Appendix 2

Conservation Estate Ecological Inventory Report

Ecological Inventory Report – Lower Hunter Lands

Northern Lands Conservation Estates

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Disclaimers

Executive Summary

INTRODUCTION

RPS Australia East Pty Ltd (RPS) has been commissioned by Coal & Allied Industries Limited (Coal & Allied) to undertake an *Ecological Inventory Report* (EIR) over land within Stockrington and Tank Paddock, for conservation offsets for proposed developments at Minmi/Link Road and Black Hill Development Estates as outlined within the Lower Hunter Regional Strategy. This report provides the results of field investigations made during this study as well as considering the results of studies undertaken in the immediate vicinity and other available information such as NSW NPWS Atlas data and Hunter Bird Observer Club (HBOC) records.

BACKGROUND

Harper Somers O'Sullivan (2005) has previously undertaken Preliminary Vegetation Mapping over various holdings administered by Coal & Allied in the Lower Hunter Valley / Central Coast Region. This preliminary mapping was undertaken to provide a baseline dataset pertaining to the broad-scale distribution of ecological communities throughout the land holdings. This assessment was largely undertaken at a desktop level relying on aerial photography combined with existing regional mapping datasets and limited ground-truthing.

Between January 2007 – April 2010 ecological investigations were undertaken to inform the urban design and NSWG assessment process.

These investigations were intended to provide a brief assessment of the conservation status of previously delineated vegetation communities.

Although not restricted to such parameters, some emphasis has been placed upon locally and/or regionally significant species or ecological communities known from the vicinity of the site. These species or communities include those listed under the various schedules of the *Threatened Species Conservation (TSC) Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999.*

At the state level, the proposal is to be assessed pursuant to Part 3A of the EPA Act. To this end, in August 2010, the DGEAR's were issued for the site. To ensure completeness, ecological fieldwork and assessment has covered the full extent of the Coal & Allied surplus lands, including all development and Conservation Estates.

METHODS

The methodology employed to survey the proposed Conservation Estates does not comply with DECCW Guidelines. However, the vegetation mapping was to provide baseline knowledge pertaining to the broad scale distribution of ecological communities throughout these proposed conservation areas. This mapping has been based upon both aerial photograph interpretation and ground truthing. The ground truthing involved random meanders and driving over the site for approximately 6 days. The survey effort then consisted of detailed quadrats to sample the vegetation and provide data for non-parametric statistical analysis (PATN Ver. 3.11, Belbin 2006). This data was used within cluster analysis to assist in the delineation of the vegetation communities.

The fauna assessments within the Stockrington and Tank Paddock Conservation Estates consisted of mainly habitat assessment and opportunistic surveys throughout. No trapping was performed within the Conservation Estate. Targeted Swift Parrot surveys were undertaken within

the Conservation Estates. This survey effort was performed due to the strategic location of this portion for a native corridor which links Hexham Swamp to the proposed Conservation Estates to the west of Tank Paddock. In brief the methods employed to assess the ecological merit of the site involved the following:

- Literature Review
- Preliminary (Desktop) Assessments
- Flora Assessment
  - » Plant Identification and Vegetation Mapping
  - » Floristic Structure Information
  - » Targeted and Significant Flora Surveys
- Fauna Assessment
- Habitat Assessment and Mapping

Results

Flora

A total of 516 flora species were identified during the survey period over the Conservation Estates within the quadrats, transects and random meander surveys, including seven threatened flora species, two ROTAP species (Briggs & Leigh, 1996) and six Endangered Ecological Communities.

Threatened species include:

- *Arthropteris palisotii*

This species was recorded by EcoBiological (2006) when surveying the Subtropical Rainforest for the proposed Abel Underground Mine Operations. This species was tentatively identified within that report and this species is considered to be significant as sightings are extremely rare.

- *Eucalyptus nicholii*

Four (4) individuals of this species were recorded within the site. This species distribution has been recorded on shallow infertile soils such as slate, shales, granite and porphyrite from Niangala to Glen Innes on the northern tableland of NSW. As the distribution of this species is not naturally occurring in the Hunter Region it is most probable that this species has been introduced from land fill as it was recorded on a road edge.

- *Callistemon linearifolius*

At least 355 individuals of this species were located within the Lower Hunter Spotted Gum Ironbark Forest within the Conservation Estates. The counts of this species involved counting above ground stems, therefore the genetic individuals which may be present could be below this amount. This species is scattered throughout the main ridge top within the north western portion of the site. Targeted surveys to gauge the extent of the population have not been completed and it is expected that the population may be considerably larger than what has been reported here.

- *Rutidosis heterogama*

It is estimated that 1000-1500 individual plants were recorded during field visits and the actual extant population is expected to be far greater. It should be noted that this species appeared to be more common within disturbed areas such as along track sides, near railway verges and amongst dumped refuse. There was also a large population within a power easement just outside of the site on the western slopes of the Sugarloaf Range. This species was recorded predominately within the Lower Hunter Spotted Gum Ironbark Forest vegetation community.

- *Syzygium paniculatum*

One (1) plant was found within the Conservation Estates. Examination of the fruit of this plant found it to be 3 locular which is a distinguishing feature of this plant from other similar species (i.e. *Acmena smithii)*. This plant was growing in an area of high disturbance, adjoining Alluvial Tall Moist Forest and may have been brought in from another site in land fill. The plant is located near Blue Gum Creek and it is possible, however, that it has come from upstream in Alluvial Tall Moist Forest or Subtropical Rainforest. Whichever is the case it is considered that this species is significant as it is growing in suitable habitat (albeit disturbed). A search of this area was performed with no further specimens located within the vicinity.

- *Tetratheca juncea*

Approximately 352 *Tetratheca juncea* plant clumps were located during field visits in 2005, late 2007 and 2008. The population is estimated to be considerably larger as the majority of the surveys were performed outside of the flowering period for this species. It is estimated that 256 ha of suitable habitat, within the Conservation Estates, remains to be surveyed. Thus, it is considered that this population will be significantly larger than what has been recorded during the vegetation surveys.

A further fourteen threatened flora species were considered to have potential habitat. No targeted surveys for any of these species have been undertaken within the Conservation Estates, however all threatened flora have been recorded which were found during the Random Meanders and Quadrat surveys throughout the Conservation Estate.

Twelve vegetation communities have been delineated and described within the LHCCREMS framework for the Conservation Estates, including six EECs. These communities have been delineated utilising a combination of groundtruthing, aerial photography interpretation and the use of Cluster analysis (PATN statistical program). Variations occurred from the LHCCREMS descriptions in many of the vegetation communities and these are described within the description of each community.

- *Coastal Foothills Spotted Gum - Ironbark Forest*

This community occupies the majority of the Conservation Estates and covers approximately 1,047 ha. This vegetation community is commensurate with MU 15 Coastal Foothills Spotted Gum – Ironbark Forest as described by LHCCREMS (NPWS 2000; House 2003). This community is associated with the steep or south facing slopes across the site and was generally evident between Lower Hunter Spotted Gum Iron-bark Forest (LHSGIF) and Hunter Valley Moist Forest (HVMF). Two sub-variants were recorded within this community, namely a Moist Sheltered variant and a Dry Exposed variant.

- *Coastal Plains Smooth-barked Apple Woodland*

This vegetation community occupies several patches throughout the Conservation Estates. This vegetation community encompasses 204 ha and occurs on the slopes and within the ridge top in the north-eastern portion of the Conservation Estates. It is commensurate with MU 30 Coastal Plains Smooth-barked Apple Woodland as described by LHCCREMS (NPWS 2000; House 2003). The threatened flora species *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* were recorded within this community. One sub variant dry exposed, dominated by *Eucalyptus fibrosa* was recorded within this community.

- *Lower Hunter Spotted Gum Ironbark Forest (EEC – Lower Hunter Spotted Gum Ironbark Forest)*

This community occupies the western portion of the site and covers approximately 313 ha. This vegetation community is commensurate with MU 17 Lower Hunter Spotted Gum – Ironbark Forest (LHSGIF) as described by LHCCREMS (NPWS 2000; House 2003). This community varied in some areas with a dense shrub layer of *Melaleuca nodosa* and other areas a dense understorey of *Daviesia ulicifolia*. The remaining areas of the site have a grassy understorey dominated by *Joycea pallidea, Themeda australis, Entolasia stricta* and *Imperata cylindrica.*

- *Hunter Valley Moist Forest*

This vegetation community occurs within slopes above creeklines particularly on southern aspects, or where moisture retention occurs. This vegetation community covers approximately 129 ha and is commensurate with MU 12 Hunter Valley Moist Forest (HVMF) as described by LHCCREMS (NPWS 2000; House 2003). This community occurs on sheltered gullies and south facing slopes below steep sandstone outcrops. Often this community develops in the head drainage lines at a slightly elevated level. This vegetation community has a high diversity of natives and was at times difficult to delineate from the Alluvial Tall Moist Forest.

- *Alluvial Tall Moist Forest*

This vegetation community occurs within the creeklines within the Conservation Estates, these creeklines include Blue Gum Creek, Long Gully and Minmi Creek. Whilst weed infestations are present there are a number of natives still present throughout this vegetation community. This vegetation community covers approximately 166 ha and is commensurate with MU 5 Alluvial Tall Moist as described by LHCCREMS (NPWS 2000; House 2003). This community is very similar to HVMF across the site and is often hard to delineate. It was noted that in the ATMF within the site, tall thick stands of *Melaleuca styphelioides* often dominated the upper-mid stratum with species including *Eucalyptus saligna* and *Eucalyptus grandis* as the dominant canopy species. Whilst *Melaleuca styphelioides* occasionally occurred in HVMF it was not nearly as dense and not as tall as the stands in ATM. The dominant tree cover varied throughout this vegetation community. Two variants of this community were recorded within the site. Firstly, a broad-leaf understorey variant in which upper stratum included *Toona ciliata* (Red Cedar), *Alphitonia excelsa* (Red Ash) and *Eucalyptus salinga* (Blue Gum). Small *Dendroscnide excelsa* (Giant Stinging Tree), *Cryptocarya microneura* and *Commersonia fraserii* dominate the mid storey with a sparse understorey. The second variant *M. styphelioides/E. acmenoides* variant which occurs in drainage lines where the canopy is more open.

- *Subtropical Rainforest (EEC – Lowland Rainforest of the NSW North Coast and Sydney Basin Bioregion)*

This rainforest covers approximately 21 ha and occurs in the deep gullies of Long Gully and another one to the west of Long Gully. This community is commensurate with MU 1a Coastal Warm Temperate – Sub Tropical Rainforest as described by LHCCREMS (NPWS 2000; House 2003). EcoBiological (2006) have previously analysed this community in detail and concluded that this community is best described as Subtropical Rainforest and was closely related to *Ficus* spp. – *Dysoxylum fraserianum* – *Toonia* – *Dendrocnide* sub alliance 15 of Floyd (1990). The results of this survey concur with the EcoBiological (2006) due to the dominance of *Toonia ciliata*, *Dendrocnide excelsa, Dendrocnide photinophylla* and *Ficus* species which were identified within this community.

- *Hunter Lowland Redgum Forest (EEC – Hunter Lowland Redgum Forest in the Sydney Basin and the North Coast Bioregion)*

This vegetation community occurs in two small areas on the western side of the conservation area and in small patches of Tank paddock. This vegetation encompasses approximately 14 ha. The largest portion of this community follows a north – south drainage flat on the western side of the Conservation Estates and is depicted by a dominance of large *Eucalyptus tereticornis* (Forest Red Gum) in the upper stratum. Two variants of this community were delineated, firstly a disturbed variant which was sampled in highly degraded areas in which the canopy was intact but the understorey was disturbed by weed infestation and clearing. The remaining variant is a *Melaleuca decora* variant in which this species is dominant in the understorey.

- *Swamp Oak Rushland Forest (EEC – Swamp Oak Floodplain Forest on Coastal Floodplains)*

This vegetation community occurs in two small areas within the low lying areas adjoining Hexham Swamp within Tank Paddock. This vegetation community encompasses approximately 0.57 ha and is commensurate MU 40 Swamp Oak Rushland Forest as described by LHCCREMS (NPWS 2000; House 2003). This community had a high incursion of *Lantana camara* and it was difficult to gain access.

- *Swamp Mahogany – Paperbark Forest (EEC – Swamp Sclerophyll Forest on Coastal Floodplains)*

This vegetation community in a small area in the northern portion of Tank Paddock, and is linked to a swamp which is located on the adjoining property. This vegetation community encompasses 0.23 ha. This vegetation community is commensurate with MU 37 Swamp Mahogany – Paperbark Forest as described by LHCCREMS (NPWS 2000; House 2003). This vegetation community fringes a swamp that occurs offsite and flows into Pambalong Swamp to the north west of the site.

- *Freshwater Wetland Complex (EEC – Freshwater Wetlands on Coastal Floodplains)*

This vegetation community occurs as two areas in the north east of Tank Paddock. These areas are connected to and drain into Hexham Swamp. This community is floristically diverse and provides habitat for a range of native flora and fauna. This vegetation community covers approximately 11 ha and is commensurate with MU 46 Freshwater Wetland Complex as described by LHCCREMS (NPWS 2000; House 2003).

- *Weeds and Cleared Areas*

This vegetation community occurs within the central area of the site and exists as a quarry. Smaller

areas on the eastern and western side of the site are the result of clearing for the mining operations. The remaining areas are either unformed tracks or electricity easements. This community encompasses approximately 196 ha and is not commensurate with any vegetation communities that have been described by LHCCREMS (NPWS 2000; House 2003). These areas are highly disturbed and have high weed incursions.

- *Dams*

This vegetation community occurs as manmade dams within the cleared areas of the site, with the large dams in the north east of the site were utilised as water reservoirs for the mining operations. This community encompasses approximately 0.43 ha and is not commensurate with any vegetation communities that have been described by LHCCREMS (NWPS 2000; House 2003).

Fauna

A total of fifty-eight (58) threatened fauna species have been previously recorded within 10km (DECCW Atlas of NSW Wildlife Data 2010) of the Conservation Estate (as per existing records). A total of 13 of these species are highly unlikely to occur within the Stockrington and Tank Paddock Conservation Estates due to the absence of suitable habitat. Of the remaining 45 species, four were recorded during fauna surveys or previous surveys (Atlas of NSW Wildlife data 2008). Assessment of habitat potential within Conservation Estates found that a further 24 species have a moderate or greater opportunity of occurring within the Conservation Estates.

Swift Parrot Target Survey Results

Although no Swift Parrots or Regent Honeyeaters were observed within the Coal & Allied lands during the 2008 survey these results are not considered to be a faithful indication of the capacity of these lands to support the Swift Parrot or Regent Honeyeaters. Overall the Conservation Estates exhibit greater habitat opportunities for these species, due to the greater extent of widespread habitat, predominantly Spotted Gum-Ironbark assemblages, ATMF, and the inclusion of riparian Forest Red Gum communities, which are likely to represent focal habitat points for these species during seasons when they occur within the locality. The absence of both of these species from the Conservation Estates during the winter of 2008 is consistent with the paucity of coastal and Lower Hunter records for both of these species during the 2008 season. There have been few Swift Parrot records within the region compared with previous years and no Regent Honeyeaters during the 2008 winter period. Evaluation of potential habitats within Conservation Estates suggests that there is a good probability that both of these species would use the Conservation Estates during favourable years within the region. However, the same assumptions are not considered to apply to the Development Estates, due to the smaller amounts of suitable habitat, lack of Forest Red Gum habitats and the somewhat isolated and to some extent fragmented nature of these lands in comparison with the extent of the Conservation Estates and their continuity to large significant forest areas in the regional context.

Flora Habitat

The vegetation communities present throughout the Conservation Estates at Stockrington and Tank Paddock offer a number of suitable habitat types for a relatively diverse representation of native flora communities and species occurring in the Lower Hunter Region. A number of geomorphologic factors contribute to those vegetation communities present within these lands. These factors include the geology, soils, elevation and rainfall patterns, and are further diversified by topological context in relation to slope, aspect and substrate permeability. The geomorphologic influences underlying these sites provide suitable conditions for ten native vegetation communities, being Coastal Foothills Spotted Gum - Ironbark Forest (CFSGIF), Coastal Plains Smooth-barked Apple Woodland (CPSBAW), Lower Hunter Spotted Gum Ironbark Forest (LHSGIF), Hunter Valley Moist Forest (HVMF), Alluvial Tall Moist Forest (ATMF), Subtropical Rainforest (STRF), Hunter Lowland Redgum Forest (HLRF), Swamp Oak Rushland Forest (SORF), Swamp Mahogany-Paperbark Forest (SMPF), and Freshwater Wetland Complex. Apart from these naturally occurring

vegetation communities there are areas within the site that have been cleared to facilitate energy and transport infrastructure and road works material quarrying and associated maintenance and accessibility requirements. These cleared areas are characterised by disturbed substrates and high levels of light, which provide opportunities for exotic weeds and colonists from adjacent native vegetation communities.

A number of threatened flora species and ROTAP listed flora are known to occur regionally within vegetation communities occurring within Conservation Estates at Stockrington and Tank Paddock.

The condition of the vegetation communities varies across the site with some areas exhibiting degradation with proximity to tracks, infrastructure easements and lands cleared for previous land-use practices. The edges of ATMF and HVMF offer opportunities for mesic vegetation, including serious introduced weeds like *Lantana camara* (Lantana). Other than those opportunities for weeds occurring within cleared easements, vegetation community disturbances within the site are by and large limited to edge effects associated with access tracks and small occasional incidences of rubbish dumping.

Fauna Habitat

Fauna potentially occurring within the site varies with respect to vegetation quality, density and community form. The site encompasses vegetation communities encompassing both wet and dry sclerophyll vegetation associations as well as rainforest community associations. The variation in vegetation within the site provides habitat for a diversity of common fauna species and opportunities for a moderate – high number of threatened fauna species.

The Open Forest communities within the site provide suitable habitat for a number of common terrestrial mammals, including small marsupials, rodents and the Echidna. General understorey density variations within the site largely follow a pattern of more open understoreys on dry or north facing ridges and slopes and higher densities on south facing and lower slopes where dry communities merge with riparian and wet forest communities in the gullies and flats. Open forest habitats offer grazing opportunities for herbivorous fauna, such as Macropods and Wombats.

Habitats for terrestrial mammals within the Conservation Estates (particularly Stockrington) are of considerably greater quality than those occurring within the Development Estates at Black Hill and Minmi/Link Road. This is due to a number of factors not the least of which is the large and continuous stand of vegetation these lands represent and the broad continuous linkages they possess to more southerly areas of the Sugarloaf Range and as a consequence the Watagans further to the south.

There are extensive areas of dry and mesic forest within the proposed Conservation Estates that exhibit a diversity of age cohort within canopy tree species, suggesting that these areas of the site have not been cleared in the recent past. Consequently large areas of these lands are covered in forests containing trees of sufficient maturity to develop hollows, which provide shelter and nesting opportunities for arboreal mammals.

The wooded and adjacent open areas within the site provide extensive insectivorous foraging habitat for Microchiropteran bat species. Furthermore, there are substantial areas of both wet and dry forest communities offering a wide diversity of hunting niche for the majority of Microchiropteran species that have been recorded within the Lower Hunter Valley. The Stockrington Conservation Estate offers roosting opportunities for both hollow-dwelling and cave-dwelling bats and is adjacent to cave-dwelling opportunities of the Sugarloaf Range.

Canopy trees within the site offer abundant blossom foraging opportunities for Grey-headed Flying-foxes and rainforest trees occurring in the gullies provide seasonal fruit resources for this species. No roosting camps were observed but some of the rainforest gullies appear to offer suitable roosting sites for this species.

Stockrington Conservation Estates encompass the headwaters of Buttai and Surveyors Creeks in the west and the western tributaries of Blue Gum Creek in the east including Long Gully. These creek heads represent relatively steep and relatively small catchments offering largely ephemeral water flows, although there are flat areas where more permanent pools persist. The wet nature of these gullies would make them highly suitable sites for frog species including potential habitat for locally occurring threatened frog species. The Tank Paddock Conservation Estate occurs on the south western fringe of the Hexham floodplain with areas of wetland habitat entering the site where mesic forested drainage lines interface with floodplain habitats. Floodplain habitats and lower mesic drainage lines are likely to provide a diversity of habitat niches for common frog species.

Habitat within the site has potential for representing significant shelter and foraging opportunities for a diversity of reptile species. This can be attributed to the complexity of understorey strata and the high incidence of forest debris in the ground cover layer.

A diversity of continuous dry forest and woodland habitats interspersed with wet gullies containing mesic vegetation and at times well-developed rainforest offer abundant habitat opportunities for a wide range of common bird species within the Stockrington Conservation Estate. The occurrence of wetland habitat adjacent to dry and alluvial forests at Tank Paddock also offers a diverse suite of habitat opportunities for a wide range of bird species.

Key Habitat and Corridors

The Conservation Estates represent important components of a number of regional and sub-regional corridors, such that their integrity is important to fauna movements within the wider locality. The Stockrington Conservation Estate also represents areas of Key Habitat in the southwest and southeast with small areas also represented in the east and south as mapped within KHC. Locally the site has relatively unbroken linkages with lands to the north and northwest and tentative linkages to larger areas of vegetation broadly continuous with the Sugarloaf Range to the southwest. Vegetation within the site represents the most significant bushland linkages between forests to the south and remnant bushlands to its east across the F3 Freeway. Corridor mapping for the area is currently under review within the “Draft Western Corridor Planning Strategy”, although this work is limited to desktop assessments by the DoP of work already undertaken and results have not been released at the time of writing this report.

CONSERVATION OUTCOMES

The Lower Hunter Region’s vegetation is of bio-geographic significance as it supports a transition between the northern and southern plant and animal assemblages. This north-south link is not evident elsewhere in the Hunter Valley. The Region also forms an east-west migratory pathway and a drought refuge for inland species.

The preservation of large vegetated areas that are linked to other similar areas has been recognised as fundamentally important to achieving long term regional biodiversity outcomes in the Lower Hunter region. The two most valued of these areas in the Lower Hunter contain large land areas owned and controlled by Coal & Allied. The first is the green corridor that links the Watagans and Yengo National Parks with the coastal plains of the Tomago Sandbeds, Stockton Bight and Port Stephens and secondly, the Wallarah Peninsula lands provide a regionally significant break between urban areas, and contain areas of high biodiversity, scenic amenity and heritage value.

The Coal & Allied lands to be dedicated form both large areas of vegetation in their own right, and complete linkage of identified regional corridors in key areas.

In addition to their important strategic location in a wider landscape context, the Conservation

Estates contain valuable biodiversity resources. They contain and will conserve a range of important vegetation communities, including areas of Endangered Ecological Communities (EEC) and other vegetation types that have been depleted in the region. Several threatened plant species have been recorded within the Conservation Estates, including *Arthropteris palisotii, Tetratheca juncea* (Black-eyed Susan), *Grevillea parviflora* subsp. *parviflora*, *Eucalyptus nicholii, Rutidosis heterogama, Syzygium paniculatum* and *Callistemon linearifolius*. Two of the threatened flora species recorded in the Conservation Estates are considered to be planted specimens and not naturally occurring, being *Eucalyptus nicholii* and *Syzygium paniculatum*, although *S. paniculatum* may have been transported to its position in a disturbed area by natural means. In addition to these threatened species two rare (ROTAP) species *Callistemon shiressii* and *Eucalyptus fergusonii* subsp. *dorsiventralis* were also identified within the Conservation Estates.

The diverse nature of both the landform settings, varying from coastal ranges forests and woodlands to wetlands, provides a diverse array of habitats and resources for native fauna. The Conservation Estates are known to contain important populations of numerous threatened fauna species, including birds, mammals and herpetofauna. The conservation of these lands will provide secure regional biodiversity gene pools, and also through linkages facilitate valuable genetic material exchange and other key processes associated with sustainable ecological population dynamics.

In summary, the Coal & Allied conservation dedications provide outcomes that contribute to meeting the Environmental Protection goals outlined in the Sustainability Criteria contained within the Lower Hunter Regional Strategy. Such includes:

- Outcomes consistent with the Lower Hunter Regional Conservation Plan;
- Maintains/improves areas of regionally significant biodiversity;
- Maintains environmental areas for air & water quality; and
- Protects areas of Aboriginal cultural heritage value and historical heritage value.

These outcomes:

- Conserve in perpetuity key strategic parcels of land that complete long sought after regional biodiversity conservation corridors and buffer areas;
- Provide large intact areas of conserved habitat that will function as regional biodiversity gene pools;
- Protect an important array of vegetation communities, flora and fauna species, and natural landscape assets, including threatened species and EEC's and
- Contribute significantly to the successful implementation of the Lower Hunter Regional Conservation Plan.

CONCLUSION

This ecological inventory of the Stockrington and Tank Paddock Conservation Estates has been undertaken to support the Minmi/Link Rd and Black Hill Development Estates as part of the proposal for Coal & Allied surplus Northern Estates. The Stockrington and Tank Paddock Conservation Estates are an integral part of the Watagan to Stockton Corridor which will achieve regional conservation outcomes. Furthermore, suitable actions are proposed to minimise potentially deleterious permanent and ongoing impacts to the conservation lands.

The field and desktop studies have recorded the following parameters of ecological significance within the Conservation Estates:

- native vegetation commensurate with those listed as EEC's;
- threatened flora species recorded within and adjacent to the proposed development;
- threatened fauna species recorded within and adjacent to the proposed development;
- habitat for threatened flora and fauna species known from within and adjacent to the proposed development; and
- other areas containing native vegetation with varying degrees of modification / degradation.

The large areas of Conservation Estates at Stockrington and Tank Paddock that will be set aside as part of the proposed developments provide excellent ecological outcomes across the sites. The Stockrington Conservation Estate will contribute a large portion of land to conservation in perpetuity, which will in essence formalise the Watagan to Stockton Corridor. The importance of the conservation of Tank Paddock as part of the Conservation Estates will result in maintaining a vegetation corridor from Hexham Swamp and the Hunter Estuary to the Watagan Mountains and the Sugarloaf Range. This large tract of native vegetation will provide habitat for a wide variety of native flora and fauna.

Terms & Abbreviations

Abbreviation	Meaning
aff.	Affinity
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
Coal & Allied	Coal & Allied Industries Ltd
Conservation OR Offset Lands	Land proposed for dedication to NSW Government
Development Estate	Proposed Development Lands
DBH	Diameter (centimetres) at Breast Height
DECCW	NSW Department of Environment, Climate Change and Water
DEWHA	Commonwealth Department of Environment, Hertiage and the Arts
DGEAR's	Director General's Environmental Assessment Requirements
DoP	NSW Department of Planning
EAR	Ecological Assessment Report
EEC	Endangered Ecological Community
EIR	Ecological Inventory Report
EMP	Environmental Management Plan
EPA Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act1994*
ha	hectare
HBOC	Hunter Bird Observers Club
Hwy	Highway
LGA	Local Government Area
LHCCREMS	Lower Hunter and Central Coast Regional Biodiversity Strategy(NPWS 2000; House 2003)
LHRCP	Lower Hunter Regional Conservation Plan
LHRS	Lower Hunter Regional Strategy
NPWS	NSW National Parks and Wildlife Service
NSWG	NSW Government
PFC	Projected Foliage Cover
RPS	RPS Australia East Pty Ltd
ROTAP	Rare or Threatened Australian Plants (Briggs & Leigh 1995) ROTAP Codes are as follows:- 2 = Geographic Range in Australia is less than 100 km R = Rare C = Conserved - = Reserved population unknown
SEPP 14	State Environmental Planning Policy 14 "Coastal wetlands"
SEPP 44	State Environmental Planning Policy 44 "Koala Habitat Protection"
Ssp. or subsp.	Subspecies
Sp	Singular Species
Spp	Multiple Species
SSS	State Significant Site
TSC Act	NSW *Threatened Species Conservation Act 1995*
Var.	Variety

Contents

Figures

Tables

Appendices

APPENDIX 1

Flora Species List

APPENDIX 2

Fauna Species List

APPENDIX 3

Letter from Royal Botanical Gardens, Sydney

APPENDIX 4

Vegetation Communities Photographs

APPENDIX 5

Qualifications of Personnel

1 Introduction

RPS has been commissioned by Coal & Allied Industries Limited (Coal & Allied) to undertake an *Ecological Inventory Report* (EIR) over land within Stockrington and Tank Paddock, as a component of the Lower Hunter Lands Project where these lands will be utilised as conservation offsets for proposed greenfield developments at Minmi/Link Road and Black Hill as outlined within the Lower Hunter Regional Strategy. The proposal is to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. Due recognition and consideration of the *Threatened Species Conservation Act 1995*, *Environmental Protection, Biodiversity and Conservation Act 1999*, *Water Management Act 2000* and the *Fisheries Management Act 1994* have been made throughout this assessment.

This report specifically provides an inventory of the field investigation results made during this study as well as considering the results of studies undertaken in the immediate vicinity and other available information such as NSW NPWS Atlas data and Hunter Bird Observer Club (HBOC) records.

This *Ecological Inventory Report* aims to document the flora, fauna and habitat characteristics of the Conservation Estates. It is envisaged that the results of this study will supply detailed baseline data on the ecological characteristics of the Conservation Estate at Stockrington and Tank Paddock. This data will be utilised to assess the relative merits of the sites as conservation offsets and to inform the future end user management.

1.1 Background

Harper Somers O'Sullivan (2005) has previously undertaken Preliminary Vegetation Mapping over various holdings administered by Coal & Allied in the Lower Hunter Valley / Central Coast Region. This preliminary mapping was undertaken to provide a baseline dataset pertaining to the broad-scale distribution of ecological communities throughout the land holdings. This assessment was largely undertaken at a desktop level relying on aerial photography combined with existing regional mapping datasets and limited ground-truthing.

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At the state level, the proposal is to be assessed pursuant to Part 3A of the EPA Act. To this end, in August 2010, the DGEAR's were issued for the site. To ensure completeness, ecological fieldwork and assessment has covered the full extent of the Coal & Allied surplus lands, including all development and Conservation Estates.

1.2 Site Particulars

Locality – The site is on the eastern side of the F3 freeway to the north of Minmi and to the west of the F3 freeway which include lands surrounding Stockrington and George Booth Drive to the east of Mt Sugarloaf.

LGA – Cessnock City Council, Newcastle City Council and Lake Macquarie City Council.

Title(s) –
Stockrington –

83//DP755260	Part 71//DP1065169
84//DP755260	2//DP250339
8//DP755260	2//DP124209
51//DP1095513	1//DP155446
89//DP755260	1//DP503566
13//DP1078246	3//DP977096
72//DP755260	2//DP877416
125//DP755260	1//DP1039968
1//DP124209	9//DP1078246
83//DP755260	4//DP977096
84//DP755260	1//DP119630
8//DP755260	101//DP881099
51//DP1095513	Part 71//DP1065169
89//DP755260	2//DP250339
13//DP1078246	2//DP124209
72//DP755260	1//DP155446
125//DP755260	1//DP503566
1//DP124209	3//DP977096
1//DP119630	2//DP877416
4//DP977096	1//DP1039968
9//DP1078246	

Tank Paddock – Lot 1 DP 1007615

Area – The area of the Conservation Estate is approximately 2411 hectares.

Zoning – Stockrington – 1(a) Rural "A" Zone, 5(6) Special Uses (Railways) Zone, 7(2) Conservation (Secondary) and 5 Infrastructure
Tank Paddock – 7(b) Environmental Protection Zone.

Boundaries – The site is bounded to the North by the Black Hill and extends as far south as Seahampton. To the west by Mount Sugarloaf and to the north-east by Hexham Swamp and bounded by the F3 freeway to the south east, and Seahampton to the south.

Current Land Use – The majority of the site is natural bushland with weed infestations evident, particularly in the drainage lines and gullies. A quarry is currently being operated at Stockrington to extract gravel. The remainder of the site is criss crossed with various easements and unformed tracks which are illegally used by 4WD vehicles and Motorbikes.

Topography – The Conservation Estates occur across undulating topography ranging in elevation from 210m on the footslopes of Mt Sugarloaf to 10m in Blue Gum Creek. In the south the lands straddle the eastern foothills of the Sugarloaf Range and encompass the watersheds of south-western feeder creeks of the Hexham flood plain, including Blue Gum Creek. The lands to the north west flow into Surveyors Creek, while the land to the north flows into Buttai Creek. Both of these creeks are part of the Wallis Creek Catchment.

Soils and Geology - There are at least 10 different categories of soils across the site according to Soils Landscapes of the Newcastle region (Matthei 2005).

The majority of the soil across the site is classified as erosional soil landscape of Killingworth. This soil type is typical across the rolling hills around Minmi and Stockrington. This type of soil has low to very low fertility and high erosion potential. The topsoils of this classification are typically brownish black sand or silt loams and the subsoils are usually sand or silt clays. Other erosional soil landscapes which have been mapped by Matthei (2005) include Bolwarra Heights. The coalluival soil landscapes include Cedar Hill, Stockrington and Sugarloaf. Residual landscape of Beresfield has also been mapped within the conservation estate.

Surveyors Creek and Blue Gum Creek have been mapped as alluival soil landscapes of Wyong and Cockle Creek. The remainder of the conservation estate has been mapped as a mixture of Coalluival and Alluival soil Landscapes.

The majority of the Conservation is underlain by the Newcastle Coal Measures of Permian Age with the northern section including Tank Paddock underlain by the Tomago Coal Measures of Permian Age.

1.3 Description of the Proposal

It is proposed that the entire Coal & Allied owned Minmi/Link Road, Black Hill, Stockrington and Tank Paddock sites be rezoned/listed as a 'State Significant Site' (SSS) in Schedule 3 of State Environmental Planning Policy (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The development and conservation of the Coal & Allied land holdings in the Lower Hunter, has been collectively classified into 'Southern Lands' and 'Northern Lands' (Refer to Figure 1-1). The Northern Lands encompass the Minmi/Link Road and Black Hill Development Estates and the Stockrington and Tank Paddock Conservation Estates. Refer to Figure 1-2, Figure 1-3 and figure 1-4.

The Concept Plan for a residential subdivision of the Minmi/Link Road site will apply to the entire 525ha Minmi/Link Road and 1561ha Stockrington site. Similarly the entire 183ha Black Hill and the 545ha Stockrington/ Tank Paddock sites. The key environmental parameters for the proposed development of the sites are as follows:

- Dedication of 2,106ha of conservation land at Stockrington and Tank Paddock to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan.

It is proposed to dedicate land for conservation purposes as part of the Major Project Application via a Voluntary Planning Agreement (VPA) between Coal & Allied and the NSWG in accordance with s.93F of the Environmental Planning & Assessment Act, 1979 (EP&A Act). Notably the Conservation Estates are identified in the LHRCP prepared by the DECCW and make significant contributions toward meeting conservation goals indentified in the LHRCP. Refer to Figure 1-4.

1.4 Definitions

The definitions given below are relevant to the Director-General's requirements:

'development' has the same meaning as in the *NSW Environmental Planning and Assessment Act 1979.*

'activity' has the same meaning as in the *NSW Environmental Planning and Assessment Act 1979.*

'proposal' is the development, activity or action proposed. Other terminology used for the 'proposal' includes the **'current proposal'** or **'development proposal'**.

The **'Site'** refers to the entire land holding, inclusive of development and conservation areas.

The **'Development Estate'** refers to the area(s) scheduled for development.

The **'Conservation Estates'** refers to the area(s) scheduled for dedication to the NSW Government. Other terminology used for the 'Conservation Lands' includes the **'Offset Lands'** or **'Dedication Lands'.**

Due to the size and separation of land holdings proposed for development and conservation, they have been broken down into two distinct geographical components. As such the sites have been condensed into the '**Southern Lands'** and **'Northern Lands'**.

All other definitions are the same as those contained in the *NSW TSC Act, 1995*.

1.5 Qualifications & Licensing

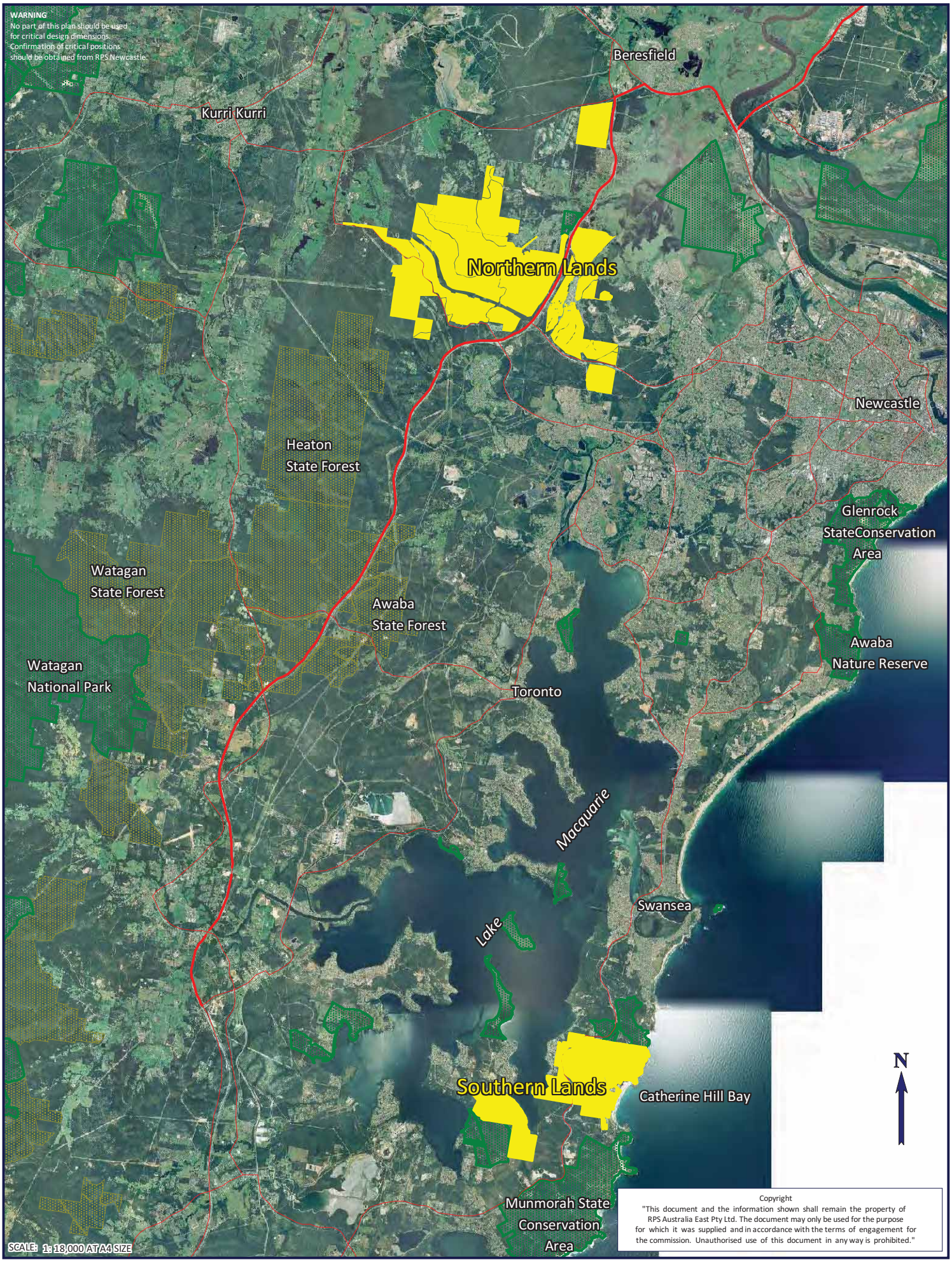
1.5.1 Qualifications

The principal author of this report was Matthew Doherty BLMC of RPS Pty Ltd, with additional input from Craig Anderson BAppSc (EAM), Deborah Landenberger BSc (Hons), Allan Richardson BEnvSc (Hons), Sam Bishop BEnvSc, Alex Saddington BAppSc, Shaun Corry DipCons&LndMgt, and Anna McConville BEnvSc. The academic qualifications and professional experience of all RPS ecologists involved in the project are documented in Appendix 5.

1.5.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2011);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).

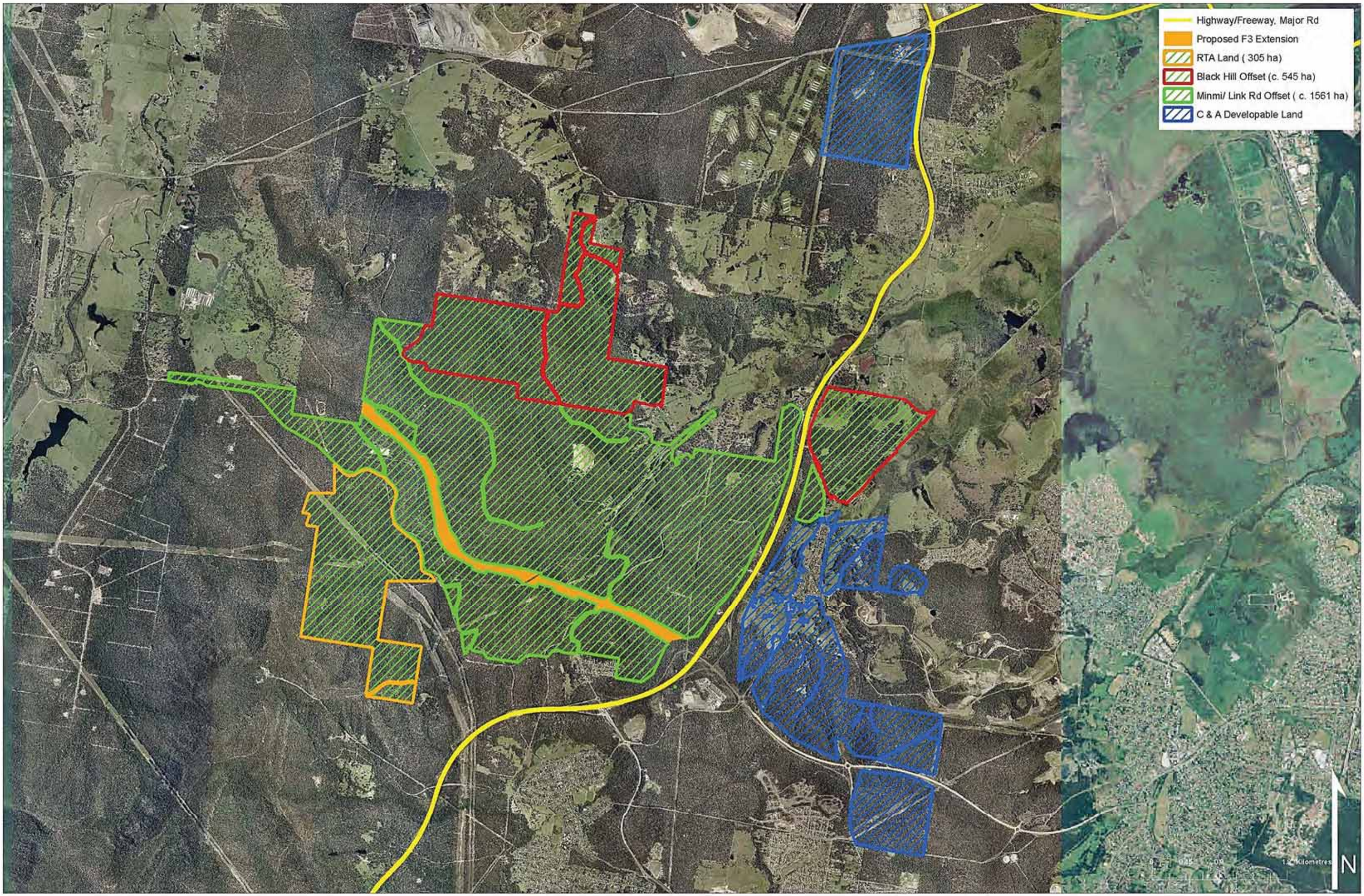


TITLE: FIGURE 1-1 COAL & ALLIED SURPLUS LANDS	LOCATION: HUNTER REGION	DATUM: N/A PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 7/02/2011 PURPOSE: EAR	LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting VERSION (PLAN BY): C (A.P-M.D)

CLIENT: COAL & ALLIED INDUSTRIES PTY LTD
JOB REF: 24530-2

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

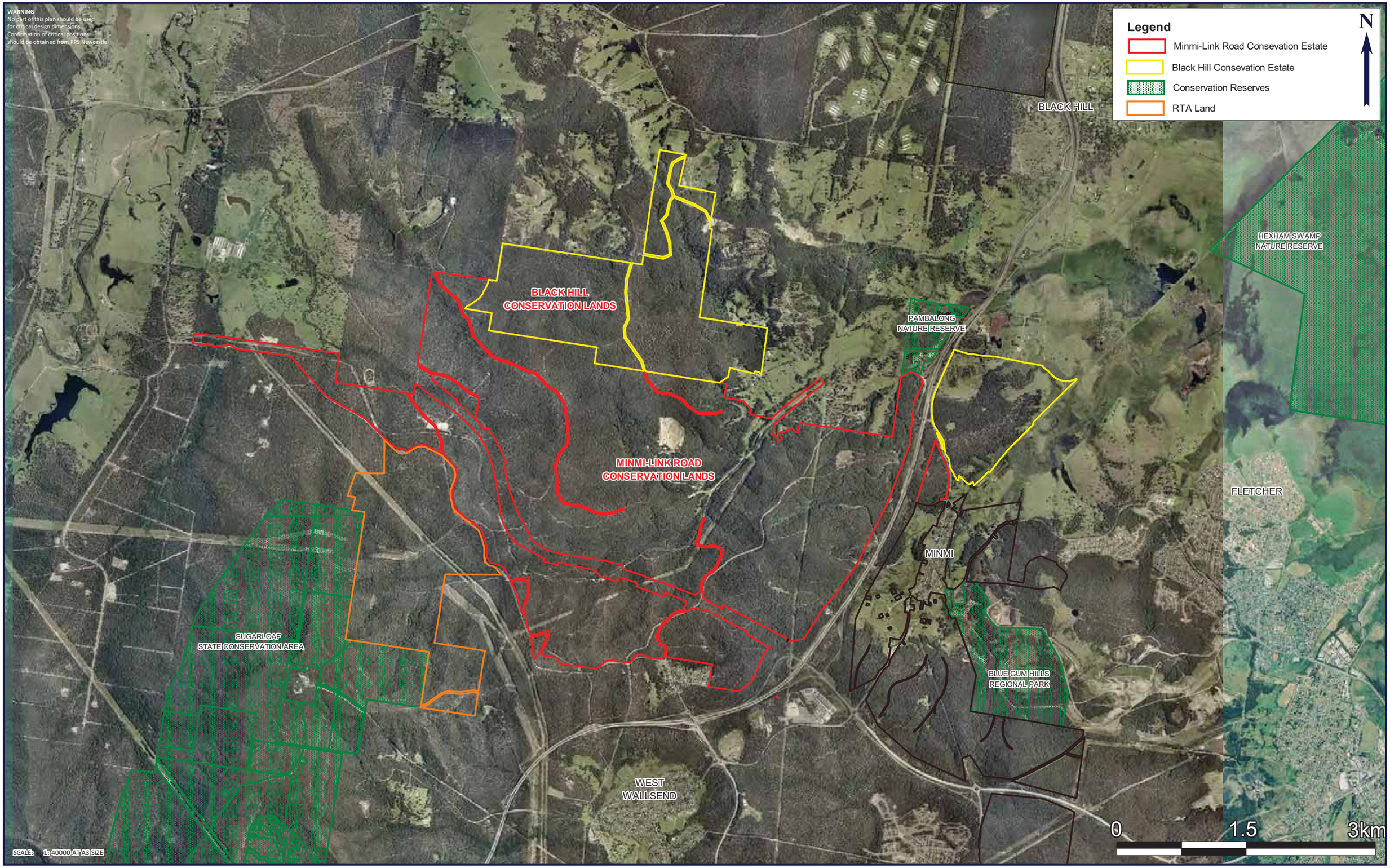
RPS



NORTHERN AREA- FINAL DEVELOPMENT AND CONSERVATION AREAS

COAL & ALLIED

urbis



TITLE: FIGURE 1-3 SITE LOCATION

LOCATION: CONSERVATION ESTATES

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 7/02/2011
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\Cons Estate\24530-2 Figure 1-3 Site Location D A3
VERSION (PLAN BY): D (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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WARNING
No part of this plan should be used
for critical design dimensions.
Confirmation of critical positions
should be obtained from RPS Newcastle.

Hawks Nest
Nelson Bay
Maitland
Raymond Terrace
Cessnock
Kurri Kurri
NORTHERN LANDS
Newcastle
Morisset
SOUTHERN LANDS

Important Wildlife Corridors
Main Towns
Local Government Areas
National Park Estate
State Forest Estate
Marine Park (Approximate Boundary)
State Forest FMZ 2 and 3a transfer to Flora Reserves

High Priority Conservation Lands
Private Land
Government Land (Lower Hunter Reservations Bill 2006)

N

SCALE: 1: 330000 AT A3 SIZE

TITLE: FIGURE 1-4 LOWER HUNTER REGIONAL CONSERVATION PLAN
LOCATION: HUNTER REGION
DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 7/02/2011
PURPOSE: EAR
24530\DRAFTING\ECOLOGY\SOUTHERN\ALLWORKSPACES
LAYOUT REF: 2010TEMPLATE\FIGURE 1-4 LHRCP 2010 C A3
VERSION (PLAN BY): C A3 (A.P-M.D)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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1.6 Sub-consultants, Personal Communications & Observations

1.6.1 Subconsultants

RPS used the following organisations during this study where appropriate input was required.

Plant Species Identification: (for *Callistemon linearifolius*)	Royal Botanic Gardens National Herbarium of NSW The Domain Mrs Macquaries Road SYDNEY NSW 2000 Ph: (02) 9231 8111
Hair and Scat Analysis	Barbara Triggs "Dead Finish" GENOA VIC 3981 Ph / Fax: (03) 5158 0445

1.6.2 Personal Observations

Relevant observations made by the authors or other RPS ecologists outside of the project or other published studies have been included within this report as 'personal observations' (pers. obs.).

1.6.3 Agency/ Group/ Organisation Consultation

The following agencies were consulted during the preparation of this EIR. Note this list is not comprehensive. For a full account of the consultation undertaken during the project (Charette) process, refer to the consultation section included within the wider EA submission.

DECCW (Lucas Grenadier)	NPWS (Tom Bagnat)
WSC (Deb McKenzie)	LMCC (Robbie Economos/Greg Gilles)
Hunter-Central Rivers CMA	Green Corridor Coalition (Brian Purdue)
Lake Macquarie Coastal and Wetlands Alliance	The Newcastle Wilderness Society
Department of Primary Industries	Hunter Environment Lobby

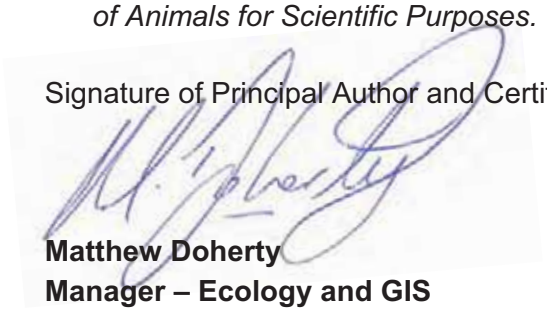
1.7 Certification

As the principal author, I, Matthew Doherty make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the site;

- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995, National Parks and Wildlife Act 1974* and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.*

Signature of Principal Author and Certifier:



Matthew Doherty
Manager – Ecology and GIS
RPS
January 2011

2 Methods

The DGEARs stipulate assessment should have due regard to DEC Threatened Species Assessment Guidelines. These guidelines refer the user to consult the Threatened Biodiversity Survey and Assessment Guidelines – Working Draft (DECC 2004) and any relevant recovery plans and threat abatement plans for ecological assessment. To this end these documents have formed the core basis for the adopted ecological assessment methodology over the site.

For the purposes of continuity and to best represent a holistic survey approach, the regional guidelines considered as part of the combined survey design and efforts are as follows:

- The Flora and Fauna Survey Guidelines, Lower Hunter Central Coast Region (Murray et al 2002);
- The Flora and Fauna Survey Guidelines of the Lake Macquarie Local Government Area (July 2001); and
- Wyong Ground Orchid Survey Wyong Shire (Gunninah Environmental Consultants, 2003).

The methodology employed to survey the proposed Conservation Estates does not strictly comply with DECCW Biodiversity Survey Guidelines. However, the vegetation mapping was to provide baseline knowledge pertaining to the broad scale distribution of ecological communities throughout these proposed conservation areas. This mapping has been based upon both aerial photograph interpretation and ground truthing. The ground truthing involved random meanders and driving over the site for approximately 6 days. The survey effort then consisted of detailed quadrats to sample the vegetation and provide data for non-parametric statistical analysis (PATN). This data was used within cluster analysis to assist in the delineation of the vegetation communities.

The fauna assessments consisted of mainly habitat assessment and opportunistic surveys throughout the Conservation Estate. No trapping was undertaken within the Conservation Estate. Targeted Swift Parrot surveys were undertaken with the Conservation Estates. This survey effort was performed due to the strategic location of this portion for a native corridor which links Hexham Swamp to the proposed Conservation Estates to the west of Tank Paddock.

2.1 Preliminary (Desktop) Assessments

Preliminary assessments drew on a number of information sources including previous preliminary reporting and information held on government databases and archives. It must be noted here that the EcoBiological (2006) mapping was groundtruthed whilst performing the current survey. RPS HSO generally concurred with the majority of the mapping performed by EcoBiological, however some minor changes have been made

which on groundtruthing were considered to differ from that of the previous mapping. This mapping was then used in the final vegetation mapping for this project.

Data gathered during preliminary assessments was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. The preliminary assessment utilised a number of other additional information sources, including:

- Vegetation Assessment Report, Harper Somers O'Sullivan (2005);
- Phase One Ecological Constraints Investigations RPS HSO (2007);
- Aerial Photograph Interpretation (API) and literature reviews to determine the broad categorisation of vegetation within the site;
- Review of fauna and flora records contained in the DECCW Wildlife Atlas (Accessed January 2010);
- Literature reviews;
- LHCCREMS – Vegetation Survey, Classification and Mapping. (NPWS 2000, House 2003);
- Hunter Bird Observers Club (HBOC) records;
- Birdata (web version of Birds Australia's New Atlas of Australian Birds);
- A review of GIS data including aerial photography, topographic maps, SEPP 14 Wetland Mapping, Soil Landscapes, Acid Sulphate Soil Potential;
- DECCW database of Threatened Species, Populations and Ecological Communities (website);
- DEWHA *EPBC Act 1999* Protected Matters Search; and
- Collective knowledge gained from extensive work in the area.

2.2 Flora Assessment

2.2.1 Flora Stratification Units

Stratification of the site was undertaken based on interpretation of Phase 1 base data, API and previous field inspections along with consideration of biophysical, vegetation structure, soil type and floristic boundaries. The DECCW Flora Survey Guidelines were consulted to determine survey requirements for large sites. These guidelines suggest that area should be initially stratified on biophysical attributes (e.g. soil, geology) followed by vegetation structure (e.g. Woodland, Forest, Shrubland) and then floristics i.e. species. Within the Northern Proposed Conservation Estates, five vegetation structures of Subtropical Rainforest, Dry Open Forest, Coastal Wet Sclerophyll Forest, cleared/weeds and Freshwater Wetlands exist. While groundtruthing was ongoing, amendments were made and thus some stratification units were dismissed as not occurring within the site and some new units were identified. Amendments to the survey effort were based on the area of the vegetation communities and thus when new vegetation communities were

delineated extra survey effort in the form of extended random meanders to determine the edge of vegetation communities were conducted.

2.2.2 Preliminary Vegetation Mapping

A variety of field survey techniques were employed over the course of fieldwork for this assessment to target the full suite of flora species and fauna guilds across the site. Nomenclature and classification of delineated vegetation communities followed the LHCCREMS Vegetation Community Mapping (NPWS 2000: House 2003) wherever those communities were commensurate with those encompassed by LHCCREMS mapping.

Vegetation Mapping

Flora surveys and vegetation mapping carried out on the site has been undertaken as follows:

- API to map the community(s) extent into definable map units;
- Confirmation of the community type(s) present (dominant species) via the undertaking of detailed flora surveys and identification;
- Review of previous preliminary environmental studies conducted by HSO (2005) and RPS HSO (2007);
- Review of the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) Vegetation Mapping (NPWS 2000: House 2003) for the site and surrounding areas;
- The conservation status of the derived vegetation communities was considered in light of the findings of the LHCCREMS Vegetation Mapping (2003);
- Vehicle reconnaissance was carried out over most of the area on all the unformed tracks within the Conservation Estates. Notes on the distribution of the vegetation community assemblages were taken during these general traverses.
- Flora surveys were carried out the majority of the site, with an emphasis on potentially significant species. Over 100 flora quadrats 20m X 20m and five 100m Transects (Figure 2-1) were performed in the Conservation Estate. The general flora survey involved Random Meanders in line with methodology termed as the “Random Meander Technique” by Cropper (1993). Over 29 km of random meanders were undertaken on foot (Figure 2-2).
- Map the type and general extent of the community(s) present into definable map units where appropriate;
- Assessment of the potential for the derived vegetation communities to constitute EEC’s as listed within the *TSC Act (1995*) and the *EPBC Act (1999)* was also undertaken. The floristic composition, geomorphological characters and geographic distribution were considered when determining whether an EEC was present; and
- Vegetation mapping was mapped utilising a combination of the PATN Analysis, API and groundtruthing.

2.2.3 Plant Identification

During this survey when a plant could not be identified accurately within the field, a voucher sample was collected, together with notes on habitat, form and height, labelled and identified according to nomenclature in Harden (1992 – 2002). Opportunistic sightings of taxa were also collected if they were not found in any of the sampled sites. At a minimum, all dominant species were identified in all stratums to ensure that an informed delineation resulted. All flora species recorded are documented in Appendix 1.

Voucher specimens were forwarded to Royal Botanical Gardens, Sydney, for verification of potential threatened flora species considered as difficult to separate from common flora species.

2.2.4 Data Recording

Site location and any threatened species were recorded in eastings and northings using Map Grid of Australia (GDA 94) Zone 56 co-ordinated system on a Trimble GEO XH GPS, which has sub-metre accuracy following post-processing.

2.2.5 Landform and Geophysical Information

Topographic information was collected along with measurements of altitude, slope and aspect. Slope was determined from a slope map, which was derived from 2m contours for the entire site. Aspect was measured using a Sunto compass with reference to magnetic north. Information on geology, soils, fire and other disturbances were collected on NPWS survey data sheets. Site location was recorded in eastings and northings using Map Grid of Australia Zone 56 (GDA 94) co-ordinated system on a Trimble GEO XH GPS, which has sub-metre accuracy following post-processing.

2.2.6 Floristic Structure Information

Vegetation structure was determined based on Specht *et al,* (1995) by estimation of the height and PFC within each stratum present. Individual taxon data for each quadrat/transect was recorded using the NPWS species data forms. Species abundances were recorded utilising a modified Braun-Blanquet (1982) cover abundance six ranking scale as follows:

Cover Code	Projected Canopy Cover
1	<5% and uncommon
2	<5% and common
3	6-20%
4	21-50%
5	51-75%
6	76-100%

2.2.7 Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included, threatened species (Endangered or Vulnerable) and EEC listed under the *TSC Act (1995)*, those species listed on the *EPBC Act (1999),* ROTAP listed

flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance.

No targeted searches were undertaken of threatened flora species within the proposed Conservation Estates. However, when threatened species were found, the extent of the population within the vicinity was mapped using a Trimble Geo XH GPS system.

2.2.8 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDE's) is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). Identification of GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the vegetation communities which are located in drainage depression, swamps and creeklines, where groundwater comes up to the surface. An assessment of whether GDE's occur within the Conservation Estates has been made within this EIR.

The NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002) and Groundwater Dependent Ecosystems Assessment, Registration and Scheduling of High Priority (DWE 2006) were consulted to determine if any GDE's are present within the Conservation Estates and to classify them according to these policies.

There are differing types of Groundwater Systems (DLWC, 2002) these include:-

1. Deep Alluvial Groundwater Systems;
2. Shallow Alluvial Groundwater Systems;
3. Fractured Rock Groundwater Systems;
4. Coastal Sand Bed Groundwater Systems; and
5. Sedimentary Rock Groundwater Systems.

Three of these types of groundwater systems have the potential to occur in the Hunter region and these include Shallow Alluvial, Coastal Sand Bed and Sedimentary Rock Groundwater Systems. The most likely system to occur within the Conservation Estates would be Shallow Alluvial Groundwater System and thus soil mapping is important in assessing the potential for the presence of groundwater aquifers. Therefore, the soil mapping of Newcastle (Matthei, 1995) was consulted to determine the boundaries of alluvial soil mapping within the Conservation Estates.

2.2.9 Data Analysis

Vegetation data was collected from a total of 107 quadrats within the entire Northern Lands. A total of six quadrats were located within Black Hill Development Estate and 39 of these quadrats were located within the Minmi/Link Road Development Estate. The remaining 62 quadrats were sampled within the Conservation Estates at Tank Paddock and Stockrington. Agglomerative cluster analysis of the vegetation data collected was performed using the PATN Statistical Analysis Package Ver. 3.11 (Belbin 2006), to assist in the delineation of the vegetation communities across the Northern Lands. This statistical program has been used in previous large vegetation surveys in the region (Bell

2002, Bell 2004, Hill 2003, NPWS 2000 & Peake 2006). Cluster analysis groups objects that are similar to one another. In the case of vegetation community analysis this statistical tool groups communities based on their similarity of plant species recorded.

Cluster analysis groups objects (in this case survey sites) together by way of an assessment of the association between data pairs. PATN provides several association measures which are applicable to different types of data. For the data collected within the Northern Lands, both the Bray Curtis and Kulzcynski association measures were explored on the data with the default PATN settings. Belbin (2003) suggests that the Bray Curtis association measure is most appropriate where matches between higher values are more significant than matches between lower values and this would suggest that this measure is the most appropriate for abundance data. An unweighted pair-group arithmetic averaging (UPGMA) clustering strategy was applied to both association matrices with a default beta value of -0.1.

Dendrograms were produced using both association measures, with the Bray Curtis analysis giving clearer delineation of the vegetation communities present. Thus this methodology was employed for the dendrograms and further analysis of vegetation delineation. Exotic species were removed from the analysis to refine the delineations and give a clear idea of the native vegetation communities present. A two-step analysis was then performed upon the data using the species as variables and the quadrats as objects, to detect noisy and outlier variables (as recommended by Belbin 2008, Marine Community Example). Box Whisker were also produced which are plots which graphically display of the ability of a specific variable to discriminate between groups, this analysis also gives a Kruskal-Wallis statistic for each variable (this statistic is a non-parametric version of the f-ratio (Belbin, 2006, PATN ver. 3.11 help)). A two way table was produced and this table assisted in the analysis of which species were dominant in the different variants of the vegetation communities produced.

The data was transposed and using the quadrats as variables and the species as objects, the Two-step analysis was performed and noisy quadrats with a low KW statistic (<0.1) were also removed from the analysis. Three quadrats were identified as noisy and were removed from the analyses, these quadrats were placed in highly disturbed areas in which little natives were present and were not representative of the vegetation. Two were in the Alluival Tall Moist Forest and had severe weed infestations, with the remaining quadrat was located in Coastal Foothills Spotted Gum Ironbark Forest which had been recently subjected to a severe fire. Removal of these quadrats and species did not alter the analysis significantly; however' it did help to clearly delineate the vegetation communities.

The number of groups which is to be determined from the Dendrogram can be based on the point at which a levelling of scree plot of dissimilarity and number of fusion points occur. At this levelling point many clusters are formed at essentially the same linkage distance. Thus row fusion points were exported from PATN and plotted to assist in determining the cut off point for delineation of the vegetation communities.

The Freshwater Wetland Complex was not included within the data as it is clearly distinct from the dry sclerophyll and wet sclerophyll forests that occur elsewhere within the site.

Moreover, quadrats are difficult to perform within this type of vegetation community. In addition, quadrats were not performed within the Weeds and cleared areas or the Dams vegetation communities. Sampling was undertaken by opportunistic survey and random meanders for these vegetation communities.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Legend

- Development Estate
- Conservation Estate
- RTA Land
- Quadrat

N

Q-84 Q-95 Q-92 Q-88 Q-89 Q-97 Q-96 Q-87 Q-93 Q-62 Q-90 Q-56 Q-86 Q-94 Q-61 Q-83 Q-85 Q-106 Q-102 Q-63 Q-98 Q-79 Q-105 Q-103 Q-54 Q-101 Q-48 Q-82 Q-80 Q-81 Q-100 Q-104 Q-99 Q-78 Q-68 Q-77 Q-72 Q-73 Q-69 Q-70 Q-71 Q-75 Q-76

Q30 Q25 Q26 Q27 Q29 Q28 Q19 Q31 Q-47 Q18 Q37 Q32 Q34 Q33 Q35 Q36 Q9 Q17 Q-52 Q6 Q8 Q7

0 1 2km

SCALE: 1:30000 AT A3 SIZE

TITLE: FIGURE 2-1 FLORA SURVEY LOCATIONS
LOCATION: CONSERVATION ESTATES
DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 7/02/2011
PURPOSE: EAR
LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\Cons Estate\ 24530-2 Figure 2-1 Flora Survey Locations D A3
VERSION (PLAN BY): D (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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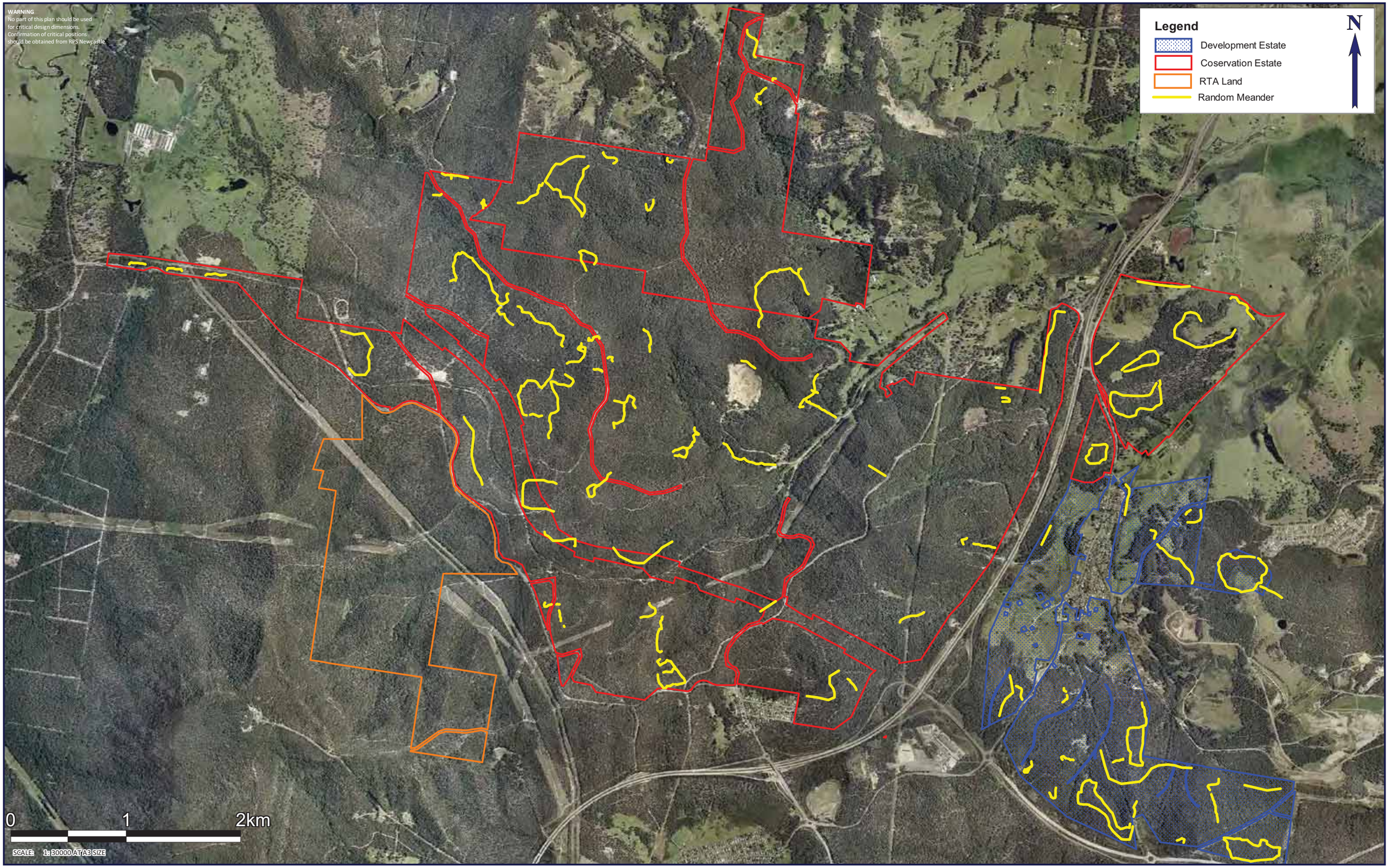

TITLE: FIGURE 2-2 RANDOM MEANDER SURVEY LOCATION

LOCATION: CONSERVATION ESTATES

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 7/02/2011
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24K\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\Cons Estate\24530-2 Figure 2-2 Random Menader Locations D A3
VERSION (PLAN BY): D (A.P-M.N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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2.3 Fauna Assessment

The fauna survey methodology initially consisted of the production of an Expected Fauna Species List for the area (Appendix 2) and an assessment of the potential use of the site by threatened fauna species (as listed under the *TSC Act 1995* and *EPBC Act 1999*) identified from the vicinity of the site. This was achieved by undertaking literature and database reviews followed by confirmation through habitat assessment and the known movements, distribution and habitat requirements of threatened fauna species recorded from the wider locality. Additional species observed were also noted on the list. Furthermore, those species not occurring within fauna record databases, but for which potential habitat exists within the site have been assessed.

Diurnal Birds

Incidental bird observations were made and bird habitat assessments were undertaken across the entire site during the delineation of vegetation communities and targeted threatened flora searches. Particular note was taken of habitat quality based on structural complexity, community age cohort and evidence of successional growth patterns. Habitat quality attributes were used to inform assessment of site suitability for those potential avifauna species that were not detected due to seasonal movements, cryptic or secretive habits or general scarcity.

Habitat assessment included targeted searches for habitat attributes used by threatened species listed as having potential to occur within the site, including the seasonally occurring Swift Parrot and Regent Honeyeater. Targeted searches for Glossy Black Cockatoo were undertaken, including searches for chewed (*Allocasuarina*) cones indicative of past feeding by this species.

For diurnal surveys, emphasis was placed on peak activity periods, i.e. dawn and dusk, to maximise the chances of species encountered. Birds were identified by direct observation, by recognition of calls or distinctive features such as nests, feathers etc. Furthermore, whenever other survey work was conducted, during both diurnal and nocturnal day periods, opportunistic observations of those bird species encountered were recorded.

Nocturnal Birds

Incidental forest owl searches were conducted and habitat assessment was undertaken across the entire site during the delineation of vegetation communities and targeted threatened flora searches. Particular note was taken of habitat quality based on structural complexity, community age cohort and evidence of successional growth patterns. Other targeted habitat attributes included mature trees containing hollows, which may represent nesting opportunities for forest owl prey species or breeding opportunities for forest owls. Understorey strata densities were also assessed for their potential to represent potential habitat for terrestrial mammals, which are the favoured prey guild of some forest owl species.

Targeted Swift Parrot Surveys

Swift Parrot surveys were undertaken within proposed Conservation Estates and Development Estates over two days during July 2008. The survey period coincided with known Swift Parrot movements into south-eastern Australia. Surveys encompassed two different methodologies to ensure adequate coverage of potential Swift Parrot habitat was made, and included:

Targeting of small discrete vegetation community areas containing potential foraging species, such as occur in riparian zones; and

Driving through more widespread foraging habitat to locate indicators (foraging aggregations of honeyeaters / lorikeets or the presence of blossom) that specific areas may have the potential to attract Swift Parrots during the current season.

As survey effort was limited to one part of the potential Swift Parrot season, habitat evaluation was also undertaken to determine where the most favourable areas of potential Swift Parrot habitat might occur across the Coal & Allied Lands.

Arboreal and Terrestrial Mammals

Incidental observations and habitat assessments for arboreal and terrestrial mammal species were undertaken across the entire proposed Conservation Estates during ecological surveys. Key habitat attributes targeted during ecological surveys, were structural complexity of vegetation communities, incidence of hollow-bearing trees, presence of blossom-producing trees and shrubs and levels of understorey forest debris.

The potential presence of Koala was assessed through the identification of potential Koala food trees, followed by inspection for signs of Koala usage. Trees were inspected for the presence of Koalas, characteristic scratch and claw marks on the trunk and scats around the base of each tree.

Opportunistic sightings of potential secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were sought. Such indicators included:

Distinctive scats left by mammals. Any scats unable to be positively identified in the field were collected for further analysis, and scats of predator species containing fur / bones were sent for analysis if appropriate;

Scratch marks made by various types of arboreal animals;

Scats consistent with Koalas; and

Feeding scars on *Eucalyptus* trees made by Gliders.

Any other incidental observations of fauna were recorded during all phases of fieldwork.

Microchiropteran Bats

Habitat assessment of the entire site was conducted during vegetation surveys to assess the suitability of proposed Conservation Estates to contain habitat for Microchiropteran bat species. Targeted habitat attributes included the incidence of caves and man-made structures, which may be suitable roosting habitat for cave-dwelling species, hollow-bearing trees, pools, dams, watercourses and structural complexity of onsite vegetation communities as an indication of niche diversity and foraging opportunities.

Megachiropteran Bats

Habitat for these species, specifically the Grey-headed Flying Fox, was assessed by the incidence of blossom-producing and fruit-bearing tree species. Opportunistic searches were also conducted for roosting camps within the site's gullies.

Herpetofauna

Opportunistic Herpetofauna (frog and reptile) searches were carried out and habitat assessments were conducted during vegetation surveys across the site. Habitat attributes targeted during habitat assessment, included ephemeral watercourses, pools, dams, poorly draining hillsides and wetland habitats for amphibian species and understorey forest debris levels, rocky outcrops, understorey complexity and densities were noted with regard to potential reptile habitat.

2.4 Habitat Assessment

An assessment of the relative value of the habitat present on the Conservation Estate was carried out. This assessment focused primarily on the identification of specific habitat types and resources on the site favoured by known threatened species from the region.

Key features assessed for flora habitat included vegetation type and stratification, soil type, depth and drainage, landform pattern, aspect and past disturbance including fire regime. Habitat key features assessed for fauna type at each survey point included hollow bearing tree density, feed tree density, diversity and density of Proteaceae species, Eucalypt diversity, vegetation strata number and density of dead wood debris across the ground as outlined in Table 2-1 below. The assessment also considered the potential value of the site (and surrounds) for all major guilds of native flora and fauna.

Table 2-1: Ecological / Environmental Attributes Collected within Flora Survey Points

Feature	Variables	Value
Hollow Bearing Tree Density	Low Density Moderate Density High Density	Determine the density and distribution of denning and roosting habitat for native fauna species across the site.
Eucalypt diversity	Low Density Moderate Density High Density	Determine the diversity of Eucalypt feeding opportunities for native fauna species across the site.
Allocasuarina sp.	Low Density Moderate Density High Density	Determine the density and distribution of this habitat resource across the site, particularly as a forage plant species for Glossy Black-Cockatoo.
Proteaceae sp.	Low Density Moderate Density High Density	Determine the density and diversity of Proteaceae species across the site, as an indicator of winter foraging resources for threatened arboreal mammals, such as the Squirrel Glider and potentially the Pygmy Possum.
Structural Diversity	Low (1 layer) Moderate (2 layers) High (3+ layers)	A measure of habitat quality across the site, particularly as an indicator of microhabitat diversity and niche opportunity for bird species, potential threatened terrestrial mammals and the prey species of forest owls.
Fallen Timber	Low (few or none) Moderate (scattered) High (intact)	A measure of habitat quality across the site, particularly as an indicator of microhabitat diversity and niche opportunity for bird species, potential threatened terrestrial mammals and the prey species of forest owls.

The assessment was also based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

2.5 Survey Dates, Type and Prevailing Conditions

The following Table 2-2 depicts the dates, survey type and prevailing weather during the ecological investigations conducted during the survey period.

Table 2-2: Survey Dates, Types and Prevailing Weather

DATE	SURVEY TYPE	WEATHER					
				Sun		Moon	
		Temperature ^{0}C	Rain (24 hrs to 9:00am)	Rise	Set	Rise	Set
Vegetation Surveys							
26/06/08	Vegetation community identification and classification	11 - 15	0 mm	6:56	16:55	-----	11:19
27/06/08		5 - 18	0mm	6:44	16:44	-----	11:48
30/06/08		5 - 22	0mm	6:56	16:57	3:39	13:19
01/07/08		12 - 20	0mm	6:56	16:57	4:47	14:39
02/07/08		11 - 18	0mm	6:56	16:58	5:58	15:45
03/07/08		6 - 18	0mm	6:56	16:58	7:01	16:57
04/07/08		5 - 17	0mm	6:56	16:58	7:54	18:11
07/07/08		7 - 20	0mm	6:56	17:00	9:44	21:34
08/07/08		10 - 18	0mm	6:56	17:00	10:13	22:35
09/07/08	Flora Quadrats	5 - 14	3.6mm	6:55	17:01	10:39	23:34
10/07/08		8 - 15	0mm	6:55	17:01	11:06	-----
11/07/08		7 - 15	0mm	6:55	17:02	11:34	00:32
16/07/08		5 -19	0mm	6:53	17:05	14:59	5:15
17/07/08		4 - 18	0.2mm	6:53	17:05	15:55	6:03
18/07/08		5 - 20	0mm	6:52	17:06	16:55	6:46
Fauna Surveys							
Incidental fauna surveys/ habitat assessment were conducted during vegetation surveys as listed above.							
16/07/08	Swift Parrot Surveys	12 – 18	0mm	6:53	17:05	14:59	5:15
17/07/08		20 – 33	0.2mm	6:53	17:05	15:55	6:03

Source:
Australian Government – Geoscience Australia [http://www.ga.gov.au/geodesy/astro/.jsp]
National Rainfall and Temperature Map Archives [http://www.bom.gov.au/silo/products/ClimMaps.shtml]

2.6 Limitations

Limitations associated with the EIR are presented herewith. The limitations have been taken into account throughout this assessment specifically in relation to threatened species assessments, results and conclusions.

In these instances, a precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic inventory.

Seasonality

Timing limitations are always encountered during ecological assessment surveys due to the seasonal variations across the broad spectrum of flora and fauna species to be studied. Preliminary surveys were carried out during March, targeted searches for threatened flora and fauna were undertaken during September, November and January. As such there was less survey work undertaken during times when certain migratory bird or bat species would have a higher probability for presence on the site and when some

reptile and amphibian species might exhibit greater activity.

Most notably, several threatened flora species, particularly cryptic orchids, should be surveyed within their respective flowering periods. Several of the threatened orchids, which have potential habitat, could not be comprehensively surveyed to provide information on whether they occur within the site. Therefore, these threatened orchids cannot be discounted as occurring within the site.

The flowering and fruiting plant species that attract some nomadic or migratory threatened species, often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened species fail. As a consequence threatened species may be absent from some areas where potential habitat exists for extended periods and this might be the case for the above-mentioned species. Again, this has been taken into account in the habitat assessment phase, although ongoing surveys, conducted during a range of seasonal periods, are designed to elucidate any potential significance the Coal & Allied lands might represent for seasonal species.

In addition, the seasonality of the surveys also places limits on the number of flora species identified in the site as the optimum time to survey would be throughout Spring and Summer when the majority of flora species flower.

Data Availability & Accuracy

The collated threatened flora and fauna species records provided by the NPWS for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. For the purposes of this assessment this information has been considered to have an accuracy of ± 1km.

Threatened flora and fauna records within the region were predominantly sourced from the DECCW Atlas of Wildlife Database and a DEWHA Protected Matters Search. Other sources such as Birdata and HBOC were also utilised. Similar limitations are known to exist with regards to these data sources and their accuracy.

Note: Data recorded by RPS HSO during the survey period, has been undertaken with a Trimble GeoXH GPS unit, which is capable of sub-metre accuracy following post processing.

Access

The survey was limited by access and size of the Conservation Estate; in some areas the topography or density of flora (i.e. *Lantana camara* tangles) restricted access to some parts of the Conservation Estate. Furthermore, some of the tracks have been severely degraded or blocked off by fallen timber.

Fauna

Fauna survey effort varied according to the standards set within the DECCW Biodiversity Survey Guidelines due to the following reasons:

- Seasonal constraints as outlined above.
- Diurnal Birds - Habitat assessment and previous records and reporting were used to determine the probability of site use. Bird census surveys outlined in the aforementioned methods in combination with opportunistic surveys conducted during other fieldwork were considered as representing a wider and more thorough coverage of the site than short periods over limited transects. Survey coverage was determined by stratification units designed to represent other fauna guilds and flora surveys. Survey of seasonally occurring threatened species, including Swift Parrot and Regent Honeyeater was limited to two days. However, the site was assessed for its potential to support these species by the presence / absence of winter-flowering *Eucalyptus* species and known habitat preferences elsewhere in the region.
- Habitat assessment was utilised where survey effort was less than recommended for particular fauna guilds such as arboreal mammals and nocturnal birds.

Despite the apparent deficiencies, suitable coverage of the site is considered to have been accomplished, particularly as potential occurrences of likely species is assumed (precautionary approach) in light of habitat assessment, previous local records, seasonality deficiencies, the known movements of locally occurring threatened species and the combined authors local knowledge and experience.

3 Results

3.1 Flora

A total of 516 flora species were identified during the survey period over the Conservation Estates within the quadrats, transects and random meander surveys. A complete list of the flora species identified is provided in Appendix 1 of this report.

3.1.1 Vegetation Community Delineation

Vegetation communities have been delineated via the methods outlined within Section 3. Following the initial field surveys and mapping, subsequent statistical analysis was employed to qualify and test the results.

A scree plot, Figure 3-1 shows the dissimilarity against groups in which it shows the point of inflection at 0.70 dissimilarity level. Therefore 15 groups have been recognised by the non-parametric statistical analysis (PATN Ver. 3.11, Belbin 2006). However, the data levels off at 0.72 dissimilarity showing 9 groups. These nine groups are supported by ground truthing with nine vegetation communities being delineated.

Figure 3-2 includes the Dendrogram produced by the PATN program (Ver. 3.11, Belbin 2006), which indicates the floristic relationships between the vegetation communities. A combination of statistical analysis and groundtruthing has delineated nine vegetation communities within both the Conservation Estates and the Development Estates. Extensive survey effort of over 100 quadrats was used within the statistical analyses. A clear delineation is shown between the dry sclerophyll and wet sclerophyll forests within the northern lands. However, several variants of these vegetation communities were delineated at a lower level of dissimilarity and are shown in the Dendrogram of the site (Figure 3-2). When taking into consideration the variants there are 15 which correspond to the scree plot. Therefore as a result of groundtruthing and statistical analysis 9 vegetation communities have been delineated within the Northern Lands (this includes both the Conservation Lands and the development estates of Minmi/Link Rd and Black Hill), with some communities containing several variants. These variants are described within the description of the individual communities. It must be noted that the variants are not defined vegetation communities in their own right but floristic variation does occur throughout the community. These have not been mapped due to the time constraints imposed on this project and in any case are not necessary as they do not assist the assessment of conservation significance of any of these communities to any further significant degree.

The PATN analysis did not delineate between two the community of Swamp Oak Rushland Forest or Swamp Mahogany Paperbark Forest and this is due to low sampling in these communities (1 quadrat each) as these communities occurred in Tank Paddock in small areas (<1ha).

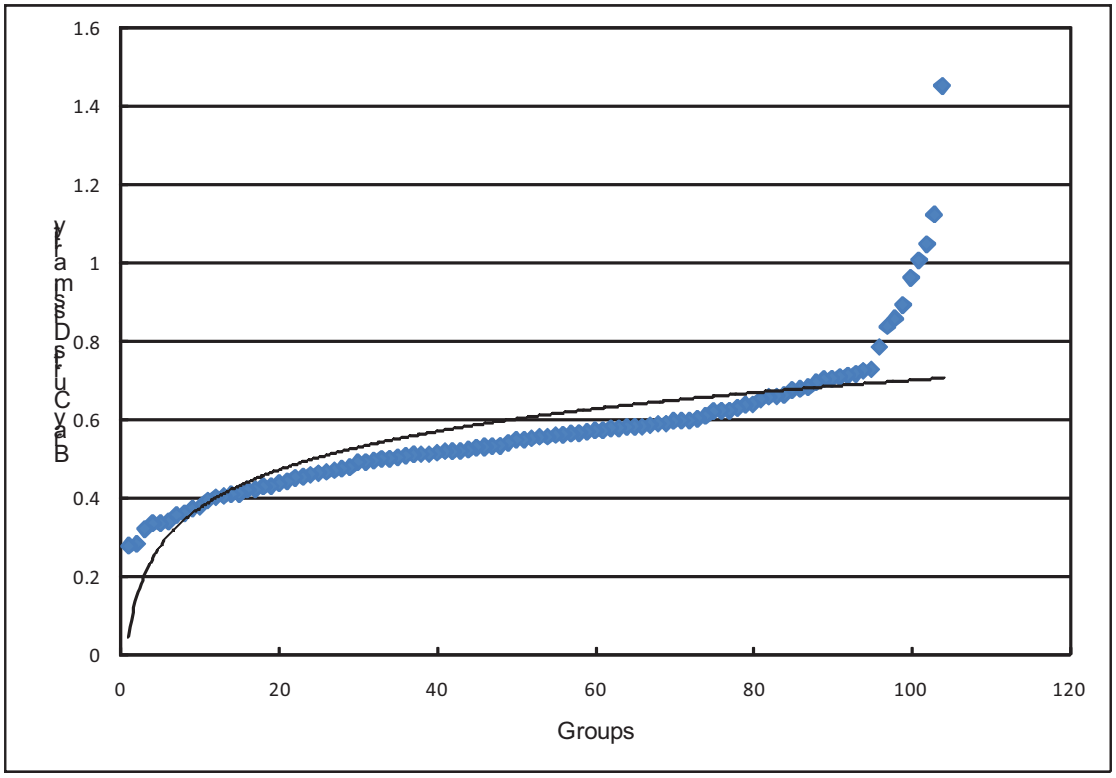


Figure 3-1: Scree Plot of Bray Curtis Association Measure Results

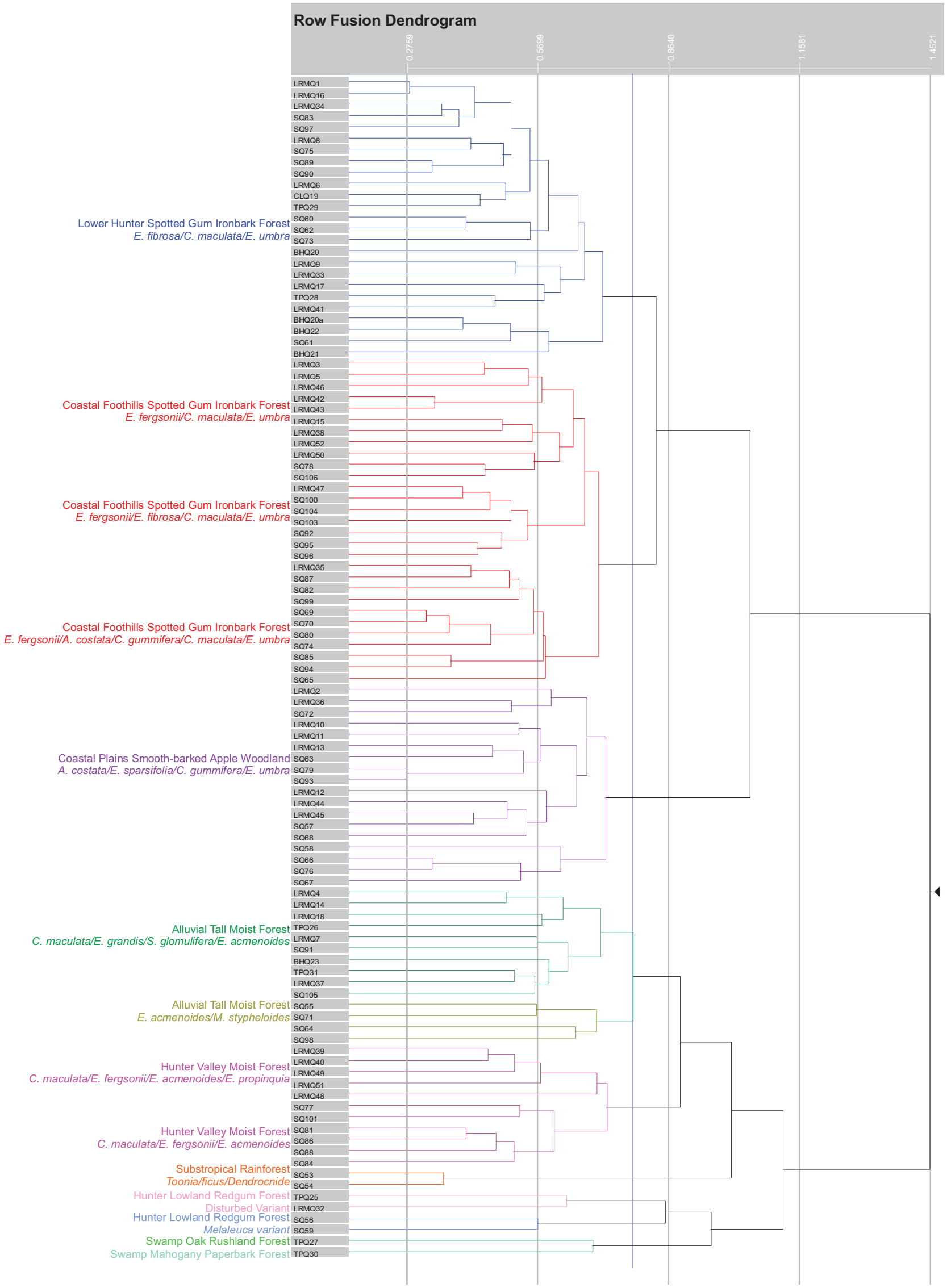


Figure 3-2: Dendrogram showing vegetation communities and dissimilarity association for the Northern Estates

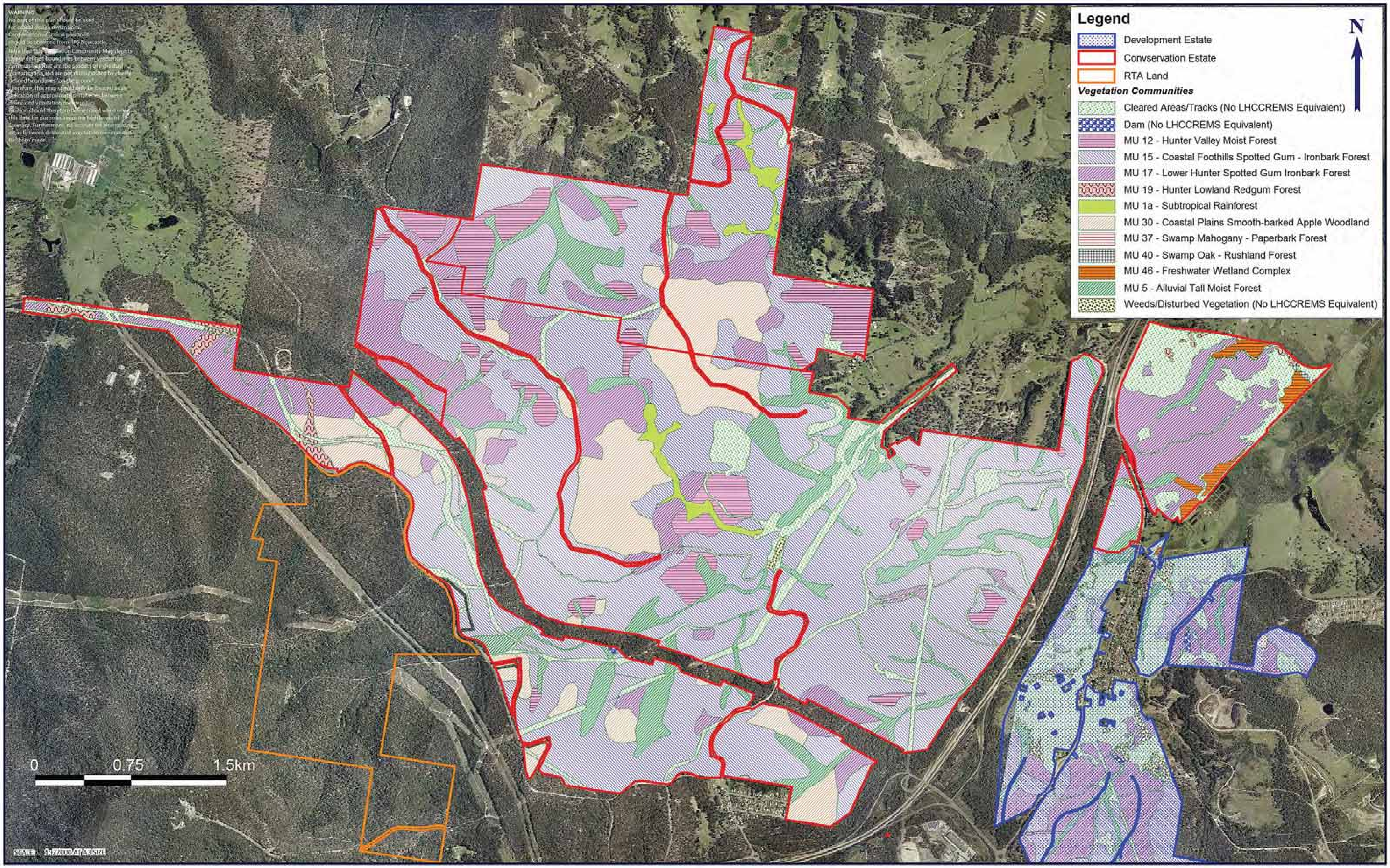
3.1.2 Description of Vegetation Communities

A description of each community and classification into the adopted regional vegetation classification, being Lower Hunter and Central Coast Regional Biodiversity Strategy (NPWS 2000; House 2003) has occurred. However the vegetation types have not always conformed to these descriptions. The descriptions below describe the vegetation communities and, where relevant, deviations from LHCCREMS classifications. The following 12 vegetation communities were delineated within Northern Conversation Estates as shown in Figure 3-3 and listed below: EEC's are identified by bold text. Table 3-1 summarises total approximate vegetation community areas and status. Photographs of each vegetation community can be found in Appendix 4.

1. Coastal Foothills Spotted Gum - Ironbark Forest (CFSGIF);
2. Coastal Plains Smooth-barked Apple Woodland (CPSBAW);
3. **Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) (EEC – Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion);**
4. Hunter Valley Moist Forest (HVMF);
5. Alluvial Tall Moist Forest (ATMF);
6. **Subtropical Rainforest (SR) (EEC – Lowland Rainforest of the NSW North Coast and Sydney Basin Bioregion);**
7. **Hunter Lowland Redgum Forest (HLRF) (EEC – Hunter Lowland Redgum Forest in the Sydney Basin and the North Coast Bioregion);**
8. **Swamp Oak Rushland Forest (SORF) (EEC – Swamp Oak Floodplain Forest on Coastal Floodplains);**
9. **Swamp Mahogany – Paperbark Forest (SMPF) (EEC – Swamp Sclerophyll Forest on Coastal Floodplains);**
10. **Freshwater Wetland Complex (EEC – Freshwater Wetlands on Coastal Floodplains);**
11. Weeds and Cleared Areas; and
12. Dam.

Table 3-1: Vegetation Community Areas

Vegetation Community	1. TSC Act 2. EPBC Act 3. Other	Area in Conservation Estate (Ha)	
		Minmi Link Rd Offset	Black Hill Offset
Alluvial Tall Moist Forest		129.88	36.22
Coastal Foothills Spotted Gum-Ironbark Forest		859.01	188.39
Coastal Plains Smooth-Barked Apple Woodland		160.58	44.03
Dam		0.43	0
Freshwater Wetland Complex	***1. EEC - Freshwater Wetlands***	0	11.89
Hunter Lowland Redgum Forest	***1. EEC - HLRF***	11.80	2.28
Hunter Valley Moist Forest		66.87	62.54
Lower Hunter Spotted Gum Ironbark Forest	***1. EEC - LHSGIF***	181.66	131.46
Sub-tropical Rainforest	***1.EEC - LOWLAND RAINFOREST***	11.53	9.99
Swamp Mahogany – Paperbark Forest	***1. EEC - SSF***	0	0.23
Swamp Oak Rushland Forest	***1. EEC - SOFF***	0	0.57
Weeds And Cleared Areas		139.24	56.76



TITLE:	FIGURE 3-3 VEGETATION MAP
LOCATION:	CONSERVATION ESTATES
DATUM:	N/A
PROJECTION:	MGA ZONE 56 (GDA 94)
DATE:	7/02/2011
PURPOSE:	EAR
LAYOUT REF:	24530-2 Figure 3-3 Vegetation Map D A3
VERSION (PLAN BY):	D (A.P-M.D-N.W)
CLIENT:	Coal & Allied Industries Ltd
JOB REF:	24530-2

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1 Coastal Foothills Spotted Gum Ironbark Forest

This community occupies the majority of the Conservation Estates and covers approximately 1047.4 ha. This vegetation community is commensurate with MU 15 Coastal Foothills Spotted Gum – Ironbark Forest as described by LHCCREMS (NPWS 2000; House 2003). This community is associated with the steep or south facing slopes across the site and was generally evident between LHSGIF and HVMF. This community is extremely variable throughout the Conservation Estates with the moister slopes having *Angophora costata*, *Corymbia gummifera* and *Eucalyptus acmenoides* as a co-dominant within the canopy layer. The ridge tops had these species missing and were dominated by *Corymbia maculata*, *Eucalyptus fergusonii* subsp. *dorsiventralis* and *Eucalyptus umbra* subsp. *umbra* as the dominant canopy species. The ROTAP species *Eucalyptus fergusonii* subsp. *dorsiventralis* was the dominant canopy species through the vegetation community.

The cluster analysis has delineated three variants at a dissimilarity level of 0.6, and this has mostly been attributed to the presence of *Angophora costata* and *Corymbia gummifera* in the more sheltered aspects of the site. The more exposed sites on northerly facing aspects and ridge tops mostly had these two species absent. The exception to this rule is where the community adjoined Coastal Plains Smooth-barked Apple Woodland or Lower Hunter Spotted Gum Ironbark Forest and ecotones have species common to both communities within them. Further detailed description of the three variants is provided below.

E. fergusonii/C. maculata/E. umbra

This was the dominant of the three variants and commonly occurring on the ridge tops and south facing slopes with the conservation lands. The majority of this variant occurs within the Minmi/Link Rd development estate, with only two quadrats sampled within the Conservation Estate. These three canopy species were joined by co-dominants of *E. acmenoides* and *E punctata*. The understorey consisted of Acacia floribunda and occasionally *Indigofera australis*. The groundlayer was consisted of *Themeda australis*, *Entolasia stricta*, *Imperata cylindrica* and *Lomandra longifolia*.

E. fergusonii/A. costata/C. gummifera/C. maculata/E. umbra

At the base of the slopes where CFSGIF is ecotoning with HVMF it is not uncommon to have a mixture of canopy species from the two communities. *Doryanthes excelsa* (Gymea Lilly) was noted to be an informative species for this community on this site given that it only occurred within CFSGIF and along the fringes of CPSBAW. The mid storey in this variant consisted of more moist species including *Rhodamnia rubescens* (Brush Turpentine), *Gymnostachys anceps* (Settlers Flax*), Rapanea variabilis* (Muttonwood) and *Smilax australis*. This variant was dominated by *Acacia fimbriata* in the south eastern portion of the conservation estate.

E. fergusonii/E. fibrosa/C. maculata/E. umbra

It was observed that where CFSGIF was occupying a north facing slope or on level areas, the mid and lower storeys are dominated more by dry species and almost appeared to resemble LHSGIF. The canopy is still dominated by *E fergusonii* subsp. *dorsiventralis*, *C.*

maculata, *E umbra* subsp. *umbra* and *E punctata*, however *E. fibrosa* were also recorded within this variant. The mid storey consisted of *Daviesia ulicifolia*, *Pultenea villosa* and *Macrozamia reducta* with *Joycea pallida* replacing *Themeda australis* as the dominant ground cover.

Upper Stratum – 15 m to 22 m with a PFC of 20% to 50%, the dominant species being *Corymbia maculata* (Spotted Gum), *Eucalyptus fergusonii* subsp. *dorsiventralis*, *Eucalyptus propinqua* (Small-fruited Grey Gum), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus acmenoides* (White Mahogany) and *Eucalyptus umbra* subsp. *umbra* (Broad-leaved Mahogany).

Mid Stratum 1 – 3 m to 10 m with a PFC of 10% to 20%, the dominant species being *Allocasuarina torulosa* (Forest She-oak) and juvenile Eucalyptus sp.

Mid Stratum 2 – 1.5 m to 3 m with a PFC of 30% to 40%, the dominant species being *Daviesia ulicifolia* (Eggs and Bacon), *Acacia fimbriata* (Fringed Wattle), *Acacia floribunda*, *Pultenaea daphnoides*, *Leptospermum polygalifolium* (Lemon-scented Tea-tree), and *Persoonia linearis* (Narrow-leaved Geebung).

Lower Stratum – 0.3 m to 1.5 m with a PFC of 40% to 80%, the dominant species being *Doryanthes excelsa* (Gymea Lilly), *Poa affinis*, *Oplismenus imbecillus* (Basket Grass), *Dichondra repens* (Kidney Weed), *Gonocarpus tetragynus* (Raspwort), *Lomandra longifolia* (Mat Grass), *Goodenia heterophylla* var. *heterophylla* (Variable-leaved Goodenia), *Joycea pallidea* (Silver-Top Wallaby Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic) and *Hardenbergia violacea* (Native Sarsaparilla).

2 Coastal Plains Smooth-barked Apple Woodland

This vegetation community occupies several patches throughout the Conservation Estates. This vegetation community encompasses 204.61 ha and occurs on the slopes and on the ridge top in the north-eastern portion of the Conservation Estates. It is commensurate with MU 30 Coastal Plains Smooth-barked Apple Woodland as described by LHCCREMS (NPWS 2000; House 2003). The threatened flora species *Tetratheca juncea* and *Grevillea parviflora* subsp. *parviflora* were recorded within this community. The community varies throughout its range. The ridge top section where *Callistemon linearifolius* was observed was on an ecotone with CFSGIF and had some elements of this community present. The portion in the south western area had a co-dominant understorey of *Angophora bakeri* as the soil had a high sand content. The presence of *A. bakeri* and *Grevillea parviflora* subsp. *parviflora* within this section of CPSBAW may indicate that this area is a variation of this community.

The cluster analysis delineated two variants of this community which varied in canopy layer, on variant had *Eucalyptus sparsifolia* as the dominant and this variant occurred mainly on the ridge top within the two larger patches within the conservation estates. The second variant which contained *Eucalyptus capitellata* as the dominant stringybark occurred within the sections in the eastern portion of the conservation lands and within the

Minmi/Link Rd development estate.

Variant: Dry Exposed

A dry variant of this community was identified where this community occurs on the ridge tops in the southern portions of the Conservation Estates. The ironbark *Eucalyptus fibrosa* was present and *Banksia spinulosa* var. *collina* was generally absent. This variant was not separated by the cluster analysis but this is mainly attributed to small sample size of three quadrats (Q12, Q36, Q44, Q45) and three of these quadrats being clustered closely together. EcoBiological (2006) also identified this *Eucalyptus fibrosa* variant. Further sampling of this community is required to give a clear description of this variant.

<u>Upper Stratum</u> – 15 m to 20 m with a PFC of 30 to 50%, the dominant species being *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark) and *Eucalyptus fibrosa* (Broad-leaved Ironbark).

<u>Mid Stratum 1</u> – 4 m to 10 m with a PFC of 10% to 40%, the dominant species being *Allocasuarina torulosa* (Forest She-oak) and juvenile *Eucalyptus sp*.

<u>Mid Stratum 2</u> – 2 m to 3 m with a PFC of 40% to 50%, the dominant species being *Banksia spinulosa* var. *collina* (Hair-pin Banksia), *Epacris pulchella*, *Leptospermum polygalifolium* (Lemon-scented Tea-tree) and *Dillwynia retorta* (Eggs and Bacon).

<u>Lower Stratum</u> – 0.5 to 1m with a PFC of 60% to 90%, the dominant species being *Phyllanthus hirtellus* (Thyme Spurge), *Hibbertia aspera* subsp*. aspera*, *Lomandra obliqua* (Fish Bones), *Xanthorrhoea latifolia* subsp. *latifolia* (Forest Grass Tree), *Themeda australis* (Kangaroo Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Entolasia stricta* (Wiry Panic) and *Joycea pallida* (Silver-top Wallaby Grass).

3 Lower Hunter Spotted Gum Ironbark Forest (EEC)

This community occupies the western portion of the site and covers approximately 313.12 ha. This vegetation community is commensurate with MU 17 Lower Hunter Spotted Gum – Ironbark Forest (LHSGIF) as described by LHCCREMS (NPWS 2000; House 2003). This community varied, some areas containing a dense shrub layer of *Melaleuca nodosa* and other areas a dense understorey of *Daviesia ulicifolia*. The remaining areas of the site have a grassy understorey dominated by *Joycea pallidea*, *Themeda australis*, *Entolasia stricta* and *Imperata cylindrica*. This variant was also illustrated within the cluster analysis where this community varied with no clear variants delineating out at lower dissimilarity levels.

This community differs from the CFSGIF community in that the dominant ironbark is *Eucalyptus fibrosa* and the understorey has dominants of *Melaleuca nodosa*, *Daviesia ulicifolia* and *Bursaria spinosa*. *Eucalyptus crebra* has replaced *Eucalyptus fibrosa* as the dominant ironbark along a strip of this community on the western side of the site. The scientific determination for LHSGIF describes this vegetation community as occurring principally on Permian geology with some occurrences on Triassic Narrabeen Group. The

site occurs on Permian Geology of Newcastle and Tomago Coal Measures. The dominant species which are described within the scientific determination are present within this community. This vegetation community occurred on exposed ridge tops and slopes which were mostly north facing. The community is disjunct and occurs in small localised patches throughout the eastern portion of the Conservation Estates. The occurrence within the western portion of the Conservation Estates is large and is generally intact as the lands are relatively flat. In places this vegetation community was difficult to delineate and in some areas scattered individuals of *Angophora costata* occurred and the stringybark *Eucalyptus globoidea* was a co-dominant in the canopy layer.

Upper Stratum – 18 m to 20 m with a PFC of 30% to 40%, the dominant species being *Corymbia maculata* (Spotted Gum), *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Eucalyptus punctata* (Grey Gum), and *Eucalyptus umbra* subsp. *umbra* (Broad-leaved Mahogany).

Mid Stratum 1 – 5 m to 13 m with a PFC of 20% to 40%, the dominant species being juvenile Eucalypts and *Melaleuca nodosa* (Ball Honeymyrtle).

Mid Stratum 2 – 1.5 m to 3 m with a PFC of 20% to 70%, the dominant species being *Melaleuca nodosa* (Honeymyrtle), *Acacia ulicifolia* (Prickly Moses), *Acacia fimbriata* (Fringed Wattle), *Pultenaea villosa*, *Daviesia ulicifolia* (Gorse Bitter Pea*), Bursaria spinosa* (Blackthorn) and *Persoonia linearis* (Narrow-leaved Geebung).

Lower Stratum – 0.5 m to 2 m with a PFC of 60% to 80%, the dominant species being *Lomandra filiformis* subsp. *coriacea*, *Lomandra multiflora* subsp. *multiflora*, *Cymbopogon refractus* (Barbed-wire Grass), *Austrodanthonia tenuior* (Wallaby Grass), *Joycea pallidea* (Silver-top Wallaby Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Themeda australis* (Kangaroo Grass), *Eustrephus latifolius* (Wombat Berry), *Entolasia stricta* (Wiry Panic) and *Aristida vagans* (Three-awned Spear Grass).

4 Hunter Valley Moist Forest

This vegetation community occurs within slopes above creeklines particularly on southern aspects, or where moisture retention occurs. This vegetation community covers approximately 129.41 ha and is commensurate with MU 12 Hunter Valley Moist Forest (HVMF) as described by LHCCREMS (NPWS 2000; House 2003). This community occurs on sheltered gullies and south facing slopes below steep sandstone outcrops. Often this community develops in the head drainage lines at a slightly elevated level. It has a high diversity of natives and was at times difficult to delineate from the ATMF. It was considered that ATMF generally occurred in the well developed drainage line on alluvial soils. This produced a greater diversity within *Melaleucas*, particularly the dominance of *Melaleuca styphelioides* and certain Eucalypts such as *Eucalyptus salinga*, *Eucalyptus grandis*, *Eucalyptus siderophloia* and mature *Syncarpia glomulifera* trees. HVMF had a dominant canopy cover of *Eucalyptus fergusonii* subsp. *dorsiventralis*, *Corymbia maculata* and *Eucalyptus acmenoides*, with *Syncarpia glomulifera* and *Melaleuca styphelioides* being present as a shrub species only. This community generally occurred on the upper south facing slopes and in gullies where moisture is retained and it

generally adjoined ATMF. This community is most likely an ecotone between ATMF and CFSGIF in sheltered steep gullies as it contains species from both of these communities.

The cluster analysis delineated two variants at a dissimilarity level of approximately 0.72. These two variants are described below:

C. maculata/E. fergusonii/E. acmenoides/E. propinquia Variant
This variant occurred within both the Conservation and the Development Estate, *Eucalyptus propinquia* was a dominant canopy tree. The understorey was had dryer species present such as *Pteridium esculentum* (Bracken Fern) and

C. maculata/E. fergusonii/E. acmenoides Variant
This variant was similar to the previous one with *E. propinquia* absent from the canopy cover. In addition the understorey had a dominance of wetter species such as *Gymnostachys anceps*, *Rhodamnea rubescens*, and *Oplismenus aemulus*. Whilst these two variants were similar the dominance in the understorey varied within the community.

Both of these variants occur within the Stockrington Conservation Estates.

<u>*Upper Stratum*</u> – 15 to 20 m with a Projected Foliage Cover (PFC) of 30% to 60%, the dominant species being *Corymbia maculata* (Spotted Gum), *Eucalyptus fergusonii* subsp. *dorsiventralis*, *Eucalyptus punctata* (Grey Gum) and *Eucalyptus acmenoides* (White Mahogany).

<u>*Mid Stratum 1*</u> – 10 m to 15 m with a PFC of 10% to 30%, the dominant species being *Allocasuarina torulosa* (Forest She-oak) and juvenile Eucalypts.

<u>*Mid Stratum 2*</u> – 2 m to 8 m with a PFC of 30% to 60%, the dominant species being *Backhousia myrtifolia* (Grey Myrtle), *Synoum glandulosum* (Scentless Rosewood), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Syncarpia glomulifera* (Turpentine), *Rapanea variabilis* (Muttonwood), *Rhodamnia rubescens* (Brush Turpentine), *Acacia irrorata* (Green Wattle) and *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree).

<u>*Lower Stratum*</u> – 0.3 to 1.0m with a PFC of 50% to 80%, the dominant species being *Entolasia stricta* (Wiry Panic), *Imperata cylindrica* var*. major* (Blady Grass), *Lomandra longifolia* (Spiny Mat-rush), *Themeda australis* (Kangaroo Grass), *Pteridium esculentum* (Bracken Fern), *Adiantum aethiopicum* (Common Maidenhair), *Doodia apsera* (Rasp Fern), *Oplismenus aemulus* (Basket Grass), *Plectranthus parviflorus*, *Lantana camara*, *Gymnostachys anceps* (Settlers Flax), *Rubus mollucans* var *trilobus* (Molucca Bramble), *Cayratia clematidea* (Native Grape), *Desmodium varians*, *Geranium homeanum* (Native Geranium) and *Oplismenus imbecillis* (Basket Grass).

5 Alluvial Tall Moist Forest

This vegetation community occurs within the creeklines within the Conservation Estates, these creeklines include Blue Gum Creek, Long Gully and Minmi Creek. Whilst weed infestations are present there are a number of natives still present throughout this vegetation community. This vegetation community covers approximately 166.1 ha and is commensurate with MU 5 Alluvial Tall Moist as described by LHCCREMS (NPWS 2000; House 2003). This community is very similar to HVMF across the site. It was noted that in the ATMF within the site, tall thick stands of *Melaleuca styphelioides* often dominated the upper-mid stratum with species including *Eucalyptus salinga* and *Eucalyptus grandis* as the dominant canopy species. Whilst *Melaleuca styphelioides* occasionally occurred in HVMF it was not nearly as dense and not as tall as the stands in ATMF. The dominant tree cover varied throughout this vegetation community. The well defined creeklines were dominated by *Eucalyptus salinga* and *Eucalyptus grandis*. The north eastern portion adjoining Stockrington in Minmi Creek was co-dominated by *Eucalyptus grandis* whilst Blue Gum Creek is dominated by *Eucalyptus salinga*. The remaining portions of the vegetation community were similar with the exception that the former species was not present.

The cluster analysis has separated this community into two variants which are described below:

C. maculata/S. glomulifera/E. acmenoides (Broad-leaf understorey) variant
This variant occurred in the wider drainage lines where more broad-leaf species were present due to a more closed canopy cover. An example of this variant occurred along a small section of Blue Gum Creek to the south east of the quarry, the ATMF was bordering on Subtropical Rainforest without the high density canopy cover. The upper stratum included *Toona ciliata* (Red Cedar), *Alphitonia excelsa* (Red Ash) and *Eucalyptus salinga* (Blue Gum). Small *Dendroscnide excelsa* (Giant Stinging Tree), *Cryptocarya microneura* and *Commersonia fraserii* dominate the mid storey with a sparse understorey. Whilst this occurred it was not delineated as rainforest as the canopy was not closed and contained a co-dominance of *Melaleuca styphelioides* in the sub canopy layer in addition to the rainforest species. Whilst these species did not occur within all the areas of this variant, the floristic composition generally contained more diversity of broad-leaf species than the variant below.

Melaleuca styphelioides/Eucalyptus acmenoides variant
In this variant the shrub *Melaleuca styphelioides* was the dominant sub canopy layer whilst *Eucalyptus acmenoides* always occurred within this variant. However the other canopy species varied. The broad-leaf species were absent from this variant as the canopy cover was more open. In some areas this was due to *Lantana camara* infestation and others it was where the drainage line narrowed allowing for drying along the banks of the drainage lines.

<u>Upper Stratum</u> – 20 to 25 m with a Projected Foliage Cover (PFC) of 30% to 60%, the dominant species being *Eucalyptus grandis* (Flooded Gum), *Eucalyptus salinga* (Sydney Blue Gum), *Eucalyptus paniculata* (Grey Ironbark), *Eucalyptus siderophloia* (Northern

Grey Ironbark), *Syncarpia glomulifera* (Turpentine), *Cryptocarya microneura* (Murrogun), *Corymbia maculata* (Spotted Gum) and *Eucalyptus acmenoides* (White Mahogany).

Mid Stratum 1 – 10 m to 20 m with a PFC of 10% to 20%, the dominant species being, *Melaleuca styphelioides* (Prickly-leaved Melaleuca), *Commersonia fraseri* (Brush Kurrajong) and *Syncarpia glomulifera* (Turpentine).

Mid Stratum 2 – 2 m to 8 m with a PFC of 30% to 80%, the dominant species being, *Backhousia myrtifolia* (Grey Myrtle), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Cassine australis* (Red Olive Plum), *Hibiscus heterophyllus* (Native Rosella), *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree) and *Lantana camara* (Lantana).

Lower Stratum – 0.3 to 1.5m with a PFC of 30% to 40%, the dominant species being *Carex appressa*, *Adiantum aethiopicum* (Common Maidenhair), *Adiantum formosum* (Giant Maidenhair), *Dianella caerulea* var *producta* (Blue-flax Lilly), *Doodia apsera* (Rasp Fern), *Lomandra longifolia* (Spiky-headed Mat-rush), *Oplismenus imbecillus* (Basket Grass), *Smilax australis* (Native Raspberry), *Stephania japonica* var. *discolor* (Snake Vine), *Sarcopetalum harveyanum* (Pearl Vine), and *Cissus antarctica* (Native Grape).

6 Subtropical Rainforest (EEC – Lowland Rainforest)

This rainforest covers approximately 21.52 ha and occurs in the deep gullies of Long Gully and another one to the west of Long Gully. This community is commensurate with MU 1a Coastal Warm Temperate – Sub Tropical Rainforest as described by LHCCREMS (NPWS 2000; House 2003). EcoBiological (2006) have previously analysed this community in detail and concluded that this community is best described as Subtropical Rainforest and was closely related to *Ficus* spp. – *Dysoxylum fraserianum* – *Toonia* – *Dendrocnide* sub alliance 15 of Floyd (1990). The results of this survey concur with the EcoBiological (2006) due to the dominance of *Toonia ciliata*, *Dendrocnide excelsa*, *Dendrocnide photinophylla* and *Ficus* species which were identified within this community. EcoBiological (2006) have also studied in detail the difference between the two possible Endangered Ecological Communities of Lowland Rainforest on Floodplains of the NSW North Coast Bioregion and Lowland Rainforest of the NSW North Coast and Sydney Basin Bioregion which could relate to Subtropical Rainforest. EcoBiological found that 65% of the 108 plant taxa listed for Lowland Rainforest EEC occurred on site whilst only 42% occurred within the Lowland Rainforest on Floodplain EEC. Thus it is considered that this community is considered to be Lowland Rainforest of the NSW North Coast and Sydney Basin Bioregion.

This vegetation community is currently under threat from severe incursions of *Lantana camara*. This species has taken hold at the base of the drainage lines and heavily infested on the bottom slopes, particularly where tributaries run into the main creekline.

Upper Stratum – 18 to 25 m with a Projected Foliage Cover (PFC) of 60% to 80%, the dominant species being *Dendrocnide excelsa* (Giant Stinging Tree), *Alphitonia excelsa* (Red Ash), *Toonia ciliata* (Red Cedar), *Dendrocnide photinophylla* (Shiny-leaved Stinging), *Baloghia inophylla* (Brush Bloodwood), *Ficus watkinsoniana* (Strangler Fig),

Neolitsea dealbata (White Bollygum), *Cryptocarya microneura* (Murrogum) and *Euroschinus falcata* (Ribbonwood)

Mid Stratum 1 – 10 m to 16 m with a PFC of 10% to 20%, the dominant species being, *Diploglottis australis* (Native Tamarind), *Claoxylon australis* (Brittlewood), *Eupomatia laurina* (Bolwarra), *Commersonia fraseri* (Brush Kurrajong), *Guioa semiglauca* and *Diospyros australis* (Black Plum).

Mid Stratum 2 – 2 m to 8 m with a PFC of 30% to 80%, the dominant species being, *Streblus brunonianus* (Whalebone Tree), *Acmena smithii* (Lilly Pilly), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Cassine australis* (Red Olive Plum), *Alphitonia excelsa* (Red Ash), *Alectryon subcinereus* (Native Quince), *Hibiscus heterophyllus* (Native Rosella), *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree) and *Lantana camara* (Lantana).

Lower Stratum – 0.3 to 1.5m with a PFC of 10% to 30%, the dominant species being *Carex appressa*, *Adiantum aethiopicum* (Common Maidenhair), *Adiantum formosum* (Giant Maidenhair), *Adiantum hispidulum* (Rough Maidenhair), *Pellaea falcata* (Sickle Fern), *Doodia apsera* (Rasp Fern), *Dendrobium gracilicaule*, *Gymnostachys anceps* (Settlers Flax), *Lomandra longifolia* (Spiky-headed Mat-rush), *Pyrrosia rupestris* (Rock Felt Fern), *Oplismenus imbecillus* (Basket Grass).

Vines - *Cissus antarctica* (Native Grape), *Arthropteris tenella* (Jointed Fern), *Stephania japonica* var. *discolor* (Snake Vine), *Capparis arborea* (Brush Caper Berry), *Tetrastigma nitens* (Three-leaved Water Vine), *Dioscorea transversa* (Native Yam), *Geitonoplesium cymosum* (Scrambling Lily), *Ripogonum album* (White Supplejack), *Morinda jasminoides*, *Smilax australis* (Native Raspberry), *Parsonsia straminea* (Monkey Rope) and *Cissus antarctica* (Native Grape).

7 Hunter Lowland Redgum Forest (EEC)

This vegetation community occurs in two small areas on the western side of the conservation area and in small patches of Tank Paddock. This vegetation encompasses approximately 14.08 ha. The largest portion of this community follows a north-south drainage flat on the western side of the Conservation Estates and is depicted by a dominance of large *Eucalyptus tereticornis* (Forest Red Gum) in the upper stratum.

The cluster analysis has delineated this community into two variants and it is considered that they are one community. The reason for this is the quadrats which were surveyed at Tank Paddock and the Minmi/Link Rd Development Estate are highly degraded with mostly the canopy cover which is representative of this community remaining. The remaining areas in which the quadrats were performed (within the western portion of the Conservation Estate) had an understorey of *Melaleuca decora* and *Melaleuca linearifolia*.

Upper Stratum – 15 to 20 m with a Projected Foliage Cover (PFC) of 20% to 40%, the dominant species being *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus punctata* (Grey Gum), *Corymbia maculata* and *Eucalyptus fibrosa* (Red Ironbark)

Mid Stratum 1 – 5 to 8 m with a Projected Foliage Cover (PFC) of 30% to 40%, the dominant species being *Melaleuca linearifolia* (Snow in Summer), *Casuarina glauca* (Swamp Oak), and *Melaleuca decora*

Mid Stratum 2 – 1 to 2 m with a Projected Foliage Cover (PFC) of 20% to 40%, the dominant species being *Dodonea triquetra* (Hop Bush), *Acacia longifolia* (Sydney Golden Wattle) and *Leucopogon juniperinus* (Prickly Beard-heath).

Lower Stratum – 0 to 0.5 m with a Projected Foliage Cover (PFC) of 40% to 50%, the dominant species being *Lomandra longifolia* (Mat-Rush), *Cymbopogon refractus* (Barbed Wire Grass), *Entolasia stricta* (Panic Grass), *Themeda australis* (Kangaroo Grass) and *Digitaria parviflora* (Finger Grass).

8 Swamp Oak Rushland Forest (EEC – Swamp Oak Floodplain Forest on Coastal Floodplains)

This vegetation community occurs in two small areas within the low lying areas adjoining Hexham Swamp within Tank Paddock. This vegetation community encompasses approximately 0.57 ha and is commensurate MU 40 Swamp Oak Rushland Forest as described by LHCCREMS (NPWS 2000; House 2003). This community had a high incursion of *Lantana camara* and it was difficult to gain access.

The cluster analysis grouped this vegetation community with Swamp Mahogany Paperbark Forest due to a similar floristic composition within the groundlayer. However the SORF is highly disturbed due to incursions of Lantana camara and was difficult did not contain a large diversity of natives. This community also adjoined the Freshwater Wetland Complex and had some wetland species on its fringes. For the purposes of this project these two communities have been delineated separately on the basis of the canopy layer.

Upper Stratum – to 10 m with a PFC of 10% to 20%, the dominant species is *Casuarina glauca* (Swamp Oak).

Mid Stratum – to 3 m with a PFC of 60% to 80%, the dominant species being, *Lantana camara* (Lantana) around the fringes of the community.

Lower Stratum – to 1 m with a PFC of 30% to 40%, the dominant species being *Carex appressa, Juncus usitatus*, *Cynodon dactylon* (Common Couch), *Isolepis nodosa* (Nodding Sedge) and *Typha orientalis* (Typha).

9 Swamp Mahogany – Paperbark Forest (EEC – Swamp Sclerophyll Forest on Coastal Floodplains);

This vegetation community in a small area in the northern portion of Tank Paddock, and is linked to a swamp which is located on the adjoining property. This vegetation community encompasses 0.23 ha. This vegetation community is commensurate with MU 37 Swamp

Mahogany – Paperbark Forest as described by LHCCREMS (NPWS 2000; House 2003). It fringes a swamp that occurs offsite and flows into Pambalong Swamp to the north west of the site. Further discussion on the cluster analysis results of this vegetation community are outlined above in the Swamp Oak Rushland Forest description.

Upper Stratum – to 20 m with a Projected Foliage Cover (PFC) of 40% to 60%, the dominant species being *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquinervia* (Broad-leafed Paperbark).

Mid Stratum 1 – 4 m to 8 m with a PFC of 10% to 20%, the dominant species being *Melaleuca linearifolia* (Snow-in Summer) and *Melaleuca ericifolia* (Swamp Paper-bark).

Mid Stratum 2 – 3 m to 5 m with a PFC of 30% to 90%, the dominant species being *Lantana camara* (Lantana), *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Pittosporum undulatum* (Sweet Pittosporum).

Lower Stratum – to 1.5 m with a PFC of 10% to 50%, the dominant species being *Juncus mollis*, *Cynodon dactylon* (Couch Grass), *Imperata cylindrica* var *major* (Blady Grass), *Ranunculus inundatus* (River Buttercup), *Carex appressa* (Tall Sedge), *Oplimenus aemulus* (Basket Grass) and *Smilax glyciphylla* (Native Sarsaparilla).

10 Freshwater Wetland Complex (EEC – Freshwater Wetlands on Coastal Floodplains);

This vegetation community occurs as two areas in the north east of Tank Paddock. These areas are connected to and drain into Hexham Swamp. This community is floristically diverse and provides habitat for a range of native flora and fauna. This vegetation community covers approximately 11.89 ha and is commensurate with MU 46 Freshwater Wetland Complex as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – to 10 m with a Projected Foliage Cover (PFC) of 10% to 20%, the dominant species being *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca styphelioides* (Prickly-leaved Melaleuca) and *Melaleuca ericifolia* (Swamp Paperbark).

Mid Stratum – to 3m with a PFC of 30% to 40%, the dominant species being *Melaleuca lineariifolia* (Snow in Summer) around the edges.

Lower Stratum – to 1.5m with a PFC of 20% to 30%, the dominant species being *Gahnia clarkei* (Tall Saw Sedge), *Ranunculus inundatus* (River Buttercup), *Adiantum aethiopicum* (Common Maidenhair), *Blechnum cartilagineum*, *Persicaria strigosa*, *Persicaria hydropiper* (Water Pepper), *Hydrocotyle peduncularis*, *Dichondra repens* (Kidney Weed) and *Paspalium distichum* (Water Couch).

Emergents – *Baumea articulata* (Jointed Twig-Rush), *Typha orientalis* (Bull Rush) *Juncus continuus* and *Philydrum lanuginosum* (Woolly Frogmouth).

Aquatics – *Azolla pinnata* (Ferny Azolla) and *Alisma plantago-aquatica* (Water Plantain).

11 Weeds and Cleared Areas

This vegetation community occurs within the central area of the site and exists as a quarry. Smaller areas on the eastern and western side of the site are the result of clearing for the mining operations. The remaining areas are either unformed tracks or electricity easements. This community encompasses approximately 196 ha and is not commensurate with any vegetation communities that have been described by LHCCREMS (NPWS 2000; House 2003). These areas are highly disturbed and have high weed incursions. The canopy cover of this community generally exists as scattered examples of Eucalypt trees which are outlined below.

Upper Stratum – 15 to 18 m with a Projected Foliage Cover (PFC) of 5% to10%, the dominant species being *Eucalyptus punctata* (Grey Gum), *Eucalyptus propinqua* (Small-fruited Grey Gum), *Melaleuca styphelioides* (Prickly-leaved Melaleuca), *Corymbia maculata* (Spotted Gum), *Erythrina x sykesii* (Coral Tree) and *Eucalyptus acmenoides* (White Mahogany).

Mid Stratum – 1.5 m to 3 m with PFC of 20 to 50%, the dominant species being *Acacia longifolia* var*. longifolia* (Sydney Golden Wattle), *Kunzea ambugia* (Tick Bush), *Acacia falcata* (Sickle Wattle), *Lantana camara* (Lantana), *Cinnamomum camphora* (Camphor Laurel) and *Grevillea robusta* (Silky Oak).

Lower Stratum – 0.3 m to 1 m with a PFC of 80% to 90%, the dominant species being *Pennisetum clandestinum* (Kikuyu), *Pteridium esculentum* (Bracken Fern), *Cynodon dactylon* (Common Couch), *Verbena bonariensis* (Purple Top), *Ageratina adenophorum*, (Crofton Weed), *Eragrostis curvula* (African Lovegrass), *Physalis peruviana* (Cape Gooseberry), *Senecio madagascariensis* (Fireweed), *Paspalum dilatum* (Paspalum), *Richardia brasiliensis* (White Eye), *Andropogon virginicus* (Whisky Grass), *Hypochaeris radicata* (Flatweed), *Plantago lanceolata* (Ribwort), *Bidens pilosa* (Farmer's Friends), *Trifolium repens* (White Clover) and *Sida rhombifolia* (Paddy's Lucerne).

12 Dams

This vegetation community occurs as constructed dams within the cleared areas of the site, with the large dams in the north east of the site having been utilised as water reservoirs for the mining operations. This community encompasses approximately 0.43 ha and is not commensurate with any vegetation communities that have been described by LHCCREMS (NWPS 2000; House 2003). The terrestrial vegetation described below is the vegetation which occurs within the immediate surrounds of the dam. The edges of the dams have high weed infestations particularly of pasture weeds and Lantana camara. The emergent vegetation fringes the shallow areas of the dam and is dominated by *Typha orientalis*.

Upper Stratum – 15 m to 18 m with a PFC of 5%, the dominant species being dominant species being *Eucalyptus punctata* (Grey Gum), *Eucalyptus propinqua* (Small-fruited Grey Gum), *Eucalyptus paniculata* (Grey Ironbark), *Syncarpia glomulifera* (Turpentine),

Eucalyptus acmenoides (White Mahogany) and *Cinnamomum camphora* (Camphor Laurel).

Mid Stratum –2 m to 4 m with a PFC of 20% to 40%, the dominant species being *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle), *Acacia suaveolens*, *Pittosporum undulatum* (Sweet Pittosporum), *Alphitonia excelsa* (Red Ash), *Lantana camara* (Lantana), *Senna pendula* var. *glabrata* (Winter Senna) and *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree).

Lower Stratum – 0.5 m to 1 m with a PFC of 60% to 80%, the dominant species being *Pennisetum clandestinum* (Kikuyu), *Carex appressa*, *Andropogon virginicus* (Whisky Grass), *Hypochaeris radicata* (Flatweed), *Cynodon dactylon* (Common Couch), *Verbena bonariensis* (Purple Top), *Richardia brasiliensis* (White Eye), *Andropogon virginicus* (Whisky Grass), *Hypochaeris radicata* (Flatweed) and *Plantago lanceolata* (Ribwort).

Emergents – 0.5 m to 1 m with a PFC of 10% to 20%, the dominant species being *Baumea articulata* (Jointed Twig-Rush), *Typha orientalis* (Typha), *Phragmites australis* (Native Rush), *Persicaria decipiens* (Spotted Knotweed), *Juncus subsecundus* (Finger Rush) and *Juncus usitatus* (Common Rush).

3.1.3 Conservation Status of Vegetation Communities

Six EEC's that are listed under the *TSC Act 1995* occur within six delineated vegetation communities extant on the Northern Lands Conservation Estates. These six communities are listed below:

- The vegetation community delineated as Lower Hunter Spotted Gum Ironbark Forest is commensurate with 'Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion';
- The vegetation community delineated as Hunter Lowland Redgum Forest is commensurate with 'Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions';
- The vegetation community delineated as Swamp Oak Rushland Forest is commensurate with 'Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions';
- The vegetation community delineated as Subtropical Rainforest is commensurate with 'Lowland Rainforest of the NSW North Coast and Sydney Basin Bioregion';
- The vegetation community delineated as Swamp Mahogany - Paperbark Forest is commensurate with 'Swamp Sclerophyll Forest on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East Corner Bioregions'; and
- Freshwater Wetland Complex is commensurate with 'Freshwater Wetlands on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East corner Bioregions'.

3.1.4 Regionally Significant Vegetation Communities within Lake Macquarie LGA

Newcastle City Council does not at present have any flora and fauna guidelines so the guidelines for Lake Macquarie Council were used to identify any regionally significant vegetation communities in the area.

The following vegetation communities, which occur within the site, are considered to be regionally significant by Lake Macquarie Flora and Fauna Guidelines within the Lake Macquarie LGA and Lower Hunter and Central Coast Regional Biodiversity Strategy (Payne 1998) (EEC's in bold):

- Alluvial Tall Moist Forest;
- Coastal Foothills Spotted Gum – Ironbark Forest;
- **Hunter Lowland Redgum Forest (EEC – Hunter Lowland Redgum Forest on Coastal Floodplains);**
- **Freshwater Wetland Complex (EEC – Freshwater Wetlands on Coastal Floodplains);**
- **Swamp Mahogany - Paperbark Forest (Swamp Sclerophyll Forest on Coastal Floodplains - listed as EEC); and**
- **Swamp Oak Rushland Forest (Swamp Oak Floodplain Forest - listed as EEC); and**
- **Subtropical Rainforest - (EEC Lowland Rainforest in the Sydney Basin Bioregion).**

3.1.5 Regionally Significant Flora Species

Two ROTAP listed species (Briggs and Leigh, 1996) were identified within the Northern Lands Conservation Site. These are as follows:-

- *Callistemon shiressii* 3RC-, this species occurred within the Alluvial Tall Moist Forest and the Coastal Foothills Spotted Gum Ironbark Forest (Figure 3-4 shows location of this species);
- *Eucalyptus fergusonii* subsp. *dorsiventralis* 2RC-. This species occurred throughout both the Hunter Valley Moist Forest and the Coastal Foothills Spotted Gum Ironbark vegetation communities throughout the Conservation Estates. As previously discussed in Section 4.1.5 this species fruits varied and may have hybridised with *Eucalyptus paniculata* in some areas of the site.

In addition, Lake Macquarie Flora and Fauna Guidelines (2001) contain a list of regionally significant flora species and nine of these were identified within the site, and are listed as follows:

- *Callistemon shiressii*;

- *Eucalyptus fergusonii* ssp. *dorsiventralis;*
- *Eucalyptus grandis*;
- *Eucalyptus robusta*;
- *Ficus fraseri*;
- *Ficus watkinsiana*;
- *Muehlenbeckia gracillima*;
- *Ottelia ovalifolia*; and
- *Syzygium paniculatum*.

The Part 3A Environment Assessment for the Abel Underground Mine Project (EcoBiological 2006) lists several species which have range extensions and are rare which were detected during surveys within the Subtropical Rainforest Vegetation Community. This survey was more extensive than the current survey and included quadrat and statistical analyses on the vegetation communities. These are as follows:-

- *Christella hispidula* (Rare in NSW);
- *Capparis arborea* (Range Extension);
- *Drypetes australasica* (Range Extension);
- *Ficus watkinsoniana* (Range Extension);
- *Mallotus philippensis* (Range Extension);
- *Randia benthamiana* (Range Extension);
- *Mischocarpus australis* (Range Extension);
- *Rhysotoechia bifolioata* (Range Extension);
- *Alangium villosum* subsp. *polyosmoides* (Range Limit);
- *Daphnandra* sp. *A* (Range Limit);
- *Dendrocnide photinophylla* (Range Limit); and
- *Embelia australiana* (Range Limit).

3.1.6 Desktop Assessment – Threatened Flora Search Results

The results of this search indicated numerous threatened flora species have been previously recorded within the locality and/ or have potential habitat within the site. The following nine species have been recorded within 10 km (DECCW Atlas of NSW Wildlife Data 2010) of the site:

- *Acacia bynoeana* (Bynoe's Wattle);
- *Angophora inopina* (Charmhaven Apple);
- *Callistemon linearifolius* (Netted Bottle Brush);
- *Eucalyptus parramattensis* subsp. *decadens*;

- *Eucalyptus glaucina* (Slaty Red Gum)
- *Grevillea parviflora* ssp *parviflora* (Little-flower Grevillea);
- *Melaleuca biconvexa* (Biconvex Paperbark)
- *Rutidosis heterogama* (Heath Wrinklewort);
- *Syzygium paniculatum* (Magenta Lilly Pilly);
- *Tetratheca juncea* (Black-eyed Susan); and
- Zanichellia palustris.

In addition, to the above threatened flora species recorded on the DECCW Atlas of NSW Wildlife Data, it was considered the following species have potential habitat and or have been recorded within the vicinity of the site and should be considered within this assessment:

- *Arthropteris palisotii*;
- *Caladenia tessellata* (Thick Lip Spider Orchid);
- *Cynanchum elegans*;
- *Dendrobium melaleucaphilum* (Spider Orchid); and
- *Diuris praecox* (Rough Double Tail).

3.1.7 Threatened Flora Species with Potential to Occur

The following 14 threatened flora species have potential habitat within the Northern Conservation Estates:

- *Acacia bynoeana* – Sub-optimal habitat within disturbed areas under the electricity easements. However this species preferred habitat is open woodland on sandy soils. This species closest record is within the Lake Macquarie SCA to the south west of the site;
- *Arthropteris palisotii* – An epiphytic fern, this species was located within the Subtropical Rainforest by Ecobiological (2006) in the north of the Stockrington Conservation Estates within the Subtropical Rainforest;
- *Caladenia tessellata* – Potential habitat within the dry sclerophyll forests within the Conservation Estates;
- *Callistemon linearifolius* – A small shrub, a large population of this species was located within the Lower Hunter Spotted Gum Ironbark Forest in the north western portion of the Conservation Estates. The remaining areas of LHSGIF contains potential habitat for this species;
- *Cynanchum elegans* – vine found in Rainforest habitats. Potential habitat within the ecotone between the riparian zones and the subtropical rainforest within the Conservation Estate;
- *Dendrobium melaleucaphilum* – Epiphytic orchid mostly found on *Melaleuca styphelioides*, habitat within the Alluvial Tall Moist Forest, Subtropical Rainforest and

Hunter Valley Moist Forest within the Conservation Estates;

- *Diuris praecox* – cryptic orchid with potential habitat within the Hunter Valley Moist Forest, Coastal Foothills Spotted Gum Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Lower Hunter Spotted Gum Ironbark vegetation community within the Conservation Estates;
- *Eucalyptus glaucina* – a tree, with potential habitat within the Hunter Lowland Redgum Forest vegetation community within the Conservation Estates;
- *Grevillea parviflora* subsp. *parviflora* – a shrub, a large population was located within the Lower Hunter Spotted Gum Ironbark Forest and potential habitat exists within the remaining sections of this vegetation community;
- *Melaleuca biconvexa* – Shrub to small tree found in low-lying swamping areas, marginal habitat within the wet sclerophyll vegetation communities within the Conservation Estates;
- *Rutidosis heterogama* – A small shrub, a large population of this species has been located within Lower Hunter Spotted Gum Ironbark Forest in the western portion of the Conservation Estates. Potential habitat occurs within the Lower Hunter Spotted Gum Ironbark Forest vegetation community within the Conservation Estates;
- *Syzygium paniculatum* – Shrub to small tree found in rainforests or riparian vegetation, potential habitat within riparian zones and the Subtropical Rainforest within the Conservation Estates; One specimen of this species was located in a disturbed area adjoining Alluvial Tall Moist Forest at Stockrington;
- *Tetratheca juncea* – Shrub found within dry sclerophyll forests and woodlands, potential habitat within this Conservation Estates occurs within the Coastal Plains Smooth-barked Apple Woodland. Over 300 plant clumps were located within the western portions of the Conservation Estates; and
- *Zanichellia palustris* – an aquatic species which has sub-optimal habitat within the Freshwater Wetland Complex vegetation community.

3.1.8 Threatened Flora Species

Seven threatened flora species, being *Arthropteris palisotii*, *Callistemon linearifolius*, *Eucalyptus nicholii*, *Grevillea parviflora* subsp. *parviflora*, *Rutidosis heterogama*, *Syzygium paniculatum* and *Tetratheca juncea* were located within the Conservation Estates. *Arthropteris palisotii* was recorded by EcoBiological (2006). Two species being *Eucalyptus nicholii* and *Syzygium paniculatum*, may be not be naturally occurring within the Conservation Estates.

Arthropteris palisotii

This species was recorded by EcoBiological (2006) when surveying the Subtropical Rainforest for the proposed Abel Underground Mine Operations (Refer to Figure 3-4). This species was tentatively identified within that report. This species is considered to be significant as sightings are extremely rare.

Eucalyptus nicholii

Four individuals of this species were recorded within the Conservation Estates (Refer to Figure 3-4). This species distribution has been recorded on shallow infertile soils such as slate, shales, granite and porphyrite from Niangala to Glen Innes on the northern tableland of NSW. As the distribution of this species is not naturally occurring in the Hunter Region it is most probable that this species has been introduced from land fill as it was recorded on a road edge.

Callistemon linearifolius

At least 355 individuals of this species were located within the Lower Hunter Spotted Gum Ironbark Forest within the Conservation Estates (Refer to Figure 3-4). The counts of this species involved counting above ground stems, therefore the total genetically distinct individuals which may be present could be below this amount. This species is scattered throughout the main ridge top within the north western portion of the Conservation Estates. Targeted surveys to gauge the extent of the population have not been completed and it is expected that the population may be considerably larger than what has been reported here. A voucher specimen was sent to the Royal Botanical Gardens in Sydney and has been confirmed to be *Callistemon linearifolius* (Refer to Appendix 3).

Rutidosis heterogama

It is estimated that over 1000-1500 individual plants were recorded during field visits and the actual extant population is expected to be far greater (Refer to Figure 3-4). It should be noted that this species appeared to be more common within disturbed areas such as along track sides, near railway verges and amongst dumped refuse. There was also a large population within a power easement just outside of the Conservation Estates on the western slopes of the Sugarloaf Range. This species was recorded predominately within the Lower Hunter Spotted Gum Ironbark vegetation community.

Syzygium paniculatum

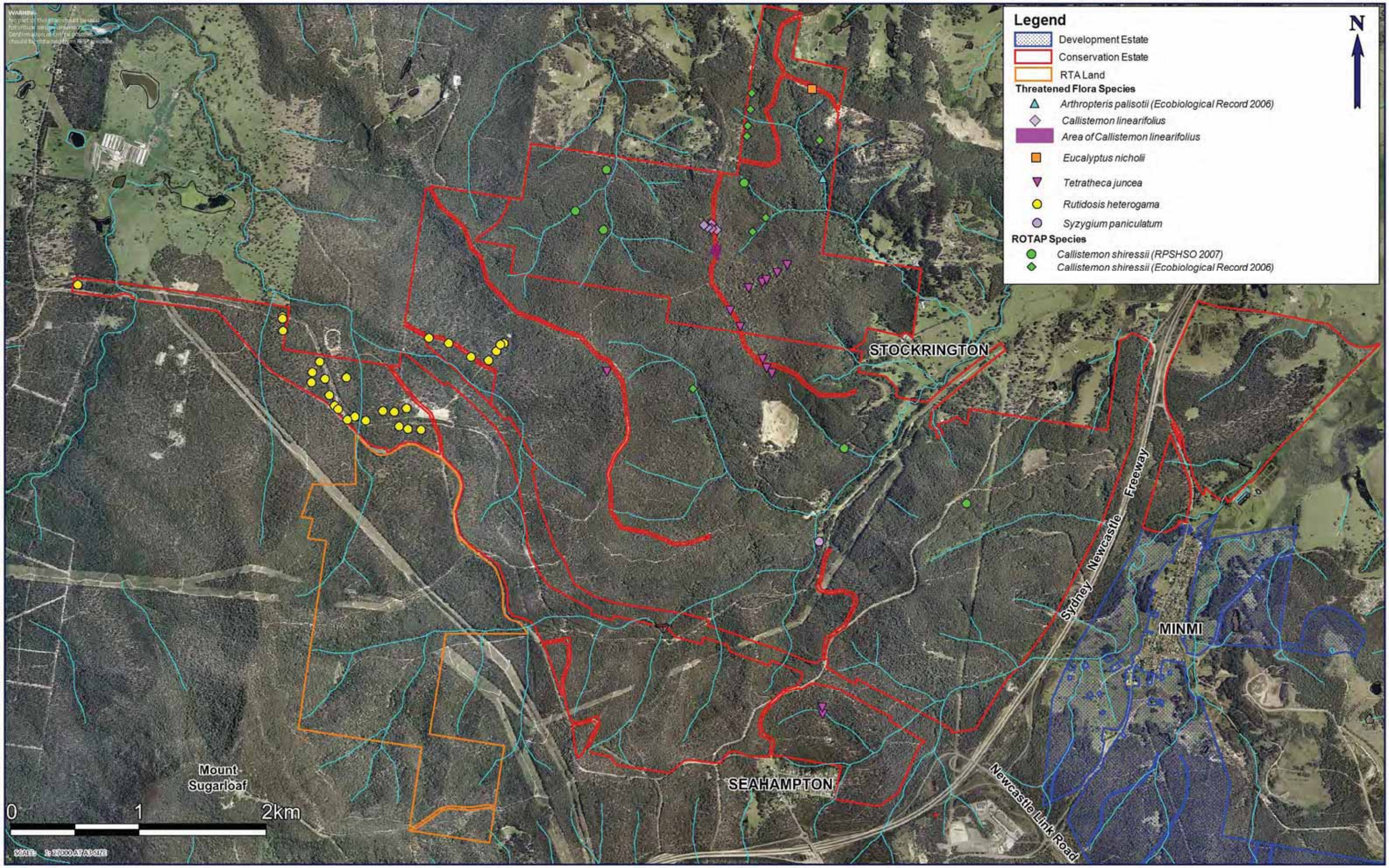
One plant was found within the Conservation Estates (Refer to Figure 3-4), examination of the fruit of this plant found it to be 3 locular which is a distinguishing feature of this plant from other similar species (i.e. Acmena smithii). This plant was growing in an area of high disturbance, adjoining Alluvial Tall Moist Forest and may have been brought in from another Conservation Estates in land fill. The plant is located near Blue Gum creek and it is possible, however, that it has come from upstream in Alluvial Tall Moist Forest or Subtropical Rainforest or may have been transported to its position in a disturbed area by natural means (i.e. seed dispersal by birds). Whichever is the case it is considered that this species is significant as it is growing in suitable habitat (albeit disturbed). A search of this area was performed with no further specimens located within the vicinity.

Tetratheca juncea

Approximately 352 Tetratheca juncea plant clumps were located during field visits in 2005, late 2007 and 2008 (Refer to Figure 3-4). The population is estimated to be considerably larger as the majority of the surveys were performed outside of the flowering period for this species. It is estimated that 256 ha of habitat within the Conservation Estates, remains to be surveyed. Thus, it is considered that this population will be significantly larger than what has been recorded during the vegetation surveys.

Other Cryptic orchids

No threatened cryptic orchids were located during the targeted surveys within the Conservation Estates. The main common orchids that have been identified within the Conservation Estates, include *Acianthus* sp., *Caladenia* sp., *Calochilus* sp., *Cymbidium* sp., *Dendrobium* sp., *Dipodium* sp., *Microtis* sp., *Pterostylis* sp. and *Thelymitra* sp.



TITLE: FIGURE 3-4 THREATENED FLORA SPECIES RECORDED

LOCATION: NORTHERN CONSERVATION LAND

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 7/02/2011
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Drafting\Ecology\Northern Lands\Cons Estate \24530-2 Figure 3-4 Threatened Flora Species Records
VERSION (PLAN BY): D (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

3.1.9 Groundwater Dependent Ecosystems

GDE's is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). Several of the vegetation communities on the Conservation Estates have been identified as GDE's, and these include Freshwater Wetland Complex, Swamp Mahogany Paperbark Forest, Swamp Oak Rushland Forest, HVMF, HLRF and ATMF (Refer to Figure 3-5). Identification of GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the communities which are located in drainage depression, swamps and creeklines, where groundwater comes up to the surface.

Matthei (1995) has mapped the several soil landscapes within the Conservation Estates and these include Cockle Creek (alluvial), Wyong (alluvial), Stockrington (coalluvial), Cedar Hill (coalluvial), Sugarloaf (coalluvial), Killingworth (erosional), Bolwarra Heights (erosional) Beresfield (residual), Hamilton (Residual), Rivermead (Residual), Awaba (associated) and Bobs Farm (estuarine). The erosional soils of Killingworth are mapped at the higher elevations and are likely to be comprised of clay soil overlying weathered rock. The soil landscapes of Beresfield, Rivermead and Hamilton have been mapped in the northern portion of the Conservation Estates at the high elevations adjoining Hexham Swamp. These soil landscapes are similar to Killingworth in that residual clay loams occur over weathered rock. Similarly the Stockrington, Cedar Hill and Sugarloaf coalluvial would occur over weathered rock.

However, lower lying areas at Tank Paddock in the Conservation Estates are likely to have regular inundation due to the close proximity to Hexham Swamp where the groundwater table is often on the surface. Hexham Swamp is part of the floodplain of the Hunter River. The estuarine soils of Bobs Farm are subject to water logging and have permanently high water tables, this soil landscape is mapped in the Tank Paddock in the north eastern portion of the Conservation Estate and adjoining Hexham Swamp. The alluvial soil landscapes of Cockle Creek and Wyong within Surveyors Creek (west) and Blue Gum Creek (east) are likely to contain unconfined alluvial aquifers.

Six vegetation communities within the Conservation Estates are classified as GDE's and these include, Freshwater Wetland Complex, Swamp Mahogany Paperbark Forest, Swamp Oak Rushland Forest, HVMF, HLRF and ATMF. These vegetation communities occur on the estuarine soils of Bob's Farm and the alluvial soils of Cockle Creek and Wyong. The remaining vegetation communities are not likely to be dependent upon groundwater and are most likely to be a result of surface runoff rather than groundwater dependence.

GDE's have been classified into several different types according to DLWC (2006). These classes take into consideration aquifer, ecological and geomorphic types. The aquifers present would be unconsolidated alluvial aquifers classed as A1 with Hypogean habitat. Table 3-2 below outlines the GDE types, classes and sub-classes as per DLWC (2006) which occur within the Conservation Estates.

Table 3-2: GDE's Types and Classes for Conservation Estates

Vegetation Community at Conservation Estate	GDE TYPE	Class	Description of Class	Habitat
Alluvial Tall Moist Forest (northern occurrences)	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Hunter Valley Moist Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Hunter Lowland Redgum Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Swamp Oak Rushland Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Swamp Mahogany Paperbark Forest	Riparian & Terrestrial Vegetation (T)	T1`	Riparian Vegetation Community	Terrestrial
Freshwater Wetland Complex	Wetlands (W)	W2	Coastal Floodplain Freshwater Forested Wetland	Epigean