GLOUCESTER RESOURCES LTD

ABN: 46 114 162 597

ROCKY HILL COAL PROJECT

Terrestrial Biodiversity Assessment

Prepared by

Ecotone Ecological Consultants Pty Ltd

February 2013

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Terrestrial Biodiversity Assessment

Prepared for:

R.W. Corkery & Co. Pty Limited
1st Floor, 12 Dangar Road
PO Box 239
BROOKLYN NSW 2083

Tel: (02) 9985 8511
Fax: (02) 9985 8208
Email: brooklyn@rwcorkery.com

On behalf of:

Gloucester Resources Limited
Level 37, Riverside Centre
123 Eagle Street
BRISBANE QLD 4000

Tel: (07) 3006 1830
Fax: (07) 3006 1840
Email: gpolwarth@amci.com.au

Prepared by:

Ecotone Ecological Consultants Pty Ltd
39 Platt Street
WARATAH NSW 2298

Tel: (02) 4968 4901
Fax: (02) 4968 4960
Email: info@ecotoneconsultants.com.au

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COMMONLY USED ACRONYMS IN THIS DOCUMENT

BBAM	BioBanking Assessment Methodology
BM	Benchmark (in relation to vegetation attributes)
CHPP	Coal Handling and Preparation Plant
CMA	Catchment Management Authority
DBH	Diameter at Breast Height
DGRs	Director-General's Requirements
DP&I	Department of Planning & Infrastructure (NSW)
DRE	Division of Resources and Energy (NSW)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
DSF	Dry sclerophyll forest
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EL	Exploration Licence
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (*Commonwealth*)
GIS	Geographic Information System
GRL	Gloucester Resources Limited
LEP	Local Environmental Plan
LGA	Local Government Area
NES	National Environmental Significance
NOW	NSW Office of Water
OEH	Office of Environment and Heritage (NSW)
PFC	Projective Foliage Cover
ROM	Run-of-Mine
ROTAP	Rare or Threatened Australian Plants (Briggs and Leigh 1996)
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995 (NSW)*
VEC	Vulnerable Ecological Community

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EXECUTIVE SUMMARY

This report investigates the impacts associated with a proposal for a small scale open cut coal mine 3.5km to 7km southeast of the Gloucester urban area, NSW known as the Rocky Hill Coal Project ("the Proposal"). Mining and associated activities, including transportation of coal by overland conveyor and train loading are proposed within an area referred to as "the Site" covering approximately 856ha within a total Study Area of approximately 2 030ha.

Desktop investigations were firstly carried out to identify known or likely threatened species, populations, ecological communities or other matters relating to local biodiversity that may need to be addressed or considered. From aerial photograph interpretation, it was found that the majority of the Study Area is cleared pastureland with scattered trees. However, forest is present on the upper slopes of the Mograni Range in the east of the Study Area; various small patches of vegetation and a narrow roadside corridor of vegetation are present in the centre of the Study Area; and narrow riparian corridors are present along the watercourses around the northern, western and southern boundaries of the Study Area.

Field surveys designed to target the various vegetation types, fauna habitats and threatened flora and fauna species were then conducted within the Study Area.

As a result of the field surveys, the vegetation communities and habitats present were found to have been modified to various degrees through grazing and fire. The Study Area was found to contain nine threatened fauna species listed under the TSC Act, plus one Vulnerable Ecological Community (Lower Hunter Valley Dry Rainforest). The threatened fauna species were mostly present within the open forest, rainforest and riparian vegetation. Additional threatened fauna species are likely to be present, or at least visit the Site from time to time for foraging. No threatened flora species or endangered populations were recorded within the Study Area.

The mature roadside open forest vegetation along McKinleys Lane was found to provide known habitat for four threatened species, namely the Squirrel glider, the Grey-crowned babbler, the Eastern bent-wing bat and the Large-footed myotis. The existing viability of the local Squirrel glider population in this area must be considered tenuous due to the linear connection with other suitable habitat.

The proposed disturbance area for the Rocky Hill Coal Project will mostly coincide with cleared pastureland containing scattered trees and open forest vegetation ranging from low to good condition. The Proposal has been designed to minimise impacts on the vulnerable ecological community and habitats known or potentially used by threatened species within the Study Area but small patches of the vulnerable ecological community totalling 4.3ha will be removed.

The northern section of McKinleys Lane has been excluded from mining and bands of vegetation planted adjacent to local roads will in time enhance the habitat connectivity from this area to the more extensive forest vegetation to the north and east. However, the retained vegetated corridor adjacent to McKinleys Lane will be located close to a new Mine Area access road, a new 11kV power line easement and an overburden stockpiling area. There will be some reduction in available habitat and potential indirect impacts for these four species. Ongoing monitoring of the habitat and the Squirrel glider and Grey-crowned babbler populations in the McKinleys Lane road reserve as part of a Rocky Hill Coal Project Biodiversity Management Plan, will allow adaptive management of this area and the populations of threatened species therein.

The rainforest areas that have been identified on the slopes on the eastern side of the Study Area are remnants of a Vulnerable Ecological Community (Lower Hunter Valley Dry Rainforest) and provide known or potential habitat for a range of threatened species such as the Wompoo fruit-dove, Spotted-tail quoll and various forest micro-bats. Substantial areas of this vegetation community and the open forest vegetation community will be conserved within the proposed Biodiversity Offset Area.

Only very minor impacts on riparian vegetation (including trimming where the conveyor corridor is proposed to traverse the Avon River and Waukivory Creek) are expected in the west of the Study Area. Selective slashing may be required where the 132kV power line diversion (45m corridor width) is proposed to cross Oaky Creek in the north and Waukivory Creek in the south of the Study Area, and where the 11kV power line (50m corridor width) is proposed to cross Oaky Creek in the north of the Study Area. The extent of slashing would be minimal given the vegetation is located within the topographically low areas.

A comprehensive rehabilitation plan incorporating progressive revegetation of the final landform to a combination of pasture, open woodland with scattered trees, and a system of interconnecting native vegetation/fauna habitat corridors, is proposed.

It is proposed to provide offsets for the residual impacts on native vegetation communities and threatened species. These will be within a proposed Biodiversity Offset Area to be established along the eastern side of the Study Area along the upper slopes of the Mograni Range, and calculations of the required offsets have been made using the BioBanking Calculator Version 2.

With the proposed adoption of avoidance, minimisation and mitigation measures; the proposed extensive rehabilitation of the final landform to provide woodland and native vegetation corridors; and the proposed establishment of a substantial Biodiversity Offset Area for residual impacts, the Proposal is expected to have a very minor impact on local biodiversity, native vegetation and threatened species. Substantial improvement in connectivity of local vegetation patches will be achieved in the longer-term through the revegetation proposed within the Biodiversity Offset Area and through the progressive revegetation of the disturbance area as mining is completed.

1. INTRODUCTION

Gloucester Resources Limited (GRL) is proposing to develop and operate a small scale open cut coal mine and associated facilities ("the Proposal") between 3.5km and 7km southeast of Gloucester urban area. The Proposal would be carried out within an area referred to as "the Site". This report examines the potential impacts on terrestrial biodiversity relating to the proposed mine and associated facilities within the approximately 856ha Site. **Figure 1** shows the location of the Study Area within the Study Locality and **Figure 2** shows the Site within the Study Area boundary.

This report has been prepared at the request of R W Corkery & Co. Pty Ltd on behalf of Gloucester Resources Limited.

For the purposes of this assessment:

- the *Potential Open Cut Mine Impact Area* is defined as the land area that could be directly affected by the Proposal and includes the Mine Area, Overland Conveyor Corridor, Rail Load-out Facility and two Power Line Corridors;
- the *Study Area* for this report, consists of the *Potential Open Cut Mine Impact Area*; the immediately surrounding land and watercourses that could potentially be affected directly or indirectly by the Proposal and vegetated lands that could potentially be suitable to provide offsets for lands to be impacted; and
- the *Study Locality* for this report, is the area of land within a 10km radius of the centre of the Study Area.

Within this report, reference is given to the relevant sections of the:

- *NSW Threatened Species Conservation Act 1995* (TSC Act);
- *NSW National Parks and Wildlife Act 1974* (NP&W Act);
- *NSW Environmental Planning and Assessment Act 1979* (EP&A Act);
- *NSW State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44);
- *Noxious Weeds Act 1993*; and
- *NSW Native Vegetation Act 2003* (NV Act) and subsequent amendments to these.

The general objectives of this assessment are to address the Biodiversity Impact Assessment requirements of the DP&I and OEH for the Rocky Hill Coal Project as presented in the Director-General's Requirements, and consider and appropriately address those relevant matters in the correspondence from other agencies and stakeholders.

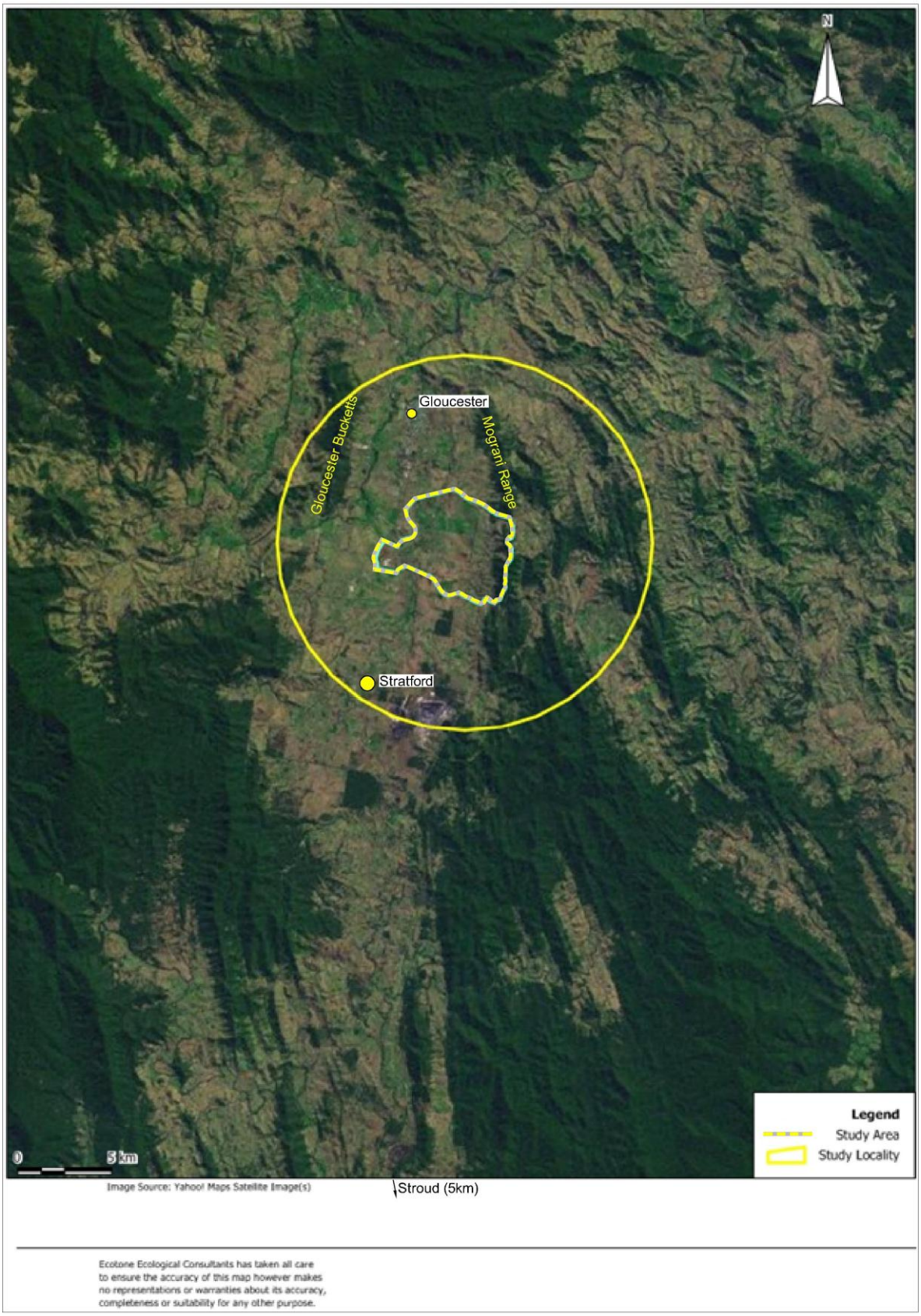

Figure 1 Study Area and Study Locality

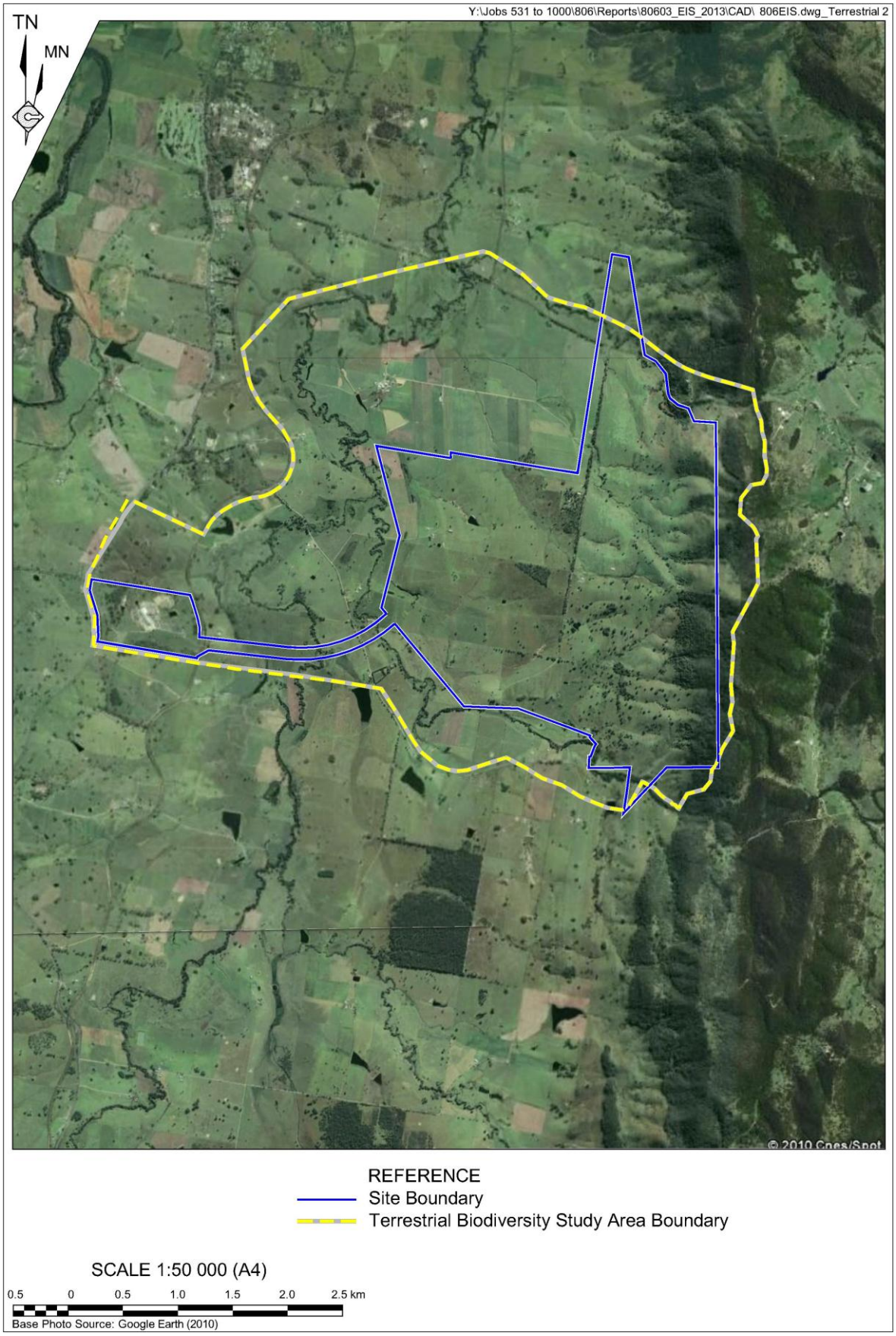

Figure 2 Terrestrial Biodiversity Study Area

The ecological studies have been conducted in four stages.

1. Desktop reviews of available terrestrial biodiversity literature and databases pertaining to the Study Area and surrounding Study Locality.
2. General and targeted field surveys of flora and fauna within the entire Study Area.
3. Assessment of the significance of impact on terrestrial biodiversity and particularly on threatened flora and fauna, as a result of the Proposal, in accordance with the relevant NSW legislation and planning instruments.
4. Identification and evaluation of measures that should be adopted as part of the Proposal to avoid, minimise and mitigate potential adverse effects on terrestrial biodiversity within the proposed area of disturbance and on the location and suitability of other parts of the Study Area to provide biodiversity offsets for residual impacts.

1.1 GENERAL DESCRIPTION OF THE STUDY AREA

The Study Area used for the terrestrial biodiversity assessment comprises approximately 2 030ha of land centred approximately 5km southeast of Gloucester, NSW and approximately 5 km to the northeast of Stratford, incorporating:

- part of Exploration Licence 6523; and
- surrounding land potentially impacted or potentially suitable for offsets.

A broad description of the prominent natural and developed features of the Study Locality and the Study Area is provided in **Table 1**. The location and extent of the Study Area and Potential Impact Areas are shown in **Figure 2**.

Table 1
Description of the Study Locality and Study Area

Page 1 of 2

Client	R.W. Corkery & Co Pty Limited on behalf of Gloucester Resources Limited.
Study Locality	
Location	Southeast of the town of Gloucester and east of The Bucketts Way. 1:100 000 map sheets - 9233 Dungog & 9333 Bulahdelah
LGA	Gloucester
Zoning	RU1 and E3 (Gloucester LEP 2010)
Bioregion	NSW North Coast
Botanical subregion	North Coast
Local Catchment Management Authority	Hunter-Central Rivers CMA
Geology	Late Permian Coal Measures-Gloucester Basin
Elevation	Mostly around 105m AHD but rising to the east to 460m AHD on the ridge tops.

Table 1 (Cont'd)
Description of the Study Locality and Study Area

Study Area	
Location	The proposed mine will be developed within the central part of the 2 030ha parcel of land comprising the Study Area Approximate centre of Study Area: 56H 403000 E 6452000 N (WGS84)
Broad habitat description	The Study Area encompasses an area of approximately 2 030ha mostly on gently undulating land within the Avon River and Waukivory Creek valleys but extending to the top of the ridge of the ranges to the east. The Study Area is predominantly cleared and most land has been converted to open pasture. Minor remnants of natural vegetation remain as small islands and individual isolated trees occur in some parts of the cleared pasture. The remnants of natural vegetation vary significantly in condition and in the extent of thinning of the tree layer and clearing of the shrub and ground layers. These range from an entirely intact community to a thinned stand of trees with the tree and shrub layers entirely removed and converted to pasture. A corridor of remnant natural vegetation occurs in the road reserve along both sides of McKinleys Lane. A few farm houses with gardens occur within the Study Area, as well as sheds and farm infrastructure such as stockyards.
Current land use	The current predominant use of the Study Area is cattle grazing (beef and dairy).
Watercourses, drainage and catchment	The Study Area is drained by ephemeral drainage lines that drain into Waukivory Creek, Oaky Creek or directly into the Avon River. The Avon River flows into the Gloucester River to the north of the Study Area. Several farm dams occur on drainage lines or shallow drainage lines within the Mine Area, and some small wet soak / wetland areas occur where drainage is impeded along drainage lines at the southern end of the Study Area.
Significant features	The vegetation along McKinleys Lane is a Significant Roadside Area according to Gloucester Shire Council. Small remnant patches of rainforest vegetation also occur near the southeastern end of the Disturbance Area and more extensively in the drainage lines along the eastern side of the Study Area
Surrounding land use	The Study Area is surrounded by similar farming and grazing land to the south and west. Steep forested slopes and hills occur along the Mograni Range, to the immediate east of the Study Area. The foothills of this range extend into the eastern part of the Study Area. A new housing subdivision which is currently being developed occurs to the immediate north of the Study Area, and the town of Gloucester occurs a short distance to the northwest.

1.2 DESCRIPTION OF THE PROPOSAL

The proposed Rocky Hill Coal Project comprises four principal components (**Figure 3**) namely:

1. four separate and/or contiguous open cut pits and a coal handling and preparation plant (CHPP) within the Mine Area;
2. an overland conveyor for transporting product coal to the Rail Load-out Facility. The overland conveyor is located within a 50m wide Overland Conveyor Corridor;
3. a Rail Load-out Facility (incorporating a rail loop and two coal storage bins); and
4. two Power Line Corridors incorporating a re-located 132kV power line and a new 11kV power line external to the Mine Area.

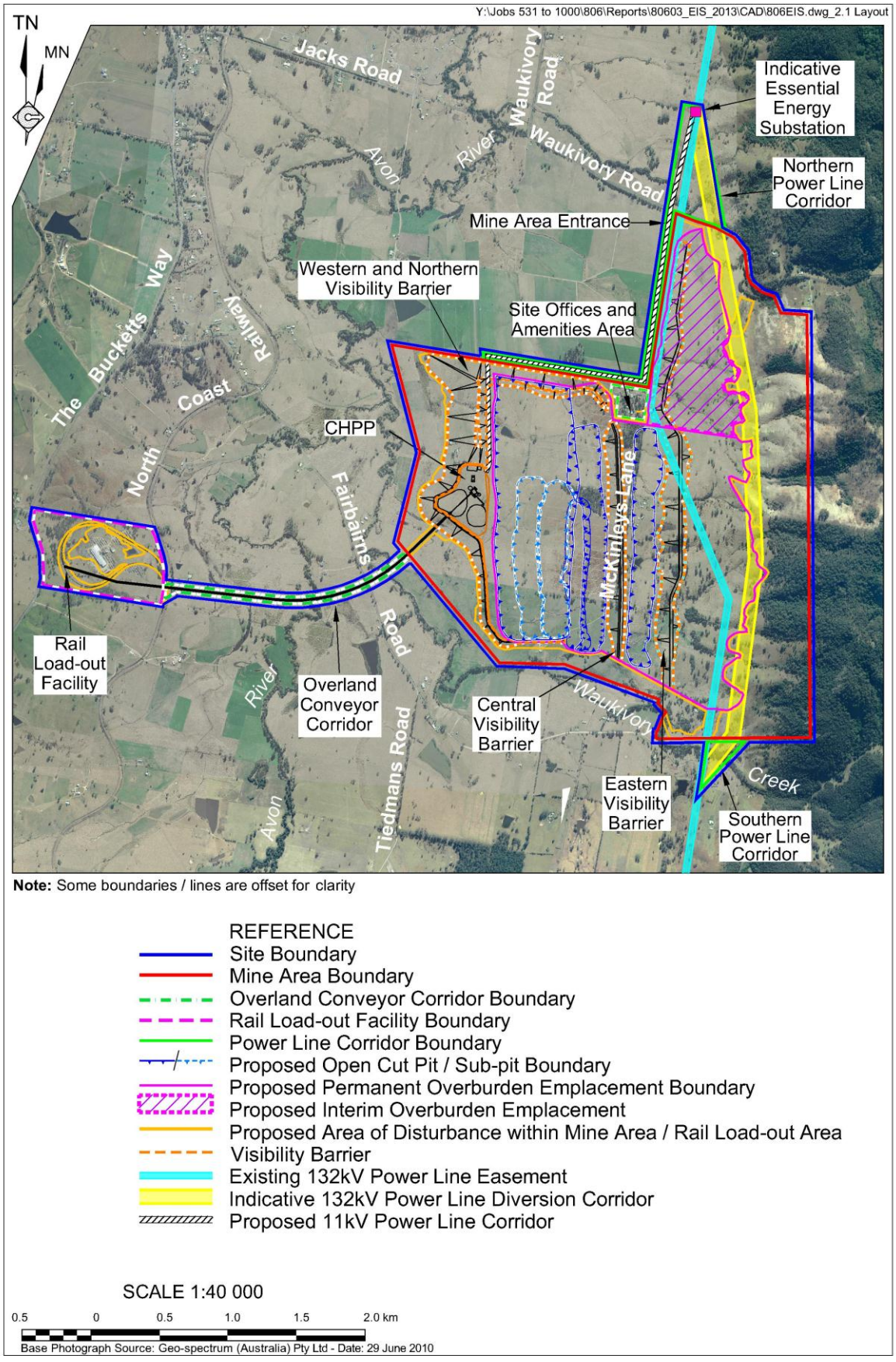

Figure 3 Rocky Hill Coal Project

Figure 4 displays the conceptual layout of the proposed Mine Area comprising the following major components.

- The mine entrance off McKinleys Lane, approximately 50m beyond the intersection of Waukivory Road.
- A private Mine Area access road to the site offices and amenities area, a road aligned generally parallel to and immediately east of the McKinleys Lane reserve.
- A site offices and amenities area off McKinleys Lane.
- Four open cut pits varying in depth from approximately 70m to approximately 190m with mining within the limits of the Main Pit initially involving the development of two smaller, shallower sub-pits to enable some production of the highest quality coals during the initial years of mining. Though based on current mine planning, the depths nominated are approximate given the steeply dipping nature of the seams and the extent of geological knowledge and, in such situations, the potential effects of changes in controlling economic factors. The ultimate depths of development in each open cut pit would reflect the optimisation of coal quality, the outcomes of detailed mine planning as the mine progresses and market factors.
- Three generally north-south trending short term or long term visibility barriers. The barriers would either be stand-alone structures or comprise the western margins of the out-of-pit emplacement as it is progressively developed.
- A consolidated in-pit overburden emplacement and out-of-pit interim and final overburden emplacement extending beyond the open cut pits.
- A coal handling and preparation plant (CHPP) with associated run-of-mine (ROM) and product stockpile areas, a switchyard, workshop and ancillary buildings.
- A 3.7km section of re-located 132kV power line and a new 11kV power line providing power for the mine's operations. The remaining sections of the re-located 132kV power line together with the 11kV power line providing power for the mine operations lie external to the Mine Area within the defined Power Line Corridors.

Figure 5 displays the proposed layout of the Rail Load-out Facility identifying the location of the rail loop, spoil emplacement, surge bin and train load-out bin.

The Rocky Hill Coal Mine would involve the following principal operational components and activities.

- Approximately 130 million bank cubic metres (bcm) of overburden and interburden would be removed to gain access to the targeted coal seams within the individual open cut pits. The overburden would be removed by a combination of scrapers, and excavators and trucks following blasting, and be used to create visibility barriers initially, with the remainder emplaced in, out of, or over the mined out pits either permanently or temporarily and used to form the final landform.
- The coal exposed in each open cut pit would be removed by excavator and transported by haul truck to the ROM coal stockpile adjacent to the CHPP. The maximum ROM coal production rate for which approval is sought would be 2.5 million tonnes per annum (Mtpa).

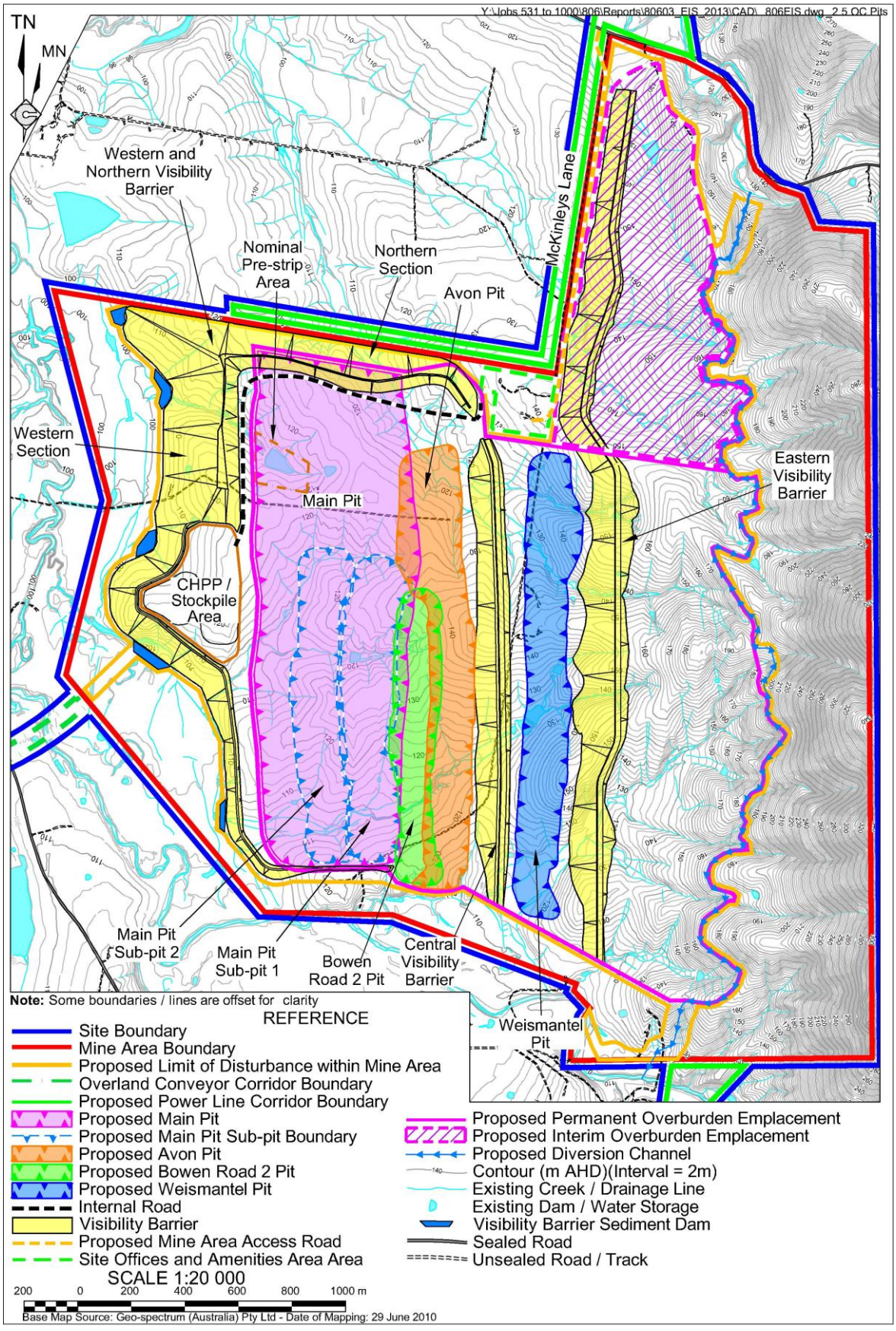

Figure 4 Proposed Mine Area

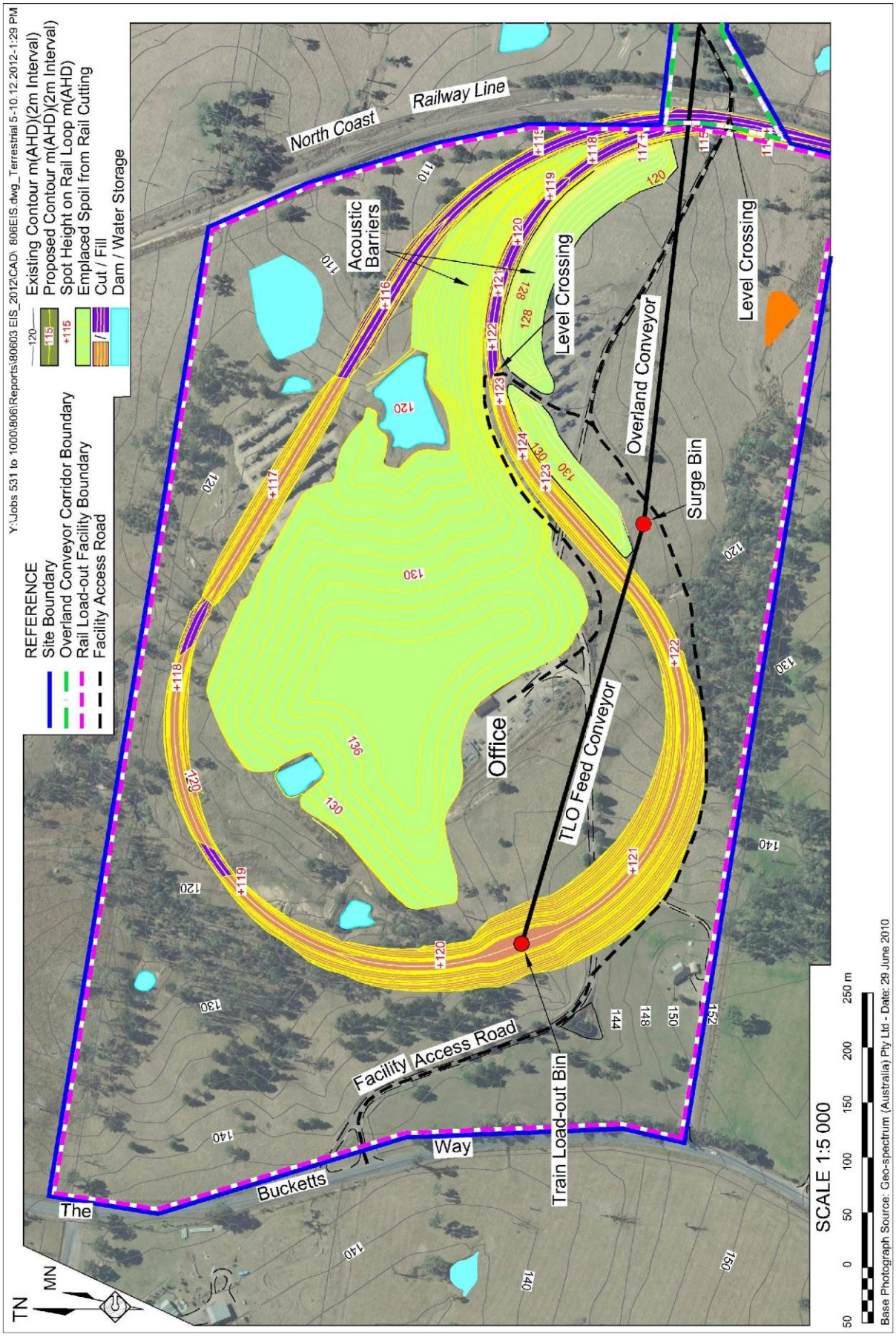

Figure 5 Proposed Rail Load-out Facility

- Processing of all ROM coal at the CHPP. At the maximum ROM coal production rate for which approval is sought and an estimated peak yield (i.e. product coal as a percentage of ROM coal processed through the CHPP) of 70%, 1.75Mtpa of product coal would be produced.
- Transportation of product coal via the overland conveyor to the Rail Load-out Facility where it would be loaded on trains for despatch to the Port of Newcastle.
- Other ancillary activities, including clearing, stripping of topsoil and suitable subsoil from the areas to be disturbed, equipment maintenance and rehabilitation.
- A 267ha Biodiversity Offset Area on Company-owned land east of the proposed area of disturbance within the Mine Area.

A range of rehabilitation procedures would be adopted throughout the life of the mine to achieve the objectives set out in Section 2.15.2 of the EIS. These procedures relate to:

- short-term stabilisation/temporary rehabilitation of interim landforms, e.g. visibility barriers and the interim out-of-pit emplacement;
- long-term stabilisation of final landforms to be returned to grazing or passive nature conservation; and
- re-establishment of native vegetation for habitat and corridor purposes.

The establishment of pasture on the nominated sections of the Mine Area would be undertaken following the final shaping of the landform and the respreading of in the order of 0.85m of subsoil and 0.15m of topsoil. The pasture mix would be applied with a fertiliser using conventional farm equipment.

The establishment of the areas of open woodland with a pasture understorey which would be suitable for a grazing land use, and of native vegetation which would in time form fauna habitat and provide wildlife corridors suitable for fauna between the habitat in the northern part of McKinleys Lane and the proposed Biodiversity Offset Area. These potential corridors are displayed in **Figure 6** and would be achieved by a combination of direct seeding and seedling planting programs, preferentially using seed collected from within and immediately surrounding the Site. A sterile cover crop would be sown within the areas to be re-established with native vegetation without fertiliser to stabilise the surface whilst the native seed mix propagates and flourishes.

The Applicant also proposes to establish tree lots within the areas returned to pasture which would ultimately provide shade for grazing stock, i.e. similar to the existing landscape within the Mine Area. The principal shade trees would be as follows:

- Northern grey ironbark (*Eucalyptus siderophloia*).
- Grey gum (*Eucalyptus punctata*).
- White mahogany (*Eucalyptus acmenoides*).
- White stringybark (*Eucalyptus globoidea*).
- Broad-leaved apple (*Angophora subvelutina*).

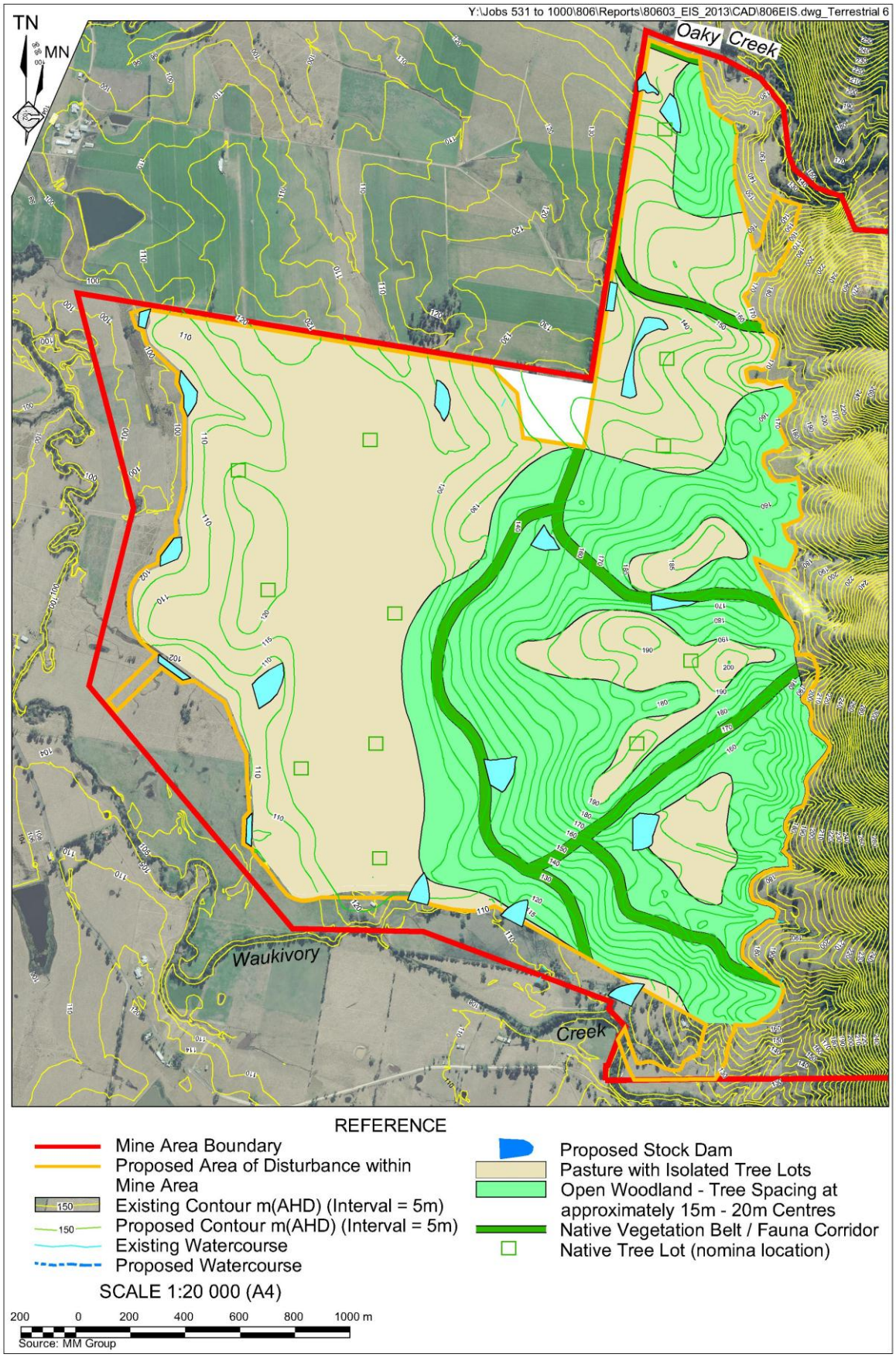

Figure 6 Proposed Rehabilitation Plan

The native vegetation areas would incorporate a selection of the following species.

- Northern grey ironbark (*Eucalyptus siderophloia*)
- Blackthorn (*Bursaria spinosa*)
- Red ironbark (*Eucalyptus fibrosa*)
- Prickly moses (*Acacia ulicifolia*)
- Grey gum (*Eucalyptus punctata*)
- Green wattle (*Acacia irrorata*)
- White mahogany (*Eucalyptus acmenoides*)
- Prickly shaggy pea (*Podolobium ilicifolium*)
- Grey box (*Eucalyptus moluccana*)
- Mock olive (*Notelaea longifolia*)
- Cabbage gum (*Eucalyptus amplifolia*)
- Narrow-leaved orangebark (*Maytenus silvestris*)
- White stringybark (*Eucalyptus globoidea*)
- Prickly beard heath (*Leucopogon juniperinus*)
- Broad-leaved apple (*Angophora subvelutina*)
- Falcate wattle (*Acacia falcata*)
- Spotted gum (*Corymbia maculata*)
- Hairy clerodendrum (*Clerodendrum tomentosum*)
- Blackwood (*Acacia melanoxylon*)
- Coffee bush (*Breynia oblongifolia*)
- Turpentine (*Syncarpia glomulifera*)
- Narrow-leaved geebung (*Persoonia linearis*)
- Forest oak (*Allocasuarina torulosa*)
- Common hop bush (*Dodonaea triquetra*)
- Sticky hop bush (*Dodonaea viscosa* subsp. *angustifolia*)
- Blue flax lily (*Dianella caerulea*)
- Spreading flax lily (*Dianella revoluta*)

The corridors and tree lots would be fenced to limit/prevent grazing by native animals and stock. In the longer term, the tree lots could be grazed whereas the corridors would not be grazed. The areas of open woodlands would initially be grazed in short duration programs to promote growth of the grasses until the trees are sufficiently advanced to support sustained longer term grazing.

Rehabilitation monitoring would be conducted in accordance with an approved monitoring plan. Monitoring would focus on the presence and magnitude of erosion, vegetation cover, weed propagation, strike rate and plant growth (for native vegetation). The performance indicators to be monitored and the frequency of monitoring would be specified in the MOP and Visibility Management Plan.

The Applicant's commitment to effective rehabilitation would involve an ongoing maintenance program arising from the results of the monitoring program. This would include re-seeding and re-topsoiling and/or the application of mulch if monitoring identifies deficiencies in rehabilitated areas. Drainage controls would also be maintained. Appropriate weed eradication methods and programs would be undertaken, as required.

The Applicant intends to maximise the use of the land within its ownership for agricultural purposes throughout the life of the mine and after the Site is rehabilitated. This would be achieved through the following practices.

1. All land owned by the Applicant beyond the boundary of the Site would continue to be used for cattle grazing. The Applicant has negotiated a range of agreements with the former land owners and others to allow cattle grazing, dairying fodder production and, in the case of the adjacent Speldon Partnership dairy, an extension of dairying operations etc. to continue during the life of the Proposal.
2. All manageable parcels of land within the Site beyond the proposed areas of disturbance during the first 2 years of operations would continue to be used for grazing purposes. Beyond the end of the first 2 years, the land used for grazing would be progressively reduced until about the end of the fourth year.
3. The rehabilitated land within the Mine Area to be returned to a grazing land use would be allowed to regenerate for a period of at least 3 years before cattle would be re-introduced onto that land. The re-introduction of cattle would invariably be limited in the first instance to high intensity, short duration programs which would avoid selective grazing which may affect the botanical composition of the sward, prevent the formation of rank, stemmy growth and assist in the maintenance of a diverse and extensive ground cover.

The native vegetation areas to be established would serve both as habitat and corridors for native fauna, while the scattered individual or groups of trees across the final landform would provide shade for stock and enhance the aesthetics of the area through the expansion of an open woodland.

1.3 DIRECTOR-GENERAL'S REQUIREMENTS

The NSW Department of Planning and Infrastructure Director-General's Requirements (DGRs) for the Environmental Impact Statement and the additional matters raised by other agencies and stakeholders for the proposed Rocky Hill Coal Mine, were issued on 24 April 2012.

Those parts of the DGRs and Agency Stakeholder Comments that are relevant to terrestrial biodiversity are listed in **Table 2,** along with a listing of those sections of this report that address each requirement relevant to biodiversity.

In accordance with the Environment Protection Authority and the Office of Environment and Heritage requirements, the Applicant has selected the option of Scenario 2 to assess biodiversity impacts from the Proposal. The BioBanking Assessment Methodology (BBAM) was used within this scenario as an objective method to quantify the type and extent of offsets that would be required (based on ecosystem credits alone) as a result of the residual impacts due to the Proposal. A formal BioBanking Statement is not being sought.

Table 2
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
	BIODIVERSITY	
DP&I (24/04/12)	The EIS must address the following specific issues: including:	
	• measures taken to avoid, reduce or mitigate impacts on biodiversity	Section 4.2.2, Step 4
	• accurate estimates of proposed vegetation clearing;	Table 16
	• a detailed assessment of potential impacts of the development on any:	
	– terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; and	Section 4 Section 4.2.6
	– regionally significant remnant vegetation, or vegetation corridors.	Section 2.3 Section 4.3.2
	• a comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term;	Section 5
EPA (02/04/12)	Biodiversity impacts can be assessed using **either** the BioBanking Assessment Methodology (Scenario 1) or a detailed Biodiversity Assessment (Scenario 2). The BioBanking Assessment Methodology can be used either to obtain a BioBanking statement or to assess impacts of a proposal and to determine required offsets without obtaining a statement. In the latter instances, if the required credits are not available for offsetting, appropriate alternative options may be developed in consultation with the Office of Environment and Heritage (OEH) and in accordance with OEH policy. The requirements for **Scenario 1** (2 and 2a only) and for all of Scenario 2 are detailed in the following sections.	
	Scenario 1 Where the BioBanking Assessment Methodology is being used to assess impacts of a proposal and to determine required offsets, and a BioBanking Statement is not being obtained, the EIS should contain a detailed biodiversity assessment and all components of the assessment must be undertaken in accordance with the *BioBanking assessment Methodology and Credit Calculator Operation Manual* (DECCW, 2008).	Section 5

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	The EIS should include a specific Statement of Commitments which:	
	• is informed by the outcomes of the proposed BioBanking assessment offset package;	Sections 1.2, 5.5
	• sets out the ecosystem and species credits required by the BioBanking Assessment Methodology and how these ecosystem and/or species credits will be secured and obtained;	
	• if the ecosystem or species credits cannot be obtained, provides appropriate alternative options to offset expected impacts, noting that an appropriate alternative option may be developed in consultation with OEH officers and in accordance with OEH policy;	Not applicable for ecosystem credits Species credits species have been assessed under Scenario 2
	• demonstrates how all options have been explored to avoid red flag areas;	Section 5.5
	• includes all relevant BioBanking files (e.g. *xml output files), data sheets, underlying assumptions (particularly in the selection of vegetation types from the vegetation types database), and documentation (including maps, aerial photographs, GIS shape files, other remote sensing imagery, etc. [as per **Attachment 3**] to ensure that OEH can conduct an appropriate review of the assessment.	Appendix 6, electronic submission of files to OEH
	Scenario 2 The EIS should include a detailed biodiversity assessment, including assessment of impacts on threatened biodiversity, native vegetation and habitat. This assessment should address the matters included in the following sections.	
	A field survey of the site should be conducted and documented in accordance with relevant guidelines, including:	
	• the *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians* (DECCW, 2009)	Section 3.2.1
	• *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004), and	Section 3
	• Threatened species survey and assessment guideline information on www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm .	Section 3

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	Recent (less than five years old) surveys and assessments may be used. However, previous surveys should not be used if they have: • been undertaken in seasons, weather conditions or following extensive disturbance events when the subject species are unlikely to be detected or present, or • utilised methodologies, survey sampling intensities, timeframes or baits that are not the most appropriate for detecting the target subject species. Unless these differences can be clearly demonstrated to have had an insignificant impact upon the outcomes of the surveys. If a previous survey is used, any additional species listed under the TSC Act since the previous surveys took place, must be surveyed for.	Section 3
	Determining the list of potential threatened species for the site must be done in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004) and the *Guidelines for Threatened Species Assessment* (Department of Planning, July 2005). The OEH Threatened Species website http://www.environment.nsw.gov.au/threatenedspecies/ and the *Atlas of NSW Wildlife* database must be the primary information sources for the list of threatened species present. The BioBanking Threatened Species Database, the Vegetation Types databases (available on DECCW website at http://www.environment.nsw.gov.au/biobanking/biobankingtspd.htm and http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm respectively) and other data sources (e.g. PlantNET, On line Zoological Collections of Australian Museums (http://www.ozcam.org/, previous or nearby surveys, etc.) may also be used to compile the list.	Section 3 Appendices 4 & 5
	OEH would expect all communities (forested and non-woody/grassy native vegetation communities (albeit with varying levels of anthropogenic disturbance), which include derived grasslands) to be adequately sampled and assessed, including the application of an appropriate offset strategy that compensates for the loss of all impacted habitats.	Figure 7 Section 4 Section 5.2
	OEH notes the following known and/or predicted threatened species (based on OEH *Atlas of NSW Wildlife* database, vegetation mapping and potential habitat) which have broad habitat matches to that of the site occur on or areas nearby (approx. 10-20 km radius) to the Proposal. These should be targeted during surveying (but not be limited to just these):	
	FLORA	
	Trailing woodruff *(Asperula asthenes)** - flowers and fruits in spring (Thompson 2009); fruits are required to separate genera *Asperula* and *Galium* (Harden, 1992).	Section 2.1.1.1, Table 3, Appendix 4

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	**FLORA (Cont'd)**	
	White-flowered wax plant *(Cynanchum elegans)** - flowers August to February (-May), with a peak in November; and mature fruits appear between December and May (Benson & McDougall, 1993).	Section 2.1.1.1, Table 3, Appendix 4
	Slaty red gum *(Eucalyptus glaucina)* - flowers from September to November (Brooker & Kleinig, 1999); although locally frequent it is restricted to these areas, where it is known to hybridise with the closely allied red gum - *Eucalyptus tereticornis* (e.g. Taree area). It can be distinguished by its angled (quadrangular) younger branchlets which have persistent angle striations on older growth (K. Hill [RBG] correspondence sent to DECC).	Appendix 4
	Grove's paperbark *(Melaleuca groveana)** - flowers spring (Harden, 2002).	Appendix 4
	Scant pomaderris *(Pomaderris queenslandica):* - flowers in spring - summer (Stanley & Ross, 1986), with buds apparent for many months before flowers open; NPWS (2002) note flowering occurs specifically between October to November.	Section 2.1.1.1, Table 3, Appendix 4
	Rainforest senna (*Senna acclinis)* - flowers spring and summer (Harden, 2002).	Appendix 4
	Magenta lilly pilly *(Syzygium paniculatum)** - flowers December to January *I* March (Harden, 2002, Benson & McDougall, 1998), though mature fruits are required to positively identify this species, which mature in May (Payne, 1997).	Appendix 4
	FAUNA	
	Amphibians	
	Booroolong frog*(Litoria booroolongensis)**	Appendix 5
	Stuttering frog*(Mixophyes balbus)*	Tables 5 & 14, Appendix 5
	Giant barred frog*(Mixophyes iteratus)* - OEH would expect specific targeted searches on this species given that it is known to occur to the south of the Proposal and there is a potential for indirect impacts, especially if there is a proposal for a discharge to waters or a proposal to irrigate mine water in the area.	Section 3.2, Figure 9a and 9b, Tables 5 & 14, Appendix 5
	Reptiles	
	Stephen's banded snake*(Hoplocephalus stephensii)*	Tables 5 & 14, Appendix 5
	Birds	
	Bush stone-curlew (*Burhinus grallarius*)	Section 3.2.7, Table 11
	Gang-gang cockatoo (*Callocephalon fimbriatum*)	Appendix 5
	Glossy black cockatoo (*Calyptorhynchus lathami)*	Tables 4 & 14, Section 4.2.2, Appendix 5
	Spotted harrier (*Circus assimilis*)	Table 4, Table 18, Section 4.2.2,Appendix 5
	Brown treecreeper (*Climacteris picumnus subsp. victoriae*)	Appendix 5
	Barred cuckoo-shrike (*Coracina lineata*)	Appendix 5

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	**Birds (Cont'd)**	
	Varied sittella (*Daphoenositta chrysoptera*)	Tables 6 & 14, Section 4.2.2
	Black-necked stork (*Ephipporhynchus asiaticus*)	Section 2.1.2.1, Tables 4 & 14, Appendix 5
	White-fronted chat (*Epthianura albifrons*)	Appendix 5
	Little lorikeet (*Glossopsitta pusilla*)	Tables 6 & 14, Section 4.2.2, Appendix 5
	Little eagle (*Hieraaetus morphnoides*)	Tables 6 & 14, Section 4.2.2, Appendix 5
	Swift parrot (*Lathamus discolor*)*	Table 14, Section 4.2.2, Appendix 5
	Hooded robin (*Melanodryas cucullata*)	Appendix 5
	Turquoise parrot (*Neophema pulchella*)	Appendix 5
	Barking owl (*Ninox connivens*)	Tables 5, 11 & 14, Sections 3.2.7 & 4.2.2, Appendix 5
	Powerful owl (*Ninox strenua*)	Tables 4, 5, 11 & 14, Sections 3.2.7 & 4.2.2, Appendix 5
	Oliver whistler (*Pachycephala olivacea*)	Appendix 5
	Scarlet robin (*Petroica boodang*)	Appendix 5
	Flame robin (*Petroica phoenicea*)	Appendix 5
	Grey-crowned babbler (*eastern subspecies*) (*Pomatostomus temporalis subsp. temporalis*)	Tables 4, 13 & 14, Sections 3.4.2.1, 4.2.2, 4.3.2 & 5, Appendices 3 & 5, Figure 3
	Rose-crowned fruit-dove (*Ptilinopus regina*)	Tables 5 & 14, Section 4.2.2, Appendix 5
	Wompoo fruit-dove (*Ptilinopus magnificus*)	Tables 13 & 14, Sections 3.4.2.1 & 4.2.2, Appendix 5, Figure 3
	Superb fruit-dove (*Ptilinopus superbus*)	Table 14, Sections 3.4.2.1 & 4.2.2, Appendix 5
	Speckled warbler (*Pyrrholaemus sagittatus*)	Tables 4 & 14, Section 4.2.2, Appendix 5
	Diamond firetail (*Stagonopleura guttata*)	Appendix 5
	Red-backed button-quail (*Turnix maculosa*)	Appendix 5
	Masked owl (*Tyto novaehollandiae*)	Tables 6, 11 & 14, Sections 3.2.7 & 4.2.2, Appendix 5
	Sooty owl (*Tyto tenebricosa*)	Tables 5, 11 & 14, Sections 3.2.7 & 4.2.2, Appendix 5
	Regent honeyeater (*Xanthomyza phrygia*)*	Table 14, Section 4.2.2, Appendix 5

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	**Mammals**	
	Rufous bettong (*Aepyprymnus rufescens*)	Appendix 5
	Eastern pygmy-possum (*Cercartetus nanus*)	Appendix 5
	Large-eared pied bat (*Chalinolobus dwyen*)	Tables 4 & 14, Section 4.2.2, Appendix 5
	Spotted-tailed quoll (*Dasyurus maculatus*) *	Tables 4 & 14, Section 4.2.2, Appendix 5
	Eastern false pipistrelle (*Falsistrellus tasmaniensis*)	Tables 5 & 14, Section 4.2.2, Appendix 5
	Golden-tipped bat (*Kerivoula papuensis*)	Table 5, Appendix 5
	Parma wallaby (*Macropus parma*)	Table 5, Appendix 5
	Little bentwing-bat (*Miniopterus australis*)	Tables 13 & 14, Sections 3.4.2.1 & 4.2.2, Appendices 3 & 5, Figure 3
	Eastern bent-wing bat (*Miniopterus schreibersii* subsp*. oceanensis*)	Tables 13 & 14 Sections 3.4.2.1 & 4.2.2, Appendices 3 & 5, Figure 3
	Eastern free-tail bat (*Mormopterus norfolkensis*)	Table 14, Section 4.2.2, Appendix 5
	Large-footed myotis (*Myotis adversus*)	Tables 13 & 14, Appendices 3 & 5, Figure 3
	Yellow-bellied glider (*Petaurus australis*)	Section 3.2.7, Table 5 & 11, Appendix 5
	Squirrel glider (*Petaurus norfolcensis*)	Sections 3.2.7, 3.4.2.1 & 4.2.2, Table 6, 11, 13 & 14, Appendices 3 & 5, Figure 3
	Brush-tailed rock wallaby (*Petrogale peniciillata*) *	Appendix 5
	Brush-tailed phascogale (*Phascogale tapoatafa*)	Tables 4 & 14, Section 4.2.2, Appendix 5
	Koala (*Phascolarctos cinereus*)	Tables 4, 5 & 11, Sections 3.4.2.2 & 4.2.4, Appendix 5
	Common planigale (*Planigale maculata*)	Appendix 5
	Long-nosed potoroo (*Potorous tridactylus*)* only subspecies tridactylus (SE Mainland) is listed on EPBC Act.	Table 5, Appendix 5
	Grey-headed flying-fox (*Pteropus poliocephalus*)*	Table 14, Section 4.2.2, Appendices 3 & 5
	Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)	Tables 6, 13 & 14, Section 4.2.2, Appendices 3 & 5, Figure 3

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	**Mammals (Cont'd)**	
	Greater broad-nosed bat (*Scoteanax rueppellii*)	Tables 4, 5 & 14, Section 4.2.2, Appendix 5
	Red-legged pademelon (*Thylogale stigmatica*)*	Table 5, Appendix 5
	* EPBC Act listed species.	
	The EIS should contain the following information as a minimum:	
	a) The requirements set out in the *Guidelines for Threatened Species Assessment* (Department of Planning, July 2005).	Section 4.2.2
	b) Description and geo-referenced mapping of Study Area (and spatial data files), e.g. overlays on topographic maps, satellite images and /or aerial photos, including details of map datum, projection and zone, all survey locations, all vegetation communities, key habitat features and reported locations of threatened species, populations and ecological communities present in the subject site and Study Area.	Figures 2, 3 & 4
	c) Description of survey methodologies used, including timing, location and weather conditions.	Section 3
	d) Details, including qualifications and experience of all staff undertaking the surveys, mapping and assessment of impacts as part of the EIS.	Appendix 8
	e) Detailed description of all vegetation communities (both forested and non-woody [e.g. derived grasslands], including classification and methodology used to classify) and including all plot data. Plot data should be supplied to the OEH in electronic format (e.g. MS-Excel) and organised by vegetation community;	Section 3.1, Appendix 2
	f) Identification of national and state listed threatened biota known or likely to occur in the Study Area and their conservation status.	Section 2
	g) Description of the likely impacts of the Proposal on biodiversity and wildlife corridors, including direct and indirect and construction and operation impacts. Wherever possible, quantify these impacts such as the amount of each vegetation community or species habitat to be cleared or impacted, or any fragmentation of a wildlife corridor. The Proposal should provide an assessment of the cumulative impacts of the Proposal in relation to other nearby developments, such as (but not limited to) Stratford Coal Extension Project, AGL Coal Seam Gas Projects and various exploratory activities. .	Section 3 Section 4.4
	h) Identification of the avoidance, mitigation and management measures that will be put in place as part of the Proposal to avoid or minimise impacts, including details about alternative options considered and how long term management arrangements will be guaranteed.	Section 3

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	i) Description of the residual impacts of the Proposal. If the Proposal cannot adequately avoid or mitigate impacts on biodiversity, then a biodiversity offset package is expected.	Section 5
	j) Provision of specific Statement of Commitments relating to biodiversity.	EIS Section 6
	An assessment of the significance of direct and indirect impacts of the Proposal must be undertaken for threatened biodiversity known or considered likely to occur in the Study Area based on the presence of suitable habitat. This assessment must take into account:	
	a) the factors identified in s.5A of the EP&A Act, and	Section 3
	b) the guidance provided by *The Threatened Species Assessment Guideline - The Assessment of Significance (DECCW, 2007).*	Section 3
	Where an offsets package is proposed by an Applicant for impacts to biodiversity (and a BioBanking Statement has not been sought) this package should:	
	a) Meet OEH's *Principles for the use of biodiversity offsets in NSW,* which are available at: www.environment.nsw.gov.au/biocertification/offsets.htm	Section 5
	b) Identify the conservation mechanisms to be used to ensure the long term protection and management of the Biodiversity Offset Area.	Section 5
	c) Include an appropriate Management Plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features within the development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.	Section 5
	With respect to managing and conserving a proposed offset in perpetuity, OEH considers and supports the following as appropriate conservation mechanisms: • The establishment of biobanking sites with biobanking agreements under the *Threatened Species Conservation Act 1995* (TSC Act); • The dedication of land under the *National Parks and Wildlife Act* 1974 (NPW Act); • A Conservation Agreement under the NPW Act; • A Trust Agreement under the *Nature Conservation Trust Act 2001*; or • A Planning Agreement under s 93F of the *Environmental Planning and Assessment Act 1979*.	Section 5

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
EPA (02/04/12) (Cont'd)	Where appropriate, likely impacts (both direct and indirect) on any adjoining and/or nearby OEH estate reserved under the *National Parks and Wildlife Act 1974* or any marine and estuarine protected areas under the *Fisheries Management Act 1994* or the *Marine Parks Act 1997* should be considered. Please refer to the Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010). The OEH notes The Glen Nature Reserve is located just to the east *I* southeast of the Proposal, and as such any direct or indirect impacts need to be documented and assessed.	Section 2.4
	With regard to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the assessment should identify and assess any relevant Matters of National Environmental Significance and whether the Proposal has been referred to the Commonwealth or already determined to be a controlled action.	Section 1.4
Great Lakes Council (30/03/12)	Habitat offsetting requirements for clearing of remnant vegetation on the site and disruption of corridors should consider the procurement of offsets in the local area which contribute to the "Tops to Lakes" corridor linkage. Any approval should ensure offsetting benefits the local environment and contributes to work already underway to improve habitat linkages.	Section 2.3 Section 5
Hunter-Central Rivers Catchment Management Authority (11/03/12)	Initial reports indicate up to 25ha of intact native vegetation will be required to be removed to allow mining operations. Where native vegetation is to be cleared, it should be adequately off-set with the offsets determined using a State accepted methodology such as Biobanking or otherwise consistent with the Improve or Maintain principle of the *Native Vegetation Act*. Off-sets should be listed on the land title in perpetuity and accompanied by sufficient resources to provide for on-going management. The EIS should address the full extent of native vegetation removal and address offsets based on the above principles.	Section 5
NSW Division of Resources and Energy (04/04/12)	The flora, fauna and ecological attributes of the disturbed area should be recorded and placed in a regional context.	Section 3 Table 10 Table 16

Table 2 (Cont'd)
Coverage of DGRs and Additional Matters

Government Agency	Paraphrased Requirement	Relevant Section(s)
DGRs Attachment 1. Technical and Policy Guidelines EPA Attachment 2 Guidance Materials	Take into account the following guidelines (as applicable).	
	• *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECCW 2009)*	Section 2
	• *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC, 2004)*	Section 2
	• *The Threatened Species Assessment Guideline - The Assessment of Significance (DECCW, 2007).*	Section 4.2.3
	• *Guidelines for Threatened Species Assessment (DoP 2005)*	Section 4.2.2
	• *BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECCW 2008)*	Section 5
	• *NSW State Groundwater Dependent Ecosystem Policy (DLWC)*	Section 4.2.6
	• *State Environmental Planning Policy No. 44 – Koala Habitat Protection*	Section 4.2.5

1.4 REQUIREMENTS UNDER THE COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was gazetted in 2000 and focuses Commonwealth interests on matters of National Environmental Significance (NES) including integrated biodiversity conservation and the management of important protected areas. The Act also establishes a streamlined environmental assessment and approvals process.

The matters of NES which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage properties
- National Heritage places
- RAMSAR wetlands
- Nationally threatened species and ecological communities and migratory species
- Commonwealth Marine areas
- Nuclear actions (including uranium mining)

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities. For certain projects, the Commonwealth accredits the NSW process of assessment of environmental impact for the purposes of the EPBC Act, provided that the assessment has been done in accordance with an agreed process.

For the purposes of this report, the matters of NES that are potentially relevant to the Proposal are nationally listed threatened and migratory fauna species.

A Referral under the EPBC Act was submitted to DSEWPaC on 5 April 2012 and it was determined on 11 May 2012 that the proposed Rocky Hill Coal Mine was not a Controlled Action under the EPBC Act. No further assessment under the EPBC Act is therefore required and no consideration of Commonwealth Matters of NES is presented within this assessment report.

2. REVIEW OF DATABASES AND LOCAL STUDIES

2.1 REVIEW OF THREATENED AND OTHER SIGNIFICANT SPECIES RECORDS AND PREDICTED OCCURRENCES WITHIN THE STUDY LOCALITY

2.1.1 Previous Local Ecological Studies

Reviews of the documented records and predicted occurrences of threatened and significant flora and fauna species within the Study Locality were undertaken. Records were initially accessed from the NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife database with a search area of 10km radius from the centre of the Study Area, in 2009 prior to the field surveys, and the records have been updated to 10 August 2012 for this Terrestrial Biodiversity Assessment report. Additional records of threatened flora and fauna species were obtained from ecological surveys and assessment reports previously undertaken in the Study Locality. Additional species considered to have potential to occur in the Study Locality were also identified.

Previous documents that were reviewed for terrestrial biodiversity information comprised:

- Flora and Fauna Surveys and Fauna Impact Statement (FIS) for Timber Harvesting within Terreel (Ecotone Ecological Consultants Pty Ltd, 1994)
- EIS for the Stratford Coal Project (Stratford Coal, 1994)
- Supporting Documents for the Gloucester-Chichester Management Areas EIS (State Forests of NSW, 1995)
  - Supporting Document No. 4 Flora Surveys (State Forests of NSW, 1995)
  - Supporting Document No. 5 Fauna Surveys (Ecotone Ecological Consultants, 1995)
  - Supporting Document No. 6 Bat Fauna Survey (Applied Bat Research Australia, 1992)
  - Supporting Document No. 7 Frog Survey (Biosphere Environmental Consultants, 1994)
- EIS for the Bowens Road North Project (Resource Strategies, 2001)
- Gloucester Gas Project Environmental Assessment, AGL, (AECOM 2009)
- Gloucester Coal Seam Gas Project, Pilot Well Sites and Water Monitoring Site, Ecological Assessment AGL Upstream Investments (Alison Hunt & Associates, March 2011)

2.1.2 Threatened and Significant Flora Species Previously Recorded within the Study Locality from the Atlas of NSW Wildlife

From the data review, a total of four threatened flora species have previously been recorded within the Study Locality. These are listed in **Table 3**. Two of these species are listed as endangered under the NSW TSC Act (*Cynanchum elegans* and *Pomaderris queenslandica*) and two as vulnerable (*Asperula asthenes* and *Eucalyptus glaucina*). Three of these species are listed under the national database known as ROTAP, *Rare or Threatened Australian Plants* (Briggs & Leigh 1996).

Table 3
Atlas of NSW Wildlife Threatened Flora Species Records in the Study Locality

Scientific name	Status (TSC Act)	ROTAP risk code	Earliest-latest record	Number of records within 10km
THREATENED SPECIES				
Asperula asthenes	V	3VC-	1897	2
Cynanchum elegans	E	3ECi	2002	2
Eucalyptus glaucina	V	3VCa	1974	2
Pomaderris queenslandica	E	-	1897	2

Nomenclature follows Harden (1990-1993), Harden & Murray (2000) and subsequent updates as obtained from PlantNET.

Status (TSC Act): V=vulnerable, E=endangered.

ROTAP risk code: 3=Geographic range in Australia greater than 100km, E=Endangered species: in serious risk of disappearing from the wild within 10-20 years if present land use and other threats continue to operate, V=Vulnerable species: not presently endangered, but possibly at risk in future due to continuing depletion or land-use change, C=Reserved: indicates taxon has at least one population within a national park, or other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora, a=1000 plants or more are known to occur within a conservation reserve(s), i= less than1000 plants are known to occur within a conservation reserve(s)-=reserved population size is not accurately known. Relevant flora information collected during previous local studies.

Table 4 lists an additional 10 threatened or significant flora species (mainly ROTAP-listed) that have been recorded by State Forests of NSW (1995) in the Gloucester and Chichester Forestry Management areas, an area which extends up to 50km radius from the Study Area. Species that are restricted to alpine or sub-alpine habitats or clearly unsuitable habitat in relation to the Study Area have been excluded from the list. No rare or threatened flora species additional to those already listed in **Tables 3** and **4** were documented in any of the relevant local studies reviewed.

Table 4
Additional Rare or Significant Flora Species recorded by State Forests of NSW (1995)

Scientific Name	Common Name	Status (TSC)	Other
Acacia barringtonensis	Barrington wattle	-	ROTAP 3RCa
Chiloglottis platyptera	-	V	ROTAP 2KC-
Galium curvihirtum	Tight bedstraw	-	Rare in NSW
Hibbertia hermanniifolia	A guinea flower	-	ROTAP 3RCa
Leptospermum argenteum	A tea tree	-	ROTAP 2RC-
Plantago palustris	-	-	ROTAP 2RC-
Plectranthus suaveolens	Native mint	-	ROTAP 3KC-
Pomaderris helianthemifolia	-	-	Rare in NSW
Prasophyllum sp. A	A leek orchid	-	Rare in NSW
Pterostylis riparia	A greenhood	-	ROTAP 3VCa

V=vulnerable

ROTAP risk code: 2=Geographic range in Australia less than 100km, 3=Geographic range in Australia greater than 100km, V=Vulnerable species: not presently endangered, but possibly at risk in future due to continuing depletion or land-use change, R=Rare species: rare in Australia, but currently without any identifiable threat, K=Poorly known: taxon that is suspected, but not definitely known, to belong to one of the above categories, C=Reserved: indicates taxon has at least one population within a national park, or other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora, a=1000 plants or more are known to occur within a conservation reserve(s), -=reserved population size is not accurately known. Relevant flora information collected during previous local studies.

Few threatened or significant ecological communities have been recorded in the relevant local studies that were reviewed. State Forests of NSW (1995) recorded several rainforest types in the Barrington Tops and Gloucester Tops areas, some of which would constitute the Endangered Ecological Community *Lowland Rainforest* (TSC Act), although this EEC was not listed at the time of that study.

AECOM (2009) recorded the Endangered Ecological Community *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions* (TSC Act) in the Study Area for the Gloucester Coal Seam Gas Project. However, this was only recorded towards the southern end of the project route near Clarence Town, which is approximately 80km south of the Study Area for the Rocky Hill Coal Project.

Threatened Flora Species to be addressed from the DGRs

The DGRs note that the following flora species that have broad habitat requirements matching the habitats of the Site or that occur on areas nearby (approximate 10-20km radius) should be targeted during surveying:

- Trailing woodruff (*Asperula asthenes*)
- White-flowered wax plant (*Cynanchum elegans*)
- Slaty red gum (*Eucalyptus glaucina*)
- Grove's paperbark (*Melaleuca groveana*)
- Scant pomaderris (*Pomaderris queenslandica*)
- Rainforest senna (*Senna acclinis*)
- Magenta lilly pilly (*Syzygium paniculatum*)

The above list includes three additional species (*Melaleuca groveana, Senna acclinis* and *Syzygium paniculatum*) not already listed in **Table 3**.

2.1.3 Summary of Threatened and Significant Flora Species Known or with Potential to Occur in the Study Locality

Based on the combination of review of databases, local studies and the DGRs list, a total of 26 species of rare, threatened or significant flora species are known or have some potential to occur within Study Locality and were targeted in the field surveys of the Study Area, if suitable habitat was present. These species are listed in **Table 5**.

Table 5
Targeted Flora Species in Field Surveys

Acacia fulva	*Eucalyptus rudderi*	*Plectranthus suaveolens*
Acacia barringtonensis	*Galium curvihirtum*	*Pomaderris helianthemifolia*
Asperula charophyton	*Grevillea obtusiflora*	*Pomaderris queenslandica*
Asperula asthenes	*Hibbertia hermanniifolia*	*Prasophyllum sp. A*
Chiloglottis platyptera	*Leionema elatius subsp. elatius*	*Pterostylis riparia*
Cynanchum elegans	*Leptospermum argenteum*	*Eucalyptus glaucina*
Dodonaea megazyga	*Plantago palustris*	*Melaleuca groveana*
Dodonaea rhombifolia	*Plantago cladarophylla*	*Senna acclinis*
Eucalyptus largeana		*Syzygium paniculatum*

All these species are also assessed for consideration as subject species for impact assessment, within **Appendix 4**.

2.1.4 Threatened Fauna Species Previously Recorded within the Study Locality from the Atlas of NSW Wildlife

A total of 17 threatened terrestrial fauna species have previously been recorded within the Study Locality based on the Atlas of NSW Wildlife. These comprise seven species of birds and ten species of mammals (**Table 6**)**.** Of these species, one (Black-necked stork) is listed as endangered and 16 are listed as vulnerable under the NSW TSC Act.

Table 6
Atlas of NSW Wildlife Threatened Fauna Species Records in the Study Locality

Scientific name	Common name	Status (TSC)	Earliest-latest records	Number of records within 10km of Site
BIRDS				
Calyptorhynchus lathami	Glossy black-cockatoo	V	1981 - 2007	2
Chthonicola saggitatus	Speckled warbler	V	1981	1
Circus assimilis	Spotted harrier	V	1988	1
Ephippiorhynchus asiaticus	Black-necked stork	E	1977-2003	15
Ninox strenua	Powerful owl	V	1974	1
Pomatostomus temporalis temporalis	Grey-crowned babbler (eastern subspecies)	V	1981-2010	45
Ptilinopus superbus	Superb fruit-dove	V	2004	1
MAMMALS				
Chalinolobus dwyeri	Large-eared pied bat	V	2003	1
Miniopterus schreibersii oceanensis	Eastern bent-wing bat	V	1970 - 2010	5
Mormopterus norfolkensis	Eastern free-tail bat	V	2003 - 2004	2
Myotis macropus/Myotis adversus	Large-footed myotis	V	2002 - 2006	4
Scoteanax rueppellii	Greater broad-nosed bat	V	2003	1
Dasyurus maculatus	Spotted-tailed quoll	V	1976-2006	8
Petaurus australis	Yellow-bellied glider	V	2003	2
Petaurus norfolcensis	Squirrel glider	V	1988	1
Phascogale tapoatafa	Brush-tailed phascogale	V	1966-2006	5
Phascolarctos cinereus	Koala	V	1949-2006	10

Status (TSC Act): V=vulnerable, E=endangered. Atlas search area centred on 403000 E and 6452000 N for Dungog 9233 and Bulahdelah 9333 1:100 000 mapsheets Zone 56 AGD66.

2.1.5 Relevant Fauna Information Collected during Previous Local Studies and Experience

Table 7 has been compiled from the review of previous studies identified in Section 2.1.1 that have been conducted around the general Study Locality. Any species additional to those which have already been identified in the above database reviews has been considered for assessment where there is some likelihood that the species would be present in the potential impact area.

Table 7
Threatened Fauna Species recorded within the Study Locality during previous local studies

Scientific Name	Common Name	Status (TSC)	Source
Petaurus australis	Yellow bellied Glider	V	Ecotone (1995)
Phascolarctos cinereus	Koala	V	Ecotone (1995)
Hoplocephalus stephensii	Stephens banded snake	V	Ecotone (1994)
Mixophyes balbus	Stuttering frog	E	Ecotone (1994)
Myxophyes iteratus	Giant barred frog	E	Ecotone (1994)
Kerivoula papuensis	Golden tipped bat	V	Ecotone (1994)
Falsistrellus tasmaniensis	Eastern false pipistrelle	V	Ecotone (1994)
Scoteanax rueppellii	Greater broad nosed bat	V	Ecotone (1994)
Macropus parma	Parma wallaby	V	Ecotone (1994)
Thylogale stigmatica	Red legged pademelon	V	Ecotone (1994)
Potorous tridactylus	Long nosed potoroo	V	Ecotone (1994)
Ninox strenua	Powerful owl	V	Ecotone (1994)
Tyto tenebricosa	Sooty owl	V	Ecotone (1994)
Ninox connivens	Barking owl	V	Ecotone (1995)
Ptilinopus regina	Rose-crowned fruit-dove	V	Ecotone (1995)
Litoria brevipalmata	Green thighed tree frog	V	Biosphere (1994)
V=vulnerable, E=endangered			

Table 8 is a list of species that Ecotone Ecological Consultants consider to have the potential to occur in the Study Locality and possibly the Study Area based on local knowledge and experience in the locality.

Table 8
Threatened Fauna Species considered by Ecotone Ecological Consultants to have potential to occur in the Study Area

Scientific Name	Common Name	Status (TSC Act)
Hieraaetus morphnoides	Little eagle	V
Glossopsitta pusilla	Little lorikeet	V
Tyto novaehollandiae	Masked owl	V
Daphoenositta chrysoptera	Varied sittella	V
Petaurus norfolcensis	Squirrel glider	V
Saccolaimus flaviventris	Yellow-bellied sheath-tail bat	V
Litoria aurea	Green and golden bell frog	E
Lophoictinia isura	Square-tailed kite	V
Vespadelus troughtoni	Eastern cave bat	V
Pteropus poliocephalus	Grey-headed flying fox	V

Table 9 identifies the 55 threatened fauna species nominated in the DGRs.

Table 9
Threatened Fauna Species to be addressed from the DGRs

Scientific Name	Common Name
Litoria booroolongensis	Booroolong frog
Mixophyes balbus	Stuttering frog
Mixophyes iteratus	Giant barred frog
Hoplocephalus stephensii	Stephen's banded snake
Burhinus grallarius	Bush stone-curlew
Callocephalon fimbriatum	Gang-gang cockatoo
Calyptorhynchus lathami	Glossy Black cockatoo
Circus assimilis	Spottedharrier
Climacteris picumnus subsp. victoriae	Brown treecreeper
Coracina lineata	Barred cuckoo-shrike
Daphoenositta chrysoptera	Varied sittella
Ephipporhynchus asiaticus	Black-necked stork
Epthianura albifrons	White-fronted chat
Glossopsitta pusilla	Little lorikeet
Hieraaetus morphnoides	Little eagle
Lathamus discolour	Swift parrot
Melanodryas cucullata	Hooded robin
Neophema pulchella	Turquoise parrot
Ninox connivens	Barking owl
Ninox strenua	Powerful owl
Pachycephala olivacea	Oliver whistler
Petroica boodang	Scarlet robin
Petroica phoenicea	Flame robin
Pomatostomus temporalis subsp. temporalis	Grey-crowned babbler (eastern subspecies)
Ptilinopus regina	Rose-crowned fruit-dove
Ptilinopus magnificus	Wompoo fruit-dove
Ptilinopus superbus	Superb F\fruit-dove
Pyrrholaemus sagittatus	Speckled warbler
Stagonopleura guttata	Diamond firetail
Turnix maculosa	Red-backed button-quail
Tyto novaehollandiae	Masked owl
Tyto tenebricosa	Sooty owl
Xanthomyza phrygia	Regent honeyeater
Aepyprymnus rufescens	Rufous bettong
Cercartetus nanus	Eastern pygmy-possum
Chalinolobus dwyen	Large-eared pied bat
Dasyurus maculatus	Spotted-tailed quoll
Falsistrellus tasmaniensis	Eastern false pipistrelle
Kerivoula papuensis	Golden-tipped bat
Macropus parma	Parma wallaby
Miniopterus australis	Little bent-wing bat
Miniopterus schreibersii subsp*. oceanensis*	Eastern bent-wing bat

Table 9 (Cont'd)
Threatened Fauna Species to be addressed from the DGRs

Scientific Name	Common Name
Mormopterus norfolkensis	Eastern free-tail bat
Myotis macropus/Myotis adversus	Large-footed myotis
Petaurus australis	Yellow-bellied glider
Petaurus norfolcensis	Squirrel glider
Petrogale peniciillata	Brush-tailed rock wallaby
Phascogale tapoatafa	Brush-tailed phascogale
Phascolarctos cinereus	Koala
Planigale maculata	Common planigale
Potorous tridactylus	Long-nosed potoroo
Pteropus poliocephalus	Grey-headed flying-fox
Saccolaimus flaviventris	Yellow-bellied sheathtail-bat
Scoteanax rueppellii	Greater broad-nosed bat
Thylogale stigmatica	Red-legged pademelon

2.1.6 Summary of Threatened Fauna Species Known or with Potential to Occur in the Study Locality

From the combination of the database search, literature search and DGRs list, a total of 59 species of fauna, listed under the NSW TSC Act as endangered or vulnerable, have been recorded or have some likelihood of occurring within the Study Locality and have been targeted in the field surveys of the Study Area, if suitable habitat was present. These species are listed in **Table 10**.

Table 10
Threatened Fauna Species Known or with Potential to Occur in the Study Locality (TSC Act)

Glossy black-cockatoo	Rose-crowned fruit-dove	Long-nosed potoroo
Spotted harrier	Superb fruit-dove	Spotted-tail quoll
Square-tailed kite	Little lorikeet	Koala
Little eagle	Varied sittella	Brush-tailed phascogale
Black-necked stork	Speckled warbler	Common planigale
Gang gang cockatoo	Diamond firetail	Brush-tailed rock wallaby
Brown tree-creeper	Red-backed button quail	Rufous bettong
Barred cuckoo-shrike	Swift parrot	Eastern pygmy possum
White-fronted chat	Bush stone-curlew	Yellow bellied glider
Powerful owl	Wompoo fruit-dove	Squirrel glider
Barking owl	Southern/Giant barred frog	Large-eared pied bat
Masked owl	Stuttering frog	Eastern bent-wing bat
Sooty owl	Green thighed tree frog	Little bent-wing bat
Grey-crowned babbler (eastern subspecies)	Green and golden bell frog	Eastern coast free-tail bat
Hooded robin	Booroolong frog	Large-footed myotis
Scarlet robin	Stephens banded snake	Greater broad-nosed bat
Flame robin	Regent honeyeater	Yellow-bellied sheath-tail bat
Turquoise parrot	Grey-headed flying-fox	Eastern false pipistrelle
Olive whistler	Red legged pademelon	Eastern cave bat
	Parma wallaby	Golden tipped bat

All these species are also assessed for consideration as subject species for impact assessment, within **Appendix 5**.

Endangered Populations with Potential to Occur in the Study Locality

Flora

The following endangered populations of flora have been predicted by OEH as having potential to occur within the Dungog (9233) and Bulahdelah (9333) 1:100 000 map sheets and may also occur within the Study Locality, and possibly the Study Area.

- *Leionema lamprophyllum* subsp. *obovatum* population in the Hunter Catchment: occurs in dry eucalypt forest on exposed rocky terrain.

  Cymbidium canaliculatum (Tiger orchid) population in the Hunter Catchment: grows in the hollows of trees in Dry sclerophyll forest or woodland.

- *Acacia pendula* (Weeping myall) population in the Hunter Catchment: within the Hunter catchment the species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations.

- *Eucalyptus camaldulensis* (River red gum) population in the Hunter Catchment: typically occurs on floodplains with *Eucalyptus tereticornis*, *Eucalyptus melliodora*, *Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda*

Since the Study Area lies within the Gloucester River catchment and drains northwards to ultimately flow into the Manning River, it does not coincide with the Hunter Catchment. Therefore, none of these Endangered Populations are relevant to the Study Locality or Study Area.

Fauna

The following endangered populations of fauna have been predicted by the OEH to have potential to occur within the Dungog (9233) and Bulahdelah (9333) 1:100 000 map sheets and may also occur within the Study Locality.

- *Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area*: uses a wide range of habitats but its distribution has been largely reduced on and near the coast since European settlement.

- *Broad-toothed Rat at Barrington Tops in the local government areas of Gloucester, Scone and Dungog*: restricted to sub-alpine swamp complexes and associated grassland and heath at high elevations.

The Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area is largely restricted to the greater Port Stephens area and has not been recorded within 10km of the Study Area on the Atlas of NSW Wildlife. This species is not expected to occur in the Study Area.

The Broad-toothed rat is restricted to sub-alpine swamp complexes and associated grassland and heath at high elevations. Neither of these habitats is present within the Study Area and this species is not expected to occur.

Neither of these endangered fauna populations is addressed further in this report.

2.2 THREATENED ECOLOGICAL COMMUNITIES WITH POTENTIAL TO OCCUR IN THE STUDY LOCALITY

Threatened Ecological Communities (TECs) can consist of Critically Endangered Ecological Communities, Endangered Ecological Communities or Vulnerable Ecological Communities, depending on the threat level. The following threatened ecological communities (TECs) are considered to have potential to occur within the Study Locality, and possibly the Study Area. Based on the presence of potentially suitable habitat in the locality, the following list has been culled from a list of TECs considered by OEH to have potential to occur within the Dungog (9233) and Bulahdelah (9333) 1:100 000 map sheets.

Critically Endangered Ecological Communities

- none

Endangered Ecological Communities

- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- White Box Yellow Box Blakely's Red Gum Woodland
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Sub-tropical Coastal Floodplain Forest of the New South Wales North Coast Bioregions
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion
- Grey Box - Grey Gum Wet sclerophyll forest in the NSW North Coast Bioregion
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions
- Swamp sclerophyll forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Vulnerable Ecological Communities

- Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions

The actual occurrence or absence of these TECs within the Study Area is addressed in Section 3 of this report on the basis of field surveys.

2.3 FLORA AND FAUNA HABITAT CORRIDORS

The desktop assessment identified the presence of narrow habitat corridors through the landscape. A narrow habitat corridor comprising remnant mature forest vegetation remains along the roadside of McKinleys Lane. This corridor provides a tenuous link from small patches of forest within the Study Area, to riparian vegetation along Oaky Creek (north of the proposed impact area) and then to the extensive forest vegetation along the Mograni Range to the east. There is limited connectivity at the northern end of the McKinleys Lane road reserve to riparian vegetation along the Avon River to the west of the proposed impact area, via Oaky Creek.

Riparian vegetation along Waukivory Creek (located typically 100m to 400m outside the southern boundary of the Mine Area) provides an additional narrow corridor between the Mograni Range and riparian vegetation along the Avon River. This corridor is contiguous with narrow corridors of riparian vegetation along the Gloucester and Manning Rivers and form part of a significant corridor network in the region.

The potential establishment of a *Tops to Lakes* vegetation corridor is currently in the early stages of investigation by the Hunter Central Rivers Catchment Management Authority and the Great Lakes Council (Matt Bell, Great Lakes Council, pers. comm.). No mapping is yet available, but from aerial photographs, currently the narrowest gap between forested areas leading down from Barrington Tops towards the Myall and Wallis Lakes, occurs at Wards River, approximately 17km south of the Rocky Hill Coal Project

The other potential location for such a corridor would be at Craven approximately 10 km south of the Site where a relatively narrow gap of cleared land separates The Glen Nature Reserve from the Avon River State Forest and Running Creek Nature Reserve.

The land affected by the Rocky Hill Coal Project is unlikely to form part of any future Tops to Lakes vegetation corridor.

2.4 ADJOINING OR NEARBY OEH ESTATE

The Glen Nature Reserve is the closest area of land being administered by OEH. The Glen Nature Reserve is located east of Craven and approximately 5km south of the Rocky Hill Coal Project. The Glen Nature Reserve is located upstream of the Rocky Hill Coal Project.

The Running Creek Nature Reserve is located 9km to the southwest of the proposed Rocky Hill Coal Project and west of The Bucketts Way.

Neither of these nature reserves is likely to be directly or indirectly impacted by the Proposal.

3. FIELD SURVEYS

Field surveys were carried out within the Study Area during various campaigns between 2010 and 2012. Different flora and/or fauna techniques were adopted and different species or taxonomic groups were targeted during these campaigns, based on seasonal detectability and the DGRs, but opportunistic recording of any flora or fauna species observed, was carried out on all occasions.

3.1 FLORA INVESTIGATIONS

3.1.1 Methodology

Flora field surveys were undertaken over the majority of the Study Area on the 8th and 21st July 2010. Following expansion of the operational area and additions at the eastern side of the current Study Area to provide possible Biodiversity Offset Areas, further flora fieldwork was conducted in these areas on the 16th to 18th March 2011. Additional fieldwork was undertaken on the 2nd to 4th August 2011 using plots and transects for the BioBanking methodology. A supplementary survey of the grassland condition and paddock trees in the eastern part of the Mine Area was undertaken on the 10th and 11th May 2012, including additional BioBanking plots and transects.

The survey methodology involved five components.

- A general traverse on foot within the parts of the Study Area where at least a remnant native tree and/ or shrub layer occurred, using the random meander method of Cropper (1993). Areas that were largely cleared and devoid of native vegetation except for scattered trees were generally surveyed from a slowly moving vehicle driving along adjoining roads, tracks or through the pasture itself. Any significant features detected in this way were examined in further detail on foot. The foot or vehicle meander was used to assess the range of floristic variation, vegetation structure, extent of modification, disturbance, weed invasion and condition of the vegetation generally.
- Adoption of the suggested length of walking transects and flora quadrats per stratification unit (DEC 2004) within each natural vegetation unit according to the total area of each unit. A total of six standard 400m^2 quadrats were established. The quadrat shape was 20m x 20m by default, or 40m x 10m in linear vegetation such as riparian communities. In addition, nine BioBanking plots were examined in the proposed area of disturbance, all of which included a standard 400m^2 flora quadrat. All vascular flora species were recorded within the quadrats, along the transects and along the random meanders.
- A targeted search for potential threatened flora species or potential locally-occurring endangered flora populations as listed in the TSC Act 1995 for which potential habitat was available and which were detectable at the time of the survey.
- Objective field analysis of the condition of grassland and clusters of paddock trees in the eastern part of the proposed area of disturbance east of McKinleys Lane for use in the BioBanking methodology. Application of this methodology is explained in detail in Section 5.
- BioBanking transects and plots targeting both the proposed area of disturbance and wider Study Area. These were used to provide the prescribed data for calculation of biodiversity credits required due to the Proposal and biodiversity credits generated by the proposed Biodiversity Offset Area. A total of nine transects and plots were examined in the proposed area of disturbance and 12 in the Biodiversity Offset Area plus the wider Study Area. Application of this methodology is explained in detail in Section 5.

A small sample of any unknown plant species was obtained for further examination and identification during fieldwork.

The distribution of vegetation communities within the Study Area was based on a combination of high resolution aerial photography interpretation and ground truthing from fieldwork. The vegetation communities are shown in **Figure 7** and described in Section 3.1.3.1. The figure shows vegetation communities in both the proposed impact area and Biodiversity Offset Area, including vegetation classified as being in low condition according to the BioBanking Assessment Methodology.

The locations of all flora quadrats, BioBanking transects and plots, and grassland analysis plots are shown in **Figure 8**.

The survey methodology complied with current best practice flora survey guidelines for a full impact assessment, such as OEH's *Draft Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004) and the *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (BBAM) (DECC 2009a). **Table 11** outlines the level of compliance with the OEH or BBAM recommended level of survey effort. The combined survey effort met or exceeded the suggested or required minimum survey effort for the proposed impact area. For the Biodiversity Offset Area, there was one plot short of the four required for the total vegetation zone area for Community 4 only. This minor shortfall in replication was overcome by adding a plot from an area with similar attributes near the boundary of the proposed impact area/ Biodiversity Offset Area.

Table 11
Compliance with Suggested Minimum Flora Survey Effort

Method	**Suggested Minimum Effort* (Community = Stratification Unit or Vegetation Zone)**		**As Carried Out**
Impact Area			
Transects (or Traverses)	Community 2	3 traverses of 100m each = 300m total traverse length	Numerous traverses exceeding total minimum length
	Community 3	3 traverses of 100m each = 300m total traverse length	One traverse exceeding 300m
	Community 4	2 traverses of 100m = 200m total traverse length	2 traverses exceeding 100m each
Random Meander	30 minutes for each quadrat sampled within the same stratification unit as the quadrat		Done
400m^2 quadrats	Community 2	3 quadrats	3 quadrats
	Community 3	1 quadrat	1 quadrat
	Community 4	2 quadrats	2 quadrats
BioBanking Plots and Transects	Community 2	3 plots	5 plots
	Community 3	1 plot	1 plot
	Community 4	3 plots	3 plots
Biodiversity Offset Area			
BioBanking Plots and Transects	Community 2	5 plots	5 plots
	Community 3	2 plots	4 plots
	Community 4	4 plots	3 plots

*Adapted from Section 5 of the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft (DEC 2004) and BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009a).

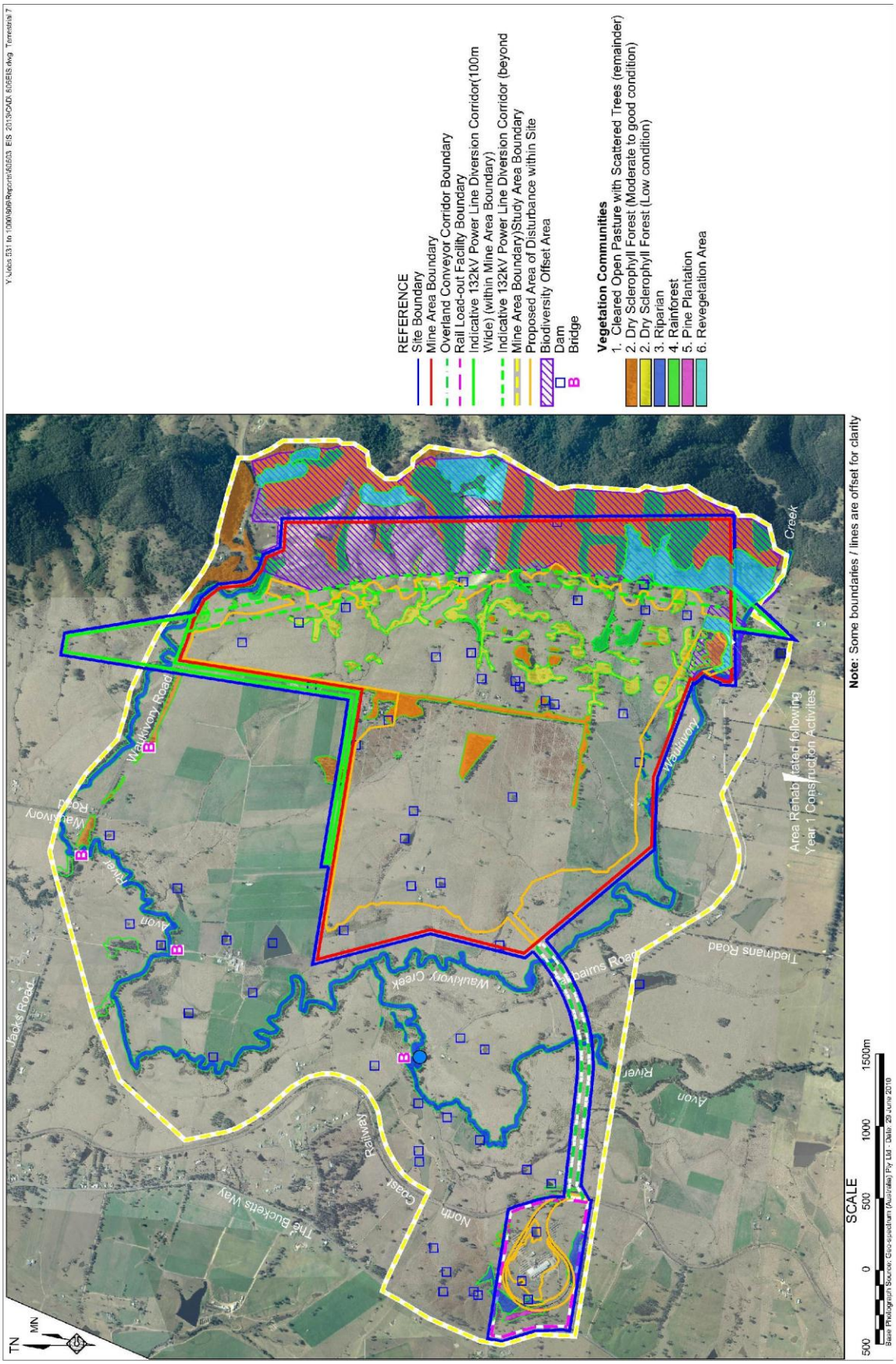

Figure 7 Vegetation Communities and Fauna Habitat Features within the Study Area

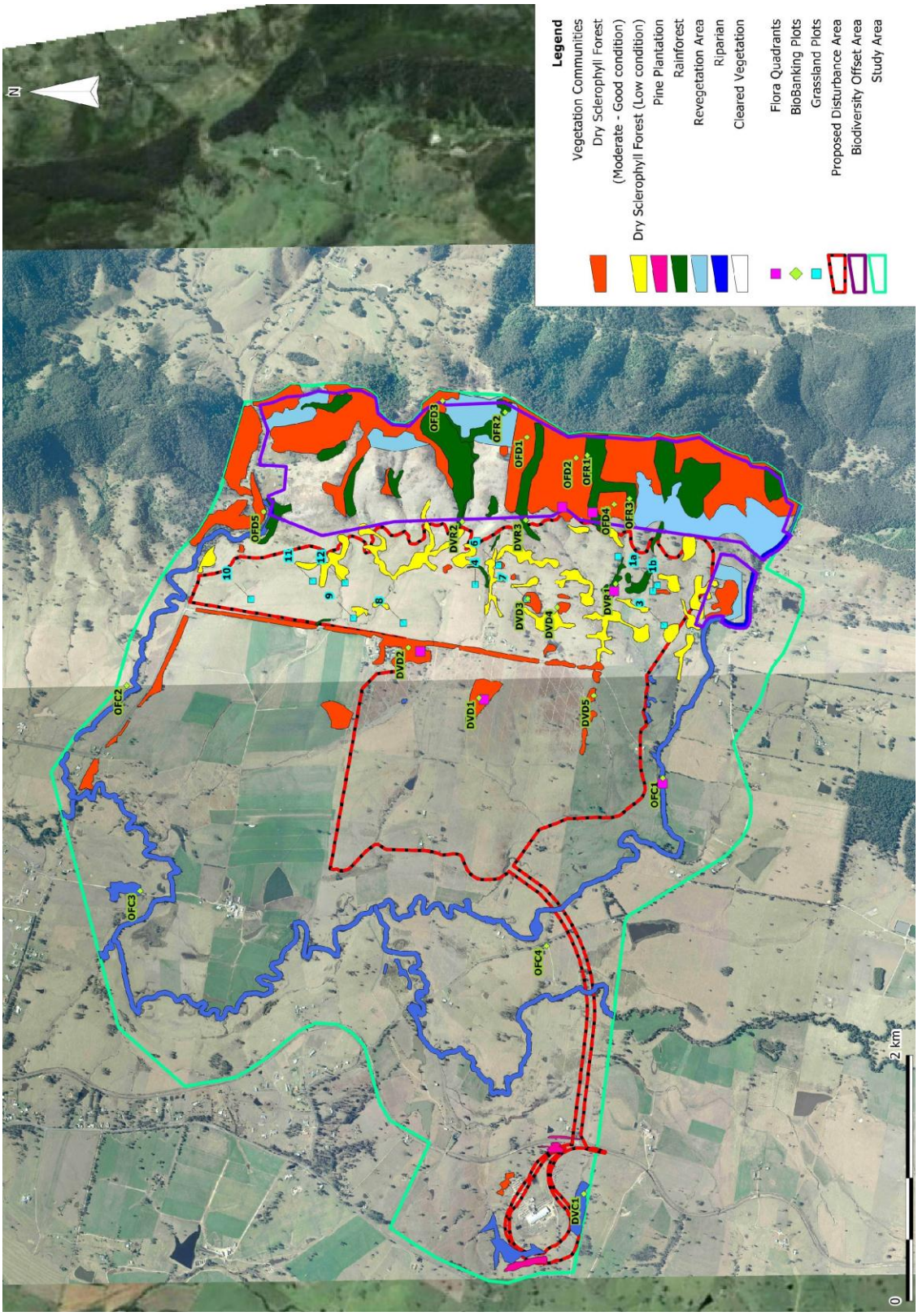

Figure 8 Flora Survey Techniques

Details of the dates, areas targeted, survey methodology and estimated survey effort to target each threatened flora species with any potential to occur in the impact area or biodiversity offset area are given in **Table 12**.

Table 12
Detail of Survey Efforts to Target Threatened Flora Species

Species	Seasonal Survey Required?	Habitat / Area(s) targeted	Date(s) targeted	Survey Method	Estimated Total Survey Effort within targeted Area(s)*
Asperula asthenes (Trailing woodruff)	Yes – preferably during early spring when it flowers and fruits	Selected damp areas associated with drainage lines within impact area; selected damp areas and riparian areas outside impact area.	8.7.2010; 21.7.2010; 2-4.8.2011.	Random meanders (DEC 2004) within damp areas; quadrats DVC1, OFC1-OFC4	1100m meanders plus 1 quadrat in impact area; 4 quadrats outside impact area /2 hr.
Chiloglottis platyptera (Barrington Tops Ant Orchid)	Yes – during flowering period July-October	Grassy understorey in the major eucalypt forest remnants and selected areas along McKinleys Lane.	8.7.2010; 21.7.2010; 2-4.8.2011.	Random meanders (DEC 2004) within relevant habitat; quadrats DVD1-DVD5	2km meanders plus 5 quadrats in impact area / 5hr.
Cynanchum elegans (White-flowered wax plant)	No (NPWS 2002), however flowers and fruits may aid in accurate identification.	Rainforest remnants in south-eastern part of impact area; selected rainforest edges in biodiversity offset area.	8.7.2010; 21.7.2010; 16.3.2011; 2-4.8.2011; 10-11.5.2012.	Random meanders (DEC 2004) within relevant habitat; quadrats DVR1-DVR3	800m meanders plus 3 quadrats in impact area / 3hr.
Eucalyptus glaucina (Slaty red gum)	No, however easier to identify when glaucous buds occur in spring.	Remnant forest in moister sections of McKinleys Lane, moister areas at southern end in the vicinity of riparian habitat	8.7.2010; 21.7.2010; 16-18.3.2011; 2-4.8.2011; 10-11.5.2012.	Driving transect and walking random meanders (DEC 2004) within relevant habitat; quadrats DVD3-DVD5	3.5km driving transect plus 500m walking meanders plus 3 quadrats in impact area
Grevillea obtusiflora	No	Not specifically targeted due to lack of suitable habitat (altitude too low).	-	-	-
Melaleuca groveana (Groves paperbark)	No	Not targeted in impact area due to lack of suitable habitat (low elevation and no rocky ridges). Selected rocky ridgetop areas in Biodiversity Offset Area targeted.	4.8.2011	Random meander (DEC 2004) within relevant habitat; quadrat OFD3	300m meander; 1 quadrat/ 30 min in offset area

Table 12 (Cont'd)
Detail of Survey Efforts to Target Threatened Flora Species

Species	Seasonal Survey Required?	Habitat / Area(s) targeted	Date(s) targeted	Survey Method	Estimated Total Survey Effort within targeted Area(s)*
Pomaderris queenslandica (Scant pomaderris)	No, however flowers and fruits may aid in accurate identification.	Shrubby understorey in the major eucalypt forest remnants in the south of the impact area and selected areas along McKinleys Lane, and moist areas along drainage lines.	8.7.2010; 21.7.2010; 16-18.3.2011; 2-4.8.2011; 10-11.5.2012.	Random meanders (DEC 2004) within relevant habitat; quadrats DVD1-DVD5	2km meanders plus 5 quadrats in impact area / 5hr.
Senna acclinis (Rainforest senna)	No	Rainforest remnants in south-eastern part of impact area; selected rainforest edges in biodiversity offset area.	8.7.2010; 21.7.2010; 16-18.3.2011; 2-4.8.2011; 10-11.5.2012.	Random meanders (DEC 2004) within relevant habitat; quadrats DVR1-DVR3; OFR1-OFR3	1.2km meanders plus 3 quadrats in impact area / 3hr.
Syzygium paniculatum (Magenta lilly pilly)	No, however presence of fruits may aid in accurate identification.	Rainforest remnants in south-eastern part of impact area; selected rainforest edges in biodiversity offset area.	8.7.2010; 21.7.2010; 16-18.3.2011; 2-4.8.2011; 10-11.5.2012.	Random meanders (DEC 2004) within relevant habitat; quadrats	1.2km meanders plus 3 quadrats in impact area / 3hr.

*Note: the estimated meander lengths and survey times overlap for species with similar habitat requirements

3.1.2 Survey Limitations

For this Proposal, the flora survey limitations relate mainly to the moderately large size of the Study Area, the rugged nature of much of the Biodiversity Offset Area and the consequent impossibility of surveying the entire ground area in detail. As is the convention in such situations, a targeted approach was adopted in which representative areas of vegetation communities and areas of potentially suitable habitat for possible threatened species, endangered populations or threatened ecological communities, based on maps, aerial photographs and ground-truthing, were examined most thoroughly.

3.1.3 Results

3.1.3.1 Vegetation Communities

A total of five vegetation communities were identified in the Study Area as shown in **Figure 7**. Two artificial vegetation community types occur consisting of cleared open pasture with no native tree or shrub layers (except for occasional isolated paddock trees), a ground layer of predominantly introduced pasture grasses and herbaceous weeds (Community 1); and

patches of pine plantation (Community 5). Three remnant natural vegetation communities were found to occur in the Study Area, with various levels of disturbance including tree and understorey clearing (Communities 2, 3 and 4).

1. Cleared open pasture
2. Ironbark / Grey Gum / Spotted Gum / White Mahogany Open Forest/ Woodland (Moderate to Good and Low Condition) (also referred to as Dry sclerophyll forest)
3. River Oak / Cabbage Gum / Broad-leaved Apple Riparian Forest (also referred to as Riparian Forest)
4. Giant Stinging Tree / Fig Rainforest Gullies (also referred to as dry rainforest)
5. Pine Plantation

Descriptions of the structure and floristics of each of the vegetation communities within the Study Area are given below.

Community 1: CLEARED OPEN PASTURE

This community occupies by far the greatest component within the Study Area and approximately 90% of the area to be disturbed. It consists of cleared land of short pasture grasses characterised by a lack of a native tree or shrub understorey and only isolated, scattered native trees or clumps of trees. The levels of ongoing disturbance in the area (mainly grazing and more recently slashing) are high to extreme, and consequently the vegetation that occurs is predominantly introduced and weedy, although some robust native pasture grasses and herbs persist. Several farm dams and wet soak or aquatic areas with rushes and fringing vegetation occur within this community. Apart from the habitat value to frogs and other fauna groups provided by these features, the community overall has no conservation significance in terms of flora.	

Community 2: IRONBARK / GREY GUM / SPOTTED GUM / WHITE MAHOGANY OPEN FOREST / WOODLAND

Stratum	Height	% cover*	Dominant Species	Comments
Tree layer	22m – 28m	10 – 30	*Eucalyptus siderophloia* *E. fibrosa* *E. punctata* *E. acmenoides* *E. globoidea* *E. moluccana* *Corymbia maculata*	Habitat: Well-drained slopes and ridgetops on heavy, loamy soil. Structure/Characteristics: Modified open forest to woodland with thinned tree layer, sparse and disturbed shrub layer to varying degrees and dense ground layer of grasses and herbs. A complex and highly variable community with varying mixes of dominant eucalypt species, often associated with transitional areas between riparian (Community 2) and rainforest (Community 3) vegetation. See text for further discussion. Distribution within Study Area: Represented by small remnants within the central part of the Study Area, mainly west of and along McKinleys Lane and Waukivory Road. Occupies a small percentage of the Study Area, but large patches occur in the potential Biodiversity Offset Areas upslope to the east. Condition & Presence of Weeds: Partially modified by past and current tree thinning, slashing and current grazing. Minor herbaceous weeds present such as flatweed and fire weed. The community was divided into two condition classes according to the BioBanking Assessment Methodology: Moderate to Good and Low (see Section 5). Conservation Status: No particular conservation significance – not listed under legislation.
Small tree layer	8m – 10m	0 – 20	*Angophora subvelutina* *Acacia melanoxylon*	
Shrub layer	1m – 2 m	0 – 30	*Bursaria spinosa* *Podolobium ilicifolium* *Acacia ulicifolia*	
Ground layer	To 1m	80 – 95	*Imperata cylindrica* *Themeda australis* *Entolasia stricta* *Aristida vagans* *Pteridium esculentum* *Eremophila debilis* *Dichondra repens* *Cheilanthes sieberi*	

*projective canopy foliage cover

Community 3: RIVER OAK / CABBAGE GUM / BROAD-LEAVED APPLE RIPARIAN FOREST

Stratum	Height	% cover*	Dominant Species	Comments
Tree layer	18m – 22m	20 - 30	*Casuarina cunninghamii* *Eucalyptus amplifolia* *E. microcorys* *Angophora subvelutina*	Habitat: Floodplains along major creeks or watercourses. Structure/Characteristics: Narrow bands of riparian forest dominated by river oaks and/or an open eucalypt tree layer, paperbark/myrtle/wattle small tree layer, sparse to moderate shrub layer and a dense grassy understorey. Distribution within Study Area: Along the banks of the Avon River, Waukivory Creek and Oaky Creek and their associated floodplains in the lowland part of the Study Area, and small swampy areas along smaller watercourses. Condition & Presence of Weeds: Disturbed by ongoing cattle grazing with minor to moderate patches of weeds - mainly weeping willow, wild tobacco, whisky grass and minor occurrences of herbaceous weeds. Conservation Status: No particular conservation significance – not listed under legislation. Not a TEC according to the corresponding Biometric Map Unit HU598 (DECC 2009a). Has some affinities to the EEC 'Subtropical Coastal Floodplain Forest' (NSW Scientific Committee 2004) in parts. This is discussed further in Section 3.1.3.2
Small tree layer	8m – 12m	20 - 30	*Backhousia myrtifolia* *Melaleuca styphelioides* *Acacia irrorata* *Capparis arborea* *Scolopia braunii*	
Shrub layer	3m – 4 m	5 - 20	*Bursaria spinosa* *Notelaea longifolia* *Acacia ulicifolia* *Pittosporum revolutum* *Maytenus silvestris*	
Ground layer	To 1m	70 - 80	*Imperata cylindrica* *Oplismenus aemulus* *Pteridium esculentum* *Adiantum aethiopiocum* *Doodia aspera* *Pellaea falcata* *Einadia hastata* *Plectranthus parvifolius* *Asplenium flabellifolium* *Andropogon virginicus* *Dichondra repens* *Solanum mauritianum* *Senecio madagascariensis* *Carex fascicularis* *Glycine tabacina*	
Vines, Climbers			*Eustrephus latifolius* *Rubus parvifolius*	

*projective canopy foliage cover

Community 4: GIANT STINGING TREE / FIG RAINFOREST GULLIES

Stratum	Height	% cover*	Dominant Species	Comments
Emergent Tree layer	25m - 28m	20 - 30	*Eucalyptus propinqua* *E. siderophloia*	Habitat: Steep drainage lines along rocky ephemeral watercourses in the eastern foothills on high nutrient granite soil. Structure/Characteristics: Closed forest with taller emergent eucalypts over a dense canopy of mesophyllous tree species, a sparse shrub layer and very sparse ground layer. Vines, climbers and epiphytes are common. Distribution within Study Area: Two small patches of the community occur in the lowland area near the south-eastern corner of the Study Area. The patches are no wider than approximately 50m and no longer than 200-300m. Larger patches occur in drainage lines on the steep hillsides at the eastern end of the Study Area in the potential Biodiversity Offset Area. Condition & Presence of Weeds: Currently minor disturbances due to low-level cattle grazing and with signs of past clearing, but otherwise in good condition and weed-free except in edge zones. Conservation Status: Corresponds to the TEC 'Lower Hunter Valley Dry Rainforest' (vulnerable) according to the Final Determination (NSW Scientific Committee 2008) – see section 3.1.3.6
Canopy layer	12m - 20m	60 - 70	*Dencrocnide excelsa, Ficus macrophylla, F. coronata, Baloghia inophylla, Daphnandra micrantha, Streblus brunonianus, Melicope micrococca, Elaeodendron australe, Capparis arborea, Backhousia myrtifolia, Alectryon subcinereus, Rhodamnia rubescens, Scolopia braunii, Diospyros australis, Syzygium australe, Claoxylon australe, Drypetes deplanchei, Neolitsea australiensis, Melia azedarach, Pararchidendron pruinosum.*	
Shrub layer	1m – 2m	10 - 20	*Pittosporum multiflorum, Breynia oblongifolia, Notelaea* spp., *Morinda jasminoides, Melicytus dentatus, Gymnostachys anceps*	
Ground layer	To 0.5m	5 - 20	*Doodia apsera, Adiantum* spp., *Pellaea* spp., *Lastreopsis decomposita, Asplenium flabellifolium, Oplismenus aemulus*	
Vines, Climbers, Epiphytes			*Pandorea pandorana, Legnephora moorei, Cissus* spp., *Marsdenia* spp., *Parsonsia straminea, Smilax australis, Dioscorea transversa Tetrastigma nitens, Grammitis billardieri, Platycerium bifurcatum*	

*projective canopy foliage cover

Community 5: PINE PLANTATION

This community is restricted to the western side of the Study Area and occupies a relatively small area in two separate patches within the area proposed as the Rail Load-out Facility. It is an entirely artificial community and consists of introduced pine trees planted in rows possibly for timber production or more likely to provide a windbreak or screen. No native understorey occurs, with the ground layer consisting of grazed pasture. A few naturally-occurring forest red gums occur within parts of the plantation. The community has no conservation significance in terms of flora.	

3.1.3.2 Comparison with Regional Vegetation Units

No regional vegetation mapping studies covering the Study Area have been undertaken to a level of detail and resolution which would enable direct comparisons to the mapping from the current study with OEH BioMetric Vegetation Types for the Hunter-Central Rivers Catchment Management Authority area which have been created from a combination of broad regional vegetation studies, principally NPWS (1999) and Floyd (1990).

The BioMetric Vegetation Types that are considered to broadly correspond to the vegetation communities of the Study Area are listed in **Table 13**, together with the State-wide classifications of Vegetation Formation and Vegetation Class of Keith (2004) to which they belong.

It should be noted that each community can contain elements of, or intergrade with, other related BioMetric Vegetation Types according to the classification. Community 2, in particular, is a complex and highly variable community spatially, and difficult to assign to one particular BioMetric map unit. In reality, the community locally comprises a complex of intergrading vegetation types depending on its habitat and in, particular, environmental factors such as slope, moisture, soil type and exposure. It is difficult to map the variants of this community separately since the assemblage of characteristic species at different locations shows considerable variation. Therefore, Community 2 has been determined to correspond principally to one BioMetric Vegetation Type, but spatial variants of the community (particularly in intergrade areas with riparian or rainforest communities) contain distinct elements of two additional vegetation units as shown in **Table 13**. By contrast, Communities 3 and 4 are distinct and identifiable, corresponding well to specific BioMetric vegetation units. Community 4 is also consistent with the description of Vulnerable Ecological Community *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions* as discussed in Section 3.1.3.6.

Table 13
Corresponding Vegetation Types from State-wide and Regional Classifications

Vegetation Communities (this study)	Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	BioMetric Vegetation Type (DECC 2009a)	Threatened Ecological Community
Communities 1&5	Unclassified	Unclassified	Unclassified	No
Community 2	Dry sclerophyll forests (shrub/ grass sub-formation)	Hunter-Macleay Dry sclerophyll forests	HU630: Spotted Gum – Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast (also REMS MU16)	No
	Dry sclerophyll forests (Shrubby sub-formation)	North Coast Dry sclerophyll forests	HU605: Rough-barked apples grassy open forest on valley flats of the North Coast and Sydney Basin (generally in intergrade areas with Riparian – Community 2)	No
	Wet sclerophyll forests (grassy sub-formation)	Northern Hinterland Wet sclerophyll forests	HU620: Small-fruited Grey Gum - Tallowwood shrubby open forest on coastal foothills of the southern North Coast (generally in intergrade areas with Rainforest – Community 3)	No
Community 3	Forested Wetlands	Eastern Riverine Forests	HU598: River Oak riparian woodland of the North Coast and northern Sydney Basin	No
Community 4	Rainforests	Dry Rainforests	HU541: Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast (Alliance VI, Suballiance 23 *Ficus* – *Streblus* – *Dendrocnide* - *Cassine* Alliance of Floyd 1990)	Yes – Lower Hunter Valley Dry Rainforest

3.1.3.3 Floral Diversity

A moderate to high species diversity was found to be present in the entire Study Area with 25% of species being exotic. Within the entire Study Area, 312 flora species from 98 families were identified comprising 20 ferns, 2 conifers, 225 dicotyledons and 65 monocotyledons.

A list of all flora species recorded and identified from within the Study Area is included as **Appendix 1**. Data from the six flora quadrats is presented in **Appendix 2** and data from the BioBanking plots is presented in **Appendix 6**.

3.1.3.4 Condition of the Vegetation and Presence of Weeds

The natural vegetation throughout the Study Area was found to be in a highly modified condition, most of it having been cleared to provide pasture for cattle grazing. Small remnants of natural vegetation in a disturbed condition remain in the central and southern parts of the Study Area. These consist of a narrow linear strip of remnant natural vegetation adjacent to each side of McKinleys Lane, three small remnant patches in the central part of the Mine Area and small remnants adjacent to watercourses in the southeastern part of the Study Area. Vehicular tracks are present through some of the central remnant vegetation patches. All remnants appear to have undergone past tree thinning and clearing of the shrub layers to varying degrees.

Scattered isolated trees or clumps of trees occur sporadically throughout the cleared pasture areas. The cleared area to the west of McKinleys Lane contains only isolated paddock trees and the pasture is predominantly exotic, large areas being dominated by whisky grass. Clusters of paddock trees occur in the cleared area to the east of McKinleys Lane, and some areas of pasture may contain a higher proportion of native species. In spite of the extent of past vegetation clearing throughout the Study Area, very little erosion or soil instability appeared to be present.

In regard to the broader Study Area, including the potential Biodiversity Offset Area, much larger areas of intact natural vegetation have been retained in the steeper elevated land to the east. However, at present, cattle grazing still occurs in these areas, and parts of the lower slopes have been partially cleared or under-scrubbed. Full clearing of the natural vegetation and conversion to open pasture had been carried out up to and over the ridgetop in some patches.

Noxious and environmental weeds occurred in patches throughout the Study Area at low to moderate density as detailed below.

Five weed species that are declared under the *Noxious Weeds Act 1993* for the control area of Gloucester Shire Council were recorded within the Study Area. The legal requirements for their control are listed in **Table 14**.

Table 14
Declared Noxious Weeds within the Site and their Legal Control Requirements

Scientific Name	Common Name	Class	Legal Requirements
Ageratina adenophora	Crofton weed	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Lantana camara	Lantana	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold or knowingly distributed.
Lycium ferocissimum	African boxthorn	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Rubus fruticosus aggr. spp.	Blackberry	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.
Xanthium occidentale	Noogoora burr	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

Notes Further explanations of the relevant control categories are as follows:

Class 4 – Locally Controlled Weeds: Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area. The local control authority is Gloucester Shire Council. Management plans for Class 4 weeds published by Council are available at: http://www.gloucester.nsw.gov.au/environment/1134/2187.html

The noxious weeds present were found to occur at generally low density within the Study Area. Lantana was absent throughout most of the Study Area, but was present in the vicinity of watercourses and gully areas, such as areas bordering the rainforest gully areas of the steep slopes to the east. Invasion and establishment of Lantana (*Lantana camara*) is also a listed Key Threatening Process under the NSW TSC Act.

Apart from declared noxious species, common agricultural or environmental weed species recorded within the Study Area include Whisky grass (*Andropogon virginicus*) which occurred at high density throughout some pasture areas, Camphor laurel (*Cinnamomum camphora*), Small-leaved privet (*Ligustrum sinense*), Fleabane (*Conyza* sp.), Spear thistle (*Cirsium vulgare*), Fire weed (*Sencio madagascariensis*), Paddy's lucerne (*Sida rhombifolia*), Stinking Roger (*Tagetes minuta*), Redflower mallow (*Modiola caroliana*), Purple top (*Verbena bonariensis*) and Veined verbena (*Verbena rigida*). Many occurrences of these weeds would be directly removed during clearing for the proposed open cut pits and associated infrastructure. For any retained or managed areas of vegetation within the Study Area, control or management of any of these species would be highly desirable.

3.1.3.5 Threatened or Regionally Significant Flora Species

No threatened flora species listed under the NSW TSC Act were recorded within the Study Area during the field surveys.

No flora species that form part of an Endangered Population listed under the NSW TSC Act were recorded within the Study Area during the field surveys.

No rare flora species listed exclusively by ROTAP were recorded within the Study Area during the field surveys.

3.1.3.6 Threatened Ecological Communities

Threatened Ecological Communities (TECs) can include Critically Endangered, Endangered or Vulnerable Ecological Communities. One Threatened Ecological Community listed under the NSW TSC Act occurs within the Study Area. The location, structure, habitat and species composition of the dry rainforest community (Community 4) indicates that it constitutes the Vulnerable Ecological Community (VEC) *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions.* As described in the Final Determination for the VEC (NSW Scientific Committee 2008) the community occurs on Carboniferous volcanics and sediments of the Barrington footslopes along the northern rim of the Hunter Valley floor, occupying drainage lines and steep hillslopes. It often occurs on steep rocky or scree slopes. The community usually forms a closed forest 15m-20m high with emergent trees (usually eucalypts) 20m-30m high. As described, vines are abundant in most parts of the community, although the shrub and ground layers are not necessarily as dense as indicated by the Final Determination. Of the assemblage of 60 species that characterise the VEC (NSW Scientific Committee 2008), 48 (80%) are present in Community 4 from the current study, including most of the common species.

In terms of species composition, Community 4 (or parts of it) also has some affinities with the Endangered Ecological Community (EEC) *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions* (NSW Scientific Committee 2006a). One of the corresponding

BioMetric vegetation types (DECC 2009), *Giant stinging tree - Fig dry subtropical rainforest of the North Coast and Brigalow Belt South* also correlates with the species composition of Community 4, up to a point. However, the rocky substrate and steep gully habitat, together with the general abundance of vines, suggest a greater affinity with the VEC *Lower Hunter Valley Dry Rainforest.*

In summary, only Community 4, which is confined to the eastern side of the Study Area, would qualify as a true TEC.

3.1.3.7 Overall Significance of the Vegetation

The main significance of the vegetation within the Study Area is that it contains occupied habitat for one threatened ecological community, the Vulnerable Ecological Community *Lower Hunter Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions*. This is generally restricted to the drainage lines on the sloping land on the eastern side of the Study Area.

Apart from the listed vegetation, the main ecological function of the remnant vegetation in the Study Area is as part of a corridor that provides connectivity both for movement of fauna and for exchange of genetic material between native flora and fauna species locally. This would tend to reduce the risk of local populations becoming isolated.

3.2 FAUNA INVESTIGATIONS

3.2.1 Methodology

In establishing a stratified sampling design for the field surveys, it was apparent that the study area comprised mostly cleared grazing land with small areas of disturbed vegetation communities and habitats.

During the initial site inspection, those patches of native vegetation were stratified by vegetation community type and within those vegetation community types there was little variation in biophysical attributes. However, the Dry sclerophyll forest was present in patches on the lower slopes and on the mid-slopes and as young growth and old growth. The Rainforest was present as small isolated patches and as part of a more extensive area of remnant vegetation along the Mograni Range.

Therefore the following stratification was adopted in selecting the principal fauna survey sites:

- Site 1 - Dry sclerophyll forest on lower slopes (young growth)
- Site 2 - McKinleys Lane - Dry sclerophyll forest on lower slopes (narrow corridor of old growth)
- Site 3 - Rainforest occurring as an isolated patch
- Site 4 - Riparian forest
- Site 5 - Dry sclerophyll forest on mid-slopes
- Site 6 - Rainforest occurring as part of more extensive vegetation area

Some of these sites were too small or did not contain suitable habitat for the use of all field survey techniques. The cleared paddocks were only sampled where specific habitat features such as farm dams were present.

In addition to the principal fauna survey sites listed above, targeted searches for specific fauna groups (frogs, micro-bats, platypus) were carried out where specific fauna habitat features occurred, such as watercourses, bridges, farm dams, etc. Targeted surveys for Barred frogs at pre-selected riparian sites during suitable conditions in spring and summer and recording of all opportunistically detected fauna, were also carried out.

The initial fauna surveys were undertaken throughout the Study Area between the 15th and 18th April 2011. Fauna habitat assessment, targeted surveys for threatened species and searches for any evidence of the presence of threatened species, were undertaken using a range of survey methods in suitable habitat. Vegetation communities, farm dams and bridge locations are shown on **Figure 7**. Locations where the fauna survey techniques were deployed are shown on **Figures 9a** and **9b.**

Further field surveys were carried out to specifically target frogs (riparian transects) within spring (11th and 13th October 2011) and summer (18th and 19th January 2012). Opportunistic records of fauna species were made during all flora and fauna fieldwork periods. The fauna survey methods and sampling effort employed during the fauna surveys are described below and in **Table 15**, and their locations illustrated in **Figure 9a** and **Figure 9b**.

Walking Traverse/Habitat Assessment

Walking traverses throughout the Study Area were used to record and map the types of habitats present and to establish the location and availability of habitat features known to be important for threatened species, such as tree hollows, logs, particular plant species, water bodies, caves and bridges.

Diurnal Bird Census

Three, 1 hour diurnal bird transects were undertaken in selected habitats that included Dry sclerophyll forest /woodland on the slopes in the east, riparian vegetation, and the remnant mature forest habitat corridor along McKinleys Lane. During censuses, two observers moved slowly through the search area recording birds by visual identification with the aid of binoculars and recognition of their distinctive calls. Species observed outside the search area were recorded separately.

Platypus searches

While not a listed threatened species under the NSW TSC Act, the Platypus is an iconic species that is considered to be relatively rare in most locations. Late afternoon watching of long pools within Waukivory Creek and Avon River were carried out in order to observe this species, if present (**Figure 9a**).

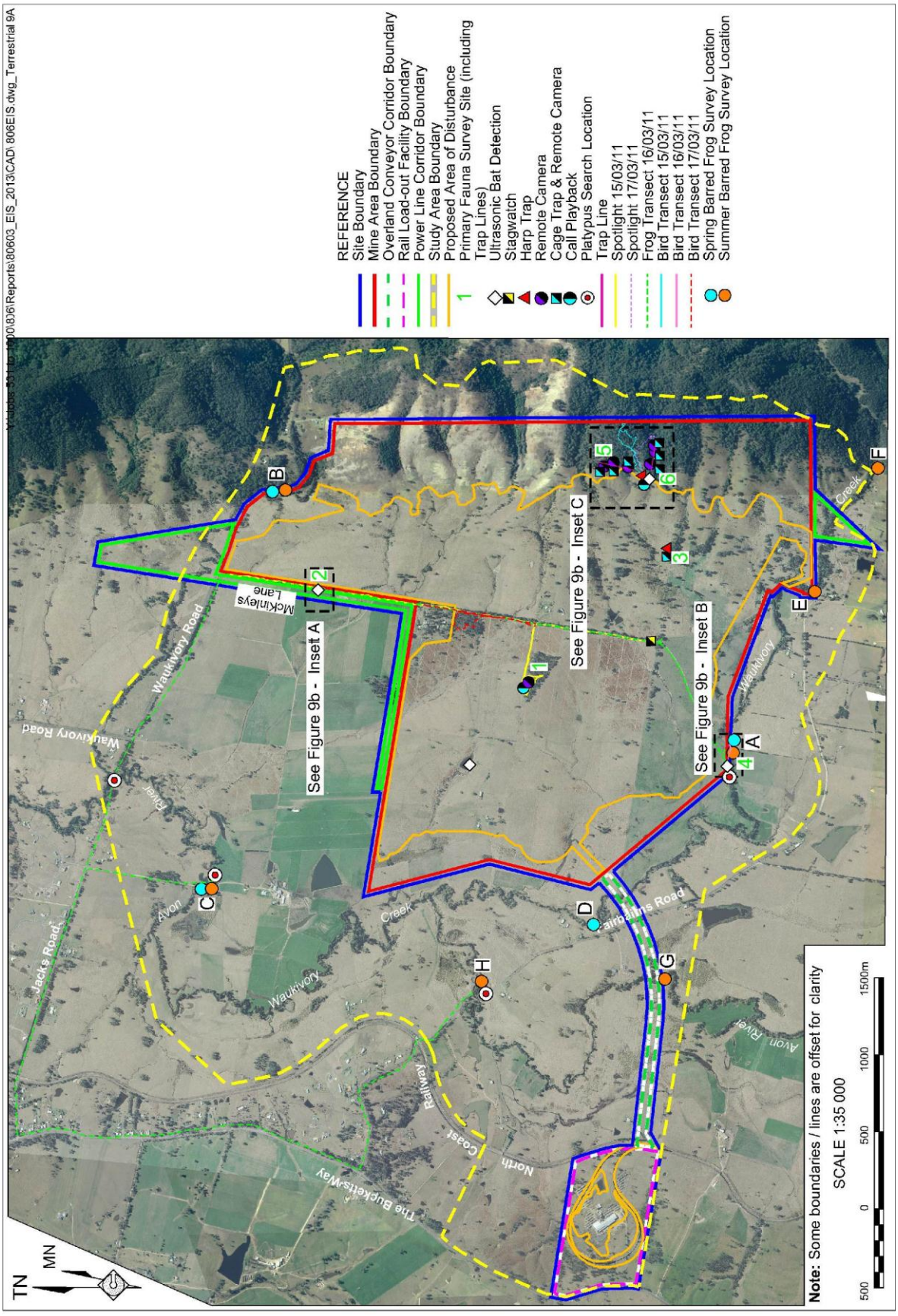

Figure 9a Fauna Survey Techniques

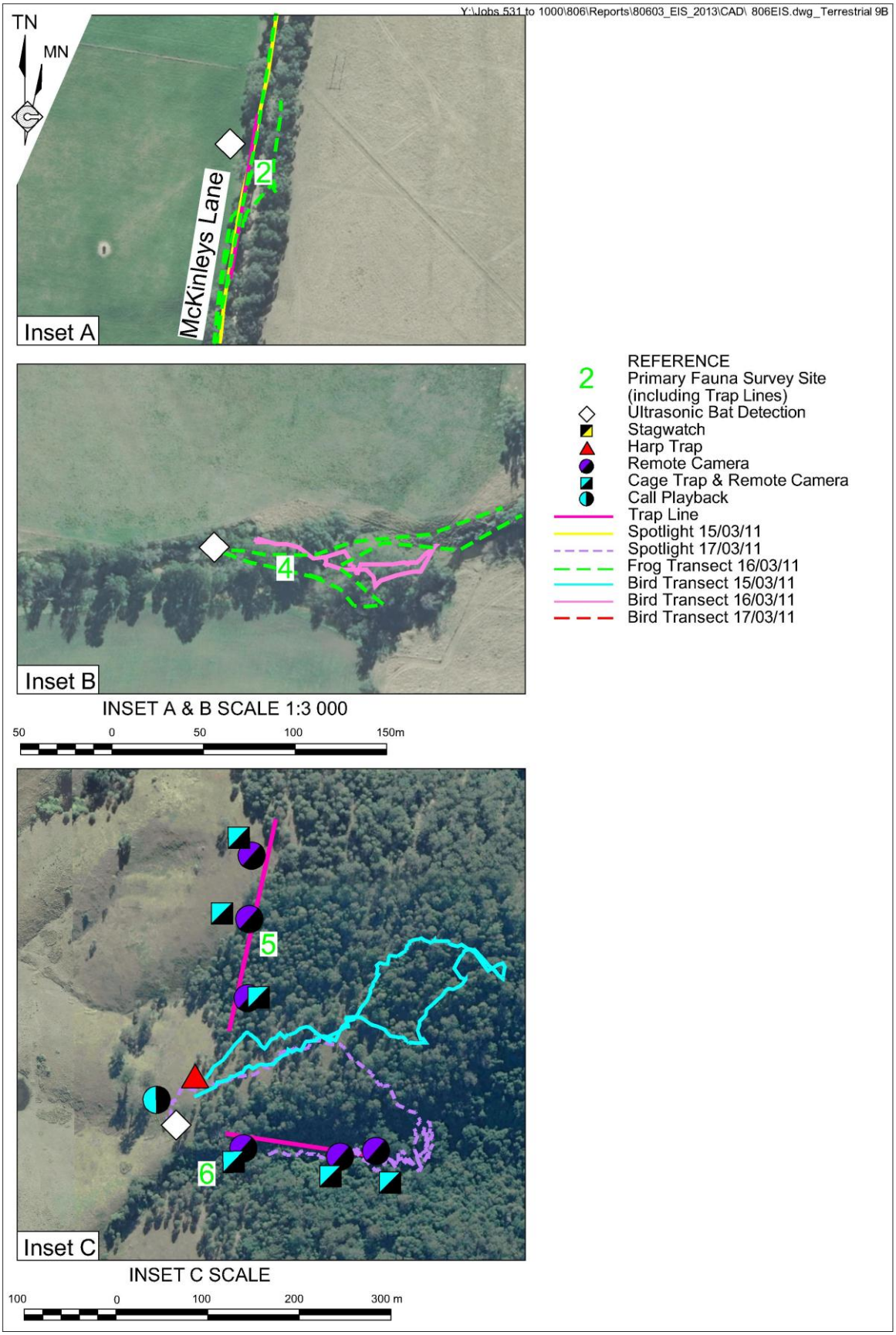

Figure 9b Fauna Survey Techniques

Frog Search

A long road transect frog search was undertaken by two observers after a heavy downpour of rain on 16 March 2011. A vehicle was driven slowly along McKinleys Lane, Waukivory Road, Jacks Lane, The Bucketts Way and Fairbairns Road, and any frogs heard or seen were identified. Around creeks and water bodies, the vehicle was stopped for a period of 5 minutes to hear any calls. Torches were used to locate frogs and tadpoles that were active in and around the water bodies and calling from shelter sites. Additional frog and tadpole searches and listening surveys were undertaken around farm dams and riparian areas within the Study Area during spotlight searches and call broadcast surveys.

Reptile Searches

Reptile searches were undertaken concurrently with the diurnal bird searches and the spotlighting transects, and also opportunistically at other times whilst traversing the Study Area.

Spotlight Survey

Walking spotlight surveys were undertaken on two evenings (15th March 2011 and 17th March 2011) during which two observers used spotlights, torches and binoculars to locate and visually identify nocturnal fauna species during slow walking traverses throughout the Study Area. Species were also identified by their distinctive calls. Spotlight surveys were undertaken in each habitat type. Observers traversed the Study Area 20m -100 m apart, achieving a broad spotlight coverage corridor.

Driving spotlight surveys were also carried out along McKinleys Lane, Waukivory Road and Fairbairns Road on the evening of 16th March 2011, in conjunction with the road frog transect.

Call Broadcast Survey

Call broadcast surveys were conducted on two nights, during which the pre-recorded calls of the Squirrel Glider, Yellow-bellied glider, Bush stone curlew; Powerful, Masked, Barking and Sooty Owls were broadcast through a megaphone. The call of each species was broadcast for a period of five minutes, followed by a five-minute listening period. Call broadcast surveys were preceded by a 15-minute listening period and followed by ten minutes of spotlighting.

Harp Trap Survey

Two harp traps were set at two different locations within the Study Area for a total of three nights each, to capture insectivorous bats. Harp traps were set in potential bat flight paths along vehicle tracks within the Dry sclerophyll forest on the lower slopes in the eastern part of the Study Area and within a small patch of rainforest within the Study Area. Harp traps were checked each morning at dawn and captured bats were released into nearby tree hollows or left in a “release box” which was attached to a tree and from which they were free to emerge at dusk.

Table 15
Fauna Survey Methods and Survey Effort

DEC (2004) Threatened Biodiversity Survey & Assessment Guidelines for Developments & Activities (Working Draft) Suggested Survey Requirement				Survey Effort	Sites Sampled	Effort in line with DEC 2004 Guidelines
Group	**Target or Species Type**	**Method**	**Suggested Minimum Effort (DEC 2004)**	**Ecotone 2011/12**		
Amphibians	All species particularly targeting the Giant Barred Frog *Mixophye siteratus* and Green-thighed frog *Litoria brevipalmata*	Systematic day habitat search	One hour per stratification unit	30minutes search by two ecologists (1 person hour) in the two stratification units containing aquatic/wet habitat plus opportunistic searches and listening surveys.	Rainforest Sites 3 and 6, plus other aquatic habitat areas	Yes
		Night habitat search of damp and watery sites	30 minutes on two separate nights per stratification unit	One hour search completed by two ecologists in riparian area plus one road transect search covering 15km on warm wet night and opportunistic searches around farm dams. Targeted Surveys Carried out 200m riparian transects on two evenings in both spring and summer at 8 sites along the Avon and Waukivory Rivers as part of supplementary targeted frog surveys (2 persons x 30+ mins).	Riparian forest Site 4 Riparian habitat sites A to H	Yes
		Nocturnal call playback	At least one playback on each of two separate nights	Carried out on two nights in both spring and summer as part of supplementary frog surveys.	Riparian habitat sites A to H	Yes
		Night watercourse search	Two hours per 200m of water body edge	Carried out on at least one evening in both spring and summer as part of supplementary frog surveys	Riparian habitat sites A to H	Yes
Avifauna (Diurnal)	All species	Area search	Not resolved (*Species time curve approach should be utilised)*	Three one hour, bird transects in three stratification units by two ecologists plus opportunistic detection	Riparian Site 4, Dry sclerophyll Site 5, Dry sclerophyll site 2 (McKinleys Lane)	Yes
		Wetland census	A one-hour census at dawn or dusk, for each identified wetland.	No true wetland within Site, but farm dams and riparian areas were opportunistically censused.	Farm dams and Riparian	Yes
		Water source census	A 20-minute census at dawn or dusk, for each identified water source.	As above	Farm dams and Riparian	Yes
Avifauna (Nocturnal)	All species	Call playback	Sites should be separated by 800m – 1km, and each site must have the playback session repeated.	Two call broadcast surveys on separate nights in two stratification units. Repeated visits not warranted due to small areas of poor habitat	Dry sclerophyll Site 1 and Rainforest Site 6	Yes, however not repeated
	Powerful Owl, Barking Owl & Grass Owl	Call playback	at least 5 visits per site, on different nights.	Two nights. Repeated visits not warranted due to small areas of poor habitat and likelihood of bringing birds into Site from nearby forest	Dry sclerophyll Site 1 and Rainforest Site 6	Yes, however not repeated
	Sooty Owl,	Call playback	at least 6 visits per site	Two nights. Repeated visits not warranted due to small areas of poor habitat and likelihood of bringing birds into Site from nearby forest	Dry sclerophyll Site 1 and Rainforest Site 6	Yes, however not repeated

Table 15 (Cont'd)
Fauna Survey Methods and Survey Effort

DEC (2004) Threatened Biodiversity Survey & Assessment Guidelines for Developments & Activities (Working Draft) Suggested Survey Requirement				Survey Effort	Sites Sampled	Effort in line with DEC 2004 Guidelines
Group	**Target or Species Type**	**Method**	**Suggested Minimum Effort (DEC 2004)**	**Ecotone 2011/12**		
Avifauna (Nocturnal) (Cont'd)	Masked Owl	Call playback	and 8 visits per site	Two nights. Repeated visits not warranted due to small areas of poor habitat and likelihood of bringing birds into Site from nearby forest	Dry sclerophyll Site 1 and Rainforest Site 6	Yes, however not repeated
	Bush Stone-curlew	Call playback	Sites should be 2-4km apart and conducted during the breeding season	Two nights. Repeated visits not warranted due to small areas of poor habitat	Dry sclerophyll Site 1 and Rainforest Site 6	Yes, however not repeated
Mammals (Excluding microbats)	Small mammals	Small Elliott 'A' traps	100 trap nights over 3-4 consecutive nights	200 trap nights comprising two trap lines with 25 traps each over 4 nights.	Dry sclerophyll site 5 and Rainforest site 6	Yes
	Medium to large animals	Large Elliott traps	100 trap nights over 3-4 consecutive nights	Wire cage traps and remote cameras used as alternative except at mature Dry sclerophyll forest site 2 at McKinleys Lane	-	-
	Arboreal animals	Arboreal Elliott 'B' traps	24 trap nights over 3-4 consecutive nights	100 trap nights comprising 3 trap lines, 2 with 10 traps per line, 1 with 5 traps all over four consecutive nights.	Dry sclerophyll Site 5 and Rainforest Site 6 and Dry Sclerophyll site 2 at McKinleys Lane	Yes
	Medium to large animals	Wire cage traps	24 trap nights over 3-4 consecutive nights	7 wire cage traps (3 at each of 2 trap lines and 1 at Site 3), each with a remote camera, (Scout guard SG550) over 4 nights.	Dry sclerophyll Site 5 plus Rainforest sites 3 & 6	Yes
	Small mammals	Pitfall traps with drift nets	24 trap nights over 3-4 consecutive nights	No suitable habitat or species likely to be detected by this technique alone	-	-
	Small to medium animals	Hair tubes	10 large and 10 small tubes in pairs for at least 4 days and 4 nights	Since trapping, spotlighting and remote cameras were used, this technique was not adopted	-	-
	Arboreal animals	Arboreal hair tubes	3 tubes in each of 10 habitat tree up to 100ha of stratification unit, for at least 4 days and 4 nights	Since trapping, spotlighting and remote cameras were used, this technique was not adopted	-	-
	Arboreal and terrestrial mammals	Spotlighting on foot	2 x 1 hour and 1km up to 200ha of stratification unit, walking at approximately 1km per hour on 2 separate nights	5 spotlight transects, for 1 hours over 3 nights by 2 ecologists Opportunistic sightings during targeted frog searches at Sites A-H	Sites 1,2,4,5 & 6 Sites A to H	Yes

Table 15 (Cont'd)
Fauna Survey Methods and Survey Effort

DEC (2004) Threatened Biodiversity Survey & Assessment Guidelines for Developments & Activities (Working Draft) Suggested Survey Requirement				Survey Effort	Sites Sampled	Effort in line with DEC 2004 Guidelines
Group	**Target or Species Type**	**Method**	**Suggested Minimum Effort (DEC 2004)**	**Ecotone 2011/12**		
Mammals (Excluding microbats) (Cont'd)	Arboreal and terrestrial mammals	Spotlighting from vehicle	2 x 1km of track at maximum speed of 5km per hour, up to 200ha of stratification unit, on 2 separate nights	1 driving spotlight transect, mostly along McKinleys Lane and other roads by 2 ecologists	15km road transect along Waukivory Road, Fairbairns Road and Dry sclerophyll site 2 at McKinleys Lane	Yes, however not repeated due to walking spotlighting being carried out
	Medium to large terrestrial mammals)	Sand plots	6 soil plots for 4 nights	Not carried out since spotlighting, trapping, remote cameras were carried out	-	-
	Gliders, koalas	Call playback	2 sites per stratification unit up to 200ha, plus an additional site per 100ha above 200ha. Each playback site must have the session conducted twice on separate nights.	Call broadcast for Squirrel Glider and Yellow-bellied Glider over 2 stratification units over 2 nights.	Dry sclerophyll forest site 1 and Rainforest site 6	Yes
	Gliders and possums	Stag-watching	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.	1 stagwatch transect along on McKinleys Lane by 2 ecologists	Mature Dry sclerophyll forest site 2 at McKinleys Lane	Yes
	All mammals	Search for scats and signs	30 minutes searching each relevant habitat, including trees for scratch marks.	Opportunistically carried out in all stratification units	All sites	Yes
	Mostly medium to large terrestrial mammals	Track search	1km of track search with emphasis where substrate is soft	Opportunistically carried out in all stratification units	All sites	Yes
	All mammals	Collection of predator scats	Opportunistic collection of predators scats for hair analysis	Opportunistically carried out in all stratification units	All sites	Yes
Mammals (Microbats)	All species	Harp trapping	Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night)	2 harp traps placed in suitable locations for 3 nights each. Trap sites within flyways were extremely limited in the study area.	Rainforest site 3 and Dry sclerophyll forest site 5	Yes
		Ultrasonic call recording	Two sound activated recording devices utilized for the entire night (a minimum of four hours) starting at dusk for two nights.	3 ultrasonic detectors in 3 stratification units for 2 full nights each, 1 unit deployed for 3.5 hrs & 5hrs on 2 separate nights. Mobile hand held units used while spotlighting, stagwatching and during the targeted frog searches (Sites A-H)	Riparian site 4, Rainforest site 6, mature Dry sclerophyll forest site 2 at McKinleys Lane and farm dam within cleared paddock Sites A to H	Yes

Table 15 (Cont'd)
Fauna Survey Methods and Survey Effort

DEC (2004) Threatened Biodiversity Survey & Assessment Guidelines for Developments & Activities (Working Draft) Suggested Survey Requirement				Survey Effort	Sites Sampled	Effort in line with DEC 2004 Guidelines
Group	**Target or Species Type**	**Method**	**Suggested Minimum Effort (DEC 2004)**	**Ecotone 2011/12**		
Reptiles	All species (Nov-March)	Habitat search	30 minute search on two separate days targeting specific habitat	Opportunistically carried out in all stratification units	All sites	Yes
		Pitfall traps with drift nets	24 trap nights, preferably using six traps for a minimum of four consecutive nights	Habitat and species to be targeted are unsuitable for this technique	-	-
		Spotlighting	30 – Minute search on two separate nights targeting specific habitat.	Opportunistically carried out in all stratification units during spotlighting.	All sites	Yes

Ultrasonic Bat Call Survey

Three Anabat ultrasonic bat call detectors were deployed overnight in three different locations through the Study Area on two nights in March 2011. One additional Anabat detector was deployed in the Study Area for 3.5 hours and 5 hours on two separate nights. The detectors were deployed near Waukivory Creek, on potential bat flight paths and clearings in a Dry sclerophyll forest area on the slopes in the eastern part of the Study Area, and within the mature forest along McKinleys Lane, to record calls of micro-bats.

Further ultrasonic detection was carried out using a fixed detector operating overnight on the 2nd and 3rd August 2011 at a farm dam within the Study Area (**Figure 9a**).

Recorded bat calls were analysed and identified by Amy Rowles and Ray Williams of Ecotone Ecological Consultants (**Appendix 3**).

Trapping

Three trap lines were set to sample different habitats. One trap line sampled a rainforest gully, one in Dry sclerophyll forest and one in the mature forest along the McKinleys Lane road reserve. Where there was sufficient vegetation stratification, the habitat was sampled using ground traps in conjunction with arboreal traps. The rainforest and the Dry sclerophyll forest trap lines consisted of 25 Elliott A ground traps, 10 Elliott B tree traps and two wire cage traps on the ground. The trap line on McKinleys Lane consisted of five arboreal Elliott B traps. Each trap line was sampled for a total of four consecutive nights as per the OEH recommendations (DECC, 2004). Trap lines were checked each morning and all captures were recorded and immediately released.

3.2.2 Survey limitations

There were no specific survey limitations. Weather conditions during the survey periods were generally regarded as being good for the detection of most species. Reasonable species diversity was obtained for most fauna groups suggesting adequate conditions for survey.

While the duration of the surveys was adequate to fulfil the requirements of the assessment, and a reasonable species diversity was recorded, as with any fauna field surveys, the number of species detected will rise as the length of time on Site increases.

3.2.3 Results

3.2.3.1 Fauna Habitat Types

Eight fauna habitat types were identified within the Study Area.

1. Cleared open paddocks
2. Ironbark/Grey gum/Spotted gum/White mahogany Open Forest/Woodland
3. River oak/Cabbage gum/Broad-leaved apple Riparian Forest
4. Giant stinging tree/Fig Rainforest Gullies
5. Farm Dams
6. Watercourses (creeks and rivers)
7. Bridges/culverts
8. Paddock trees/dead stags

Each habitat is briefly described as follows.

Fauna habitat descriptions

Fauna Habitat Type	**1. Cleared open paddocks**	
Description	The cleared open paddocks are typically made up of native and introduced grasses and forbs. This habitat type covers the majority of the Study Area and is important foraging area for many species of bird and larger mammal species such as the Eastern grey kangaroo.	
Condition	Most of the cleared paddock is open and consists of a good ground cover. There is little degradation in the form of erosion.	
Location	Throughout the Study Area, mostly restricted to the flatter plains and mid to lower slopes.	

Fauna Habitat Type	**2. Ironbark/Grey gum/Spotted gum/White mahogany Open Forest/Woodland**	
Description	Typically made up of Ironbark, Grey gum, Spotted gum and White mahogany. Made up of a grass/shrub layer, a middle story and a canopy layer. This type of habitat provides refuge for woodland bird and mammal species and shelter for macropods on the lower plains.	
Condition	Some patches of this type of vegetation may be described as degraded by grazing practices and localised forest harvesting. Other areas where this habitat type exists could be described as managed by burning and grazing practices.	
Location	Some remnant patches on the lower plains and vegetation corridor around McKinleys Lane. On the upper slopes extending to the top of the range.	

Fauna Habitat Type	**3. River oak/Cabbage gum/Broad-leaved apple Riparian Forest**	
Description	The riparian forest is made up of River oak / Cabbage gum / Broad-leaved apple Riparian Forest. This habitat type has the capability of supporting a range of fauna species that use vegetation along creek lines, rivers and small streams for foraging, refuge and roosting.	
Condition	In some areas this habitat type has been affected by stock access. This has opened up the vegetation allowing pioneer weed species to establish and has also degraded the banks of the watercourses where this has occurred.	
Location	The riparian habitat extends the length of most of the watercourses within the Study Area.	

Fauna Habitat Type	**4. Giant stinging tree/Fig Rainforest Gullies**	
Description	The rainforest habitat is made up of giant stinging trees, figs, vines and other species indicative of rainforest habitat. This habitat is dark and moist and may support a range of species that typically use rainforest areas for foraging and refuge. Within this habitat there are rock crevices and tree hollows that range in sizes that may provide potential refuges for arboreal mammals, ground dwelling mammals and micro bats.	
Condition	This habitat type has been affected by fragmentation through years of burning and grazing. There is some edge effect of pioneer weed species.	
Location	The rainforest habitat is restricted to the upper slope wet drainage lines and drainage lines, there are some remnant patches on the lower slopes.	

Fauna Habitat Type	**5. Farm dams**	
Description	The farm dams are predominantly used for pumping stock and domestic water although some may be utilised for stock watering. Most are vegetated around the perimeter with Cumbungi and Common reed. These dams provide good habitat for some amphibians, foraging habitat for micro bats and water birds.	
Condition	Most of the farm dams within the Study Area are in good condition. Those that have had stock access are typically more turbid and the vegetation has been removed.	
Location	Farm dams are common throughout the lower plains and slopes of the Study Area.	

Fauna Habitat Type	**6. Watercourses (Creeks and Rivers)**	
Description	The watercourses throughout the Study Area range from small to large pondages with shallow rocky overflow areas. Many of the watercourses have an abundance of debris such as logs. These habitats may support a range of species such as platypus, aquatic reptiles such as turtles and water dragons.	
Condition	The watercourses range from good condition where there is no stock access to poor and degraded in areas where stock have accessed.	
Location	Watercourses that traverse the Study Area include the Avon River, Waukivory Creek and Oaky Creek.	

Fauna Habitat Type	**7. Bridges/Culverts**	
Description	The bridges and culverts throughout the Study Area range from concrete to composite constructions, i.e. timber and concrete. These bridges provide potential roosting habitats for micro bats, and refuge for reptiles such as pythons and small lizards.	
Condition	Most of the bridges observed during the field study are in good condition and contain numerous cracks and crevices for fauna to utilise. The bridge over the Avon River at Jacks Road is in poor condition and is currently closed to traffic.	
Location	At several creek and watercourses within the Study Area.	

Fauna Habitat Type	**8. Paddock trees/dead stags**	
Description	Dead stags are large trees that have died and are slowly breaking down. Most of the isolated paddock trees on the Study Area contain hollows that may provide roosting habitat for micro bats, birds and arboreal mammals. They are moderately common throughout the Study Area.	
Condition	The majority of the dead stags are in a reasonable state of decay to allow for an abundance of hollows and fissures.	
Location	Throughout the Study Area, however mostly restricted to the lower slopes.	

3.2.3.2 Hollow-bearing trees

The density of hollow-bearing trees was measured as one of the parameters recorded within the BioBanking plots (proposed disturbance area and proposed offset area) and has been taken into consideration in the calculation of offsets required for the Proposal.

Tree hollows were found to be quite common (average 36/1000 square metres) within the Dry sclerophyll forest, but much more scarce within the Riparian areas (average 5/1000 square metres) and Rainforest areas (average 3/1000 square metres) within the proposed disturbance area.

Some of the isolated paddock trees scattered through the Study Area also contain hollows.

3.2.3.3 Fauna species detected

Fauna species diversity

A total of 111 species of vertebrate fauna were positively identified during the field surveys, including fourteen species of frogs, seven species of reptiles, 26 species of mammals and 64 species of birds (**Appendix 3**). Of these species, nine species are listed as vulnerable under the TSC Act. Seven of the species have been introduced to Australia. No platypus were detected but since they are a very secretive species, it cannot be assumed that Platypus do not occur within the rivers and creeks of the locality.

Threatened Species recorded

Nine threatened fauna species were recorded within the Study Area during the field surveys (see **Table 16**). The occurrences of each threatened species in the Study Area are discussed below and the general locations are displayed on **Figure 10**.

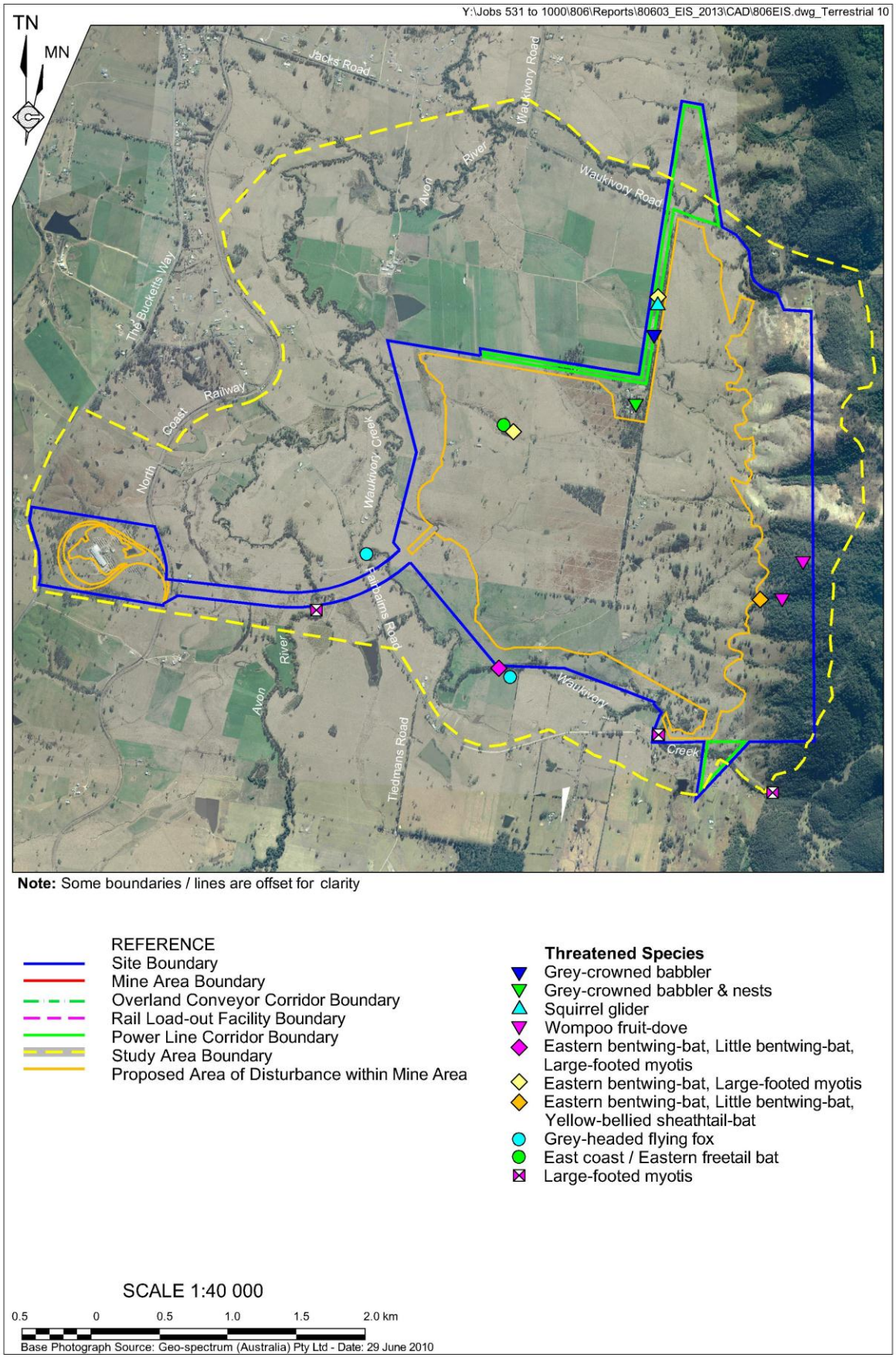

Figure 10 Threatened Fauna Detected within the Study Area

Table 16
Threatened species recorded during the Field Surveys

Scientific name	Common name	Status TSC Act
Ptilinopus magnificus	Wompoo fruit-dove	V
Pomatostomus temporalis	Grey-crowned babbler	V
Petaurus norfolcensis	Squirrel glider	V
Saccolaimus flaviventris	Yellow-bellied sheath-tail bat	V
Miniopterus australis	Little bent-wing bat	V
Miniopterus schreibersii oceanensis	Eastern bent-wing bat	V
Myotis macropus/Myotis adversus	Large-footed myotis	V
Mormopterus norfolkensis	Eastern coast free-tail bat	V
Pteropus poliocephalus	Grey-headed flying fox	V

Birds

- Wompoo fruit-dove (*Ptilinopus magnificus*)

  The Wompoo fruit-dove was identified via its unique call. The call was heard opportunistically whilst traversing trap line 5 (**Figure 9a**), in the rainforest on the middle slope (**Figure 10**). It is estimated that the call came from an area approximately 70m to the south.

- Grey-crowned babbler (*Pomatostomus temporalis*)

  Grey-crowned babblers were identified along McKinleys Lane and nests were identified in the yard of a property adjacent to McKinleys Lane (**Figure 10**).

Arboreal Mammals

- Squirrel glider (*Petaurus norfolcensis*)

  A squirrel glider was trapped in an arboreal tree trap (trap line 2, **Figures 9a** and **10**), along McKinleys Lane. It was observed that the trees in this location contained substantial hollows and, although the vegetation corridor is only narrow, it does have some connectivity to remnant patches and there is substantial area for foraging for this species.

Insectivorous Bats

Four threatened insectivorous bats were recorded on the Study Area during the field survey. Three species were recorded with “definite” confidence and one with “probable” confidence level, based on the analysis of calls recorded by Anabat recorders (**Figure 10**).

- Yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*)

  The Yellow-bellied sheath-tail bat was recorded with “probable” confidence by one Anabat recorder on the edge of the rainforest area on the upper slope of the Study Area. This species prefers relatively large tree hollows for roosting and typically forages above the canopy (**Figure 10**).

- Little bent-wing bat (*Miniopterus australis*)

  The Little bent-wing bat was recorded with definite confidence in the riparian habitat along Waukivory Creek, on the edge of the rainforest area and in the vegetated corridor of McKinleys Lane. These bats prefer to roost in caves, abandoned mines, tunnels, stormwater drains and buildings. The Little bent-wing bat typically forages between the shrub layer and the canopy of well timbered areas (**Figure 10**).

- Eastern bent-wing bat (*Miniopterus schreibersii oceanensis*)

  The Eastern bent-wing bat was recorded with "definite" and "probable" confidence at three Anabat detector sites, the rainforest edge, the vegetated corridor of McKinleys Lane and the riparian habitat. This species is predominantly a cave dweller but, like the Little bent-wing bat, is also known to use human structures for roosting. In forested habitats this species forages just above the canopy and in more open areas will forage a few metres from the ground (**Figure 10**).

- Large-footed myotis (*Myotis macropus*/*Myotis adversus*)

  The Large-footed myotis was recorded with definite confidence in the riparian corridor along Waukivory Creek, at a farm dam in the centre of the Study Area and the vegetated corridor of McKinleys Lane (**Figure 10**). This species is typically associated with streams and permanent waterways. The Large-footed myotis lives in most habitat types as long as it is near water as they forage over water for small fish and aquatic insects.

- Eastern coast free-tail bat (*Mormopterus norfolkensis*)

  The Eastern coast free-tail bat was recorded with "definite" confidence at an Anabat detector site at a farm dam within the Site (**Figure 10**).

Fruit-bats

- Grey-headed Flying Fox (*Pteropus poliocephalus*)

  While carrying out frog surveys along Waukivory Creek, Grey-headed flying foxes were opportunistically observed foraging within the riparian vegetation at Barred frog survey sites A and D (**Figure 10**).

3.2.3.4 Koala Scat Searches

No Koala scats were observed during Koala scat searches and no scratch marks on the trunks of trees resembled the characteristic scratch marks made by the Koala.

3.3 SUPPLEMENTARY BARRED FROG SURVEYS

Targeted supplementary frog surveys were carried out by Ecotone Ecological Consultants to establish the presence or absence of the Giant barred frog, *Mixophyes iteratus* within or in the vicinity of the Study Area. The Giant barred frog is listed as Endangered under the NSW Threatened Species Conservation Act 1995 and Commonwealth EPBC Act and has been detected near the Duralie Mine, approximately 27km south of the proposed Mine Area for the Rocky Hill Coal Project.

This subsection presents the methodology and results of both the spring (11th and 13th October 2011) and summer (18th and 19th January 2012) Giant barred frog survey periods. **Figure 9a** displays the locations of the survey sites.

3.3.1 Methods

The methodology employed for these targeted surveys exceeds the *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians* (DECCW, 2009). The following methodology is specific for targeting the Giant barred frog (*Mixophyes iterates)* but also targets the Stuttering frog (*Mixophyes balbus)* and many other frog species found along riparian corridors.

The recommended survey techniques for the Giant barred frog (from DECCW, 2009) comprise a combination of tadpole surveys, call surveys and nocturnal searches along flowing streams in suitable weather conditions along minimum of one 200m transect per water body, repeated on a minimum of two separate nights. This species may respond to call playback or a good imitation of their call.

Surveys can be conducted between September and March with males calling during spring and summer. Surveys should be undertaken when air temperature is above 18^{o}C.

3.3.2 Typical Habitat

Suitable habitat for the Giant barred frog ranges from rainforest and wet sclerophyll forest, to farmland, although it is seldom found beyond 20 m from a watercourse. Giant barred frogs can also exist in disturbed areas within vegetated riparian strips. The Giant barred frog requires shallow, permanently flowing, rocky streams for breeding, with a riparian strip that can provide a thick damp leaf litter layer in which this species takes cover.

3.3.3 Survey Sites

3.3.3.1 Spring Surveys

Four sites (A, B, C, D) were initially chosen from aerial mapping and site knowledge, but Site D was later discarded. The criteria for choosing each site were based on site access, relevance of site in terms of the intended areas of disturbance for the proposed Rocky Hill Coal Project and availability of potentially suitable habitat (**Figure 9a**). Areas that were excluded from being surveyed were intermittent or ephemeral streams.

3.3.3.2 Summer Surveys

Seven sites were selected for survey in order to repeat the sites previously surveyed in spring (A, B, C); sample a watercourse within the expanded Study Area (Site G), and to survey the broader area surrounding the proposed site of the Rocky Hill Coal Project (Sites E, F and H).

3.3.4 Results

3.3.4.1 Spring Surveys

On the evenings of 11th and 13th October 2011, four sites in total were inspected. Two were surveyed over two evenings, namely Sites A & B while a third site was surveyed on the night of 13th only (Site C). The fourth site, Site D, was deemed to be unsuitable due to the lack of suitable habitat (**Figure 9a**).

Weather conditions on the 11th October 2011 were mild with clear skies, a near full moon and no rain. At the GRL Weather Station at the time of the surveys, the temperature was around 15ºC with an overnight minimum temperature of approximately 5.2ºC the following morning. At the GRL Weather Station light rain had fallen on the 4th, 6th and 7th October 2011.

Conditions on 13th October 2011 were slightly warmer, overcast with no rain. At the GRL Weather Station at the time of the surveys, the temperature was around 16ºC.

A site on the Mammy Johnsons Creek near Stroud was used as a reference site. At the reference site, Giant barred frogs were observed around the same period, but were not calling. No Giant barred frogs were detected by call or hand searches at any of the Rocky Hill Coal Project sampling sites. Results are tabulated in **Table 17**.

The results from the spring surveys indicate that while Giant barred frogs were present at the reference site, at the time the survey was undertaken, they were absent from the Rocky Hill Coal Site. The reasons for this could be that local conditions were not favourable at the time (low activity due to cool weather) although the same conditions did not affect their identification at the reference site, or that the vegetation within the subject sites is not ideal (survey sites had a sparse ground cover of leaf litter and the riparian zones were generally very open), or that the in-stream conditions within the survey sites are not ideal for the Giant barred frog. Factors such as distance from and extent of upstream forested habitat, may also affect the suitability of riparian areas for this species.

Table 17
Spring and Summer Survey Results – Giant barred frog

Page 1 of 2

Site name	Location	Habitat description	Spring Surveys (11 & 13 October 2011)		Summer Surveys (18 & 19 January 2012)	
			***Mixophyes iteratus* Present or Absent**	**Other species detected**	***Mixophyes iteratus* Present or Absent**	**Other species detected**
Site A	Waukivory Creek	Narrow riparian strip approximately 5m at its widest point down to 3m either side of stream bank predominantly made up of River oak (*Casuarina cunninghamiana)*, low amount of leaf litter, patchy in places, some deep ponds, and stream bed predominantly gravel. Poor canopy cover. Salt encrustation on rocks in creek.	Absent	*Litoria peronii, Litoria wilcoxii, Adelotus brevis, Crinia signifera*	Absent	*Litoria peronii, Litoria wilcoxii, Adelotus brevis, Litoria latopalmata, Litoria phyllochroa, Limnodynastes peronii*

Table 17 (Cont'd)
Spring and Summer Survey Results – Giant barred frog

Site name	Location	Habitat description	Spring Surveys (11 & 13 October 2011)		Summer Surveys (18 & 19 January 2012)	
			***Mixophyes iteratus* Present or Absent**	**Other species detected**	***Mixophyes iteratus* Present or Absent**	**Other species detected**
Site B	Oaky Creek	Narrow riparian strip ranging from approximately 3m in some places to 8m at its widest point either side of the stream bank. Some leaf litter present but patchy. Weedy understorey dominated by *Tradescantia fluminensis*. Dark, sheltered habitat north of the bridge. Salt encrustation on rocks in creek.	Absent	*Litoria wilcoxii, Litoria fallax, Limnodynastes tasmaniensis, Crinia signifera, Rattus sp, Ninox novaeseelandiae* Southern boobook.	Absent	*Litoria wilcoxii, Litoria fallax, Limnodynastes peronii*
Site C	Avon River	Narrow riparian strip consisting of steep deep banks, vegetation dominated by River oak (*Casuarina cunninghamiana)* and Weeping willow (*Salix babylonica)*. Ground cover weedy. Little to no leaf litter and little to no canopy cover.	Absent	*Litoria tyleri, Litoria peronii, Litoria fallax, Crinia signifera, Limnodynastes tasmamiensis.*	Absent	*Litoria fallax, Litoria phyllochroa, Limnodynastes peronii* on transect. *Limnodynastes tasmaniensis* calling from nearby dam.
Site D	Waukivory Creek	Narrow riparian strip dominated by weedy understorey and a tree layer dominated by River oak (*Casuarina cunninghamiana)* and Weeping willows (*Salix babylonica)*.	Not surveyed due to unsuitable habitat.	N/A	Not surveyed due to unsuitable habitat.	N/A
Site E	Waukivory Creek	Off Fairbairns Road, Waukivory Creek, near southeast corner of Study Area. Riparian vegetation 3-15m either side of creek.			Absent	*Adelotus brevis, Litoria latopalmata, Litoria peronii, Litoria wilcoxi, Limnodynastes peronii*
Site F	Waukivory Creek	Off end of Fairbairns Road, Waukivory Creek, extreme south east corner of the Study Area. Riparian vegetation 10 m wide on one side and >50m on other side. Close to extensive forest area on hills. Salt encrustation on rocks in creek	Not Surveyed		Absent	*Adelotus brevis, Litoria phyllochroa, Litoria wilcoxi*
Site G	Avon River	Bill Toombs' property. Narrow (8 m each side) riparian strip with Weeping willows (*Salix babylonica)*, Grey myrtle (*Backhousia myrtifolia)*, River oak, Willow bottlebrush (*Callistemon salignus)* and many weeds in groundcover. Bank disturbed by cattle. . Salt encrustation on rocks in creek.	Not Surveyed		Absent	*Litoria caerulea, Limnodynastes peronii Litoria latopalmata* on transect and *Litoria tyleri, Litoria fallax and Limnodynastes peronii* at nearby dam
Site H	Avon River	Fairbairns Road bridge crossing. Riffles and pools. Disturbed habitat on both sides of creek with approx. 5 m width of riparian vegetation each side. Many weeds.	Not Surveyed		Absent	*Litoria peronii, Limnodynastes peronii*

3.3.4.2 Summer Surveys

Over the evenings of the 18th and 19th January 2012, seven sites in total were inspected (**Figure 9a**). Three were surveyed (sites A, B and G) on 18th January 2012 and four (sites C, E, F and H) were surveyed on the night of 19th January 2012. Site D, was deemed to be unsuitable at the time of the spring surveys due to the lack of suitable habitat.

Weather conditions on the 18th January 2012 were warm with clear skies, no moon and no rain. Light rain had fallen the previous night, so groundcover was wet. The temperature measured at each of the sites was between 20ºC and 24ºC. At the GRL Weather Station at the time of the surveys, the temperature was between 20ºC and 23ºC with an overnight minimum temperature of approximately 17ºC the following morning.

Conditions on the 19th January 2012 were partly cloudy, no wind and no moon visible and temperature measured at each of the sites ranged from 18.5ºC to 25ºC. At the GRL Weather Station at the time of the surveys, the temperature was between 19ºC and 21ºC with a minimum temperature of approximately 16ºC the following morning.

The previous site, Mammy Johnsons Creek near Stroud, was again used as a reference site. At the reference site, Giant barred frogs were observed and were calling repeatedly. No Giant barred frogs were detected at any of the Rocky Hill Coal Project sampling sites. Results are tabulated in **Table 17.**

Opportunistic sightings of terrestrial and aquatic fauna and flora species were made during the course of the supplementary frog surveys and hand-held Anabat detectors were operated while searching for frogs. The threatened (EPBC Act and TSC Act) species, Grey-headed Flying-fox, was detected, and additional locations (E, F and G) for the threatened fauna species Large-footed myotis, which was identified elsewhere within the Study Area, during the earlier surveys were recorded.

All species detected have been incorporated into the species lists presented in **Appendix 3** and **Table 18** is a complete list of threatened species detected from all field surveys. All locations where threatened species were recorded within the Study Area during any of the field survey work are shown in **Figure 10**.

3.3.5 Conclusions

Weather and seasonal conditions were very suitable for the detection of Giant barred frogs, but none was detected around the Study Area, despite the species being detected at the reference site in spring and calling well at the reference site in summer.

The reference site is located approximately 27km south of the proposed Rocky Hill Coal Mine site, but within a different catchment (flowing southwards) and may be a factor in the distribution of this frog species. It does appear that the lack of natural leaf litter at most of the sites around the Site of the proposed Rocky Hill Coal Project and apparently saline water conditions within the watercourses, may not provide suitable habitat for this species in this area, despite many other frog species being detected.

4. ASSESSMENT OF IMPACTS

4.1 OVERVIEW OF THE IMPACTS OF THE PROPOSAL

The overall proposed area of disturbance is 525ha, comprising all categories of land, with or without native vegetation. Of this area, 51.8ha consists of native vegetation in any condition. Vegetation Community 2 (Dry sclerophyll forest) was divided into two categories (moderate to good or low condition) for the purposes of calculations using the BioBanking Assessment Methodology (BBAM) (see Section 5.5 and **Table 25**). The methodology provides for the actual areas of patches of low condition vegetation to be adjusted to effective clearing areas. The effective clearing area recognises that the total canopy cover of low condition vegetation is significantly less than that of moderate-to-good condition vegetation (DECC 2009a).

Vegetation Community 2 covers an actual area of 46.4ha, of which 15.8ha is in moderate to good condition and 30.6ha in low condition. The actual area for the low condition vegetation converts to 19.9ha effective clearing area. Thus the total effective clearing area for Community 2 is 35.7ha.

Vegetation Community 3 (Riparian) covers an area of 1.1ha and is all in moderate to good condition. Vegetation Community 4 (Rainforest) covers an area of 4.3ha and is all in moderate to good condition.

Therefore, the effective clearing areas of each vegetation community that would be impacted and the resulting total effective clearing area for all native vegetation communities, taking into account low condition vegetation, are as follows.

Community 2 (Dry sclerophyll forest)	35.7ha
Community 3 (Riparian)	1.1ha
Community 4 (Rainforest)	4.3ha
TOTAL	41.1ha

The effective clearing area is used in all biobanking calculations and flora assessments in this report.

A number of isolated large paddock trees inside the proposed Mine Area would also be removed, mostly within areas mapped as low condition Dry sclerophyll forest, and some trimming of trees at the conveyor crossings of the Avon River and Waukivory Creek would be required as a result of the Proposal.

One vegetation community (Community 4) within the Study Area has been identified as a Vulnerable Ecological Community pursuant to the NSW TSC Act. This dry rainforest community mainly occupies the drainage lines on the steeply sloping forested land at the eastern side of the Study Area. However, some smaller remnant patches occur on the cleared, flatter land east of McKinleys Lane, particularly two remnant patches at the southern end of the Study Area (**Figure 3**) within the proposed area of disturbance.

Nine threatened fauna species were detected within the Study Area, but no threatened flora species were detected. Potential habitat for up to 55 threatened fauna species is present within the Study Area.

Four threatened species were recorded within the road-side vegetation along McKinleys Lane, namely the Grey-crowned babbler, Squirrel glider, the Eastern bent-wing bat and the Large-footed myotis. The Eastern bent-wing bat and the Large-footed myotis are highly mobile and may forage over a large area, however the Grey-crowned babbler and the Squirrel glider are relatively sedentary and are likely to have small populations resident along the road-side vegetation which may be affected by the Proposal, despite the northern end of McKinleys Lane being excluded from the proposed area of disturbance.

The majority of the other threatened species were detected in the rainforest community on the upper slopes; in the riparian areas; or in the Dry sclerophyll forest on the upper slopes. It is unlikely that there would be a direct impact from the Proposal on those habitats on the upper slopes, however, indirect impacts such as noise, vibration and dust may potentially have an impact on these habitats.

4.2 NSW STATE LEGISLATIVE REQUIREMENTS

4.2.1 Division 4.1 of the Environmental Planning and Assessment Act 1979

The Proposal will be assessed under Part 4 Division 4.1 of the *Environmental Planning and Assessment Act 1979* as a State significant development. Under Division 4.1, the Department of Planning and Infrastructure identifies the issues that the Applicant must address in the Environmental Impact Statement for the Proposal, known as the Director-General's Requirements. The Director-General's Requirements are developed in consultation with relevant agencies, in this case the Environment Protection Authority/Office of Environment and Heritage; NSW Catchment Management Authority; NSW Division of Resources and Energy; Gloucester Shire Council.

4.2.1.1 Determination of Subject Species for Impact Assessment

The OEH, in its requirements for the EIS, defines subject species as those threatened species, populations and ecological communities known or considered likely to occur in the habitats present within the Study Area.

The database and literature search described in Section 2 identified 26 threatened flora species (**Table 5**) and 59 threatened fauna species (**Table 10**) that had previously been recorded or were considered likely to occur in the Study Locality. During the field habitat assessment and surveys, these species were assessed for their potential to occur in the habitats within the disturbance areas and, for threatened fauna, whether foraging, sheltering and/or breeding habitat was likely to be present. The assessment to determine subject species for impact assessment is presented in **Appendix 4** and **Appendix 5**. Two additional species only identified from the BioBanking Credit Calculator (Black-chinned honeyeater and Freckled duck) are also assessed for inclusion as subject species for impact assessment in **Appendix 5**.

This has resulted in the refinement of the list in Section 2, to 36 fauna species and one endangered ecological community for impact assessment.

A list of subject species for impact assessment is provided in **Table 18** below. The potential impacts of the proposed Rocky Hill Coal Mine on the 36 subject species (all fauna) and one Endangered Ecological Community, are assessed in accordance with *Draft Guidelines for Threatened Species Assessment* (DECC and DPI July 2005) and in accordance with Section 5a of the EP&A Act, as specified in the DGRs.

Note that the reference to *Draft Guidelines for Threatened Species Assessment* DECCW and DoP July, 2005 in the EPA/OEH Agency Comments, is assumed to be an error, since the correct reference for *Draft Guidelines for Threatened Species Assessment* is (DECC and DPI, July 2005)

4.2.2 Assessment in accordance with Draft Guidelines for Threatened Species Assessment (DECC and DPI, 2005)

In accordance with other matters provided by the EPA, the EIS must take into account the *Draft Guidelines for Threatened Species Assessment* (DECC and DPI July 2005), which recommends a five step process of assessing a Proposal.

Step 1. Preliminary Assessment

The main purpose of the preliminary assessment is to determine the likelihood of the Study Area supporting threatened species, populations or ecological communities.

This has been addressed in Section 2, **Appendix 4** and **Appendix 5** of this report, in which the likelihood of threatened flora and fauna species, endangered populations of flora and fauna or threatened ecological communities occurring within the Study Area has been assessed on the basis of the nature and quality of habitats available and the presence of previous records in the Study Locality.

Step 2. Field Survey and Assessment

Field surveys have been conducted by suitably qualified and experienced investigators using currently accepted survey methodologies.

The methodology and results of the field surveys has been documented in Section 3 of this report.

Step 3. Evaluation of Impacts

This step involves an assessment of the magnitude and extent of the impacts of the Proposal on threatened species, as well as consideration of their significance in the context of the relative conservation importance of the habitat, population and individuals likely to be affected.

An assessment of the impacts of the Proposal on threatened species, populations or ecological communities that are known or could potentially occur within the proposed disturbance area (proposed disturbance within the Mine Area, Conveyor Corridor and Rail Load-out Facility) needs to be prepared in accordance with the factors listed in Appendix 3 of the guidelines.

Table 18
Subject Species for Impact Assessment

Scientific name	Common name	Status TSC Act
ENDANGERED ECOLOGICAL COMMUNITIES		
	Lower Hunter Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	V
BIRDS		
Ephippiorhynchus asiaticus	Black-necked stork	E
Neophema pulchella	Turquoise parrot	V
Lophoictinia isura	Spotted harrier	V
Lophoictinia isura	Square-tailed kite	V
Hieraeetus morphnoides	Little eagle	V
Glossopsitta pusilla	Little lorikeet	V
Chthonicola sagittata	Speckled warbler	V
Daphoenositta chrysoptera	Varied sittella	V
Xanthomyza phrygia	Regent honeyeater	E
Melithreptus gularis gularis	Black-chinned honeyeater	V
Lathamus discolour	Swift parrot	E
Ninox connivens	Barking owl	V
Ninox strenua	Powerful owl	V
Tyto novaehollandiae	Masked owl	V
Tyto tenebricosa	Sooty owl	V
Pomatostomus temporalis temporalis	Grey-crowned babbler	V
Ptilinopus superbus	Superb fruit-dove	V
Ptilinopus regina	Rose crowned fruit-dove	V
Ptilinopus magnificus	Wompoo fruit-dove	V
MAMMALS		
Phascogale tapoatafa	Brush-tailed phascogale	V
Chalinolobus dwyeri	Large-eared pied bat	V
Falsistrellus tasmaniensis	Eastern false pipistrelle	V
Miniopterus schreibersii oceanensis	Eastern bent-wing bat	V
Miniopterus australis	Little bent-wing bat	V
Mormopterus norfolkensis	Eastern coast free-tail bat	V
Myotis macropus/Myotis adversus	Large-footed myotis	V
Saccolaimus flaviventris	Yellow-bellied sheath-tail bat	V
Scoteanax rueppellii	Greater broad-nosed bat	V
Vespadelus troughtoni	Eastern cave bat	V
Pteropus poliocephalus	Grey-headed flying-fox	V
Petaurus norfolcensis	Squirrel glider	V
AMPHIBIANS		
Litoria aurea	Green and golden bell frog	E
Litoria brevipalmata	Green thighed frog	V
Myxophyes iteratus	Giant barred frog	E
Myxophyes balbus	Stuttering frog	E
REPTILES		
Hoplocephalus stephensii	Stephens banded snake	V

V = Vulnerable, E = Endangered

Determinations of threatened species that are considered to have potential to occur in the Study Area (subject species) have been made in **Appendix 4** (flora) and **Appendix 5** (fauna) and the resultant list is presented in **Table 18**.

Those species considered to be subject species for impact assessment in **Appendix 4** and **Appendix 5** and any Endangered Ecological Communities identified within the Study Area are assessed below in accordance with *Guidelines for Threatened Species Assessment* (DECC & DPI, 2005).

How is the Proposal likely to affect the lifecycle of a threatened species and/or population?

Black-necked stork – Endangered under the NSW TSC Act

The Black-necked stork was not recorded in the Study Area during field survey. While the Black-necked stork has been previously recorded within the Study Locality and within 2km of the Study Area (NSW OEH Wildlife Atlas), there are no previous records of the Black-necked stork breeding in the Gloucester area (Clancy and Andren 2010). Within the predicted territory for a pair of Black-necked storks at Gloucester there has been 176ha of wetland and 3 943ha of floodplain identified that would provide substantial foraging opportunities for the Black-necked stork (Clancy and Andren 2010). The proposed Rocky Hill Coal Project would result in the disturbance of an estimated 525ha of land, none of which is classified as flood prone, but may constitute marginally suitable foraging habitat for the Black-necked stork. There are vast tracts of more suitable habitat for foraging directly to the north and west of the disturbance area.

In conclusion, it is unlikely that the proposed Rocky Hill Coal Project would affect the breeding habitat of the Black-necked stork, however, the Proposal may result in a small reduction of potential foraging habitat for this species. This small reduction in potential foraging habitat is unlikely to have a significant effect on the lifecycle of any local population of this species.

Spotted harrier – Vulnerable under the NSW TSC Act. The Spotted harrier has been recorded only once previously within the Study Locality according to the OEH Wildlife Atlas and was not detected during the field surveys for this biodiversity assessment.

The proposed Rocky Hill Coal Project would remove a relatively small area (approximately 473.2ha) of potential foraging habitat (cleared open pasture) for the Spotted harrier and possibly some potential nest site trees. Since the foraging habitat within the area of disturbance would constitute a very small part of the foraging range of a Spotted harrier and there were no nests observed on the Study Area, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the life cycle or the long-term viability of any local population of this species.

Square-tailed kite – Vulnerable under the NSW TSC Act

The Square-tailed kite was not recorded during the surveys within the Study Area nor has this species been recorded by the NSW OEH Wildlife Atlas within the Study Locality, although this species could forage throughout the habitats in the Study Area. No evidence of a nest was seen but there were a number of tall eucalypts which could be used for nesting by this species.

The proposed Rocky Hill Coal Project would disturb approximately 525ha of land of which only a small portion (46.4ha of Dry sclerophyll forest of any condition and 1.1ha of Riparian vegetation) would constitute potential breeding sites for the Square-tailed kite. Considering the large areas of forest used by this bird and the lack of any sightings of this species in the Study Area during the field studies, the proposed Rocky Hill Coal Project is not expected to have a significant effect on the life cycle or long-term viability of any local population of this species.

Little eagle – Vulnerable under the NSW TSC Act

The Little eagle was not recorded during the survey within the Study Area nor has this species been recorded by the NSW OEH Wildlife Atlas within the Study Locality. This species could, however, forage throughout the Study Area and potentially nest in one of the tall Eucalypts within the Study Area, although no large nests were observed during the survey.

The proposed Rocky Hill Coal Project would remove a relatively small area (approximately 473.2ha) of potential foraging habitat (cleared open pasture) for the Little Eagle and possibly some potential nest site trees. Since the foraging habitat within the area of disturbance would constitute a very small part of the foraging range of a Little eagle and there were no nests observed on the Study Area, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the life cycle or the long-term viability of any local population of this species.

Little lorikeet – Vulnerable under the NSW TSC Act

The Little lorikeet was not was not recorded during the surveys within the Study Area nor has this species been recorded by the NSW OEH Wildlife Atlas within the Study Locality. However this species has the potential to forage in flowering Eucalypts in forested parts of the Study Area, predominantly within Community 2. There are tree hollows of a suitable size for Little lorikeets to nest in within Community 2 in the Study Area.

The Little lorikeet is generally considered to be a nomadic species which responds to mass flowering events of Eucalypts and feeds largely from flowers. This species could forage on flowering trees in the Study Area from time to time and could also nest within the Study Area, if there was a sufficient supply of food nearby. Due to its nomadic nature, its local population would extend across at least hundreds of square kilometres and include the nearby ranges and coast.

It is considered unlikely that the proposed Rocky Hill Coal Project would have any significant adverse effect on the life cycle or long-term viability of any local population of the Little lorikeet, given the habit of this species to move relatively large distances in response to availability of seasonal food resources and the lack of records during the field survey. The proposed Rocky Hill Coal Project would therefore be unlikely to have a significant effect on this species.

Non hollow-dependent, insectivorous and granivorous woodland birds

- **Speckled warbler** – Vulnerable under the NSW TSC Act
- **Varied sittella** – Vulnerable under the NSW TSC Act
- **Turquoise parrot** – Vulnerable under NSW TSC Act

The Speckled warbler, the Turquoise parrot and the Varied sittella were not recorded in the Study Area during the field surveys and only the Speckled warbler has been recorded in the Study Locality (NSW OEH Wildlife Atlas). All of these species are resident in a home range area for most or all of the year, occur in relatively open forest, woodland and nearby grassland. The Speckled warbler and Turquoise parrot forage mainly on the ground while the Varied sittella forages mainly for insects in the canopy. The Turquoise parrot requires tree hollows for nesting.

The proposed Rocky Hill Coal Project would result in the loss of a portion (46.4ha) of potential foraging and breeding habitat in the form of vegetation Community 2 and adjacent grassland (Dry sclerophyll forest in any condition) and this reduction in area of available habitat could result in the displacement of some birds if they are present. The Speckled warbler is likely to have restricted local populations. It has been recorded to the southwest of the Study Locality in the Gloucester Tops area. There is much more habitat that would be suitable for all three species on the eastern side of the Study Area (the steep slopes of the Mograni Range provide forest and forest edge habitat). It therefore seems unlikely that the small patches of potentially suitable habitat within the proposed area of disturbance would comprise part of an important area of habitat for any of these species based on the lack of records during survey work undertaken by Ecotone Ecological Consultants and on the Atlas of NSW Wildlife.

The Speckled warbler and the Varied sittella would be expected to forage and possibly nest in regenerating native vegetation, particularly if this occurred in adjacent habitat, and considering that much of the vegetation suitable for all three of these species would remain untouched on the upper slopes, the small loss of habitat caused by the Rocky Hill Coal Project would be compensated in the interim by vegetation to be established within the visibility barrier areas and in time by the vegetation to be established as open woodland and native vegetation corridors as part of the rehabilitation plan for the disturbance area and the proposed revegetation of the cleared parts of the proposed Biodiversity Offset Area

In conclusion, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on these species.

Blossom and mistletoe-feeding woodland birds

- **Regent honeyeater** – Endangered under the NSW TSC Act
- **Swift parrot** – Endangered under the NSW TSC Act
- **Black-chinned honeyeater** – Vulnerable under the NSW TSC Act

None of these species was recorded in the Study Area during the surveys but all have some potential to use the Study Area for foraging for Eucalypt blossom. The Regent honeyeater and Swift parrot have recognised breeding areas in particular parts of New South Wales and Tasmania, respectively, none of which are located within the Study Locality. The Black-chinned honeyeater is widespread in NSW but rare in coastal districts. They tend to use the largest remnants of vegetation, so they are unlikely to be affected by the relatively minor removal of small patches of vegetation for this Proposal.

The proposed Rocky Hill Coal Project would result in the loss of a relatively small portion (maximum 15.8ha, comprising small patches of Dry sclerophyll forest in moderate to good condition) of potential foraging habitat for these species in the locality. Since the Regent

honeyeater and Swift parrot are migratory or nomadic, and travel large distances in response to availability of food resources, it is unlikely that the Study Area provides an important foraging area for either of them. Similarly, the Black-chinned honeyeater prefers the largest patches of woodland/forest. It is therefore unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the habitat, lifecycle or long-term viability of any local population of these species.

Large forest owls

- **Barking owl** – Vulnerable under the NSW TSC Act
- **Powerful ow**l – Vulnerable under the NSW TSC Act
- **Masked owl** – Vulnerable under the NSW TSC Act
- **Sooty owl** – Vulnerable under the NSW TSC Act

None of these owl species was recorded in the Study Area by Ecotone Ecological Consultants during the survey, but the Powerful owl has been recorded in the Study Locality (NSW OEH Wildlife Atlas). Each of these species has been recorded during previous surveys to the north and south of the Study Locality (Ecotone 1994, 1995) and there is some potential for these species to use the forested parts of the Study Area, at least for foraging.

Some potential roosting habitat was present in the Study Area for the Barking owl and Powerful owl. Potential nest hollows for the Powerful owl, Barking, Sooty and Masked owls were observed in the Study Area during the surveys in the form of large tree hollows, although their suitability is difficult to determine.

The proposed Rocky Hill Coal Project would remove a maximum of 47.5ha of potential foraging habitat for the Powerful, Masked and Barking owls (Dry sclerophyll forest and Riparian vegetation in any condition). Within this, 15.8ha of Dry sclerophyll forest in moderate to good condition and the 1.1ha of Riparian vegetation provide some potential nest hollows and potential daytime roost sites for the owls. The Proposal would remove only isolated small patches totalling approximately 4.3ha, of potential foraging and roosting habitat for the Sooty owl. Since this species has a preference for rainforest or wet sclerophyll forest in drainage lines, this habitat is mostly located on the eastern side of the Study Area on the steep slopes outside of the area of disturbance.

Each of these species forages over a large territory encompassing at least 800ha and probably more than 1000ha. They have all been recorded showing high fidelity to nesting sites, using the same site over many years.

The proposed Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of the forest owls, since only a very small fraction of the home range of a single pair of each species at most would be impacted, and far better quality and more extensive tracts of suitable foraging, roosting and nesting habitat occurs to the east of the Study Area

The size of the local populations of the Masked, Powerful, Sooty and Barking owls are not known, although both the Masked and Sooty owls have been recorded south of the Study Area in The Glen Nature Reserve, and it is likely that their distributions extend through the forest to the east of the Study Area along the Mograni Range.

On the basis of what is known about the local occurrences of these species and their potential habitat within the proposed area of disturbance, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the life cycles of the Powerful, Sooty, Masked or Barking owl.

Grey-crowned babbler – Vulnerable under the NSW TSC Act

The Grey-crowned babbler was recorded on two occasions during the field surveys: a group of this species was identified foraging along the northern section of McKinleys Lane and on a separate occasion, a group was observed in the yard of a property along McKinleys Lane. Nests were also observed at this location. This species has also been recorded many times throughout the Study Locality (NSW OEH Wildlife Atlas).

The Grey-crowned babbler is a communal-breeding species noted for its gregarious social behaviour. It is sedentary and territorial, with co-operatively breeding social groups (known as family groups). It is rarely seen singly or in unattended pairs. Grey-crowned babblers have a 'flock' behaviour, with individuals usually within 15m of each other, and groups usually occupying an area of less than 30m in diameter. The activity ranges of Grey-crowned babbler groups vary from 2 to 53ha and increases with increasing group size and habitat connectivity (GSC, 2005). There are reported to be approximately 20 family groups known to be distributed throughout the Gloucester LGA, from Gloucester township to Monkerai in the south, both sides of The Bucketts Way (GSC, 2005).

Two family groups of Grey-crowned babbler are known to currently occur in the southern half of Gloucester township. These groups form the northerly extent of the Grey-crowned babbler population within the Gloucester LGA (GSC, 2005). The Study Area under the current Proposal falls to the southeast of Gloucester township. It is likely that the Grey-crowned babblers recorded within the Study Area form part of one the recognised family groups.

The proposed Rocky Hill Coal Project would disturb an estimated area of 525ha of which a small portion totalling 15.8ha (Community 2 - the portion in moderate to good condition only) provides potentially suitable habitat for the Grey-crowned babbler. It is proposed that the roadside vegetation that bounds McKinleys Lane in the area where the Grey-crowned babblers were observed, would remain untouched.

Monitoring of Grey-crowned babblers at the Tarrawonga Mine near Gunnedah suggests that where this species occupies habitat adjacent to mining activities, it is resilient to those activities (Countrywide Ecological Service, December 2010).

The Proposal also includes retaining most trees within the Open Forest/Woodland patch adjoining the western side of McKinleys Lane where the site offices and amenities area is proposed; the construction of the western and northern visibility barrier and the northern section of the eastern visibility barrier that will be temporarily planted out with tree and shrub species that are currently present within the McKinleys Lane road reserve; and the progressive rehabilitation of corridors of the final landform with native vegetation.

Tree planting adjacent to Waukivory Road has been carried out and revegetation of the final landform will be progressively carried out to create woodland and native vegetation corridors to the north and east of McKinleys Lane.

Despite these proposed mitigation measures and the recorded resilience of the species, it remains possible that the Rocky Hill Coal Project could have an adverse impact on the group of Grey-crowned babblers that inhabit McKinleys Lane area (the local population).

Fruit eating doves

- **Wompoo fruit-dove -** Vulnerable under the NSW TSC Act
- **Superb fruit-dove -** Vulnerable under the NSW TSC Act
- **Rose-crowned fruit-dove -** Vulnerable under the NSW TSC Act

The Wompoo fruit-dove was recorded during field surveys, but the Superb fruit-dove and the Rose-crowned fruit-dove were not recorded. The Wompoo fruit-dove was recorded in the rainforest community (Community 4) on the steep upper slopes of the eastern side of the Study Area. The Wompoo fruit-dove, Superb fruit-dove and the Rose-crowned fruit-dove all prefer rainforest, dry rainforest and moist eucalypt forest habitats and feed on the fruits of trees and vines in these areas.

The proposed Rocky Hill Coal Project would remove a small amount (4.3ha) of suitable habitat (Community 4). These remnant patches represent only a small proportion of the total area of suitable habitat available for these species within the Study Area. The portions of habitat that would be removed may be used for occasional foraging by these species however they are unlikely to provide suitable breeding opportunities due to these areas being small isolated patches disconnected from the more extensive suitable habitat on the steep upper slopes and drainage lines to the east.

In conclusion it is unlikely that the Rocky Hill Coal Project would have a significant impact on the lifecycles of any local populations of the Wompoo, Superb and Rose-crowned fruit-doves.

Brush-tailed phascogale – Vulnerable under the NSW TSC Act

While the Brush-tailed phascogale was not recorded in the Study Area during field surveys, this species has been identified by a local resident on McKinleys Lane (McKinleys pers. comm.) and has also been recorded within the Study Locality (NSW OEH Wildlife Atlas). The Brush-tailed phascogale is an arboreal marsupial carnivore that prefers Dry sclerophyll open forest with a sparse groundcover of herbs, grasses, or leaf litter. It is an agile climber preferring trees with a diameter at breast height (DBH) greater than 25cm to forage in. It forages on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates.

Due to past clearing and agriculture activities, most remnant woodland habitat in the Study Area likely to be preferred by the Brush-tailed phascogale is confined to narrow strips along roads and streams. Along such strips there can sometimes be up to 10 times the large mature trees compared to many state forests and parks, as these areas have typically not been harvested for timber (van der Ree *et al* 1999). Populations of Brush-tailed phascogales in such areas are often dense with females occupying home ranges of 2.3 - 8.0ha with an average of 5.0ha (van der Ree *et al* 1999). Home ranges of males are somewhat larger (greater than 20ha), as a male home range may take in several female home ranges (van der Ree *et al* 1999).

Approximately 46.4ha of potentially suitable Dry sclerophyll forest habitat (Community 2 – all condition types) for the Brush-tailed phascogale occurs within the proposed area of disturbance. This area could potentially be occupied by as many as six females, but is likely only to potentially support one or two males. The removal of this vegetation could potentially affect the lifecycle of any local population of the Brush-tailed phascogale by:

- displacing individuals into surrounding territories;
- reducing the available breeding and roosting habitat by removing hollow-bearing trees;
- disturbing and possibly causing death to individuals during tree clearing operations; and,
- reducing genetic variation within the remaining population by limiting the number of occupied territories in this area.

The Proposal includes retaining most of the trees within the Open Forest/Woodland patch adjoining the western side of McKinleys Lane where site offices and amenities area and the remnant vegetation along the northern section of the lane. The proposed visibility barriers will be planted out temporarily with tree and shrub species that currently occur along McKinleys Lane and the other Dry sclerophyll forest areas, and the rehabilitation plan will include progressive establishment of native vegetation and trees.

In conclusion, should a Brush-tailed phascogale population currently occur within the Study Area, it is possible that the Rocky Hill Coal Project could have at least a short term impact on the lifecycle of the Brush-tailed phascogale population.

Cave/structure-roosting insectivorous bats

- **Large-eared pied bat** – Vulnerable under the NSW TSC Act
- **Eastern bent-wing bat** – Vulnerable under the NSW TSC Act
- **Large-footed myotis** – Vulnerable under the NSW TSC Act
- **Eastern cave bat** – Vulnerable under the NSW TSC Act
- **Little bent-wing bat** - Vulnerable under the NSW TSC Act

The Eastern bent-wing bat, Little bent-wing bat and the Large-footed myotis were recorded on the Study Area with definite confidence levels during the survey, while the Eastern cave bat and Large-eared pied bat were not recorded during field survey. The Large-footed myotis was recorded at six separate locations in the Study Area on the flatter areas, probably due to the presence of water bodies that include the Avon River, Waukivory Creek, Oaky Creek and a number of farm dams.

The Eastern cave bat has not been previously recorded in the Study Locality and was identified with only “possible” confidence, although it is difficult to distinguish from similar species by call analysis.

The Large-eared pied bat was not recorded during the field surveys. The Eastern bent-wing bat and Little bent-wing bat are both likely to forage throughout most of the Study Area, particularly in and near the forested areas: the Eastern bent-wing bat was recorded at three different locations whilst the Little bent-wing bat was recorded in two different locations (see

Figure 10). The Large-footed myotis could forage over water bodies within the Study Area and potentially roost in tree hollows, although it more commonly roosts under bridges and other structures closer to more extensive bodies of water.

The proposed Rocky Hill Coal Project would disturb a total area of around 525ha within which a variety of potential foraging habitats for the each of these species occurs. Although no breeding or roosting sites were identified during field surveys, it is possible that some breeding and roosting sites for the Eastern bent-wing bat and Large-eared pied bat, could be removed as a result of the development of the Rocky Hill Coal Project, due to the removal of old farm buildings, bridges and culverts. While there are several bridges within the Study Area, only one bridge, at the Avon River crossing on Jacks Road will be impacted, and this will be replaced.

All five of these species are known to establish maternal roost sites for the birth and development of young. Should a communal breeding site be present within the disturbance area at the time of the disturbance, mortality of individual bats could ensue, and possibly an abandonment of the breeding attempt. A clearing protocol as part a Biodiversity Management Plan for the Proposal would alleviate this potential by specifying clearing and demolition outside the breeding period for these bats.

The most likely effects of the proposed Rocky Hill Coal Project on the lifecycle of these five bat species is to cause a change in roosting and possibly breeding behaviour due to the loss of some potential roost/breeding sites such as old farm buildings and, in the case of the Large-footed myotis, potential tree-hollow roosts. For the Eastern cave bat and the Little bent-wing bat the likely effects of the Rocky Hill Coal Project would be a decrease in the area of available habitat for foraging. If disturbance to a breeding site occurred during the breeding cycle, it could lead to mortality of individual bats and/or an abandonment of the breeding attempt. Such an event is unlikely given the Applicant would adopt protocols to avoid such events.

The local populations of the Eastern bent-wing bat, Little bent-wing bat and Large-eared pied bat are likely to be extensive, including large areas of adjacent forest, and more open habitats in the case of the Eastern bent-wing bat. The Large-footed myotis was detected in several locations near water within the Study Area and may occur widely in the locality, particularly in association with the Avon River, Waukivory and Oaky Creeks. The Eastern cave bat has not been recorded within the Study Locality however there may be a local population of this species that exists in the Study Area. Throughout the forest adjacent to the Study Area extending to the south and east there would appear to be potentially suitable habitat for this species. Therefore, the Study Area is unlikely to play an important role in maintaining the long-term viability of the local population of any of these five species.

In consideration of the above, the proposed Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of any of these bat species.

Hollow-roosting insectivorous bats

- **Eastern false pipistrelle** – Vulnerable under the NSW TSC Act
- **Eastern coast free-tail bat** – Vulnerable under the NSW TSC Act
- **Yellow-bellied sheath-tail bat** – Vulnerable under the NSW TSC Act
- **Greater broad-nosed bat** – Vulnerable under the NSW TSC Act

The Yellow-bellied sheath-tail bat was identified in the Study Area during the field surveys by ultrasonic detection to the probable level of confidence and the Eastern coast free-tail bat was identified in the Study Area by ultrasonic detection to the definite level of confidence. The Eastern false pipistrelle and Greater broad-nosed bat were not recorded during field surveys. The Greater broad-nosed bat and the Eastern coast free-tail bat have previously been recorded within the Study Locality (NSW OEH Wildlife Atlas). The Eastern false pipistrelle and the Greater broad-nosed bat have been recorded in The Glenn Nature Reserve and at Terreel to the south of the Study Area by Ecotone Ecological Consultants (1994). All of these species have the potential to forage throughout the Study Area, particularly in and near the forested areas, and also to roost and breed in tree hollows.

The proposed Rocky Hill Coal Project would disturb around 525ha of land which contains portions of potential open forest foraging habitat. Existing open habitats that may be used for foraging would also be removed. There would be a loss of potential roost sites and breeding sites through the removal of hollow-bearing trees.

These impacts would result in a change of foraging behaviour and possibly force a change in roosting and breeding behaviour. Bats may have to slightly extend their foraging ranges into adjacent forest and use alternative roost sites to any used within the potential disturbance area. If disturbance to a breeding roost site occurred during a critical stage in the breeding cycle, a failed breeding attempt and/or mortality of individual bats could occur. The local populations of each of these four species are expected to extend into large areas of forest adjoining the Mine Area to the east, and in the case of the Yellow-bellied Sheath-tail bat, possibly as far as northern Australia. The proposed Rocky Hill Coal Project could directly affect the habitat of these species, but this habitat is not expected to be important for the long-term viability of the local population of any of these species. It is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on any of these four species.

Grey-headed flying fox – Vulnerable under NSW TSC Act

The Grey-headed flying-fox was opportunistically recorded at Waukivory Creek immediately to the south of the proposed area of disturbance during the supplementary Barred frog surveys. This species has the potential to forage on the flowers of Eucalypts, figs and other rainforest tree fruits, throughout the Study Locality and the Study Area.

The proposed Rocky Hill Coal Project would result in the loss of approximately 46.4ha of potential foraging habitat for the Grey-headed flying-fox (Dry sclerophyll forest of any condition), but would have no direct effect on roosting or breeding habitat. Based on the capacity of this species to travel long distances to exploit seasonal food sources, the effect of the Proposal on the lifecycle or habitat of the Grey-headed flying-fox would be minor. The proposed Rocky Hill Coal Project is not expected to have a significant effect on this species.

Squirrel glider – Vulnerable under the NSW TSC Act

The Squirrel glider was recorded in the Study Area during field surveys. This species was only captured in the Dry sclerophyll forest (Community 2) corridor along the northern section of McKinleys Lane. However, it is likely that the Squirrel glider could potentially forage the length of McKinleys Lane, adjacent forest/woodland areas and could also exist in the elevated forested parts of the eastern side of the Study Area.

It is documented that populations of Squirrel gliders can persist in roadside corridors such as McKinleys Lane, mainly due to fact that these corridors often have mature trees (van der Ree *et al* 1999) and these mature trees often hold hollows that this species requires for both breeding and roosting. The extent of the local population and the numbers of individuals in the Study Area, particularly for the area that would be removed as part of the Rocky Hill Coal Project, is currently unknown, but is likely to comprise one or two family groups.

The proposed Rocky Hill Coal Project would remove a maximum of 15.8ha of potential foraging, sheltering and breeding habitat (Dry sclerophyll forest in moderate to good condition) for the Squirrel glider. The McKinleys Lane population may well currently be isolated from other potential populations to the north or east of the Study Area. If a connection exists then it is tenuous along McKinleys Lane to Waukivory Road and east to the forested slopes of the Mograni Range. While the roadside vegetation along the northern half of McKinleys Lane is proposed for retention, indirect impacts from adjacent mining, light, noise and blasting may occur. This has the potential to affect this species lifecycle by causing: a change in foraging behaviour; a change in roosting behaviour; displacement of individuals; disruption of the social structure of the population and where the new access road crosses the McKinleys Lane near its intersection with Waukivory Road, potential mortality of individual gliders. However, most traffic is expected to be slow moving in this location due to the proximity of the intersection.

Even with the mitigation measures proposed to improve connectivity between the McKinleys Lane roadside vegetation and the more extensive vegetation of the Mograni Range, it is possible that the proposed Rocky Hill Coal Project could have an adverse effect on the local population that exists in the McKinleys Lane road reserve.

Green and golden bell frog – Endangered NSW TSC Act

The Green and golden bell frog was not recorded during the field surveys and has not been previously recorded within the Study Locality, but has some potential to occur in marginally suitable habitat in the Study Area such as the few well vegetated dams and soak areas.

The Proposal would result in the removal of some farm dams that may provide suitable habitat features for the Green and golden bell frog within the proposed area of disturbance.

Based on the lack of records in the locality, the marginal quality of the habitat on the subject site for the Green and golden bell frog and the numerous small farm dams in the Study Locality, the habitat and individuals that could be affected by the proposed mining operations would be unlikely to play an important role in the long-term viability of any local population of this species.

In conclusion, the proposed Rocky Hill Coal Project is unlikely to have a significant effect on the Green and golden bell frog.

Green thighed frog – Vulnerable under TSC Act

The Green thighed frog was not recorded in the Study Area during the field survey and has not been recorded within the Study Locality, however this species has been recorded to the south of the Study Locality (in the Glenn Nature Reserve) in 1994. This species tends to be restricted to rainforest and wet sclerophyll forests. Suitable habitat for this species exists on the steep slopes on the eastern side of the Study Area and in the small patches of remnant rainforest further down the slopes within the proposed area of disturbance.

Small areas of rainforest habitat would be removed as part of the Proposal (4.3ha) and if the Green thighed frog were to utilise these small patches, the life cycles of those individuals would be affected by the Proposal. Due to a lack of records in the Study Locality and the small patches of the habitat that is in the area of disturbance by comparison with the extensive areas of better quality habitat to the east of the Study Area, it is unlikely that the Rocky Hill Coal Project would adversely affect the long-term viability of any local population of Green thighed frogs.

In conclusion the mining operations and associated activities within the Study Area are unlikely to have a significant effect on the lifecycle of individuals or on any local viable population of the Green thighed frog.

Giant barred frog – Endangered NSW TSC Act

The Giant barred frog was not recorded in the Study Area during the primary field surveys or during the supplementary targeted Barred frog surveys and has not been recorded in the Study Locality. It has been recorded just out of the Study Locality along the Wards River and Mammy Johnsons Creek approximately 20km to the south of the Study Area (A. White *pers. comm*).

There is habitat in the Study Area that is superficially similar to these rivers, i.e. Waukivory and to a lesser extent Oaky Creek, are both permanent running creeks that have vegetation that would appear to be suitable for the Giant barred frog to exist (predominantly Community 4 and Community 3). However, the creeks and rivers within the Study Area flow northwards, they are part of a separate catchment from the watercourses around Wards River and Mammy Johnsons Creek where the Giant barred frog has been recorded (which flow to the south), they traverse shorter lengths of moist forest/Rainforest and they are naturally quite saline.

In conclusion, the Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of any individuals or any local viable population of the Giant barred frog.

Stuttering frog – Endangered NSW TSC Act

The Stuttering frog was not recorded in the Study Area during primary field surveys or during the supplementary targeted Barred frog surveys and there have been no records in the Study Locality (according to the NSW Atlas of NSW Wildlife). The Stuttering frog has been recorded in The Glenn Nature Reserve southeast of the Study Locality in habitat that has some connection to the remnant rainforest (Community 4) on the upper slopes and drainage lines within the Study Area. Based on the existence of similar habitat, the Stuttering frog has the potential to occur in the Study Area.

There is a small amount of remnant Community 4 that would be removed as part of the Proposal (4.3ha). However, this is degraded and is unlikely to provide the necessary habitat required to support a significant local population of the Stuttering frog. Better habitat for the Stuttering frog exists in the north-east end of the Study Area, Oaky Creek and the southeast end, Waukivory Creek and beyond to the east.

In conclusion, the Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of individuals or any local viable population of the Stuttering frog.

Stephens banded snake – Vulnerable NSW TSC Act

Stephens banded snakes have a preference for rainforest and eucalypt forests and rocky areas up to an altitude of 950m. Within the Study Area, the high slopes on the eastern side contain elements of suitable habitat for Stephens banded snake in the form exposed rocky areas, eucalypt forest and moist remnant rainforest drainage lines. This species was not recorded during field surveys nor has it been recorded in the Study Locality but has been recorded around Terreel approximately 20km south of the Study Locality. The rainforest drainage lines along the eastern side of the Study Area and along the Mograni Range share similar habitat traits with those at Terreel, such that it is conceivable that Stephens banded snake may occur in the those parts of the Study Area.

The areas that are most likely to provide suitable habitat for Stephens banded snake are areas that are outside the proposed area of disturbance and as such the operations involved in the proposed Rocky Hill Coal Project are unlikely to displace, disrupt the breeding cycle or create changes to foraging or tree sheltering sites or effect dispersal of Stephens banded snakes. There may be disturbance in the form of vibrations from blasting. These vibrations could result in the loss of refuges by creating small rock falls or may drive the species away, however, the effects that blasting may have in this area is not yet fully known.

In conclusion, the Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of individuals or any local viable population of Stephens banded snake.

b) How is the Proposal likely to affect the habitat of a threatened species, population or ecological community?

The overall area of disturbance from the Rocky Hill Coal Project will be approximately 525ha comprising the habitat types potentially suitable for subject species (in **Table 19**):

c) Does the Proposal affect any threatened species that are at the limit of its known distribution?

No species are at the limit of their known distribution within the Gloucester area.

d) How is the Proposal likely to affect current disturbance regimes?

The majority of the Study Area has been previously disturbed by grazing activities and the construction of earth dams and vehicle tracks. Most of the Study Area is cleared, with improved pasture, limited native pasture and some weedy areas.

Current disturbance regimes include use of vehicle tracks by four-wheel-drive vehicles for Site investigations and farming, and stock grazing. Weed invasion poses a minor threat to the integrity of the natural habitats on the Site.

The proposed Rocky Hill Coal Project would disturb approximately 525ha within the Study Area. The level of weed invasion into habitats adjacent to the proposed areas of disturbance could potentially increase. The implementation of a Biodiversity Management Plan detailing practices to maintain the integrity of native vegetation adjacent to the proposed areas of disturbance (including proposed Biodiversity Offset Area) and protecting the proposed rehabilitation areas, would greatly reduce or remove the likelihood of this disturbance regime being exacerbated by the proposed Rocky Hill Coal Project.

Table 19
Habitats to be affected and potential subject species presence

Community	Habitat Type	Subject Species detected within Habitat Types	Subject species with potential to occur within Habitat Types	Potential Habitat Removed as part of the proposed area of disturbance (ha)
1	Cleared Open Pasture with scattered remnant trees and farm dams	Nil	Black-necked stork Turquoise parrot Square-tailed kite Spotted harrier Little eagle Green & golden bell frog (dams only) Eastern bent-wing bat Little bent-wing bat	473.2
2	Dry sclerophyll forest	Grey-crowned babbler, Eastern bent-wing, Large-footed myotis, Squirrel glider	Turquoise parrot Square-tailed kite Spotted harrier Little lorikeet Speckled Warbler Varied sittella Regent honeyeater Swift parrot Barking owl Masked owl Powerful owl Grey-crowned babbler Brush-tailed phascogale Grey-headed flying fox Yellow-bellied sheathtail bat Greater broad-nosed bat Eastern cave bat Eastern free-tail bat Large-eared pied bat Eastern false pipistrelle	46.4
3	Riparian corridors	Eastern bent-wing bat, Little bent-wing bat, Large-footed myotis, Grey-headed flying fox	Black-necked stork Barking owl Giant barred frog Stuttering frog	1.1
4	Rainforest	Eastern bent-wing, Little bent-wing, Yellow-bellied sheath-tail, Wompoo fruit-dove	Sooty owl Superb fruit-dove Red-crowned fruit-dove Green-thighed frog Stephens banded snake Giant barred frog Stuttering frog	4.3
5	Pine Plantation	N/A	Nil	0.4

A rehabilitation plan will be adopted leading to progressive re-establishment of grassland with patches of Dry sclerophyll forest similar to that which currently exists, open woodland and specific flora and fauna corridors. An improvement in habitat available for threatened species and in connectivity between vegetation patches in the locality is likely to occur once revegetation is carried out.

e) How is the Proposal likely to affect habitat connectivity?

The proposed Rocky Hill Coal Project would not sever an existing link between two discrete habitat patches, and on a broad scale would have a negligible impact on habitat connectivity. Therefore, the proposed mine is unlikely to reduce habitat connectivity. The existing planted roadside strips along Waukivory Road; the plantings that are part of the proposed Biodiversity Offset Area and the implementation of the proposed rehabilitation plan for the final landform are likely to, in time, improve local habitat connectivity.

f) How is the Proposal likely to affect critical habitat?

There are no areas of recommended critical habitat or declared critical habitat within the Study Area or that could be reasonably expected to be affected by the proposed Rocky Hill Coal Project, except in the broadest sense. For example, the gases emitted into the atmosphere by the burning of fossil fuels to extract coal from the proposed mine, and the burning of the coal itself, both contribute to anthropogenic climate change, which inevitably affects areas of listed critical habitat. The contribution of the proposed Rocky Hill Coal Project to global "greenhouse" gas emissions and human induced climate change would be negligible.

Conclusions from step 3

The proposed Rocky Hill Coal Project would impact directly on the habitat of several threatened fauna species, through the removal of foraging, roosting and nesting resources; potentially causing displacement of individual animals into adjacent areas and possible mortality of individuals. However, the impacts are not expected to be significant on any local population of most species. However, the impacts on the local Squirrel glider and Grey-crowned babbler populations are difficult to assess due to the viability of the current populations being tenuous as a result of their apparent isolation.

In taking the above into consideration, the proposed Rocky Hill Coal Project is unlikely to have a significant effect on any of the subject threatened fauna species considered by this assessment, on the basis that it is unlikely to adversely affect the habitat, lifecycle or long-term viability of any local population of the species such that it would be placed at risk of extinction. However, small and apparently tenuous known local populations of the Squirrel glider and Grey-crowned babbler may be impacted along McKinleys Lane due to mining associated activities and if currently present, any local population of the Brush-tailed phascogale could also be impacted.

Step 4 – Avoid, mitigate and then offset

The nature of the proposed activity, open cut mining, makes it impossible to totally avoid impacts on biodiversity within the area where the coal mining takes place. The layout of the proposed Rocky Hill Coal Project was therefore selected by the Applicant so that it included areas previously disturbed by grazing activities to the greatest possible extent. Measures identified during the development of the mine plan and during the preparation of the EIS that that would allow potential impacts on threatened species and native vegetation to be avoided, minimised, mitigated or offset, have pro-actively been incorporated into the Rocky Hill Coal Project. They include:

Avoid

The nature of the proposed open cut mining makes it impossible to totally avoid impacts on biodiversity. However, the layout of the Site has been designed by the Applicant with the intent to maximise disturbance in areas previously disturbed by grazing activities.

The Applicant has planned to avoid clearing the roadside vegetation corridor along the northern section of McKinleys Lane and has avoided those parts of the Study Area containing better quality terrestrial habitats and riparian habitats. However, indirect impacts may occur in these areas as a result of vehicle movements, noise, lighting and dust.

The Proposal also includes the retention of most of the trees within the Dry sclerophyll forest patch adjoining the western side of McKinleys Lane where the site offices and amenities area are proposed.

Mitigate

The second priority is to mitigate any disturbances to natural vegetation and threatened species habitat. Individual Grey-crowned babblers, Squirrel Gliders and potentially some other threatened fauna could potentially be impacted along McKinleys Lane. The Proposal has been designed to avoid direct impact on the known habitat for these two species but, since the size of the local populations of these species and their movement patterns are unknown, the local populations of these threatened species along McKinleys Lane will be monitored in order to identify how they can be better managed to improve their viability in the longer term. The approach to monitoring would be outlined in the Biodiversity Management Plan.

The planting of the outer faces of the northern and eastern visibility barrier and the northern section of the eastern visibility barrier with indigenous trees and shrubs; the replanting of roadside corridors along Waukivory Road; and the progressive revegetation of the final landform to include native vegetation corridors, are all mitigation measures for the temporary loss of habitat and native vegetation that is an unavoidable part of the Proposal. These will ultimately improve connectivity of the vegetation along McKinleys Lane with the more extensive vegetation along the Mograni Range. The requirement for a 45m wide cleared easement for the relocated 132kV power line along the boundary between the proposed Mine Area and the proposed Biodiversity Offset Area is likely to impose a partial impediment to ground and arboreal fauna movement east from the Mine Area during construction and west from the Biodiversity Offset Area post-construction. We understand that the vegetation within the drainage lines along the relocated easement can be largely retained, due to the greater distance between the ground and the power lines. These drainage lines will continue to provide important movement corridors.

Offset

As there will be residual impacts on native vegetation as a result of the Proposal, the BioBanking Assessment Methodology and BioBanking Credit Calculator (Version 2) have been adopted to calculate the credits required and the credits available within a proposed biodiversity offset area, an area to the east of the proposed area of disturbance together with the progressive establishment of areas on the final landform with native vegetation.

The objective of the offset is to ensure that the Proposal meets the “No Net Loss” benchmark nominated by DECCW (2010).

Full details of the credits required and available within the proposed Biodiversity Offset Area are presented within Section 5 of this report.

Step 5 – Key Thresholds

The development application needs to contain a justification of the preferred option based on:

- *whether or not the Proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts, will maintain or improve biodiversity values;*

The impacts on threatened species from the Proposal would be minimised through the design of the mine layout, the impacts would be mitigated following the completion of a risk assessment and the residual impacts are proposed to be offset by designation of suitable good quality habitats to the east of the mine (the proposed Biodiversity Offset Area) for conservation and the restoration of adjacent degraded habitats through fencing and replanting. While the BioBanking Assessment Methodology specifies ecosystem credits can be used to offset for loss of habitat for the Grey-crowned babbler and the Squirrel Glider, the indirect effects on the retained habitat along the northern part of McKinleys Lane are as yet unknown and there is no currently available habitat suitable for the Grey-crowned babbler within the proposed Biodiversity Offset Area. The Applicant has commenced the creation of potential additional habitat for this species within roadside vegetation strips along Waukivory Road and more extensive woodland is to be established as part of the rehabilitation plan for the final landform, but with the current tenuous connection of both the Squirrel Glider and Grey-crowned babbler populations to nearby forest areas, a monitoring program will be established as part of the Proposal.

With the revegetation of the proposed Biodiversity Offset Area, further improvement in connectivity of native vegetation along the Mograni Range will also be progressively achieved.

With the proposed avoidance, mitigation and offset measures, it is likely that biodiversity values in the Study Area will be maintained or improved in the longer term.

- *whether or not the Proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community;*

The current viability of the local populations of Squirrel gliders and Grey-crowned babblers within the Study Area appear to be very tenuous, due to their apparent isolation from more extensive areas of suitable habitat in the eastern parts of the Study Area and beyond. These species may have their short-term viability reduced by the Proposal but in the long-term, with more extensive native vegetation areas and improved connectivity to the Mograni Range, their viability should improve.

- *whether or not the Proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction;*

No threatened species, population or ecological community is likely to have accelerated extinction or be placed at risk of extinction as a result of the Proposal

- *whether or not the Proposal will adversely affect critical habitat.*

No critical habitat has been designated within the Study Area.

4.2.3 Section 5A of the EP&A Act

The threatened species and endangered ecological community (TSC Act) that are known or considered likely to occur within the proposed area of disturbance (subject species), are addressed below via the 7-part test of section 5A of the EP&A Act.

There is a considerable amount of duplication between the factors to be considered in Appendix 3 of the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI July 2005) and *Threatened Species Assessment Guidelines – The assessment of Significance* (DECC, 2007) which is the 7-part test of section 5a of the EP&A Act.

7-part test for *Lower Hunter Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions Rainforest* (Community 4)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the like cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable, no species of threatened flora are known or likely to occur in the Study Area.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species likely to be placed at risk of extinction.

Not applicable, no endangered populations of flora are known or likely to occur in the Study Locality.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No endangered ecological communities or critically endangered ecological communities occur within the Study Area. In relation to the vulnerable ecological community (VEC) *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions* that would be directly impacted by the Proposal.

(i) The Proposal would result in the direct removal or modification of remnant isolated patches of the VEC totalling 4.3ha from the overall disturbance area. This includes removal of the lower ends of rainforest gully patches that occur downslope from the proposed Biodiversity Offset Area. The areas that would be removed represent the small isolated remnants that have been retained within the surrounding cleared exotic pasture landscape or, in the case of the ends of gully patches, represent small and usually degraded patches directly connected to substantially larger patches that occupy the hillside drainage lines in the proposed Biodiversity Offset Area. Given the area of

the VEC that would remain and be managed in the proposed Biodiversity Offset Area, this level of removal would not have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

(ii) The ecological community would be removed in its entirety within the proposed Mine Area. There is potential for the composition of the ecological community to undergo indirect modification where small areas are removed at the ends of the retained gully patches. These could be affected by edge effects such as hydrological changes, weed invasion and increased light at the newly created edges. However, none of these local changes would result in the local occurrence of the ecological community being placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed action would result in the direct removal of 4.3ha of occupied habitat for the ecological community. This represents approximately 6% of a total area of at least 78ha of the ecological community that has been mapped within the Study Area. The community also extends on to adjoining land to the north, south and east. In terms of the total estimated occurrence of the community of less than 10, 000km^2 (NSW Scientific Committee 2008), this represents an overall loss of approximately 0.0005%.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Since either entire isolated patches of the ecological community would be removed, or incremental loss would occur at the ends of gully habitat, no additional areas of habitat would become fragmented or isolated than is currently the case.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The habitat to be lost or modified is of little overall importance to the long-term survival of the ecological community in the locality, due to the presence of substantial patches of the same community in drainage lines to the east of the impact area and beyond.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No areas of designated critical habitat identified under the provisions of the *Threatened Species Conservation Act 1995* apply to the Study Area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or approved recovery plans have been prepared in relation to this ecological community to date. The NSW Office of Environment and Heritage has identified the following 'activities to assist this species', some or all of which could form the basis for a recovery plan in the future:

- Exclude fire from remnants where possible.
- Exclude grazing by domestic stock in remnants of this community by appropriate fencing.
- Prevent further clearing and fragmentation of remnants.
- Restore degraded remnants using bush regeneration techniques such as weed control and supplementary planting.
- Control invasion and spread of weeds.

The proposed action is not inconsistent with any of these activities except for 'prevent further clearing', since some habitat will be directly cleared.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

To date, 37 key threatening processes have been listed on Schedule 3 of the TSC Act. Eight are relevant to fauna and the Proposal. Other key threatening processes would be only peripherally or remotely relevant to the current Proposal.

1. Clearing of Native Vegetation

The Proposal would remove 51.8ha of natural vegetation, approximately half of which is in low condition. As such, a number of ecological impacts identified by the Final Determination for the threatening process (NSW Scientific Committee 2001) could occur including incremental reductions in the size of local populations of individual species, increased greenhouse emissions, increased habitat for invasive species and changes to soil biota.

2. Invasion of Native Plant Communities by Exotic Perennial Grasses

Several species of exotic perennial grass were recorded in the Study Area, including at least three species *Andropogon virginicus* (Whisky grass), *Pennisetum clandestinum* (kikuyu) and *Chloris gayana* (Rhodes grass) that are specifically noted by the Final Determination as having the capacity to outcompete and displace native vegetation (NSW Scientific Committee 2003). These grasses are prevalent within the cleared pasture and highly disturbed parts of the Study Area, and would be largely removed by the Proposal. The potential threat of invasion by exotic perennial grasses into natural habitat at the interface between the developed and retained areas could be ameliorated by appropriate weed control measures and management of natural vegetation as part of a Biodiversity Management Plan.

3. Invasion, establishment and spread of Lantana (Lantana camara L. sens. lat)

Very little Lantana occurs in the proposed disturbance area. Isolated patches of Lantana have become established mainly in drainage lines adjacent to the rainforest community in the Biodiversity Offset Area to the east of the proposed disturbance area. The potential threat of further invasion by Lantana into natural habitat at the interface between the developed and retained areas could be ameliorated by appropriate weed control measures and management of natural vegetation as part of a Biodiversity Management Plan (NSW Scientific Committee 2006b).

4. Infection of Native Plants by Phytophthora cinnamomi

Spores of the root-rot fungus *Phytophthora cinnamomi* could be introduced to the Site on machinery or equipment that has been in a contaminated area, on clothing/boots or in soil or fill imported to the Site (NSW Scientific Committee 2002). These could infect and adversely affect some groups of native flora species within the subject Site, although none were recorded in the Site that are listed by the Final Determination as being particularly prone to the pathogen. Protocols should be established to ensure that machinery is fully washed prior to being brought to site.

5. Introduction and Establishment of Exotic Rust Fungi on Plants of the Family Myrtaceae

Spores of exotic rust (fungi of the Order Pucciniales) could be introduced to the Site on vehicles, tools, machinery or equipment that have been in a contaminated area, on work clothing/vests/boots or with infected plant material. Introduction of the disease to the Site could potentially infect species of the family Myrtaceae adjacent to the construction site. One variant of a rust species (*Uredo rangelii*) has recently become naturalised in Australia and is commonly known as 'Myrtle Rust'. Naturally-occurring myrtaceous species recorded in the Study Area that are currently known to be susceptible to infection by various species of rust include *Eucalyptus acmenoides, E. amplifolia, E. microcorys, E. moluccana, E. punctata* and *Syncarpia glomulifera* (NSW Scientific Committee 2011). Protocols should be established to ensure that machinery is fully washed prior to being brought to site. Plant material (particularly of angophoras, eucalypts, leptospermums or melaleucas) should not be brought onto the Site unless known to be uncontaminated.

6. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

There is potential for the Proposal to impact on the natural flow of Oaky Creek, Waukivory Creek, the Avon River or associated watercourses where the proposed mine pit comes close to these watercourses. A full assessment of the potential hydrological impacts due to the Proposal has been undertaken, and the proposed mine has been designed in such a manner that no adverse impacts on the natural flows of these rivers or streams will occur as a result of the Proposal.

7. Human-caused Climate Change

The Proposal may result in minor exacerbation of human-caused climate change through the removal of vegetation, an increase in truck and train traffic and direct carbon emissions due to the mining process itself.

In conclusion, the proposed construction of a mine and associated infrastructure at Gloucester is not expected to significantly increase the incidence of designated key threatening processes listed on Schedule 3 of the TSC Act, or any other threatening processes, if they are appropriately managed. Such management would mainly include hydrological management, erosion and sediment control, noxious and environmental weed control and exclusion of root-rot and myrtle fungus. Full details are given in Section 5 above.

7- part test for Threatened Fauna Species

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Black-necked stork – Endangered under the NSW TSC Act

The Black-necked stork was not recorded in the Study Area during field survey. While the Black-necked stork has been previously recorded within the Study Locality and within 2km of the Study Area (NSW OEH Wildlife Atlas), there are no previous records of the Black-necked stork breeding in the Gloucester area (Clancy and Andren 2010). Within the predicted territory for a pair of Black-necked storks at Gloucester there has been 176ha of wetland and 3 943ha of floodplain identified, that would provide substantial foraging opportunities for the Black-necked stork (Clancy and Andren 2010).

The proposed Rocky Hill Coal Project would result in the disturbance of a total of 525ha of land of which none is flood prone land or wetland providing suitable foraging habitat for the Black-necked stork. There are vast tracts of more suitable habitat for foraging directly to the north and west of the disturbance area.

In conclusion it is unlikely that the proposed Rocky Hill Coal Project would affect the breeding habitat of the Black-necked stork however the Proposal would result in a small reduction of potential foraging resources of the Black-necked stork, this small reduction in potential foraging habitat is unlikely to have a significant effect on the life cycle of any local population of this species.

Spotted harrier – Vulnerable under the NSW TSC Act

The Spotted harrier has been recorded only once previously within the Study Locality according to the OEH Wildlife Atlas and was not detected during the field surveys for this biodiversity assessment.

The proposed Rocky Hill Coal Project would remove a relatively small area (approximately 473.2ha) of potential foraging habitat (cleared open pasture) for the Spotted harrier and possibly some potential nest site trees. Since the foraging habitat within the area of disturbance would constitute a very small part of the foraging range of a Spotted harrier and there were no nests observed on the Study Area, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the life cycle or the long-term viability of any local population of this species.

Square-tailed kite – Vulnerable under the NSW TSC Act

The Square-tailed kite was not recorded during the surveys within the Study Area nor has this species been recorded by the NSW OEH Wildlife Atlas within the Study Locality. This species could forage throughout the habitats in the Study Area. No evidence of a nest was seen but there were a number of tall eucalypts which could be used for nesting by this species.

The proposed Rocky Hill Coal Project would disturb approximately 525ha of land, of which only a small portion (46.4ha of Dry sclerophyll forest of any condition and 1.1ha of Riparian vegetation) would constitute potential breeding sites for the Square-tailed kite. Considering the large areas of forest used by this bird and the lack of any sightings of this species in the Study Area during the field studies, the proposed Rocky Hill Coal Project is not expected to have a significant effect on the life cycle or long-term viability of any local population of this species.

Little eagle – Vulnerable under the NSW TSC Act

The Little eagle was not recorded during the survey within the Study Area nor has this species been recorded by the NSW OEH Wildlife Atlas within the Study Locality. This species could forage throughout the Study Area and potentially nest in one of the tall Eucalypts within the Study Area, although no large nests were observed during the survey.

The proposed Rocky Hill Coal Project would remove a relatively small area (approximately 473.2ha) of potential foraging habitat (cleared open pasture) for the Little Eagle and possibly some potential nest site trees. Since the foraging habitat within the Area of Disturbance would constitute a very small part of the foraging range of a Little Eagle and there were no nests observed on the Study Area, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the life cycle or the long-term viability of any local population of this species.

Little lorikeet – Vulnerable under the NSW TSC Act

The Little lorikeet was not was not recorded during the surveys within the Study Area nor has this species been recorded by the NSW OEH Wildlife Atlas within the Study Locality, however this species has the potential to forage in flowering Eucalypts in forested parts of the subject Site, predominantly within Community 2. There are small tree hollows of a suitable size for Little lorikeets to nest in occurring within Community 2 in the Study Area.

The Little lorikeet is generally considered to be a nomadic species which responds to mass flowering events of eucalypts and feeds largely from flowers. This species could forage on flowering trees in the Study Area from time to time and could also nest on the subject Site if there was a sufficient supply of food nearby. Due to its nomadic nature, its local population would extend across at least hundreds of square kilometres and include the nearby ranges and coast.

It is considered unlikely that the proposed Rocky Hill Coal Project would have any significant adverse effect on the life cycle or long-term viability of any local population of the Little lorikeet, given the habit of this species to move relatively large distances in response to availability of seasonal food resources and the lack of records during the field survey. The proposed Rocky Hill Coal Project would therefore be unlikely to have a significant effect on this species.

Non hollow-dependent, insectivorous and granivorous woodland birds

- **Speckled warbler** – Vulnerable under the NSW TSC Act
- **Varied sittella** – Vulnerable under the NSW TSC Act
- **Turquoise parrot** – Vulnerable under NSW TSC Act

The Speckled warbler, the Turquoise parrot and the Varied sittella were not recorded in the Study Area during the field surveys and only the Speckled warbler has been recorded in the Study Locality (NSW OEH Wildlife Atlas). All of these species are resident in a home range area for most or all of the year, occur in relatively open forest, woodland and nearby grassland. The Speckled warbler and Turquoise parrot forage mainly on the ground while the Varied sittella forages mainly for insects in the canopy. The Turquoise parrot requires tree hollows for nesting.

The proposed Rocky Hill Coal Project would result in the loss of a portion (46.4ha) of potential foraging and breeding habitat in the form of vegetation Community 2 and adjacent grassland (Dry sclerophyll forest in any condition). This reduction in area of available habitat could result in the displacement of some birds if they are present. The Speckled warbler is likely to have restricted local populations. This species has been recorded to the southwest of the Study Locality in the Gloucester Tops area. There is much more habitat that would be suitable for all three species on the eastern side of the Study Area (the steep slopes of the Mograni Range provide forest and forest edge habitat). It therefore seems unlikely that the small patches of potentially suitable habitat within the proposed area of disturbance comprises part of an important area of habitat for any of these species based on the lack of records during survey work undertaken by Ecotone Ecological Consultants and on the NSW OEH Wildlife Atlas.

The Speckled warbler and the Varied sittella would be expected to forage and possibly nest in regenerating native vegetation, particularly if this occurred in adjacent habitat, and considering that much of the vegetation suitable for these species would remain untouched on the upper slopes, the small loss of habitat caused by the Rocky Hill Coal Project would be compensated in the interim by vegetation to be established within the visibility barrier areas and in time by the vegetation to be established as open woodland and native vegetation corridors as part of the rehabilitation plan for the disturbance area and the proposed revegetation of the cleared parts of the proposed Biodiversity Offset Area.

In conclusion, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on these species.

Blossom and mistletoe-feeding woodland birds

- **Regent honeyeater** – Endangered under the NSW TSC Act
- **Swift parrot** – Endangered under the NSW TSC Act
- **Black-chinned honeyeater** – Vulnerable under the NSW TSC Act

None of these species was recorded in the Study Area during the surveys but both have some potential to use the Study Area for foraging for Eucalypt blossom. The Regent honeyeater and Swift parrot have established breeding areas in particular parts of New South Wales and Tasmania, respectively, none of which are located within the Study Locality. Black-chinned honeyeater is widespread in NSW but rare in coastal districts. They tend to use the largest

remnants of vegetation, so they are unlikely to be affected by the relatively minor removal of small patches of vegetation for this Proposal.

The proposed Rocky Hill Coal Project would result in the loss of a relatively small portion (maximum 15.8ha, comprising small patches Dry sclerophyll forest in moderate to good condition) of potential foraging habitat for these species in the locality. Since the Regent honeyeater and Swift parrot are migratory or nomadic and travel large distances in response to availability of food resources, it is unlikely that the Study Area provides an important foraging area for either of them. Similarly, the Black-chinned honeyeater prefers the largest patches of woodland/forest. It is therefore unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the habitat, life cycle or long-term viability of any local population of these species.

Large forest owls

- **Barking owl** – Vulnerable under the NSW TSC Act
- **Powerful owl** – Vulnerable under the NSW TSC Act
- **Masked owl** – Vulnerable under the NSW TSC Act
- **Sooty owl** – Vulnerable under the NSW TSC Act

None of these owl species was recorded in the Study Area by Ecotone Ecological Consultants during the survey, but the Powerful owl has been recorded in the Study Locality (NSW OEH Wildlife Atlas). Each of these species has been recorded during previous surveys to the north and south of the Study Locality (Ecotone 1994, 1995). Each of these species has potential to use the forested parts of the Study Area for foraging.

Some potential roosting habitat was present in the Study Area for the Barking owl and Powerful owl. Suitable nest hollows for the Powerful owl, Barking, Sooty and Masked owls were observed during the surveys in the form of large tree hollows, in the Study Area, although their suitability is difficult to determine.

The proposed Rocky Hill Coal Project would remove a maximum of 35.7ha of potential foraging habitat for the Powerful, Masked and Barking owls and some potential nest hollows and potential daytime roost sites for the owls (15.8ha) Dry sclerophyll forest in moderate to good condition. The Proposal would remove only isolated small patches totalling approximately 4.3ha, of potential foraging and roosting habitat for the Sooty owl. Since this species has a preference for rainforest or wet sclerophyll forest in drainage lines, this habitat is mostly located on the eastern side of the Study Area on the steep slopes outside of the Area of Disturbance.

Each of these species forages over a large territory encompassing at least 800ha and probably more than 1000ha. They have all been recorded showing high fidelity to nesting sites, using the same site over many years.

The proposed Rocky Hill Coal Project is unlikely to have a significant effect on the life cycle of the forest owls, since only a very small fraction of the home range of a single pair of each species at most, would be impacted and far better quality and more extensive tracts of suitable foraging, roosting and nesting habitat occurs to the east of the Study Area.

The size of the local populations of the Masked, Powerful, Sooty and Barking owls are not known, although both the Masked and Sooty owls have been recorded south of the Study Area in The Glen Nature Reserve, and it is likely that their distributions extend through vast tracts of forest adjoining the subject Site.

On the basis of what is known about the local occurrences of these species and their potential habitat within the proposed area of disturbance, it is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on the life cycles of the Powerful, Sooty, Masked or Barking owl.

Grey-crowned babbler – Vulnerable under the NSW TSC Act

The Grey-crowned babbler was recorded on two occasions during field surveys: a group of this species was identified foraging along the northern section of McKinleys Lane, on a separate occasion a group was also observed in the yard of a property along McKinleys Lane. Nests were also observed at this location. This species has also been recorded many times throughout the Study Locality (NSW OEH Wildlife Atlas).

The Grey-crowned babbler is a communal-breeding species noted for its gregarious social behaviour. It is sedentary and territorial, with co-operatively breeding social groups (known as family groups) and is rarely seen singly or in unattended pairs. Grey-crowned babblers have a 'flock' behaviour, with individuals usually within 15m of each other, and groups usually occupying an area of less than 30m in diameter. The activity ranges of Grey-crowned babbler groups vary from 2 to 53ha and increases with increasing group size and habitat connectivity (GSC, 2005). There are reported to be approximately 20 family groups known to be distributed throughout the Gloucester LGA from Gloucester township to Monkerai in the south, both sides of The Bucketts Way (GSC, 2005).

Two family groups of Grey-crowned babbler are known to currently occur in the southern half of Gloucester township. These groups form the northerly extent of the Grey-crowned babbler population within the Gloucester LGA (GSC, 2005). The Study Area under the current Proposal falls to the south-east of Gloucester township. It is likely that the Grey-crowned babblers recorded within the Study Area form part of one the recognised family groups.

The proposed Rocky Hill Coal Project would disturb an estimated total area of 525ha of which a small portion totalling 15.8ha (Community 2 – the portion in moderate to good condition only) provides potentially suitable habitat for the Grey-crowned babbler. It is proposed that the roadside vegetation that bounds McKinleys Lane, where the Grey-crowned babblers were observed, would remain untouched.

Monitoring of Grey-crowned babblers at the Tarrawonga Mine near Gunnedah suggests that where this species occupies habitat adjacent to mining activities, it is resilient to those activities (Countrywide Ecological Service, December 2010).

The Proposal also includes retaining most trees within the Open Forest/Woodland patch adjoining the western side of McKinleys Lane where the site offices and amenities area is proposed; the construction of the western and northern visibility barrier and the northern section of the eastern visibility barrier that will be temporarily planted out with tree and shrub species that are currently present within the McKinleys Lane road reserve; and the progressive rehabilitation of corridors of the final landform with native vegetation.

Tree planting adjacent to Waukivory Road has been carried out and revegetation of the final landform will be progressively carried out to create woodland and native vegetation corridors to the north and east of McKinleys Lane.

Despite these proposed mitigation measures and the recorded resilience of the species, it remains possible that the Rocky Hill Coal Project could have an adverse impact on the group of Grey-crowned babblers that inhabit McKinleys Lane area (the local population).

Fruit eating doves

- **Wompoo fruit-dove** - Vulnerable under the NSW TSC Act
- **Superb fruit-dove** - Vulnerable under the NSW TSC Act
- **Rose-crowned fruit-dove** - Vulnerable under the NSW TSC Act

The Wompoo fruit-dove was recorded during the field surveys. The Superb fruit-dove and the Rose-crowned fruit-dove were not recorded. The Wompoo fruit-dove was recorded in the rainforest community (Community 4) on the steep upper slopes of the eastern side of the Study Area. The Wompoo fruit-dove, Superb fruit-dove and the Rose-crowned fruit-dove all prefer habitat that is rainforest, dry rainforest and moist eucalypt forests feeding on the fruits of trees and vines in these areas.

The proposed Rocky Hill Coal Project would remove a small amount (4.3ha) of suitable habitat (Community 4). These remnant patches represent only a small proportion of the total area of suitable habitat available for these species within the Study Area. The portions of habitat that would be removed may be used for occasional foraging by these species however they are unlikely to provide suitable breeding opportunities due to these areas being small isolated patches disconnected from the more extensive suitable habitat on the steep upper slopes and drainage lines to the east.

In conclusion it is unlikely that the Rocky Hill Coal Project would have a significant impact on the life cycles of any local populations of the Wompoo, Superb and Rose-crowned fruit doves.

Brush-tailed phascogale – Vulnerable under the NSW TSC Act

While the Brush-tailed phascogale was not recorded in the Study Area during field surveys, this species has been identified by a local resident on McKinleys Lane (McKinleys pers. comm.) and has also been recorded within the Study Locality (NSW OEH Wildlife Atlas). The Brush-tailed phascogale is an arboreal marsupial carnivore that prefers Dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. It is an agile climber preferring trees with a DBH greater than 25cm to forage in, it forages on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates.

Due to past clearing and agriculture activities, remnant woodland habitat in the Study Area likely to be preferred by the Brush-tailed phascogale is confined to narrow strips along roads and streams. Along such strips there can sometimes be up to 10 times the large mature trees compared to many state forests and parks, as these areas have typically not been harvested for timber (van der Ree *et al* 1999). Populations of Brush-tailed phascogales in these areas are often dense with females occupying home ranges of 2.3 - 8.0ha with an average of 5.0ha (van der Ree *et al* 1999). Home ranges of males are somewhat larger (greater than 20ha), as a male home range may take in several female home ranges (van der Ree *et al* 1999).

Approximately 46.4ha of potentially suitable Dry sclerophyll forest habitat (Community 2 – all condition types) for the Brush-tailed phascogale occurs within the proposed area of disturbance. This area could potentially be occupied by as many as six females, but is likely only to potentially support one or two males. The removal of this vegetation could potentially affect the lifecycle of any local population of the Brush-tailed phascogale by;

- displacing individuals into surrounding territories,
- reducing the available breeding and roosting habitat by removing hollow-bearing trees,
- disturbing and possibly causing death to individuals during tree clearing operations and,
- reducing genetic variation within the remaining population by limiting the number of occupied territories in this area.

The Proposal includes retaining most of the trees within the Open Forest/Woodland patch adjoining the western side of McKinleys Lane in the proposed site offices and amenities area and the remnant vegetation along the northern section of the lane. The proposed northern section of the eastern visibility barrier will be planted out temporarily with tree and shrub species that are currently present within the McKinleys Lane road reserve and the other Dry sclerophyll forest areas, and the rehabilitation plan will include progressive establishment of native vegetation and trees.

In conclusion, should a Brush-tailed phascogale population currently occur within the Study Area, it is possible that the Rocky Hill Coal Project could have at least a short term impact on the lifecycle of the Brush-tailed phascogale population.

Cave/structure-roosting insectivorous bats

- **Large-eared pied bat** – Vulnerable under the NSW TSC Act
- **Eastern bent-wing bat** – Vulnerable under the NSW TSC Act
- **Large-footed myotis** – Vulnerable under the NSW TSC Act
- **Eastern cave bat** – Vulnerable under the NSW TSC Act
- **Little bent-wing bat** - Vulnerable under the NSW TSC Act

The Eastern bent-wing bat, Little bent-wing bat and the Large-footed myotis were recorded in the Study Area with definite confidence levels during the survey. The Large-footed myotis was recorded at six separate locations in the Study Area on the flatter areas, probably due to the presence of water bodies that include the Avon River, Waukivory Creek, Oaky Creek and a number of farm dams.

The Eastern cave bat has not been previously recorded in the Study Locality and was identified with only “possible” confidence, although it is difficult to distinguish from similar species by call analysis.

The Large-eared pied bat was not recorded during the field surveys. The Eastern bent-wing bat was recorded at three different locations while the Little bent-wing bat was recorded in two different locations (see **Figure 10**).

The Eastern bent-wing bat and Little bent-wing bat are both likely to forage throughout most of the Study Area, particularly in and near the forested areas.

The proposed Rocky Hill Coal Project would disturb a total area of around 525ha within which a variety of potential foraging habitats for the each of these species occurs. No breeding or roosting sites were identified during field surveys. It is possible that some short term roosting sites for the Little bent-wing bat, Eastern bent-wing bat and Large-eared pied bat would be removed or altered as a result of the development of the Rocky Hill Coal Project. These typically include old farm buildings, bridges and culverts. While there are several bridges within the Study Area, only one bridge, at the Avon River crossing on Jacks Road will be impacted, and this will be replaced.

All five of these species are known to establish maternal roosts for the birth and development of young. Should a communal breeding site be present within the disturbance area at the time of the disturbance, mortality of individual bats could ensue, and possibly an abandonment of the breeding attempt. A clearing protocol as part a Biodiversity Management Plan for the Proposal would alleviate this potential by specifying clearing and demolition outside the breeding period for these bats.

There is not likely to be any adverse effect from the proposed Rocky Hill Coal Project, on the Large-footed myotis or its habitat due to its close association with water bodies. The most likely effects of the proposed Rocky Hill Coal Project on the lifecycle of the other four bat species is to cause a change in roosting behaviour due to the loss of some potential short term roost sites such as old farm buildings. For the Eastern cave bat and the Little bent-wing bat the likely effects of the Rocky Hill Coal Project would be an incremental decrease in the area of available habitat for foraging only.

The local populations of the Eastern bent-wing bat, Little bent-wing bat and Large-eared pied bat are likely to be extensive, occurring within large areas of adjacent forest, and more open habitats in the case of the Eastern bent-wing bat. The Large-footed myotis was detected in several locations near water within the Study Area and may occur widely in the locality, particularly in association with the Avon River, Waukivory and Oaky Creeks. The Eastern cave bat has not been recorded within the Study Locality however there may be a local population of this species that forages in the Study Area. Throughout the forest adjacent to the Study Area extending to the south and east, there would appear to be potentially suitable habitat for this species. Therefore, the Study Area is unlikely to play an important role in maintaining the long-term viability of the local population of any of these five species.

In consideration of the above, the proposed Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of any of these bat species.

Hollow-roosting insectivorous bats

- **Eastern false pipistrelle** – Vulnerable under the NSW TSC Act
- **Eastern coast free-tail bat** – Vulnerable under the NSW TSC Act
- **Yellow-bellied sheath-tail bat** – Vulnerable under the NSW TSC Act
- **Greater broad-nosed bat** – Vulnerable under the NSW TSC Act

The Yellow-bellied sheath-tail bat was identified in the Study Area during the field surveys by ultrasonic detection to the probable level of confidence and the Eastern coast free-tail bat was identified in the Study Area by ultrasonic detection to the definite level of confidence. The Eastern false pipistrelle and Greater broad-nosed bat were not recorded during field surveys. The Greater broad-nosed bat and the Eastern coast free-tail bat have previously been recorded within the Study Locality (NSW OEH Wildlife Atlas). The Eastern false pipistrelle and the Greater broad-nosed bat have been recorded in The Glenn Nature Reserve and at Terreel to the south of the Study Area by Ecotone Ecological Consultants (1994). All of these species have the potential to forage throughout the Study Area, particularly in and near the forested areas, and also to roost and breed in tree hollows.

The proposed Rocky Hill Coal Project would disturb around 525ha of land which contains portions of potential open forest foraging habitat. Existing open habitats that may be used for foraging would also be removed. There would be a loss of potential roost sites and breeding sites through the removal of hollow-bearing trees.

These impacts would result in a change of foraging behaviour and possibly force a change in roosting and breeding behaviour. Bats may have to slightly extend their foraging ranges into adjacent forest and use alternative roost sites to those used within the potential disturbance area. If disturbance to a breeding roost site occurred during a critical stage in the breeding cycle, a failed breeding attempt and/or mortality of individual bats could occur.

The local populations of each of these four species are expected to extend into large areas of forest adjoining the subject Site to the east, and in the case of the Yellow-bellied Sheath-tail bat, possibly as far as northern Australia. The proposed Rocky Hill Coal Project could directly affect the habitat of these species, but this habitat is not expected to be important for the long-term viability of the local population of any of these species. It is unlikely that the proposed Rocky Hill Coal Project would have a significant effect on any of these four species.

Grey-headed flying fox – Vulnerable under the NSW TSC Act

The Grey-headed flying-fox was opportunistically recorded at Waukivory Creek immediately to the south of the proposed area of disturbance, during the supplementary Barred frog surveys. This species has the potential to forage on the flowers of Eucalypts, figs and other rainforest tree fruits, throughout the Study Locality and the Study Area.

The proposed Rocky Hill Coal Project would result in the loss of approximately 46.4ha of potential foraging habitat for the Grey-headed flying-fox, but would have no direct effect on roosting or breeding habitat. Based on the capacity of this species to travel long distances to exploit seasonal food sources, the effect of the Proposal on the lifecycle or habitat of the Grey-headed flying-fox would be minor. The proposed Rocky Hill Coal Project is not expected to have a significant effect on this species.

Squirrel glider – Vulnerable under the NSW TSC Act

The Squirrel glider was recorded in the Study Area during field surveys. This species was captured in the Dry sclerophyll forest (Community 2) corridor along the northern section of McKinleys Lane. However, it is likely that the Squirrel glider could potentially forage the length of McKinleys Lane, adjacent forest/woodland areas and could also exist in the elevated forested parts of the eastern side of the Study Area.

It is documented that populations of Squirrel gliders can occur in roadside corridors such as McKinleys Lane, this is mainly due to fact that these corridors often have mature trees (van der Ree *et al* 1999) and these mature trees often hold sufficient hollows that this species requires for both breeding and roosting. The extent of the local population and the numbers of individuals in the Study Area, particularly for the area that would be removed as part of the Rocky Hill Coal Project, is unknown, but is likely to comprise one or two family groups.

The proposed Rocky Hill Coal Project would remove a maximum of 15.8ha of potential foraging, sheltering and breeding habitat (Dry sclerophyll forest in moderate to good condition) for the Squirrel glider. The McKinleys Lane population may well currently be isolated from other potential populations to the north or east of the Study Area. If a connection exists then it is tenuous along McKinleys Lane to Waukivory Road and east to the forested slopes of Rocky Hill. While the roadside vegetation along the northern half of McKinleys Lane is proposed for retention, indirect impacts from adjacent mining, light, noise and blasting may occur. This has the potential to affect this species lifecycle by causing: a change in foraging behaviour; a change in roosting behaviour; displacement of individuals, disruption of the social structure of the population and, where the new access road crosses McKinleys Lane, near its intersection with Waukivory Road, potential mortality of individual gliders. However, most traffic is expected to be slow moving in this location due to the proximity of the intersection.

Even with the impact mitigation measures recommended (e.g. glider poles), to improve connectivity between the McKinleys Lane roadside vegetation (see Section 7) and the more extensive vegetation of the Mograni Range, it is possible that the proposed Rocky Hill Coal Project could have an adverse effect on the local population that exists in the McKinleys Lane road reserve.

Green and golden bell frog – Endangered under the NSW TSC Act

The Green and golden bell frog was not recorded during the field survey and has not been previously recorded within 10 km of the subject Site, but has some potential to occur in marginally suitable habitat in the Study Area particularly the few well vegetated dams and soak areas.

The Proposal would result in the removal of some farm dams that may provide suitable habitat features for the Green and golden bell frog within the proposed area of disturbance. If the Green and golden bell frog did exist in the proposed area of disturbance the Proposal would affect the lifecycle of the Green and golden bell frogs in this area.

Based on the lack of records in the locality and the marginal quality of the habitat on the subject Site for the Green and golden bell frog, the habitat and individuals that could be affected by the proposed mining operations would be unlikely to play an important role in the long-term viability of any local population of this species.

In conclusion, the proposed Rocky Hill Coal Project is unlikely to have a significant effect on the Green and golden bell frog.

Green thighed frog – Vulnerable under the NSW TSC Act

The Green thighed frog was not recorded in the Study Area during the field survey and has not been recorded within the Study Locality, however this species has been recorded to the south of the Study Locality (The Glenn Nature Reserve) by Biosphere in 1994. This species tends to

be restricted to rainforest and wet sclerophyll forests. Suitable habitat for this species exists on the steep slopes on the eastern side of the Study Area and in the small patches of remnant rainforest further down the slopes within the proposed area of disturbance.

Small areas of rainforest habitat would be removed as part of the Proposal (4.3ha) and if the Green thighed frog were to utilise these small patches, the lifecycles of those individuals would be affected by the Proposal. Due to a lack of records in the Study Locality and the small patches of the habitat that is in the area of disturbance by comparison with the extensive areas of better quality habitat to the east of the Study Area, it is unlikely that the Rocky Hill Coal Project would adversely affect the long-term viability of any local population of Green thighed frogs.

In conclusion the mining operations and associated activities within the Study Area are unlikely to have a significant effect on the lifecycle of individuals or on any local viable population of the Green thighed frog.

Giant barred frog – Endangered under the NSW TSC Act

The Giant barred frog was not recorded in the Study Area during the primary field surveys or during the supplementary targeted Barred frog surveys and has not been recorded in the Study Locality. It has been recorded just out of the Study Locality along the Wards River and Mammy Johnsons River approximately 20km to the south of the Study Area (A. White pers. comm.).

There is habitat in the Study Area that is superficially similar to these rivers, i.e. Waukivory and to a lesser extent Oaky Creek are both permanent running creeks that have vegetation that would appear to be suitable for the Giant barred frog to exist (predominantly Community 4 and Community 3). However, the creeks and rivers within the Study Area flow northwards, they are part of a separate catchment from the watercourses around Wards River and Mammy Johnsons Creek where the Giant barred frog has been recorded (which flow to the south), they traverse shorter lengths of moist forest/Rainforest and they are naturally quite saline.

In conclusion, the Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of any individuals or any local viable population of the Giant barred frog.

Stuttering frog – Endangered under the NSW TSC Act

The Stuttering frog was not recorded in the Study Area during primary field surveys or during the supplementary targeted Giant barred frog surveys and there have been no records in the Study Locality, (according to the NSW Atlas of NSW Wildlife). The Stuttering frog has been recorded in The Glenn Nature Reserve southeast of the Study Locality in habitat that has some connection to the remnant rainforest (Community 4), on the upper slopes and drainage lines within the Study Area. Based on the existence of similar habitat, the Stuttering frog has the potential to occur in the Study Area.

There is a small portion of remnant Community 4 that would be removed as part of the Proposal, this portion is degraded and is unlikely to provide the necessary habitat required to support a significant local population of the Stuttering frog. Better habitat for the Stuttering frog exists in the north-east end of the Study Area, Oaky Creek and the southeast end, Waukivory Creek and beyond to the east.

In conclusion, the Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of individuals or any local viable population of the Stuttering frog.

Stephens banded snake – Vulnerable under the NSW TSC Act

Stephens banded snakes have a preference for rainforest and eucalypt forests and rocky areas up to an altitude of 950m. Within the Study Area the high slopes on the eastern side contain elements of suitable habitat for Stephens banded snake in the form exposed rocky areas, eucalypt forest and moist remnant rainforest drainage lines. This species was not recorded during field surveys nor has it been recorded in the Study Locality. It has been recorded around Terreel approximately 20 km south of the Study Locality. The eastern side of the Study Area shares similar habitat traits with these areas such that it is conceivable that Stephens banded snake may occur in the Study Area.

The areas that are most likely to provide suitable habitat for Stephens banded snake are areas that are outside the proposed Area of Disturbance and as such the operations involved in the proposed Rocky Hill Coal Project would not displace, disrupt the breeding cycle or create changes to foraging, roosting behaviour or effect migration and or dispersal of Stephens banded snake. There may be disturbance in the form of vibrations from blasting. These vibrations could result in the loss of refuges by creating small rock falls or may drive the species away, however, the effects that blasting may have in this area is not yet fully known.

In conclusion, the Rocky Hill Coal Project is unlikely to have a significant effect on the lifecycle of individuals or any local viable population of Stephens banded snake.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species likely to be placed at risk of extinction.

Not applicable, no endangered populations of fauna are known or likely to occur in the Study Locality.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- ***(j) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
- ***(iii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not relevant to fauna.

(d) in relation to the habitat of a threatened species, population or ecological community:
- ***(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***
- ***(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

- See **Table 18** above.
- No fragmentation or isolation of habitat is likely to occur as a result of habitat removal but indirect effects of mining activities on the northern end of McKinleys Lane may indirectly result in further isolation of the roadside habitat in this area.
- The roadside habitat along McKinleys Lane is habitat that is likely to be important to the local Squirrel glider and Grey-crowned babbler populations.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No areas of designated critical habitat identified under the provisions of the *Threatened Species Conservation Act 1995* apply to the Study Area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or final recovery plans or threat abatement plans have been prepared for most of the subject threatened fauna species. However, the following species have been addressed in recovery plans:

- Powerful owl (*Ninox strenua*) – Vulnerable
- Masked owl (*Tyto novaehollandiae*) – Vulnerable
- Sooty owl (*Tyto tenebricosa*) - Vulnerable

Since parts of the proposed area of disturbance (Dry sclerophyll forest – moderate to good condition and Rainforest) are potential habitat for the Powerful owl, Sooty owl and Masked owl, the proposed removal of some Dry sclerophyll forest habitat as part of the Proposal is inconsistent with objective 5 (minimise loss and fragmentation of owl habitat areas) of the Large Forest Owl Recovery Plan (DEC 2006). However, none of these owls was detected during the surveys and the habitat cannot be considered “known” habitat for any of these species. With the large home range of all these species, and the large extent of similar adjacent habitat to that proposed to be removed, the significance of loss of habitat is reduced. A pre-clearing protocol will be developed in order to identify the presence of any nest trees and avoid clearing during the breeding season.

- Barking Owl (*Ninox connivens*) – Vulnerable

Parts of the proposed area of disturbance are potential habitat for the Barking owl, but not known Barking owl nest sites. The removal of some Dry sclerophyll forest habitat would not be inconsistent with actions 3a (protect known barking owl nest sites and surrounding habitat) and 3.2 (assist with the protection of barking owl habitat from disturbance due to developments and activities) of the Recovery Plan for the barking owl (DECC 2003). A pre-clearing protocol will be developed in order to identify the presence of any nest trees and avoid clearing during the breeding season.

- Grey-headed flying fox (*Pteropus poliocephalus*) - Vulnerable

A Draft National Recovery Plan for this species has been prepared (DECCW 2009). The main objectives relating to habitat protection (objectives 1 to 4) comprise identification and protection of known roost sites and identification and protection of key foraging areas. No roost sites were detected or are likely to occur within the Study Area and the Study Area is not likely to contain any key foraging areas for this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

To date, 36 key threatening processes have been listed on Schedule 3 of the TSC Act. Eight are relevant to fauna and the proposed development. Other key threatening processes would be only peripherally or remotely relevant to the current Proposal.

1. Clearing of Native Vegetation

The Proposal would remove 51.8ha of natural vegetation, more than half of which is in low condition thus producing an effective clearing area of 41.1ha of native vegetation. As such, a number of ecological impacts identified by the Final Determination for the threatening process (NSW Scientific Committee 2001) could occur to a minor extent, including incremental reductions in the size of local populations of individual species, increased greenhouse gas emissions, increased habitat for invasive species and changes to soil biota.

2. Removal of Dead Wood and Dead Trees

The Proposal would result in the removal of some dead standing trees within the cleared paddocks. Dead wood in the form of logs on the ground was uncommon. The removal of dead wood and dead trees for the Proposal would incrementally increase this key threatening process listed on Schedule 3 of the TSC Act.

3. Loss of Hollow-bearing Trees

Some hollow-bearing trees will be removed within the proposed area of disturbance as scattered large paddock trees and within the Dry sclerophyll forest patches. The removal of hollow-bearing trees would be largely unavoidable. The Proposal is unlikely to significantly increase the impact of the loss of hollow-bearing trees key threatening process listed on Schedule 3 of the TSC Act in the locality due to extensive areas of similar habitat being present within adjacent land. A pre-clearing protocol will be developed in order to identify the presence of hollow-bearing trees and to avoid clearing during the breeding season of local hollow-breeding fauna. Hollow trees that are removed for mining, will be used to provide habitat for ground fauna in the rehabilitation areas.

4. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

There is potential for the Proposal to impact on the natural flow of Oaky Creek, Waukivory Creek, the Avon River or associated watercourses where the proposed mine pit comes close to these watercourses. A full assessment of the potential hydrological impacts due to the Proposal has been undertaken, and the proposed mine has been designed in such a manner that no adverse impacts on the natural flows of these rivers or streams will occur as a result of the Proposal.

5. Human-caused Climate Change

The Proposal may result in an exacerbation of human-caused climate change through the removal of vegetation, an increase in truck and train traffic and direct carbon emissions due to the mining process itself. The Proposal may contribute to human-caused climate change.

In conclusion, the proposed construction of a mine and associated infrastructure for the Rocky Hill Coal Project is not expected to significantly increase the incidence of designated key threatening processes listed on Schedule 3 of the TSC Act, or any other threatening processes, if they are appropriately managed. Such management would mainly include hydrological management, erosion and sediment control, noxious and environmental weed control and exclusion of root-rot and myrtle fungus. Full details are given in the Recommendations section (see Section 6).

4.2.3.1 Seven-part Test Conclusions

Following an assessment of the significance of potential impacts of the Proposal, it was found that the Rocky Hill Coal Project is unlikely to have a significant impact on any local populations of the subject threatened species.

While the northern end of McKinleys Lane has been excluded from the proposed area of disturbance, and revegetation along adjoining roadsides has been carried out to improve habitat connectivity, there is some potential for indirect effects on the local Squirrel glider population and the local Grey-crowned babbler population that has been identified within the roadside vegetation along McKinleys Lane. However, it is not currently possible to predict the level of impact.

In view of the existing vulnerability of this relatively isolated roadside habitat, it is proposed to include a Squirrel glider and Grey-crowned babbler monitoring program as part of a Biodiversity Management Plan for the Proposal. This will allow adaptive management of the northern end of McKinleys Lane if changes in the populations are identified from the monitoring.

4.2.4 Native Vegetation Act 2003

Not relevant under Part 4, Division 4.1 of the EP&A Act.

4.2.5 Koala Habitat Assessment - SEPP 44

Assessment of potential Koala habitat under SEPP 44 requires the following steps be undertaken:

1. identification of “Potential Koala Habitat” within the proposed development area. Areas where trees of the types listed as Koala feed trees under Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component are “Potential Koala habitat”;

2. identification of "Core Koala habitat" within the development area. "Core Koala habitat" is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population;
3. where an area has been identified as "Core Koala habitat", a plan of management must be prepared and must accompany the application.

Three of the Koala feed tree species listed under Schedule 2 of SEPP 44 were positively identified within the Study Area, the Forest red gum, *Eucalyptus tereticornis*, Grey gum *Eucalyptus punctata* and Tallowwood, *Eucalyptus microcorys*. In some parts of the Study Area at least 15% of the tree species comprise Koala feed tree species, particularly in the lower slopes and valley floor. Therefore these parts constitute "Potential Koala habitat".

Searches of the threatened species database and previous reports indicate that Koalas are rarely observed within the Study Locality, with only 10 previous records over the last 50 years. Surveys for signs of Koalas (scats and scratches) were undertaken opportunistically at potential food trees, daytime tree searches and spotlighting was used to detect their presence. No evidence of occupation of the Study Area by Koalas was detected during the survey and it is concluded that none of the Study Area constitutes "Core Koala habitat".

4.2.6 The NSW State Groundwater Dependent Ecosystem Policy 2002

The NSW *Water Management Act 2000* provides the legislative framework for implementing *The NSW State Groundwater Dependent Ecosystems Policy*, which would be used to assist in determining whether the Proposal is likely to result in any impacts on groundwater dependent ecosystems.

Section 2.3 of the Policy states that the types of groundwater dependent ecosystems in NSW can include:

- Terrestrial vegetation – where the groundwater is sufficiently high to sustain the vegetation
- Base flows in streams – where groundwater emerges from saturated sediment or rocks and enters a stream or river bed
- Aquifer and cave ecosystems – subterranean ecosystems
- Wetlands – relatively low-lying areas which are kept moist by inflow of groundwater

Vegetation Community 3 (Riparian) has some potential to depend on groundwater sources, however, only a small area of this community (1.1ha) is likely to be directly impacted by the Proposal. The impact within the riparian zone adjacent to the Waukivory Creek and Avon River would be limited to vegetation trimming rather than removal. The 0.8ha of the riparian vegetation within the Rail Load-out Facility would be completely removed.

The Mine Area has been specifically located to minimise impacts on flood-prone land adjacent to Waukivory Creek, Avon River and Oaky Creek.

The Proposal is considered unlikely to have a significant effect on any groundwater dependent ecosystem.

4.3 GLOUCESTER SHIRE COUNCIL

4.3.1 Gloucester Shire Mining Policy

Gloucester Shire Council has prepared a policy document 'Mining in New South Wales: A Different Approach' (Gloucester Shire Council 2009a), which is broadly aimed at proactively regulating mining expansion within the Local Government Area and thus providing certainty to the industry. Council has defined two buffer areas relevant to mining from the borders of the town of Gloucester - 1 km and 5 km respectively. The proposed mine is situated beyond the 1km buffer but within the 5 km buffer, which is a voluntary acquisition zone. Within this zone, exploration activities may require a greater detailed survey 'up to the point where the value of the resource could be higher than the cost to relocate the town or village area'.

The local and regional impact expected from the Rocky Hill Coal Project on biodiversity is very minor.

4.3.2 Roadside Areas of Significance

McKinleys Lane within the Study Area has been designated by Gloucester Shire Council as containing an area of roadside significance (Gloucester Shire Council 2009b). Significant roadside environments are recognised by Council as possessing particular ecological values (in addition to specified social and economic values) including "habitat for threatened and other fauna species, retention of Endangered Ecological Communities, wildlife corridors, a source of native seed for rehabilitation programs, protecting waterways and acting as buffer zones from strong wind, dust and noise" (Gloucester Shire Council 2009b). Ground truthing of roadside vegetation mapping and prioritising of significant roadside areas is currently being undertaken by Council as the final stage of the development of tools for Roadside Vegetation Management, a process that has been underway by the Environment Division of Hunter Councils for several years. Of particular significance for the roadside environment in the Gloucester area is habitat for the Grey-crowned babblers. All roadside environments have been assessed by Council against 10 different criteria. McKinleys Lane has been mapped as a site of third priority; where first priority are sites that meet 5-10 of the criteria, second priority sites are sites that meet 3-4 of the criteria and third priority sites are sites that meet two criteria.

From the biodiversity surveys carried out for the Proposal, four threatened fauna species were detected along McKinleys Lane, including the Grey-crowned babbler. It is considered that the McKinleys Lane roadside area has significant habitat values, but is vulnerable, due to its tenuous link with more extensive forested areas to the north and east.

The Proposal has been specifically designed to minimise direct impacts on the McKinleys Lane roadside areas. Corridors of native vegetation have already been established along Waukivory Road by the Applicant in order to create a better link with the forest to the north and east of McKinleys Lane and the rehabilitation plan includes native vegetation belts and woodland plantings to further improve habitat connectivity.

Monitoring of Grey-crowned babblers at the Tarrawonga Mine near Gunnedah suggests that where this species occupies habitat adjacent to mining activities, it is resilient to the mining activities (Countrywide Ecological Service, December 2010).

It is also proposed to establish a monitoring program for the populations of the Grey-crowned babbler and Squirrel glider in the northern part of McKinleys Lane in order to ensure their viability over the construction and operational phases of the Proposal and to assess the effectiveness of the measures designed to improve connectivity to the more extensive areas of forest north and east of McKinleys Lane.

4.4 CUMULATIVE IMPACTS

The Rocky Hill Coal Project would incrementally contribute to loss of native vegetation and native species habitat in the Gloucester area due to mining projects and ongoing agricultural activities. Nearby coal projects include the Stratford Extension Project, for which 105ha of native vegetation would be removed if approved. This is in addition to the native vegetation that has already been removed in previous phases of mining associated with the Stratford Mining Complex (FloraSearch 2012).

The Duralie Coal Extension Project located further south near Stroud, is expected to involve native vegetation loss of 87ha (Cenwest Environmental Services and Resource Strategies 2010) and an area of 18.2ha of native vegetation is expected to be removed for the proposed AGL Gloucester Coal Seam Gas Project (AECOM 2009).

In comparison to the other nearby open cut coal projects, the contribution to the total loss of native vegetation due to the Rocky Hill Coal Project would be relatively small at 41.1ha. This loss would be offset for each vegetation community by an appropriate, objectively determined offsets package, as explained in the next section. Offsets have also been implemented or are proposed for the other projects.

A breakdown of the areas of each BioMetric vegetation type that would be removed by the Stratford Extension Project (FloraSearch 2012) is given in **Table 20**.

Table 20
BioMetric Vegetation Types to be removed for the Stratford Extension Project

Vegetation Type	**Approximate Area to be cleared (ha)**
Tallowwood – Brush Box – Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast (HU642)	0.2
Tallowwood – Small fruited Grey Gum dry grassy open forest of the foothills of the North Coast (HU644)	19
Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (HU526)	13.5
Spotted Gum – Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast (HU630)	65
Derived Grasslands in Coastal Valleys (HU670)	5.5
Acacia Regeneration	0.5
Total	**103.7 (rounded to 105)**

Details of the areas of each BioMetric vegetation type that would be removed by the Duralie Extension Project (Cenwest Environmental Services and Resource Strategies 2010) are given in **Table 21**.

Table 21
BioMetric Vegetation Types to be removed for the Duralie Extension Project

Vegetation Type	Approximate Area to be cleared (ha)
Spotted Gum – Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast (HU630)	63
Grey Box - Forest Red Gum – Grey Ironbark open forest of the hinterland ranges of the North Coast (HU549)	23
Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin (HU641)	1
Total	**87**

The BioMetric vegetation communities to be cleared are different for all coal projects, but the single largest area of clearing in all cases (including the Rocky Hill Coal Project) would be of the same BioMetric vegetation type, this being the Spotted Gum – Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast (HU630).

Details of the areas of each vegetation community that would be removed by the Gloucester Coal Seam Gas Project (AECOM 2009) are given in **Table 22**. For this project, equivalent BioMetric vegetation types were not assigned to the vegetation communities documented and therefore it is difficult to directly compare the cumulative loss of each vegetation unit with the other studies.

Table 22
Vegetation Types to be removed for the Gloucester CSG Project

Vegetation Type	Approximate Area to be cleared (ha)
Dry foothills spotted gum	9.2
Rainforest	0.3
South Coast Shrubby Grey Gum	1.4
Ironbark	2.6
Redgum / Apple	0.1
Spotted Gum - Ironbark Forest	1.5
Grey Gum – Stringybark – Bloodwood ± Spotted Gum Ironbark Forest	2.6
Forest Red Gum / Spotted Bum Woodland (Hunter Lowland Redgum Forest EEC)	0.23
Riparian Communities	0.22
Total	**18.2 (rounded)**

The native vegetation clearing for the Rocky Hill Coal Project includes the loss of 4.3ha of the VEC *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions*, as listed by the NSW TSC Act. This was considered to be a minor loss of the VEC on a local or regional basis according to the impact assessment, and would be fully offset.

No threatened or significant flora species are expected to be impacted by the Proposal; therefore no cumulative impact on threatened flora is anticipated.

5. BIODIVERSITY OFFSETS FOR RESIDUAL IMPACTS

5.1 METHODOLOGY

It is proposed to provide offsets for the residual impacts on native vegetation communities and threatened species. These will be within a proposed Biodiversity Offset Area to be established along the eastern side of the Study Area along the upper slopes of the Mograni Range (see **Figure 7**). The proposed Biodiversity Offset Area contains both vegetation in moderate to good condition, and vegetation in low condition that will be enhanced by additional management actions to obtain additional ecosystem credits.

In particular, the revegetation of areas where the vegetation is in low condition will improve the connectivity of natural vegetation between the northern and southern ends of the Biodiversity Offset Area. This will facilitate the movement of fauna through areas that are currently fragmented by past clearing within the Biodiversity Offset Area. A small part of the offset area at the southern end is partially isolated by the corridor for the re-located 132kV power line, but revegetation within this area will improve the vegetated connection with the riparian vegetation along Waukivory Creek.

The BioBanking Assessment Methodology (BBAM) was applied to both the proposed impact area and the proposed Biodiversity Offset Area to objectively quantify the ecosystem credits required due to the Proposal and the ecosystem credits capable of being generated by the Biodiversity Offset Area. A credit comparison was then made to determine the capacity of the proposed Biodiversity Offset Area to provide the required credits to offset the residual biodiversity impacts due to the Proposal.

Both the Grey-crowned babbler and the Squirrel glider were recorded near the proposed disturbance area during the fauna surveys and anecdotal sightings of the Brush-tailed phascogale were reported by a local resident. However, these records were not entered into the credit calculator since the potential impacts on these species are being assessed and accounted for separately and species credits are not being sought for particular threatened species from the proposed Biodiversity Offset Area.

5.2 GRASSLAND AND LOW CONDITION VEGETATION ANALYSIS

The cleared land to the west of McKinleys Lane in the proposed disturbance area contains very few paddock trees and the grass cover is almost entirely exotic. Large areas of land in this part of the Site consist of a monoculture of whisky grass.

The land to the east of McKinleys Lane, however, contains clusters of paddock trees and cleared grassland that may have contained a proportion of native species cover. These trees are mostly in poor condition and many are suffering signs of dieback. The clusters of paddock trees were predicted to constitute vegetation that is defined as being in ‘Low Condition’ according to the BBAM. For the relevant Biometric Vegetation Type in this area, (HU630: Spotted Gum – Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast) the definition of Low Condition vegetation is:

- the native over-storey percentage of foliage cover is less than 25% of the lower value of the over-storey percentage of foliage cover benchmark for that vegetation type (in this case 3.75%); and
- less than 50% of the ground cover vegetation is indigenous species.

As part of the BBAM, a field assessment was carried out to objectively determine whether the open grassland in the paddocks to the east of McKinleys Lane (in the open or beneath paddock tree clusters) was derived native grassland or essentially cleared, exotic pasture. The Paddock Tree Calculator (DECC 2009a) was then used to assess whether the vegetation formed by the clusters of paddock trees would be classified as in Low or Moderate to Good condition.

Field assessments were undertaken on the 10th and 11th May 2012 using the 'Pointed Stick Method', which is one of the assessment methods recommended for use in the Native Vegetation Act 2003 to determine whether groundcover vegetation can be classified as cleared or not cleared (Catchment Management Authorities NSW 2006). These methods are recommended by the BBAM to determine whether marginal groundcover vegetation is cleared or in low condition. The method is based on the proportion of random hits on exotic grassland species to native grassland species by a thrown pointed stick, repeated 50 times at each location.

Replicate samples using this method were taken at 13 locations within the paddocks east of McKinleys Lane, spread approximately evenly throughout the area from north to south. The locations of these grassland plots are shown in **Figure 11**. Most of the plots were located in open grassland whilst three were located within areas of tree clusters.

A summary of results from the grassland analysis for each of the 12 grassland plots is given in **Table 23**.

Table 23
Results from Grassland Analysis

Plot	Easting	Northing	Description	Total hits native	Total hits exotic	Percent native	Overall Condition
1a	404981	6450648	Paddock	11	45	20	Cleared
1b	404940	6450677	Trees	40	18	69	Not cleared
2	405178	6450919	Paddock	23	38	38	Cleared
3	404705	6450600	Paddock	19	43	31	Cleared
4	404975	6451899	Paddock	12	45	21	Cleared
5	405277	6451890	Paddock	17	40	30	Cleared
6	405109	6451739	Trees	33	25	57	Not cleared
7	404878	6451543	Trees	37	26	59	Not cleared
8	404706	6452389	Paddock	6	47	11	Cleared
9	404737	6452733	Paddock	11	47	19	Cleared
10	404861	6453438	Paddock	13	46	22	Cleared
11	404989	6453015	Paddock	6	50	11	Cleared
12	404981	6452792	Paddock	10	46	18	Cleared
OVERALL TOTAL				**238**	**516**	**32**	

Over the entire investigation area in which the 13 grassland plots were assessed for the grassland analysis, the average percent native cover was 32%, therefore the grassland within the eastern paddocks was predominantly exotic.

The criterion given by Catchment Management Authorities NSW (2006) is that groundcover that comprises less than 50% native live cover is considered not to be native grassland and can be cleared without a permit. This principle was applied to the results of the grassland analysis, the practical interpretation being that grassland that comprises less than 50% native species can be considered to be 'cleared pasture' and no offsetting requirements under the

BioBanking Assessment Methodology applies to these areas. Only three of the 13 plots assessed had greater than 50% native cover of the groundcover, all of which were beneath denser clusters of trees. These areas were mapped as being in 'moderate to good' condition and assessed accordingly by the BBAM. The overall conclusion was that the bulk of the grassland area to the east of McKinleys Lane was dominated by exotic species and was not derived native grassland. Apart from specific mapped areas in low or moderate to good condition, this grassland could be deemed to be cleared pasture and requires no further consideration in the BBAM.

For the remaining areas where paddock trees occurred, but the groundcover comprised substantially less than 50% native cover, concave polygons were drawn around individual groups of trees according to the methodology given in Appendix 3 of DECC (2009). These polygons are shown in **Figure 11**. The Paddock Tree Calculator was then used to determine objectively whether the vegetation of each polygon was Low Condition or not. The results are given in **Table 24.**

Table 24
Results Summary for Patches of Low Condition Vegetation (Paddock Trees) in Proposed Mine Area East

Paddock Tree Polygon No.#	Inputs from Field and GIS data				Results According to Paddock Tree Calculator		
	Av. Crown Diam. (m)	Av. % foliage cover	No. trees in polygon	Actual Area of polygon (ha)	Low Condition?	Percent Foliage Cover %	Effective clearing area (ha)
1	*12*	*45*	*2*	*0.16*	*No**	*6.4*	*N/A*
2	12	45	12	3.62	Yes	1.7	1.6
3	12	45	24	6.32	Yes	1.9	3.3
4	12	45	1	0.41	Yes	1.2	0.1
5	12	45	3	0.48	Yes	3.2	0.4
6	12	45	9	1.48	Yes	3.1	1.2
7	12	45	7	1.78	Yes	2.0	1.0
8	12	45	3	0.58	Yes	2.6	0.4
9	12	45	8	2.50	Yes	1.6	1.1
10	12	45	16	2.35	Yes	3.5	2.2
11	12	45	19	4.10	Yes	2.4	2.6
12	12	45	8	1.37	Yes	3.0	1.1
13	12	45	12	2.28	Yes	2.7	1.6
14	12	45	6	0.92	Yes	3.3	0.8
15	*12*	*45*	*8*	*1.20*	*Yes*	*3.4*	*1.1*
16	12	45	6	1.10	Yes	2.8	0.8
17	10	45	6	0.62	Yes	3.4	0.8
18	12	45	13	2.57	Yes	2.6	1.8
19	*12*	*45*	*7*	*1.05*	*Yes*	*3.4*	*1.0*
20	10	45	5	0.50	Yes	3.5	0.5
21	12	45	3	0.57	Yes	2.7	0.4
22	12	45	4	1.01	Yes	2.0	0.5
TOTAL AFFECTED POLYGONS				**35.8**			**23.3**
AVERAGE AFFECTED POLYGONS						**2.6**	

* Assessed as Moderate-Good Condition in BBAM
Italics – not in proposed disturbance area
See location on **Figure 11**

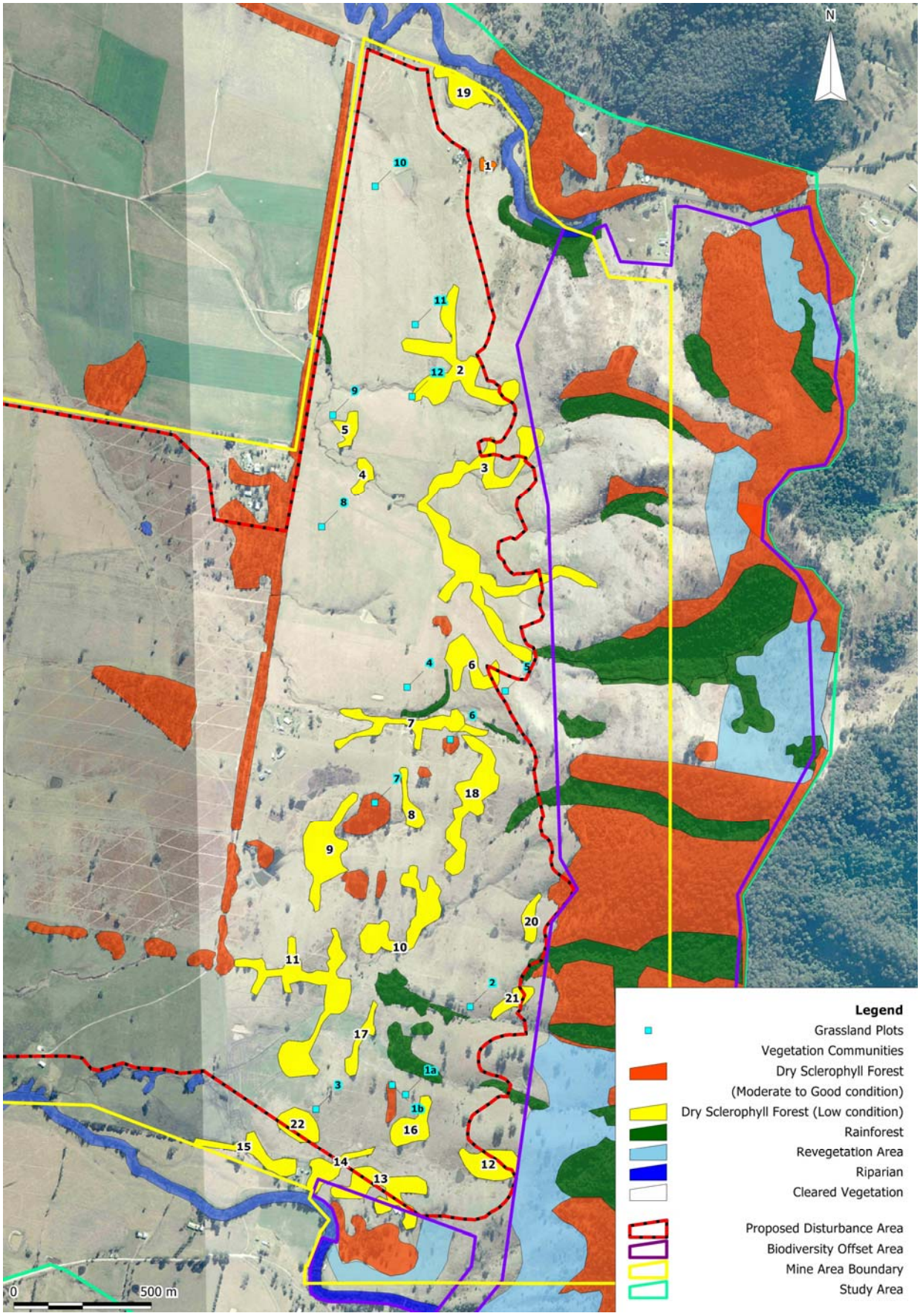

Figure 11 Paddock Tree Polygons and Grassland Plot Locations

Only one paddock tree polygon (No 1) was determined to not be Low Condition vegetation by the Paddock Tree Calculator. This patch plus Polygons No 15 and 19 were originally within the impact area but following modifications to the Proposal are no longer in the proposed disturbance area. Therefore these three polygons are excluded from the subsequent analysis. Parts of polygons 2, 3, 6, 12, 13, 14, 21 and 22 also fall outside the proposed disturbance area. These areas are also excluded from the subsequent analysis.

The remaining polygons were aggregated into the one vegetation zone (Low Condition – Vegetation Community 2). The portion of this vegetation zone that occurred within the proposed disturbance area was assessed for total clearing within the BBAM for the impact area, along with the other vegetation zones. The proportion of the 'effective clearing area' to be cleared was entered into the BioBanking credit calculator as the actual area lost for the zone.

5.3 BIOBANKING PLOTS AND TRANSECTS

The BBAM involved supplementary fieldwork in both the proposed impact and Biodiversity Offset Areas to gather data in a form specified in the BioBanking Operational Manual (DECC 2009) for use in the BBAM. The fieldwork was carried out on the 18th March 2011, 2nd - 4th August 2011 and 10th - 11th May 2012. During the fieldwork, data were recorded from BioBanking plots and transects within each native vegetation zone. The plots and transects were located throughout the Study Area to sample the range of variation within each vegetation zone. The locations of the BioBanking Plots are shown in **Figure 8**.

The number of plots and transects used compared to those specified by the BBAM methodology is summarised in **Table 25**. The plots and transects met or exceeded the minimum requirements specified by the methodology, except for Community 4 in the Biodiversity Offset Area, as explained in Section 3.1.1.

Table 25
Plots and Transects used in BBAM Fieldwork

Vegetation Zone	Total Area of Zone (ha)	Plots and Transects	
		Required by Methodology	As Carried Out
		IMPACT AREA	
Community 2. Dry sclerophyll forest	35.7	3	5
Community 3. Riparian Woodland	1.1	1	1
Community 4. Dry Rainforest	4.3	3	3
		OFFSET AREA	
Community 2. Dry sclerophyll forest	94.6	5	5
Community 3. Riparian Woodland	2.7	2	4
Community 4. Dry Rainforest	43.2	4	3

5.4 BIOBANKING ASSESSMENT USING THE BIOBANK CREDIT CALCULATOR

Separate BioBanking Credit Calculations were performed for different aspects of the Proposal.

- Credits required for the Impact Area
- Credits generated by the Biodiversity Offset Area

This allowed for a credit comparison that accounted for credits required due to losses of biodiversity as a result of the Proposal to be compared with credits generated from the proposed Biodiversity Offset Area that adjoins the proposed impact area.

Landscape values required by the methodology (DECC 2009) were determined from three overlapping 1000ha assessment circles for the impact area (the minimum required to cover the Site) (**Figure 12**), and two 1000ha assessment circle for the Biodiversity Offset Area (**Figure 13**). The three inner 100ha assessment circles for the impact area (**Figure 12**) were placed over the most highly disturbed areas within the impact area. For the Biodiversity Offset Area (**Figure 13**), the two 100ha assessment circles were placed over more heavily vegetated parts. Values for local native vegetation cover and connectivity width and condition were determined from these circles.

The data from the plots and transects, paddock tree calculator analysis, landscape values and results from the general field surveys were entered into the BioBanking Credit Calculator (Version 2.0).

For the impact area, total clearing of vegetation was entered as the ultimate outcome in the management zones for each threatened species sub-zone. Accordingly, management scores were reduced to 0 as a result of the Proposal.

For the Biodiversity Offset Area, a total land area of 267ha will be reserved. Of this, 195ha will consist of managed native vegetation. In particular, 45.1ha of this area currently consists of Community 2 in low condition which will be actively revegetated (**Figure 13**).

Default gains in Site value were used for vegetation zones where vegetation was in good condition and generally intact. A set of standard management actions are required to be undertaken at all BioBank sites according to Section 2.6 of the methodology (DECC 2008) and it is expected that these would be undertaken within the Biodiversity Offset Area to obtain the predicted ecosystem credits due to default increases in site value. These management actions are listed in Section 7 and **Appendix 6.**

In the zone of highly disturbed woodland (Community 2) in low condition consisting of 45.1ha to be revegetated, additional management actions were entered according to the guidelines given in Appendix 5 of the BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009). These were applied to obtain additional credits for restoring partially cleared, degraded vegetation.

A detailed explanation of the approach and assumptions made in carrying out the BBAM, including the particular management actions to be applied in each zone is provided in **Appendix 6**.

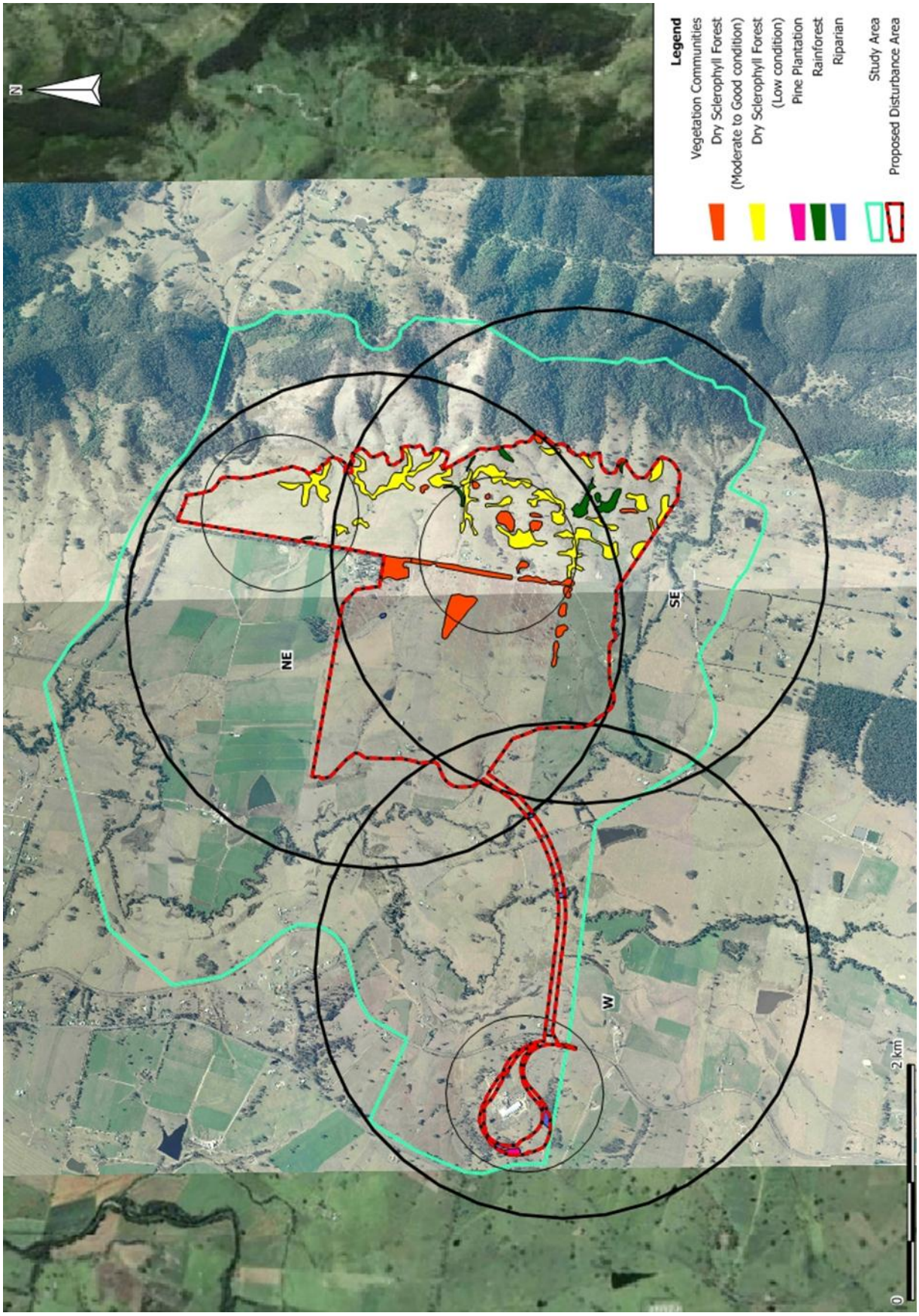

Figure 12 BioBanking Circles used in the BioBanking Assessment Methodology for the Disturbance Area

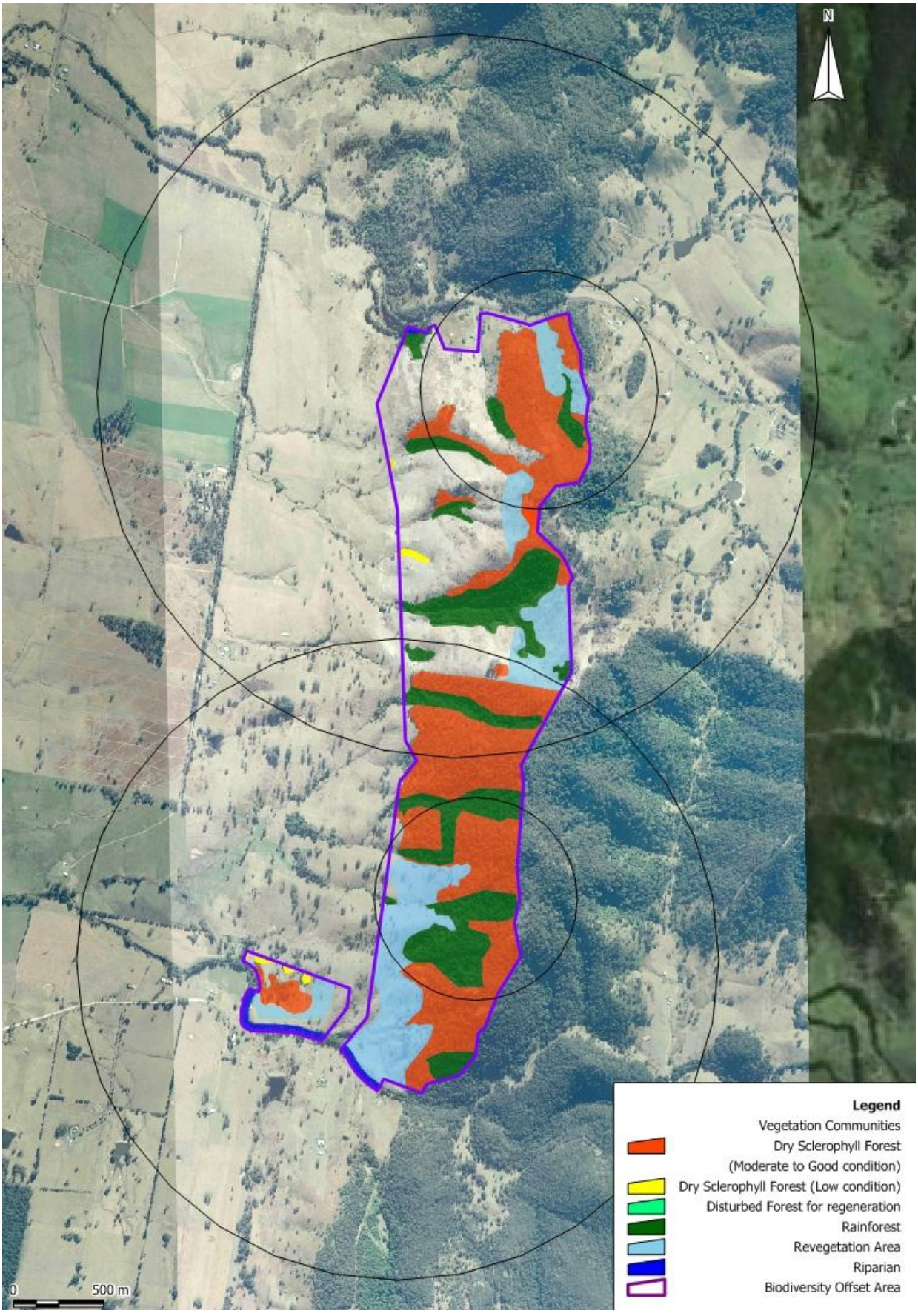

Figure 13 BioBanking Circles used in the BioBanking assessment Methodology for the Biodiversity Offset Area

5.5 BIOBANKING CREDIT CALCULATION RESULTS

A summary of results from the BioBanking Assessment for both the proposed disturbance area and the Biodiversity Offset Area is presented in **Table 26**. The results show that the Biodiversity Offset Area provides more than the minimum ecosystem credits required for all vegetation community types that would be disturbed by the proposal.

The Biodiversity Offset Area provides just over 100% of the credits required for the Dry sclerophyll forest, i.e. if the low condition areas are regenerated with management actions in addition to the default increases in Site value obtained in the moderate-to-good condition zones of vegetation elsewhere. Likewise, the Riparian community at the southern end of the Biodiversity Offset Area would yield over 110% of the required credits when additional management actions are applied to restore the community to a better condition. The rainforest patches within the Biodiversity Offset Area provide over 140% of the required credits with only default management actions applied.

The methodology has determined one vegetation community to be a 'red flag' within the proposed impact area. The riparian community where it would be impacted along the creeks and river (HU598 - River Oak Riparian Woodland) is a red flag because the vegetation type is >70% cleared within its entire known range. In a formal BioBanking Assessment, a red flag determination must be made by the Director-General to waive the red flag, if the development is regarded as improving or maintaining biodiversity values. In this case, a set of criteria must be considered to avoid impacts on red flags. All steps have been taken to avoid or minimise impacts on the red flag community by locating components for the Rail Load-out facility and overland conveyor such that they minimise vegetation disturbance to the greatest extent possible.

This vegetation type is not classified as a red flag where it occurs in the Biodiversity Offset Area, since red flags do not apply to any vegetation types in areas classified as BioBank or offset sites (**Appendix 7**).

In summary, the Biodiversity Offset Area alone would provide more than the required number of ecosystem credits to offset the impacts on all vegetation communities affected. These credits depend on application of the standard and additional management actions within each area as specified by the methodology (see Section 6 Recommendations) and **Appendix 7**.

Table 26
Summary Table – Ecosystem Credits Balance Including Biodiversity Offset Area Only

Vegetation Community (this study)	Equivalent Biometric Vegetation Type and Map Unit Number	Area (ha)		Ecosystem Credits		Credit Comparison	Minimum Offset Area Required (ha)	% of Target Ecosystem Credits provided by Offset Area
		Impacted by Proposal	Maximum available in Biodiversity Offset Area	Required by Proposal	Generated by Biodiversity Offset Area			
2. Dry sclerophyll forest	Spotted Gum – Grey Ironbark dry open forest (HU630)	35.7	141.9*	1245	1251	6 credit surplus	141	100.5%
3. Riparian	River Oak Riparian Woodland (HU598)	1.1	2.9	28	31	3 credit surplus	2.6	110.7%
4. Rainforest	Fig – Whalebone tree – Stinging Tree dry rainforest of the southern North Coast (HU541)	4.3	50.6	291	418	127 credit surplus	35	143.6%
Total		41.1	195.4	1564	1700	136 credit surplus	178.6	

Note: Minimum % native vegetation cover class and minimum adjacent remnant area class requirements have been satisfied for each Vegetation Group in the Biodiversity Offset Area.

* Includes 45.1ha of Community 2 in Low Condition that will be revegetated and to which additional management actiosn will be applied (see **Appendix 6**)

Table 27 summarises the offset ratios for each vegetation type as derived from the current BioBanking Assessment taking into account credits obtained from the Biodiversity Offset Area.

Table 27
Summary of Offset Ratios for each Vegetation Type

Veg Type	Credits Required per ha lost	Credits Generated per ha offset	Offset Ratio
2. Dry sclerophyll forest	34.87	8.81	3.96 : 1
3. Riparian	25.45	10.69	2.38 : 1
4. Rainforest	67.67	8.26	8.19 : 1

6. RECOMMENDATIONS

As the design of this Proposal has progressed and the potential impacts from the Proposal on terrestrial biodiversity have emerged, a range of potential mitigation measures identified by Ecotone Ecological Consultants, Gloucester Resources Limited and others, have been incorporated into the Proposal.

The Applicant proposes to adopt the mitigation measures presented throughout Section 5 of this report together with the following recommendations. Hence, the impact assessment section of this report reflects the adoption of these measures and recommendations.

The following are recommendations provided for the Applicant to consider for the Proposal.

General

- A Biodiversity Management Plan should be prepared to address the anticipated environmental impacts due to the Proposal, including biodiversity. This should include the following.
  - Management protocols to address short-term stabilisation of interim landforms and long-term stabilisation of final landforms to be returned to open woodland and native vegetation corridors.
  - A hydrological management plan to minimise impacts on watercourses and the natural hydrology of the Site. The aim should be to avoid or minimise impacts on the natural flow regime and sedimentation/ pollution of rivers and creeks downstream from the Site. In particular, minimise disturbance to watercourses during road bridge or conveyor crossing works. This would protect any Platypus populations and other aquatic species that may occur in the watercourses.
  - Best practice measures for the control of erosion and sedimentation during the life of the mine.
  - Protocols for control and management of noxious and environmental weeds, particularly at the interface or edge areas between the proposed disturbance area and the retained, managed areas such as the Biodiversity Offset Area.
  - Protocols to minimise root-rot and myrtle fungus.
  - The first step in establishing a monitoring program for the local populations of the Grey-crowned babbler and Squirrel glider, known to be present within the roadside vegetation along McKinleys Lane within the Study Area, should be to determine the size of the current population of both species.
  - It may be found, during the precise alignment of the new Mine Area access road where it crosses the existing McKinley's Lane near its intersection with Waukivory Road, that that no large mature trees are available for retention on both sides of the access road where it crosses the existing McKinley's Lane near its intersection with Waukivory Road. Should this be the situation, then the erection of a glider pole just outside the road alignment on each side may be necessary to aid the movement of gliders across the new road at a height that would avoid vehicles hitting Squirrel gliders during a glide.

- While vehicle speeds on the new Mine Area access road where it crosses the existing McKinleys Lane near its intersection with Waukivory Road, are expected to be relatively slow, a sign should be erected to highlight that this area is likely to be a fauna crossing point and that drivers proceed with caution.
- If the results of the proposed monitoring program indicate that an adverse effect on the tenuous populations of Squirrel gliders and Grey-crowned babblers within the McKinleys Lane roadside vegetation are occurring, then further measures should be investigated that could be adopted to minimise direct and indirect impacts on the roadside environment of McKinleys Lane,
- Preparation of a pre-clearing protocol designed to, where practicable, avoid or minimise clearing during critical life cycle periods for fauna and designed to rescue any fauna species, and particularly any threatened fauna species, as clearing progresses.
- The proposed realignment of the power line along the eastern boundary of the proposed area of disturbance has the potential to reduce the effectiveness of the agreed mitigation measures that were designed to provide greater connectivity between the McKinleys Lane roadside vegetation and the more extensive vegetation along the Mograni Range. The slashing of the vegetation in the easement will create at least a temporary impediment to ground and arboreal fauna movement from the disturbance area to the proposed Biodiversity Offset Area and Mograni Range during clearing works for the mine, and similarly will impede the movement of these fauna between these areas after mining is completed. In order to minimise this effect, the easement should coincide with existing cleared land wherever possible and in consultation with TransGrid, any potential for retaining low vegetation and/or fallen timber within the easement should be explored in order to provide protection from predators during ground-level crossings of the easement by fauna.

Biodiversity Offset Area

- For the Biodiversity Offset Area, preparation of a Biodiversity Management Plan will be required that will address, as a minimum, the standard and additional management actions specified by the BBAM (DECC 2008; DECC 2009a) for each vegetation community. Implementation of the standard management actions will need to be integrated into the plan. The standard management actions are as follows.
  - Management of grazing for conservation
  - Weed control
  - Management of fire for conservation
  - Management of human disturbance
  - Retention of regrowth and remnant native vegetation
  - Replanting or supplementary planting where natural regeneration will not be sufficient

- Retention of dead timber
- Erosion control
- Retention of rocks.

Additional Management Actions specific to particular vegetation types as specified in the BioBanking Credit Report (See **Appendix 7**) are as follows.

- Cat and/or fox control (all vegetation types)
- Exclude miscellaneous feral species (all vegetation types)
- Control feral pigs (Riparian community only)
- Feral and/or native herbivore control/ exclusion (e.g. rabbits, goats, deer, etc.) (all vegetation types)
- Maintain or reintroduce flow regimes (aquatic flora) (all vegetation types)

Additional management actions to obtain extra credits in the more degraded parts of the Biodiversity Offset Area will also need to be incorporated into the plan depending on the management zone (see **Tables A6.8 – A6.10**) as follows.

- Strategic replanting of a diverse range of species to boost species richness
- Site preparation and planting of local provenance species in all of the over-storey, mid-storey, shrub and ground layers
- Preparation of an integrated weed management plan
- Introduction of hollow logs from the adjoining Proposed impact area

7. CONCLUSIONS

The Rocky Hill Coal Project is located within a mostly cleared valley floor and sides 3.5km to 7km southeast of Gloucester urban area.

The layout of the proposed Rocky Hill Coal Mine has been designed to minimise the removal of native vegetation and fauna habitat within the disturbance area.

The Proposal would result in the removal or modification of 41.1ha of native vegetation within an area of 51.8ha, ranging from low condition to good condition, within the 856ha Site. This comprises 35.7ha of Dry sclerophyll forest, 1.1ha of Riparian vegetation and 4.3ha of Rainforest.

The rainforest vegetation corresponds to the Vulnerable Ecological Community *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions*.

None of the 26 threatened or significant flora species that could potentially occur within the Study Locality were detected within the Study Area during the comprehensive flora surveys and nine of the 59 threatened fauna species known or considered likely to occur at least periodically within the Study Locality, were detected within the Study Area.

Despite the limited extent of suitable habitat within the proposed disturbance area, 35 threatened fauna species (subject species) could potentially occur, at least on an occasional basis.

An assessment of significance of impact has been carried out in accordance with *Draft Guidelines for Threatened Species Assessment* (DECCW and DPI July 2005) and the 7-part test of section 5A of the EP&A Act (the 7-part test) has been carried out for these 36 fauna species and for *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions* VEC. It is concluded from the assessment of significance of impact that the Squirrel glider and Grey-crowned babbler are the only local populations of threatened species that could potentially be adversely impacted from the Proposal. However, if currently present, other threatened species such as the Brush-tailed phascogale, could also be impacted to some degree. A monitoring program for the populations of these species will be established as part of a Biodiversity Management Plan, prior to commencement of the Rocky Hill Coal Project.

The residual impact of removal of small areas of native vegetation communities is proposed to be offset by the establishment of a Biodiversity Offset Area to the east of the proposed disturbance area. This area will be set aside and managed to provide sufficient ecosystem credits to offset those required due to the loss of biodiversity in the proposed disturbance area in accordance with the BioBanking Assessment Methodology (Version 2). It should be noted that the BBAM is currently under review, with the revised methodology (OEH 2012) expected to result in significantly lower offset requirements than currently applies.

In addition, the proposed mine disturbance area will be rehabilitated to a Dry sclerophyll forest (to provide fauna corridors) or woodland community as mining progresses and is eventually completed.

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APPENDICES

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Appendix 1

Flora Species recorded within the Study Area

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The following is a list of all flora species recorded within the Study Area. Please note that this list may be not fully comprehensive, and should be regarded as an indication of the flora present. A period of some years is often needed to identify all species present in an area, particularly for cryptic or seasonally detectable species (such as orchids and small grass-like herbs).

Notes:

* indicates an exotic or introduced native species
R indicates locally indigenous species that are potentially suitable for revegetation or replanting works

D = Disturbance Area
O = Biodiversity Offset Area

Nomenclature follows Harden (1990, 1992, 1993, 2002) and subsequent recent revisions according to Plant Net.

CLASS / FAMILY / *Scientific Name*		Common Name		
CLASS FILICOPSIDA (Ferns)				
ADIANTACEAE				
Adiantum aethiopicum	R	Common maidenhair fern	D	O
Adiantum hispidulum	R	Rough maidenhair fern		O
Cheilanthes sieberi subsp. *sieberi*	R	Mulga fern	D	O
Pellaea falcata	R	Sickle fern		O
Pellaea paradoxa	R	Heart fern		O
ASPLENIACEAE				
Asplenium australasicum	R	Bird's nest fern		O
Asplenium flabellifolium	R	Necklace fern		O
AZOLLACEAE				
Azolla filiculoides var. *rubra*		Pacific azolla	D	
Azolla pinnata		Ferny azolla	D	
BLECHNACEAE				
Doodia aspera	R	Prickly rasp fern		O
DAVALLIACEAE				
Arthropteris tenella	R	-		O
DENNSTAEDTIACEAE				
Pteridium esculentum		Bracken	D	O
DICKSONIACEAE				
Calochlaena dubia	R	False bracken fern / rainbow fern		O
DRYOPTERIDACEAE				
Lastreopsis decomposita	R	Trim shield fern		O
Lastreopsis microsora subsp. *microsora*	R	Creeping shield fern		O
GRAMMITIDACEAE				
Grammitis billardieri	R	Finger fern		O
MARSILACEAE				
Marsilea sp.		Nardoo		O
POLYPODIACEAE				
Platycerium bifurcatum	R	Elkhorn		O
Pyrrosia confluens	R	Robber Fern		O
Pyrrosia rupestris	R	Rock felt-fern		O

CLASS / FAMILY / *Scientific Name*		Common Name		
CLASS CONIFEROPSIDA (Conifers)				
PINACEAE				
*Pinus radiata**		Radiata pine	D	
PODOCARPACEAE				
Podocarpus elatus	R	Plum pine / brown pine	D	
CLASS MAGNOLIOPSIDA (Flowering Plants)				
Subclass Magnoliidae (Dicotyledons)				
ACANTHACEAE				
Pseuderanthemum variabile	R	Pastel flower	D	O
AMYGDALACEAE				
*Prunus persica**		Peach	D	
APHANOPETALACEAE				
Aphanopetalum resinosum	R	Gum vine		O
APIACEAE				
Centella asiatica	R	Swamp pennywort / Indian pennywort	D	
Daucus glochidiatus		Native carrot	D	O
Platysace lanceolata Broad-leaved form	R	Native parsnip		O
APOCYNACEAE				
*Araujia sericifera**		Moth vine / false choko	D	O
Marsdenia flavescens	R	Hairy milk vine		O
Marsdenia rostrata	R	Common milk vine	D	
Parsonsia velutina		Hairy silkpod		O
Parsonsia straminea		Common silkpod / monkey rope	D	O
Tylophora barbata		Bearded tylophora		O
ARALIACEAE				
Polyscias sambucifolia	R	Elderberry panax		O
ASCLEPIADACEAE				
*Asclepias curassavica**		Blood flower		O
*Gomphocarpus fruticosus**		Narrow leaf cotton bush		O
ASTERACEAE				
*Ageratina adenophora**		Crofton weed		O
*Ageratina riparia**		Creeping crofton weed / mist flower		O
*Ambrosia artemisiifolia**		Annual ragweed	D	
*Bidens pilosa**		Cobblers pegs	D	
*Bidens subalternans**		Greater beggar's ticks	D	
Brachyscome multifida var. *dilatata*	R	Cut-leaf daisy	D	
Calotis dentex		White burr-daisy		O
Cassinia quinquefaria	R	A cassinia		O
*Centaurea melitensis**	R	Maltese cockspur/ saucy jack	D	
*Cirsium vulgare**		Spear thistle / black thistle	D	
Conyza sp.*		Fleabane	D	O
*Delairea odorata**		Cape ivy	D	
Euchiton sphaericus		Star cudweed		O
*Galinsoga parviflora**		Potato weed	D	
*Gamochaeta spicata**		Cudweed	D	
*Hypochaeris radicata**		Flatweed/catsear	D	
Olearia sp.		-		O
Ozothamnus diosmifolius	R	Ball everlasting/pill flower/ rice flower		O
Pseudognaphalium luteoalbum	R	Jersey cudweed	D	
*Senecio madagascariensis**		Fire weed	D	O
Senecio sp.		A groundsel	D	
Sigesbeckia orientalis subsp. *orientalis*		Indian weed	D	O
*Silybum marianum **		Variegated thistle		O

CLASS / FAMILY / *Scientific Name*		Common Name		
ASTERACEAE (cont'd)				
Soliva sessilis *		Bindii/jo-jo	D	
Sonchus asper subsp. *asper**		Prickly sowthistle	D	
*Sonchus oleraceus**		Common sowthistle	D	
*Tagetes minuta**		Stinking Roger	D	
*Taraxacum officinale**		Dandelion		
Vernonia cinerea	R	-	D	O
Vittadinia sp.		-		O
*Xanthium occidentale**		Noogoora burr	D	
BIGNONIACEAE				
*Jacaranda mimosifolia**		Jacaranda	D	
Pandorea pandorana	R	Wonga wonga vine	D	O
BRASSICACEAE				
Brassica rapa subsp. *sylvestris**		Wild turnip	D	
*Cardamine hirsuta**		Common bittercress / hairy woodcress	D	
*Lepidium virginicum**		Virginian peppercress		O
CAMPANULACEAE				
Wahlenbergia sp.	R	A native bluebell		O
CAPPARACEAE				
Capparis arborea	R	Brush caper berry / wild lime / noble caper	D	
CARYOPHYLLACEAE				
*Cerastium glomeratum**		Mouse-eared chickweed	D	
*Stellaria media**		Common chickweed	D	O
CASUARINACEAE				
Allocasuarina torulosa	R	Forest oak	D	O
Casuarina cunninghamiana subsp. *cunninghamiana*	R	River oak	D	O
CELASTRACEAE				
Elaeodendron australe var. *australe*	R	Red olive plum		O
Maytenus silvestris	R	Narrow-leaved orange bark		O
CHENOPODIACEAE				
*Chenopodium album**		Fat hen / white goosefoot	D	
Einadia hastata		Saloop	D	
Einadia trigonos subsp. *trigonos*		Fishweed	D	
CLUSIACEAE				
Hypericum gramineum		Small St. John's wort		O
CONVOLVULACEAE				
Convolvulus erubescens	R	Blushing bindweed	D	O
Dichondra repens	R	Kidney weed	D	O
DILLENIACEAE				
Hibbertia aspera subsp. *aspera*	R	Rough guinea flower	D	
Hibbertia diffusa	R	Guinea flower		O
Hibbertia scandens	R	Golden guinea flower		O
EBENACEAE				
Diospyros australis	R	Black/grey plum / yellow persimmon	D	O
ELAEOCARPACEAE				
Elaeocarpus obovatus	R	Hard quandong		O
ERICACEAE - Subfamily Styphelioideae				
Leucopogon juniperinus	R	Prickly beard heath	D	O
EUPHORBIACEAE				
Alchornea ilicifolia	R	Native holly / doveweed		O
Baloghia inophylla	R	Brush bloodwood / ivory birch		O
Claoxylon australe	R	Brittlewood		O
Croton insularis	R	Silver croton		O
Croton verauxii	R	Green or native cascarilla		O

CLASS / FAMILY / *Scientific Name*		Common Name		
FABACEAE - Subfamily Caesalpinoideae				
Senna clavigera	R	Pepperleaf senna		O
*Senna pendula**		Cassia	D	
FABACEAE - Subfamily Faboideae				
Desmodium rhytidophyllum	R	Hairy trefoil	D	O
Desmodium varians	R	Slender tick-trefoil		O
Glycine clandestina	R	A love creeper	D	
Glycine tabacina sens. lat.	R	A love creeper	D	O
Hardenbergia violacea	R	False sarsaparilla	D	O
*Medicago polymorpha**		Burr medic	D	
Podolobium ilicifolium	R	Prickly shaggy pea / native holly	D	O
Pultenaea villosa	R	A bush pea		O
*Trifolium pratense**		Red clover	D	
*Trifolium repens**		White clover	D	
FABACEAE - Subfamily Mimosoideae				
Acacia falcata	R	Falcate wattle		O
Acacia implexa	R	Hickory / lightwood		O
Acacia irrorata subsp. *irrorata*	R	Green wattle		O
Acacia longissima	R	Long-leaf wattle		O
Acacia maidenii	R	Hickory / Maidens wattle		O
Acacia melanoxylon	R	Blackwood		O
Acacia ulicifolia	R	Prickly Moses	D	O
Pararchidendron pruinosum var. *pruinosum*		Snow wood/ tulip siris		O
FLACOURTIACEAE				
Scolopia braunii		Flintwood / brown birch	D	O
GERANIACEAE				
Geranium homeanum		Northern cranesbill	D	
Geranium solanderi var. solanderi		Cutleaf cranesbill	D	O
GOODENIACEAE				
Goodenia heterophylla subsp. *heterophylla*	R	Variable-leaved goodenia	D	O
HALORAGACEAE				
Gonocarpus teucrioides	R	Germander raspwort		O
LAMIACEAE				
Clerodendrum tomentosum	R	Hairy clerodendrum		O
Plectranthus parviflorus	R	Cockspur flower	D	O
Prostanthera incana	R	Velvet mint bush		O
*Salvia verbanaca**		Wild sage	D	
LAURACEAE				
Cassytha pubescens		Devil's twine		O
*Cinnamomum camphora**		Camphor laurel	D	
Neolitsea australiensis	R	Green bolly gum		O
LOBELIACEAE				
Pratia purpurascens	R	White root	D	
LYTHRACEAE				
Lythrum hyssopifolia		Hyssop loosestrife	D	
MALVACEAE				
Abutilon oxycarpum	R	Straggly lantern bush		O
Hibiscus heterophyllus subsp. *heterophyllus*	R	Native hibiscus/rosella		O
*Modiola caroliniana**		Redflower mallow	D	
*Sida rhombifolia**		Paddy's Lucerne	D	
MELIACEAE				
Melia azedarach		White cedar	D	
Synoum glandulosum subsp. *glandulosum*	R	Scentless rosewood		O

CLASS / FAMILY / *Scientific Name*		Common Name		
MENISPERMACEAE				
Legnephora moorei	R	Round-leaf vine		O
Sarcopetalum harveyanum	R	Pearl vine		O
Stephania japonica	R	Snake vine	D	O
MONIMIACEAE				
Daphnandra micrantha	R	Socketwood	D	
Palmeria scandens?	R	Anchor vine / pomegranate vine	D	
MORACEAE				
Ficus coronata	R	Creek sandpaper fig	D	O
Ficus macrophylla	R	Moreton Bay fig		O
Ficus watkinsiana	R	Strangling fig		O
Maclura cochinchinensis	R	Cockspur thorn		O
Streblus brunonianus	R	Whalebone tree		O
MYOPORACEAE				
Eremophila debilis	R	Amulla / winter apple	D	O
MYRSINACEAE				
Myrsine howittiana	R	Brush muttonwood		O
Myrsine variabilis	R	Muttonwood		O
MYRTACEAE				
Acmena smithii	R	Lilly-pilly	D	O
Angophora subvelutina	R	Broad-leaved apple	D	O
Backhousia myrtifolia	R	Grey myrtle/lancewood		O
Callistemon salignus	R	Willow bottlebrush	D	
Callistemon viminalis (planted)*	R	Weeping bottlebrush	D	
Corymbia maculata	R	Spotted gum		O
Eucalyptus acmenoides	R	White mahogany	D	O
Eucalyptus amplifolia subsp. *amplifolia*	R	Cabbage gum		
Eucalyptus carnea ?		Thick-leaved mahogany		O
Eucalyptus fibrosa	R	Broad-leaved red ironbark	D	
Eucalyptus globoidea	R	White stringybark	D	O
Eucalyptus microcorys	R	Tallowwood		O
Eucalyptus moluccana	R	Grey box	D	O
Eucalyptus propinqua ?	R	Small-fruited grey gum	D	
Eucalyptus punctata	R	Grey gum	D	O
Eucalyptus siderophloia	R	Northern grey ironbark	D	O
Eucalyptus tereticornis	R	Forest red gum	D	O
Gossia bidwillii	R	Python tree		O
Melaleuca decora	R	White feather honeymyrtle		O
Melaleuca linariifolia	R	Snow-in-summer / flax-leaved paperbark	D	
Melaleuca styphelioides	R	Prickly-leaved paperbark	D	O
Rhodamnia rubescens	R	Scrub turpentine	D	O
Syncarpia glomulifera	R	Turpentine	D	O
Syzygium australe		Brush cherry	D	O
ONAGRACEAE				
Ludwigia peploides subsp. *montevidensis*		Water primrose		O
OLEACEAE				
*Ligustrum sinense**		Small-leaved / Chinese privet	D	
Notelaea longifolia forma *longifolia*	R	Mock olive		O
Notelaea ovata	R	A native olive	D	O
OXALIDACEAE				
*Oxalis articulata**				O
*Oxalis corniculata**		Creeping oxalis	D	
Oxalis perennans		A wood sorrell	D	O
PASSIFLORACEAE				
*Passiflora edulis**		Edible passionfruit	D	
Passiflora herbertiana	R	Native passionfruit	D	O
PHYLLANTHACEAE				
Breynia oblongifolia	R	Coffee bush	D	O
Phyllanthus gunnii		Scrubby spurge		O
Phyllanthus hirtellus		Thyme spurge	D	

CLASS / FAMILY / *Scientific Name*		Common Name		
PHYTOLACCACEAE				
*Phytolacca octandra**		Inkweed	D	
PITTOSPORACEAE				
Billardiera scandens var. *scandens*	R	Apple dumplings/ hairy apple berry	D	O
Bursaria spinosa subsp. *spinosa*	R	Blackthorn / sweet bursaria	D	O
Hymenosporum flavum	R	Native frangipani		O
Pittosporum multiflorum	R	Orange thorn		O
Pittosporum revolutum	R	Rough-fruit pittosporum		O
PLANTAGINACEAE				
Plantago debilis		Shade plantain		O
*Plantago lanceolata**		Common plantain	D	O
*Veronica persica**		Creeping speedwell	D	
Veronica plebeia	R	Trailing speedwell	D	
POLYGONACEAE				
Persicaria hydropiper	R	Knotweed	D	
Rumex brownii		Swamp dock	D	
PORTULACACEAE				
Portulaca oleracea		Pigweed/ purslane	D	
PRIMULACEAE				
*Anagallis arvensis**		Pimpernel	D	O
PROTEACEAE				
Orites excelsus	R	Prickly ash/ mountain silky oak		O
Persoonia linearis	R	Narrow-leaved geebung	D	O
PUTRANJIVACEAE				
Drypetes deplanchei	R	Yellow tulipwood		O
RANUNCULACEAE				
Clematis aristata	R	Old man's beard / traveller's joy		O
Clematis glycinoides var. *glycinoides*	R	Headache vine / old man's beard	D	
RHAMNACEAE				
Alphitonia excelsa		Red ash	D	O
Pomaderris sp.		-		O
ROSACEAE				
Rubus fruticosus species aggregate*		Blackberry	D	
Rubus parvifolius		Native raspberry	D	O
RUBIACEAE				
Asperula conferta		Common woodruff		O
Galium propinquum		Maori bedstraw		O
Morinda jasminoides	R	Jasmine morinda		O
RUTACEAE				
Correa reflexa var. *reflexa*	R	Common correa / native fuchsia		O
Melicope micrococca	R	Hairy-leaved doughwood/ white euodia		O
Zieria smithii	R	Sandfly zieria		O
SALICACEAE				
*Salix babylonica**		Weeping willow	D	O
SANTALACEAE				
Exocarpus cupressiformis	R	Cherry ballart	D	O
SAPINDACEAE				
Alectryon subcinereus		Native quince / wild quince	D	
Dodonaea triquetra	R	Common hop bush		O
Dodonaea viscosa subsp. *angustifolia*	R	Sticky hop bush		O
Guioa semiglauca	R	Guioa		O

CLASS / FAMILY / *Scientific Name*		Common Name		
SCROPHULARIACEAE				
Mimulus repens	R	Creeping monkey flower	D	
SOLANACEAE				
*Lycium ferocissimum**		African boxthorn	D	
*Solanum mauritianum**		Wild tobacco tree	D	O
*Solanum nigrum**		Blackberry nightshade	D	O
Solanum prinophyllum	R	Southern forest nightshade	D	
*Solanum pseudocapsicum**		Madeira winter cherry	D	
Solanum stelligerum	R	Devil's needles	D	
STERCULIACEAE				
Brachychiton populneus subsp. *populneus*	R	Kurrajong	D	O
Commersonia fraseri	R	Brush kurrajong	D	
THYMELAEACEAE				
Pimelea linifolia subsp. *linifolia*	R	Rice flower	D	O
ULMACEAE				
Trema tomentosa	R	Native peach		O
URTICACEAE				
Dendrocnide excelsa	R	Giant stinging tree		O
Urtica incisa		Stinging nettle	D	
VERBENACEAE				
*Lantana camara**		Lantana	D	O
*Verbena bonariensis**		Purpletop	D	
*Verbena quadrangularis**		-	D	
Verbena rigida var. *rigida**		Veined verbena	D	
VIOLACEAE				
Melicytus dentatus	R	Tree violet	D	O
Viola betonicifolia	R	Purple violet		O
Viola hederacea	R	Native violet	D	O
VITACEAE				
Cayratia clematidea	R	Slender grape	D	O
Cissus antarctica	R	Kangaroo grape		O
Cissus hypoglauca	R	Five-leaf water vine		O
Clematicissus opaca	R	Small-leaved water vine / pepper vine		O
Tetrastigma nitens	R	Three-leaf water vine / native grape		O
Subclass Liliidae (Monocotyledons)				
AMARYLLIDACEAE				
*Leucojum aestivum**		Snowflake / Loddon lily	D	
ARACEAE				
Gymnostachys anceps		Settler's flax / settler's twine		O
COMMELINACEAE				
Aneilema acuminatum	R	Pointed Aneilema	D	
Commelina cyanea		Scurvy weed	D	
*Tradescantia fluminensis**		Trad / wandering jew		O
CYPERACEAE				
Carex appressa	R	Tall sedge	D	
Carex fascicularis?	R	Tassel sedge	D	
*Cyperus brevifolius**		Mullumbimby couch	D	
*Cyperus eragrostis**		Umbrella sedge	D	
Cyperus gracilis		Umbrella sedge	D	
Eleocharis acuta	R	Common spike-rush	D	
Schoenoplectus mucronatus	R	A club-rush		O
DIOSCOREACEAE				
Dioscorea transversa		Native yam		O
IRIDACEAE				
Romulea rosea var. *australis**		Onion grass	D	

CLASS / FAMILY / *Scientific Name*		Common Name		
JUNCACEAE				
Juncus usitatus	R	Common rush	D	O
LEMNACEAE				
Spirodela punctata		Duck weed	D	
LOMANDRACEAE				
Lomandra filiformis	R	Iron grass		O
Lomandra longifolia	R	Spiny-headed mat-rush		O
LUZURIAGACEAE				
Eustrephus latifolius	R	Wombat berry	D	O
Geitonoplesium cymosum	R	Scrambling lily	D	O
ORCHIDACEAE				
Dendrobium aemulum	R	Ironbark orchid/ white feather orchid		O
Dendrobium speciosum	R	Rock lily / rock orchid		O
Dendrobium teretifolium ?	R	Rat's tail orchid		O
Pterostylis sp.	R	A greenhood		O
PHORMIACEAE				
Dianella caerulea var. *cinarescens*	R	Blue flax lily	D	
Dianella caerulea var. *producta*	R	Blue flax lily	D	
Dianella revoluta var. *revoluta*	R	Spreading flax lily	D	
POACEAE				
*Andropogon virginicus**		Whisky grass	D	
Aristida vagans	R	A three-awn speargrass	D	O
*Axonopus fissifolius**		Narrow-leaved carpet grass	D	O
*Briza minor **		Shivery grass	D	
*Bromus cartharticus**		Prairie grass	D	
Capillipedium spicigerum		Scented-top grass		O
*Chloris gayana**		Rhodes grass	D	O
Cymbopogpn refractus		Barbed wire grass	D	
Cynodon dactylon		Couch	D	
*Digitaria ciliaris**	R	Summer grass	D	
Digitaria parviflora	R	A fingergrass		O
Echinopogon caespitosus var. *caespitosus*	R	Bushy hedgehog grass	D	
*Ehrhardta erecta**	R	Panic veldtgrass	D	O
Entolasia marginata	R	Bordered panic	D	O
Entolasia stricta	R	Wiry panic	D	
Eragrostis brownii	R	Brown's love grass		O
*Eragrostis cilianensis**		Stinkgrass	D	O
Eragrostis leptostachya	R	Paddock love grass		O
*Eragrostis mexicana**		Mexican love grass	D	
Imperata cylindrica var. *major*		Blady grass	D	O
Lachnagrostis filiformis	R	Common blown grass	D	
*Lolium perenne**		Perennial ryegrass	D	
Microlaena stipoides var. *stipoides*	R	Weeping grass	D	O
Oplismenus aemulus	R	Basket grass	D	O
Oplismenus imbecillus	R	Basket grass		O
Panicum effusum		Hairy panic / poison panic	D	O
Panicum simile	R	Two colour panic	D	O
Paspalidium distans	R	Spreading panic-grass		O
*Paspalum dilatatum**		Paspalum	D	
*Paspalum urvillei**		Tall paspalum / Vasey grass	D	
*Pennisetum clandestinum**		Kikuyu	D	O
Phragmites australis	R	Native reed/thatch reed	D	
Poa sieberiana var. *sieberiana*		Snowgrass	D	O
*Setaria gracilis**		Slender pigeon grass		O
Sporobolus creber		Western rat's tail grass	D	O
Themeda australis	R	Kangaroo grass	D	O
SMILACACEAE				
Smilax australis	R	Austral sarsaparilla	D	O
TYPHACEAE				
Typha orientalis	R	Bullrush/cumbungi	D	

Appendix 2

Data from the Flora Quadrats

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Table A2-1
Locations and Physical Characteristics of the 400 m^2 Flora Quadrats

Quadrat	AMG (GDA94)		Size	Veg. Comm.	Slope	Soil type	Disturbances / Signs of Fire	Weed Infestation
	Easting	Northing						
1	404184	6451832	20x20	1	Gently undulating – upper slope	Loam (dark brown)	Recent & past tree thinning, current grazing. Minor charring from fire >10 yr.	Minor – fireweed, flatweed
2	404511	6452271	20x20	1	Gently undulating – mid-slope	Loam (dark brown)	Recent & past tree thinning, recent track. No visible signs of fire.	Minor – fireweed, flatweed
3	404939	6450945	40x10	3	Almost flat - gully	Gravelly loam (dark brown), deep, stony	Practically nil disturbance – accessible by cattle. No signs of fire.	Nil
4	403615	6450600	40x10	2	Flat floodplain with steep banks	Stony alluvial loam (brown)	Past clearing, heavy current grazing. No signs of fire.	Moderate – weeping willow, wild tobacco, moth vine, weedy herbs
5	405515	6451305	20x20	1	Steep slope – mid slope	Stony loam (dark brown, deep)	Past clearing/ logging, current grazing. Moderate charring from fire <5 yr.	Minor – lantana
6	405481	6451097	20x20	3	Steep slope – gully in mid slope	Stony heavy loam (dark brown, shallow). Large rocks & boulders.	None evident.	Nil

Communities
1 – DSF
2 – Riparian
3 – Rainforest

General Locations

1. Triangular sclerophyll remnant – pasture area
2. Remnant sclerophyll vegetation S of houses on McKinleys Lane
3. Remnant rainforest patch in flat area
4. Riparian veg by creek near S end
5. Sclerophyll forest up the eastern slope near rainforest
6. Rainforest in upper gully

Table A2-2
Species Recorded in the 400 m^2 Standard Flora Quadrats

Species	Quadrat					
	1	2	3	4	5	6
Acacia maidenii			3			
Acacia melanoxylon	1	2				
Acacia ulicifolia	1	2				
Adiantum aethiopicum			3			
Adiantum hispidulum			3		5	
Alchornea ilicifolia						6
Alectryon subcinereus			3			
Allocasuarina torulosa					5	
*Andropogon virginicus**	1	2				
Aneilema acuminatum			3			
Angophora subvelutina		2				
*Araujia sericifera**				4		
Aristida vagans	1					
Arthropteris tenella						6
*Asclepias curassavica**					5	
*Axonopus fissifolius**	1					

Table A2-2 (Cont'd)
Species Recorded in the 400 m^2 Standard Flora Quadrats

Species	Quadrat					
	1	**2**	**3**	**4**	**5**	**6**
Backhousia myrtifolia			3			
Baloghia inophylla			3			6
*Bidens pilosa**				4		
*Bidens subalternans**				4		
Billardiera scandens					5	
Breynia oblongifolia			3		5	
Bursaria spinosa subsp. *spinosa*	1	2				
Callistemon salignus			3			
Capparis arborea						6
Cayratia clematidea			3	4	5	
Casuarina cunninghamiana subsp. *cunninghamiana*				4		
*Centaurea melitensis**				4		
Cheilanthes sieberi subsp. *sieberi*	1	2				
*Chloris gayana**				4		
*Cinnamomum camphora **				4		
*Cirsium vulgare**				4		
Cissus antarctica			3			
Claoxylon australe			3			
Clematis aristata					5	
Clematis glycinoides var. *glycinoides*	1	2				
Commelina cynaea				4		
Convolvulus erubescens					5	
Conyza sp.*				4	5	
Corymbia maculata					5	
*Cyperus eragrostis**				4		
Dendrocnide excelsa						6
Desmodium rhytidophyllum					5	
Desmodium varians					5	
Dianella revolutum		2				
Dichondra repens	1	2				
Digitaria parviflora		2			5	
Dioscorea transversa			3			
Diospyros australis			3			
Doodia aspera			3			
Echinopogon caespitosus var. *caespitosus*	1	2				
Einadia trigonos subsp. *trigonos*				4		
Elaeocarpus obovatus			3			
Elaeodendron australe			3			
Entolasia stricta	1	2				
Eragrostis brownii	1					
Eremophila debilis	1				5	
Eucalyptus acmenoides	1				5	
Eucalyptus amplifolia				4		
Eucalyptus fibrosa	1					
Eucalyptus globoidea	1	2				
Eucalyptus punctata	1	2	3		5	
Eucalyptus siderophloia					5	
Eustrephus latifolius					5	
Euchiton sphaericus					5	
Ficus coronata			3	4		
Exocarpus cupressiformis		2				
*Gamochaeta spicata**	1					
Geitonoplesium cymosum		2	3		5	6
Geranium solanderi				4		
Glycine tabacina sens. lat.					5	
Gymnostachys anceps			3			
Hardenbergia violacea		2			5	
Hibbertia scandens					5	
*Hypochaeris radicata**	1	2				
Imperata cylindrica var. *major*	1	2			5	

Table A2-2 (Cont'd)
Species Recorded in the 400 m^2 Standard Flora Quadrats

Species	Quadrat					
	1	**2**	**3**	**4**	**5**	**6**
Juncus usitatus				4		
*Lantana camara**					5	
Lastreopsis decomposita			3			
Lastreopsis microsora						6
Legnephora moorei			3			6
*Ligustrum sinense**				4		
Lomandra longifolia	1	2		4		
*Lycium ferocissimum**				4		
Marsdenia flavescens			3			
Maytenus silvestris	1				5	
Melaleuca styphelioides			3			
Morinda jasminoides						6
Myrsine howittiana			3			
Myrsine variabilis					5	6
Neolitsea australiensis						6
Notelaea longifolia			3			
Oplismenus aemulus				4	5	6
Oplismenus imbecillus			3			
Orites excelsus						6
*Oxalis corniculata**		2				
Oxalis perennans				4	5	
Palmeria scandens			3			
Pandorea pandorana	1		3			
Pararchidendron pruinosum var. *pruinosum*						6
Parsonsia straminea			3			
Pellaea falcata			3		5	6
Pellaea paradoxa			3			6
*Pennisetum clandestinum**				4		
Persicaria hydropiper				4		
Phyllanthus gunnii					5	
Plantago debilis					5	
*Plantago lanceolata**	1					
Plectranthus parvifolius				4	5	
Pittosporum multiflorum			3			6
Poa sieberiana var. *sieberiana*		2				
Podolobium ilicifolium	1	2				
Pratia purpurascens	1	2				
*Prunus persica**				4		
Pteridium esculentum		2				
Pseuderanthemum variabile		2		4	5	6
*Rubus fruticosus**				4		
Rubus parvifolius					5	
*Salix babylonica**				4		
Scolopia braunii			3			
*Senecio madagascariensis**	1	2				
Senna clavigera					5	
*Senna pendula**				4		
*Setaria gracilis **				4		
*Sida rhombifolia**				4		
*Sigesbeckia orientalis**				4		
*Solanum mauritianum**				4		
*Solanum pseudocapsicum**				4		
*Stellaria media**				4		
Stephania japonica				4	5	
Themeda australis	1	2			5	
*Tradescantia fluminensis **				4		
*Verbena bonariensis**	1			4		
Vernonia cinerea					5	
Viola hederacea		2				
*Xanthium occidentale**				4		

Table A2-3
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (DVD1-DVC1)

Species	BioBanking Quadrat					
	DVD1	DVD2	DVD3	DVD4	DVD5	DVC1
Acacia ulicifolia	+	+				+
Alternanthera denticulata			+			
*Ambrosia artemisiifolia**					+	
*Anagallis arvensis**				+		
*Andropogon virginicus**		+			+	
Angophora subvelutina	+	+				+
Aristida vagans	+					+
*Axonopus fissifolius**	+					
*Bidens pilosa**	+				+	
Brachyscome multifida var. dilatata	+				+	
Breynia oblongifolia		+				
*Briza minor**						+
Bursaria spinosa subsp. spinosa	+	+				
Centella asiatica	+				+	
Cheilanthes sieberi subsp. sieberi		+				+
*Cirsium vulgare**				+		
Clematis aristata	+					
Commelina cynaea	+		+			
Convolvulus erubescens	+					
*Conyza sp.**	+	+		+		+
Cymbopogpn refractus						+
Cynodon dactylon					+	
*Cyperus brevifolius**	+					
*Cyperus eragrostis**			+		+	
Cyperus gracilis			+			
Desmodium rhytidophyllum	+					
Desmodium varians	+					+
Dianella caerulea var. *cinarescens*	+					
Dianella revoluta var. *revoluta*	+	+				
Dichondra repens	+	+	+	+		+
Digitaria parviflora	+	+				+
Doodia aspera	+					
Echinopogon caespitosus var. caespitosus	+	+	+			+
*Ehrhardta erecta**			+	+	+	
Einadia hastata	+			+		
Entolasia marginata	+					
Entolasia stricta	+	+				
Eragrostis brownii	+				+	+
Eremophila debilis	+					
Eucalyptus acmenoides	+	+		+		
Eucalyptus amplifolia					+	
Eucalyptus fibrosa	+					
Eucalyptus globoidea		+	+			
Eucalyptus punctata			+	+		
Eucalyptus siderophloia	+	+	+	+	+	
*Gamochaeta spicata**						+
Geranium solanderi			+	+		
Glycine clandestina	+					
Glycine tabacina sens. lat.	+	+	+			
Gonocarpus teucrioides		+				
Goodenia heterophylla	+					
Hardenbergia violacea	+					
Hibbertia diffusa	+					+
Hydrocotyle sp.		+				
Hypericum gramineum					+	
*Hypochaeris radicata**	+	+			+	+
Imperata cylindrica var. major	+	+				+
Juncus usitatus						+
Lachnagrostis filiformis					+	
*Lolium perenne**						+
Lomandra longifolia	+					
*Medicago polymorpha**						+
Microlaena stipoides			+	+		

Table A2-3 (Cont'd)
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (DVD1-DVC1)

Species	BioBanking Quadrat					
	DVD1	DVD2	DVD3	DVD4	DVD5	DVC1
Oplismenus aemulus			+	+		
*Oxalis corniculata**			+			
Oxalis perennans	+					
Panicum simile		+				
Paspalidium distans			+			
*Paspalum dilatatum**					+	+
*Paspalum urvillei**					+	
*Pennisetum clandestinum**			+	+	+	+
Persicaria hydropiper						+
Phyllanthus hirtellus	+					
*Plantago lanceolata**	+	+	+		+	+
Plectranthus parvifolius				+		
Poa sieberiana var. sieberiana	+	+				
Podolobium ilicifolium	+					
Pratia purpurascens	+	+			+	+
Pseudognaphalium luteoalbum						+
Pseuderanthemum variabile			+	+		
Pultenaea villosa		+				
Rumex brownii						+
Schoenoplectus mucronatus						+
*Senecio madagascariensis**	+	+	+	+	+	
*Setaria gracilis **					+	
*Sida rhombifolia**	+		+	+	+	
*Sigesbeckia orientalis**				+		
*Solanum mauritianum**			+			
*Solanum nigrum**	+		+	+	+	
Solanum prinophyllum	+					
Solanum stelligerum			+	+		
Sporobolus creber					+	+
*Stellaria media**			+	+	+	+
Themeda australis						+
*Trifolium repens **					+	+
*Verbena bonariensis**	+	+			+	+
Vernonia cinerea	+					
Veronica plebeia	+		+			
Viola hederacea		+				
Unidentified grass 1	+					
Unidentified grass 2						+
Unidentified grass 3						+
Unidentified herb 1		+				
Unidentified herb 2		+				
Unidentified herb 3		+				
Unidentified herb 4			+			
Unidentified herb 5				+		
Unidentified exotic herb 1*						+
Unidentified sedge 1						+
Unidentified sedge 2						+

Table A2-4
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (DVR1-OFD3)

Species	BioBanking Quadrat					
	DVR1	DVR2	DVR3	OFD1	OFD2	OFD3
Acacia implexa						+
Acacia longissima				+		
Acacia maidenii			+		+	
Acmena smithii	+	+	+			
Adiantum aethiopicum		+	+			
Adiantum hispidulum	+				+	
*Ageratina adenophora**		+				
Allocasuarina torulosa				+	+	+
*Anagallis arvensis**		+				
*Axonopus fissifolius**		+				
Billardiera scandens				+		
Brachychiton populneus						+
Breynia oblongifolia				+	+	+
*Bromus catharticus**		+				
Calochlaena dubia		+				
Carex appressa		+	+			
Cayratia clematidea			+	+	+	+
*Cerastium glomeratum**		+				
Cheilanthes sieberi subsp. sieberi					+	
*Cirsium vulgare**			+		+	
Cissus antarctica	+	+	+		+	
Cissus hypoglauca					+	
Clematis aristata	+			+		+
Clerodendrum tomentosum				+		+
*Conyza sp.**			+			+
Corymbia maculata				+	+	+
*Delairea odorata**		+				
Daucus glochidiatus				+		
Desmodium varians			+	+	+	+
Dianella caerulea				+	+	+
Dianella revoluta var. *revoluta*						+
Dichondra repens	+	+	+	+	+	
Digitaria parviflora					+	
Dioscorea transversa	+			+	+	
Doodia aspera	+	+			+	+
Entolasia marginata	+					
Eragrostis brownii					+	
Eucalyptus acmenoides				+		+
Eucalyptus punctata					+	
Eucalyptus siderophloia			+	+	+	
Eustrephus latifolius				+	+	+
Ficus coronata		+	+			
Exocarpus cupressiformis				+		
Galium propinquum					+	
*Gamochaeta spicata**		+				
Geitonoplesium cymosum	+	+	+	+	+	+
Geranium solanderi		+	+		+	
Glycine tabacina sens. lat.				+	+	
*Gomphocarpus fruticosus**				+	+	+
Grammitis billiardieri			+			
Guioa semiglauca	+					
Gymnostachys anceps	+			+	+	
Hardenbergia violacea				+		+
Hibbertia scandens					+	
Hibiscus heterophyllus subsp. *heterophyllus*		+				
*Hypochaeris radicata**		+		+		
Imperata cylindrica var. major				+	+	+
Juncus usitatus		+				
*Lantana camara**	+	+	+	+		
Lastreopsis microsora	+					

Table A2-4 (Cont'd)
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (DVR1-OFD3)

Species	BioBanking Quadrat					
	DVR1	DVR2	DVR3	OFD1	OFD2	OFD3
Legnephora moorei	+	+				
*Ligustrum sinense**	+					
Lomandra filiformis				+		+
Lomandra longifolia					+	+
Maclura cochinchinensis		+	+		+	
Marsdenia flavescens						+
Maytenus silvestris					+	+
Melaleuca styphelioides	+		+			
*Modiola caroliniana**		+				
Myrsine variabilis				+	+	+
Neolitsea australiensis	+		+			
Notelaea longifolia	+				+	+
Notelaea ovata	+		+			
Olearia sp.						+
Oplismenus aemulus	+	+	+	+	+	
*Oxalis corniculata**			+			
Oxalis perennans					+	
Pandorea pandorana	+		+			
Parsonsia straminea		+				
*Paspalum dilatatum**		+				
Passiflora herbertiana					+	
Pellaea falcata	+		+			
Pellaea paradoxa			+		+	
*Pennisetum clandestinum**		+				
Persoonia linearis				+		
Phyllanthus gunnii						+
*Plantago lanceolata**		+				
Platysace lanceolata						+
Plectranthus parvifolius			+			+
Pittosporum multiflorum	+	+	+		+	
Poa sieberiana var. sieberiana				+		+
Podolobium ilicifolium						+
Polyscias sambucifolia				+		+
Pratia purpurascens		+		+	+	+
Pteridium esculentum		+				
Pseuderanthemum variabile	+					
Pterostylis sp.					+	
Pyrrosia confluens		+	+			
Pyrrosia rupestris	+					
Rubus parvifolius			+	+	+	+
Rumex brownii		+				
Sarcopetalum harveyanum	+	+				
Scolopia braunii		+	+			
*Senecio madagascariensis**		+				
*Sida rhombifolia**		+	+			
*Sigesbeckia orientalis**			+	+		
Smilax australis	+	+		+		+
*Solanum mauritianum**		+				
*Solanum nigrum**			+			
Solanum prinophyllum				+		
Solanum stelligerum				+	+	
Sporobolus creber		+				
*Stellaria media**		+				
Stephania japonica		+				
Streblus brunonianus	+		+			
Synoum glandulosum	+	+	+			
Themeda australis				+	+	+
Trema tomentosa					+	
*Trifolium repens **		+				
Tylophora barbata						+
Urtica incisa		+				
*Verbena bonariensis**		+				

Table A2-4 (Cont'd)
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (DVR1-OFD3)

Species	BioBanking Quadrat					
	DVR1	DVR2	DVR3	OFD1	OFD2	OFD3
*Verbena rigida**		+				
Vernonia cinerea				+	+	
Viola hederacea				+	+	
Unidentified grass 1			+			
Unidentified herb 1	+					
Unidentified herb 2	+					
Unidentified herb 3				+		
Unidentified herb 4				+	+	
Unidentified herb 5					+	
Unidentified herb 6						+
Unidentified exotic herb 1*		+				
Unidentified exotic herb 2*		+				
Unidentified shrub1						+
Unidentified shrub2						+
Unidentified shrub3						+
Unidentified rainforest tree 1	+					
Unidentified rainforest tree 2	+		+			
Unidentified rainforest tree 3			+			
Unidentified rainforest tree 4		+	+			
Unidentified rainforest shrub 1	+					
Unidentified rainforest shrub 2			+			
Unidentified rainforest shrub 3			+			
Unidentified rainforest vine			+			
Unidentified vine 1				+		
Unidentified vine 2						+

Table A2-5
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (OFD4-OFC4)

Species	BioBanking Quadrat					
	OFD4	OFD5	OFC1	OFC2	OFC3	OFC4
Acacia implexa	+					
Acacia sp.	+					
Acianthus sp.		+				
Allocasuarina torulosa		+				
Angophora subvelutina				+		
Aristida vagans	+					
*Bidens pilosa**		+			+	
Billardiera scandens		+				
Brachychiton populneus	+	+				
Breynia oblongifolia	+	+				
Bursaria spinosa subsp. spinosa	+	+				
*Cardamine hirsuta**			+	+		
Carex appressa			+	+	+	+
Cayratia clematidea	+	+		+		
Cassinia quinquefaria		+				
Casuarina cunninghamiana subsp. cunninghamiana			+	+		
Centella asiatica						+
Cheilanthes sieberi subsp. sieberi	+					
*Cirsium vulgare**	+		+	+	+	
Clematis aristata	+	+				
Clerodendrum tomentosum		+				
Convolvulus erubescens	+					
*Conyza sp.**	+			+		
Correa reflexa		+				
Corymbia maculata		+				
Daucus glochidiatus	+	+				+
Desmodium rhytidophyllum	+	+				
Desmodium varians	+	+				
Dianella caerulea	+	+				
Dichondra repens	+	+			+	
Digitaria parviflora		+				
Dodonaea triquetra		+				
Doodia aspera	+	+				
Echinopogon caespitosus var. caespitosus		+				
Einadia hastata					+	
Entolasia marginata				+		
Entolasia stricta		+				
*Eragrostis cilianensis**			+	+	+	
Eucalyptus amplifolia					+	
Eucalyptus acmenoides	+	+				
Eucalyptus microcorys	+					
Eucalyptus punctata		+				
Eucalyptus tereticornis	+					
Eustrephus latifolius	+	+				
Exocarpus cupressiformis	+					
Galium propinquum	+	+				
Geitonoplesium cymosum	+	+				
Geranium solanderi	+	+	+	+		
Glycine tabacina sens. lat.	+					
*Gomphocarpus fruticosus**	+					
Hardenbergia violacea	+	+				
Hibbertia dentata		+				
Hibbertia scandens	+	+				
Hydrocotyle laxiflora						+
Hymenosporum flavum	+	+				
*Hypochaeris radicata**	+					
Imperata cylindrica var. major	+	+				
Juncus usitatus					+	+
*Lantana camara**	+	+				
*Lepidium virginicum**					+	
Lomandra longifolia			+			
Ludwigia peploides						+

Table A2-5 (Cont'd)
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (OFD4-OFC4)

Species	BioBanking Quadrat					
	OFD4	OFD5	OFC1	OFC2	OFC3	OFC4
Maclura cochinchinensis				+		
Marsilea sp.						+
Maytenus silvestris		+				
Melaleuca decora					+	
Melaleuca linariifolia						+
*Modiola caroliniana**			+	+	+	
Myrsine variabilis	+	+				
Notelaea longifolia	+	+				
Olearia sp.	+					
Oplismenus aemulus	+	+	+			
*Oxalis articulata**				+		
Oxalis perennans	+	+	+	+		
Panicum simile	+	+				
*Paspalum dilatatum**			+	+	+	+
Pellaea paradoxa	+	+				
*Pennisetum clandestinum**			+	+	+	
Persicaria decipiens						+
Persoonia linearis	+					
Phyllanthus gunnii		+				
Phyllanthus hirtellus	+					
*Plantago lanceolata**	+		+	+	+	+
Plectranthus parvifolius		+				
Poa sieberiana var. sieberiana	+		+			+
Pomaderris sp.	+					
Podolobium ilicifolium		+				
Pratia purpurascens	+	+		+		
Pseudognaphalium luteoalbum	+					
*Rubus fruticosus**			+			
Rubus parvifolius	+	+				
Rumex brownii			+	+	+	+
Sarcopetalum harveyanum		+				
*Senecio madagascariensis**	+			+	+	+
*Setaria gracilis **					+	
*Sida rhombifolia**				+	+	+
*Silybum marianum **			+			
Smilax australis	+	+				
*Solanum mauritianum**				+		
*Solanum pseudocapsicum**			+			
Sporobolus creber		+				
*Stellaria media**			+	+	+	
Stephania japonica		+				
*Taraxacum officinale**				+	+	
Themeda australis	+	+				
*Tradescantia fluminensis **			+	+		
*Trifolium repens **				+	+	+
Tylophora barbata		+				
Urtica incisa			+			
*Verbena bonariensis**	+		+	+	+	+
Vernonia cinerea	+					
*Veronica persica**				+		
Vittadinia sp.	+					
Unidentified herb 1	+		+			
Unidentified herb 2	+					
Unidentified herb 3	+					
Unidentified herb +				+		
Unidentified herb 5				+		
Unidentified herb 6						+
Unidentified lily					+	
Unidentified exotic herb 1*			+			
Unidentified exotic herb 2*				+		
Unidentified exotic herb 3*						+
Unidentified sedge 1			+			

Table A2-5 (Cont'd)
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (OFD4-OFC4)

Species	BioBanking Quadrat					
	OFD4	OFD5	OFC1	OFC2	OFC3	OFC4
Unidentified sedge 2					+	
Unidentified vine 1	+					
Unidentified vine 2	+					
Unidentified vine 3	+					
Unidentified mistletoe	+	+				

Table A2-6
Species Recorded in the 400 m^2 Flora Quadrats for the BBAM (OFR1-OFR3)

Species	BioBanking Quadrat		
	OFR1	OFR2	OFR3
Acacia maidenii	+		+
Acmena smithii	+	+	+
Adiantum hispidulum			+
Asplenium australasicum	+		
Baloghia inophylla	+		
Breynia oblongifolia			+
Cissus antarctica		+	
Dendrobium speciosum			+
Dendrobium teretifolioum?	+	+	+
Dendrocnide excelsa		+	
Dioscorea transversa	+	+	+
Doodia aspera	+	+	
Ficus sp.	+	+	
Geitonoplesium cymosum	+	+	+
Grammitis billiardieri	+		
Gymnostachys anceps	+	+	
*Lantana camara**			+
Legnephora moorei	+		
Lomandra longifolia	+		
Marsdenia flavescens	+		
Morinda jasminoides		+	
Myrsine howittiana	+	+	
Neolitsea australiensis		+	
Notelaea ovata			+
Oplismenus imbecillus			+
Pandorea pandorana	+		+
Pellaea paradoxa	+		+
Pittosporum multiflorum	+	+	+
Pyrrosia rupestris	+	+	+
Scolopia braunii	+	+	+
Smilax australis	+	+	
Synoum glandulosum	+	+	
Unidentified grass 1	+		+
Unidentified herb 1	+	+	+
Unidentified herb 2	+	+	
Unidentified herb 3	+	+	
Unidentified rainforest tree 1	+	+	+
Unidentified rainforest tree 2	+	+	+
Unidentified rainforest tree 3	+		+
Unidentified rainforest tree 4			+
Unidentified rainforest shrub 1	+	+	+
Unidentified rainforest shrub 2	+	+	+
Unidentified rainforest shrub 3	+	+	+
Unidentified rainforest shrub 4	+	+	+
Unidentified rainforest shrub 5	+		
Unidentified rainforest shrub 6		+	
Unidentified rainforest shrub 7		+	
Unidentified rainforest vine 1		+	+
Unidentified rainforest vine 2		+	
Unidentified rainforest vine 3		+	

Appendix 3

Fauna Species Recorded within the Study Area

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Table A3-1
Fauna Species Recorded within the Study Area

Scientific name	**Common name**	**Status (TSC)**	**Obs type**	**Reliability of bat recording**
AMPHIBIANS				
Adelotis brevis	Tusked frog	-	W	
Crinia signifera	Common eastern toadlet	-	W	
Limnodynastes peronii	Brown-striped frog/ Striped marsh frog	-	O	
Limnodynastes tasmaniensis	Spotted marsh frog	-	W	
Pseudophryne coriacea	Red-backed toadlet	-	W	
Litoria caerulea	Green tree frog		W	
Litoria dentata	Bleating tree frog	-		
Litoria fallax	Eastern dwarf tree frog	-	O/W	
Litora latopalmata	Broad-palmed frog/ Rocket frog		O/W	
Litoria lesueuri	Lesueur's frog	-		
Litoria peronii	Peron's tree frog	-	O	
Litoria phyllochroa	Leaf green tree frog		W	
Litoria tyleri	Tyler’s tree frog		W	
Litoria wilcoxi	Stoney creek frog		O/W	
REPTILES				
Lampropholis delicata	Grass skink	-	O	
Tiliqua scincoides	Eastern blue-tongued lizard	-	O	
Physignathus lesueurii	Eastern water dragon	-	O	
Varanus varius	Lace monitor	-	O	
Pseudechis porphyriacus	Red-bellied black snake	-	O	
Morelia spilota ssp. spilota	Diamond Python		O	
Chelodina longicollis	Long-necked Turtle		O	
BIRDS				
Alectura lathami	Australian brush turkey		W	
Coturnix ypsilophora	Brown Quail		W	
Dendrocygna eytoni	Plumed whistling-duck	-	O	
Anas superciliosa	Pacific black duck		O	
Chenonetta jubata	Australian wood duck		O	
Ardea ibis	Cattle egret	-	OW	
Ardea modesta	Eastern great egret	-	O	
Phalacrocorax sulcirostris	Little black cormorant	-	O	
Falco cenchroides	Nankeen kestrel	-	O	

Table A3-1 (Cont'd)
Fauna Species Recorded within the Study Area

Scientific name	**Common name**	**Status (TSC)**	**Obs type**	**Reliability of bat recording**
BIRDS (Cont'd)				
Falco longipennis	Australian hobby	-	O	
Aquila audax	Wedge-tailed eagle	-	O	
Elanus axillaris	Black-shouldered kite	-	O	
Threskiornis spinicollis	Straw-necked ibis		O	
Porphyrio porphyrio	Purple swamphen	-	O	
Ocyphaps lophotes	Crested pigeon	-	O	
Lopholaimus antarcticus	Topknot pigeon		O	
Ptilinopus magnificus	**Wompoo fruit-dove**	**V**	**W**	
Eolophus roseicapillus	Galah	-	OW	
Platycercus eximius	Eastern rosella	-	OW	
Platycercus elegans	Crimson rosella		O	
Centropus phasianinis	Pheasant coucal		O	
Chalcites basalis	Horsfields bronze cuckoo		O	
Cacomantis flabelliformis	Fan-tailed cuckoo		OW	
Ninox novaeseelandiae	Southern boobook	-	OW	
Podargus strigoides	Tawny frogmouth	-	OH	
Eurostopodus mysticalis	White-throated nightjar	-	W	
Aegotheles cristatus	Australian owlet nightjar		W	
Ceyx azureus	Azure kingfisher		O	
Todiramphus sanctus	Sacred kingfisher		O	
Dacelo novaeguineae	Laughing kookaburra	-	OW	
Cormobates leucophaeus	White-throated treecreeper	-	O	
Pardalotus punctatus	Spotted pardalote	-	W	
Pardalotus striatus	Striated pardalote	-	W	
Acanthiza nana	Yellow thornbill	-	OW	
Acanthiza pusilla	Brown thornbill	-	OW	
Gerygone olivacea	White-throated gerygone	-	OW	
Sericornis frontalis	White-browed scrubwren	-	OW	
Malurus cyaneus	Superb fairy-wren		OW	
Acanthorhynchus tenuirostris	Eastern spinebill	-	O	
Lichenostomus chrysops	Yellow-faced honeyeater	-	OW	
Manorina melanocephala	Noisy miner	-	OW	
Meliphaga lewinii	Lewin's honeyeater	-	W	
Philemon corniculatus	Noisy friarbird	-	O	
Eopsaltria australis	Eastern yellow robin	-	OW	

Table A3-1 (Cont'd)
Fauna Species Recorded within the Study Area

Scientific name	**Common name**	**Status (TSC)**	**Obs type**	**Reliability of bat recording**
BIRDS (Cont'd)				
Pomatostomus temporalis	**Grey-crowned babbler**	**V**	O/W	
Psophodes olivaceus	Eastern whipbird	-	W	
Colluricincla harmonica	Grey shrike-thrush	-	O	
Pachycephala pectoralis	Golden whistler	-	O	
Pachycephala rufiventris	Rufous whistler	-	OW	
Rhipidura fuliginosa	Grey fantail	-	OW	
Rhipidura leucophrys	Willie wagtail	-	OW	
Cracticus nigrogularis	Pied butcherbird	-	OW	
Gymnorhina tibicen	Australian magpie	-	OW	
Strepera graculina	Pied currawong	-	W	
Coracina novaehollandiae	Black-faced cuckoo-shrike	-	O	
Corvus orru	Torresian crow	-	OW	
Corvus coronoides	Australian raven		W	
Corcorax melanorhamphos	White-winged chough	-	O	
Grallina cyanoleuca	Magpie lark		O	
Eurystomus orientalis	Dollarbird		O	
Ptilonorhynchus violaceus	Satin bowerbird	-	O	
Neochmia temporalis	Red-browed finch	-	OW	
Zosterops lateralis	Silvereye	-	W	
Acridotheres tristis	Common Myna*	U	O	
MAMMALS				
Antechinus stuartii	Brown antechinus	-	TO	
Rattus rattus	Black rat*	**-**	O	
Rattus fuscipes	Bush rat	-	T	
Petaurus norfolcensis	**Squirrel glider**	**V**	**O**	
Petaurus breviceps	Sugar glider	-	W	
Macropus giganteus	Eastern grey kangaroo	-	P	
Oryctolagus cuniculus	Rabbit*	U	O	
Bos taurus	Cow*	U	O	
Canis lupus familiaris	Dog*	U	O	
Vulpes vulpes	Fox*	U	PF	
Ovis aries	Sheep*	U	O	
MEGABATS				
Pteropus poliocephalus	**Grey-headed flying fox**	**V**	**W**	
MICROBATS				

Table A3-1 (Cont'd)
Fauna Species Recorded within the Study Area

Scientific name	**Common name**	**Status (TSC)**	**Obs type**	**Reliability of bat recording**
MAMMALS (Cont'd)				
Rhinolophus megaphyllus	Eastern horseshoe-bat	-		D
Saccolaimus flaviventris	**Yellow-bellied sheath-tail bat**	**V**	**U**	**PR**
Mormopterus ridei or sp. 2 (Adams et al)	Little freetail bat	-	U	D
Mormopterus norfolkensis	**Eastern coast free-tail bat**		**U**	**D**
Tadarida australis	White-striped freetail bat	-	W	D
Chalinolobus gouldii	Gould's wattled bat	-	U	D
Chalinolobus morio	Chocolate wattled bat	-	U	D
Miniopterus australis	**Little bent-wing bat**	**V**	**U**	**D**
Miniopterus schreibersii oceanensis	**Eastern bent-wing bat**	**V**	**U**	**D**
Myotis macropus/adversus	**Large-footed myotis**	**V**	**U**	**D**
Nyctophilus sp.	Long-eared bat	-	U	PR
Scotorepens orion	Eastern broad-nosed bat	-	U	PR
Vespadelus pumilus	Eastern forest bat	-	T/U	D
Vespadelus vulturnus	Little forest bat	-	U	D

- Status (TSC): U = introduced/exotic, V = vulnerable, E = endangered,
- Observation type: O = observed, W = heard, H = hair, feathers or skin, F = tracks/scratching, P = scat, X = in scat, U = ultrasonic call, T = trapped
- Reliability of bat recording: D = definite call, PR = Probable call
- threatened species are shown in **bold** text
- exotic species are shown with an *

Appendix 4

Determination of Subject Flora Species

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Table A4-1
Determination of Subject Flora Species

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat available in Study Area	Potential to occur in disturbance areas	Subject Species[a]
		10km	2km				
Threatened Species (TSC Act)							
Asperula asthenes (Trailing woodruff)	1897	3	0	Damp sites, often along river banks.	Possibly	**Low** due to lack of recent nearby records and not recorded during field surveys.	No
Chiloglottis platyptera	No records			Grows among grass in tall forest; north from Barrington Tops.	Possibly	**Low** No records for locality.	No
Cynanchum elegans (White-flowered wax plant)	2002	1	0	Occurs mainly at the ecotone between dry subtropical rainforest and sclerophyll forest/woodland communities	Possibly	**Low** Only one record for the locality and not recorded during field surveys	No
Eucalyptus glaucina (Slaty red gum)	-	0	0	Locally frequent but very sporadic, in grassy woodland on deep, moderately fertile and well-watered soil.	Possibly	**Low** No records for locality and not recorded during field surveys.	No
Grevillea obtusiflora	1979	1	0	Subspecies *obtusiflora* occurs as scattered groups in the understorey of low open eucalypt forest at an altitude of 730m AHD. Subspecies *fecunda* occurs in clusters within low, open scrub beneath open, Dry sclerophyll forest, on orange, sandy loam soils with sandstone boulders, at an altitude of 570m AHD. It appears to respond favourably to mechanical soil disturbance and is known to quickly recolonise roadside scrapes.	No	**Minimal** Habitat unsuitable	No

Table A4-1 (Cont'd)
Determination of Subject Flora Species

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat available in Study Area	Potential to occur in disturbance areas	Subject Species[a]
		10km	2km				
Threatened Species (TSC Act) (Cont'd)							
Melaleuca groveana (Groves paperbark)	-	0	0	Grows on exposed rocky ridges, high mountain slopes and the summits of mountains, at altitudes between 340-600m AHD. It generally occurs in heaths and eucalypt woodlands and forests with heath understoreys. It is also found in tall open forest with a grassy understorey and in microphyll vine forests. It has been recorded growing on red sandy loams, brown loams, skeletal rocky soils and sandy soils over sandstone rock. (Barker 1997; Byrnes 1986)	No	**Low** Potentially suitable habitat in rocky hilltop area, but not in disturbance area.	No
Pomaderris queenslandica (Scant pomaderris)	1897	2	0	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	Possibly	**Low** due to lack of recent, nearby records and not recorded during field surveys.	No
Senna acclinis (Rainforest senna)	-	0	0	Grows in margins of subtropical, littoral and dry rainforest and vine thickets.	Possibly	**Low** No records for locality and not recorded during field surveys.	No
Syzygium paniculatum (Magenta lilly pilly)	-	0	0	Grows in subtropical rainforest on Quaternary gravels, sands, silts and clays in riparian gallery rainforests and remnant littoral rainforest communities; or on sandy grey soils over sandstone in littoral rainforest on stabilised dunes near the sea.	Possibly	**Low** No records for locality and not recorded during field surveys.	No
ROTAP only and Rare Species							
Acacia barringtonensis (Barrington wattle)	-	-	-	Grows in Dry sclerophyll forest and woodland, usually by streams or on margins of swamps.	Possibly	**Low - Moderate**	
Acacia fulva (Velvet wattle, Soft wattle)	2002	34	0	Grows in Dry sclerophyll forest on ridges, slopes, and in drainage lines, in basalt- and shale-derived soils.	Possibly	**Low - Moderate**	

Table A4-1 (Cont'd)
Determination of Subject Flora Species

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat available in Study Area	Potential to occur in disturbance areas	Subject Species[a]
		10km	2km				
ROTAP only and Rare Species (Cont'd)							
Asperula charophyton (Strapleaf woodruff)	1914	1	0	Grows in sclerophyll forest, often near creeks.	Possibly	**Low** due to lack of recent records	
Dodonaea megazyga	1990	1	0	Usually grows in Dry sclerophyll forest or on margins of rainforest usually on sandstone.	Unlikely	**Low**	
Dodonaea rhombifolia (Broad-leaf hop-bush)	1994	13	0	Often grows in shrubland in rocky granitic or basaltic soil by creeks.	Possibly	**Low - Moderate**	
Eucalyptus largeana (Craven grey box)	2009	5	0	Grows in rainforest on sloping sites in subcoastal ranges	Possibly	**Low - Moderate**	
Eucalyptus rudderi (Rudder's box)	1991	1	0	Grows in wet or Dry sclerophyll forest on sloping soil of medium fertility.	Possibly	**Low - Moderate**	
Galium curvihirtum	No records			Grows in moist shaded sites in open sclerophyll forest on granite.	Unlikely	**Low**	
Hibbertia hermanniifolia	No records			Open forest on sandstone; confined to Bents Basin (Nepean R), Yarrowitch district and the coastal ranges south from Wadbilliga N.P.	No	**Minimal**	
Leionema elatius subsp. *elatius* (Tall phebalium)	1897	2	0	Recorded from Tenterfield and Grafton districts, and Guy Fawkes RNP.; not common.	Unlikely	**Low**	
Leptospermum argenteum	No records			Grows in sclerophyll forest and woodland communities along watercourses or in swamps, confined to Barrington Tops area.	Possibly	**Low**	
Plantago cladarophylla	1971	1	0	Grows in swamps, along stream banks and in herbfields on Barrington and Gloucester Tops plateaus.	Unlikely	**Low**	
Plantago palustris	No records			Grows in swamps, confined to Barrington Tops.	No	**Minimal**	
Plectranthus suaveolens	No records			Grows in rocky, exposed areas.	No	**Minimal**	

Table A4-1 (Cont'd)
Determination of Subject Flora Species

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat available in Study Area	Potential to occur in disturbance areas	Subject Species[a]
		10km	2km				
ROTAP only and Rare Species (Cont'd)							
Pomaderris helianthemifolia	No records			Restricted to rocky situations in gorges.	No	**Minimal**	
Prasophyllum sp. A sensu Harden (1993)	No records			Grows in rich black-soil flats with native grasses and open woodland; from Barrington Tops to Glen Innes.	No	**Minimal**	
Pterostylis riparia	No records			Grows on moist, sheltered slopes in montane forest.	No	**Minimal**	

Notes for Appendix 4
*compiled primarily from OEH threatened species profiles http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx and/or Harden (1990-2002), Harden & Murray (2000) and PlantNET.
[a]Note - Species rated as having a low to moderate or better likelihood of occurring are regarded as potential subject species for impact assessment, if listed by legislation. Species listed exclusively by ROTAP are not eligible to be subject species.

Appendix 5

Determination of Subject Fauna Species

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Table A5-1
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Gang-gang cockatoo *(Callocephalon fimbriatum*)	Occupies tall montane forests & woodlands, heavily timbered and mature wet sclerophyll forests. Winters at lower altitudes in drier, open eucalypt forests and woodlands; in box-ironbark assemblages, or in dry forest in coastal areas. Requires hollows in large trees in which to breed.	No	No	No	Low. No local records and habitat within disturbance area comprises small patches of vegetation and is generally unsuitable	No
Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)	Occupies eucalypt woodlands, particularly open woodland. Nests in tree hollows. Forages on tree trunks and amongst leaf litter for ants, beetles and larvae. Threatened by clearance and the fragmentation of the woodland habitat including removal of dead timber. This species appears unable to maintain viable populations in remnants less than 200ha and its abundance decreases as remnant size decreases.	No	No	No	Low. No local records and habitat within disturbance area comprises small patches of vegetation and is generally unsuitable	No
White-fronted chat (*Epthianura albifrons*)	Foothills and lowlands below 1000m AHD. Occurs in damp open habitats along the coast, and near waterways in western NSW. Found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands or lightly timbered lands. Found in estuarine and marshy grounds. Nests in low vegetation.	No	No	No	Low. Habitat unsuitable	No
Hooded robin (*Melanodryas cucullata cucullata*)	Occurs in most of continental Australia except the humid southeastern forests. Inhabits shrublands, dry eucalypt & acacia woodlands. Feeds on insects, skinks, frogs and seeds, taken from the ground, trunks, branches and in the air. Main threat is fragmentation and degradation of habitat. Severely affected by habitat and population fragmentation, although the reason is unclear. Absent from patches dominated by Noisy miners.	No	No	No	Low. No local records and habitat unsuitable	No

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Turquoise parrot (*Neophema pulchella*)	Inhabits steep, rocky ridges, drainage lines, rolling hills, valleys and river-flats and the nearby plains of the Great Dividing Range. Occurs in eucalyptus woodlands and open forests. Also recorded in savannah, riparian woodlands and farmland, preferring edges of forest and pasture. Feeds on the seeds of grasses, herbaceous plants and shrubs. Requires reliable water. Nests may be in hollows of small trees, dead eucalyptus or in holes, stumps or fence posts.	Yes	Yes	No	Low. No local records but within species range and forest edges present	Yes
Olive whistler (*Pachycephala olivacea*)	Endemic to southeastern Australia. Occurs from the coast to the Great Dividing Range. Usually uncommon throughout their range. Occur in dense vegetation of eucalypt forests, rainforests, paperbarks, alpine forests and coastal scrubs and heathlands. The Olive whistler mainly feeds on invertebrates, some seed and leaves.	No	No	No	Low. No local records and habitat unsuitable	No
Scarlet robin (*Petroica boodang*)	The Scarlet robin is found in southeastern Australia. Occupies open forests and woodlands from the coast to the inland slopes. Breeds in drier eucalypt forests and temperate woodlands within an open understorey of shrubs and grasses. Abundant logs and coarse woody debris are important structural components of its habitat. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Sensitive to habitat degradation and overgrazing	No	No	No	Low. No local records and habitat unsuitable.	No

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Flame robin (*Petroica phoenicea*)	The Flame robin is found in southeastern Australia, Qld border to Tasmania, western Vic and southeast S.A. In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris.	No	No	No	Low. No local records and habitat unsuitable	No
Diamond firetail (*Stagonopleura guttata*)	In NSW it occurs predominantly west of the Great Dividing Range, although known from drier coastal areas such as the Hunter Valley. Occupies eucalypt woodlands, forests and mallee. Nests in trees and bushes, and forages on the ground for grass seeds, other plant material and insects.	No	No	No	Low. No local records and habitat within disturbance area comprises small patches of vegetation and is generally unsuitable.	No
Red-backed button-quail (*Turnix maculosa*)	Largely coastal and sub-coastal. In NSW, the majority of Red-backed button-quail records are from the North Coast with historical records south as far as Sydney. Inhabits grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 mm or more of summer rain. Prefers sites near water, including grasslands and sedgelands near creeks, swamps and springs, and wetlands. Usually breed in dense grass near water.	No	No	No	Low. No local records and habitat generally unsuitable	No

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Rufous bettong (*Aepyprymnus rufescens*)	Occupies a wide variety of habitats, from coastal eucalypt forests through tall, wet sclerophyll to low dry open woodland west of the Great Dividing Range. Occupies areas of sparse or grassy understorey, adjacent areas of dense undergrowth. Browses on herbs & grasses and especially in dry conditions, digs for roots & tubers. Underground fungi make an important contribution to the diet. Has a large home range; 75-110 ha for males and 45-60 ha for females.	Yes	Yes	Yes	Low. No local records and habitat patchy and generally unsuitable within impact area	No
Eastern pygmy-possum (*Cercartetus nanus*)	Occurs from rainforest through to sclerophyll forest to tree heath. Banksias and myrtaceous shrubs and trees are favoured as food sources and nesting sites.	Yes	Yes	Yes	Low. No local records and habitat generally too small and unsuitable within impact area	No
Common planigale (*Planigale maculata*)	Occupies a range of habitats from rainforest, sclerophyll forest and grasslands to marshlands and rocky areas.	Yes	Yes	Yes	Low. No local records and habitat generally too small and unsuitable within impact area	No

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Glossy black-cockatoo (*Calyptorhynchus lathami*)	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black she-oak (*Allocasuarina littoralis*), Forest she-oak (*A. torulosa*) or Drooping she-oak (A. verticillata) occur. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), Dependent on large hollow-bearing eucalypts for nest sites. Forest she-oak trees were observed on the Study Area during the survey on the upper wooded slopes, many trees had fruits however no signs of Glossy black cockatoos were identified in the areas surveyed. It is likely that this species may inhabit the upper slopes of the Study Area only.	Yes	Yes	Yes	Low habitat generally too small and fragmented within the disturbance area	No
Barred cuckoo-shrike (*Coracina lineata*)	This species appears to use rainforest and open forest habitats	Yes	Yes	Yes	Low. No local records and very small amount of suitable habitat within impact area	No
Spotted harrier (*Circus assimilis*)	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Yes	No	No	Moderate. Possible foraging within disturbance area	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Square-tailed kite (*Lophoictinia isura*)	Specialised canopy predator, feeding on small birds, eggs and insects. Primarily hunts over open forest, woodlands and mallee communities that are rich in passerines, as well as over adjacent heaths and other low scrubby habitats and in wooded towns. Appears to prefer a structurally diverse landscape.	Yes	Yes	Yes	Moderate Possible foraging within disturbance area	Yes
Little eagle (*Hieraeetus morphnoides*)	Forests, woodlands, open shrublands, tree-lined watercourses of interior. Most abundant where open country intermixes with wooded or forested hills (as in farmland/irrigated land). Avoids dense forest, but will use clearings and margins on dense eucalypt and rainforest. Prefers hilly country.	Yes	Yes	Yes	Moderate Possible foraging within disturbance area	Yes
Black-necked Stork (*Ephippiorhynchus asiaticus*)	Black-necked storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.	Yes	Yes	No	Low Only very small areas of riparian habitat along Waukivory Creek and Avon River will be disturbed but grassland will be disturbed	Yes
Little lorikeet (*Glossopsitta pusilla*)	Dry open eucalypt forest and woodland on the east coast and adjacent ranges and slopes. Feeds primarily on nectar and pollen from eucalypts but also on fruit. Generally considered to be nomadic, localised influxes of the species can occur at any time of year, apparently in relation to availability of food resources such as flowering of eucalypts. Requires small (~3cm) tree hollows for breeding.	Yes	Yes	Yes	Moderate Periodic visitation during peak eucalypt flowering	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Speckled warbler (*Chthonicola sagittata*)	The Speckled warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in drainage lines. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about 10ha, with a slightly larger home-range when not breeding.	Yes	Yes	Yes	Moderate Habitat within disturbance area is small and fragmented	Yes
Varied sittella (*Daphoenositta chrysoptera*)	Occur in eucalypt forest, woodland, mallee, farm trees, shelter belts, roadside trees and parks and gardens. Occur in most treed habitats except rainforest.	Yes	Yes	Yes	Moderate	Yes
Regent honeyeater (*Xanthomyza phrygia*)	Inhabits dry open forest and woodland, particularly box-ironbark woodlands, and riparian forests of river she-oak. Feeds on nectar from a wide range of eucalypts and mistletoe. When nectar is scarce feeds on lerp, honeydew and insects. Regent honeyeaters undertake large-scale nomadic movements most likely in search of flowering areas, or other unknown resource requirements. The nomadic nature of this species makes it difficult to assess. Known to frequent areas with densely blossoming winter-flowering trees on an opportunistic basis along the coast and ranges of NSW.	Yes	Yes	No	Moderate Periodic visitation during peak eucalypt flowering	Yes
Swift parrot (*Lathamus discolor*)	The migratory nature of this species makes it difficult to assess. Known to frequent sclerophyll forest and woodlands with winter flowering trees (e.g. Spotted gum, Red ironbark, Narrow-leaved ironbark, Forest red gum and Swamp mahogany) on an opportunistic basis along the coast and ranges of NSW. Breeds in Tasmania.	Yes	Yes	No	Moderate Periodic visitation during peak eucalypt flowering	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Barking owl (*Ninox connivens*)	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as acacia and casuarina species, or the dense clumps of canopy leaves in large eucalypts. Feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Live alone or in pairs. Territories range from 30 to 200ha and birds are present all year.	Yes	Yes	Yes	Moderate	Yes
Powerful owl (*Ninox strenua*)	The Powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open rainforest and rainforest. The Powerful owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation. The main prey items are medium-sized arboreal marsupials, particularly the Greater glider, Common ringtail possum and Sugar glider. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. Pairs of Powerful owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400-1450 ha. Powerful owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Yes	Yes	No	Moderate Prey species present but large tree hollows scarce	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Masked owl (*Tyto novaehollandiae*)	Lives in eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000ha. Roosts and breeds in moist eucalypt forested drainage lines, using large tree hollows or sometimes caves for nesting.	Yes	Yes	No	Moderate	Yes
Sooty owl (*Tyto tenebricosa*)	Large areas of tall open forest and woodland particularly in and around dense creek and gully areas. Nests in large hollows in rainforest trees and eucalypts.	Yes	Yes	Yes	Moderate Limited foraging and roosting habitat available.	Yes
Grey-crowned babbler (*Pomatostomus temporalis*)	Open eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. May also be observed along streams in cleared areas and grassy road verges. Conspicuous large communal nests/roosts are constructed out of twigs. Detected within the Study Area on McKinleys Lane	Yes	Yes	Yes	Known adjacent to impact area	Yes
Superb fruit-dove (*Ptilinopus superbus*)	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Yes	Yes	Yes	Moderate. Only small patches of suitable habitat within disturbance area	Yes
Rose crowned fruit-dove (*Ptilinopus regina*)	Rose-crowned fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	Yes	Yes	Yes	Moderate Only small patches of suitable habitat within disturbance area	Yes
Wompoo fruit-dove (*Ptilinopus magnificus*)	Most often seen in mature forests, but also found in remnant and regenerating rainforest. Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit; some of its feed trees rely on species such as this to distribute their seeds. Feeds alone, or in loose flocks at any height in the canopy.	Yes	Yes	Yes	Known adjacent to disturbance area. Only small patches of suitable habitat within disturbance area	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Large-eared pied bat (*Chalinolobus dwyeri*)	Occupies a range of well-wooded habitats, including Dry sclerophyll forests and woodlands of coastal and semi-arid areas. Occasionally in sub-alpine woodlands and at the edge of rainforest and semi-arid areas. Reliant on suitable roosting habitat including caves and mine tunnels (though may use other structures, e.g. abandoned fairy martin nests).	Yes	Yes	No	Moderate. Some potential foraging habitat	Yes
Eastern false pipistrelle (*Falsistrellus tasmaniensis*)	Tall forest, woodland or heath/ grassland edges. Roosts in hollow trunk of the largest trees and sometimes buildings. Hunts flying insects above or just below the canopy.	Yes	Yes	Yes	Moderate Some potential foraging habitat	Yes
Eastern bent-wing bat (*Miniopterus schreibersii oceanensis*)	Forages within a variety of habitat types including moist and dry eucalypt forest, woodland, rainforest, heath and open environments, including urban areas. Reliant on suitable roosting/breeding habitat in caves and mine tunnels, though will also roost in stormwater channels, road culverts and other comparable structures (including buildings). Estimated nightly foraging range of 20km. Detected within the Study Area at 2 locations.	Yes	Yes	No	Known to forage adjacent to disturbance area	Yes
Little bent-wing bat (*Miniopterus australis*)	Moist eucalypt forest, rainforest, vine thicket, wet and Dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little bent-wing bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common bent-wing bat and, in winter, the two species may form mixed clusters. Detected at 2 locations in the Study Area.	Yes	Yes	No	Known adjacent to disturbance area	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
East coast free-tail bat (*Mormopterus norfolkensis*)	The habitat preference of this species is unclear. It has been predominantly recorded in dry eucalypt forest and woodland, but has been recorded in moist and edge environments. The wing morphology indicates that this species is adapted to the more open habitats. This species primarily roosts in tree hollows, although the roofs of buildings are also used. Detected within Study Area.	Yes	Yes	Yes	Known from farm dam within disturbance area	Yes
Large-footed myotis (*Myotis macropus/ Myotis adversus*)	Habitats adjacent to large bodies of water for hunting aquatic insects. Usually forages over streams or pools, catching insects and small fish by raking its feet across the water surface. Roosts in caves, mines, tunnels, bridges, culverts and dense foliage. Detected within the Study Area.	Yes	No	No	Known from within and adjacent to disturbance area but would make limited use of the habitats of the disturbance area	Yes
Yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*)	Wide range of habitats, including open forest. Forages above the canopy in wooded areas and lower down in more open areas or along creeklines. Reliant on suitable trees with hollows for roosting. Breeds from mid-December to March. Detected within the Study Area.	Yes	Yes	Yes	Known adjacent to disturbance area	Yes
Greater broad-nosed bat (*Scoteanax rueppellii*)	Forages for insects over a range of natural and altered habitats, including tall forest, woodland or heath/grassland edges, often along the tree line boundary. Prefers tree hollows in large, often isolated, mature trees for roosting. Usually associated with tall moist open forest.	Yes	Yes	Yes	Moderate	Yes
Eastern cave bat (*Vespadelus troughtoni*)	The Eastern cave bat inhabits tropical mixed woodland and wet sclerophyll forest on the coasts and drier forests on the western slopes and inland. This species is a cave dweller, using shallow sandstone caves, boulder piles, buildings and sites near the entrance of mine tunnels. Little is known about the diet and breeding of the Eastern cave bat. Potential foraging habitat exists throughout the Study Area.	Yes	No	No	Moderate	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Grey-headed flying-fox (*Pteropus poliocephalus*)	Found within 200km of the eastern coast of Australia. Regularly occurs along the eastern coastal plain through NSW. Roosts in camps, usually in dense riparian habitats. At dusk disperses in search of the preferred food source, mainly eucalypt nectar and pollen, and rainforest fruits. Occurs in subtropical and temperate rainforest, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and planted fruit crops. May travel up to 50 km each night in search of food.	Yes	No	No	Known adjacent to disturbance area	Yes
Golden tipped bat (*Kerivoula papuensis*)	Found in rainforest and adjacent wet and Dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Roost mainly in abandoned hanging Yellow-throated scrubwren and Brown gerygone nests, also in tree hollows, dense foliage and epiphytes; located in rainforest drainage lines on small first- and second-order streams.	Yes	Yes	Yes	Low within disturbance area	No
Squirrel glider (*Petaurus norfolcensis*)	Usually inhabits dry open sclerophyll forest and woodlands, but has also been observed in moist regenerating forest and moist drainage lines. Forages on acacia gum, eucalypt sap, nectar, honeydew and manna, invertebrates and pollen, utilising areas with an abundance of flowering eucalypts and tall shrubs (e.g. banksias). Acacia species are the preferred sap feeding trees. This species requires an abundance of suitably sized hollow-bearing trees for den sites. Trapped during field survey.	Yes	Yes	Yes	Known adjacent to disturbance area	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Spotted-tailed quoll (*Dasyurus maculatus*)	Inhabits a variety of habitat types from moist and wet sclerophyll through to dry forests and woodlands on the edge of open grasslands. Individuals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky cliff faces as den sites. Use latrine sites, often on rocks or boulders. Feed on a wide variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, insects, domestic fowls. Also eats carrion. Female home ranges range up to 750 ha, males 3500 ha.	Yes	No	No	Low within disturbance area	No
Parma wallaby (*Macropus parma*)	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. Typically feed at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. During the day they shelter in dense cover.	Yes	Yes	Yes	Low within disturbance areas	No
Brush-tailed rock-wallaby (*Petrogale penicillata*)	Occupy rocky cliffs, escarpments and outcrops, with a preference for complex structures with fissures, caves and ledges facing north. Eat grasses and forbs, as well as fruit and foliage of shrubs and trees. Home range areas average 15 ha and family groups, typically of 2 to 5, are highly territorial. Breeding is likely to be year-round.	No	No	No	Low	No
Long-nosed potoroo (*Potorous tridactylus*)	Coastal heath and dry and wet sclerophyll forests - relatively thick ground cover is essential and it prefers areas with light, sandy soils.	No	No	No	Low	No
Brush-tailed phascogale (*Phascogale tapoatafa*)	Found in Dry sclerophyll open forests and woodlands, with a preference for sparse ground cover. Also inhabits heath, swamps, rainforest and wet sclerophyll forest. Requires large areas of intact habitat.	Yes	Yes	Yes	Moderate	Yes
Red legged pademelon (*Thylogale stigmatica*)	Inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub. Wet drainage lines with dense, shrubby ground cover provide shelter from predators. In NSW, rarely found outside forested habitat.	No	No	No	Low	No

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Hastings river mouse (*Pseudomys oralis*)	Preferred habitat tends to be areas in minor drainage lines, swamps, seepages, grassy flats with good soil moisture, at least seasonally, and some refuge from fire.	No	No	No	Low	No
Koala (*Phascolarctos cinereus*)	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees.	No	No	No	Low	No
Yellow bellied glider (*Petaurus australis*)	Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal drainage lines and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Live in small family groups of two - six individuals and are nocturnal. Den, often in family groups, in hollows of large trees. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	No	No	No	Low	No
Booroolong frog (*Litoria booroolongensis*)	Permanent flowing rocky streams with fringing vegetation or groundcover. Forage up to 100m from streams and creeks. Predominantly restricted to western flowing streams of the Great Dividing Range.	No	No	No	Low	No

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Green and golden bell frog (*Litoria aurea*)	Inhabits marshes, dams and stream-sides, particularly those containing bulrushes (Typha spp.) or spike rushes (Eleocharis spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as plague minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet. Males call while floating in water and females produce a raft of eggs that initially float before settling to the bottom, often amongst vegetation. Tadpoles feed on algae and other plant matter; adults eat mainly insects, but also other frogs.	Yes	Yes	Yes	Moderate	Yes
Green-thighed Frog (*Litoria brevipalmata*)	Green-thighed frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain.	Yes	Yes	Yes	Moderate	Yes
Stephens banded snake (*Hoplocephalus stephensii*)	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Stephens banded snake is nocturnal, and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day.	Yes	Yes	Yes	Moderate	Yes
Giant barred frog (*Mixophyes iteratus*)	Giant barred frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m.	Yes	Yes	Yes	Moderate. Most suitable habitat occurs outside disturbance area and not detected during targeted surveys	Yes

Table A5-1 (Cont'd)
Determination of Subject Fauna Species

Species	Preferred Habitat and Comments	Habitat available in Study Area			Potential to occur in disturbance areas	Subject species
		Foraging	Shelter	Breeding		
Stuttering frog (*Mixophyes balbus*)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor	Yes	Yes	Yes	Moderate. Most suitable habitat occurs outside disturbance area and not detected during targeted surveys	Yes
Black-chinned Honeyeater	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga ironbark (*Eucalyptus sideroxylon*), White box (*E. albens*), Inland Grey box (*E. microcarpa*), Yellow box (*E. melliodora*), Blakely's red gum (*E. blakelyi*) and Forest red gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares. Only previously recorded in scattered sites in the Hunter region. Not detected during the field surveys.	Yes	Yes	No	Moderate Could potentially occur within the Dry sclerophyll forest areas during peak flowering periods but are more likely to use the more extensive areas of forest outside the disturbance area.	Yes
Freckled Duck	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Not detected during the field surveys.	Yes	Yes	No	Low. Possible short term use of farm dams only.	No

Appendix 6

BBAM Methods and Underlying Assumptions

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This Appendix presents an explanation of the steps undertaken and assumptions adopted in the use of the BioBanking Credit Calculator (Tool Version 2.0, web-based) for the calculation of ecosystem credits required to offset impacts due to the Proposal and the ecosystem credits capable of being generated in the proposed Biodiversity Offset Area.

PROPOSED DISTURBANCE AREA

Landscape Values

Three 1000ha assessment circles were used (labelled SE, NE and W), which was the minimum number into which the proposed disturbance area would fit. The inner 100ha circles were centred over the areas of most intense disturbance **(Figure 12**).

Assessment Circle Details

% native vegetation cover was estimated to be <10% for the NE and W 1000ha and 100ha circles before development, but would not be completely reduced to 0 in any circle after development, so these values remained unchanged for 'after development'.

For the SE circle, the % native vegetation cover was estimated to be 21-30% for the 1000ha circle, and <10% for the 100ha circle. These values were considered to remain within the same range and unchanged after development for the 1000ha circle, but reduced to 0 for the 100ha circle.

Connectivity Value

According to the BioBanking Operational Manual, all the values for Connectivity must be the same for all assessment circles. The values that were derived are set out below.

Width

The most limiting width occurs along Waukivory Creek and the Avon River to the west of the Mine Area. This was classified as being in the range >5m-30m. This connection would be maintained following development (since trimming less than a 10m wide strip of the riparian vegetation for conveyor installation would occur); therefore the value would not change.

Overstorey condition

The Projective Foliage Cover (PFC) of the overstorey is at Benchmark (BM) and this would not change after development.

Mid storey/Ground cover condition

The mid storey and ground cover were generally in poor condition along the entire length of the river but not entirely absent, therefore the PFC was considered to be >25% of lower BM and this value would not change after development.

Vegetation Zones

Selection of Vegetation Types from Biometric Vegetation Types Database

The reasoning behind the selection of corresponding vegetation types from the Biometric Vegetation Types database is explained in Section 3.1.3.2 of this report.

Vegetation Zone Areas

Vegetation Zone areas for each 1000ha assessment circle were calculated using GIS. Areas of vegetation in the overlap zones were assigned to one assessment circle only.

The areas (ha) of each vegetation community within each assessment circle forming each vegetation zone are as follows:

SE Circle

Veg Zone 1 – HU630 DSF	15.80
Veg Zone 2 – HU541 Rainforest	4.26
Veg Zone 3 – HU630 DSF (Low condition)*	17.72*

NE Circle

Veg Zone 4 – HU630 DSF (Low condition)*	2.22*

*The effective clearing areas for low condition vegetation for HU630 were calculated using results from the Paddock Tree Calculator (see section 5.2 on Grassland and Low Condition Vegetation Analysis) as follows:

Low Condition DSF Vegetation at E end (Circles NE and SE)

The overall ratio of actual cleared area to effective clearing area for all low condition polygons was calculated:

36.81 : 24.3 = **0.660**

SE circle
Actual area cleared = 26.85ha
Effective clearing area = 26.85 x 0.66 = **17.72ha (Veg Zone 3)**

NE circle
Actual area cleared = 3.37ha
Effective clearing area = 3.37 x 0.66 = **2.22ha (Veg Zone 4)**

W Circle

Veg Zone 5 – HU598 Riparian	1.1

Clearing areas for riparian vegetation (Vegetation Zone 5) in the Rail Load-out Facility and conveyor disturbance areas in the W assessment circle were calculated and supplied by R.W. Corkery & Co. (15.8.2012).

Threatened Species Sub-zones

According to the rules in the BioBanking Methodology (DECC 2009a), it was necessary to divide Vegetation Zones 1, 2 and 5 into separate Threatened Species Sub-zones on the basis of different Adjacent Remnant Areas. This was due to some vegetation patches being isolated and others well connected to the extensive areas of vegetation to the east.

The reasons for identification of separate Threatened Species Sub-zones and the way the values for Adjacent Remnant Area and Patch Size, including low Condition were calculated are given in **Table A6-1**.

Table A6-1
Establishment of Threatened Species Sub-zones

Veg Type	TS subzone	Adjacent Remnant Area (ha)	Patch Size (ha)	Reason (ARA = Adjacent Remnant Area) PS = Patch Size, including low condition)
Vegetation Zone 1 (15.8 ha)				
HU630 Spotted Gum	SE-DSF-triangle	4.90	4.90	Completely isolated >100m from nearest patch
HU630 Spotted Gum	SE-DSF-McKinley	9.00	501	ARA includes all vegetation along McKinleys Lane and around corner to Jacks Road until break of >100m occurs PS connects via low condition vegetation to east with extensive vegetation on hills
HU630 Spotted Gum	SE-DSF-Epatches	4.00	501	ARA – several small patches but assumed to be one isolated patch PS connects via low condition veg. to east with extensive veg on hills
HU630 Spotted Gum	SE-DSF-hill	501	501	ARA and PS – directly connected to extensive vegetation on hills
Vegetation Zone 2 (4.26 ha)				
HU541 Rainforest	SE-RF-isolated patches	3.79	501	ARA – several small patches but assumed to be one isolated patch – area calculated by deducting 0.47 (finger to E connected to hill) from 4.26ha PS connects via low condition vegetation to east with extensive vegetation on hills
HU541 Rainforest	SE-RF-hill	501	501	ARA and PS – directly connected to extensive vegetation on hills
Vegetation Zone 3 (17.72 ha) (Effective Clearing Area)				
HU630 Spotted Gum	SE-DSF-Low Cond-connected	0	501	PS - individual patches connected with <100m gaps to extensive vegetation on hills
Vegetation Zone 4 (2.22 ha) (Effective Clearing Area)				
HU630 Spotted Gum	NE-DSF-Low Cond-connected	0	501.00	PS – directly connected to extensive vegetation on hills
Vegetation Zone 5 (1.1 ha)				
HU598 Riparian	W-Riparian-rail loop	3.00	3.00	ARA and PS – Isolated patches around rail loop
HU598 Riparian	W-Riparian-conveyor	501	501	ARA and PS – Directly connected to extensive riparian vegetation along river

Geographic / Habitat Features

It was considered that the geographic or habitat features listed in **Table A6-2** by the BBAM do occur and may be impacted upon in the proposed disturbance area. The relevance to particular predicted threatened species is indicated.

Table A6-2
Geographic / Habitat Features considered to be present in the proposed disturbance area

Geographic / Habitat Feature	Relevant Species	Comments
Land within 40 m of rainforest, coastal scrub, riparian or estuarine communities	Grey-headed Flying-fox (Breeding)	The proposed disturbance area contains small remnants of dry rainforest and a river oak riparian community. The grey-headed flying-fox was recorded in the riparian vegetation along Waukivory Creek immediately south of the proposed disturbance area, but no breeding camps were present in the proposed disturbance area.
Hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone	Large-footed Myotis (Breeding)	Hollow-bearing trees were present within 200m of the riparian zone.
Rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	Common Planigale	Rainforest, eucalypt forest and grassland were present.
Land within 100 m of emergent aquatic or riparian vegetation	Green and golden bell frog	Emergent aquatic or riparian vegetation was present by the river and creeks and around some of the farm dams.
Land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter	Green-thighed Frog	Semi-permanent or ephemeral ponds or depressions containing leaf litter were present along the creeks.
Rainforest or tall open wet forest with understorey and/or leaf litter and within 100 m of streams	Stuttering Barred Frog	Remnant rainforest with leaf litter occurs within 100m of ephemeral streams.
Land below 1000m in altitude and within 40m of rainforest or eucalypt forest with deep leaf litter	Giant barred frog	Land with deep leaf litter below 1000m AHD occurs within some rainforest remnants.

It was considered that the geographic or habitat features listed in **Table A6-3** by the BBAM do not occur or would not be impacted upon in the proposed disturbance area. The associated species are excluded from further consideration in the assessment.

Table A6-3
Geographic / Habitat Features considered to be absent from the Proposed disturbance area

Geographic / Habitat Feature	Relevant Species	Comments
Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	Eastern Cave Bat (Breeding) Large-eared Pied Bat (Breeding) Large-eared Pied Bat	No escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels occur in the proposed disturbance area.
Land containing caves or similar structures	Little Bentwing-bat (Breeding) Eastern Bentwing-bat (Breeding)	No caves or similar structures occur in the proposed disturbance area.
Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	Osprey	The proposed disturbance area is remote from marine or saline water systems or larger rivers or creeks.
Land north of Gloucester in Karuah Manning CMA subregion	Rufous Bettong	The proposed disturbance area is south of Gloucester.
Land within 5 km of Wallaroo Nature Reserve in Upper Hunter CMA subregion	*Angophora inopina*	The proposed disturbance area is not within 5 km of Wallaroo Nature Reserve.

Site Values

Transect / Plot

For each vegetation zone, the transect and plot data for the vegetation zones in moderate to good condition were entered as .csv files from the transcribed plot and transect field data. Where a vegetation type was split into different vegetation zones as required by the additional assessment circles, the same replicate transect and quadrat data were used for the vegetation zones divided by different assessment circles.

For the two low condition vegetation zones, no field plots and transects were used and values for entry into the credit calculator were derived from the Paddock Tree Calculator results and grassland plots results (see Section 5.2) as follows.

Native plant species: estimated from grassland plot analysis.

Overstorey cover: averages from the paddock tree calculator (% foliage cover) were calculated for polygons in the northern or southern paddock areas.

Midstorey cover: there was no midstorey so the value is 0.

Groundcover grasses: estimated from grassland plot analysis.

Groundcover shrubs: there were no groundcover shrubs so the value is 0.

Groundcover other: estimated from grassland plot analysis.

Exotic cover: estimated from grassland plot analysis.

No. of trees with hollows: estimated to be 1 per plot on average.

Overstorey regeneration:	no overstorey regeneration was detected in the low condition area so the value is 0.
Length of fallen logs:	there were no fallen logs so the value is 0.
Easting and Northing:	nominal values only entered.
Zone:	56

The results for Plot DVDL1 were derived from low condition clusters of trees at the southern end of the eastern paddock area, while the results for Plot DVDL2 were derived from low condition patches at the northern end of this area.

Results from the transects/plots are shown in **Table A6-4**.

Management Scores

Since the only management scenario within the proposed development area is expected to be total clearing, a single Management Zone for each Vegetation Zone (clearing) was linked to all Threatened Species Sub-zones. Accordingly, the site scores for each of the site attributes were reduced from their original site values to 0 resulting in total future site values of 0 out of 100 in each case.

Threatened Species Survey Results

Most threatened species listed in this section were considered to be absent from the proposed disturbance area as a result of the comprehensive and targeted field surveys and were consequently not considered to be impacted by the activity. A few species could not be conclusively ruled out from being present by field survey, but were assumed to be absent for the following reasons:

- *Tetratheca juncea:* suitable habitat is absent and the Site is far removed from the species' nearest known occurrence.
- *Cryptostylis hunteriana:* suitable habitat is absent and the Site is far removed from the species' nearest known occurrence.
- *Rhizanthella slateri*: this species is almost impossible to conduct targeted surveys for, but the Site is far removed from the species' nearest known occurrence.

Both the Grey-crowned Babbler and the Squirrel Glider were recorded within or near the proposed disturbance area during the fauna surveys and anecdotal sightings of the Brush-tailed Phascogale were reported by local residents. However, these records were not entered into the credit calculator since the potential impacts on these species are being assessed and accounted for separately and species credits are not being sought for particular threatened species from the proposed Biodiversity Offset Area.

Table A6-4
Summarised data from Transects/Plots using BBAM in Proposed disturbance area

Transect/ Plot Name*	Native spp (No)	O/storey cover (%)	Midstorey cover (%)	G/cover grasses (%)	G/cover shrubs (%)	G/cover other (%)	Exotic cover (%)	No trees with hollows	O/storey Regen (out of 1)	Length Fallen Logs (m)	Easting	Northing
DVD1	41	16	0	82	0	20	10	0	0.4	72	404194	6451866
DVD2	25	5	13	100	6	8	18	0	0.4	0	404536	6452354
DVD3	16	41	0	54	2	0	38	8	0.4	56	404881	6451537
DVD4	13	46	0	66	8	0	36	4	0.4	45	404825	6451333
DVD5	10	23	0	32	0	0	72	0	0.4	9	404217	6451077
DVC1	23	14	10	72	0	0	50	5	0	3	400776	6451114
DVR1	34	72	12	0	2	44	0	4	0.63	70	404989	6450933
DVR2	30	21	30	4	6	22	12	0	0.63	23	405409	6451994
DVR3	35	45	46	22	20	18	16	3	0.63	64	405424	6451554
DVDL1	5	1.72	0	12	0	4	84	1	0	0	-	-
DVDL2	7	2.07	0	28	0	5	67	1	0	0	-	-

*Explanation of Plot Name:

DV = Development

D = Dry sclerophyll (Vegetation Community 2)

C = Riparian ('Creek') (Vegetation Community 3)

R = Rainforest (Vegetation Community 4)

L = Low Condition (Vegetation Community 2)

Numbers refer to replicate plots

BIODIVERSITY OFFSET AREA

Landscape Values

Two 1000ha assessment circles (labelled 'North' and 'South') were used over the proposed Biodiversity Offset Area to the east of the proposed disturbance area. The inner 100ha circles were centred over more heavily vegetated parts of the Biodiversity Offset Area.

Vegetation Zones

Eight vegetation zones were identified within the Biodiversity Offset Area (1-4 in the northern circle; 5-8 in the southern circle), six of which represent Vegetation Communities 2, 3 and 4 that are in moderate-to-good condition. Vegetation Zones 4 and 8 cover low condition patches of Vegetation Community 2.

According to section 2.6 of the BBAM (DECC 2008), standard management actions are required to be undertaken in all BioBank sites as follows:

- management of grazing for conservation
- weed control
- management of fire for conservation
- management of human disturbance
- retention of regrowth and remnant native vegetation
- replanting or supplementary planting where natural regeneration will not be sufficient
- retention of dead timber
- erosion control
- retention of rocks.

Additional management such as site preparation and replanting of local provenance species would be carried out mainly in Vegetation Zones 4 and 8 Community 2 - Low Condition) to obtain additional ecosystem credits, as outlined in Appendix 5 of the *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (DECC 2009a). Some additional management would also be undertaken in Vegetation Zone 7 (Riparian - moderate-to-good condition – South circle). Further details of the additional management measures proposed are given under 'Site Values'.

All vegetation patches in the Biodiversity Offset Area are well connected to extensive existing vegetation to the east, therefore adjacent remnant area and patch size were both deemed to be >501ha for all threatened species sub-zones.

Geographic / Habitat Features

It was considered that the geographic or habitat features listed in **Table A6-5** by the BBAM do occur within the proposed Biodiversity Offset Area. The relevance to particular predicted threatened species is indicated.

Table A6-5
Geographic / Habitat Features considered to be present in the Biodiversity Offset Area

Geographic / Habitat Feature	Relevant Species	Comments
Land containing caves or similar structures	Little bentwing-bat (Breeding) Eastern bentwing-bat (Breeding)	Caves occur in the proposed Biodiversity Offset Area, particularly at its southern end.
Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	Eastern cave bat (Breeding) Large-eared pied bat (Breeding) Large-eared Pied Bat	Some of the listed habitat features may be present in the rocky areas of the proposed Biodiversity Offset Area, particularly at its southern end.
Land within 40 m of rainforest, coastal scrub, riparian or estuarine communities	Grey-headed flying-fox (Breeding)	The Biodiversity Offset Area contains large dry rainforest drainage lines and a section of river oak riparian community. The grey-headed flying-fox was recorded in the riparian vegetation along Waukivory Creek within the proposed Biodiversity Offset Area.
Hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone	Large-footed myotis (Breeding)	Hollow-bearing trees were present within 200m of the riparian zone.
Rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	Common planigale	Rainforest, eucalypt forest and grassland were present.
Land within 100 m of emergent aquatic or riparian vegetation	Green and golden bell frog	Emergent aquatic or riparian vegetation was present by the river and creeks and around some of the farm dams.
Land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter	Green-thighed frog	Semi-permanent or ephemeral ponds or depressions containing leaf litter were present along Waukivory Creek
Rainforest or tall open rainforest with understorey and/or leaf litter and within 100 m of streams	Stuttering frog	Remnant rainforest with leaf litter occurs within 100m of ephemeral streams.
Land below 1000m in altitude and within 40m of rainforest or eucalypt forest with deep leaf litter	Giant barred frog	Land with deep leaf litter below 1000m AHD occurs within the rainforest drainage lines.

It was considered that the following geographic or habitat features listed in **Table A6-6** by the BBAM do not occur in the proposed Biodiversity Offset Area. The associated species are excluded from further consideration in the assessment.

Table A6-6
Geographic / Habitat Features considered to be absent from the Biodiversity Offset Area

Geographic Feature	Relevant Species	Comments
Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	Osprey	The proposed Biodiversity Offset Area is remote from marine or saline water systems or larger rivers or creeks.
Land north of Gloucester in Karuah Manning CMA subregion	Rufous bettong	The Site is south of Gloucester.
Land within 5 km of Wallaroo Nature Reserve in Upper Hunter CMA subregion	*Angophora inopina*	The Site is not within 5 km of Wallaroo Nature Reserve.

Site Survey Details

Transects and Plots

For each of Vegetation Zones 1 -- 3 and 5 -- 7, the transect and plot data for the vegetation zones were entered as .csv files from the transcribed plot and transect field data. There was one plot short of the four required for the Rainforest Vegetation Zone (HU541). Therefore, to make up the required replication, data from the three plots were averaged to provide data for a nominal fourth plot.

For Vegetation Zones 4 and 8 (Low Condition Community 2), the same values were used as for the nominal Low Condition (Community 2) transects and plots for the proposed disturbance area analysis. Since three quadrats were required, values for the third one were estimated as being intermediate between other two.

The results from the transects/plots for the Biodiversity Offset Area are summarised in **Table A6-7**.

Management Zones

Management Zones were designated for each of the eight Vegetation Zones as follows.

North Circle

- Management Zone 1 (HU630 Dry sclerophyll forest in moderate-to-good condition) (29.89ha)The vegetation within this zone was generally in good condition and at or close to benchmark. Default gains in site value were used for all site attributes in this zone.
- Management Zone 2 (HU541 Dry Rainforest in moderate-to-good condition) (21.9ha): The vegetation within this zone was generally in good condition and at or close to benchmark. Default gains in site value were used for all site attributes in this zone.
- Management Zone 3 (HU598 River Oak Riparian woodland in moderate-to-good condition) (0.12ha): Although in moderate-to-good condition generally, the understorey of the riparian vegetation is partially degraded by cattle grazing and weed invasion and most attributes are below benchmark values. However default gains in site value only were used for all site attributes in this zone.

Table A6-7
Summarised data from Proposed Biodiversity Offset Area BBAM Plots

Transect/ Plot Name*	Native spp (No)	O/storey cover (%)	Midstorey cover (%)	G/cover grasses (%)	G/cover shrubs (%)	G/cover other (%)	Exotic cover (%)	No trees with hollow	O/storey Regen (out of 1)	Length Fallen Logs (m)	Easting	Northing
OFD1	40	39	0	56	8	34	0	11	0.8	38	405997	6451552
OFD2	49	39	10	84	2	40	0	4	0.8	3	405857	6451215
OFD3	40	28	0	30	26	50	0	3	0.8	49.5	406242	6452135
OFD4	52	33	8	82	0	28	2	3	0.8	52	405537	6450950
OFD5	54	38	10	78	14	38	0	2	0.8	32	405465	6453358
OFC1	12	24	0	0	0	2	100	2	0.2	13.5	403651	6450597
OFC2	12	21	7	0	0	10	70	4	0.2	14.5	404256	6454288
OFC3	9	33	5	0	0	8	100	1	0.2	2	402839	6454182
OFC4	12	6	2	2	0	95	0	4	0.2	17	402485	6451385
OFR1	34	71	28	0	0	10	0	2	0.75	34	405876	6451138
OFR2	33	60	49	0	16	10	0	5	0.75	42	406167	6451704
OFR3	28	64	39	2	0	12	0	4	0.75	33	405578	6450844

*Explanation of Plot Name:

OF = Offset

D = Dry sclerophyll (Vegetation Community 2)

C = Riparian ('Creek') (Vegetation Community 3)

R = Rainforest (Vegetation Community 4)

Numbers refer to replicate plots

- Management Zone 4 (HU630 Dry sclerophyll forest in low condition) (1.45ha): The vegetation within this zone is in low condition and below benchmark, but is made up of small and isolated remnants. Default gains in site value were used for all site attributes in this zone.
- Management Zone 5 (HU630 Dry sclerophyll forest in low condition) (16.2ha): Since this zone is in low condition, there is considerable scope for improvements in site condition. Therefore, additional management actions were entered to increase the gain in site value from default values. The additional management actions proposed and the resulting increases in site value are shown in **Table A6-8**.

Table A6-8
Dry Sclerophyll Forest Low Condition Offset Zone North Circle – Additional Management

Site Attribute	Current Score	Default Increased Score	Score with Management	Additional Management Actions
Species richness	1.0	1.5	2.00	Strategic replanting of a diverse range of species
Over-storey cover	1.0	2.00	2.50	Site preparation and planting local provenance species
Mid-storey cover	0.0	1.00	1.50	Site preparation and planting local provenance species
Native ground cover (grasses)	2.00	3.00	3.00	
Native ground cover (shrubs)	0.00	1.00	1.00	
Native ground cover (other)	1.00	2.00	2.00	No change from default permitted
Exotic plant cover	0.00	0.50	0.50	
Number of trees with hollows	3.00	3.00	3.00	No change from default permitted
Over-storey regeneration	0.00	0.50	1.00	Site preparation and planting local provenance species
Total length of fallen logs	0.00	0.00	0.50	Hollow logs brought in from adjoining development area

A summary of the changes in site value due to the additional management actions is given below:

Current Site Value /100	21.35
Default Increased Site Value /100	35.42
Future Site Value / 100	46.88
Increase in Site Value /100	25.53

South Circle

- Management Zone 6 (HU630 Dry sclerophyll forest in moderate-to-good condition) (63.41ha): The vegetation within this zone was generally in good condition and at or close to benchmark. Default gains in site value were used for all site attributes in this zone.

- Management Zone 7 (HU541 Dry Rainforest in moderate-to-good condition) (28.7ha): The vegetation within this zone was generally in good condition and at or close to benchmark. Default gains in site value were used for all site attributes in this zone.
- Management Zone 8 (HU598 River Oak Riparian woodland in moderate-to-good condition) (2.8ha): Although in moderate-to-good condition generally, the understorey of the riparian vegetation is partially degraded by cattle grazing and weed invasion and most attributes are below benchmark values. Its condition could be improved significantly by additional management measures which would increase the site value from the default increased values. Therefore, additional management actions were entered to increase the gain in default site values. The additional management actions proposed and the resulting increases in site value are shown in **Table A6-9**.

Table A6-9
River Oak Riparian Offset Zone South Circle – Additional Management

Site Attribute	Current Score	Default Increased Score	Score with Management	Additional Management Actions
Species richness	1.0	1.5	2.00	Strategic replanting of a diverse range of species
Over-storey cover	3.00	3.00	3.00	
Mid-storey cover	0.0	2.00	2.50	Site preparation and planting local provenance species
Native ground cover (grasses)	0.00	1.00	1.50	Site preparation and planting local provenance species
Native ground cover (shrubs)	0.00	1.00	1.00	
Native ground cover (other)	3.00	3.00	3.00	No change from default permitted
Exotic plant cover	0.00	0.50	0.50	
Number of trees with hollows	0.00	0.00	0.00	No change from default permitted
Over-storey regeneration	1.00	2.00	2.00	
Total length of fallen logs	3.00	3.00	3.00	No additional management required

A summary of the changes in site value due to the additional management actions is given below:

Current Site Value /100	36.00
Default Increased Site Value /100	55.44
Future Site Value / 100	62.44
Increase in Site Value /100	26.44

- Management Zone 9 (HU630 Dry sclerophyll forest in low condition) (2.06ha): The vegetation within this zone is in low condition and below benchmark, but is made up of small and isolated remnants. Default gains in site value were used for all site attributes in this zone.

- Management Zone 10 (HU630 Dry sclerophyll forest in low condition) (28.9ha): Since this zone is in low condition, there is considerable scope for improvements in site condition. Therefore, additional management actions were entered to increase the gain in site value from default values. The additional management actions proposed and the resulting increases in site value are shown in **Table A6-10**.

Table A6-10
Dry Sclerophyll Forest Low Condition Offset Zone South Circle – Additional Management

Site Attribute	Current Score	Default Increased Score	Score with Management	Additional Management Actions
Species richness	1.0	1.5	2.00	Strategic replanting of a diverse range of species
Over-storey cover	1.0	2.00	2.50	Site preparation and planting local provenance species
Mid-storey cover	0.0	1.00	1.50	Site preparation and planting local provenance species
Native ground cover (grasses)	2.00	3.00	3.00	
Native ground cover (shrubs)	0.00	1.00	1.00	
Native ground cover (other)	1.00	2.00	2.00	No change from default permitted
Exotic plant cover	0.00	0.50	0.50	
Number of trees with hollows	3.00	3.00	3.00	No change from default permitted
Over-storey regeneration	0.00	0.50	1.00	Site preparation and planting local provenance species
Total length of fallen logs	0.00	0.00	0.50	Hollow logs brought in from adjoining development area

A summary of the changes in site value due to the additional management actions is given below:

Current Site Value /100	21.35
Default Increased Site Value /100	35.42
Future Site Value /100	46.88
Increase in Site Value /100	25.53

Threatened Species Survey Results

It is not intended to specifically manage any threatened species to obtain species credits in the Biodiversity Offset Area, therefore for the purposes of offset credit calculations, none are listed as being present.

Appendix 7

BioBanking Credit Reports

(Note: Datasheets for the BioBanking Biometric Assessment have been separately lodged electronically with the Office of Environment and Heritage)

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BioBanking Credit Calculator

BioBanking credit report

This report identifies the number and type of credits required at a DEVELOPMENT SITE.

Date of report: 27/09/2012 Time: 12:28:17PM Tool version: 2.0

Development details

Proposal ID:	0024/2012/0316D
Proposal name:	Rocky Hill Coal Project 3
Proposal address:	Waukivory Road Gloucester
Proponent name:	Gloucester Resources Limited
Proponent address:	Level 37 Riverside Centre 123 Eagle Street BRISBANE QLD 4000
Proponent phone:	(07) 3006 1834
Assessor name:	Stefan Rose
Assessor address:	39 Platt Street WARATAH NSW 2298
Assessor phone:	4968 4901
Assessor accreditation:	0024

Improving or maintaining biodiversity

An application for a red flag determination is required for the following red flag areas

Red flag	Reason
River Oak riparian woodland of the North Coast and northern Sydney Basin	Vegetation type being > 70% cleared; or it contains an endangered ecological community;

The application for a red flag determination should address the criteria set out in the BioBanking Assessment Methodology. Please note that a biobanking statement cannot be issued unless the determination is approved.

Additional information required for approval:

- ☐ Change to percent cleared for a vegetation type/s
- ☐ Use of local benchmark
- ☐ Change negligible loss
- ☐ Expert report
- ☐ Predicted threatened species not on site
- ☐ Change threatened species response to gain (Tg value)

Ecosystem credits summary

Vegetation type	Area (ha)	Credits required	Red flag
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	15.80	1,079	No
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	4.26	291	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	17.72	154	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	2.22	12	No
River Oak riparian woodland of the North Coast and northern Sydney Basin	1.10	28	Yes
Total	41.10	1,564	

Credit profiles

1. Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast, (HU541)

Number of ecosystem credits required	291
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	11-30%
Minimum adjacent remnant area class	0-5 ha

Offset options - vegetation types	Offset options - CMA sub-regions
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast, (HU541)	Karuah Manning
Coachwood - Crabapple warm temperate rainforest of the North Coast and northern Sydney Basin, (HU529)	Round Mountain
Hill Kanuka - Tea-tree low closed forest on escarpment ranges of the North Coast and eastern New England Tablelands, (HU559)	East Gippsland Lowlands (Part B)
Lilly Pilly - Sweet Pittosporum warm temperate rainforest of the Liverpool Range, Brigalow Belt South, (HU562)	Ebor Basalts
Sassafras - Crabapple - Soft Corkwood warm temperate rainforest of the North Coast, (HU607)	Yuraygir
Shatterwood - Giant Stinging Tree - Yellow Tulipwood dry rainforest of the North Coast and northern Sydney Basin, (HU613)	Clarence Lowlands
Tuckeroo - Yellow Tulipwood littoral rainforest of the North Coast and northern Sydney Basin, (HU649)	Richmond - Tweed (Qld - Scenic Rim) (Part A)
Weeping Lilly Pilly - Water Gum riparian rainforest of the southern North Coast, (HU651)	Murwillumbah (Qld - Southeast Hills and Ranges)
Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast, (NR110)	Washpool
Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest of the	Wollemi (Part A)
	Wollemi (Part B)
	Yengo - Hunter/Central Rivers
	Cumberland - Sydney Metro

North Coast, (NR111)

Brush Box - Tuckeroo littoral rainforest on coastal headlands of the North Coast, (NR142)

Coachwood - Soft Corkwood - Crabapple warm temperate rainforest of the North Coast, (NR147)

Giant Stinging Tree - Fig dry subtropical rainforest of the North Coast and Brigalow Belt South Bioregions, (NR166)

Hill Kanuka - Tea-tree low closed forest of the escarpment of the North Coast and eastern New England Tablelands, (NR178)

Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast, (NR179)

Native Olive - Gorge Alectryon vine thicket of the gorges of the North Coast, (NR198)

Sassafras - Crabapple - Soft Corkwood warm temperate rainforest of the North Coast, (NR226)

Shatterwood - Giant Stinging Tree - Yellow Tulipwood dry rainforest of the North Coast, (NR229)

Soft Corkwood - Yellow Carabeen - Cryptocarya spp. subtropical rainforest of the North Coast, (NR241)

Tuckeroo - Riberry - Yellow Tulipwood littoral rainforest of the North Coast, (NR273)

White Booyong - Fig subtropical rainforest of the North Coast, (NR280)

Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin, (SR568)

Lilly Pilly littoral rainforest of the southern Sydney Basin and South East Corner, (SR571)

Sassafras - Blackwood - Lilly Pilly temperate rainforest on basalt soils in the Robertson area, southern Sydney Basin, (SR615)

Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin, (SR662)

Wyong

Barrington

Walcha Plateau - Northern Rivers

Macleay Hastings - Hunter/Central Rivers

Macleay Hastings - Northern Rivers

Armidale Plateau

Mummel Escarpment

Upper Manning

Comboyne Plateau - Hunter/Central Rivers

Comboyne Plateau - Northern Rivers

Dalmorton

Chaelundi

Coffs Coast & Escarpment

Clarence Sandstones

Rocky River Gorge

Cataract

Ettrema

Jervis

Sydney Cataract - Sydney Metro

Bateman

Illawarra

Wongwibinda Plateau

Nightcap

Northeast Forest Lands - Border Rivers/Gwydir

Northeast Forest Lands - Northern Rivers

Tomalla

South East Coastal Ranges (Part C)

Upper Hunter

Hunter

Richmond - Tweed (Qld - Scenic Rim) (Part B)

Woodenbong

Wollemi (Part C)

Stanthorpe Plateau

2. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	12
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	0-10%
Minimum adjacent remnant area class	

Offset options - vegetation types	Offset options - CMA sub-regions
Bendemeer White Gum - Silvertop Stringybark grassy open forest of hills of the southern Nandewar and North Coast, (HU504)	Wollemi (Part A)
Broad-leaved Stringybark - Blakely's Red Gum grassy woodlands of the gorges and upper Hunter Valley, North Coast, (HU517)	Wollemi (Part B)
Broad-leaved Stringybark grassy open forest of the eastern New England Tablelands, (HU519)	Karuah Manning
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin, (HU544)	Yengo - Hunter/Central Rivers
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin, (HU556)	Wyong
Melaleuca decora low forest of the central Hunter Valley, Sydney Basin, (HU564)	Barrington
Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin, (HU575)	Walcha Plateau - Hunter/Central Rivers
Narrow-leaved Peppermint - Wattle-leaved Peppermint shrubby open forest of the New England Tablelands, (HU577)	Macleay Hastings - Hunter/Central Rivers
New England stringybarks - peppermint open forest of the New England Tablelands, (HU589)	Mummel Escarpment
Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest on hills of the upper Hunter Valley, southern North Coast, (HU603)	Comboyne Plateau - Hunter/Central Rivers
Rough-barked Apple - Silvertop Stringybark - Ribbon Gum shrub/grass open forest on hills of the southern Nandewar Bioregion, (HU604)	Tomalla
Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619)	Ellerston
Spotted Gum - Broad-leaved Ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin, (HU629)	Upper Hunter
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)	Kerrabee - Hunter/Central Rivers
Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin, (HU631)	Hunter
	Liverpool Range - Hunter/Central Rivers
	Pilliga - Hunter/Central Rivers
	Wollemi (Part C)
	Hunter/Central Rivers - marine zone

3. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	154
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	11-30%
Minimum adjacent remnant area class	

Offset options - vegetation types	Offset options - CMA sub-regions
Bendemeer White Gum - Silvertop Stringybark grassy open forest of hills of the southern Nandewar and North Coast, (HU504) Broad-leaved Stringybark - Blakely's Red Gum grassy woodlands of the gorges and upper Hunter Valley, North Coast, (HU517) Broad-leaved Stringybark grassy open forest of the eastern New England Tablelands, (HU519) Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin, (HU544) Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin, (HU556) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin, (HU564) Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin, (HU575) Narrow-leaved Peppermint - Wattle-leaved Peppermint shrubby open forest of the New England Tablelands, (HU577) New England stringybarks - peppermint open forest of the New England Tablelands, (HU589) Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest on hills of the upper Hunter Valley, southern North Coast, (HU603) Rough-barked Apple - Silvertop Stringybark - Ribbon Gum shrub/grass open forest on hills of the southern Nandewar Bioregion, (HU604) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Spotted Gum - Broad-leaved Ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin, (HU629) Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630) Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin, (HU631)	Wollemi (Part A) Wollemi (Part B) Karuah Manning Yengo - Hunter/Central Rivers Wyong Barrington Walcha Plateau - Hunter/Central Rivers Macleay Hastings - Hunter/Central Rivers Mummel Escarpment Comboyne Plateau - Hunter/Central Rivers Tomalla Ellerston Upper Hunter Kerrabee - Hunter/Central Rivers Hunter Liverpool Range - Hunter/Central Rivers Pilliga - Hunter/Central Rivers Wollemi (Part C) Hunter/Central Rivers - marine zone

4. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	1,079
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	11-30%
Minimum adjacent remnant area class	0-5 ha

Offset options - vegetation types	Offset options - CMA sub-regions

Spotted Gum- Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630) Spotted Gum- Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin, (HU631)	Karuah Manning Clarence Lowlands Clarence Sandstones Hunter Stanthorpe Plateau

5. River Oak riparian woodland of the North Coast and northern Sydney Basin, (HU598)

Number of ecosystem credits required	28
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	0-10%
Minimum adjacent remnant area class	0-5 ha

Offset options - vegetation types	**Offset options - CMA sub-regions**
River Oak riparian woodland of the North Coast and northern Sydney Basin, (HU598)	Karuah Manning Clarence Lowlands Richmond - Tweed (Qld - Scenic Rim) (Part A) Murwillumbah (Qld - Southeast Hills and Ranges) Orange - Lachlan Cumberland - Hawkesbury/Nepean Walcha Plateau - Northern Rivers Macleay Hastings - Northern Rivers Armidale Plateau Coffs Coast & Escarpment Bateman Illawarra Monaro - Murrumbidgee MU Fans Hunter Nandewar, Northern Complex Upper Slopes - Murray Upper Slopes - Murrumbidgee Upper Slopes - Lachlan Lower Slopes - Murray Lower Slopes - Murrumbidgee Lower Slopes - Lachlan
	MR - Murray

BioBanking Credit Calculator

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE.

Date of report: 19/02/2013 Time: 10:06:10AM Tool version: 2.0

Biobank details

Proposal ID:	0024/2013/0451B
Proposal name:	Rocky Hill Coal Project BOA 010213
Proposal address:	Waukivory Road Gloucester NSW
Proponent name:	Gloucester Resources Limited
Proponent address:	Level 37, Riverside Centre 123 Eagle Street BRISBANE QLD 4000
Proponent phone:	(07) 3006 1830
Assessor name:	Stefan Rose
Assessor address:	39 Platt Street WARATAH NSW 2298
Assessor phone:	4968 4901
Assessor accreditation:	0024

Additional information required for approval:

☐ Use of local benchmark

☐ Expert report

☐ Change threatened species response to gain (Tg value)

Ecosystem credits summary

Vegetation type	Area (ha)	Credits required	Red flag
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	21.90	198	No
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	28.70	220	No
River Oak riparian woodland of the North Coast and northern Sydney Basin	2.80	30	No
River Oak riparian woodland of the North Coast and northern Sydney Basin	0.12	1	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	1.45	12	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	16.20	185	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	63.41	481	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	2.06	15	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	28.90	290	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	29.89	268	No
Total	195.43	1,700	

Credit profiles

1. Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast, (HU541)

Number of ecosystem credits required	198
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

2. Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast, (HU541)

Number of ecosystem credits required	220
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

3. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	197
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	

4. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	268
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

5. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	305
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	

6. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	481
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

7. River Oak riparian woodland of the North Coast and northern Sydney Basin, (HU598)

Number of ecosystem credits required	1
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

8. River Oak riparian woodland of the North Coast and northern Sydney Basin, (HU598)

Number of ecosystem credits required	30
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

Species credits

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	Cat and/or Fox control
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	Exclude miscellaneous feral species
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	Feral and/or native herbivore control/ exclusion (eg rabbit, goats, deer etc)
Fig - Whalebone Tree - Stinging Tree dry rainforest of the southern North Coast	Maintain or reintroduce flow regimes (aquatic flora)
River Oak riparian woodland of the North Coast and northern Sydney Basin	Cat and/or Fox control
River Oak riparian woodland of the North Coast and northern Sydney Basin	Control feral pigs
River Oak riparian woodland of the North Coast and northern Sydney Basin	Exclude miscellaneous feral species
River Oak riparian woodland of the North Coast and northern Sydney Basin	Feral and/or native herbivore control/ exclusion (eg rabbit, goats, deer etc)
River Oak riparian woodland of the North Coast and northern Sydney Basin	Maintain or reintroduce flow regimes (aquatic flora)
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Cat and/or Fox control
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Exclude miscellaneous feral species
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Feral and/or native herbivore control/ exclusion (eg rabbit, goats, deer etc)
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Maintain or reintroduce flow regimes (aquatic flora)

Appendix 8

Study Personnel

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Table A8-1
Study Personnel

Report Component	Study Team Members	Qualifications	Experience
Project Supervision Fauna Impact Assessment	Brian Wilson Principal Ecologist	B. Appl. Sc. (Env. Biol), Adv. Dip. Busn. Mgmt, MEIANZ, MECA, MAIBiol.	>35 years
Flora field surveys and quadrats Flora community descriptions Flora impact assessment BioBanking Assessment	Stefan Rose Senior Ecologist - Flora	B.A. (Biol. Sci), M.Env.Stud., MAIBiol, MECA. Accredited BioBanking Assessor	>20 years
Fauna field surveys	Ray Williams Senior Ecologist - Fauna	Biol. Techn. Cert. MECA	>35 years
Fauna field surveys Fauna habitat descriptions	Adam Greenhalgh Ecologist	B. App. Sc. (Env. Res. Mgmt), Dip. App. Sc. (Biological Techniques), MEIANZ, MECA	>10 years
Fauna field surveys	Anna McConville Ecologist	B. Env. Sc	>10 years
Fauna Field Surveys, Analysis of Bat Detector Calls	Narawan Williams Ecologist	TAFE Cert II (Conserv. & Land Mgt. Nat. Area Rest.), MECA	>10 years
Micro-bat call analysis	Amy Rowles Ecologist	B. Sc. (Hons) Ecology	>10 years

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Appendix 9

Relevant licences held by Ecotone Ecological Consultants

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Table A9-1
Relevant licences held by Ecotone Ecological Consultants

Type	For	Licence no.	Name	Date Valid to	Organisation	Location
Animal Research Authority	Vertebrate Fauna Surveys	08/8633	Brian Wilson	15-Nov-13	Animal care and ethics committee of the Director-General of NSW Agriculture	NSW
Certificate of Approval	Vertebrate Fauna Surveys	08/8633	Brian Wilson	15-Nov-14		
Licence to	Access OEH Wildlife Atlas Data Base	CON93002	Brian Wilson	30-Jun-13	NSW Office of Environment and Heritage	
Scientific Licence	Harm/ trap/ release: protected fauna; pick/ hold: native flora	SL 100733	Brian Wilson Stefan Rose Jenny Lewis Amy Williams Narawan Williams Anne Williams Anna McConville Ray Williams	31-Mar-13		
	As above plus bat banding	SL 100734	Ray Williams	31-Mar-17		

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