## **ATTACHMENT 1**

# Environmental Assessment for Proposed Modifications to Rix's Creek DA 49/94 N90/00356 (Mod 9) and Rix's Creek North Open Cut Project 08\_0102 (Mod 7).

### Introduction

Bloomfield Collieries Pty Limited (Bloomfield) has operated the Rix's Creek Open Cut Mine, 5km North of Singleton, since 1990. The mine currently operates under consent DA 49/94 granted on the 16/10/1995 and subsequent modifications.

In December 2015 Bloomfield completed the purchase of the adjoining Integra Open Cut Mine inclusive of the Coal Preparation Plant (CHPP) and Rail Loading facility. The Integra Open Cut sits on the northern boundary of the Rix's Creek Mine and had been placed in care and maintenance mode under the previous ownership of Vale. The Integra Complex consent was divided into separate open cut and underground consents, 23 August 2016, with Bloomfield Collieries retaining Project 08\_0102 Rix's Creek North Open Cut project. Bloomfield has recommenced production activities in the Rix's Creek North Open Cut by integrating the operation into the Rix's Creek Mine. Rix's Creek Mine now manages the two open cut workings, the two CHPP's and the two Rail Loading facilities as one combined mine. Whilst the combined operation is Rix's Creek the working areas are referred to as Rix's Creek North (RCN) and Rix's Creek South (RCS) for clarity of development consent requirements and access arrangements.

The recommencement of production from Rix's Creek North has resulted in substantial employment opportunities to the local area. While planned production levels are well below past production rates, Rix's Creek North production now has 114 additional employees working on the combined site.

For operational efficiency opportunities Bloomfield was granted approval in February 2016 (RCN Mod 5 and RCS Mod 7) for modification of both mining area consent's to allow Run of Mine Coal (ROM) from Rix's Creek North to be transported and processed at the Rix's Creek South (Rix's Creek) CHPP and or Rix's Creek South ROM to be transported to Rix's Creek North CHPP for processing. Product coal from both CHPP's reports to their separate Rail loading facilities which are both located on the former Integra rail loop.

Bloomfield is now seeking consent to modify both DA 49/94 (RCS) and 08\_0102 (RCN) to allow for:

- Rix's Creek South CHPP dried tailings refuse to be emplaced in Rix's Creek North overburden dumps
- Rix's Creek South overburden to be emplaced in Rix's Creek North overburden dumps
- Exploration drilling to be conducted in the area between Rix's Creek North mine area and the northern limit of Rix's Creek South boundary.

## **Site Location**

The combined Rix's Creek Mine sits 5 kilometres north of Singleton adjoining the New England Highway (NEH) and extends to 10 kilometres North West of Singleton along Bridgeman Road. Access to Rix's Creek South is via NEH and Rix's Creek lane while Rix's Creek North is accessed from Bridgeman Road. Figure 1 shows the site location, consent boundaries, mining tenements and land ownership. Bloomfield owns the mining tenements for the combined site and the vast majority of the land within the consent areas. All current mining operations and operations envisaged under these modifications are contained within Bloomfield owned land.





## **Proposed Modification**

Bloomfield is seeking modification to DA 49/94 and DA 08\_0102 to allow:

i) Exploration drilling to be conducted in an area marked "Area not to be disturbed" in Integra Open Cut Project EA. Figure 1.3. This area is bounded on the northern side by the Rix's Creek North mine area and to the south by the Rix's Creek South boundary and is contained in ML1648, ML 1649 and ML 1650. The exploration drilling is required to confirm the geological structure in this area (to be used for Highwall stability design purposes) and the available coal resource within this area.





ii) Up to 5 million BCM of Rix's Creek South overburden and 0.5 million BCM of dried tailings refuse from the Rix's Creek South CHPP per annum to be emplaced within the Rix's Creek North overburden dumps. The consented Rix's Creek North rehabilitated final landform will remain unchanged by these operations. Due to geotechnical stability reasons a large portion of the southern extent of the Rix's Creek North *Mine Area* cannot currently be mined, the Rix's Creek South overburden will be utilized to bring forward the completion of the final landform so rehabilitation can be carried out. This elevated area of the final landform has been untouched since the Integra Open Cut mine was placed into "care and maintenance". Since Bloomfield recommenced production in the RCN open cut, overburden emplacement has been used to fill the lower areas of the Integra (RCN) South Pit, by emplacing some RCS overburden, in the elevated landform areas the Integra (RCN) South Pit, final landform will be achieved sooner.

In all instances production levels will be managed to ensure the individual mine development consent maximum production levels are not exceeded. This will ensure the environmental impact stays within the assessed impact levels of the consent's EIS's.

## The Proponent

Bloomfield is a wholly Australian owed, Hunter Valley based, family company which operates Rix's Creek North and Rix's Creek South combined into one management structure and one work force. Bloomfield is the approved proponent of both DA 49/94and 08\_0102 consents and owner of Coal Leases 352, 357 and Mining Licenses 1432, 1648, 1649 and 1650 across the combined site.

## Approval Pathway and Permissibility

Bloomfield is seeking approval to modify both development consents DA 49/94 (Rix's Creek) and 08\_0102 (RCN) under Section 75W of the EP&A Act as transitional Part 3A projects.

## **Existing Approvals**

Development consent for mining operations were first issued;

- Rix's Creek 1989
- Integra (Camberwell) 1990

The history of subsequent modifications and development consents for both mine is shown in Table 1.

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Year	Project	Description	Approval Reference
1989	Rix's Creek Mine	Construction and operation of a Surface coal mine, associated transport and coal loading facilities, including CHPP. Consent was granted to mine up to 1.5Mtpa of ROM coal. CL 352 was subsequently granted on 20 October 1989.	Minister for Local Government and Minister for Planning
1995	Rix's Creek Mine	Coal Mining within CL 352 and on land subject to Coal Lease Application No 17 om Singleton, construction and operation of surface coal mine and infrastructure and equipment upgrades. Total mine production capped at 15 million bank cubic metres of material movement.	DA 49/94 – Minister for Urban Affairs and Planning
1999	Rix's Creek Mine	Modification to amend applicable potentially affected lands monitoring requirements.	DA 49/94 Modification 1 – Minister for Infrastructure and Planning
2003	Rix's Creek Mine	Modification to receive ROM coal from Glennies Creek underground mine, process the coal and transport by rail.	DA 49/94 Modification 2 – Minister for Infrastructure and Planning
2004	Rix's Creek Mine	Modification to receive process and transport bulk coal samples from the Bickham exploration project.	DA 49/94 Modification 3 – Minister assisting the Minister for Infrastructure and Planning
2009	Rix's Creek Mine	Modification to allow a cut and cover tunnel under the New England Highway.	DA 49/94 Modification 4 – Minister for Planning
2013	Rix's Creek Mine	Modification to enable the construction and operation of a rail loop and associated clean coal	DA 49/94 Modification 5 – Minister for Planning and Infrastructure

		stockpile and rail loading facility on the Rix's Creek mine site.	
2014	Rix's Creek Mine	Modification of the total volume of material that can be moved annually from 15 million bank cubic metres to 16.1 million bank cubic metres.	DA 49/94 Modification 6 – Minister for Planning
2016	Rix's Creek Mine	Modification to allow ROM Coal from RCN to be processed at RCS CHPP	DA 49/94 Modification 7- Minister of Planning
2016	Rix's Creek Mine	Modification to allow the construction of two satellite ROM coal stockpiles at RCS	DA 49/94 Modification 8- Minister of Planning
1990	Camberwell Coal Mine	Application for open cut mining of the North and South pits, development and operation of a coal handling and preparation plant, train loader and associated facilities submitted in 1990.	DA 86/2889 approved in 1990 (and subsequently modified). Approved open cut activities were incorporated into the Integra Open Cut Project (MP 08_0102).
2006	Surface Facilities Project	Construction of surface facilities at the Complex. This application was submitted in 2006.	Approved under MP 06_0057 in 2007. Approved open cut activities were incorporated into the Integra Open Cut Project (MP 08_0102).
2007	Glennies Creek Open Cut Coal Mine (NOC Project)	The NOC Project was assessed in the Glennies Creek Open Cut Coal Mine EA prepared by R.W. Corkery & Co Pty Limited in 2007 (referred to as the NOC EA).	Approved under MP 06_0073 in 2008 (and subsequently modified). Approved open cut activities were incorporated into the Integra Open Cut Project (MP 08_0102).
2009	Integra Open Cut Project (incorporating SOC and western mining area)	Western extension of the existing SOC (the western mining area) and incorporation of the approved NOC operations. An application and accompanying EA (URS 2009) (Open Cut Project EA) was lodged in 2009.	<ul> <li>The Combined Project Approval was granted in 2010 for the Integra Open Cut Project which incorporated the NOC Project (MP 06_0073) and Surface Facilities Project (MP 06_0057). Modifications relating the Open Cut include:</li> <li>a) Modification 1 – extension of the NOC out-of-pit emplacement area. Approved 2012.</li> <li>b) Modification 3 – interim modification to timeframes in project approval. Approved 2012.</li> <li>c) Modification 2 – amendment to overland conveyor and extension of timeframes to secure biodiversity offsets. Approved 2013.</li> <li>d) Modification 5- to allow RCS ROM coal to be processed at RCN CHPP. Approved in 2016</li> <li>f) Modification 6- separation of Integra Complex consent into separate open cut and underground consents. Approved 2016.</li> </ul>

Mining tenements for both operations are owned by Bloomfield and shown in figure 1.

Environmental Protection Licence (EPL) 3391 encompasses all open cut operations at Rix's Creek. . See figure 3.



Figure 3

## Existing onsite Overburden and CHPP Dried Refuse Haulage

Rix's Creek currently utilises large Excavators and Front End loaders to load large Rear Dump Trucks (180T and 240T), for the mining of overburden and transportation of dried CHPP tailings. Rix's Creek North's open cut machine fleet is predominantly the same manufacture and class size as the existing Rix's Creek South mobile plant fleet and has been integrated into the operation of the mining areas. The operational haul roads have all been constructed using the same overburden rock types and are maintained by the same Caterpillar Road Graders and Water Carts.

## **Existing Overburden Production**

Rix's Creek (South) has a consented maximum allowable movement of material onsite of 16.1m bank cubic metres (bcm) per annum total, with planned production levels under this limit. Rix's Creek North (Integra Open Cut) western extension area has a maximum consented overburden production level of 26M BCM per annum. Bloomfield's current mining plans include production levels up to 10M BCM per annum. Any additional emplacement of RCS material into RCN dump areas will remain below current consent production limits.

### Existing Employment

Rix's Creek's employment level is currently 254 to allow for the operation of both RCS and RCN mining operations.

### The Proposal

This proposal is to allow a portion of the RCS overburden and CHPP refuse to be emplaced in the RCN dumping areas which will:

- i) Bring forward the completion of final rehabilitation landform as proposed in the RCN consent. This elevated, exposed area has been untouched since Integra Open Cut went into "care and maintenance" in August 2014. Since Bloomfield recommenced operations in the RCN open cut, overburden emplacement has been used to fill the lower areas of the former Integra South Pit. By emplacing some RCS overburden, in the elevated landform areas of the Integra South Pit (RCN), final landform will be achieved sooner.
- ii) Bring forward establishment of final rehabilitated surface water drainage lines, which will increase the amount of runoff returning to natural water courses thus reducing the amount of rainfall captured as mine water.
- iii) Room exists within the RCN final landform design as the current geotechnical design of the southern end of Mine Area could preclude up to 20M BCM of overburden removal. RCS overburden would be used to fill this portion of the final landform.
- iv) Provide operational efficiencies by having a combined dumping area in this part of the dump. On occasions both RCN and RCS overburden would report to the same dumping area which will mean a reduction in road way and dump maintenance requirements when compared to two distinct dumping areas.

Figure 4 shows the proposed haul routes and RCN dumping area in the RCN consent Appendix 8 final landform.

Also proposed in this modification is the drilling of up to 8 exploration boreholes within the area marked *Not for Disturbance* in the area in Figure 1.3 of the Open Cut EA 2008. The information gained from these boreholes will be used to:

- Improve the accuracy of the JORC geological model for the combined RCS and RCN site. This information can then be used in mine planning for any subsequent consent modifications to allow for maximum extraction of coal reserves within the existing mining tenements.
- vi) Better define the mines geotechnical model particularly highwall stability in the region of the steeply dipping western subcrop.

## Proposed Overburden and CHPP Dried Refuse Haulage

The overburden and Dried tailings will be transported in the mines existing fleet of 180T and 240T class rear dump trucks. Figure 4 shows the proposed haul route will be on existing RCS haulroads to the boundary with RCN. From this point the rear dump trucks will utilise the existing RCN haulroad to gain access into the proposed dumping area. Within the dumping area the rear dump trucks will operate in the normal sequence of temporary haulroads within the dump benches that are normally between 6 and 10 metres in height up to the completed final landform. The dried tailings will normally be block tipped on the flat dump areas with at least 2 metres of inert fill covering the refuse prior to rehabilitation of the final landform.

The temporary haulroads with the dump area will be maintain by the mines existing fleet of graders and water carts to control any potential dust generation.





## Proposed Overburden Production

RCS DA 49/94 allows maximum production levels in the consent area of 16.1M BCM of overall material movement (ROM coal and overburden) per annum. The proposed modification does not allow for any increase in overburden production levels, in RCS, but would allow a portion of this production to be emplaced within the RCN overburden dump.

RCN western mining area maximum overburden production level is highlighted in section 3.7.4 of the Integra Open Cut Project EA 2009 as 26M BCM per annum. Current budgeted overburden production from the RCN mine area is 10M BCM per annum. The proposed addition of up to 5M BCM of overburden and 0.5M BCM dried tailings per annum, from RCS, will result in maximum material movement levels well below the maximum production rate envisaged and modelled for the RCN consent.

## **Proposed CHPP Dried Refuse Emplacement**

RCS Mod 7 and RCN Mod 5 allowed for ROM coal from either consent area to be processed at either of the sites two CHPP's. This proposal is to allow dried CHPP refuse from the RCS CHPP to be emplaced in the RCN dumping area. The site practice of ensuring at least 2 metres of inert material will be used to cover any CHPP refuse, prior to final rehabilitation, will continue in this proposal.

# Proposed Exploration Drilling in 'do not disturb area' Figure: 1.3 Integra Open Cut Project

The proposed exploration activities will mainly comprise exploration drilling and associated works that will improve the geological model and the understanding of the coal resource in the south west area of Rix's Creek North.

The proposed exploration will take place within the Open Cut Project Area and the Mining Leases ML1648, ML1650 and ML1649. The proposed exploration activities are within the current EPL area. The proposed boreholes will be within an area marked as "area not to be disturbed" as shown in Figure 1.3 'Open Cut Project & Open Cut Extension Components' of the Integra Open Cut Project EA 2009.

The proposed drilling will comprise of seven open holes and one cored hole that will help delineate seam structure and subcrops within the area. The location of the proposed holes is shown in Figure 5. Prior to drilling, the proposed locations will be assessed by heritage and biodiversity surveys with the borehole locations adjusted to minimise any potential impacts identified by the assessments. The boreholes will be positioned to minimise any potential disturbance caused in gaining access to the proposed locations by utilizing previously cleared areas and existing tracks. The heritage and biodiversity reports are attached as Appendix 3 and 4.

Prior to any exploration work commencing, the contract drillers will be incorporated into Bloomfield Contractor Management Plan including submitting a safe method work statement for the exploration activity. The drilling equipment and vehicles will also be inspected by the mine before work can commence to ensure the equipment confirms to the Bloomfield Engineering Management System. An environmental spill kit is to be at each location whilst drilling.

Once the site has been established the disturbance at the site will be minimised by using above ground sumps, for retainment of drilling fluids. This will reduce the area of ground vegetation and topsoil disturbed at each site.

On completion the holes will be geophysically logged and the core and samples of the drill cuttings retained for future analysis. The drilling contractor's equipment and any rubbish is to be removed before the site is rehabilitated.

The rehabilitation of each borehole will include sealing the hole with grout and returning any topsoil removed during the initial preparation of the drill site. The aim of the rehabilitation is to return the area disturbed by exploration activities to a condition that is safe and stable and that allows the current land use.

The borehole sites rehabilitation will be monitored over time and remedial action taken if required to ensure the long term outcome for each site.





## **Proposed Employment**

With recommencement of production from Rix's Creek North the total number of Rix's Creek employees has increased to 254. Sufficient applications for these positions were received from local residents to fill all positions from within the local area. This proposal does not envisage any increase in current employment levels.

## **Environmental Assessment of the Proposal**

The now combined Rix's Creek site will manage its environmental impacts using the Rix's Creek Environmental Management Plans (EMP). The operational EMP's have been modified to ensure compliance with the environmental conditions of both consents, DA 49/94 and 08\_0102, as well as EPL 3391. These EMP's will be modified post the Rix's Creek Extension Project to ensure compliance with any modification to consent levels.

## Air Quality

Todoroski Air Sciences (TAS) has assessed the potential air quality impacts associated with the proposal (Appendix 1).

The proposed haul routes would extend a short distance north from the RCS Arties Pit east of the New England Highway and the RCS CHPP along existing haul routes to the RCN emplacement area. As the overburden and reject material handled for this Modification would already have been transported some distance along the proposed haul routes to be emplaced in RCS Arties Pit, only the additional distance travelled to the RCN emplacement area would result in additional dust being generated relative to the existing activities.

To investigate the potential effect that the Modification may have on dust levels in the surrounding environment TAS undertook a qualitative analysis of the proposed change in dust levels associated with the Modification relative to the dust emission estimates in the most recent air quality assessments for RCS (*TAS 2015*) and RCN (*Holmes Air Sciences 2009*).

As the overburden and reject material would already be transported some distance along the proposed haul routes, only the additional distance travelled to the RCN emplacement area would generate additional dust emissions relative to the existing activities. The results of the TAS analysis indicate that the estimated total dust emissions from the Modification would result in an approximate 1.0 to 1.3% increase in total dust emissions relative to the total dust emission estimates for RCS and an approximate 1.6% to 3.4% decrease in total dust emissions relative to the total dust emissions relative to the total dust emission estimates from RCN.

The TAS assessment estimates that the Modification may generate approximately a.08 to 1.1 % decrease in dust relative to the existing operations of the mines. Additionally the activities of the Modification would be in a relatively central position for both mines and not close to any off-site receptors. The small potential change in the contribution of dust generated due to the Modification is unlikely to be noticeable at any off-site location.

The Modification would operate within existing approvals as it does not seek to increase the amount of overburden or reject material handled for the operations or require additional material to be emplaced within the approved emplacement areas. The RCS and RCN mines would continue to operate with appropriate best practice controls and dust mitigation measures to ensure that dust levels are minimised.

## Noise

Global Acoustics have assessed the noise impact of the proposal with the letter attached as Appendix 2. A summary of the opinion is the proposed overburden movement activity represents a lesser noise emitting scenario than the activities modelled for the RCN EIS. The overburden and tailings will be carried by the existing RCN haul trucks, now owned by Rixs Creek and;

- Plant operated is the same as approved.
- Current total site emissions should be well below that approved.
- The additional plant operations would still be less than those approved.
- The total tonnage of overburden proposed to be moved annually is somewhat less than that approved.

## Surface Water

The haulage routes are on existing haul roads or across disturbed (overburden) material and all runoff from these areas report to the sites existing dirty water management infrastructure. Rix's Creek is a nil water discharge site with no mine or contaminated water allowed to leave the site.

No changes will occur to the water balance as there will be no significant increase or decrease in site water requirements from the project. Existing site water monitoring will continue to gauge impacts under existing controls.

By bringing forward the establishment of the final landform, the surface water drainage paths will also be established earlier. Once the vegetation cover is advanced enough to ensure there will be no erosion within these drainage lines the clean runoff can be reconnected to the clean water diversion system, therefore reducing the amount of rainfall that reports as mine water.

Utilizing above ground sumps for the exploration drilling and rehabilitating the borehole sites promptly means any surface water impact from the exploration drilling will be minimal.

### **Ground Water**

The proposed modifications will have no impact on groundwater as the mine plans and mining extraction process will not be changed.

## Visual Impacts and Night Lighting

The haul routes are on existing haul roads apart from the overburden dump area where the haul roads will be established as part of the dumping process. The dump faces in these elevated areas will be orientated so lighting plants do not shine towards the New England Highway. The existing NEH visual bunds will assist in shielding any visual impacts or headlights from impacting on the community and the NEH. The advancing of the rehabilitation to the final landform shape, in areas not shielded by visual bunds, will assist with the visual amenity of these currently exposed dumping areas, that have remain unchanged since the RCN site went into care and maintenance in 2014.

## Ecology

The haulage routes are on existing haul roads or across disturbed (overburden) material. All of these areas have been mined through and have not currently reached final rehabilitation standards. There are no flora of fauna present on the haul routes.

Eastcoast Flora Survey and Forest Fauna Surveys Pty Limited were engaged to undertake an ecological assessment of the Borehole exploration Area (Appendix 3)The report outlines;

- The proposed drill hole sites occur within previously cleared and grazed lands, where the dominant *Eucalyptus crebra* and *Eucalyptus moluccana* formally comprised a grassy woodland of forest. Current-day vegetation is regrowth from a few older trees left during the grazing era, with little or no shrub layer, over a diverse ground layer of native and exotic species. Broadly speaking, this vegetation falls within the Central Hunter Grey Box-Ironbark Woodland of Peake (2006) now enshrined as the Endangered ecological community of the same name under the NSW *TSC Act 1995*. It is also included in the Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
- The derived native grasslands and regrowing woodlands at the proposed drill sites potentially support populations of the threatened orchid *Diuris tricolor*. However as this species flowers from late September to early October no flowering plants could be detected during field surveys in June. However, leaves of this species emerge from late April and are currently present (mid-June 2017) on *ex situ* reference plants elsewhere. No such leaves were detected at any of the proposed drill sites during the field inspection, so the likelihood of a population being affected by the proposed actions are very minor. In addition, the small footprint (approximately 400m2) at each of the eight drill sites is significantly smaller than the surrounding grasslands and woodlands (all potential *Diuris* habitat) that will remain undisturbed by the proposed actions.
- The is no requirement to follow the standardised tree clearing procedure due to the absence of habitat, or microhabitat features essential for threatened or protected fauna species known to occur in the general locality. No evidence of threatened fauna species was detected at each of the borehole exploration sites, and it is not considered likely that any species would occur. Therefore, it is considered that there is no requirement for assessment of threatened fauna species and or their habitat under s.5A of the *Environmental Planning & Assessment Act 1979* by the proposed action.
- The proposed disturbance (<0.5ha) to the endangered Central Hunter Grey Box-Ironbark Woodland community (occupying approx. 40,000ha; NSW Scientific Committee 2010), within which the eight drill sites broadly reside, is considered minor and negligible and will not impose a significant impact on this community. This is particularly the case as all drill sites have been positioned in either previously cleared and ripped ground (Sites 01,06,07 &08), or in open grassland away from woody regrowth forest (sites 02,03,04 &05). As a consequence, there is no necessity to undertake a seven-part test under the relevant legislation.

### Waste Management

The existing consents, approvals and licences which currently cover reject and tailings emplacement on the site will not need to be modified.

## Heritage

a) Material Movement

The haul route is on areas that have been completely disturbed by open cut mining activities and entirely contained within the mining lease areas. These areas were surveyed for archaeological sites as part of the original approval processes. Consents to destroy were obtained for areas that would be impacted such as mined areas. No sites remain along the haul routes.

b) Exploration Drilling

AECOM were engaged to undertake an Aboriginal Archaeological Due Diligence Assessment for exploration drilling, in the area designated *Area not to be disturbed*, which is attached as appendix 4. The purpose of the due diligence assessment was to assess if the proposed activities of drilling eight boreholes and clearance of associated access tracks (where required) could be carried out without any impacts to Aboriginal objects.

The assessment included;

- A review of the landscape context of the project area and surrounds.
- A review of existing Aboriginal heritage Information Management System
- A review of findings from previous Aboriginal archaeological investigations relevant to the project area.
- A site inspection by a heritage specialist.

The key findings of the assessment were;

- No previously recorded Aboriginal sites are located within the proposed drill locations. The closest site is located 90 m to the northwest of Borehole 1.
- No Aboriginal objects were identified during the visual inspection component of the assessment.
- Land within the project area has undergone varying levels of disturbance through historical land use activities. Key landscape disturbances have included vegetation clearance across the entire project area and areas of bulk earthworks associated with construction contour drains, bunds and access tracks. However the majority of the project area was assessed as retaining a moderate degree of integrity.
- Taking into account the projects area's extant landforms, the nature and extent of past ground disturbances, as well as the results of previous Aboriginal archaeological assessments in the local area, the Aboriginal archaeological sensitivity of the project area is considered low.

## **Social and Economic**

The modifications will deliver some operational efficiencies that will assist in the long term viability of Rix's Creek and its employment opportunities.

### **Traffic and Transport**

All product coal will continue to be transported from site utilising the Rix's Creek rail loop.

## **Greenhouse Gas**

The modifications will mean no more changes to the number of vehicles on site or the number of trips required to transport the overburden or reject. The impacts will continue to be managed under the Air Quality and Greenhouse Gas Management Plan.

### Rehabilitation

At completion of the useful life of the haul routes they will be rehabilitated to the rehabilitation standards for the site.

The proposed modification to overburden emplacement will result in an earlier completion date for the achievement of the RCN final landform. The RCS final landform could decrease in final height and/or final landform slope, in some areas, depending on the total amount of overburden transported to RCN. The development of rehabilitated landforms is currently monitored and reported on an annual basis. Any opportunity for a decrease in final landform height and/or reduction in the rehabilitation landform slope will be designed into ongoing final landform design.

Exploration borehole sites will be rehabilitated in line with the current landuse.

### Conclusion

Bloomfield proposes to modify development consents DA 49/94 and 08\_0102 pursuant to Section 75W of the EP&A Act to allow for overburden from RCS to be emplaced within the approved RCN final landform. This will result in some operational efficiencies for the sites overburden dumping operations as well as assist with a more timely achievement of the RCN final landform.

All mining will be undertaken within existing approved mining areas within current approved mining rates. All environmental impacts will remain within the limits currently assessed for Rix's Creek North and Rix's Creek South mining operations. Bloomfield will continue actively manage the environmental impacts utilising the existing approved EMP's.

The biodiversity and Aboriginal heritage reports show any environmental impact associated with the drilling of the proposed exploration boreholes will be minimised. Information obtained from this drilling will be essential in the planning for the geotechnical stability of the mine workings and estimation of the coal reserves contained within the sites mining tenements.



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29 June 2017

Garry Bailey General Manager of Mining Development The Bloomfield Group Via email: <u>gbailey@bloomcoll.com.au</u>

# RE: Air Quality Assessment for Rix's Creek South and Rix's Creek North – Proposed overburden emplacement in RCN

#### Dear Garry,

Todoroski Air Sciences has assessed the potential for air quality impacts associated with the proposed emplacement of Rix's Creek South (RCS) overburden and reject material in Rix's Creek North (RCN) (hereafter referred to as the Modification). This report investigates the potential change in dust emissions associated with the Modification relative to the approved operations.

#### Overview

Rix's Creek Mine of Rix's Creek Pty Limited, is owned and operated by Bloomfield Collieries Pty Limited (Bloomfield). It is an open cut coal mine approximately 5 kilometres (km) north-west of Singleton in the Hunter Valley Coalfields of New South Wales (NSW) and currently produces approximately 1.5 million tonnes per annum (Mtpa) of product coal from its existing operations.

The Bloomfield Group recently purchased the Camberwell Open Cut Mine (re-named as Rix's Creek North, RCN) in 2015, located on the adjacent mining lease immediately to the north of the Rix's Creek Mine, and plans to fully integrate both operations. The current approval at RCN permits extraction of up to 1.5Mtpa of ROM coal from the northern mining area and 4.5Mtpa of ROM coal in the western mining area.

#### **Modification description**

The Modification seeks approval to allow for up to 5 million bank cubic meters (Mbcm) per annum of overburden material (equivalent to approximately 12 million tonnes, assuming conversion factor of 2.4) and up to 0.5Mbcm per annum of rejects (1.2 million tonnes) originating from RCS to be emplaced directly into the approved RCN emplacement area.

An overview of the Project showing the location of the emplacement area in RCN and associated haul roads is shown in **Figure 1**.



### Figure 1: Location of proposed emplacement area and associated haul roads

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The overburden and reject material proposed to be emplaced in RCN would otherwise be emplaced within the RCS emplacement areas, therefore there is no additional overburden and reject material handling associated with the Modification.

The proposed haul routes for the Modification would extend a short distance north from the RCS Arties Pit east of the New England Highway and RCS Coal Handling and Preparation Plant (CHPP) along existing haul routes to the RCN emplacement area as shown in **Figure 1**.

As the overburden and reject material handled for the Modification would already have been transported some distance along the proposed haul routes to be emplaced in the RCS Arties Pit, only the additional distance travelled to the RCN emplacement area would result in additional dust being generated relative to the existing activities.

#### Assessment of potential air quality impacts

To investigate the potential effect that the Modification may have on dust levels in the surrounding environment, a qualitative analysis is made of the proposed change in dust levels associated with the Modification relative to the dust emission estimates in the most recent air quality assessments for RCS (**Todoroski Air Sciences, 2015**) and RCN (**Holmes Air Sciences 2009**).

The rate of dust emission associated with the Modification has been calculated by analysing the various types of dust generating activities taking place at the Modification and applying suitable emission factors. The emission factors applied are considered the most applicable and representative factors available for calculating the dust generation rates for the proposed activities.

A summary of the total dust emissions from all significant dust generating activities for the Project is presented in **Table 1**. A detailed dust emission inventory is presented in **Appendix A**.

As the Modification interacts with two individual dust emissions inventories, this assessment investigates the potential change to RCS and RCN separately and as a combined operation. The activity highlighted in green identifies the activity occurring within the RCS boundary, the remaining activity occurs within the RCN boundary.

ACTIVITY	TSP emission (kg/y)
Hauling overburden from RCS to boundary	31,907
Hauling overburden from boundary to emplacement area at RCN	61,176
Overburden emplacing at RCN	16,780
Hauling rejects from RCS CHPP to boundary	18,085
Hauling rejects from boundary to emplacement area at RCN	7,050
Rejects emplacing at RCN	176
Total TSP emissions (kg/yr)	135,173
Total TSP emissions – RCS	49,992
Total TSP emissions – RCN	85,181

#### Table 1: Summary of estimated TSP emission rate for the Modification

kg/y = kilograms per year

As the overburden and reject material would already be transported some distance along the proposed haul routes at RCS, only the additional distance travelled to reach the RCN emplacement area would generate additional dust emissions relative to the existing activities (refer to **Figure 2**).

3

The estimated dust emissions associated with emplacing 5Mbcm of overburden and the hauling and emplacing of reject material included in the dust emission estimates for RCS need to be discounted from the estimates to prevent double counting. The dust emissions associated with these activities are accounted for in the dust emission estimates for the Modification (see **Table 1**).



Figure 2: Additional haul distance to reach RCN emplacement area

Also, as the Modification does not seek to change the amount of overburden or reject material handled at RCN, the amount of material handled and transported in RCN would need to be discounted from the dust emission estimates in accordance with the amount of material delivered from RCS to prevent double counting.

The most recent air quality assessments for RCN (**Holmes Air Sciences, 2009**) indicates numerous overburden haul routes for each of the modelled scenarios. To account for the potential reduction in dust emissions due to the haulage of 5Mbcm of overburden at RCN, the weighted average distance of the haul routes in each scenario have been applied to estimate the dust associated with this source.

4

The estimated dust emissions for the Project have been compared against the total dust emission estimates for RCS and RCN in their most recent air quality assessments (**Todoroski Air Sciences, 2015** and **Holmes Air Sciences, 2009**) in **Table 2** and **Table 3** respectively.

The estimated additional dust generated due to the recently approved Satellite ROM pads at RCS (MOD 8) (**Todoroski Air Sciences, 2016**) has also been considered in **Table 2**.

The results indicate that the estimated total dust emissions from the Modification would result in an approximate 1.0 to 1.3% increase in total dust emissions relative to the total dust emission estimates for RCS and an approximate 1.6 to 3.4% decrease in total dust emissions relative to the total dust emission estimates for RCN.

#### Table 2: Comparison of estimated TSP emission rate for the Modification on the RCS site

Scenario	Total emissions (kg) <sup>(1)</sup>	Additional TSP emissions due to MOD 8 (kg) <sup>(2)</sup>	Estimated TSP emissions due to the Modification (kg)	TSP Reductions due to Modification (kg)	Percent change in total emissions (%)
Year 2017	1,772,038	18,259	49,992	32,588	1.0%
Year 2020	1,572,177	18,259	49,992	28,827	1.3%

(1) Todoroski Air Sciences (2015)

<sup>(2)</sup> Todoroski Air Sciences (2016)

Scenario	Total emissions (kg) <sup>(1)</sup>	Estimated TSP emissions due to the Modification (kg)	TSP Reductions due to Modification (kg)	Percent change in total emissions (%)
Scenario 1	3,602,300	85,181	207,646	-3.4%
Scenario 2	4,242,442	85,181	153,851	-1.6%
Scenario 3	2,921,136	85,181	157,517	-2.5%
Scenario 4	2,989,345	85,181	170,168	-2.8%
Scenario 5	3,705,106	85,181	152,432	-1.8%
Scenario 6	2,992,035	85,181	157,035	-2.4%

### Table 3: Comparison of estimated TSP emission rate for the Modification on the RCN site

<sup>(1)</sup> Holmes Air Sciences (2009)

The estimated change in dust emissions arising from the Modification is minor relative to the existing contribution of dust from the RCS and RCN mines. The activities of the Modification would be in a relatively central position for both mines and not close to any off-site receptors. The activities would occur regardless of the Modification albeit that they would occur in a different location (i.e. dumping within RCS as opposed to RCN) and during different staging (i.e. dumping in an already approved RCN emplacement area).

**Table 4** presents a comparison of the estimated dust emissions associated with the Modification compared with dust emission estimates for the most aligned assessment years for RCS and RCN combined. The comparison suggests that overall the Modification would result in a 0.8 to 1.1% decrease in the total dust generated from the operations.

Scenario	Total emissions (kg)*	Estimated TSP emissions due to the Modification (kg)	TSP reductions due to Modification (kg)	Percent change in total emissions (%)
Year 2017 + Scenario 2	6,032,739	135,173	186,439	-0.8%
Year 2020 + Scenario 3	4,511,572	135,173	186,344	-1.1%
Year 2017 + Scenario 5	5,495,403	135,173	185,020	-0.9%
Year 2020 + Scenario 6	4,582,471	135,173	185,861	-1.1%

Table 4: Comparison of estimated TSP emission rate for the Modification on the RCS site

\*Includes TSP emissions associated with MOD 8

Overall, it is considered that the potential change in the dust levels due to the Modification at any receptor would be too small to be noticed or reasonably measurable. Regardless, RCS and RCN will apply the most appropriate operational and physical dust mitigation measures to ensure dust levels are controlled.

#### **Summary and Conclusions**

This assessment has examined the likely air quality effects associated with the proposed transport and emplacement of up to 5Mbcm of overburden and 0.5Mbcm of rejects from RCS to RCN.

The assessment estimates that the Modification would reduce the dust relative to the existing operation of the mines by approximately 0.8 to 1.1%. This potential change in the dust generated due to the mines is unlikely to be noticeable at any off-site location.

The Modification would largely operate within the existing approvals as it does not seek to increase the amount of overburden or reject material handled for the operations or require additional material to be emplaced within the approved emplacement areas.

The RCS and RCN mines would continue to operate with appropriate best practice controls and dust mitigation measures to ensure that dust levels are minimised where possible.

Overall, the assessment indicates that no adverse impacts are expected to arise due to the Modification.

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

Yours faithfully,

Todoroski Air Sciences

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A. Gall.

Philip Henschke

Aleks Todoroski



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#### Holmes Air Sciences (2009)

"Air Quality Impact Assessment – Integra Open Cut Project", prepared for URS Australia Pty Ltd on behalf of Integra Coal by Holmes Air Sciences, June 2009.

#### Todoroski Air Sciences (2015)

"Air Quality and Greenhouse Gas Assessment Rix's Creek Continuation of Mining Project", prepared for Rix's Creek Mine by Todoroski Air Sciences, August 2015.

### Todoroski Air Sciences (2016)

"Air Quality Assessment for Rix's Creek and Rix's Creek North – Proposed satellite ROM pads", prepared for The Bloomfield Group by Todoroski Air Sciences, November 2016.

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Appendix A

**Emission Inventory** 



TODOROSKI AIR SCIENCES | info@airsciences.com.au | O2 9874 2123

Table A-1. Emissions inventory																	
Activity	TSP emission (kg/y)	Intensity	Units	Emission Factor	Units	Var. 1	Units	Var. 2	Units	Var. 3	Units	Var. 4	Units	Var. 5	Units	Var. 6	Units
Hauling from RCS to boundary	31,907	12,000,000	t/yr	0.018	kg/t	224	t/load	1.2	km/return	3.2	kg/VKT	2.1	% S.C.	275	Ave. GMV (t)	85	% Control
Hauling from boundary to emplacement area at RCN	61,176	12,000,000	t/yr	0.034	kg/t	224	t/load	2.4	km/return	3.2	kg/VKT	2.1	% S.C.	275	Ave. GMV (t)	85	% Control
Emplacing overburden at RCN	16,780	12,000,000	t/yr	0.00140	kg/t	1.181	ave. (WS/2.2) <sup>1.3</sup>	2	M.C. in %								
Hauling rejects from RCS to boundary	18,085	1,200,000	t/yr	0.100	kg/t	181	t/load	6.1	km/return	3.0	kg/VKT	2.1	% S.C.	234	Ave. GMV (t)	85	% Control
Hauling from boundary to emplacement area at RCN	7,050	1,200,000	t/yr	0.039	kg/t	181	t/load	2.4	km/return	3.0	kg/VKT	2.1	% S.C.	234	Ave. GMV (t)	85	% Control
Unloading rejects at RCN	176	1,200,000	t/yr	0.00015	kg/t	1.181	ave. (WS/2.2) <sup>1.3</sup>	10	M.C. in %								
TOTAL (kg of TSP)	135,173																

Table A-1: Emissions Inventory



30 June 2017

Rix's Creek Mine PO Box 4 East Maitland NSW 2323 Attention: Garry Bailey

Dear Garry,

**Regarding:** Overburden movement from RCS to RCN

This letter provides an opinion on a proposed change of operations by Rix's Creek mine (RCM).

The change proposed is to move some Rix's Creek South mine overburden and coal tailings to the overburden emplacement areas in the Rix's Creek North mine (RCN, formerly the Integra Open Cut, or IOC).

It is understood that for this activity RCM plan to use trucks that used to operate at IOC which they now own since acquiring that mine (which will be hereafter referred to as RCN).

RCN operations were approved based on noise predictions associated with an annual overburden movement of 26 bank cubic metres (BCM). The current approved mine operation plan for RCN is for only 10 million BCM per year. The proposal is to move from RCS into RCN an additional 5 and 0.5 million BCM of overburden and tailings respectively, for a combined total (RCN and RCS material) per year of 15.5 BCM.

Given that current RCN operations are at only 10 million BCM per year, there must be considerably less activity taking place there than modelled for the EIS. For example, there would be less drilling and coaling, meaning that activities causing site noise emissions must be well below that approved.

Of course the addition of overburden movements means that the increased activity would occur on high exposed areas, dumps and associated haul roads, which is one of the primary contributors to off-site noise. However, the total overburden movements planned are still somewhat below those approved via the EIS.

The above can be summarised as follows:

- plant to be operated is the same as that approved;
- current total site emissions should be well below that approved;
- the additional plant operations would still be less than those approved; and
- the total tonnage of overburden proposed to be moved annually is somewhat less than that approved.

Based on the above it is my opinion that it is reasonable to state that the proposed overburden movement activity represents a lesser noise emitting scenario than activities modelled for the RCN EIS.

I trust this information meets your requirements. If you have any questions or need further details please contact me.

J. Weller

Wec

Prepared:

Tony Welbourne Director

QA review:

Jeremy Welbourne Civil Engineer (Acoustics)



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28 June 2017

Chris Quinn Environmental Officer Rix's Creek North The Bloomfield Group PO Box 4 East Maitland NSW 2323

Dear Chris,

# Re: Aboriginal Archaeological Due Diligence Assessment for Exploration Drilling at Rixs Creek Mine

#### 1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by The Bloomfield Group (TBG) to undertake an Aboriginal archaeological due diligence assessment of eight exploratory borehole locations and associated access tracks within the western extent of the Camberwell Pit, at Rixs Creek Mine, near Singleton, NSW (the Project area, Figure 1). AECOM understands that the drilling is required for geotechnical purposes and that TBG's Ground Disturbance Permit (GDP) process for the proposed works, requires an Aboriginal archaeological due diligence assessment to be carried out to ensure there are no impacts to Aboriginal objects.

The purpose of this assessment is to identify the known and potential Aboriginal heritage constraints for the drilling program and to provide TBG with appropriate management advice. The contents of this letter report have been compiled in accordance with the NSW Office of Environment and Heritage's (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW 2010* (DECCW, 2010b). This code has been developed to assist proponents in exercising due diligence when carrying out activities that may harm Aboriginal objects.

#### 2.0 Proposed Activity

The proposed activities consist of drilling eight boreholes and the clearance of associated access tracks (where required). Disturbances as a result of the drilling activities will include:

- Clearing of vegetation within a maximum 20 x 20 m operational borehole pad area within which disturbances will be confined. The borehole pad area will be sufficient to safely allow for the movement of vehicles and machinery during drilling;
- Topsoil disturbance consisting of the drilling of a 150 mm diameter hole below the ground surface; and
- In some instances, where no existing access tracks are present, construction of access tracks will be required.

It is understood that TBG will utilise portable, above-ground sumps, and that the excavation of sumps will not be required.

#### 3.0 Relevant Legislation

#### National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act), administered by OEH, is the primary legislation for the protection of Aboriginal cultural heritage in NSW. The NPW Act gives the Secretary of OEH responsibility for the proper care, preservation and protection of 'Aboriginal objects' and 'Aboriginal places', defined under the Act as follows:

- An Aboriginal object is any deposit, object or material evidence (that is not a handicraft made for sale) relating to Aboriginal habitation of NSW, before or during the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains).
- An Aboriginal place is a place declared so by the Minister administering the NPW Act because the place is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects.



Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to harm them and includes a 'strict liability offence' for such harm. A 'strict liability offence' does not require someone to know that it is an Aboriginal object or place they are causing harm to in order to be prosecuted. Defences against the 'strict liability offence' in the NPW Act include the carrying out of certain 'Low Impact Activities', prescribed in Clause 80B of the National Parks and Wildlife Amendment Regulation 2010 (NPW Regulation), and the demonstration of due diligence.

An Aboriginal Heritage Impact Permit (AHIP) issued under Section 90 of the NPW Act is required if impacts to Aboriginal objects and/or places cannot be avoided. An AHIP is a defence to a prosecution for harming Aboriginal objects and places if the harm was authorised by the AHIP and the conditions of that AHIP were not contravened. Consultation with Aboriginal communities is required under OEH policy when an application for an AHIP is considered and is an integral part of the process. AHIPs may be issued in relation to a specified Aboriginal object, Aboriginal place, land, activity or person or specified types or classes of Aboriginal objects, Aboriginal places, land, activities or persons.

Section 89A of the NPW Act requires notification of the location of Aboriginal sites within a reasonable time, with penalties for non-notification.

#### 4.0 Data Sources

Information regarding the known and potential Aboriginal heritage resource of the Project area was obtained from:

- A review of the landscape context of the Project area and surrounds, with particular reference to its implications for past Aboriginal land use;
- A review of existing Aboriginal Heritage Information Management System (AHIMS) data for land within and surrounding the Project area, obtained from OEH on 31 May 2017 (AHIMS Search ID# 283884);
- A review of the findings of previous Aboriginal archaeological investigations relevant to the Project area; and
- A site inspection of the Project area by AECOM senior heritage specialist Geordie Oakes on Tuesday 13 May 2017.

#### 5.0 Landscape Context

Consideration of the landscape context of the Project area is predicated on the now well-established proposition that the nature and distribution of Aboriginal archaeological materials are closely connected to the environments in which they occur. Environmental variables such as topography, geology, hydrology and the composition of local floral and faunal communities will have played an important role in influencing how Aboriginal people moved within and utilised their respective Country. Among other things, such variables will have affected the availability of suitable camp sites, drinking water and raw materials for the production of stone and organic implements, as well as economic plant and animal resources. At the same time, an assessment of historical and current land use activities, as well as geomorphic processes such as soil erosion and bioturbation, is critical to understanding the formation and integrity of archaeological deposits.

Key findings to be drawn from a review of the landscape context of the Project area are as follows:

- A review of topographic mapping indicates that the Project area encompasses the mid to upper flanks and crest of a prominent north-south trending ridgeline adjacent to the New England Highway. Elevations within the Project area range from 100 m AHD in the eastern portion of the Project area (middle slope) to 130 m AHD in the western portion (upper slope), providing a total local relief of 30 m.
- Available mapping indicates there are no creeklines within the vicinity of the Project area. The closest watercourses to the Project area include a 1<sup>st</sup> order drainage channel 700 m to the northeast, Glennies Creek 1.7 km to the north and Rixs Creek 2.3 km to the south. Existing archaeological data for the Hunter Valley indicate a strong trend for the presence of open artefact sites along watercourses, specifically, on creek banks and 'flats' (i.e., flood/drainage plains), terraces and bordering slopes. Although this distribution pattern can be attributed in part to geomorphic dynamics and archaeological sampling bias, with extensive fluvial erosion activity



along watercourses resulting in higher levels of surface visibility and, by extension, concentrated survey effort, an occupational emphasis on watercourses is supported by the results of several large scale subsurface salvage projects (e.g., Koettig, 1992, 1994; Kuskie & Clarke, 2004; Kuskie & Kamminga, 2000; MacDonald & Davidson, 1998; OzArk, 2013; Rich, 1992; Umwelt, 2006,Umwelt, in prep). Collectively, these projects have also shown that assemblage size and complexity tend to vary significantly in relation to both landform and stream order, with larger, more complex<sup>1</sup> assemblages concentrated on elevated, low gradient landform elements adjacent to higher order streams.

- Soils within the Project area have been mapped as part of the Roxburgh soil landscape. Soils of the Roxburgh soil landscape area can be generally characterised as having brown fine sandy loam A horizons overlaying brown sandy clay B horizon. PH levels range from neutral (pH 7) to alkaline (pH 9.0).
- Reference to the 1:250 000 Geological Series Sheet for Singleton (SI 56-1) indicates that the surface geology of the Project area comprises a combination of Permian aged Singleton Coal Measures (Ps). Singleton Coal Measures comprises sandstone, shale, mudstone, conglomerate and coal seams. No surface and/or near-surface deposits of stone suitable for flaked stone artefact manufacture are known to occur within the Project area.
- Much of the native vegetation within the Project area has been extensively modified as a result of historical land use and clearing activities and today consists of native/exotic grassland with pockets of remnant forest and woodland.
- Historical and contemporary aerial photographs indicate that the Project area has been subject to several ground surface impacts including historical vegetation clearance across the entire area and areas of earthworks associated with contour drains and access tracks. Nonetheless, the majority of the Project area retains a moderate degree of integrity.

#### 6.0 AHIMS Database

The AHIMS database, administered by OEH, contains records of all Aboriginal objects reported to the Director General of the Department of Premier and Cabinet in accordance with Section 89A of the NPW Act. It also contains information about Aboriginal places, which have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are known as 'Aboriginal sites'.

A search of the AHIMS database was undertaken on 31 May 2017 for a 5 x 5 km area centred on the Project area (AHIMS search area). A total of 108 Aboriginal archaeological sites were identified within the search area comprising 102 open artefact sites, four scarred trees, one art site and one resource and gathering site. Consideration of the location of previously recorded sites indicates that no previously recorded sites are located within any of the proposed drill pad locations, with the closest site – 'Integra 19' (AHIMS ID#37-3-0874) – located 90 m to the northwest of Borehole 1. Integra 19 consists of an isolated artefact recorded by Navin Officer (2008) as part of an assessment for an Integra Coal Mine extension. Table 1 provides a summary of site types within the search area with their locations shown on Figure 1.

Site Type	Count	%
Open artefact site (i.e., isolated artefacts and artefact scatters)	102	94.4
Scarred trees	4	3.8
Art	1	0.9
Resource and gathering	1	0.9
Total	108	100

#### Table 1 Site search results

<sup>&</sup>lt;sup>1</sup> Those containing a wider variety of raw materials and technological types and/or higher mean artefact densities and features such as knapping floors and hearths.



#### Figure 1 Project area



<sup>\</sup>aunt1fp001\projects\60289290\_rixcreek\_mine\4. tech work area\4.6 heritage\6.0 exploration drilling dd\reporting\60289290\_fnlrpt\_rixexdrill\_dd\_2017\_06\_28.docx 4 of 14



#### 7.0 Previous Aboriginal Heritage Assessments

The Aboriginal archaeology of the Rixs Creek area is well researched, having been the subject of numerous Aboriginal archaeological investigations since the early 1980s. Notable investigations in the area have included surveys by Biosis Research Pty Ltd (2010), Brayshaw (1981, 1982, 1983, and 1986), Effenberger (1994), Koettig (1986, 1990), Navin Officer Heritage Consultants (2008)alongside an archaeological salvage program by AECOM (2012). Key observations drawn from a review of the local and regional archaeological context of the Project area are as follows:

- In 2008, Navin Officer undertook archaeological survey of the proposed Integra Mine extraction area resulting in the identification of 47 Aboriginal sites, one of which 'Integra 19' is located 90 m northwest of Borehole 1. Integra 19 consists of an isolated artefact located in an erosion scour on a slope.
- Artefact scatters and isolated finds collectively referred to as open artefact sites are the most common site types within the region. Recorded stone artefact assemblages consist principally of flake and non-flake debitage (i.e., flakes (complete and broken), flake shatter fragments and flaked pieces), with cores, retouched tools and groundstone implements comparatively poorly represented;
- Other, comparatively rare site types include: grinding grooves, scarred trees, quarries (stone and ochre), stone arrangements, earth mounds and waterholes;
- Silcrete and tuff are the dominant raw materials for flaked stone artefact manufacture;
- Most, if not all, of the Aboriginal archaeological materials present within the Project area will be of mid-to-late Holocene antiquity;
- Flaked stone assemblages will be dominated by flake debitage (*sensu* Andrefsky 2005), with formed objects (i.e., cores and retouched flakes) comparatively poorly represented; and
- Surface and subsurface artefact distribution within the Project area will vary significantly in relation to landform, distance to water and stream order.

#### 8.0 Visual Inspection

A visual inspection of the Project area was undertaken on Tuesday 13 June 2017 by AECOM Senior Heritage Specialist Geordie Oakes. The purpose of this inspection was to help establish whether the proposed drilling will, or is likely to, harm any Aboriginal objects. During the visual inspection notes were taken regarding Ground Surface Visibility (GSV), Ground Integrity (GI, i.e. land condition), archaeological sensitivity and impact risk. Impact risk was determined on the basis of archaeological sensitivity, as well as the nature of proposed Project-related impacts.

Consistent with examined historical aerials, a visual inspection of the Project area indicated that land within the area has undergone varying levels of disturbance through historical land use activities. Key landscape disturbances have included vegetation clearance across the entire Project area and areas of bulk earthworks associated with the construction of contour drains, bunds and access tracks.

GSV was, in general, good due to limited grass cover and large erosions scours which offered higher levels of GSV. In general, land within the Project area was assessed as retaining moderate integrity with localised areas of high disturbance associated with construction drains, bunds and access tracks. Results of the visual inspection are provided in Table 2 and photos in Appendix A.

## AECOM

#### Table 2 Visual inspection results

Borehole	Centroid Easting (UTM)*	Centroid Northing (UTM)*	Landform element(s)	Estimated distance to nearest creekline (m)	Average Ground Surface Visibility (GSV) Percentage (%)	Average Ground Integrity (GI)	Key disturbance factor(s)	Surface artefacts observed	Archaeologic al sensitivity	Impact risk
1	322856	6402843	Midslope	1600 m	30	Low	Past vegetation clearance, contour drain	No	Low	Low
2	322755	6402991	Mid slope	1500 m	10	Moderate	Past vegetation clearance	No	Low	Low
3	322702	6402960	Mid slope	1500 m	20	Moderate	Past vegetation clearance	No	Low	Low
4	322626	6402913	Upper slope	1540 m	20	Moderate	Past vegetation clearance	No	Low	Low
5	322668	6403116	Mid slope	1380 m	60	Moderate	Past vegetation clearance	No	Low	Low
6	322542	6403076	Crest	1400 m	10	Low	Past vegetation clearance, bund and access track construction	No	Low	Low
7	322439	6403199	Crest	1250 m	10	Low	Past vegetation clearance, bund and access track construction	No	Low	Low
8	322319	6403399	Upper slope	1060 m	20	Low	Past vegetation clearance	No	Low	Low



#### 9.0 Key Findings

The key findings of this Aboriginal archaeological desktop assessment are as follows:

- A review of existing archaeological data for the Project area, including the results of a search of the AHIMS database, indicates that no previously recorded Aboriginal sites area located within the proposed borehole drill locations. The closest site - 'Integra 19' (AHIMS ID#37-3-0874) – located 90 m to the northwest of Borehole 1.
- No Aboriginal objects were identified during the visual inspection component of this assessment;
- Land within the Project area has undergone varying levels of disturbance through historical land use activities. Key landscape disturbances have included vegetation clearance across the entire Project area and areas of bulk earthworks associated with construction contour drains, bunds and access tracks. However, the majority of the Project area was assessed as retaining a moderate degree of integrity; and
- Taking into account the Project area's extant landforms, the nature and extent of past ground disturbances, as well as the results of previous Aboriginal archaeological assessments in the local area, the Aboriginal archaeological sensitivity of the Project area is considered low.

#### 10.0 Recommendations

On the basis of the above key findings, the following recommendations are made:

- 1. No Aboriginal heritage constraints have been identified within the Project area in relation to the proposed exploration drilling. As such, no further heritage works or reporting are considered warranted; and
- 2. In the event that Aboriginal objects, including possible human skeletal material (remains), are identified during construction the procedure outlined in Appendix B should be followed.

Yours faithfully,

Geordie Oakes Archaeologist geordie.oakes@aecom.com

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Appendix A – Site Photos



Plate 1: View west of borehole 1 (Source: AECOM 2017)



<sup>\</sup>aunt1fp001\projects\60289290\_rixcreek\_mine\4. tech work area\4.6 heritage\6.0 exploration drilling dd\reporting\60289290\_fnlrpt\_rixexdrill\_dd\_2017\_06\_28.docx 4 of 14







## ΑΞϹΟΜ



Plate 5: View east of borehole 5 (Source: AECOM 2017)



## ΑΞϹΟΜ







### Appendix B – Management of Previously Unrecorded Aboriginal Objects

#### Management of Previously Unrecorded Aboriginal Objects

Should a suspected Aboriginal site be identified at any point throughout the life of the Project, the following standard procedure should be adopted:

- 1) All works must cease immediately in the area to prevent any further impacts to the site;
- 2) Notify the Project Manager;
- Engage a suitably qualified archaeologist to determine the nature, extent and significance of the find and provide appropriate management advice. Management action(s) will vary according to the type of evidence identified, its significance (both scientific and cultural) and the nature of potential impacts;
- 4) If the find is determined to be Aboriginal, consultation is to be undertake with identified Registered Aboriginal Parties (RAP); and
- 5) Prepare and submit an AHIMS site card for the site.

#### Human Skeletal Remains

In the event that potential human skeletal remains are identified within the Project area at any point during the life of the Project, the following standard procedure (New South Wales Police Force, 2015; NSW Health, 2008) should be followed.

- 1) All work in the vicinity of the remains should cease immediately;
- 2) The location should be cordoned off and the NSW Police notified.
- 3) If the Police suspect the remains are Aboriginal, they will contact the Office of Environment and Heritage and arrange for a forensic anthropologist or archaeological expert to examine the site.

Subsequent management actions will be dependent on the findings of the inspection undertaken under Point 3.

- If the remains are identified as modern and human, the area will become a crime scene under the jurisdiction of the NSW Police;
- If the remains are identified as pre-contact or historic Aboriginal, OEH and all RAPs are to be formally notified in writing. Where impacts to exposed Aboriginal skeletal remains cannot be avoided an appropriate management mitigation strategy will be developed in consultation with OEH and RAPs;
- If the remains are identified as historic non-Aboriginal, the site is to be secured and the NSW Heritage Division contacted; and
- If the remains are identified as non-human, work can recommence immediately.

## **RIX'S CREEK NORTH MINE**

## Borehole Exploration Area Ecological Assessment



**REPORT TO** 

**RIX'S CREEK NORTH MINE** 

26 June 2017

Forest Fauna Surveys Pty Ltd Eastcoast Flora Survey

## Rix's Creek North Mine Borehole Inspection Area

## Report prepared for

## **Bloomfield Group**

This report prepared by

Michael Murray B.Sc.(Hons) Director Forest Fauna Surveys Pty Ltd Stephen Bell (B.Sc.(Hons), PhD)

**Eastcoast Flora Survey** 

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## 1.0 INTRODUCTION

## Background

Rix's Creek Mine propose to undertake the drilling of eight exploration holes for assessment of mine high wall stability. The proposed works will occur on land outside of the current disturbance limit of the mine operation. The proposed work area presently supports a mix of derived grassland and regrowth woodland, Bull Oak *Allocasuarina luehmannii*, Narrow-leaved Ironbark *Eucalyptus crebra*, Grey Box *Eucalyptus molucanna* and scattered Forest Red Gum *Eucalyptus tereticornis* trees. The scope of this report is to undertake an ecological assessment of the proposed works area to identify any ecological issues prior to commencement of the drilling investigations, and whether the proposed action would impact on any threatened species, endangered ecological communities or endangered populations.

## 2.0 METHODOLOGY

Within the proposed work area, a search was conducted on Tuesday 13 June 2017 to identify any ecological features including threatened species and significant habitat attributes (habitat trees, nest structures, etc.) that might be impacted by the proposed action. The search was conducted by walking the area and inspecting an approximate 20m x 20m search area around each of the 8 borehole locations. Any significant features were recorded by use of a hand held GPS (Garmin CSx60). Inspections were undertaken in the company of Rix's Creek mine staff Chris Quinn and Hannah Bowe.

Each proposed drill site was assessed for vegetation condition and a floristic species list collated. Notes were also made on evidence of previous disturbance and the presence and abundance of invasive weed species, and photographs taken at each drill site. Searches for threatened plant taxa were also conducted during the site visit, including those known or potentially present at this location based on local knowledge (e.g. Bell 2011) and a search of the OEH Bionet Atlas (**Table 1**).

Threatened Flora	Status	Status	Likelihood of Presence				
	NSW	C'wlth					
Acacia pendula	EP		moderate				
Asperula asthenes	V	V	low				
Cymbidium canaliculatum	EP		high				
Diuris tricolor	V		low				
Eucalyptus camaldulensis	EP		low				
Eucalyptus glaucina	V	V	low				
Ozothamnus tesselatus	V	V	low				
Persoonia pauciflora	CE		low				
Pterostylis gibbosa	E		low				

 Table 1. Summary of potential threatened plant taxa at proposed drill sites.

The Vulnerable Pine Donkey Orchid *Diuris tricolor* is well known from the Muswellbrook local government area, where it is also listed as an Endangered Population under the NSW *Threatened Species Conservation Act 1995*. Although current Bionet records show no evidence of this species east of the Antiene / Lake Liddell area on the outskirts of Muswellbrook, a small population of the species has been recently located in the North Rothbury area to the east of Singleton (OEH pers. comm.), hence there is some potential for this species to occur within the intervening area.

Plant communities present in the area were equated to regional and threatened communities through examination of dominant plant species and comparison with community profiles in Peake (2006) and Final Determinations prepared by the NSW Scientific Committee.



Figure 1. Location of Exploration Boreholes, Rixs Creek Mine.

## 3.0 RESULTS

### 3.1 Flora

On the whole, all proposed drill hole sites occur within previously cleared and grazed lands, where the dominant *Eucalyptus crebra* and *Eucalyptus moluccana* formerly comprised a grassy woodland or forest. Current-day vegetation is regrowth from the few older trees left during the grazing era, with little or no shrub layer present, over a diverse ground layer of native and exotic species. Broadly speaking, this vegetation falls within the Central Hunter Grey Box-Ironbark Woodland of Peake (2006), now enshrined as the Endangered ecological community of the same name under the NSW *TSC Act 1995*. It is also included in the Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

A full species list for all proposed drill sites is included in **Appendix A**, while photographs of each site are included in **Appendix B**.

#### <u>Site # 01</u>

Previously cleared during construction of a contour drain into a nearby dam, this area now supports a derived grassland dominated by *Aristida ramosa, Cymbopogon refractus, Bothriochloa decipiens* var. *decipiens, Calotis cuneifolia, Eragrostis leptostachya* and *Panicum effusum*. Several weeds are also present, including *Opuntia humifusum\*, Eragrostis curvula\*, Gomphocarpus fruticosus\** and *Galenia pubescens\**. Surrounding forest vegetation is dominated by *Eucalyptus crebra* and occasional *Allocasuarina luehmanii*.

#### <u>Site # 02</u>

Derived grassland within formerly cleared woodland of *Eucalyptus crebra*, with occasional *Eucalyptus moluccana*. Ground layer dominated by *Bothriochloa decipiens* var. *decipiens*, *Calotis cuneifolia*, *Lomandra conferta* subsp. *pallida*, *Chloris truncata*, *Cymbopogon refractus* and *Aristida ramosa*. Few problematic weeds are present at this location, but include Verbena bonariensis\*, *Bidens pilosa*\* and *Plantago lanceolata*\*.

#### Site # 03

Derived grassland within a wider matrix of *Eucalyptus crebra* regrowth, with scattered *Eucalyptus moluccana* also present. Dominant ground layer species include *Microlaena stipoides* var. *stipoides*, *Aristida ramosa*, *Bothiochloa decipiens* var. *decipiens*, *Calotis cuneifolia*, *Lomandra confertifolia* subsp. *pallida*, *Eragrostis leptostachya* and *Cymbopogon refractus*. Weeds species present include *Hyparrhenia hirta*\*, *Gomphocarpus fruticosus*\*, *Sida rhombifolia*\* and *Eragrostis curvula*\*. A proposed access track will be constructed between Site # 2 and Site # 3, which will require the removal of young regrowth trees of *Eucalyptus crebra*.

#### <u>Site # 04</u>

Derived native grassland adjacent to remnant and regrowth *Eucalyptus moluccana* woodland/forest. The exotic grass *Eragrostis curvula\** is locally dominant, but otherwise the ground layer is dominated by *Bothriochloa decipiens* var. *decipiens, Sporobolus creber, Aristida ramosa, Asperula conferta* and *Calotis cuneifolia*. Occasional shrubs of *Maireana microphylla* are present, but few other species are evident.

#### Site # 05

Previously cleared woodland of *Eucalyptus crebra* with occasional *Eucalyptus moluccana* and the shrub *Acacia falcata*, adjacent to an existing trail. Native species dominate the ground layer, including *Cymbopogon refractus*, *Eragrostis leptostachya*, *Calotis cuneifolia*, *Aristida ramosa*, *Cheilanthes sieberi* subsp. *sieberi*, and *Bothriochloa decipiens* var. *decipiens*. Weed species are few at this site, but include *Opuntia humifusum*\* and *Senecio madagascariensis*\*.

#### <u>Site # 06</u>

Previously cleared area adjacent to the New England Highway, currently supporting a derived grassland dominated by *Eragrostis curvula\** and *Eleusine indica\**. A row of planted, non-endemic eucalypts lines the north-eastern edge of this area. Scattered shrubs of the Western Australian *Acacia saligna\** are also present, while native ground layer species include *Bothriochloa decipiens* var. *decipiens, Aristida ramosa, Calotis cuneifolia* and *Panicum effusum*. Plants of the non-local and invasive *Grevillea robusta\** trees lie along the edge of the New England Highway, and a small number of seedlings are present in the area.

#### <u>Site # 07</u>

Derived grassland adjacent to the New England Highway, formerly cleared for grazing and/or highway construction. A row of non-endemic eucalypt species lines the north-eastern edge, beyond which is regrowth *Eucalyptus crebra* forest. The exotic grasses *Eragrostis curvula\**, *Setaria parviflora\** and *Hyparrhenia hirta\** dominate the ground layer at this location, but other native species are also present including *Bothriochloa decipiens* var. *decipiens, Calocephalus citreus* and *Cheilanthes sieberi* subsp. *sieberi*. Invasive *Grevillea robusta\** trees are also present in this area.

#### <u>Site # 08</u>

Former *Eucalyptus crebra* woodland, previously cleared and now supporting regrowth ironbark forest. A very sparse shrub layer of *Acacia decora* and *A. amblygona*, over a derived native grassland dominated by *Cymbopogon refractus*, *Aristida ramosa* and *Bothriochloa decipiens* var. *decipiens*. Dominant weeds present include *Eragriostic curvula*\*, *Opuntia humifusum*\* and *Eleusine indica*\*.

#### Potential for Threatened Orchids

Threatened terrestrial orchids, and in particular *Diuris tricolor*, potentially occur in any grassy woodland or derived native grassland environment. These orchids are only detectable during their brief flowering periods (normally early Spring), and many species flower inconsistently from year-to-year, dependent on season rainfall conditions. In addition, the detection of such orchids is further complicated by their demise through severe wind events, drought conditions or grazing by macropods, stock and invertebrates (such as grasshoppers). Monitoring of *Diuris tricolor* and *Prasophyllum petilum* in the Muswellbrook area, for example, has documented the impact of such threats on the regular flowering of these species (Bell 2016), which exacerbates understanding of their biology.

The derived native grasslands and regrowing woodlands at the proposed drill sites potentially support populations of *Diuris tricolor*, but as this species flowers from late September to early October no flowering plants could be detected during field surveys in June. However, leaves of this species emerge from late April and are currently present (mid-June 2017) on *ex situ* reference plants elsewhere. No such leaves were detected at any of the proposed drill sites during the field inspection, so the likelihood of a population being affected by the proposed actions are very minor. In addition, the small footprint (approximately 400m<sup>2</sup>) at each of the eight drill sites is significantly smaller than the surrounding grasslands and woodlands (all potential *Diuris* habitat) that will remain undisturbed by the proposed actions.

#### 3.2 Fauna

The locations of each borehole were essentially located in open grassland away from any standing remnant trees. No habitat trees or habitat features essential for known or likely threatened or protected fauna species occur within the 20m perimeter of each of the borehole locations. A population of the Grey-crowned Babbler were heard calling in vicinity of the proposed borehole #2, but no nests (either active or abandoned) were located in proximity to any of the proposed boreholes.

There may be a requirement for the clearing of remnant regrowth woodland for an access track between holes 2, 3 and 4. There are no habitat trees or mature trees present at this location, with only regrowth trees to 4m in height. A summary of the habitat characteristics associated with each borehole location is summarised below in **Table 2**.

Hole ID	Habitat Description
	Disturbed area from previous earthworks, no trees present with open grassland dominant. No ground logs or
01	litter.
	Disturbed area, scattered regrowth of Eucalyptus crebra to 6 metres in height. Grassland dominant ground
02	layer vegetation, no ground microhabitat present.
03	Regrowth Eucalyptus crebra trees to 4 metres in height, require clearing of young trees for equipment access.
	Cleared grassland with scattered Eucalyptus moluccana to 10 metres in height, none present in 20m x 20m
04	investigation area.
	Regrowth Eucalyptus crebra trees to 6 metres in height, existing minor track to borehole location. No
05	microhabitat present with scattered open grassland as dominant ground layer vegetation.
06	Open grassland, no trees or ground layer microhabitats present.
07	Disturbed open grassland, rows of planted trees along nearby bund wall. No habitat features.
	Scattered regrowth Eucalyptus crebra trees to 4 metres height. No trees occur within the 20m x 20m
08	investigation area. Grassland dominant ground layer vegetation, no additional habitat features.

 Table 2.
 Habitat characteristics, Borehole Locations, Rix's Creek Mine.

## 4.0 DISCUSSION

The proposed drill hole sites occur within previously cleared and grazed lands, where the dominant *Eucalyptus crebra* and *Eucalyptus moluccana* formerly comprised a grassy woodland or forest. Current-day vegetation is regrowth from the few older trees left during the grazing era, with little or no shrub layer present, over a diverse ground layer of native and exotic species. Broadly speaking, this vegetation falls within the Central Hunter Grey Box-Ironbark Woodland of Peake (2006), now enshrined as the Endangered ecological community of the same name under the NSW *TSC Act 1995*. It is also included in the Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The derived native grasslands and regrowing woodlands at the proposed drill sites potentially support populations of the threatened orchid *Diuris tricolor*. However, as this species flowers from late September to early October no flowering plants could be detected during field surveys in June. However, leaves of this species emerge from late April and are currently present (mid-June 2017) on *ex situ* reference plants elsewhere. No such leaves were detected at any of the proposed drill sites during the field inspection, so the likelihood of a population being affected by the proposed actions are very minor. In addition, the small footprint (approximately 400m<sup>2</sup>) at each of the eight drill sites is significantly smaller than the surrounding grasslands and woodlands (all potential *Diuris* habitat) that will remain undisturbed by the proposed actions.

There is no requirement to follow the standardised tree clearing procedure due to absence of habitat, or microhabitat features essential for threatened or protected fauna species known to occur in the general locality. No evidence of threatened fauna species was detected at each of the borehole exploration sites, and it is not considered likely that any species would occur. Therefore, it is considered that there is no requirement for assessment of threatened fauna species and or their habitat under s.5A of the *Environmental Planning & Assessment Act 1979* by the proposed action.

The proposed disturbance (<0.5ha) to the endangered Central Hunter Grey Box – Ironbark Woodland community (occupying ~40,000ha; NSW Scientific Committee 2010), within which the eight proposed drill sites broadly reside, is considered minor and negligible and will not impose a significant impact on this community. This is particularly the case as all drill sites have been positioned in either previously cleared and ripped ground (Sites 01, 06, 07, & 08), or in open

grassland away from woody regrowth forest (Sites 02, 03, 04 & 05). As a consequence, there is no necessity to undertake a seven-part test under the relevant legislation.

## 5.0 REFERENCES

Bell, S.A.J. (2011) Assessment of vegetation for expansion of Rix's Creek Mine, Hunter Valley. Unpublished Report to Rix's Creek Pty Limited, August 2011.

Bell, S.A.J. (2016) *Monitoring of translocated threatened orchids (*Diuris tricolor, Prasophyllum petilum) *at Mangoola Coal:* 2016 Results. Unpublished Report to Mangoola Coal. December 2016. Eastcoast Flora Survey.

NSW Scientific Committee (2010) *Final determination to list the Central Hunter Grey Box – Ironbark Woodland community as an Endangered Ecological Community*. NSW Scientific Committee, Hurstville.

Peake, T.C. (2006) The Vegetation of the Central Hunter Valley, New South Wales. A report on the findings of the Hunter Remnant Vegetation Project. Hunter-Central Rivers Catchment Management Authority, Paterson.

## APPENDIX A – Plant Species List

	Drill Site No.							
Species	1	2	3	4	5	6	7	8
Acacia amblygona								х
Acacia decora								x
Acacia falcata					x			
Acacia saligna *						х		
Allocasuarina luehmannii			х		x			
Anagallis arvensis *				х		х		
Aristida ramosa	x	x	х	x	x	х		x
Aristida vagans		х				х		х
Asperula conferta		x	x	x		х		
Austrostipa scabra subsp. falcata								
Bidens pilosa *	x	x					x	x
Bothriochloa decipiens var. decipiens	x	x	х	x	x	х	х	x
Brunoniella australis			х		x			
Calocephalus citreus		x	х			х		
Calotis cuneifolia	x	x	х	х	x	х	х	х
Calotis lappulacea	x		х	x		х		x
Capillipedium parviflorum						x		
Cheilanthes distans					x			x
Cheilanthes sieberi subsp. sieberi		x	x		x	x	x	x
Chloris truncata		x						
Chloris ventricosa					x	х		
Chrysocephalum semipapposum	x	x	x		x			x
Convolvulus erubescens		х						
Convza bonariensis *			х					
Cymbopogon refractus	x	x	x		x			x
Cynodon dactylon *			x				x	
Cyperus gracilis				x				
Desmodium gunnii					x			
Dichanthium sericeum subsp. sericeum						х		
Dichondra repens		x	x	x				
Digitaria spp.							х	
Eleusine indica *						х	х	x
Elymus scaber var. scaber				x				
Enchylaena tomentosa					x			
Eragrostis brownii	x							x
Eragrostis curvula *	x		x	x		x	x	x
Eragrostis leptostachya		x	x		x			
Eremophila debilis						x		
Eucalyptus crebra		x	x		x			x
Eucalyptus moluccana		x	x	x	x			
Galenia pubescens *	x					x		

	Drill Site No.							
Species	1	2	3	4	5	6	7	8
Geranium solanderi var. solanderi							x	
Glossocardia bidens	x				x			
Glycine tabacina	x	x	х		x	х	x	
Gomphocarpus fruticosus *	x		x	x		x	x	
Gomphrena celosioides *	x							
Grevillea robusta *						х	x	
Hibbertia diffusa								x
Hyparrhenia hirta *			x				x	
Imperata cylindrica				x				
Lomandra confertifolia subsp. pallida		x	x		x			
Lomandra multiflora subsp. multiflora		x	х					x
Maireana microphylla	x			х				
Mentha satureioides		x						
Microlaena stipoides var. stipoides			х					
Modiola caroliniana *				х				
Notodanthonia longifolia					x			
Opuntia humifusa *	x			x	x	х		x
Oxalis perennans	x		х	x				
Panicum effusum	x	х	х		x	х		
Paspalum dilatatum *		x				x		
Phyllanthus virgatus								x
Pimelea curviflora var. sericea	x		x		x	x		
Plantago lanceolata *	x	х	х	x		х		x
Poa labillardierei var. labillardierei								x
Richardia stellaris *	x							
Senecio madagascariensis *			х		x			
Setaria parviflora *							x	
Sida corrugata					x			
Sida rhombifolia *		х	х	x		х	x	
Sonchus oleraceus *				x			x	
Sporobolus creber		x		x				
Stackhousia muricata		x						x
Verbena bonariensis *	x	x	x	x		x	x	x
Veronica plebeia							x	
Vittadinia cuneata var. cuneata	x							
Wahlenbergia communis	x				x			

Total Species = 77

Total non-endemic Spp = 22



## APPENDIX B – Site Photographs







Proposed Drill Site # 5



