in vegetation structure is reliant on natural regeneration and therefore natural processes. However active management can effectively improve other degraded condition parameters such as weed levels, groundcover complexity, diversity and abundance.
Raw gain	5	As per OAG
Adjusted gain	4.5	As per OAG
Risk of Loss		
Risk of loss without offset	90%	Regrowth communities within the offset area undergo scheduled maintenance clearing to support the continuation of cattle grazing on the property. Removal of regrowth within the offset area is done by utilising broad scale clearing methods and is generally burnt to remove woody debris. Due to this clearing schedule, the majority of the Brigalow regrowth communities are unable to return back to the required condition to meet TEC status thresholds. Whilst regrowth communities are on a trajectory of improvement and over time will improve in condition to reach TEC status, clearing activities within the offset area will prevent this.
Risk of loss with offset	0%	The offset area will be legally secured and clearing activities will be prohibited. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes. Consequently, the risk of failure and subsequent loss is extremely low.
Time over which loss is averted	20	Maximum 20 years
Confidence in risk scores	90%	The offset area will be legally secured with clearing and thinning activities to be prohibited. This will effectively reduce risk of loss.
Raw gain	38.94	As per OAG
Adjusted gain	27.61	As per OAG
Results		
Net present value	23.62	As per OAG
TOTAL % impact offset	103.04%	Proposed offset area offsets significant residual impacts on Brigalow TEC

Clive property – Ornamental Snake

Suggested attribute values for use in the OAG have been generated and are provided below for significant impacts on Ornamental Snake. These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

The proposed offset area directly offsets approximately 100% of authorised significant residual impacts on Ornamental Snake from the project. The offset provides an overall net conservation gain by improving both current condition and protected extent of Ornamental Snake habitat. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of protected matter.

OAG values for Ornamental Snake at the impact site

Attribute	Score	Rationale
Area (ha)	33.7 ha	Significant residual impact as discussed above (refer to project Impact section)
Condition	7	Overall habitat quality calculations based on site condition and context assessments determined the condition of Ornamental Snake habitat within the impact site to be seven out of ten.
Total quantum of impact to be offset	23.59	As per OAG

OAG values for Ornamental Snake within proposed offset area

Attribute	Score	Rationale
Area (ha)	35.5 ha	Area verified in field assessments conducted by ELA (2018)
Quality		
Start quality	6	Site condition is moderate due to high weed incursion, disturbed canopy layer, the lack of large mature trees and native groundcover. However, species diversity and recruitment levels indicate that the community is in a progressive state of regrowth. Site context is generally moderate due to reduced connectivity to surrounding vegetation as a result of previous clearing activities. However, all areas are generally situated adjacent to existing vegetated areas in remnant condition that area well connected. Fauna habitat quality for Ornamental Snake is moderate due to reduced abundance of foraging and sheltering resources. However, the areas proximity to the well vegetated and highly connected areas along the Isaac River means that species mobility and recruitment capacity is high. Overall habitat quality calculations based on site condition, context and fauna assessments determined the start quality of remnant areas to be six out of ten
Future quality without offsets	3	The continued clearing cycle and the presence of cattle grazing will cause a significant degradation in the habitat quality of the regrowth areas. This includes a substantial reduction in structural complexity within the ground layer and associated sheltering resources. Continued presence of cattle can also continue to compact soils and reduce soil cracks that provide shelter habitat for the species. Grazing can also lead to erosion and sedimentation of wetlands, waterways and gilgai areas impacting negatively on frog populations, which are a key prey item for the Ornamental Snake. Current pest levels will also persist and continue to degrade habitats and foraging resources. Ongoing maintenance clearing will also reduce habitat extent and connectivity, impacting on the species ability to disperse. Ornamental Snake habitat is associated more with the soil substrate, gilgai land formation and presence of fallen logs, rather than the overlaying canopy layer. Ongoing degradation and threatening processes will continue to degrade Ornamental Snake habitat.

Attribute	Score	Rationale
Future quality with offsets	8	Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing and pest management, this improvement can be accelerated and targeted at the threatening processes that continue to degrade Ornamental Snake habitat. Removal of stock will decrease soil compaction; limit understorey trampling and improve water quality of frog habitat. This will in turn improve the quality and abundance of foraging and sheltering resources. Control of pest species will also reduce potential threats to Ornamental Snake. Protection from clearing will increase connectivity and patch size, which in turn would increase the area's ability to sustain viable populations. It is anticipated that this can improve the start quality of regrowth Ornamental Snake habitat by an order of two points.
Time until ecological benefit	20	Estimated time for canopy layer to mature and provide leaf litter and fallen woody debris for sheltering habitat. This timeframe also accommodates for an increase in Ornamental Snake abundance and breeding success (due to better quality habitat and more prey items).
Confidence in quality scores	90%	Improvement in quality and abundance of sheltering habitat is reliant on natural succession. However active management can effectively improve other degraded condition parameters such as weed levels and pest species presence.
Raw gain	5	As per OAG
Adjusted gain	4.5	As per OAG
Risk of Loss		
Risk of loss without offset	90%	Regrowth communities within the offset area undergo scheduled maintenance clearing to support the continuation of cattle grazing on the property. Removal of regrowth within the offset area is done by utilising broad scale clearing methods involving blade ploughing, and is generally burnt to remove woody debris. This ongoing maintenance clearing has the potential to continue to modify current Ornamental Snake habitat to a point where the species will no longer be able to be supported. This is due to the nature of clearing, which is highly destructive to the soil substrate resulting in the removal of essential microhabitat features such as soil cracks, fallen woody debris and gilgais. The clearing itself will also threatened the existing population by reducing numbers and subsequent genetic diversity. This factor combined with continue habitat degradation reduces chances of individual recruitment to the offset area. Therefore, the risk of modifying the habitat and reducing population numbers to the point of complete loss is considered to be high.
Risk of loss with offset	0%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes. Consequently, the risk of failure and subsequent loss is extremely low.
Time over which loss is averted	20	Maximum 20 years
Confidence in risk scores	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes only. This will effectively reduce risk of loss.
Raw gain	31.95	As per OAG
Adjusted gain	28.76	As per OAG
Results		
Net present value	23.64	As per OAG

Attribute	Score	Rationale
TOTAL % impact offset	100.2%	Proposed offset area offsets significant residual impacts on Ornamental Snake

Clive & Brigalow property – Koala

Suggested attribute values for use in the OAG have been generated and are provided below. These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

The proposed offset area directly offsets approximately 100% of anticipated significant residual impacts on Koala from the project. The offset provides a net conservation gain by improving both current condition and protected extent of Koala habitat. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the protected matter.

OAG values for Koala at the impact site

Attribute	Score	Rationale
Area (ha)	212.2 ha	Significant residual impact as discussed above (refer to project Impact section)
Condition	6	Overall habitat quality calculations based on site condition and context assessments determined the condition of Koala habitat within the impact site to be six out of ten.
Total quantum of impact to be offset	127.32	As per OAG

OAG values for Koala within proposed Clive and Brigalow offset areas

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	248.69 ha	94.52 ha	Area verified in field assessments conducted by ELA (2018)	Area verified in field assessments conducted by ELA (2018)
Quality				
Start quality	7	5	Site condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, shrub cover and ground cover has been disturbed and, in some areas, there is a lack of large mature trees. Site context is high as all areas are situated within a mapped ecological corridor. However, connectivity to surrounding vegetation varies with some areas forming large contiguous vegetation patches, whilst other are more fragmented and isolated. Fauna habitat quality for Koala is high due to low levels of existing threats and the abundance of sheltering and foraging resources. Habitat connectivity is also high and remnant areas would provide habitat refuge for the species during drought conditions. These areas within the offset area are likely to play an important role in the maintenance and recovery of the species in the region. Overall habitat quality calculations based on site condition, context and fauna assessments determined the start quality of remnant areas to be seven out of ten.	Site condition is poor to moderate due to high weed incursion, disturbed canopy layer, ground layer and the lack of large mature trees. However, species diversity and recruitment levels were recorded at moderate levels. Site context is generally moderate due to reduced connectivity to surrounding vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor. Fauna habitat quality for Koala is moderate due to reduced foraging and sheltering habitat condition as a result of the lack of a mature canopy. Risks to the species are also moderate due to the ongoing clearing of regrowth areas. Overall habitat quality calculations based on site condition, context and fauna assessments determined the start quality of regrowth areas to be five out of ten.
Future quality without offsets	6	3	Continuation of property management activities within the offset area such as cattle grazing, thinning and burning is likely to result in the reduction in habitat quality of remnant areas. This includes potential reduction in the recruitment of food trees.	Regrowth communities are generally on a trajectory of improvement. However, with the continued clearing cycle, site condition and site context will become further degraded. This includes a significant reduction in connectivity, foraging and sheltering resources due to the complete removal of the canopy layer. Habitat fragmentation is one of the key threats that impact on Koala habitat. Whilst the vegetation may be allowed to mature in some areas, providing improvements in habitat quality during non-scheduled clearing periods, these areas may be fragmented and unable to be reached by dispersing Koalas. Any habitat quality improvements associated with natural succession of regrowth could be substantially outweighed by fragmentation effects.
Future quality	9	7	Protection and management of this area will preserve the existing site condition and remove or reduce threatening processes that have the	Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing and pest

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
with offsets			potential to further degrade remnant areas. It is anticipated that this can improve the start quality of remnant Koala habitat by the order of two points.	management, this improvement can be accelerated and targeted at the threatening processes that degrade Koala habitat. Control of pest species will also reduce potential threats to Koala. Protection from clearing will increase shelter resources, connectivity and patch size, which in turn would increase the area's ability to sustain viable populations. It is anticipated that this can improve the start quality of regrowth Koala habitat by the order of two points.
Time until ecological benefit	20	20	Estimated time for weed and pest reduction.	Estimated time for canopy layer to mature and provide sheltering habitat. This timeframe also accommodates for weed and pest reduction.
Confidence in quality scores	90%	90%	Improvement in quality and abundance of sheltering habitat is reliant on natural succession. However active management can effectively improve other degraded condition parameters such as weed levels and pest species presence.	
Raw gain	3	4	As per OAG	
Adjusted gain	2.7	3.6	As per OAG	
Risk of Loss				
Risk of loss without offset	10%	90%	Approximately 10% of Koala habitat in remnant condition is not protected by State legislation from clearing activities. These areas could therefore be removed within the offset area.	Regrowth communities within the offset area undergo scheduled maintenance clearing to support the continuation of cattle grazing on the property. Removal of regrowth within the offset area is done by utilising broad scale clearing methods and is generally burnt to remove woody debris. Broad scale clearing is a major threat to Koalas. It has resulted, and continues to result, in the retraction of species distribution and population numbers in the region. It has caused the loss of the species in areas once inhabited. This threatening process also occur within the offset area and therefore the risk of loss is considered to be high.
Risk of loss with offset	0%	0%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes. Consequently, the risk of failure and subsequent loss is extremely low.	
Time over which loss is	20	20	Maximum 20 years	

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
averted				
Confidence in risk scores	90%	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes only. This will effectively reduce risk of loss.	
Raw gain	24.87	85.07	As per OAG	
Adjusted gain	22.38	76.56	As per OAG	
Results				
Net present value	77.45	54.76	As per OAG	
% impact offset	60.81%	43.01%		
TOTAL % impact offset	103.82%		Proposed offset area offsets significant residual impacts on Koala	

Clive & Brigalow property – Greater Glider

Suggested attribute values for use in the Commonwealth OAG have been generated and are provided below. These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

The proposed offset area directly offsets approximately 126% of anticipated significant residual impacts on Greater Glider from the project. The offset provides a substantial net conservation gain by improving both current condition and protected extent of Greater Glider habitat. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the protected matter.

OAG values for Greater Glider at the impact site

Attribute	Score	Rationale
Area (ha)	149.3 ha	Significant residual impact as discussed above (refer to project Impact section)
Condition	7	Overall habitat quality calculations based on site condition and context assessments determined the condition of Greater Glider habitat within the impact site to be seven out of ten.
Total quantum of impact to be offset	104.51	As per OAG

OAG values for Greater Glider within proposed Clive and Brigalow offset areas

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	248.69 ha	94.52 ha	Area verified in field assessments conducted by ELA (2018)	Area verified in field assessments conducted by ELA (2018)
Quality				
Start quality	7	5	Site condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, shrub cover and ground cover has been disturbed and, in some areas, there is a lack of large mature trees. Site context is high as all areas are situated within a mapped ecological corridor. However, connectivity to surrounding vegetation varies with some areas forming large contiguous vegetation patches, whilst other are more fragmented and isolated. Fauna habitat quality for Greater Glider is moderate to high. There are low levels of existing threats and generally the habitat areas are well connected. Availability of sheltering resources does vary depending on the extent of large mature trees within the habitat area, but overall is considered to be moderate to high. Remnant areas within the offset area do contain essential hollow-bearing trees suitable for Greater Glider and form part of a larger corridor that extends along the Isaac River. As such the area is likely to play an important role in the maintenance and recovery of the species in the region. Overall habitat quality calculations based on site condition, context and fauna assessments determined the start quality of remnant areas to be seven out of ten	Site condition is poor to moderate due to high weed incursion, disturbed canopy layer, ground layer and the lack of large mature trees. However, species diversity and recruitment levels were recorded at moderate levels. Site context is generally moderate due to reduced connectivity to surrounding vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor. Fauna habitat quality for Greater Glider is poor due to reduced foraging and sheltering habitat condition as a result of the lack of a mature canopy. The lack of a mature canopy also severely impedes the species capacity to disperse. Risks to the species are also high due to the ongoing clearing of regrowth areas. Overall habitat quality calculations based on site condition, context and fauna assessments determined the start quality of regrowth areas to be five out of ten
Future quality without offsets	6	3	Continuation of property management activities within the offset area such as cattle grazing, thinning, burning and clearing of essential infrastructure is likely to result in the reduction in habitat quality of remnant areas. This includes fragmentation of habitat and impeded recruitment of canopy trees.	Regrowth communities are generally on a trajectory of improvement. However, with the continued clearing cycle, site condition and site context will become further degraded. This includes a significant reduction in connectivity, foraging and sheltering resources due to the complete removal of the canopy layer.
Future quality with offsets	9	7	Protection and management of this area will preserve the existing site condition and remove or reduce threatening processes that have the potential to further degrade remnant areas.	Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing and pest management, this improvement can be accelerated and targeted at the

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			It is anticipated that this can improve the start quality of remnant Greater Glider habitat by the order of two points.	threatening processes that degrade Greater Glider habitat. Protection from clearing will increase shelter resources, connectivity and patch size, which in turn would increase the area's ability to sustain viable populations. It is anticipated that this can improve the start quality of regrowth Greater Glider habitat by the order of two points.
Time until ecological benefit	20	20	Estimated time for weed and pest reduction.	Estimated time for canopy layer to mature and provide improved habitat connectivity. This timeframe also accommodates for weed and pest reduction.
Confidence in quality scores	90%	90%	Improvement in quality and abundance of sheltering habitat is reliant on natural succession. However active management can effectively improve other degraded condition parameters such as weed levels and pest species presence.	
Raw gain	3	4	As per OAG	
Adjusted gain	2.7	3.6	As per OAG	
Risk of Loss				
Risk of loss without offset	10%	90%	Approximately 10% of habitat in remnant condition is not protected by State legislation from clearing activities. These areas could therefore be removed within the offset area.	Regrowth communities within the offset area undergo scheduled maintenance clearing to support the continuation of cattle grazing on the property. Removal of regrowth within the offset area is done by utilising broad scale clearing methods and is generally burnt to remove woody debris. Broad scale clearing is a major threat to Greater Gliders. It has resulted, and continues to result, in the retraction of species distribution and population numbers in the region. It has caused the loss of the species in areas once inhabited. This threatening process also occur within the offset area and therefore the risk of loss is considered to be high.
Risk of loss with offset	0%	0%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes. Consequently, the risk of failure and subsequent loss is extremely low.	
Time over which loss is averted	20	20	Maximum 20 years	

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Confidence in risk scores	90%	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes only. This will effectively reduce risk of loss.	
Raw gain	24.87	85.07	As per OAG	
Adjusted gain	22.38	76.56	As per OAG	
Results				
Net present value	77.42	54.76	As per OAG	
% impact offset	74.08%	52.4%		
TOTAL % impact offset	126.48%		Proposed offset area offsets significant residual impacts on Greater Glider	

Myuna property – Eucalyptus raveretiana

Suggested attribute values for use in the Commonwealth OAG have been generated and are provided below. These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

The proposed offset area directly offsets approximately 122% of the anticipated significant residual impacts on *Eucalyptus raveretiana* from the project. The offset provides a substantial net conservation gain by improving both current condition and protected extent of the species. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the protected matter.

OAG values for *Eucalyptus raveretiana* at the impact site

Attribute	Score	Rationale
Area (ha)	16.8 ha	Significant residual impact as discussed above (refer to project Impact section)
Condition	6	Overall habitat quality calculations based on site condition and context assessments determined the condition of *Eucalyptus raveretiana* within the impact site to be six out of ten.
Total quantum of impact to be offset	104.51	As per OAG

OAG values for *Eucalyptus raveretiana* within proposed offset area

Attribute	Score	Rationale
Area (ha)	35.57 ha	Area verified in field assessments conducted by ELA (2018)
		Quality
Start quality	6	Site condition is moderate due to high weed incursion, poor recruitment, low understorey species diversity and structure and in some areas, a disturbed canopy layer. Site context is generally moderate due to reduced connectivity and proximity to surrounding vegetation. Overall habitat quality calculations based on site condition, context and fauna assessments determined the start quality of remnant areas to be seven out of ten
Future quality without offsets	4	A high incursion of Rubber Vine is currently present within the *Eucalyptus raveretiana* habitat areas. Rubber Vine is a known threat to the species, smothering the canopy layer, reducing seedling recruitment and significantly altering the community. Die back of canopy trees as a result can in turn reduce bank stability and further undermine the viability of the species within the riparian zone. Continuation of the weed incursion is likely to continue to degrade the community resulting in ongoing degradation.
Future quality with offsets	8	Management of threats, particularly Rubber Vine incursions can improve the current canopy and understorey layer condition. This in turn will improve seedling recruitment and regeneration of the degraded canopy layer. Species diversity of the community will also improve as well as connectivity along the riparian corridor. It is anticipated that this can improve the start quality of *Eucalyptus raveretiana* habitat by an order of two points.
Time until ecological benefit	20	Estimated time for weed incursion to be managed and seedling recruitment to re-establish and understorey structure and diversity to improve.
Confidence in quality scores	90%	Active management can effectively improve weed levels.
Raw gain	4	As per OAG
Adjusted gain	3.6	As per OAG
		Risk of Loss
Risk of loss without offset	0%	Risks to *Eucalyptus raveretiana* are related to reduced condition. No current property management practices pose a risk to the species that will result in the

Attribute	Score	Rationale
		complete removal of *Eucalyptus raveretiana*
Risk of loss with offset	0%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes. Consequently, the risk of failure and subsequent loss is extremely low.
Time over which loss is averted	20	Maximum 20 years
Confidence in risk scores	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes only. This will effectively reduce risk of loss.
Raw gain	0	As per OAG
Adjusted gain	0	As per OAG
		Results
Net present value	12.3	As per OAG
TOTAL % impact offset	122.06%	Proposed offset area offsets significant residual impacts on *Eucalyptus raveretiana*

Compliance with offset principles

The delivery of environmental offsets for MNES is required to comply with the EPBC Act Environmental Offsets Policy 2012. The EPBC Act environmental offsets policy was developed with the purpose of improving environmental outcomes through the consistent application of best practice offset principles. The policy provides additional guidance on the identification and assessment of suitable offsets, helping to ensure that projects approved under the EPBC Act are consistent, transparent and achieve high quality environmental outcomes.

The policy outlines offset principles that govern the selection and nature of offsets and government assessment and decision-making. The project's compliance with these principles is outlined below.

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action

The offset areas contain remnant and regrowth Brigalow TEC and provide suitable habitat for Koala, Greater Glider, Ornamental Snake and *Eucalyptus raveretiana*. These are values that will be impacted by the project. The offset areas provide offsets in excess of minimum requirements which will result in a net conservation gain and overall improvement in the viability of the values being offset.

The management strategies have been designed to ensure that conservation outcomes for the environmental values being offset are achieved. Threatening processes within the offset will be mitigated, Brigalow will be restored to remnant condition and TEC status and the habitat quality of the offset areas will be increased to provide for sustainable populations of protected species. In doing so the proposed offset areas will deliver a conservation outcome that will maintain and improve the viability of the affected MNES.

2. Suitable offsets must be built around direct offsets but may include other compensatory measures

The proposed offsets will provide a direct land based offset and measurable conservation gain mitigating more than 100% of the impacts associated with the project. The management of the offsets will also address the key priority actions outlines in the recovery plans and/or approved conservation advice for the protected matters.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter

The proposed offsets will provide a direct offset and measurable conservation gain of more than 100 % of the impacts associated with the project. The proposed offsets have been developed using the OAG which incorporates the level of statutory protection of each protected matter being offset.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter

The proposed offsets will provide a direct offset and measurable conservation gain of more than 100% of the impacts associated with the project. The proposed offsets have been developed using the OAG, which uses the area of impact and the quality of habitat to assess the total quantum of impact to protected matters that needs to be offset. As such the offset areas are of a size and scale that is proportionate to the unavoidable impacts on protected matters.

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding

Additional measures and remedial actions have been developed and will be implemented if any potential risks occur. In addition to this, a monitoring and reporting schedule will be developed which will assess the condition of the offsets at regular intervals and trigger changes to the management strategies as required.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, agreed to under other schemes or programs

The proposed offset areas do not have any existing formal conservation arrangement in place or existing requirements from other approvals that require the landowner to undertake conservation works. Current permitted land use across the offset areas include maintenance vegetation clearing, pasture improvement and cattle grazing.

7. Suitable offsets must be efficient, timely, transparent, scientifically robust and reasonable

Direct, land-based offsets have been selected as the preferred offset methodology for this project as it is a robust and widely accepted approach, with a high degree of confidence in outcome. The proposed offsets will be implemented once approval has been granted and prior to the action occurring. Based on the OAG, ecological benefit will be achieved for Brigalow TEC, Koala, Greater Glider, Ornamental Snake and *Eucalyptus raveretiana* within 20 years. This offsets package has been prepared to ensure the efficient and effective delivery of a conservation outcome in a timely manner.

8. Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced.

The offsets will be secured using a Voluntary Declaration (VDec) under the provisions of the Queensland *Vegetation Management Act 1999* (VM Act). As per the requirements of the VDec, a detailed offset area management plan (OAMP) will be prepared that will incorporate the details of offset management that is included in this offsets package (see section below). A monitoring program and reporting schedule will be developed and will be included in the OAMP.

Offset management & security

The overall management objective of the proposed offset areas is to reduce threatening processes and increase the habitat quality of the area to a level at which it provides greater conservation value than its current form and at the current impact site.

More specifically, the desired conservation outcome for offsetting Brigalow TEC is to protect and restore current regrowth areas so that they improve in condition and maintain TEC status. The desired conservation outcomes for Koala, Greater Glider, Ornamental Snake and Eucalyptus raveretiana offsets are to protect and restore habitat in order to increase habitat extent, resources and patch connectivity so that viable populations can be sustained.

Management strategies

A range of offset management strategies are proposed to ensure offset management objectives and desired conservation outcomes are achieved. These strategies include stock management, natural regeneration, weed and pest management, selective thinning and fire management. The proposed management strategies have been developed in line with regional and local priority actions outlined in relevant Conservation Advice, recovery plans and threat abatement plans for each protected matter.

Full details of how these measures will be implemented including performance criteria will be included in the OAMP.

Offset management strategy compliance with MNES recovery plans and threat abatement plans

Protected matter recovery requirements	Offset management strategies				
	Stock management	Natural regeneration	Weed & pest management	Selective thinning	Fire management
Brigalow TEC					
Protect and conserve Brigalow communities by including buffer zones and connecting corridors		✓			
Fire management to conserve heterogeneity					✓
Weed and pest animal control, particularly on exotic grasses and Feral Pigs			✓		
Manage foxes and cats			✓		
Manage grazing to avoid degradation of understorey structure	✓				
Regeneration of high value regrowth		✓		✓	
Ornamental Snake					
Minimise adverse impacts of land use	✓				
Minimise alteration of landscape hydrology, particularly in gilgai environments	✓				
Weed control			✓		
Pest animal control such as pigs			✓		
Koala & Greater Glider					

Protected matter recovery requirements	Offset management strategies				
	Stock management	Natural regeneration	Weed & pest management	Selective thinning	Fire management
Prevent habitat loss and fragmentation		✓			
Weed and pest animal control, particularly feral dogs			✓		
Fire management to prevent mortality and habitat destruction					✓
Eucalyptus raveretiana					
Minimise adverse impacts from land use at known sites	✓				
Identify and remove weeds in the local area, which could become a threat to Eucalyptus raveretiana			✓		
Develop and implement a suitable fire management strategy for Eucalyptus raveretiana					✓
Investigate options for linking, enhancing or establishing additional populations		✓			

Legally secure mechanism

The mechanism proposed to legally secure the offset is a VDec under the provisions of the VM *Act*, based on the offset satisfying the criteria for an area of high nature conservation value.

11. Environmental Outcomes

Environmental considerations are an integral part of planning, design and implementation for the MRA2C project. Data obtained through numerous studies and field surveys have been used to inform:

- the assessment of environmental impacts
- design of creek diversions and surface water management
- groundwater modelling and monitoring programs
- the type of measures necessary to avoid, manage and mitigate potential impacts to MNES
- the values that will need to be protected and managed in perpetuity as part of a long-term commitment to compensate for significant residual impacts, including the provision of biodiversity offsets that deliver an overall improved outcome.

Specific outcomes for the project are:

Environmental feature	Proposed Outcome	Evaluation method
Creek diversion	Design and construct the creek diversion in a manner that provide features that are characteristic of incised alluvial streams within the Bowen Basin with the purpose of creating simulated natural flows and a riparian environment close to natural conditions.	A monitoring program will form part of licence conditions for the creek diversions. The monitoring program will include a semi-quantitative condition assessment scoring system known as Index of Diversion Condition. This is made up of geomorphic and riparian vegetation indices. The geomorphic index will assess erosion and/or sedimentation of the watercourse.
Creek and flood flows	Ensure changes to creek and flood flows are localised to the creek diversion and the immediate reaches of Walker and Carborough Creeks upstream and downstream from the diversion and within the SWC Mine lease. Ensure no significant impacts to other users.	Under the Environmental Authority, monitoring is required of the rates and frequencies of waterway flows. All monitoring is undertaken in accordance with the site Receiving Environment Monitoring Program (REMP).
Surface water quality	Ensure that changes in water quality associated with the discharge of mine-affected water do not result in unauthorised environmental harm. Releases to be in accordance with extant discharge limits as required by the Environmental Authority.	Under the Environmental Authority, monitoring is required of the quality of water releases and receiving waters at specific locations, and for various parameters, different frequencies. Monitoring of receiving waters is undertaken under the umbrella of the site Receiving Environment Monitoring Program (REMP).
Groundwater	Limit groundwater resource impacts to levels predicted in drawdown modelling; apply make good agreements (or offsets) to any affected user. Groundwater drawdown continues to comply with Environmental Authority requirements.	Groundwater monitoring program installed to validate modelling predictions and confirm compliance with drawdown criteria at Environmental Authority compliance monitoring bores.
Threatened Ecological Communities (TEC)	Avoid impacts to habitat areas outside of identified clearing zones. Limit impacts to the clearing of 32.7 ha of Brigalow TEC.	On site vegetation clearing supervision and field survey validation during and post clearing.
Threatened Species	Avoid impacts to habitat areas outside of identified clearing zones. Limit species related significant impacts to: Ornamental Snake habitat clearing – 33.7 ha Koala habitat clearing – 212.2 ha Greater Glider habitat clearing – 149.3 ha Clearing of Black Ironbox habitat – 16.8 ha	On site vegetation clearing supervision and field survey validation during and post clearing. Employ a qualified fauna spotter/catcher during all vegetation clearing activities.
Biodiversity offsets	In accordance with regulatory requirements and through a legal binding Offset Area Management Plan (OAMP) and VDec, deliver a biodiversity offset that provides a no net loss outcome for significant impacts to species and TECs.	OAMP will include periodic field survey of extent and condition of offset areas against the background survey results.

12. Social and Economic Considerations

BHP Billiton is the world's largest diversified natural resources company, with operations and investments designed to ensure a stable long-term future for the business, its shareholders, stakeholders and employees.

BHP Billiton's metallurgical coal operations in Queensland's Bowen Basin include BMC and the BHP Billiton Mitsubishi Alliance (BMA). The SWC Mine is one of two mines operated by BMC.

The SWC Mine is broadly characterised by low strip ratio, high yielding, pulverised coal injection (PCI) coal. Although the SWC Mine product is the benchmark PCI coal product in the Bowen Basin, it trades at a substantial discount to premium hard coking coal produced by competing coal operators.

Currently SWC Mine produces approximately 8 Mt of metallurgical coal for export each year.

In order to remain competitive in current pricing conditions it is critical that SWC Mine offset any pricing discounts through lower operating costs. It is strategically imperative to progressively develop resource by progressing low strip ratio pits such as Mulgrave.

The MRA2C project will result in a continued contribution to the Queensland economy through royalties, in addition to contributions in the short-term for construction employment opportunities (approx. 100 construction roles) and supply of goods and services.

BHP Billiton, through its assets in the Bowen Basin, remains committed to ensuring regional communities share in its business success.

In FY 2017-18, BMC contributed approximately $115 million to local suppliers in the communities which BHP operate in.

Established in Queensland in 2012, the Local Buying Program supports small businesses to engage with BHP, BHP Billiton Mitsubishi Alliance (BMA) and BMC. Over time the program has been expanded to operate in New South Wales, South Australia and Western Australia.

BMC also contributes to the economic sustainability of small businesses and assists in building the capacity of these businesses in the local communities through the BHP Local Buying Program and its associated Local Buying Foundation. The program is targeted at small businesses with less than 20 full-time equivalent employees with a significant presence near a BHP asset. It supports small local businesses to supply goods and services using a competitive tender process.

Between 2013 and the end of FY2018, BMC have engaged over 190 businesses specifically through the Local Buying Program covering the Local Government Areas of Isaac, Central Highlands and Mackay, and have provided over 1365 work opportunities totalling approximately $18 million.

BMC is working closely with traditional owners on the MRA2C project, providing employment opportunities as well as ensuring the respect and treatment of Cultural Heritage. Cultural survey work will be undertaken and the salvage of significant items identified will take place as part of the next phase of the project.

BMC is also committed to working with our near neighbours to understand and mitigate any resulting impacts.

Overall the project creates economic and social value by:

- reducing operational cost through mining lower strip ratio reserves
- enabling operational efficiency through increased mine production and life of SWC Mine
- providing continuation of royalty provision from BMC
- providing additional blending flexibility for improved product marketability
- providing opportunities for local procurement participation
- supporting increased employment during construction phase
- enabling continuation of employment opportunities and social programs through SWC Mine operations.

13. Ecological Sustainability

The MRA2C project incorporates a range of processes to achieve and promote the five principles of ecologically sustainable development.

1. **The long and short-term economic, environmental, social and equitable considerations**

Both long and short-term economic, environmental, social and equitable considerations have been integrated into decision-making processes for the project.

The project plays an important role in accessing and utilising natural mineral resources within the region and Australia more broadly. The existing Mulgrave pit, to be progressed as a component of this project, is a key asset of the well-established, long-term mining operation that has provided resources, energy and employment to international and local industries and communities. Failure to capitalise on the project's opportunities would leave a substantial volume of the coal resource unobtainable and shorten the life of the mine considerably. As a continuation of an existing mining operation there are considerable efficiencies and benefits economically, socially and environmentally in executing the project.

Environmental considerations have been, and will continue to be, an integral part of project planning, design and implementation.

2. **If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation**

The precautionary principle has been considered as part of project planning. The capitalisation of a coal resource associated with an existing mining operation has considerable benefits in terms of footprint design, infrastructure, water use and land disturbance.

Substantial research has been undertaken to understand all aspects of the project, including biodiversity, water (both surface water and groundwater), noise, dust and land disturbance studies. These studies have shown that the project presents a low environmental risk and that any impacts can be avoided, managed and offset to produce an acceptable outcome. Examples include the design of the watercourse diversion to replicate the existing system by excavating to a suitable depth to maintain hyphoreic flow connectivity within the bed sediment, as well as ongoing work on the condition of proposed offsets.

3. **The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations**

As part of the project, BMC are committed to providing biodiversity offsets that meet the requirements of the EPBC Act Environmental Offsets Policy. These offsets will deliver a conservation outcome that will maintain or improve the viability of MNES that may be significantly impacted.

The areas used to offset relevant impacts will be managed and protected to ensure the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

A conceptual final landform for the entirety of the SWC Mine has been developed through the long term mine planning and Life of Asset process. The overriding goal for SWC Mine is to meet the core Queensland Government regulatory and policy requirements. These require rehabilitated mine land to be:

- safe to humans and wildlife
- non-polluting
- stable landforms and
- able to sustain an agreed post-mining land use.

4. **The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making**

The conservation of biological diversity and ecological integrity has been fundamental in planning for the project. Thorough environmental assessment of all aspects of the project has been undertaken. Residual significant impacts, after avoidance and mitigation measures have been considered, will be offset to achieve an overall maintenance or improvement outcome.

5. **Improved valuation, pricing and incentive mechanisms should be promoted**

The coal resource within this lease contains high-grade metallurgical coal. The use of this resource with minimal environmental and social impacts is desirable and maximises the value adding potential of the resource.

14. Conclusions

BMC proposes to continue mining activities in the Mulgrave Pit of the SWC Mine. Mining will progress in a south-west direction from the existing highwall of the Mulgrave Pit. The rate of advancement of the pit will vary in accordance with resource characteristics and the best practice of maintaining a uniform high wall/pit face. It is anticipated that the mining activity will disturb an area of 753 ha however, with infrastructure, spoil and overburden placement areas and creek diversion works, disturbance of 1,279 ha is being allowed for. Mining will continue until the economical coal resource has been recovered, expected to be up until 2067.

The MRA2C project was referred under the EPBC Act and was declared a controlled action subject to assessment through Preliminary Documentation under the controlling provision for listed threatened species and communities and water resources.

The information provided in this documentation specifically addresses the further information request issued by the Department of the Environment and Energy (DoEE) on 25 October 2017.

Potential impacts of the project have been addressed according to the hierarchy of avoid, mitigate and offset. The avoidance of impacts to MNES is limited by the location of the coal resource, however, where possible supporting infrastructure and design has attempted to minimise impacts to MNES. Where impacts to MNES could not be further avoided, a range of mitigation and management measures are proposed to reduce and manage these impacts. This report has outlined these measures in detail.

It is considered that the project is likely to result in residual significant impacts to the following MNES after all measures to first avoid and then mitigate have been taken into account:

- Clearing of Brigalow TEC – 32.7 ha
- Ornamental Snake habitat clearing – 33.7 ha
- Koala habitat clearing – 212.2 ha
- Greater Glider habitat clearing – 149.3 ha
- Clearing of Black Ironbox habitat – 16.8 ha.

In accordance with the “Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources”, the development of the MRA2C project will not result in any significant impacts to water resources or users as follows:

- The environmental values of groundwater at the project site are limited, primarily to use of the water table aquifer for stock watering.
- Impacts to water resource values are minor and can be sufficiently mitigated through make good agreements, and plans are already in place to do so, backed by a more than 20-year successful history of impact mitigation at the SWC Mine.

A robust and expanded groundwater monitoring network is planned to increase understanding of the water table aquifer and reduce any uncertainty associated with ongoing water management.

15. Information Contributions

In accordance with the Preliminary Documentation information request the following table provides a list of organisations and persons who have contributed to the information and work relied upon to produce this Preliminary Documentation report. All persons involved are qualified professional in their respective fields.

Information	Organisation	Personnel
Preliminary Documentation	Adaptive Strategies Pty Ltd Ecological Australia Pty Ltd	Tom Kaveney Liz Fisher
Surface Water Impact Assessment Report Appendix C	Alluvium Pty Ltd	Jason Carter Tony Weber Rohan Lucas
Groundwater Modelling and Impact Assessment Appendix D	Golders Pty Ltd	John Fortuna Scott Fidler
Ecological Surveys and Impact Assessment Report Appendix E	Ecological Australia Pty Ltd	Liz Fisher Ailsa Kerswell
Groundwater Peer review	AQ2	Kathryn Rozlapa Jeff Jolly
BHP reviews and supply of project information	BHP Billiton	John Kennedy Marc McGowan Bonny O'Neal Anthony Russo Brett Garner Bronwyn Woodgate

16. References

Alluvium (2016) Functional Design Report: Mulgrave Resource Access Walker Creek Diversion – Stage 2C - DRAFT. Alluvium for BHP Coal projects.

Alluvium (2017) Monitoring Program: Mulgrave Resource Access Walker Creek Diversion Stage 2C. Alluvium for BHP Coal projects.

Alluvium (2018). MRA2C Surface Water Impact assessment. Report by Alluvium Consulting Australia for BHP Coal.

Austecology (2010) Biodiversity Management Plan, BMC South Walker Creek Mine.

Australian Government Department of Environment (2013) Significant impact guidelines 1.1: EPBC Act Matters of National environmental Significance.

Australian Government Department of Environment (2013) Significant impact guidelines 1.3: EPBC Act Coal seam gas and large coal mining developments – impacts on water resources.

Barnett, B., Townley, L.R., Post, V., Evans, R.E., Hunt, R.J., Peeters, L., Richardson, S., Werner, A.D., Knapton, A. and Boronkay, A (2012). Australian groundwater modelling guidelines. Waterlines Report Series No. 82, National Water Commission, Canberra, 191 pp. June.

BMT WBM (2011). South Walker Creek Mine Calculation of Maximum Affected Waters Release Discharge.

CDM Smith (2016) Mulgrave Access Resource Project - MRA2C Groundwater Impact Assessment. Report by CDM Smith for BHPB Coal.

Cardno (2012) Walker Creek Diversion – Biodiversity Assessment Report – Stage 1.

Cardno (2012) Walker Creek Diversion – Biodiversity Assessment Report – Stage 3. and addendum

Chiu, M.C., Leigh, C., Mazor, R., Cid, N. & Resh, V. 2017. Anthropogenic Threats to Intermittent Rivers and Ephemeral Streams. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London.

Cook, B. D., Abrams, K. M., Marshall, J., Perna, C. N., Choy, S., Guzik, M. T. & Cooper, S. J. B. 2012. Species diversity and genetic differentation of stygofauna (Syncarida: Bathynellacea) across an alluvial aquifer in north-eastern Australia. *Australian Journal of Zoology,* 60, 152-158.

Datry, T., Bonada, N. & Boulton, A.J. 2017. General Introduction. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London.

DEHP (2015). Environmental Authority (EA) – South Walker Creek Mine Permit No. EPML00712313

DERM (2010) Establishing Environmental Values, Water Quality Guidelines and Water Quality Objectives for Fitzroy Basin Waters. (Draft for Consultation). Queensland Department of Environment and Resource Management.

Douglas Partners (2014a). Mulgrave Proposed Pit Progression Groundwater Impact Assessment South Walker Creek Coal Mine via Nebo, Northern Bowen Basin Central Queensland. Prepared for BHP Mitsui Coal.

Douglas Partners (2014b). Annual Groundwater Review 2014 South Walker Creek Coal Mine via Nebo, Northern Bowen Basin Central Queensland.

DSITI 2015. *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna*. Brisbane: Department of Science, Information Technology, Innovation and the Arts.

DES 2018a *Monitoring and Sampling Manual, Environmental Protection (Water) Policy 2009*. Queensland Department of Environment and Science, Brisbane.

DES 2018b. Wildlife Online: https://environment.ehp.qld.gov.au/report-request/species-list/. Accessed April 2018.

Eco Logical Australia (2018) Mulgrave Stage 2C Ecological Impact Study. Prepared for BHP Billiton.

Ecoserve and LAMR (2006) Flora and Fauna Baseline Surveys and Impact Assessment for the SAA04 Project Area.

Ecoserve and LAMR (2007) Target Flora and Fauna Species Surveys – BMA South Walker Creek Mine.

Footprints (2013) Threatened Terrestrial Fauna Species Assessment Report for Mulgrave Pit Expansion Project.

frc environmental 2015. *South Walker Creek Mine: Receiving Environment Monitoring Program 2015*. Prepared for BHP Billiton Mitsui Coal.

frc environmental 2016. *South Walker Creek Mine: Receiving Environment Monitoring Program 2016*. Prepared for BHP Billiton Mitsui Coal.

frc environmental 2017. *South Walker Creek Mine: Receiving Environment Monitoring Program 2017*. Prepared for BHP Billiton Mitsui Coal.

frc environmental 2018. *South Walker Creek Mine: Receiving Environment Monitoring Program 2018*. Prepared for BHP Billiton Mitsui Coal.

Glanville, K., Schulz, C., Tomlinson, M. & Butler, D. 2016. Biodiversity and biogeography of groundwater invertebrates in Queensland, Australia. *Subterranean Biology,* 17**,** 55-76

Golder 2018. Groundwater Impact Assessment for the South Walker Creek Mine MRA2C Project. Prepared for BHP Billiton Mitsui Coal, Brisbane.

Hancock, P. J. & Boulton, A. J. 2008. Stygofauna biodiversity and endemism in four alluvial aquifers in eastern Australia. *Invertebrate Systematics,* 22**,** 117-126.

Kennard, M.J., Pusey, B.J., Olden, J.D., Mackay, S.J., Stein, J.L. & Marsh, N. 2010. Classification of natural flow regimes in Australia to support environmental flow management'. *Freshwater Biology* **55**: 171-193.

Kerezy, A., Gido, K., Magalhaes, M.F. & Skelton, P.H. 2017. The biota of intermittent rivers and ephemeral streams: fishes. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London

Pusey, B.J., Kennard, M.J. & Arthington, A.H. 2004. *Freshwater Fish of North-Eastern Australia*. CSIRO Publishing, Canberra.

Sabater, S., Timoner, X., Bornette, G., de Wilde, M., Stromberg, J.C. & Stella, J.C. 2017. The biota of intermittent rivers and ephemeral streams: algae and vascular plants. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London

Sanchez-Montoya, M.M., Moleon, M., Sanchez-Zapata, J.A. & Escoriza, D. 2017. The biota of intermittent rivers and ephemeral streams: amphibians, reptiles, birds and mammals. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London.

Steward, A.L., Marshall, J.C., Sheldon, F., Harch, B., Choy, S., Bunn, S.E. & Tockner, K. 2011. Terrestrial invertebrates of dry river beds are not simply subsets of riparian assemblages. *Aquatic Sciences* **73**: 551-566.

Steward, A.L., von Schiller, D., Tockner, K., Marshall, J.C. & Bunn, S.E. 2012. When the river runs dry: human and ecological values of dry riverbeds. *Frontiers in Ecology and the Environment* **10**: 202-209.

Steward, A.L., Langhans, S.D., Corti, R. & Datry, T. 2017. The biota of intermittent rivers and ephemeral streams: terrestrial and semi-aquatic invertebrates. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London.

Steward, A.L., Negus, P., Marshall, J.C., Clifford, S.E. & Dent, C. 2018. Assessing the ecological health of rivers when they are dry. *Ecological Indicators* **85**: 537-547.

Stubbington, R., Bogan, M.T., Bonada, M., Boulton, A.J., Datry, T., Leigh, C. & Vorste, R.V. 2017. The biota of intermittent rivers and ephemeral streams: aquatic invertebrates. In Datry, T., Bonada, N. & Boulton, A.J. (eds) *Intermittent Rivers and Ephemeral Streams: Ecology and Management*. Academic Press, London

Threatened Species Scientific Committee 2016. Conservation advice for *Petauroides volans* (Greater Glider). Australian Government, Canberra.

Tomlinson, M. & Boulton, A. 2008. Subsurface Groundwater Dependant Ecosystems: a Review of their Biodiversity, Ecological Processes and Ecosystem Services. *Waterlines Occasional Paper No. 8, National Water Commission.*

Attached Supporting Documents

Appendix A: Preliminary Documentation Requirements

Appendix B: Environmental Authority

Appendix C: Surface Water Assessment (Alluvium 2018)

Appendix D: Groundwater Assessment (Golders 2018)

Appendix E: Ecological Impact Study (Eco Logical Australia 2018)

Appendix F: Residual Void Management Report

Appendix G: Diversion Revegetation Plan

Appendix H: SWC Water Management Plan

Appendix I: Groundwater Supplementary Memo

Appendix J: Final Void Water Balance Modelling Summary