## Appendix A <br> Biodiversity Offset Strategy



Moorebank Intermodal Company

## Biodiversity Offset Areas

## Biodiversity Assessment Report

16 June 2015


PARSONS<br>BRINCKERHOFF

## Document information

Client: Moorebank Intermodal Company
Title: Biodiversity Offset Areas
Subtitle: Biodiversity Assessment Report
Document No: 2189293E-ECO-REP-001 RevA
Date: 16 June 2015


| Author, Reviewer and Approver details |  |  |  |
| :--- | :--- | :--- | :--- |
| Prepared by: | Tanya Bangel | Date: 16/06/2015 | Signature |
| Reviewed by: | Paul Rossington | Date: $16 / 06 / 2015$ | Signature: |
| Approved by: | Alex Cockerill | Date: $16 / 06 / 2015$ | Signature |

## Distribution

Moorebank Intermodal Company, Parsons Brinckerhoff file

## ©Parsons Brinckerhoff Australia Pty Limited 2015

Copyright in the drawings, information and data recorded in this document (the information) is the property of Parsons Brinckerhoff. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by Parsons Brinckerhoff. Parsons Brinckerhoff makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information.

## Document owner

Parsons Brinckerhoff Australia Pty Limited
ABN 80078004798
Level 3 51-55 Bolton Street
Newcastle NSW 2300
PO Box 1162
Newcastle NSW 2300
Australia
Tel: +61 249298300
Fax: +61 249298382
www.pbworld.com
Certified to ISO 9001, ISO 14001, OHSAS 18001

## Contents

Page number
Glossary ..... iv

1. Introduction ..... 1
1.1 Study area ..... 1
1.2 Study aims ..... 2
2. Methodology ..... 4
2.1 Personnel ..... 4
2.2 Database searches ..... 4
2.3 Field survey ..... 5
2.4 Flora ..... 6
2.5 Fauna habitat assessment ..... 11
2.6 Likelihood-of-occurrence assessment ..... 12
2.7 BioBanking assessment ..... 13
2.8 Limitations ..... 13
3. Existing environment ..... 14
3.1 Landscape assessment ..... 14
3.2 Vegetation types and zones ..... 18
3.3 Fauna habitat ..... 49
3.4 Habitat and geographic features ..... 50
3.5 Threatened communities, populations and species ..... 51
4. Management actions and management plans ..... 58
4.1 Standard management actions ..... 58
4.2 Additional management actions ..... 58
5. BioBanking credit report ..... 60
5.1 Ecosystem credits ..... 60
5.2 Species credits ..... 61
6. References ..... 64

## List of tables

Table 1.1 Study area location ..... 2
Table 2.1 Study team ..... 4
Table 2.2 Database searches ..... 5
Table 2.3 Weather conditions during the site inspection ..... 6
Table $2.4 \quad$ Location of flora quadrats ..... 7
Table 2.5 Likelihood of occurrence assessment ..... 12
Table $3.1 \quad$ Study area location ..... 14
Table $3.2 \quad$ Strategic location of the BioBank site ..... 14
Table $3.3 \quad$ Vegetation cover assessment ..... 15
Table $3.4 \quad$ Summary of vegetation type ME004 Broad-leaved Ironbark - Grey Box -Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain,Sydney Basin21
Table 3.5 Summary of vegetation type ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion ..... 21
Table 3.6 Summary of vegetation type ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion ..... 22
Table 3.7 Summary of vegetation type ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion ..... 22
Table 3.8 Summary of vegetation type ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion ..... 23
Table 3.9 Summary of vegetation type ME044 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion ..... 23
Table $3.10 \quad$ Characteristics of ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion ..... 24
Table 3.11 Comparison ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion quadrat data against vegetation benchmark data ..... 26
Table $3.12 \quad$ Characteristics of ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin ..... 27Table 3.13 Comparison ME002 Broad-leaved Ironbark - Melaleuca decora shrubby openforest on clay soils of the Cumberland Plain, Sydney Basin quadrat data againstvegetation benchmark data29
Table 3.14 Characteristics of ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin ..... 30
Table 3.15 Comparison ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathywoodland of the Cumberland Plain, Sydney Basin quadrat data against vegetationbenchmark data32
Table $3.16 \quad$ Characteristics of ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion ..... 33
Table 3.17 Comparison ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion quadrat data against vegetation benchmark data ..... 35
Table $3.18 \quad$ Characteristics of ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin ..... 36
Table 3.19 Comparison ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin quadrat data against vegetation benchmark data ..... 38
Table $3.20 \quad$ Characteristics of ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin ..... 39

## List of tables (Continued)

Table 3.21 Comparison ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin quadrat data against vegetation benchmark data41
Table 3.22 Characteristics of the exotic vegetation within the study area ..... 42
Table $3.23 \quad$ Noxious weeds identified on the site ..... 44
Table $3.24 \quad$ BioBanking Plot data ..... 45
Table 3.25 Threatened species of plant with potential to occur in habitat of the study area ..... 52
Table 3.26 Threatened species of animal with potential to occur in habitat within the study area ..... 53
Table 3.27 Threatened species predicted to occur by the BioBanking calculator within the Wattle Grove Offset Area ..... 54
Table 3.28 Threatened species predicted to occur by the biobanking calculator within the Moorebank Conservation Area and Casula Offset Area ..... 55
Table 5.1 Summary of ecosystem credits ..... 60
Table 5.2 Summary of species credits ..... 63
List of figures
Page number
Figure 1.1 Locality plan ..... 3
Figure 2.1 Survey effort ..... 9
Figure 2.2 Schematic diagram illustrating the layout of the nested $20 \times 50 \mathrm{~m}$ and $20 \times 20 \mathrm{~m}$ quadrats used for the assessment of condition attributes at each site ..... 10
Figure 3.1 Mitchell landscape ..... 16
Figure 3.2 Landscape ssessment - Moorebank Conservation Area and Casula Offset Area ..... 17
Figure 3.3 Vegetation zones ..... 20
Figure $3.4 \quad$ Threatened biodiversity ..... 57
Figure 4.1 Management zones ..... 59

## List of appendices

Appendix A Species of plant recorded
Appendix B Threatened species of plant
Appendix C Threatened species of animal
Appendix D BioBanking credit report

## Glossary

BBAM

Critical Habitat

Department of the
Environment (DoE)

Department of
Environment, Climate
Change and Water
(DECCW)
Department of
Sustainability,
Environment, Water,
Population and
Communities (SEWPAC)

Department of the Environment, Water, Heritage and the Arts (DEWHA)

Ecological community
Environmental weed
Habitat An area or areas occupied, or periodically or occasionally occupied by a species, population or ecological community, including any biotic or abiotic components.

Key Threatening Processes

## Migratory species

Moorebank Intermodal Terminal (IMT)

Office of Environment and
Heritage (OEH)

| Likely | Taken to be a real chance or possibility (Department of Environment and <br> Conservation 2004). |
| :--- | :--- |
| Locality | The area within 10 km of the study area. |
| Local population | The population that occurs within the study area, unless the existence of <br> contiguous or proximal occupied habitat and the movement of individuals or <br> exchange of genetic material across the boundary can be demonstrated <br> (Department of Environment and Climate Change 2007). |
| MIC | The Moorebank Intermodal Company (MIC). |

A process that threatens, or could threaten, the survival, abundance or evolutionary development of native species, populations or ecological communities (Department of Environment and Conservation 2004). Key Threatening Processes are listed under the Threatened Species Conservation Act 1995, the Fisheries Management Act 1994 and the Environment Protection and Biodiversity Conservation Act 1999. Capitalisation of the term 'Key Threatening Processes' in this report refers to those processes listed specifically under the relevant state and Commonwealth legislation.

Taken to be a real chance or possibility (Department of Environment and Conservation 2004).

The area within 10 km of the study area.
The population that occurs within the study area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (Department of Environment and Climate Change 2007).

A defined vegetation zone that is subject to specific management actions within a biobank site.

Species protected as Migratory under the Environment Protection and Biodiversity Conservation Act 1999. Listed migratory species are those listed in the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) and Republic of Korea - Australia Migratory Bird Agreement (RoKAMBA). Listed migratory species also include any native species identified in an international agreement approved by the Minister (Matthei 1995). Capitalisation of the term 'Migratory' in this report refers to those species listed as Migratory under the Environment Protection and Biodiversity Conservation Act 1999.

The Moorebank Intermodal Terminal (IMT) is a project proposed by the Moorebank Intermodal Company that involves the construction and operation of an IMT and associated infrastructure, facilities and warehousing at Moorebank in NSW. The Project also includes a rail link connecting the IMT site to the Southern Sydney Freight Line (SSFL) and a road entry and exit points from Moorebank Avenue at Moorebank in NSW.

Following the 2010 NSW elections the NSW Department of Environment Climate Change and Water (DECCW) was abolished, is now known as the Office of Environment and Heritage, and has been incorporated into the Department of Premier and Cabinet.

Broadly, the Office of Environment and Heritage works towards a healthy environment cared for and enjoyed by the whole NSW community: manages the state's natural resources, including biodiversity, soils and natural vegetation: manages natural and cultural heritage across the state's land and waters: acts to minimise the impacts of climate change: promotes sustainable consumption, resource use and waste management: regulates activities to protect the environment: and conducts biodiversity, plant, environmental and cultural heritage research to improve decision making.

| Protected species | Those species defined as protected under the National Parks and Wildlife Act 1974. Includes all native animals, and all native plants listed on Schedule 13 of the National Parks and Wildlife Act 1974. |
| :---: | :---: |
| Region | A bioregion defined in a national system of bioregionalisation. For this study, this is the Sydney Basin Bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway \& Cresswell 1995). |
| Significant | Important, weighty, or more than ordinary (as defined by the Department of Environment and Climate Change 2007). |
| SSFL | South Sydney Freight Line. |
| Study area | The specific area that has been assessed for flora and fauna present. |
| Subject site | The extent of direct impacts from the proposal. This includes the footprint of the proposal, associated with the proposed infrastructure and potential construction work sites. |
| Threatened biodiversity | Threatened species, populations or ecological communities, or their habitats as listed under the Threatened Species Conservation Act 1995 Fisheries Management Act 1994 or the Environment Protection and Biodiversity Conservation Act 1999. <br> Capitalisation of the terms 'Threatened' in this report refers to listing under the relevant State and/or Commonwealth legislation. |
| Threatened species, populations and ecological communities | Species, populations and ecological communities listed as Vulnerable, endangered or critically endangered (collectively referred to as Threatened) under the Threatened Species Conservation Act 1995, Fisheries Management Act 1994 or the Environment Protection and Biodiversity Conservation Act 1999. <br> Capitalisation of the terms 'threatened', 'vulnerable', 'endangered' or 'critically endangered' in this report refers to listing under the relevant state and/or Commonwealth legislation. |
| Vegetation zone (VZ) | A defined area of vegetation that is identified as homogeneous based on vegetation type and condition. |
| Viable local population | A population that has the capacity to live, develop, and reproduce under normal conditions, unless the contrary can be conclusively demonstrated through analysis of records and references (Department of Environment and Climate Change 2007). |
| Weeds of National Significance | In 1998, Australian governments endorsed a framework to identify which weed species could be considered (WONS) within an agricultural, forestry and environmental context. Thirty one WONS were identified through this process (Biosis Research 2003). |

## 1. Introduction

This report provides a Biodiversity Assessment of biodiversity conservation values within three biodiversity offset sites located in the Liverpool City Council (LCC). The biodiversity offset sites are to be utilised as part of a biodiversity offset package for impacts on biodiversity associated with the proposed construction of the Moorebank IMT Project (henceforth, referred to as the Project). The proposed Project includes the construction and operation of the IMT and associated infrastructure, facilities and warehousing. The Project also includes a rail link connecting the IMT site to the Southern Sydney Freight Line (SSFL) and a road entry and exit points from Moorebank Avenue at Moorebank in NSW.

Moorebank Intermodal Company (henceforth, referred to as MIC) are investigating whether proposed biodiversity offset sites located within the LCC can be utilised as River-flat Eucalypt Forest (i.e. Riparian Forest and Alluvial Woodland), Castlereagh Swamp Woodland, Cooks River/Castlereagh Ironbark Forest and Castlereagh Scribbly Gum Woodland offsets for the Project. This Biodiversity Assessment Report has been prepared to support the establishment of a BioBanking agreement on this land.

### 1.1 Study area

The biodiversity offset sites are located on land in the Sydney suburb of Moorebank, NSW (refer Figure 1.1). The three biodiversity offset sites include:

- Wattle Grove Offset Area - management to maintain or improve the condition of vegetation and habitat of native vegetation (approximately 73.81 ha) within part of the eastern portion of Lot 3001 DP 1125930 (east of Moorebank Avenue) which adjoins the East Hills Railway Line to the south, land owned by the SIMTA consortium to the northwest, and the residential area of the Wattle Grove to the east (Figure 1.1).
- Moorebank Conservational Area - Georges River riparian zone: restoration and management of the Georges River riparian zone (approximately 32.3-38.6 ha) including the eastern side of the river corridor from approximately 300 m south of the M5 Motorway for a length of approximately 2.5 km south to the East Hills Railway Line (Figure 1.1).
- Casual Offset Area (also referred to as the 'hourglass land): restoration and management of vegetation within Lot 4 DP 1130937 which is an irregular shaped allotment (approximately 3.2 ha) on the western side of the Georges River opposite the Project site (Figure 1.1).

The sites are large and botanically diverse, containing six vegetation communities, including five endangered ecological communities (including Shale Gravel Transition Forest, Cooks River/Castlereagh Ironbark Forest, Castlereagh Scribbly Gum Woodland, Castlereagh Swamp Woodland and River-flat Eucalypt Forest) and known habitat for at least three threatened plant species: the vulnerable Grevillea parviflora subsp. parviflora Acacia pubescens, and the endangered Persoonia nutans. The site also provides habitat for threatened fauna including the Little Lorikeet, Grey-headed Flying Fox, Powerful Owl, Swift Parrot and the Eastern Bentwing-bat which are all dependent on the forest ecosystem.

In order to determine the proposed biobank site, the potential biobank footprint was subject to detailed field assessment in accordance with BioBanking Assessment Methodology 2014 (BBAM) (Seidel \& Briggs 2008). The proposed biobank footprint was then stratified into vegetation and management zones. The final proposed biobank site was determined based on management costing that could be adequately funded by the Project.

Location information for the study area is outlined in Table 1.1.

Table 1.1 Study area location

| Location information | Study area |
| :--- | :--- |
| Bioregion | Sydney Basin bioregion |
| Botanical subregion | Central Coast |
| Local government area | Liverpool |
| Catchment Management Authority, subregion | Sydney Metropolitan CMA - Georges River sub-region |

### 1.2 Study aims

The overall objective of this study was to provide supporting information required to establish a proposed BioBanking site. Specifically, this assessment aimed to:

- Complete a Biodiversity Assessment Report describing the biological characteristics of the proposed biobank site.
- Determine and describe the characteristics and condition of the vegetation communities and flora and fauna habitats.
- Determine the occurrence, or likelihood of occurrence within the study area, of threatened species, populations and communities (biodiversity) listed under the NSW Threatened Species Conservation Act 1995, Fisheries Management Act 1994 and Commonwealth Environmental Protection and Biodiversity Conservation Act 1999.
- Complete a Biodiversity Credit Report using the BioBanking credit calculator to set out the number and type of biodiversity credits that will be created from the proposed BioBanking site.



## 2. Methodology

The biodiversity assessment for the proposed biobank site included desk-based searches of relevant databases and historical records, as well as field inspections of the study area. This section outlines the specific methods used to survey and assess biodiversity within and surrounding the study area.

### 2.1 Personnel

The contributors to the preparation of this paper, their qualifications and roles are listed in Table 2.1.
Table 2.1 Study team

| Name | Qualifications | Position and role |
| :--- | :--- | :--- |
| Paul Rossington | BSc, Dip WIdMgt | Senior Ecologist - field surveys |
| Tanya Bangel | BSc (Hons) | Senior Ecologist - field surveys, report preparation |
| Debbie Landenberger | BSc (Hons) | Ecologist - field surveys |
| Kim Lentz | BSc | Ecologist - field surveys |
| Troy Jennings | BSc | Graduate Ecologist - field surveys |
| Alex Cockerill | BSc (Hons), Accredited <br> BioBanking assessor | BioBanking assessment, calculations and reporting |

All work was carried out under the appropriate licences, including scientific licences as required under Clause 22 of the National Parks and Wildlife Regulations 2002, Section 132C of the NPW Act (License Number: SL100630) as well as an animal research authority issued by the Department of Trade and Investment, Regional Infrastructure and Services (Primary Industries).

### 2.2 Database searches

The aim of this background research was to identify threatened flora and fauna species, populations and ecological communities; Commonwealth listed Migratory species or critical habitat recorded previously or predicted to occur in the vicinity of the study area.

This allowed the known habitat characteristics to be compared with those of the study area to determinate the likelihood of occurrence of each species or population. This assessment included a review of:

- Research papers, books and other published data.
- Aerial photographs.
- The Native Vegetation of the Cumberland Plain, Wester Sydney and recent update (Tozer 2003; Tozer et al. 2006)
- Moorebank Intermodal Freight Terminal - Ecological Impact Assessment (ENSR Australia 2008)
- Moorebank Intermodal Terminal - Biodiversity Offset Strategy (Parsons Brinckerhoff 2014)
- Database searches (refer Table 2.2 and Appendix A and B).

Table 2.2 Database searches

| Database | Date of search | Search area | Reference |
| :--- | :--- | :--- | :--- |
| Bionet Atlas of NSW <br> Wildlife | 29 April 2014 | $10 \mathrm{~km} \times 10 \mathrm{~km}$ locality search | Office of Environment and <br> Heritage (2015a) |
| PlantNet Database | 29 April 2014 | $10 \mathrm{~km} \times 10 \mathrm{~km}$ locality search | Royal Botanic Gardens (2015) |
| EPBC Protected Matters <br> Search Tool | 29 April 2014 | $10 \mathrm{~km} \times 10 \mathrm{~km}$ locality search | Department of the Environment <br> $(2015 \mathrm{~b})$ |
| NSW Threatened Aquatic <br> Fauna Database | 29 April 2014 | Hawkesbury Nepean CMA | Department of Trade and <br> Investment Regional Infrastructure <br> and Services (2015b) |

### 2.2.1 Nomenclature

Names of vegetation communities used in this report are based on the Plant Community Type (PCT) used in the NSW Vegetation Information System (VIS) Classification 2.1 Database (Office of Environment \& Heritage 2014d).

These names are cross-referenced with those used for threatened ecological communities listed under the Threatened Species Conservation Act 1995 and/or the Environment Protection and Biodiversity Conservation Act 1999 Act. They are also cross-referenced with (Tozer 2003; Tozer et al. 2006) previous vegetation mapping by in 'The Native Vegetation of the Cumberland Plain, Wester Sydney' and recent update using dominant species and structure of the community.

Names of plants used in this document follow Harden (Harden 1992, 1993, 2000, 2002) with reference to PlantNet (Royal Botanic Gardens 2015) for recent taxonomic changes. Scientific names are used in this report for species of plant. Scientific and common names (where available) are provided in plant lists in Appendices A and C. The names of introduced species are denoted with an asterisk (*).

For threatened species of plants, the names used in the OEH Threatened Species Website (Office of Environment and Heritage 2015b) are also provided in the tabulated data in Appendices A and B where these differ from the names used by Harden or the PlantNet database.

Names of vertebrate fauna follow the Australian Faunal Directory maintained by the Department of the Environment (Department of the Environment 2015a). Common names are used in the report for species of animal. Scientific names are included in species lists found in Appendices B and D.

For threatened species of animals, the names used in the OEH Threatened Species Website and NSW Department of Trade and Investment Regional Investment Regional Infrastructure and Services Threatened and Protected species website (Department of Trade and Investment Regional Infrastructure and Services 2015b; Office of Environment and Heritage 2015b) are also provided in the tabulated data in Appendices C where these differ from the names used by the Australian Faunal Database.

### 2.3 Field survey

The study area was inspected during daylight hours by a team of two ecologists on 5, 20, 21, 22, 23, 26 and 27 May 2014 and by two ecologists on 30 April 2015 and 1 May 2015.

Field surveys were conducted in accordance with BBAM (Seidel \& Briggs 2008) as described in Section 2.4 and 2.5 of this report.

### 2.3.1 Weather conditions

Weather conditions were generally warm with some light winds (Table 2.3). No rainfall was recorded during the 2014 survey however light rainfall was recorded $(\sim 7.2 \mathrm{~mm})$ during the April and May 2015 survey period.

Table 2.3 Weather conditions during the site inspection

| Date | Qualifications |  | Rain (mm) | Wind speed (km/h) / <br> Direction |
| :--- | :---: | :---: | :---: | :---: |
|  | Min $\left({ }^{\circ} \mathrm{C}\right)$ | Max $\left({ }^{\circ} \mathrm{C}\right)$ |  |  |

(1) Data from Bureau of Meteorology (Bureau of Meteorology 2015) - Holsworthy Aerodrome (station 0666161)

### 2.4 Flora

The floristic diversity and possible presence of threat-listed species was assessed using a combination of random meander and plot-based (quadrat/transect) surveys in accordance with BBAM (Seidel \& Briggs 2008).

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random manner throughout the Study Area recording species observed, boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation patch was generally proportional to the size of the patch and its species richness.

### 2.4.1 Field verification of existing vegetation mapping

Vegetation within the study area and locality had already been mapped at the regional scale in the Native Vegetation of the Cumberland Plain, Wester Sydney and update (Tozer 2003; Tozer et al. 2006). Data on geology, dominant canopy species, native diversity, vegetation structure and condition was collected across the study area to validate and refine this existing vegetation classification to determine their classification as Plant Community Types (PCTs) required to be used by BBAM in the BioBanking assessment and the delineation of vegetation type boundaries.

### 2.4.2 Quadrat and transect surveys

35 quantitative (quadrat/transect) site surveys (Table 2.4 and Figure 2.1) were undertaken as outlined in the methodology contained within the BBAM (Seidel \& Briggs 2008) as described below. Figure 2.2 illustrates the plot layout that was used at each BioBanking site.

Table 2.4 Location of flora quadrats

| Plot | Easting | Northing | Orientation (magnetic <br> degrees from North) |
| :---: | :---: | :---: | :---: |

Wattle Grove Offset Area

| BB1 | 309165 | 6241019 | 270 |
| :---: | :---: | :---: | :---: |
| BB2 | 309248 | 6240883 | 30 |
| BB3 | 309209 | 6240882 | 15 |
| BB4 | 308759 | 6240894 | 0 |
| BB5 | 308668 | 6240908 | 80 |
| BB6 | 309049 | 6240719 | 230 |
| BB7 | 308756 | 6240675 | 50 |
| BB8 | 308660 | 6240536 | 50 |
| BB9 | 308866 | 6240798 | 270 |
| BB10 | 308635 | 6240487 | 100 |
| BB11 | 308655 | 6240245 | 60 |
| BB12 | 308826 | 6239938 | 330 |
| BB13 | 308837 | 6240092 | 160 |
| BB14 | 308916 | 6240340 | 230 |
| BB15 | 308573 | 6240149 | 75 |
| BB16 | 308569 | 6240050 | 85 |
| BB17 | 309074 | 6241131 | 270 |
| Q1N | 309154 | 6241152 | 98 |

Moorebank Conservation Area and Casula Offset Area

| Q1 | 307012 | 6241153 | 5 |
| :---: | :---: | :---: | :---: |
| Q3 | 307142 | 6241045 | 20 |
| Q16 | 307042 | 6240933 | 5 |
| Q17 | 307288 | 6239922 | 195 |
| Q19 | 307294 | 6241051 | 105 |
| Q20 $^{\text {Q31 }}$ | 307186 | 6240476 | 345 |
| Q33 $^{3}$ | 307466 | 6241638 | 195 |
| Q34 $_{\text {Q35 }}^{\text {Q36 }}$ | 307995 | 6241307 | 10 |
| Q37 | 309154 | 6241152 | 138 |
| Q38 | 309154 | 6241152 | 130 |
|  | 309154 | 6241152 | 168 |
|  | 309154 | 6241152 | 153 |
|  | 309154 | 6241152 | 336 |


| Plot | Easting | Northing | Orientation (magnetic <br> degrees from North) |
| :---: | :---: | :---: | :---: |
| Q39 | 309154 | 6241152 | 238 |
| Q2N | 309154 | 6241152 | 10 |
| Q3N | 309154 | 6241152 | 27 |
| Q4N | 309154 | 6241152 | 189 |

(1) Co-ordinate System = GDA 94 Zone 56
(2) Plot sampled within potential biobank footprint although located outside the final proposed biobank site
(3) Quadrats from the Moorebank development site that are representative of the ME018 (Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin) vegetation community.



Figure 2.2 Schematic diagram illustrating the layout of the nested $20 \times 50 \mathrm{~m}$ and $20 \times 20 \mathrm{~m}$ quadrats used for the assessment of condition attributes at each site

The following site attributes were recorded at each site:

- Location (easting - northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition. Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer. Vegetation condition was described in terms of the categories described in section 2.1.4.
- Native and exotic species richness (within a 400 m 2 quadrat): This consisted of recording all species by systematically walking through each $20 \times 20 \mathrm{~m}$ quadrat. The cover abundance (percentage of area of quadrat covered) of each species was estimated.
- Number of trees with hollows ( $1,000 \mathrm{~m} 2$ quadrat): This was the frequency of hollows within living and dead trees within each $50 \times 20 \mathrm{~m}$ quadrat. A hollow was only recorded if (a) the entrance could be seen:
(b) the estimated entrance width was at least 5 cm across:
(c) the hollow appeared to have depth:
(d) the hollow was at least 1 m above the ground and the (e) the centre of the tree was located within the sampled quadrat.
- Total length of fallen logs (1,000 m2 quadrat): This was the cumulative total of logs within each 50 x 20 m quadrat with a diameter of at least 10 cm and a length of at least 0.5 m .
- Native overstorey cover: This consisted of estimating the percentage foliage projective cover of the tallest woody stratum present ( $>1 \mathrm{~m}$ and including emergents). The woody stratum included species that were native to New South Wales including both indigenous and non-indigenous native species.
- Native mid-storey cover: This involved estimating the foliage projective cover of vegetation between the overstorey stratum and a height of 1 m (i.e. tall shrubs, under-storey trees and tree regeneration).
- Ground cover: This comprised estimating the foliage projective cover of plants below 1 m in height. The following categories of plants were recorded:
- Native ground cover (grasses): native grasses (Poaceae family native to NSW).
- Native ground cover (shrubs): all woody vegetation below 1 m in height and native to New South Wales.
- Native ground cover (other): non-woody vegetation (i.e. vascular plants - ferns and herbs) below 1 m in height and native to New South Wales.
- Exotic plant cover: vascular plants not native to Australia.
- Evaluation of regeneration: This was estimated as the proportion of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height $\leq 5 \mathrm{~cm}$ ). The maximum value for this measure was 1 .


### 2.4.3 Condition of vegetation communities

The condition of vegetation was assessed firstly against the BBAM definitions of 'low' and 'moderate to good' broad conditions and secondly against the BioBanking condition benchmark data for the relevant vegetation type and other parameters such as intactness, diversity, history of disturbance, weed invasion and health.

Under BBAM, vegetation in 'low' broad condition is:
a) woody native vegetation with native over-storey percent foliage cover less than $25 \%$ of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and where either: less than $50 \%$ of ground cover vegetation is indigenous species, or greater than $90 \%$ of ground cover vegetation is cleared

OR
b) native grassland, wetland or herbfield where either: - less than $50 \%$ of ground cover vegetation is indigenous species, or more than $90 \%$ of ground cover vegetation is cleared.
'Moderate to good' broad condition is native vegetation that is not in 'low' broad condition.
All vegetation sampled within the proposed biobank site was identified to fall within the 'moderate to good' broad condition class as defined under the BBAM (Office of Environment \& Heritage 2014c).

Three condition sub-categories within the 'moderate to good' broad BBAM condition class were used to further define the condition of the vegetation using factors such as levels of disturbance, weed invasion, resilience and comparison with BioBanking benchmark data:

- Condition sub-category 'High quality condition': Vegetation still retains the species complement and structural characteristics of the pre-European equivalent. The vegetation displays resilience to weed invasion due to intact groundcover, shrub and canopy layers. Native species diversity is relatively high. Weeds may exist in this vegetation type but exhibit $<5 \%$ foliage cover.
- Condition sub-category 'Medium quality condition': Vegetation has retained a native canopy (greater than or equal to $25 \%$ of the lower benchmark value) but the understorey and groundcover layers are generally co-dominated by exotic species that exhibit between 5-40\% foliage cover.
- Condition sub-category 'Poor quality condition': Vegetation has retained a native canopy (greater than or equal to $25 \%$ of the lower benchmark value) but the understorey and groundcover layers are generally dominated or co-dominated by exotic species that exhibit between $41-70 \%$ foliage cover. Native species diversity is generally relatively low and the mid and low stratums have been structurally modified due to weed incursions.

These sub-categories are based on a modified version of the Weed Invasion Mapping method developed by the Hawkesbury-Nepean Catchment Management Trust (2000).

### 2.5 Fauna habitat assessment

The fauna habitat assessment was derived from BBAM (Office of Environment \& Heritage 2014c) data collected during the plot and transect surveys. Fauna habitat assessments data was used not only for biobank credit calculations but also to assess the likelihood of threatened species of animal (those species known or predicted to occur within the locality from the literature and database review) occurring within the study area. Fauna habitat characteristics assessed included:

- Structure and floristic diversity of the canopy, understorey and ground vegetation.
- Presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles.
- Presence of fallen timber and potential to provide protection for ground-dwelling mammals, reptiles and amphibians.
- Presence of waterways (ephemeral or permanent) and water bodies.

The following criteria were used to evaluate the condition of habitat values:

- Good: A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- Moderate: Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- Poor: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.


### 2.6 Likelihood-of-occurrence assessment

The likelihood of threatened and migratory and threatened species populations occurring within the study area was assessed against the criteria outlined in Table 2.5.

Species subject to likelihood-of-occurrence assessments were those identified during the desktop and fieldbased investigations and any additional species considered having the potential to occur in the professional opinion of contributors to this assessment.

Table 2.5 Likelihood of occurrence assessment

| Likelihood-ofoccurrence | Criteria |
| :---: | :---: |
| Low | - Have not been recorded previously in the study area and surrounds which are beyond the current known geographic range. <br> - Are dependent on specific habitat types or resources that are not present in the study area. <br> - Are considered extinct in the locality. |
| Moderate | - Have been recorded previously infrequently in the study area and surrounds (i.e. vagrant individuals). <br> - Use habitat types or resources that are present in the study area, although resources are generally in a poor or modified condition. <br> - Are unlikely to maintain sedentary populations, however may utilise resources within the study area opportunistically when resources seasonally available or during migration. |
| High | - Have been previously recorded in the study area. <br> - Are dependent on habitat types or resources that are present in the study area that are abundant and/or in good condition within the study area. <br> - Are known or likely to maintain resident populations surrounding the study area. <br> - Are known or likely to visit the study area or surrounds during regular seasonal movements or migration. |
| Recorded | - Recorded in the study area during current field study. |

### 2.7 BioBanking assessment

The BioBanking credit calculator was used to provide a calculation of the number and class of biodiversity credits required to ensure maintenance or improvement in biodiversity. Quantitative (quadrat \& transect) site surveys were undertaken following the methodology contained the BBAM (Seidel \& Briggs 2008) and as outlined in Section 3.1.

### 2.8 Limitations

No sampling technique can totally eliminate the possibility that a species is present on a site. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present on site during surveys. The conclusions in this report are based upon data acquired for the site and the environmental field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of species. Also, it should be recognised that site conditions, including the presence of threatened species, can change with time.

Where surveys were conducted outside the optimal time for detecting a particular species, or field surveys were of limited scope, a precautionary approach was taken and it was assumed that the species was present if suitable habitat was observed.

The data used in the assessment is based on results of the field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of survey, including the presence or otherwise of species. For species where the timing of surveys was not appropriate for detection, a precautionary approach was taken and surveys focussed on detection of areas of potential habitat for these species.

## 3. Existing environment

### 3.1 Landscape assessment

An assessment of the landscape value of the potential BioBanking site was undertaken in accordance with Appendix 6 of the BBAM (Office of Environment \& Heritage 2014c). A summary of the landscape feature is provided in Table 3.1.

Table 3.1 Study area location

| Location information | Study area |
| :--- | :--- |
| Council | Liverpool |
| Catchment Management Authority | Sydney Metro CMA, Cumberland sub-region ${ }^{1}$ |
| IBRA sub-region | Cumberland |
| Mitchell Landscape | Georges River Alluvial Plain ${ }^{(1)}$ |

(1) While the Moorebank Site is located within the Georges River Alluvial Plain Mitchel Landscape there is a fault in the Framework for Biodiversity Credit Calculator Version 1.03 that prevents the Georges River Alluvial Plain to be entered therefore the Cumberland Mitchell Landscape has been used as a default (John Seidel 2014).

### 3.1.1 Strategic location

The site is located within an urban setting fringed by residential and urban development and roads. The site is connected to a series of bushland reserves and parks that follow Georges River and the adjoin bushland remnants associated with the Defence lands to the south.

An assessment of the site against the criteria defining a 'Strategic Location' was undertaken. While the Georges River and bushland reserves within the Defence lands are considered to be important local corridors they have not been formally identified as regional conservation links approved by the director and as such are not considered to meet the regional corridor criteria.

The site does incorporate both sides of the riparian buffer to the fifth order George River and as such meets the stream order 'Strategic location' criteria as defined within Table 25 of Appendix 6 of the BBAM (Office of Environment \& Heritage 2014c).

Given the site is identified within a strategic location assessment of connectivity value is not required and the score for connectivity value is included in the category of the strategic location.

A summary of the strategic location landscape assessment is summarised in Table 3.2.
Table 3.2 Strategic location of the BioBank site

| Site | Strategic location | Connectivity description | Score |
| :--- | :--- | :--- | :--- |
| Georges River <br> BioBank site | Riparian buffer area on <br> both sides of a 5th order <br> stream | The site does incorporates both side of the <br> riparian buffer to the fifth order Georges <br> River and is within a patch size >1000 ha | 15 |

### 3.1.2 Native vegetation cover

To assess percent current extent of native vegetation cover a 100 ha circle and a 1000 ha circle were placed centred on the site (refer Figure 3.2). The native vegetation cover within these circles was calculated in accordance with Appendix 6 of the BBAM (Office of Environment \& Heritage 2014c) and is summarised in Table 3.3. The Wattle Grove Offset Area is almost completely vegetated; revegetation and rehabilitation will not result in a change in the vegetation cover class. Alternatively, the Moorebank Conservation Area and Casula Offset Area will involve substantial revegetation and restoration of the Georges River riparian corridor to significantly improving the existing vegetation condition and width.

Table 3.3 Vegetation cover assessment

| Assessment <br> circle | Area | Native vegetation cover (\%) |  | Comments / assumptions |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Current extent | Future extent |  |

### 3.1.3 Patch size

Patch size is defined under the BBAM (Office of Environment \& Heritage 2014c) as an area of native vegetation that:
a) occurs on the development site or biobank site, and
b) is in moderate to good condition, and
c) includes native vegetation that has a gap of less than 100 m from the next area of moderate to good native vegetation (or $\leq 30 \mathrm{~m}$ for non woody ecosystems).
Patch size may extend onto adjoining land that is not part of the development site or biobank site.
Patch size for the potential biobank site has been determined in accordance with Table 31 of Appendix 6 of the BBAM (Office of Environment \& Heritage 2014c) where the percent of native vegetation cleared in the Mitchell landscape - Cumberland Plain is $<30 \%$ and the patch size class is estimated as extra-large $>1000$ ha giving a total patch size score of 12.

Table 31: Criteria for assessing patch size

| Patch size <br> class | Percent native vegetation cleared in the Mitchell landscape in <br> which most of the biobank site occurs |  |  | Patch <br> size <br> score |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | $<30 \%$ | $30-70 \%$ | $>70-90 \%$ | $>90 \%$ | $>50$ ha |
| Extra large | $>1000$ ha | $>200$ ha | $>100$ ha | $>12$ |  |
| Very large | $>500-1000$ ha | $>100-200$ ha | $>50-100$ ha | $>20-50$ ha | 9 |
| Large | $>200-500$ ha | $>50-100$ ha | $>20-50$ ha | $>10-20$ ha | 6 |
| Medium | $>100-200$ ha | $>20-50$ ha | $>10-20$ ha | $>1-10$ ha | 3 |
| Small | $\leq 100$ ha | $\leq 20$ ha | $\leq 10$ ha | $\leq 1$ ha | 1 |
| nil | 0 | 0 | 0 | 0 | 0 |


| Legend |
| :---: |
| Moorebank conservation biobank site boundary |
| Wattle Grove offset biobank site boundary |
| Casula (Hourglass) offset biobank site boundary |
| Mitchell landscape |
| Asp - Ashfield Plains |
| Cpl - Cumberland Plain |
| - Georges River Alluvial Plain |
| Drainage |


Moorebank Intermodal
Biobank Offset Areas
Figure 3.1 Mitchell landscape
250
$250 \quad 500 \mathrm{~m}$
Moorebank conservation biobank
site boundary
Casula (Hourglass) offset biobank
site boundary
Wattle Grove offset biobank
site boundary
100 ha landscape assessment
circle
1000 ha landscape assessment
circle
Remnant vegetation

## 307000

## 306000



### 3.2 Vegetation types and zones

### 3.2.1 Vegetation types

### 3.2.1.1 Wattle Grove Offset Area

The vegetation within the Wattle Grove Offset Area consisted predominantly on remnant and regrowth vegetation that has been subjected to minor weed invasion in small areas. Areas of more intense weed invasion, where introduced species are dominant in the ground layer, are limited to the periphery of the site and along the existing rail way track that intersects the lower portion of the site. There is also a linear patch of regrowth vegetation that occurs to the north-east of the site which has been subjected to vegetation maintenance as a bush fire break and access track (Figure 3.3).

The majority of the vegetation within the proposed biobank site consists of remnant forest vegetation that has been recorded to be of good to moderate condition which are representative of the following four vegetation types within the Sydney Metro CMA, Cumberland IBRA subregion:

- ME004: Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin.
- ME002: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin.
- ME003: Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.
- ME005: Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin.


### 3.2.1.2 Moorebank Conservation Area and Casula Offset Area

The vegetation within the Morrebank Conservation and Casula Offset Areas varied from patches with native species dominant in all vegetation layers to patches with the understorey and ground layer dominated by introduced vines and shrubs (e.g. *Lantana camara, *Privet spp. and *Cardiospermum grandiflorum). The sites also included areas with dirt/gravel vehicle paths, small patches of bare ground with minimal vegetation and concrete pads (Figure 3.3).

The majority of the vegetation within the proposed Moorebank Conservation Area and Casula Offset Area consisted of remnant vegetation that has been recorded in good to moderate condition and representative of the following vegetation types within the Sydney Metro CMA, Cumberland IBRA subregion:

- ME018: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin
- ME044: Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin.

In additional to the native vegetation communities outlined above each of the offset sites contained areas consisting predominantly of introduced species. This exotic vegetation has been split into two vegetation types; exotic woody vegetation and exotic grassland.

The offset sites contain in total six native vegetation communities and two exotic vegetation communities which are illustrated in Figure 3.3 and described in Tables 3.4 to 3.21.

### 3.2.2 Vegetation zones

Modification to these vegetation types has occurred as the result of:

- edge effects from adjoining urban development such as:
- road infrastructure; e.g. Moorebank Avenue and internal road network within the Defence land
- Defence infrastructure; e.g. internal road network, training grounds and buildings
- foot paths and fire trails within the vegetation remnants
- sewerage and stormwater infrastructure leading to weed infestations around point source outlets and sewer pipe leaks
- rubbish dumping
- invasion by exotic species of plant such as Lantana (Lanatana camara*), Wandering Jew (Tradescantia albiflora*) and privets (Ligustrum spp.*).

These modifications have resulted in six native vegetation types, two exotic vegetation types, four condition categories and thirteen vegetation zones which are presented in Tables 3.4 to 3.21 .
$\qquad$
Data source：
Parsons Brinckerhoff 2015；
of the Department of Finance and Services） 2012

Table 3.4 Summary of vegetation type ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin

| Vegetation zone | ME004_1 | ME004_2 |
| :--- | :--- | :--- |
| Vegetation formation | Sydney Sand Flats Dry Sclerophyll Forests |  |
| PCT/BVT codes | 724 / ME004 |  |
| PCT name | Broad-leaved Ironbark_Grey Box - Melaleuca decora grassy open forest on <br> clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion |  |
| Cumberland Plain Mapping <br> (Tozer, 2003) | Shale/Gravel Transition Forest <br> BBAM broad condition <br> class <br> Condition sub-category <br> Moderate to good <br> Moderate to good (high quality <br> condition) | Moderate to good (medium quality <br> condition) |
| Area (ha) | 13.67 | 0.05 |
| Plots | Q4 | Q5N |

Table 3.5 Summary of vegetation type ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion

| Vegetation zone | ME002_1 |
| :--- | :--- |
| Vegetation formation | Dry Sclerophyll forests (Shrub/grass) |
| PCT/BVT codes | 725 / ME002 |
| PCT name | Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the <br> Cumberland Plain, Sydney Basin Bioregion |
| Cumberland Plain Mapping <br> (Tozer, 2003) | Cooks River Castlereagh Ironbark Forest |
| BBAM broad condition <br> class | Moderate to good |
| Condition sub-category | Moderate to good (high quality condition) |
| Area (ha) | 13.07 |
| Plots | Q10 <br> Q13 <br> Q16 |

Table 3.6 Summary of vegetation type ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion

| Vegetation zone | ME003_1 | ME003_2 |
| :--- | :--- | :--- |
| Vegetation formation | Dry Sclerophyll forests (Shrubby) |  |
| PCT/BVT codes | 883 / ME003 | Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the <br> Cumberland Plain, Sydney Basin Bioregion |
| PCT name | Castlereagh Scribbly Gum Woodland |  |
| Cumberland Plain Mapping <br> (Tozer, 2003) | Moderate to good | Moderate to good (medium quality <br> condition) |
| BBAM broad condition <br> class | Moderate to good (high quality <br> condition) | 2.41 |
| Condition sub-category | 31.55 | Q2 |
| Area (ha) | Q1 | 100 |
| P9 | Q11 <br> Q15 |  |

Table 3.7 Summary of vegetation type ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion

| Vegetation zone | ME005_1 |
| :--- | :--- |
| Vegetation formation | Dry Sclerophyll forests (Shrub/grass) |
| PCT/BVT codes | 1067 / ME005 |
| PCT name | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, <br> Sydney Basin Bioregion |
| Cumberland Plain Mapping <br> (Tozer, 2003) | Castlereagh Swamp Woodland |
| BBAM broad condition <br> class | Moderate to good |
| Condition sub-category | Moderate to good (high quality condition) |
| Area (ha) | 23.54 |
| Plots | Q3 |

Table 3.8 Summary of vegetation type ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

| Vegetation zone | ME018_1 | ME018_2 |  |
| :--- | :--- | :--- | :--- |
| Vegetation formation | Grassy Woodlands |  |  |
| PCT/BVT codes | 835 / ME018 |  |  |
| PCT name | Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the <br> Cumberland Plain, Sydney Basin Bioregion |  |  |
| Cumberland Plain Mapping <br> (Tozer, 2003) | Alluvial Woodland |  |  |
| BBAM broad condition <br> class | Moderate to good | Moderate to good (poor <br> quality condition) |  |
| Condition sub-category | Moderate to good (high <br> quality condition) | Moderate to good <br> (medium quality <br> condition) | 2.73 |
| Area (ha) | 0.63 | 2.29 | Q38 <br> Q36 |
| Plots | Q2N | Q33 <br> Q3N |  |

Table 3.9 Summary of vegetation type ME044 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

| Vegetation zone | ME044_1 | ME044_2 |
| :--- | :--- | :--- |
| Vegetation formation | Wet Sclerophyll Forests (Shrubby subformation) |  |
| PCT/BVT codes | 1245 / ME044 |  |
| PCT name | Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered <br> slopes, southern Sydney Basin Bioregion |  |
| Cumberland Plain Mapping <br> (Tozer, 2003) | Riparian Forest |  |
| BBAM broad condition <br> class | Moderate to good | Moderate to good (poor quality <br> condition) |
| Condition sub-category | Moderate to good (medium quality <br> condition) | 5.50 |
| Area (ha) | 10.74 | Q16 |
| Plots | Q1 <br> Q3 <br> Q17 | Q31 |

### 3.2.3 ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin

Vegetation mapping of the study area identified the presence of Broad-leaved Ironbark - Grey Box Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin corresponding to the Shale Gravel Transition Forest community described in 'Native Vegetation of the Cumberland Plain, Wester Sydney'(Tozer 2003). The occurrence of this community was confirmed during site surveys. The community occurred within the north-west corner of the Wattle Grove Offset Area and was not recorded within the Moorebank Conservation Area or Casula Offset Area. The vegetation type corresponds to the PCT described as ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion. This was confirmed during the site surveys. It covers approximately 13.09 ha equivalent to $15 \%$ of the Wattle Grove Offset Area or $11 \%$ of the combined offset areas. The vegetation characteristics of this community and its sub-category types are summarised in Table 3.10. A comparison of this vegetation type against vegetation benchmark data is presented in Table 3.11.

Table 3.10 Characteristics of ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion

| Conservation significance | This community corresponds to the endangered ecological community of Shale Gravel Transition Forest in the Sydney Basin Bioregion under the TSC Act and as a critically endangered ecological community Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest under the EPBC Act |  |  |
| :---: | :---: | :---: | :---: |
| Condition | This community met the good to moderate BBAM condition class and has been further split into the two sub-categories which are described below: |  |  |
|  | ME004_1 (high quality condition): all vegetation layers within this sub-category retained native species which complements the structural characteristics of the pre-European equivalent. The vegetation displayed moderate to high native species diversity with minimal weed species present. |  |  |
|  | ME004_2 (moderate quality condition): the vegetation had retained a native canopy cover canopy that predominately included Eucalyptus fibrosa and Eucalyptus tereticornis. Although the canopy cover was native the understorey and groundcover layers were co-dominated by both native and exotic species such as Eragrostis curvula* and Pennisetum clandestinum*. |  |  |
|  | This vegetation community occurred only within the Wattle Grove Offset Area as a solid patch to the north-west of the site. |  |  |
| Strata | Height range (m) | Foliage cover (\%) | Dominant species |
| Canopy | 10-20 | 0-40 | Eucalyptus fibrosa and Eucalyptus tereticornis. |
| Sub-canopy | 4-8 | 0-40 | Melaleuca decora and Acacia decurrens. |
| Shrub stratum | 0.4-3 | 0-60 | Bursaria spinosa, Allocasuarina sp., Pultenaea villosa, Acacia falcata, Ozothamnus diosmifolius, Exocarpos cupressiformis, Bossiaea heterophylla, Persoonia linearis, Monotoca scoparia, Daviesia ulicifolia, Melaleuca nodosa and Notelaea Iongifolia. |
| Ground cover | 0.1-1 | 0-60 | Lomandra multiflora, Lepidosperma laterale, Microlaena stipoides, Panicum simile, Dichondra repens, Entolasia stricta, Desmodium varians, Cheilanthes sieberi, Digitaria parviflora, Lomandra filiformis, Glycine clandestina, Sporobolus creber, Einadia nutans, Eragrostis spp., Aristda vagans, Glycine tabacina, Opercularia spp., Pomax umbellata, Cymbopogon refractus, Echinopogon caespitosus, Poa spp. and Hardenbergia violacea. |

ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion

Moorebank Intermodal Company Biodiversity Offset Areas - Biodiversity Assessment Report
Table 3.11 Comparison ME004 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion quadrat data against vegetation benchmark data

| Plot | Plant species richness | Native overstorey (\% cover) | Native midstorey cover (\% cover) | Native groundcover (\% cover) |  |  | Number of trees with hollows | Exotic plant cover | Length of fallen timber (m) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Grasses | Shrubs | Other |  |  |  |  |
| Benchmark ${ }^{(1)}$ | 38 | 15.1-25.6 | 13.8-30.3 | 14.7-24.6 | 0-10 | 14.7-24.6 | 0 |  | 0 |  |
| Q4 | 27 | 45 | $2.5 *$ | 15 | 2 | 14 | 3 | 0 | 32 | Moderate to Good (high quality) |
| Q5 | 19 | 17 | 0 * | 30 | 11 | 8 | 1 | 0 | 8 | Moderate to Good (high quality) |
| Q7 | 25 | 38 | 14.5 | 24 | 5 | 17 | 1 | 0 | 37 | Moderate to Good (high quality) |
| Q8 | 22 | 34 | 11 | 5 | 2 | 43 | 1 | 0 | 16 | Moderate to Good (high quality) |
| Q1N | 24 | 0 * | 6.5 | 68 | 6 | 8 | 0 | 14 | 0 | Moderate to Good (medium quality) |

 (Office of Environment \& Heritage 2014d): Red font indicates results below benchmark value: * indicates, less than $25 \%$ of lower benchmark value.

### 3.2.4 ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin

Vegetation mapping of the study area identified the presence of Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin corresponding to the Castlereagh Ironbark Forest community described in 'Native Vegetation of the Cumberland Plain, Wester Sydney' (Tozer 2003). This was confirmed during the site surveys. The vegetation type corresponds to the PCT described as ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin. It covers approximately 13.07 ha equivalent to $15 \%$ of the Wattle Grove Offset Area and $10 \%$ of the combined offsets. The vegetation characteristics of this community and its sub-categories are summarised in Table 3.12. A comparison of this vegetation type against vegetation benchmark data is presented in Table 3.13.

Table 3.12 Characteristics of ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin

ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin

| Conservation significance | Corresponds to the endangered ecological community of Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion under the TSC Act and the critically endangered ecological community Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion listed under the EPBC Act. |  |  |
| :---: | :---: | :---: | :---: |
| Condition | This community met the good to moderate BBAM condition class and was consistent with the high quality condition sub-category. |  |  |
|  | ME002_1 (high quality condition): all vegetation layers within this sub-category retained native species which complements the structural characteristics of the pre-European equivalent. The vegetation displayed moderate to high native species diversity with minimal weed species present |  |  |
|  | This vegetation community occurred only within the Wattle Grove Offset Area as isolated patches throughout the site. |  |  |
| Strata | Height range (m) | Foliage cover (\%) | Dominant species |
| Canopy | 15-20 | 0-40 | Eucalyptus fibrosa, Eucalyptus parramattensis subsp. parramattensis, Eucalyptus tereticornis and the occasional Eucalyptus sclerophylla. |
| Sub-canopy | 4-10 | 0-30 | Acacia decurrens, Melaleuca decora and juvenile Eucalypts. |
| Shrub stratum | 1-3 | 0-80 | Melaleuca nodosa, Bursaria spinosa, Lissanthe strigosa, Notelaea Iongifolia, Pultenaea villosa, Acacia falcata, Hakea sericea, Davesia ulicifolia, Callistemon linearis, Exocarpos cupressiformis and Melaleuca thymifolia. |
| Ground cover | 0.1-1 | 0-30 | Lomandra filiformis, Entolasia stricta, Lepidosperma laterale, <br> Dianella revoluta, Lomandra multiflora, Lomandra longifolia, Aristida vagans, Pratia purpurascens, Glycine clandestina, Hardenbergia violaceae. Microlaena stipoides, Themeda australis, Panicum simile,Pos spp., Xanthorrhoea minor, Aristida warburgii, Pseuderanthemum variabile, Imperata cylindrica and Lagenophora stipitata. |

ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin

Moorebank Intermodal Company Biodiversity Offset Areas - Biodiversity Assessment Report
Table 3.13 Comparison ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin quadrat data against vegetation benchmark data

| Plot | Plant species richness | Native overstorey (\% cover) | Native midstorey cover (\% cover) | Native groundcover (\% cover) |  |  | Number of trees with hollows | Exotic plant cover | Length of fallen timber (m) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Grasses | Shrubs | Other |  |  |  |  |
| Benchmark ${ }^{(1)}$ | 34 | 16.5-21.5 | 25.5-40.5 | 10.5-16.5 | 0-10 | 10.5-16.5 | 0 |  | 0 |  |
| Q10 | 22 | 51.5 | 16.5 | 6 | 10 | 30 | 3 | 0 | 20 | Moderate to Good (high quality) |
| Q13 | 27 | 51.5 | 13 | 5 | 8 | 25 | 7 | 0 | 13 | Moderate to Good (high quality) |
| Q16 | 21 | 33.5 | 37.5 | 10 | 4 | 17 | 5 | 0 | 18 | Moderate to Good (high quality) |
| Q17 | 24 | 58.5 | 45 | 5 | 1 | 17 | 2 | 0 | 8 | Moderate to Good (high quality) |

### 3.2.5 ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin

Vegetation mapping of the study area identified the presence of Parramatta Red Gum Woodland on moist alluvium of the Cumberland Plain, Sydney Basin corresponding to the Castlereagh Scribbly Gum Woodland community described in 'Native Vegetation of the Cumberland Plain, Wester Sydney' (Tozer 2003). This was confirmed during the site surveys. This vegetation community corresponds to the PCT listed as ME003 Hardleaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin. It covers approximately 33.97 ha equivalent to $38 \%$ of the Wattle Grove Offset Area or $27 \%$ of the combined offsets. The vegetation community's characteristics and its sub-category types are summarised in Table 3.14. A comparison of this vegetation type against vegetation benchmark data is presented in Table 3.15.

Table 3.14 Characteristics of ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin

ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin

| Conservation significance | Corresponds to the vulnerable ecological community of Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion under the TSC Act and the endangered ecological community Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion listed under the EPBC Act. |  |  |
| :---: | :---: | :---: | :---: |
| Condition | This commu the two sub <br> ME003_1 (h <br> species whi vegetation present. <br> ME003_2 (m canopy that parramatten and groundco curvula* and This vegeta majority of th moderate qua periphery of | ity met the g ategories wh <br> gh quality con complemen splayed mod <br> derate qual redominately is subsp. parr ver layers w Pennisetum <br> on community eis vegetation ality condition he site or in | d to moderate BBAM condition class and has been further split into are described below: <br> ition): all vegetation layers within this sub-category retained native the structural characteristics of the pre-European equivalent. The ate to high native species diversity with minimal weed species <br> condition): the vegetation had retained a native canopy cover included Eucalyptus sclerophylla, Angophora bakeri and Eucalyptus mattensis. Although the canopy cover was native the understorey e co-dominated by both native and exotic species such as Eragrostis andestinum*. <br> occupied as the majority of the Wattle Grove Offset Area. The community existed in the high quality condition sub-category. The sub-category patches of this community occurred predominatly on the eas adjacent to access tracks and old railway line. |
| Strata | Height range (m) | Foliage cover (\%) | Dominant species |
| Canopy | 8-18 | 0-30 | Eucalyptus sclerophylla, Angophora bakeri and Eucalyptus parramattensis subsp. parramattensis. |
| Sub-canopy | 1.5-8 | 0-40 | Angophora bakeri, Melaleuca decora and Leptospermum parvifolium. |
| Shrub stratum | 1-2.5 | 10-80 | Persoonia linearis, Melaleuca nodosa, Hakea sericea, Callistemon linearis, Persoonia nutans, Banksia spinulosa, Leptospermum trinervium, Banksia oblongifolia, Persoonia lanceolata, Daviesia ulicifolia, Acacia falcata, Isopogon anemonifolius, Leptospermum continentale, Lissanthe strigosa, Melaleuca thymifolia, Daviesia ulicifolia, Bossiaea heterophylla, Banksia spinulosa, Pultenaea villosa, Acacia decurrens, Leptospermum polygalifolium, Acacia brownii, Pimelea linifolia and Persoonia levis. |

ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin

Moorebank Intermodal Company Biodiversity Offset Areas - Biodiversity Assessment Report
Table 3.15 Comparison ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin quadrat data against vegetation benchmark data

| Plot | Plant species richness | Native overstorey (\% cover) | Native midstorey cover (\% cover) | Native groundcover (\% cover) |  |  | Number of trees with hollows |  | Length of fallen timber (m) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Grasses | Shrubs | Other |  |  |  |  |
| Benchmark ${ }^{(1)}$ | 40 | 10-20 | 23-33 | 12-24 | 0-10 | 12-24 | 1 |  | 30 |  |
| Q1 | 33 | 44 | 19 | 16 | 21 | 13 | 3 | 0 | 8 | Moderate to Good (high quality) |
| Q2 | 19 | 43 | 40.5 | 10 | 12 | 3 | 2 | 25 | 0 * | Moderate to Good (medium quality) |
| Q9 | 39 | 48.5 | 16.5 | 11 | 7 | 28 | 3 | 0 | 20 | Moderate to Good (high quality) |
| Q11 | 41 | 25.5 | 25 | 5 | 9 | 34 | 4 | 0 | 4* | Moderate to Good (high quality) |
| Q15 | 28 | 27 | 9.5 | 5 | 12 | 33 | 1 | 0 | 4* | Moderate to Good (high quality) |

a benchmark value: * indicates, less than $25 \%$ of lower benchmark value.

### 3.2.6 ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion

Vegetation mapping of the study area identified the presence of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy Woodland of the Cumberland Plain, Sydney Basin corresponding to the Castlereagh Swamp Woodland community described in 'Native Vegetation of the Cumberland Plain, Wester Sydney' (Tozer 2003). This was confirmed during the site surveys. This vegetation community corresponds to the PCT listed as ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion. It covers approximately 23.54 ha equivalent to $27 \%$ of the Wattle Grove Offset Area or 19\% of the combined offsets. The vegetation community's characteristics and its sub-category types are summarised in Table 3.16. A comparison of this vegetation type against vegetation benchmark data is presented in Table 3.17.

Table 3.16 Characteristics of ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion

ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion
$\left.\begin{array}{|l|l|l|l|}\hline \begin{array}{l}\text { Conservation } \\ \text { significance }\end{array} & \begin{array}{l}\text { Corresponds to the endangered ecological community of Castlereagh Swamp Woodland } \\ \text { Community under the TSC Act. }\end{array} \\ \hline \text { Condition } & \begin{array}{l}\text { This community met the good to moderate BBAM condition class and was consistent with the } \\ \text { high quality condition sub-category. } \\ \text { ME005_1 (high quality condition): all vegetation layers within this sub-category retained native } \\ \text { species which complements the structural characteristics of the pre-European equivalent. The } \\ \text { vegetation displayed moderate to high native species diversity with minimal weed species } \\ \text { present. } \\ \text { This vegetation community occurred with the Wattle Grove Offset area only within linear } \\ \text { depressions that occur throughout the site. }\end{array} \\ \hline \text { Strata } & \begin{array}{l}\text { Height } \\ \text { range (m) }\end{array} & \begin{array}{l}\text { Foliage } \\ \text { cover (\%) }\end{array} & \begin{array}{l}\text { Dominant species }\end{array} \\ \hline \text { Canopy } & \text { 6-20 } & 0-40 & \begin{array}{l}\text { Eucalyptus parramattensis subsp. parramattensis, Eucalyptus } \\ \text { sclerophylla, Angophora bakeri, Angophora floribunda and } \\ \text { Melalueca decora. }\end{array} \\ \hline \text { Sub-canopy } & \text { 3-6 } & 0-30 & \begin{array}{l}\text { Melaleuca nodosa, Banksia oblongifolia, Bossiaea heterophylla, } \\ \text { Bossiaea obcordata, Isopogon anemonifolius, Acacia ulicifolia, } \\ \text { Banksia spinulosa, Pimelea linifolia, Persoonia levis, Leptospermum } \\ \text { trinervium, Leptospermum polygalifolium, Melaleuca linariifolia, } \\ \text { Melaleuca armillaris, Callistemon linearis, Pultenaea villosa, } \\ \text { Leptospermum continentale, Acacia falcata and Bursaria spinosa. }\end{array} \\ \hline \text { Shrub stratum } & \text { 0.9-3 } & 0-60 & \begin{array}{l}\text { Persoonia linearis, Angophora bakeri and Hakea sericea. }\end{array} \\ \hline \text { Ground cover } & \text { 0.1-1 } & 20-90 & \begin{array}{l}\text { Pteridium esculentum, Cassytha glabella, Themeda australis, } \\ \text { Entolasia stricta, Xanthorrhoea minor, Billardiera scandens, } \\ \text { Lomandra longifolia, Lomandra filiformis, Lomandra multiflora, }\end{array} \\ \text { Pomax umbellata, Lomatia silaifolia, Monotoca scoparia, } \\ \text { Trachymene incisa, Centella asiatica, Carex appressa, Baumea } \\ \text { rubiginosa, Juncus usitaris, Imperata cylindrica, Hibbertia sp., } \\ \text { Hydrocotyle peduncularis, Gonocarpus tetragynus, Goodenia } \\ \text { paniculata, Lepidosperma laterale, Panicum simile, Pratia } \\ \text { purperescens and Lagenophora stipitata. }\end{array}\right\}$

ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion

Moorebank Intermodal Company Biodiversity Offset Areas - Biodiversity Assessment Report
Table 3.17 Comparison ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion quadrat data against vegetation benchmark data

| Plot | Plant species richness | Native overstorey (\% cover) | Native midstorey cover (\% cover) | Native groundcover (\% cover) |  |  | Number of trees with hollows | Exotic plant cover | Length of fallen timber (m) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Grasses | Shrubs | Other |  |  |  |  |
| Benchmark ${ }^{(1)}$ | 36 | 6.5-41.5 | 5-25 | 12.2-38.2 | 0-10 | 12.2-38.2 | 0 |  | 0 |  |
| Q3 | 32 | 36.5 | 14 | 4 | 13 | 33 | 1 | 0 | 4 | Moderate to Good (high quality) |
| Q6 | 24 | 26 | 8 | 11 | 5 | 33 | 1 | 1 | 12 | Moderate to Good (high quality) |
| Q12 | 23 | 15.5 | 8.5 | 7 | 15 | 28 | 3 | 0 | 4 | Moderate to Good (high quality) |
| Q14 | 33 | 27.5 | 10 | 2* | 18 | 30 | 3 | 0 | 0 | Moderate to Good (high quality) |

[^0]Red font indicates results below benchmark value: * indicates, less than $25 \%$ of lower benchmark value.

### 3.2.7 ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin

Vegetation mapping of the study area identified the presence of Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin corresponding to the Alluvial Woodland community described in 'Native Vegetation of the Cumberland Plain, Wester Sydney' (Tozer 2003). This was confirmed during the site surveys. This vegetation community corresponds to the PCT listed as ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin. It covers approximately 5.65 ha equivalent to $17 \%$ of the Moorebank Conservation Area or $5 \%$ of the combined offsets. The vegetation community's characteristics and its sub-category types are summarised in Table 3.18. A comparison of this vegetation type against vegetation benchmark data is presented in Table 3.19.

Table 3.18 Characteristics of ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin

ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin

| Conservation significance | Corresponds to the endangered ecological community of River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed under the TSC Act. |  |  |
| :---: | :---: | :---: | :---: |
| Condition | This community met the good to moderate BBAM condition class and has been further split into the two sub-categories which are described below: |  |  |
|  | ME018_2 (moderate quality condition): the vegetation had retained a native canopy cover canopy that predominately included Eucalyptus tereticornis, Eucalyptus amplifolia, Angophora subvelutina and/or Angophora floribunda. Although the canopy cover was native the understorey and groundcover layers were co-dominated by both native and exotic species. |  |  |
|  | ME018_1 (poor quality condition): the vegetation had retained a native canopy that predominately included Eucalyptus tereticornis, Eucalyptus amplifolia, Angophora subvelutina and/or Angophora floribunda. Although the canopy was native the understorey and groundlayers were generally dominated by exotic species such as Ehrharta erecta*, Ligustrum spp. *, Olea europaea subsp. cuspidata* and Lantana camara*. Native species diversity within these areas was relatively low and the vegetation was structurally modified as a result of edge effects, access tracks, DOD activities and weed invasion. |  |  |
|  | This vegetation community occurred only within the Moorebank Conservation Area and Casula Offset Area running immediately adjacent along the Georges River which forms a riparian corridor to the north and south of the study area. |  |  |
| Strata | Height range (m) | Foliage cover (\%) | Dominant species |
| Canopy | 16-24 | 20-40 | Eucalyptus tereticornis, Eucalyptus amplifolia, Angophora subvelutina, Angophora floribunda and Eucalyptus baueriana. |
| Sub-canopy | 3-8 | 5-20 | Acacia decurrens, Acacia binervia, Pittosporum undulatum, Acacia parramattensis and Melaleuca decora. |
| Shrub stratum | 0.5-3 | 5-80 | Breynia oblongifolia, Bursaria spinosa, Kunzea ambigua, Ozothamnus diosmifolius, Leucopogon juniperinus and Jacksonia scoparia. |
| Ground cover | 0-1 | 80-100 | Microlaena stipoides, Commelina cyanea, Oplismenus imbecillis, Cassytha pubescens, Juncus usitatus, Cynodon dactylon, Entolasia stricta, Opercularia aspera, Sigesbeckia orientalis, Carex appressa, Trachymene incisa, Aristida ramosa, Pratia purpurascens, Einadia hastata, Dichondra repens, Centella asiatica, Glycine tabacina, Rumex brownii, Pteridium esculentum, Lomandra longifolia, Entolasia marginata, Dianella revoluta, Themeda australis and Hardenbergia violaceae. |

ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin

Moorebank Intermodal Company Biodiversity Offset Areas - Biodiversity Assessment Report
Table 3.19 Comparison ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin quadrat data against vegetation benchmark data

| Plot | Plant species richness | Native overstorey (\% cover) | Native midstorey cover (\% cover) | Native groundcover (\% cover) |  |  | Number of trees with hollows | Exotic plant cover | Length of fallen timber (m) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Grasses | Shrubs | Other |  |  |  |  |
| Benchmark ${ }^{1}$ | 24 | 27.5-32.5 | 21-31 | 24.45-30.45 | 0-10 | 24.45-32.45 | 1 |  | 50 |  |
| Q19 | 18 | 32.5 | 3.5* | 32 | 4 | 20 | 1 | 40 | 0 * | Moderate to Good (medium quality) |
| Q33 ${ }^{7}$ | 28 | 37 | 5.5* | 54 | 2 | 19 | $0 *$ | 25 | 0* | Moderate to Good (medium quality) |
| Q36 | 8 | 40 | 16.5 | 0 * | 6 | 0* | 0* | 80 | 2* | Moderate to Good (poor quality) |
| Q38 | 8 | 7.5 | 1* | $6^{*}$ | 4 | $6^{*}$ | 0 * | 80 | $0^{*}$ | Moderate to Good (poor quality) |
| Q2N | 13 | 34 | 32 | 72 | 0 | 0* | 0 * | 4 | 5* | Moderate to Good (high quality) |
| Q3N | 16 | 23.7 | 10 | 50 | 6 | 0 * | 0* | 10 | 21 | Moderate to Good (medium quality) |

(1) Benchmark data for equivalent community in Hawkesbury Nepean CMA ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Keith Formation: Grassy Woodlands: Keith Class: Coastal Valley Grassy Woodlands: source (Office of Environment \& Heritage 2014d): Red font indicates results below benchmark value: * indicates, less than $25 \%$ of lower benchmark value.

### 3.2.8 ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin

Vegetation mapping of the study area identified the presence of Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin corresponding to the Riparian Forest community described in 'Native Vegetation of the Cumberland Plain, Wester Sydney' (Tozer 2003). This was confirmed during the site surveys. This vegetation community corresponds to the PCT listed as ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin. It covers approximately 16.24 ha equivalent to $43 \%$ of the Moorebank Conservation Area or $70 \%$ of the Casula Offset Area or $13 \%$ of the combined offsets. The vegetation community's characteristics and its sub-category types are summarised in Table 3.20. A comparison of this vegetation type against vegetation benchmark data is presented in Table 3.21.

Table 3.20 Characteristics of ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin

ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin

| Conservation significance | Corresponds to the endangered ecological community of River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed under the TSC Act. |  |  |
| :---: | :---: | :---: | :---: |
| Condition | This community met the good to moderate BBAM condition class and has been further split into the thee sub-categories which are described below: |  |  |
|  | ME018_1 (high quality condition): all vegetation layers within this sub-category retained native species which complements the structural characteristics of the pre-European equivalent. The vegetation displayed moderate to high native species diversity with minimal weed species present. |  |  |
|  | ME018_2 (moderate quality condition): the vegetation had retained a native canopy cover canopy that dominantly by Eucalyptus saligna X botryoides. Although the canopy cover was native the understorey and groundcover layers were co-dominated by both native and exotic species. |  |  |
|  | ME018_1 (poor quality condition): the vegetation had retained a native canopy that was dominated by Eucalyptus saligna $X$ botryoides. Although the canopy was native the understorey and groundlayers were generally dominated by exotic species such as Ehrharta erecta*, Cardiospermum grandiflorum*, Senna pendula*, Ligustrum spp. *, Olea europaea subsp. cuspidata* and Lantana camara*. Native species diversity within these areas was relatively low and the vegetation was structurally modified as a result of edge effects, access tracks, DOD activities and weed invasion. |  |  |
|  | This vegetation community occurred only within the Moorebank Conservation Area running immediately adjacent along the Georges River which forms a riparian corridor to the north and south of the study area. |  |  |
| Strata | Height range (m) | Foliage cover (\%) | Dominant species |
| Canopy | 20-28 | 20-40 | Eucalyptus saligna $X$ botryoides with the occasional Angophora subvelutina, Angophora floribunda and Eucalyptus tereticornis |
| Sub-canopy | 2-8 | 10-30 | Acacia binervia, Acacia decurrens and the occasional Grevillea robusta. |
| Shrub stratum | 0.5-4 | 5-20 | Breynia oblongifolia, Bursaria spinosa, Banksia integrifolia, Backhousia myrtifolia and the occasional Leucopogon juniperinus. |
| Ground cover | 0-1.5 | 80-100 | Lomandra Iongifolia, Dianella revoluta, Cheilanthes sieberi, Billardiera scandens, Pratia purpurascens, Microlaena stipoides, Pteridium esculentum, Cassytha glabella, Glycine tabacina, Cheilanthes sieberi, Austrostipa ramosissima, Entolasia marginata, Einadia hastata, Centella asiatica, Eustrephus latifolius, Cayratia clematidea, Senecio hispidus, Plectranthus parviflorus and Oplismenus aemulus. |

ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin

Moorebank Intermodal Company Biodiversity Offset Areas - Biodiversity Assessment Report
Table 3.21 Comparison ME044 Sydney Blue Gum X Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin quadrat data against vegetation benchmark data

| Plot | Plant species richness | Native overstorey (\% cover) | Native midstorey cover (\% cover) | Native groundcover (\% cover) |  |  | Number of trees with hollows | Exotic plant cover | Length of fallen timber (m) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Grasses | Shrubs | Other |  |  |  |  |
| Benchmark ${ }^{(1)}$ | 30 | 61-71 | 70-81 | 0-15 | 0-5 | 23.1-29.1 | 0 |  | 0 |  |
| Q1 | 17 | 26 | 15* | 40 | 0 | 17 | 2 | 43 | 25 | Moderate to Good (medium quality) |
| Q3 | 21 | 27 | 17.5 | 81 | 0 | 0 * | 0 | 19 | 21 | Moderate to Good (medium quality) |
| Q16 | 12 | 18 | 0.5* | 0 | 6 | 32 | 3 | 62 | 12 | Moderate to Good (poor quality) |
| Q17 | 18 | 21.5 | 7* | 70 | 0 | 21 | 2 | 9 | 8 | Moderate to Good (medium quality) |
| Q20 | 13 | 19.5 | 0.5* | 28 | 0 | 16 | 10 | 26 | 11 | Moderate to Good (medium quality) |
| Q31 | $2^{*}$ | 22 | 0 * | 20 | 0 | 0 * | 1 | 80 | 0 | Moderate to Good (poor quality) |
| Q34 | 9 | 0 * | 4* | 12 | 0 | 0* | 0 | 40 | 0 | Moderate to Good (medium quality) |
| Q37 | $6^{*}$ | 11.1* | 0.5* | 6 | 6 | 0 * | 0 | 34 | 1 | Moderate to Good (medium quality) |
| Q39 | 5* | 19.5 | 8* | 0 | 0 | $0 *$ | 2 | 100 | 0 | Moderate to Good (poor quality) |
| Q4N | 8 | 11* | 9* | 24 | 0 | 0* | 0 | 34 | 0 | Moderate to Good (medium quality) |

 benchmark value: * indicates, less than $25 \%$ of lower benchmark value.

### 3.2.9 Exotic vegetation

The exotic vegetation was a highly disturbed vegetation community that occurred predominantly to the north of the Casula Offset Area, centre of the Moorebank Conservation Area and scattered throughout the Wattle Grove Offset Area. The community covered 19.09 ha equivalent to $15.32 \%$ of the combined offset area. The community was generally associated with areas that have been subjected to land clearance and weed invasion as a result of development and infrastructure (such as walk ways, railway lines and roads). Due to the previous and current land uses this community no longer resembles any local native remnant vegetation community. The vegetation community's characteristics are summarised in Table 3.22.

Table 3.22 Characteristics of the exotic vegetation within the study area

## Exotic vegetation

| Conservation <br> significance | Low. The exotic vegetation communities recorded within the study area are not consistent with <br> any native vegetation communities. |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Condition | This community met the low BBAM condition class and has been further split into the two sub- <br> categories which are described below: <br> Exotic woody vegetation: occupies 0.97 ha within the Casula Offset Area. This vegetation was <br> dominated by exotic woody plant species that formed dense sub-canopies and shrub cover <br> which predominantly excluded the growth of groundcover species. <br> Exotic grassland: occupied approximately 12.99 ha of the Moorebank Conservation Area and <br> 5.13 ha of the Wattle Grove Offset Area. This vegetation generally had a void canopy and shrub <br> cover and occurred as grassland dominated by exotic species. <br> This vegetation community occurred predominately within in the Moorebank Conservation Area <br> and as small to medium patches throughout the Wattle Grove and Casula Offset areas. |  |  |
| Strata | Height <br> range $(m)$ | Foliage <br> cover (\%) | Dominant species |



### 3.2.10 Species of plant recorded

Two hundred and fifty six plant species were recorded within the study area. Of these, 196 were native and 62 were introduced species (refer Appendix A).

Of these 62 exotic species that were recorded in the study area, 16 species of plant are listed under the Noxious Weeds Act 1993 for the Liverpool Council noxious weed control area (refer Table 3.23). Of these species eight are listed as a Weeds of National Significance (Australian Weeds Committee 2015).

Table 3.23 Noxious weeds identified on the site

| Scientific Name | Common Name | Noxious Weeds Act 1993 control class ${ }^{(1)}$ | Weed of National Significance |
| :---: | :---: | :---: | :---: |
| Alternanthera philoxeroides* | Alligator Weed | 3 | Yes |
| Sagittaria platyphylla* | Sagittaria | 4 | Yes |
| Arundo donax* | Giant Reed | 4 |  |
| Asparagus aethiopicus* | Ground Asparagus | 4 | Yes |
| Asparagus asparagoides* | Bridal Creeper | 4 | Yes |
| Asparagus officinalis* | Asparagus | 4 | Yes |
| Cestrum parqui | Green Cestrum | 3 |  |
| Lantana camara* | Lantana | 4 | Yes |
| Ligustrum sinense* | Small-leaved Privet | 4 |  |
| Ligustrum lucidum* | Large-leaved Privet | 4 |  |
| Ludwigia peruviana* | Ludwigia | 3 |  |
| Olea europaea subsp. cuspidata* | African olive | 4 |  |
| Ricinus communis* | Castor Oil Plant | 4 |  |
| Rubus fruticosus* | Blackberry | 4 | Yes |
| Senecio madagascariensis* | Fireweed | 4 | Yes |
| Eichhornia crassipes* | Water hyacinth | 2 |  |

(1) Control Categories under the Noxious Weeds Act 1993: Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority, Class 3: The plant must be fully and continuously suppressed and destroyed Class 2 The plant must be eradicated from the land and that land must be kept free of the plant (Department of Trade and Investment Regional Infrastructure and Services 2015a).

### 3.2.11 Plot data

The plot data is provided in Table 3.24. A list of flora species found in each quadrat is provided in Appendix A.
Table 3．24 BioBanking Plot data

| （sqnıys）əィ૦๐ punod6 əм！ıen |
| :---: |
| （sesseı6）ฝəィоэ punod6 əм！ıеN |
| ュəлоэ Көュоџs －pıu әм！̣еN |
|  －Іəло әィцџеN |
| səjəəds ұuejd ən！ıen |


| Q1 | ME003 | Moderate to Good （high quality） | 33 | 44 | 19 | 16 | 21 | 13 | 0 | 3 | 1 | 8 | 56 | 309165 | 6241019 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q2 | ME003 | Moderate to Good （medium quality） | 19 | 43 | 40.5 | 10 | 12 | 3 | 25 | 2 | 1 | 0 | 56 | 309248 | 6240883 |
| Q3 | ME005 | Moderate to Good （high quality） | 32 | 36.5 | 14 | 4 | 13 | 33 | 0 | 1 | 1 | 4 | 56 | 309209 | 6240882 |
| Q4 | HN512 | Moderate to Good （high quality） | 27 | 45 | 2.5 | 15 | 2 | 14 | 0 | 3 | 0.5 | 32 | 56 | 308759 | 6240894 |
| Q5 | HN512 | Moderate to Good （high quality） | 19 | 17 | 0 ＊ | 30 | 11 | 8 | 0 | 1 | 0.5 | 8 | 56 | 308668 | 6240908 |
| Q6 | ME005 | Moderate to Good （high quality） | 24 | 26 | 8 | 11 | 5 | 33 | 1 | 1 | 1 | 12 | 56 | 309049 | 6240719 |
| Q7 | HN512 | Moderate to Good （high quality） | 25 | 38 | 14.5 | 24 | 5 | 17 | 0 | 1 | 1 | 37 | 56 | 308756 | 6240675 |
| Q8 | HN512 | Moderate to Good （high quality） | 22 | 34 | 11 | 5 | 2 | 43 | 0 | 1 | 1 | 16 | 56 | 308660 | 6240536 |
| Q9 | ME003 | Moderate to Good （high quality） | 39 | 48.5 | 16.5 | 11 | 7 | 28 | 0 | 3 | 1 | 20 | 56 | 308866 | 6240798 |
| Q10 | ME002 | Moderate to Good （high quality） | 22 | 51.5 | 16.5 | 6 | 10 | 30 | 0 | 3 | 1 | 20 | 56 | 308635 | 6240487 |
| Q11 | ME003 | Moderate to Good （high quality） | 41 | 25.5 | 25 | 5 | 9 | 34 | 0 | 4 | 1 | 4 | 56 | 308655 | 6240245 |

Moorebank Intermodal Company Biodiversity Offset Areas－Biodiversity Assessment Report

| $\begin{aligned} & \text { 일 } \\ & \text { 를 } \\ & \text { 릉 } \end{aligned}$ | $\infty$ $\stackrel{\infty}{0}$ $\stackrel{\sim}{0}$ $\underset{0}{0}$ | $\begin{aligned} & \text { No } \\ & \text { O} \\ & \underset{\sim}{\circ} \end{aligned}$ | $\begin{aligned} & \stackrel{\circ}{0} \\ & \stackrel{y}{\circ} \\ & \underset{\sim}{\circ} \end{aligned}$ |  |  | $\underset{\underset{\sigma}{\underset{\sim}{\tau}}}{\underset{\sim}{\tau}}$ | $\frac{N}{\underset{\sim}{N}}$ |  | $\underset{\underset{\sim}{\underset{\sim}{\sim}} \underset{\sim}{\underset{\sim}{\sim}}}{\substack{\text { ( }}}$ | $\begin{aligned} & \text { n } \\ & \stackrel{\rightharpoonup}{\square} \\ & \underset{\sim}{\sim} \end{aligned}$ | $\begin{aligned} & \text { M } \\ & \text { O} \\ & \underset{\delta}{\circ} \end{aligned}$ | $\begin{aligned} & \underset{N}{\underset{~ N}{N}} \\ & \underset{\sim}{N} \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 일 } \\ & \text { 히 } \\ & \text { iï } \end{aligned}$ | $\begin{aligned} & 0 \\ & \infty \\ & \infty \\ & \infty \\ & \hline \end{aligned}$ | $\begin{aligned} & \hat{\infty} \\ & \infty \\ & \infty \\ & \hline 0 \end{aligned}$ | $\begin{aligned} & \bullet \\ & \stackrel{\circ}{\infty} \\ & \stackrel{\circ}{\circ} \end{aligned}$ | $\begin{aligned} & \infty \\ & \stackrel{\infty}{\infty} \\ & \infty \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { O} \\ & \text { O} \\ & \text { on } \end{aligned}$ | $\begin{aligned} & \text { ন } \\ & \stackrel{\rightharpoonup}{\circ} \\ & \hline \mathbf{N} \end{aligned}$ | $\begin{aligned} & \underset{+}{6} \\ & \stackrel{\rightharpoonup}{8} \\ & \hline \end{aligned}$ |  | $\begin{aligned} & N \\ & \stackrel{N}{0} \\ & \stackrel{-}{2} \end{aligned}$ | $\begin{aligned} & \text { N } \\ & \underset{\sim}{\underset{N}{N}} \end{aligned}$ | $\begin{aligned} & \text { N } \\ & \stackrel{\rightharpoonup}{0} \\ & \text { è } \end{aligned}$ | $\begin{aligned} & \infty \\ & \underset{N}{N} \\ & \underset{N}{\mathbf{N}} \end{aligned}$ |
| $\stackrel{0}{\circ}_{\substack{0}}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{\circ}{\circ}$ | ¢ | $\stackrel{\circ}{\circ}$ | $\mathscr{¢}$ |  | $\stackrel{\circ}{\circ}$ | $\bigcirc$ | $\mathscr{¢}$ | $\stackrel{\circ}{\circ}$ |
| s6uop uəן！！ <br>  | $\checkmark$ | $\stackrel{m}{\square}$ | $\bigcirc$ | $\checkmark$ | $\stackrel{\infty}{\sim}$ | $\infty$ | $\bigcirc$ |  | $\stackrel{\sim}{\sim}$ | $\stackrel{\sim}{\sim}$ | $\stackrel{\sim}{\sim}$ | $\infty$ |
| иоцецәиəбө』 <br>  | $\ulcorner$ | $\checkmark$ | $\ulcorner$ | － | $\ulcorner$ | $\checkmark$ | $\ulcorner$ |  | $\ulcorner$ | － | $\ulcorner$ | 0 |
| SMO｜｜OY प！！M seəı ！o Jequnn | m | N | m | － | ๑ | N | $\bigcirc$ |  | $\sim$ | $\bigcirc$ | m | $\sim$ |
| ノəィ0э <br>  | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\underset{\sim}{*}$ |  | $\stackrel{\Im}{\square}$ | $\stackrel{\square}{\square}$ | § | $\sigma$ |
|  punod6 əм！łen | $\stackrel{\sim}{\sim}$ | $\stackrel{\sim}{\sim}$ | － | m | $\stackrel{\sim}{\sim}$ | $\stackrel{\sim}{\sim}$ | $\infty$ |  | $\stackrel{\sim}{\sim}$ | $\bigcirc$ | N | $\stackrel{\Sigma}{\sim}$ |
| （sqnays）๗əィ0э punoı6 əм！ఛеN | $\stackrel{\square}{\square}$ | $\infty$ | $\stackrel{\infty}{\sim}$ | $\sim$ | $\nabla$ | $\ulcorner$ | $\omega$ |  | $\bigcirc$ | $\bigcirc$ | $\omega$ | 0 |
| （səsse．16）дəィоэ puno．j6 əм！！en | N | $\sim$ | $\sim$ | $\sim$ | 안 | $\bigcirc$ | $\stackrel{\infty}{\circ}$ |  | 앙 | 8 | $\bigcirc$ | ㅇ |
| ィөл －pıu әл！ıеN | $\begin{aligned} & \infty \\ & \infty \\ & \infty \end{aligned}$ | $\stackrel{\sim}{\sim}$ | 앙 | $\stackrel{\sim}{\circ}$ | $\stackrel{\sim}{\mathrm{N}}$ | ¢ | $\stackrel{\bigcirc}{6}$ |  | $\stackrel{\sim}{\sim}$ | $\stackrel{\sim}{\sim}$ | $\stackrel{\sim}{0}$ | $\wedge$ |
|  －ләло ә＾！ıеN |  | $\stackrel{\infty}{\dot{n}}$ | $\stackrel{n}{\sim}$ | へ | $\stackrel{L}{\infty}$ | $\begin{aligned} & \infty \\ & \infty \\ & \infty \end{aligned}$ | $\bigcirc$ | $\frac{\mathscr{W}}{\frac{\mathscr{W}}{2}}$ | $\stackrel{\ominus}{\sim}$ | N | $\stackrel{\infty}{\sim}$ | $\stackrel{\llcorner }{\stackrel{\sim}{N}}$ |
| səןəəds łuejd ən！ıeN | $\stackrel{\sim}{\sim}$ | へ | M | $\stackrel{\sim}{\sim}$ | $\bar{\sim}$ | $\underset{\sim}{*}$ | $\stackrel{ \pm}{\sim}$ | $\frac{0}{0}$ | $\stackrel{\sim}{\sim}$ | － | $\stackrel{ }{\sim}$ | $\stackrel{\infty}{\odot}$ |
| © 을 0 0 0 |  |  |  |  |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { 앙 } \\ & \stackrel{y}{2} \end{aligned}$ | $\begin{aligned} & \stackrel{\circ}{\circ} \\ & \stackrel{\text { B }}{\Sigma} \end{aligned}$ | $\begin{aligned} & \text { N } \\ & \stackrel{\text { B }}{\Sigma} \end{aligned}$ | $\stackrel{\text { O}}{\stackrel{\circ}{\mathrm{O}}}$ | $\begin{aligned} & \text { 을 } \\ & \stackrel{1}{\Sigma} \end{aligned}$ | $\begin{aligned} & \text { No } \\ & \stackrel{\text { M }}{\Sigma} \end{aligned}$ | $\begin{aligned} & \text { No } \\ & \stackrel{\text { BL }}{\Sigma} \end{aligned}$ | $\underset{\sim}{\stackrel{N}{i n}}$ | $\begin{aligned} & 0 \\ & \hline 8 \\ & 0 \\ & = \end{aligned}$ |  | $\begin{aligned} & \stackrel{\rightharpoonup}{寸} \\ & \stackrel{\rightharpoonup}{\Sigma} \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{\stackrel{~}{\Sigma}} \\ & \hline \end{aligned}$ |  |
| $\stackrel{\text { 흘 }}{\underline{E}}$ | $\stackrel{N}{\sigma}$ | $\stackrel{m}{\square}$ | $\stackrel{J}{\square}$ | $\stackrel{10}{0}$ | $\stackrel{\odot}{\sigma}$ | $\stackrel{\stackrel{\rightharpoonup}{o}}{ }$ | $\underset{\sigma}{Z}$ | $$ | $\bar{\sigma}$ | $\stackrel{m}{0}$ | $\stackrel{\circ}{\sigma}$ | $\stackrel{N}{\sigma}$ |

Moorebank Intermodal Company Biodiversity Offset Areas－Biodiversity Assessment Report

|  | $\begin{aligned} & \bar{\delta} \\ & \stackrel{\rightharpoonup}{J} \\ & \underset{6}{\prime} \end{aligned}$ | $\begin{aligned} & \bullet \\ & \stackrel{\rightharpoonup}{\mathrm{O}} \\ & \stackrel{\rightharpoonup}{\circ} \end{aligned}$ | $\begin{aligned} & \infty \\ & \stackrel{\infty}{6} \\ & \stackrel{\rightharpoonup}{\sim} \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{0} \\ & \stackrel{N}{7} \\ & \underset{\sigma}{\prime} \end{aligned}$ | $\frac{N}{\underset{\sim}{N}}$ | $\frac{N}{\underset{\sim}{\sim}}$ | $\frac{N}{\underset{N}{\sim}}$ | $\frac{N}{\underset{\sim}{N}}$ | $\frac{\underset{N}{N}}{\underset{\sim}{\underset{N}{N}}}$ | $\frac{N}{\underset{\sim}{N}}$ | $\frac{\underset{N}{\underset{\sim}{\sim}}}{\underset{\sim}{\tau}}$ | $\frac{\underset{N}{N}}{\underset{\sim}{\tau}}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 잏 흥 ï | $\begin{aligned} & \text { J } \\ & \underset{N}{N} \end{aligned}$ | $\begin{aligned} & \propto \\ & \stackrel{\infty}{N} \\ & \stackrel{\text { N}}{2} \end{aligned}$ | $\begin{aligned} & \varrho \\ & \stackrel{\circ}{+} \\ & \stackrel{\rightharpoonup}{e} \end{aligned}$ |  |  | $\begin{aligned} & \text { + } \\ & \stackrel{5}{8} \\ & \hline-8 \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{n} \\ & \stackrel{\rightharpoonup}{8} \\ & \hline \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{n} \\ & \stackrel{\rightharpoonup}{8} \\ & \hline \mathbf{D} \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{6} \\ & \stackrel{\rightharpoonup}{8} \\ & \hline \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{6} \\ & \stackrel{\rightharpoonup}{8} \\ & \hline \end{aligned}$ | $\begin{aligned} & \stackrel{\rightharpoonup}{6} \\ & \stackrel{\rightharpoonup}{8} \\ & \hline \end{aligned}$ | $\begin{aligned} & \stackrel{7}{6} \\ & \stackrel{y}{8} \\ & \hline \end{aligned}$ |
| $\stackrel{0}{0^{0}}$ | $\mathscr{\sim}$ | $\odot$ | $\stackrel{¢}{\circ}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{¢}{\circ}$ | $\stackrel{\circ}{6}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{¢}{\circ}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{\circ}{\circ}$ | $\stackrel{\circ}{\circ}$ |
| sбuop uə｜｜e！ <br>  | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\sim$ | $\ulcorner$ | $\bigcirc$ | $\bigcirc$ | $\infty$ | $\stackrel{\Sigma}{\sim}$ |
|  <br>  | $\ulcorner$ | $\checkmark$ | $\ulcorner$ | － | $\bigcirc$ | $\bigcirc$ | $\ulcorner$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\ulcorner$ | $\ulcorner$ |
| SMO｜｜OY पIIM seəц ！o ґequnN | $\ulcorner$ | $\checkmark$ | $\ulcorner$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\sim$ | $\bigcirc$ | $\bigcirc$ |
|  | 앙 | $\infty$ | $\infty$ | $\stackrel{\sim}{\sim}$ | $\infty$ | $¢$ | $\infty$ | m | 8 | 은 | $\checkmark$ | 안 |
|  puno．j6 əм！！en | 산 | $\bigcirc$ | $\bigcirc$ | $\stackrel{\text { ® }}{\sim}$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bullet$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| （sqnıys）əィ0э puno．16 әм！！en | $\checkmark$ | $\bigcirc$ | $\bigcirc$ | $N$ | $\bigcirc$ | $\bigcirc$ | $\bullet$ | $\bullet$ | $\checkmark$ | $\bigcirc$ | $\bigcirc$ | $\bullet$ |
| （sesse»б）」əлоэ puno．d6 әк！！en | N | $\stackrel{\sim}{\sim}$ | 안 | じ | $\stackrel{\sim}{\sim}$ | 은 | $\bigcirc$ | $\bullet$ | $\bullet$ | $\bigcirc$ | N | is |
|  －pıu əی！łeN | $\stackrel{\sim}{\infty}$ | $\bigcirc$ | $\bigcirc$ | 10\％ | $\checkmark$ | \％ | $\begin{aligned} & \stackrel{\circ}{\bullet} \\ & \stackrel{\ominus}{\circ} \end{aligned}$ | $\begin{aligned} & 0 \\ & 0 \\ & 0 \end{aligned}$ | $\ulcorner$ | $\infty$ | ले | 은 |
|  －」əィо ә＾！！еN | $\begin{aligned} & \stackrel{\sim}{\mathrm{N}} \end{aligned}$ | $\begin{aligned} & \text { م } \\ & \stackrel{\text { ® }}{\sim} \end{aligned}$ | N | ल | $\bigcirc$ | $\bigcirc$ | 안 | $\underset{\sim}{\text { F }}$ | $\stackrel{\sim}{\sim}$ | $\begin{aligned} & \stackrel{\circ}{\circ} \\ & \stackrel{\Gamma}{\Gamma} \end{aligned}$ | ¢ | $\stackrel{N}{N}$ |
| sejoəds quejd ən！ıen | $\stackrel{\infty}{\square}$ | $\stackrel{m}{\square}$ | $\sim$ | $\stackrel{\sim}{\sim}$ | の | $\bullet$ | $\infty$ | $\bullet$ | $\infty$ | $\sim$ | $\stackrel{m}{\square}$ | $\stackrel{\odot}{\bullet}$ |
| 응 0 0 0 0 0 |  |  |  |  |  | $3$ |  |  |  |  |  |  |
| $\stackrel{\text { 잉 }}{\stackrel{\circ}{\circ}} \stackrel{1}{7}$ | $\stackrel{\infty}{\stackrel{\infty}{\dot{~}}}$ | $\begin{aligned} & \stackrel{寸}{\stackrel{~}{\Sigma}} \\ & \stackrel{\mathrm{U}}{2} \end{aligned}$ | $\begin{aligned} & \stackrel{寸}{\stackrel{-}{\Sigma}} \\ & \stackrel{\mathrm{U}}{2} \end{aligned}$ | $\stackrel{\infty}{\stackrel{\infty}{\dot{~}}}$ |  | $\begin{aligned} & 0.0 \\ & \stackrel{\rightharpoonup}{x} \\ & \text { 㐅 } \end{aligned}$ | $\stackrel{\infty}{\stackrel{\infty}{\dot{( }}}$ | $\begin{aligned} & \stackrel{寸}{\stackrel{~}{\Sigma}} \\ & \stackrel{\mathrm{U}}{2} \end{aligned}$ |  | $\begin{aligned} & \stackrel{寸}{\stackrel{-}{\Sigma}} \\ & \stackrel{\text { U }}{2} \end{aligned}$ | $\stackrel{\infty}{\stackrel{\infty}{\dot{~}}}$ | $\stackrel{\infty}{\stackrel{\infty}{\text { ¢ }}}$ |
| $\stackrel{\rightharpoonup}{\mathrm{o}} \mathrm{E}$ | $\stackrel{\square}{\square}$ | $\stackrel{\text { N}}{0}$ | $\stackrel{\underset{0}{0}}{ }$ | $\stackrel{-m}{\underset{O}{m}}$ | $\stackrel{\underset{\sim}{\mathbf{O}}}{\substack{0}}$ | $\stackrel{L_{0}^{( }}{0}$ | $\stackrel{\varrho(0}{0}$ | $\stackrel{\widehat{m}}{0}$ | $\stackrel{\infty}{0}$ | $\stackrel{\stackrel{\circ}{0}}{0}$ | $\underset{\text { O }}{\text { Z }}$ | $\underset{\sim}{\text { ¢ }}$ |


| $\begin{aligned} & \text { 을 } \\ & \frac{1}{ㄹ} \\ & \frac{ㅡ ㅇ}{2} \end{aligned}$ | $\stackrel{N}{\stackrel{N}{N}} \underset{\sim}{\underset{\sim}{\sim}}$ |
| :---: | :---: |
|  | $\begin{aligned} & \text { + } \\ & \stackrel{\circ}{\sigma} \\ & \stackrel{\rightharpoonup}{9} \end{aligned}$ |
| $\frac{0}{\mathbf{N}^{(2)}}$ | $\stackrel{\odot}{\circ}$ |
| s6uol uə｜｜飞！ ！0 प！ | $\bigcirc$ |
| иоцедәиө6ө』 <br>  | $\leftharpoondown$ |
| SMO｜｜Oप प1！M səə．ł ！0 JəqunN | $\bigcirc$ |
| 」Өへ00 <br> ఛueןd э！ıx？ | ¢ |
| （ぇə૫10）」əィ0っ puno．j6 əィ！ఛеN | $\bigcirc$ |
| （sqnays）」əィ0ァ punoı6 ә＾！ұеN | $\bigcirc$ |
| （sesse』6）גə＾0э puno．j6 əィ！！eN | $\stackrel{ \pm}{\sim}$ |
| дөло૭ Кәдоңs －plu ə＾！łeN | $\sigma$ |
| дөлоэ Кәдоңs －Іəィо əィ！！еN | F |
| sejoeds <br> łuejd ə＾！ıeN | $\infty$ |
| so <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 <br> 0 |  |
| $\begin{aligned} & 89 \\ & \gg 8 \\ & > \end{aligned}$ | $\ddagger$ <br>  <br> $\stackrel{~}{\Sigma}$ |
| $\frac{\stackrel{c}{\mathrm{o}}}{\underline{\mathrm{E}}}$ |  |


vegetation community．
（2）Description of vegetation conditions described in Section 2
（3）MGA 94：Zone 56

### 3.3 Fauna habitat

The quality of vertebrate fauna habitats is typically correlated with the patch size, configuration, structure, species composition and connectivity of the vegetation communities present at a given site and the presence of non-biological features such as rock outcrops and water bodies. Therefore, the fauna habitats present in the study area vary from moderate in highly modified weedy areas through too high in less disturbed intact vegetation.

### 3.3.1.1 Terrestrial fauna habitats

Four broad types of terrestrial fauna habitat were found within the study area referred to here as:

- Riparian vegetation along George's River.
- Structurally intact woodland.
- Highly disturbed areas with scattered trees.
- Aquatic habitats.

These habitats are described below.

### 3.3.1.2 Riparian vegetation along the George's River

This habitat type includes all moderate to good condition Riparian Forest and Alluvial Woodland that runs adjacently along the George's River within the Moorebank development site.

These areas contain relatively intact native understorey and/or groundcover vegetation (some areas contain a high diversity of exotic shrub and groundcover species such as Lantana camara* thickets and Cardiospermum grandiflorum*). They contain a complete vegetation structure, fallen timber, and dense leaf litter layers that are essential to the life cycles of many fauna. Patches of dense understorey and diverse groundcover in this habitat type provide potential foraging and nesting habitat for a variety of terrestrial birds, reptiles and mammals.

The canopy of this habitat type consists of a moderate to dense cover of immature, semi-mature and mature trees. The canopy provides foraging habitat for nectar-feeding and seed-eating animals and is likely to contain hollows suitable for birds such as small to large parrots, owls, tree roosting microchiropteran bat and small to large arboreal mammals. Foraging opportunities exist in the canopy for predatory species including Powerful Owl and Spotted-tailed Quoll.

Overall, this fauna habitat type is in moderate to good condition providing potential habitat for species of animal that require diverse native understorey vegetation, canopy connectivity to other habitat in the locality and tree hollows.

### 3.3.1.3 Structurally intact woodland

This habitat type includes all low to good condition native woodland vegetation and occurs throughout the majority of the Wattle Grove Offset Area.

These areas contain relatively intact native understorey and/or groundcover vegetation. They contain a complete vegetation structure, fallen timber, and dense leaf litter layers that are essential to the life cycles of many fauna. Patches of dense understorey and diverse groundcover in this habitat type provide potential foraging and nesting habitat for a variety of terrestrial reptiles, bird and mammals.

The canopy of this habitat type consists of a moderate to dense cover of immature, semi-mature and mature trees. The canopy provides foraging habitat for nectar-feeding and seed-eating animals and is likely to contain hollows suitable for birds such as small to large parrots, owls, tree roosting microchiropteran bat and
small to large arboreal mammals. Foraging opportunities exist in the canopy for predatory species including Powerful Owl and Spotted-tailed Quoll.

Overall, this fauna habitat type is in moderate to good condition providing potential habitat for species of animal that require diverse native understorey vegetation, canopy connectivity and tree hollows.

### 3.3.1.4 Highly disturbed areas with scattered trees

This habitat type occurs in areas that have been subject to substantial human disturbance such as clearing for urban development and transport and power infrastructure. This habitat type does not correspond to any native vegetation community.

Native vegetation in this habitat type is restricted to occasional trees, shrubs and groundcover plants within otherwise exotic vegetation.

This habitat is only likely to provide habitat for native and introduced fauna species that are adapted to open environments and tolerant of human disturbance. Many such native species (e.g. Willie Wagtail and Noisy Miners) have increased in abundance in response to human disturbance.

This habitat type is in poor condition and generally of very limited value to threatened fauna species.

### 3.3.1.5 Aquatic habitats

Field observations identified an ephemeral water body within the native Castlereagh Swamp Woodland community recorded within the Wattle Grove Offset Area. The water body ranged from approximately 0.1-0.3 $m$ in depth. The ephemeral swamp is subjected to changes in water depth and turbulence dependent upon rainfall patterns. The substrate consisted of clay soils.

Field observation of the water body revealed that it was in moderate to good ecological condition. Moderate condition aquatic fauna habitat occurs where some habitat components are missing or have been reduced, but linkages with other remnant habitats in the landscape are generally intact, but sometimes degraded. The aquatic habitat within the study area has been subjected to low levels of weed invasion and vegetation fragmentation as a result of weed invasion and urban developments (such as the access paths). Although, the habitat has been slightly degraded, it still retains most aquatic fauna habitat features such as rocks, organic detritus, aquatic vegetation and occasional snags. These habitat features provide potential habitat for a number of aquatic and terrestrial species of fish, reptiles, birds invertebrates and amphibians.

The aquatic habitat was unlikely to provide habitat for any threatened species listed under the Fisheries Management Act 1994 due to the condition of habitat and as no records have been identified in the Hawkesbury/Nepean Catchment Management Authority (Department of Trade \& Investment Region Infrastructure and Services 2014).

### 3.4 Habitat and geographic features

The sites were surveyed in May 2014 and in April and May of 2015. Targeted surveys for Persooonia nutans and Grevillea parviflora were undertaken. The surveys did not include any targeted surveys for threatened fauna species, although opportunistic observations of Scarlet Robin (Petroica boodang) and Little Lorikeet (Glossopsitta pusilla) were made.

The following geographic habitat features were identified within the site:

- land situated in damp, disturbed sites (Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas)
- land containing bark or leaf litter accumulation (Cumberland Plain Land Snail)
- land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters (Eastern Osprey)
- land within 100 m of emergent aquatic or riparian vegetation (Green and Golden Bell Frog)
- Wet and damp areas only.( Hypsela sessiliflora)
- land within 40 m of heath, woodland or forest - providing potential habitat for Giant Burrowing Frog (Heleioporus australiacus).
- alluvial soils for Camden White Gum.
- land within 250 m of termite mounds or rock outcrops for Rosenberg's Goanna.


### 3.5 Threatened communities, populations and species

This section details the threatened biodiversity and other species of conservation concern recorded or likely to occur in the study area, based on those found within the locality and the nature of the habitats observed within the existing environment.

The sites were surveyed in May 2014 and in April and May of 2015. Targeted surveys for Persooonia nutans and Grevillea parviflora were undertaken. The surveys did not include any targeted surveys for threatened fauna species, although opportunistic observations of Scarlet Robin (Petroica boodang) and Little Lorikeet (Glossopsitta pusilla) were made.

### 3.5.1 Threatened ecological communities (critically endangered, endangered and vulnerable) are listed under the Threatened Species Conservation Act 1995, Fisheries Management Plan Act 1994 and Environmental Protection and Biodiversity Conservation Act 1999

Two Commonwealth listed threatened ecological community was recorded as present during the field survey:

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion listed as endangered under the Environmental Protection and Biodiversity Conservation Act 1999.
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest listed as critically endangered under the Environmental Protection and Biodiversity Conservation Act 1999.

Four State listed Threatened ecological communities were recorded as present during the recent field survey:

- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion listed as vulnerable under the Threatened Species Conservation Act 1995.
- Castlereagh Swamp Woodland Community listed as endangered under the Threatened Species Conservation Act 1995.
- River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed as endangered under the Threatened Species Conservation Act 1995.
- Shale Gravel Transition Forest in the Sydney Basin Bioregion listed as endangered under the Threatened Species Conservation Act 1995.

The occurrence of these communities in the study area is descripted in section 3.2 of this report.

### 3.5.2 Endangered populations

Endangered populations are listed under Schedule 1, Part 2 of the Threatened Species Conservation Act 1995. Results of the desk-top assessment indicate that one endangered population has the potential to occur in the study locality.

- Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs. This species was not recorded within the study area and no suitable however potential habitat was recorded. This species is considered to have moderately likely to occur within the study area.


### 3.5.3 Threatened species of plant

Fifty seven species of threatened plant listed under the Threatened Species Conservation Act 1995 and/or the Environmental Protection and Biodiversity Conservation Act 1999 Act are known to occur or predicted to occur within and surrounding the study area. Details of these species and their habitat requirements are provided in Appendix B.

Three threatened flora species, Persoonia nutans, Acacia pubescens and Grevillea parviflora subsp. parviflora, were recorded from the site during the current survey. In addition, based on the presence of suitable habitat, a further five species are considered to have a moderate or greater likelihood of occurrence (Table 3.25). The remaining species are considered to have a low likelihood of occurrence based on the availability of habitat. Full details of species requirements are provided in Appendix B.

Table 3.25 Threatened species of plant with potential to occur in habitat of the study area

| Species | Common name | TSC <br> Act $^{(1)}$ | EPBC <br> Act $^{(2)}$ | Likelihood of <br> occurrence |
| :--- | :--- | :---: | :---: | :--- |
| Grevillea parviflora subsp. parviflora | Small-flower Grevillea | V | V | Recorded |
| Persoonia nutans | Nodding Geebung | E 1 | E | Recorded |
| Acacia pubescens | Downy Wattle | V | V | Recorded |
| Acacia bynoeana | Bynoe's Wattle | E 1 | V | Moderate |
| Dillwynia tenuifolia |  | V | V | Moderate |
| Leucopogon exolasius | Woronora Beard-heath | V | V | Moderate |
| Persoonia hirsuta | Hairy Geebung | E 1 | E | Moderate |
| Pultenaea parviflora | Sydney Bush-pea | E 1 | V | Moderate |

(1) TSC Act = Threatened Species Conservation Act 1995, V = Vulnerable, E1 = Endangered, E2 = Endangered population in the Liverpool LGA.
(2) EPBC Act = Environment Protection and Biodiversity Conservation Act 1999, E = Endangered.

### 3.5.4 Threatened species of animal

Fifty seven species of threatened animal listed under the Threatened Species Conservation Act 1995 and/or the Environmental Protection and Biodiversity Conservation Act 1999 Act are known to occur or predicted to occur within and surrounding the study area. Details of these species and their habitat requirements are provided in Appendix C.

Two threatened species were recorded, Little Eagle and Scarlet Robin, within the Study Area (. Based on the presence of suitable habitat, an additional 23 species are considered to have a moderate or greater likelihood of occurrence (Table 3.26). The remaining species are considered to have a low likelihood of
occurrence based on the availability of habitat. Full details of species requirements are provided in Appendix C.

Table 3.26 Threatened species of animal with potential to occur in habitat within the study area

| Scientific name | Common name | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(2)} \end{aligned}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: |
| Birds |  |  |  |  |
| Glossopsitta pusilla | Little Lorikeet | V |  | High |
| Ninox connivens | Barking Owl | V |  | Moderate |
| Melithreptus gularis gularis | Black-chinned Honeyeater | V |  | Moderate |
| Petroica phoenicea | Flame Robin | V |  | Moderate |
| Callocephalon fimbriatum | Gang-gang Cockatoo | V |  | Moderate |
| Hieraaetus morphnoides | Little Eagle | V |  | Recorded |
| Anthochaera phrygia | Regent Honeyeater | CE | EM | Moderate |
| Ninox strenua | Powerful Owl | V |  | Moderate |
| Petroica boodang | Scarlet Robin | V |  | Recorded |
| Circus assimilis | Spotted Harrier | V |  | Moderate |
| Lophoictinia isura | Square-tailed Kite | V |  | Moderate |
| Lathamus discolor | Swift Parrot | E1 | E | Moderate |
| Calyptorhynchus lathami | Varied Sittella | V |  | Moderate |
| Invertebrates |  |  |  |  |
| Meridolum corneovirens | Cumberland Land Snail | E1 |  | Moderate |
| Bats |  |  |  |  |
| Miniopterus schreibersii oceanensis | Eastern Bent-wing Bat | V |  | High |
| Mormopterus norfolkensis | Eastern Free-tail Bat | V |  | High |
| Falsistrellus tasmaniensis | Eastern Flase Pipistrelle | V |  | Moderate |
| Myotis adversus | Large-footed Myotis | V |  | High |
| Scoteanax rueppellii | Greater Broad-nosed Bat | V |  | Moderate |
| Saccolaimus flaviventris | Yellow-bellied Sheathtail Bat | V |  | Moderate |
| Mammals |  |  |  |  |
| Pteropus poliocephalus | Grey-headed Flying-fox | V | V | Recorded |
| Dasyurus maculatus maculatus | Spotted-Tailed Quoll (Southern Subspecies) | V | E | Moderate |
| Cercartetus nanus | Eastern Pygmy-possum | V |  | Moderate |
| Petaurus norfolcensis | Squirrel Glider | V |  | Moderate |
| Phascolarctos cinereus | Koala | V | V | Moderate |

[^1]Eighteen threatened species were predicted to occur in the sites by the BioBanking calculator based on the data entered (Table 3.27 and Table 3.28). Although there was no targeted surveys undertaken two of these species (Scarlet Robin and Little Eagle) were incidentally observed during the field surveys. If targeted surveys recorded these species additional credits would be obtained.

Table 3.27 Threatened species predicted to occur by the BioBanking calculator within the Wattle Grove Offset Area

| Scientific name | Common name | $\begin{aligned} & \text { TSC } \\ & \operatorname{Act}^{(1)} \end{aligned}$ | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(2)} \end{aligned}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: |
| Birds |  |  |  |  |
| Ninox connivens | Barking Owl | V |  | Moderate likelihood |
| Melithreptus gularis gularis | Black-chinned Honeyeater | V |  | Moderate likelihood |
| Climacteris picumnus victoriae | Brown Treecreeper (eastern subspecies) | V |  | Unlikely |
| Stagonopleura guttata | Diamond Firetail | V |  | Unlikely |
| Tyto novaehollandiae | Masked Owl | V |  | Unlikely |
| Ninox strenua | Powerful Owl | V |  | Moderate likelihood |
| Petroica boodang | Scarlet Robin | V |  | Recorded |
| Lathamus discolor | Swift Parrot | E1 | E | Moderate likelihood |
| Invertebrates |  |  |  |  |
| Meridolum corneovirens | Cumberland Plain Land Snail | E1 |  | Moderate likelihood |
| Mammals |  |  |  |  |
| Dasyurus maculatus | Spotted-tailed Quoll | V | E | Moderate likelihood |
| Phascolarctos cinereus | Koala | V | V | Moderate likelihood |
| Myotis macropus (formally Myotis adversus) | Large-footed Myotis | V |  | High likelihood |
| Pteropus poliocephalus | Grey-headed Flying-fox | V | V | High likelihood |
| Miniopterus schreibersii oceanensis | Eastern Bentwing-bat | V |  | High likelihood |
| Falsistrellus tasmaniensis | Eastern False Pipistrelle | V |  | Moderate likelihood |
| Mormopterus norfolkensis | Eastern Freetail-bat | V |  | High likelihood |
| Scoteanax rueppellii | Greater Broad-nosed Bat | V |  | High likelihood |

(1) TSC Act = Threatened Species Conservation Act 1995, V = Vulnerable, E1 = Endangered, E2 = Endangered population in the Liverpool LGA.
(2) EPBC Act = Environment Protection and Biodiversity Conservation Act 1999, E = Endangered.

Table 3.28 Threatened species predicted to occur by the biobanking calculator within the Moorebank Conservation Area and Casula Offset Area

| Scientific name | Common name | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(2)} \end{aligned}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: |
| Birds |  |  |  |  |
| Ninox connivens | Barking Owl | V |  | Moderate likelihood |
| Melithreptus gularis gularis | Black-chinned Honeyeater | V |  | Moderate likelihood |
| Climacteris picumnus victoriae | Brown Treecreeper (eastern subspecies) | V |  | Unlikely |
| Burhinus grallarius | Bush Stone-curlew | E1 |  | Unlikely |
| Stagonopleura guttata | Diamond Firetail | V |  | Unlikely |
| Callocephalon fimbriatum | Gang-gang Cockatoo | E1 |  | Moderate Likelihood |
| Hieraaetus morphnoides | Little Eagle | V |  | Recorded |
| Glossopsitta pusilla | Little Lorikeet | V |  | Recorded |
| Tyto novaehollandiae | Masked Owl | V |  | Unlikely |
| Ninox strenua | Powerful Owl | V |  | Moderate likelinood |
| Anthochaera phrygia | Regent Honeyeater | CE | EM | Moderate likelihood |
| Petroica boodang | Scarlet Robin | V |  | Moderate likelihood |
| Circus assimilis | Spotted Harrier | V |  | Moderate likelihood |
| Lophoictinia isura | Square-tailed Kite | V |  | Moderate likelihood |
| Lathamus discolor | Swift Parrot | E1 | E | High likelihood |
| Neophema pulchella | Turquoise Parrot | V |  | Unlikely |
| Invertebrates |  |  |  |  |
| Meridolum corneovirens | Cumberland Plain Land Snail | E1 |  | Moderate likelihood |
| Amphibians |  |  |  |  |
| Litoria aurea | Green and Golden Bell Frog | E1 | V | Unlikely |
| Heleioporus australiacus | Giant Burrowing Frog | V | V | Unlikely |
| Mammals |  |  |  |  |
| Dasyurus maculatus | Spotted-tailed Quoll | V | E | Moderate likelihood |
| Phascolarctos cinereus | Koala | V | V | Moderate likelihood |

### 3.5.5 Migratory species

Migratory species are protected under international agreements to which Australia are a signatory, including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Australia Migratory Bird Agreement (RoKAMBA) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered to comprise 'Matters of National Environmental Significance' and are protected under the Environment Protection and Biodiversity Conservation Act 1999.

Based on the findings of the desk-top assessment, a total of 13 Migratory species have been recorded or have the potential to occur in the study area locality (Appendix B). No Migratory species were recorded during field surveys the site does contain potential habitat however for the Regent Honeyeater, Fork-tailed Swift, Cattle Egret, Eastern Great Egret, Latham's Snipe, White-bellied Sea-Eagle, White-throated Needletail, Black-faced Monarch, Satin Flycatcher and Rufous Fantail.


## 4. Management actions and management plans

### 4.1 Standard management actions

Standard management actions are required on all BioBank sites to improve vegetation condition when entering into a BioBanking agreement (refer to Figure 4.1). These management actions would be described in detail in the Bush Regeneration Strategy developed for the site.

The standard management actions for all BioBank sites are:

- management of grazing for conservation
- weed control
- management of fire for conservation
- management of human disturbance (e.g. Illegal mountain bike trails management)
- retention of regrowth and remnant native vegetation
- replanting or supplementary planting where natural regeneration will not be sufficient
- retention of dead timber
- erosion control
- retention of rocks.


### 4.2 Additional management actions

- No specific management actions are currently proposed.


## 5. BioBanking credit report

The BioBanking tool was used to provide a calculation of the number and class of biodiversity credits required to ensure maintenance or improvement in biodiversity. The BioBanking credit report is summarised below.

### 5.1 Ecosystem credits

The ecosystem credits obtained, based on the standard management actions are summarised in Table 5.1.
Table 5.1 Summary of ecosystem credits

| Veg code | Vegetation name | Vegetation zone | Vegetation zone area (ha) | $\begin{aligned} & \text { Current } \\ & \text { site } \\ & \text { value } \end{aligned}$ | Future site value | Gain | Number of credits |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ME018 | Forest Red Gum - Roughbarked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion | 1 | 0.63 | 56.25 | 68.75 | 12.50 | 7 |
| ME018 | Forest Red Gum - Roughbarked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion | 2 | 2.29 | 70.31 | 82.03 | 11.72 | 26 |
| ME018 | Forest Red Gum - Roughbarked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion | 3 | 2.73 | 43.23 | 55.21 | 11.98 | 30 |
| ME044 | Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion | 4 | 10.74 | 45.14 | 67.97 | 22.83 | 147 |
| ME044 | Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion | 5 | 5.50 | 50.52 | 69.36 | 18.84 | 69 |
| ME002 | Broad-leaved Ironbark Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion | 6 | 13.07 | 67.71 | 86.98 | 19.27 | 172 |
| ME004 | Broad-leaved Ironbark Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion | 7 | 13.67 | 84.90 | 100.00 | 15.10 | 175 |


| Veg code | Vegetation name | Vegetation zone | Vegetation zone area (ha) | Current site value | Future site value | Gain | Number of credits |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ME003 | Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion | 9 | 31.55 | 71.35 | 92.19 | 20.84 | 428 |
| ME004 | Broad-leaved Ironbark Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion | 8 | 0.05 | 41.67 | 61.46 | 19.79 | 1 |
| ME003 | Hard-leaved Scribbly Gum <br> - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion | 10 | 2.41 | 74.48 | 92.19 | 17.71 | 31 |
| ME005 | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion | 11 | 23.54 | 79.69 | 92.19 | 12.50 | 278 |
| N/A | Exotic woody vegetation (poor quality condition) | MZ12 |  |  |  |  |  |
| N/A | Exotic grassland and bare areas (poor quality condition) | MZ13 |  |  |  |  |  |

### 5.2 Species credits

Three threatened species of were recorded during the sites surveys by Parsons Brinckerhoff for the preparation of this report and by Hyder Consulting during preparation of the Biodiversity Assessment Report for the proposed SIMTA Intermodal Terminal Facility (Hyder Consulting 2015):

- Grevillea parviflora subsp. parviflora
- Persoonia nutans
- Acacia pubescens.


### 5.2.1 Persoonia nutans

In surveys conducted for the proposed SIMTA Intermodal Terminal Facility, Hyder Consulting recorded 115 Persoonia nutans individuals within the western portion of the Wattle Grove offset biobank site (Hyder Consulting 2015). Surveys conducted by Parsons Brinckerhoff in the eastern portion of the Wattle Grove offset biobank site recorded an additional 60 individuals.

A total of 175 Persoonia nutans individuals was recorded and this is considered to be the minimum population size for the Wattle Grove offset biobank site.

### 5.2.2 Grevillea parviflora subsp. parviflora

Hyder Consulting conducted the following intensive transect surveys in the western portion of the Wattle Grove offset biobank site:

- 2011-2012 surveys; 4 metre wide transects spaced 10 metres apart on both sides of the existing rail spur producing a count of1644 stems and a population estimate of 4110 stems based on 40 per cent of the survey area sampled
- 2014 surveys; to the west of the existing rail spur producing a total count of 2825 stems and a population estimate of approximately 7063 stems
- Intensive surveys in July 2012; focused on the subset of the population in the vicinity of the proposed Rail link; these surveys involved counting all stems within approximately 25 metres either side of the centre line of the proposed Rail link, and were undertaken over an area of approximately 0.37 hectares. A total of 842 stems were recorded in this area; this equates to 2275 stems per hectare (Hyder Consulting 2015).

This detailed density information has been used, in conjunction with habitat inspection and mapping to produce a stem count estimate across the entire Wattle Grove offset biobank site.

The estimate is based on the following:

- In their intensive count stems over a 0.37 ha area of a dense patch of the species in the west of the site, Hyder Consulting recorded a density of 2275 stems per hectare; extrapolation of this density across the large dense patches recorded alone produces a figure in excess of 11,600 stems.
- Smaller dense patches and individuals were observed throughout Castlereagh Scribbly Gum Woodland and Cooks River Castlereagh Ironbark Forest (totalling 40 ha) at an estimated overall density of at least 50 stems per hectare equating to an additional 2000 stems.
- Occasional small patches and individuals were observed in Shale/Gravel Transition Forest and Castlereagh Swamp Woodland near the boundary of these communities and adjacent areas of Castlereagh Scribbly Gum Woodland Cooks River Castlereagh Ironbark Forest.

A total stem count of 13,600 is therefore considered a reasonable and conservative estimate of the total population within the Wattle Grove offset biobank site for the purposes of the calculation of species credits for Grevillea parviflora subsp. parviflora.

### 5.2.3 Acacia pubescens

Acacia pubescens was recorded in three distinct patches. One patch contained three stems within a few metres of one another. Each of the other two patches contained a large number of stems. Due to its suckering habit resulting in clonal reproduction, it is difficult to determine how many genetic individuals are represented. The total number of stems over the three patches was estimated at 80-100 stems.

### 5.2.4 Species credits

Three species were recorded incidentally during the sites surveys within the Biobank site. There is potential habitat within the sites for a number of additional threatened species and if recorded during targeted surveys species credits could also be calculated and obtained.

The species credits obtained, based on the standard management actions are summarised in Table 5.2.

Table 5.2 Summary of species credits

| Scientific name | Common name | Number of species <br> credits created |
| :--- | :--- | :---: |
| Acacia pubescens | Downy Wattle | 710 |
| Persoonia nutans | Nodding Geebung | 1,242 |
| Grevillea parviflora subsp. parviflora | Small-flower Grevillea | 96,560 |
| Total | $\mathbf{9 8 , 5 1 2}$ |  |

## 6. References

Australian Weeds Committee 2015, Weeds of National Significance, 2015, [http://www.weeds.org.au/WoNS/](http://www.weeds.org.au/WoNS/).

Biosis Research 2003, National Highway Link F3 to Branxton - Updated Additional Flora and Fauna Assessment, Report prepared for Roads and Traffic Authority.

Bureau of Meteorology 2015, 'Climate Data Online'.
Cropper, SC 1993, Management of Endangered Plants, CSIRO Australia, Melbourne.
Department of Environment and Climate Change 2007, Threatened species assessment guidelines. The assessment of significance, Department of Environment and Climate Change, Hurstville.

Department of Environment and Conservation 2004, Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft), Department of Environment and Conservation, Hurstville.

Department of the Environment 2015a, Australian Faunal Directory, viewed 9 February 2015 [http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/home](http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/home).

Department of the Environment 2015b, EPBC Protected Matters Search Tool, viewed 1 March 2015, [http://www.environment.gov.au/epbc/pmst/](http://www.environment.gov.au/epbc/pmst/).

Department of Trade \& Investment Region Infrastructure and Services 2014, Threatened \& protected species - records viewer, [http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer](http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer).

Department of Trade and Investment Regional Infrastructure and Services 2015a, Noxious Weeds Declaration Page, viewed 8 May 2015, <http://www.dpi.nsw.gov.au/agriculture/pests-
weeds/weeds/noxweed/noxious-app-application>.
Department of Trade and Investment Regional Infrastructure and Services 2015b, 'NSW Threatened Aquatic Fauna Database'.

ENSR Australia 2008, 'Integra Coal Operations Pty Ltd, Weed Management Plan'.
Harden, G 1992, Flora of New South Wales Volume 3, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, Flora of New South Wales Volume 4, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, Flora of New South Wales Volume 1 (Revised Edition), University of New South Wales Press Ltd., Kensington.

Harden, G 2002, Flora of New South Wales Volume 2 (Revised Edition), 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

Hawkesbury Nepean Catchment Management Trust 2000, Guidelines for Bushland Weed Mapping. A Component of the Trusts Manual "Aspects of Catchment Health". Hawkesbury-Nepean Catchment Management Trust, Windsor.

Hyder Consulting 2015, Sydney Intermodal Terminal Alliance (SIMTA) Intermodal Terminal Facility Stage 1 Biodiversity Assessment Report.

John Seidel 2014, Principal Project Officer - Ecosystems \& Threatened Species - Regional Operations 2014,
Matthei, LE 1995, Soil Landscapes of the Newcastle 1:100,000 sheet, Department of Land and Water Conservation, Sydney.

Office of Environment and Heritage 2015a, NSW Bionet Atlas of NSW Wildlife,
[http://www.bionet.nsw.gov.au/](http://www.bionet.nsw.gov.au/).
Office of Environment and Heritage 2015b, 'Threatened species, populations and ecological communities of NSW online database'.

Parsons Brinckerhoff 2014, Moorebank Intermodal Terminal- Biodiversity Offset Strategy Sydney.
Royal Botanic Gardens 2015, 'PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)'.

Seidel, J \& Briggs, S 2008, Biobanking Operation Manual NSW Department of Environment and Climate Change, Sydney.

Thackway, R \& Cresswell, ID 1995, An Interim Biogeographic Regionalisation of Australia, Australian Nature Conservation Agency, Canberra.

Tozer, M 2003, 'The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities', Cunninghamia, vol. 8, no. 1, pp. 1-75.

Tozer, M, Turner, K, Simpson, C, Keith, D, Beukers, P, MacKenzie, B, Tindall, D \& Pennay, C 2006, Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands. Version 1.0, Department of Environment and Climate Change, Hurstville.


## Appendix A

Species of plant recorded


## Appendix A - Plant species recorded

| Family Name | Scientific Name | Common Name | EPBC $A c t^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Acanthaceae | Pseuderanthemum variabile | Pastel Flower |  |  | True |
| Adiantaceae | Cheilanthes austrotenuifolia | Rock Fern |  |  | True |
| Adiantaceae | Cheilanthes sieberi | Mulga Fern |  |  | True |
| Alismataceae | Sagittaria platyphylla | Sagittaria |  |  | False |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed |  |  | True |
| Amaranthaceae | Alternanthera philoxeroides | Alligator Weed |  |  | False |
| Apiaceae | Centella asiatica | Pennywort |  |  | True |
| Apiaceae | Hydrocotyle peduncularis |  |  |  | True |
| Apiaceae | Platysace ericoides |  |  |  | True |
| Apiaceae | Trachymene incisa |  |  |  | True |
| Asclepiadaceae | Araujia sericifera | Moth Vine |  |  | False |
| Asclepiadaceae | Asclepias curassavica | Blood Flower |  |  | False |
| Asparagaceae | Asparagus aethiopicus | Asparagus Fern |  |  | False |
| Asparagaceae | Asparagus asparagoides | Bridal Creeper |  |  | False |
| Asparagaceae | Asparagus officinalis | Asparagus |  |  | False |
| Asteraceae | Ageratina adenophora | Crofton Weed |  |  | False |
| Asteraceae | Aster subulatus | Wild Aster |  |  | False |
| Asteraceae | Bidens bipinnata | Bipinnate Beggars Ticks |  |  | False |
| Asteraceae | Bidens pilosa | Cobblers Pegs |  |  | False |
| Asteraceae | Cirsium vulgare | Spear Thistle |  |  | False |
| Asteraceae | Conyza albida | Tall Fleabane |  |  | False |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane |  |  | False |
| Asteraceae | Conyza sp. |  |  |  | False |
| Asteraceae | Hypochaeris radicata | Catsear |  |  | False |
| Asteraceae | Lagenifera stipitata | Blue Bottle-daisy |  |  | True |
| Asteraceae | Ozothamnus diosmifolius | White Dogwood |  |  | True |
| Asteraceae | Senecio hispidulus | Hill Fireweed |  |  | True |
| Asteraceae | Senecio madagascariensis | Fireweed |  |  | False |
| Asteraceae | Vittadinia cuneata | Fuzzweed |  |  | True |
| Caprifoliaceae | Lonicera japonica | Japanese Honeysuckle |  |  | False |
| Casuarinaceae | Allocasuarina littoralis | Black Sheoak |  |  | True |
| Casuarinaceae | Allocasuarina sp. |  |  |  | True |


| Family Name | Scientific Name | Common Name | EPBC <br> Act ${ }^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Casuarinaceae | Allocasuarina torulosa | Forest Oak |  |  | True |
| Chenopodiaceae | Einadia hastata | Berry Saltbush |  |  | True |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush |  |  | True |
| Colchicaceae | Burchardia umbellata | Milkmaids |  |  | True |
| Commelinaceae | Commelina cyanea | Native Wandering Jew |  |  | True |
| Commelinaceae | Tradescantia fluminensis | Wandering Jew |  |  | False |
| Convolvulaceae | Convolvulus erubescens |  |  |  | True |
| Convolvulaceae | Dichondra repens | Kidney Weed |  |  | True |
| Cyperaceae | Baumea rubiginosa |  |  |  | True |
| Cyperaceae | Carex appressa | Tussock Sedge |  |  | True |
| Cyperaceae | Caustis flexuosa | Curly Wig |  |  | True |
| Cyperaceae | Caustis recurvata |  |  |  | True |
| Cyperaceae | Cyathochaeta diandra | Sheath Sedge |  |  | True |
| Cyperaceae | Cyperus brevifolius | Mullumbimby Couch |  |  | False |
| Cyperaceae | Cyperus eragrostis | Umbrella Sedge |  |  | False |
| Cyperaceae | Eleocharis sphacelata | Tall Spike Rush |  |  | True |
| Cyperaceae | Gahnia aspera |  |  |  | True |
| Cyperaceae | Gahnia sp. |  |  |  | True |
| Cyperaceae | Lepidosperma laterale | Variable Sword-sedge |  |  | True |
| Cyperaceae | Ptilothrix deusta |  |  |  | True |
| Cyperaceae | Schoenoplectus validus |  |  |  | True |
| Dennstaedtiaceae | Pteridium esculentum | Bracken |  |  | True |
| Dilleniaceae | Hibbertia sp. |  |  |  | True |
| Dioscoreaceae | Dioscorea transversa | Native Yam |  |  | True |
| Elaeocarpaceae | Elaeocarpus reticulatus | Blueberry Ash |  |  | True |
| Epacridaceae | Epacris longiflora | Fuchsia Heath |  |  | True |
| Epacridaceae | Leucopogon juniperinus | Long-flower Beard-heath |  |  | True |
| Epacridaceae | Lissanthe strigosa | Peach Heath |  |  | True |
| Epacridaceae | Melichrus procumbens | Jam Tarts |  |  | True |
| Epacridaceae | Monotoca scoparia | Prickly Broom-heath |  |  | True |
| Ericaceae | Astroloma humifusum | Native Cranberry |  |  | True |
| Euphorbiaceae | Breynia oblongifolia | Coffee Bush |  |  | True |
| Euphorbiaceae | Ricinus communis | Castor Oil Plant |  |  | False |
| Euphorbiaceae | Poranthera microphylla |  |  |  | True |
| Fabaceae (Caesalpinioideae) | Senna pendula | Easter Cassia |  |  | False |


| Family Name | Scientific Name | Common Name | EPBC <br> $A c t^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \operatorname{Act}^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Fabaceae (Faboideae) | Bossiaea heterophylla | Variable Bossiaea |  |  | True |
| Fabaceae (Faboideae) | Bossiaea obcordata | Spiny Bossiaea |  |  | True |
| Fabaceae (Faboideae) | Daviesia ulicifolia | Gorse Bitter Pea |  |  | True |
| Fabaceae (Faboideae) | Desmodium varians | Slender Tick-trefoil |  |  | True |
| Fabaceae (Faboideae) | Dillwynia retorta |  |  |  | True |
| Fabaceae (Faboideae) | Glycine clandestina | Twining Glycine |  |  | True |
| Fabaceae (Faboideae) | Glycine microphylla | Small-leaf Glycine |  |  | True |
| Fabaceae (Faboideae) | Glycine tabacina |  |  |  | True |
| Fabaceae (Faboideae) | Gompholobium grandiflorum | Large Wedge Pea |  |  | True |
| Fabaceae (Faboideae) | Gompholobium pinnatum | Pinnate Wedge Pea |  |  | True |
| Fabaceae (Faboideae) | Hardenbergia violacea | False Sarsaparilla |  |  | True |
| Fabaceae (Faboideae) | Lotus uliginosus | Birds-foot Trefoil |  |  | False |
| Fabaceae (Faboideae) | Pultenaea retusa | Blunt Bush-pea |  |  | True |
| Fabaceae (Faboideae) | Pultenaea sp. |  |  |  | True |
| Fabaceae (Faboideae) | Pultenaea sp. A |  |  |  | True |
| Fabaceae (Faboideae) | Pultenaea villosa |  |  |  | True |
| Fabaceae (Faboideae) | Trifolium repens | White Clover |  |  | False |
| Fabaceae (Faboideae) | Vicia sativa | Common Vetch |  |  | False |
| Fabaceae (Mimosoideae) | Acacia baileyana | Cootamundra Wattle |  |  | True |
| Fabaceae (Mimosoideae) | Acacia binervia | Coast Myall |  |  | True |
| Fabaceae (Mimosoideae) | Acacia brownii | Heath Wattle |  |  | True |
| Fabaceae (Mimosoideae) | Acacia decurrens | Black Wattle |  |  | True |
| Fabaceae (Mimosoideae) | Acacia falcata |  |  |  | True |
| Fabaceae (Mimosoideae) | Acacia floribunda | White Sally |  |  | True |
| Fabaceae (Mimosoideae) | Acacia longifolia | Sydney Golden Wattle |  |  | True |
| Fabaceae (Mimosoideae) | Acacia parramattensis | Parramatta Wattle |  |  | True |
| Fabaceae (Mimosoideae) | Acacia pubescens | Downy Wattle |  |  | True |
| Fabaceae (Mimosoideae) | Acacia ulicifolia | Prickly Moses |  |  | True |
| Geraniaceae | Geranium homeanum | Rainforest Cranes-bill |  |  | True |
| Goodeniaceae | Goodenia hederacea |  |  |  | True |
| Goodeniaceae | Goodenia paniculata | Branched Goodenia |  |  | True |
| Goodeniaceae | Goodenia sp. |  |  |  | True |
| Haloragaceae | Gonocarpus tetragynus | Common Raspwort |  |  | True |
| Haloragaceae | Gonocarpus teucrioides |  |  |  | True |
| Iridaceae | Patersonia sericea | Silky Purple-flag |  |  | True |


| Family Name | Scientific Name | Common Name | $\begin{gathered} \text { EPBC } \\ \text { Act }^{(1)} \end{gathered}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Juncaceae | Juncus australis | Austral Rush |  |  | True |
| Juncaceae | Juncus cognatus |  |  |  | False |
| Juncaceae | Juncus usitatus | Billabong Rush |  |  | True |
| Lamiaceae | Plectranthus parviflorus | Cockspur Flower |  |  | True |
| Lauraceae | Cassytha glabella | Slender Dodder-laurel |  |  | True |
| Lauraceae | Cassytha pubescens |  |  |  | True |
| Lauraceae | Cinnamomum camphora | Camphor Laurel |  |  | False |
| Lobeliaceae | Pratia purpurascens | Whiteroot |  |  | True |
| Loganiaceae | Mitrasacme polymorpha | Varied Mitrewort |  |  | True |
| Lomandraceae | Lomandra filiformis | Wattle Matt-rush |  |  | True |
| Lomandraceae | Lomandra longifolia | Spiny-headed Mat-rush |  |  | True |
| Lomandraceae | Lomandra multiflora |  |  |  | True |
| Lomandraceae | Lomandra sp. |  |  |  | True |
| Loranthaceae | Amyema gaudichaudii |  |  |  | True |
| Luzuriagaceae | Eustrephus latifolius | Wombat Berry |  |  | True |
| Malvaceae | Modiola caroliniana | Red-flowered Mallow |  |  | False |
| Malvaceae | Pavonia hastata |  |  |  | False |
| Malvaceae | Sida rhombifolia | Paddys Lucerne |  |  | False |
| Myrtaceae | Angophora bakeri | Narrow-leaved Apple |  |  | True |
| Myrtaceae | Angophora floribunda | Rough-barked Apple |  |  | True |
| Myrtaceae | Angophora subvelutina | Broad-leaved Apple |  |  | True |
| Myrtaceae | Backhousia myrtifolia | Grey Myrtle |  |  | True |
| Myrtaceae | Callistemon linearis | Narrow-leaved Bottlebrush |  |  | True |
| Myrtaceae | Callistemon salignus | Willow Bottlebrush |  |  | True |
| Myrtaceae | Eucalyptus amplifolia | Cabbage Gum |  |  | True |
| Myrtaceae | Eucalyptus baueriana | Blue Box |  |  | True |
| Myrtaceae | Eucalyptus crebra | Narrow-leaved Ironbark |  |  | True |
| Myrtaceae | Eucalyptus eugenioides | Thin-leaved Stringybark |  |  | True |
| Myrtaceae | Eucalyptus fibrosa | Red Ironbark |  |  | True |
| Myrtaceae | Eucalyptus parramattensis subsp. parramattensis | Parramatta Red Gum |  |  | True |
| Myrtaceae | Eucalyptus resinifera | Red Mahogany |  |  | True |
| Myrtaceae | Eucalyptus saligna $x$ botryoides |  |  |  | True |
| Myrtaceae | Eucalyptus sclerophylla | Hard-leaved Scribbly Gum |  |  | True |


| Family Name | Scientific Name | Common Name | EPBC $A c t^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Myrtaceae | Eucalyptus sp. |  |  |  | True |
| Myrtaceae | Eucalyptus tereticornis | Forest Red Gum |  |  | True |
| Myrtaceae | Kunzea ambigua | Tick Bush |  |  | True |
| Myrtaceae | Leptospermum continentale | Prickly Teatree |  |  | True |
| Myrtaceae | Leptospermum parvifolium |  |  |  | True |
| Myrtaceae | Leptospermum polygalifolium |  |  |  | True |
| Myrtaceae | Leptospermum trinervium | Paperbark Tea-tree |  |  | True |
| Myrtaceae | Melaleuca armillaris |  |  |  | True |
| Myrtaceae | Melaleuca decora | White Feather Honeymyrtle |  |  | True |
| Myrtaceae | Melaleuca ericifolia |  |  |  | True |
| Myrtaceae | Melaleuca linariifolia |  |  |  | True |
| Myrtaceae | Melaleuca nodosa | Pricklyleaf Paperbark |  |  | True |
| Myrtaceae | Melaleuca thymifolia |  |  |  | True |
| Oleaceae | Ligustrum lucidum | Large-leaved Privet |  |  | False |
| Oleaceae | Ligustrum sinense | Small-leaved Privet |  |  | False |
| Oleaceae | Notelaea longifolia | Large Mock-olive |  |  | True |
| Oleaceae | Olea europaea subsp. cuspidata |  |  |  | False |
| Onagraceae | Ludwigia peruviana |  |  |  | False |
| Orchidaceae | Pterostylis sp. |  |  |  | True |
| Oxalidaceae | Oxalis perennans | Grassland Wood-sorrel |  |  | True |
| Oxalidaceae | Oxalis sp. |  |  |  | True |
| Philydraceae | Philydrum lanuginosum | Frogsmouth |  |  | True |
| Phormiaceae | Dianella revoluta |  |  |  | True |
| Phormiaceae | Dianella sp. |  |  |  | True |
| Phytolaccaceae | Phytolacca octandra | Inkweed |  |  | False |
| Pittosporaceae | Billardiera scandens | Appleberry |  |  | True |
| Pittosporaceae | Bursaria spinosa | Native Blackthorn |  |  | True |
| Pittosporaceae | Pittosporum undulatum | Sweet Pittosporum |  |  | True |
| Plantaginaceae | Plantago lanceolata | Lambs Tongues |  |  | False |
| Poaceae | Andropogon virginicus | Whisky Grass |  |  | False |
| Poaceae | Aristida ramosa | Cane Wire-grass |  |  | True |
| Poaceae | Aristida sp. |  |  |  | True |
| Poaceae | Aristida vagans | Threeawn Speargrass |  |  | True |


| Family Name | Scientific Name | Common Name | EPBC $\mathbf{A c t} t^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \operatorname{Act}^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Poaceae | Aristida warburgii |  |  |  | True |
| Poaceae | Arundo donax | Giant Reed |  |  | False |
| Poaceae | Austrostipa pubescens |  |  |  | True |
| Poaceae | Austrostipa ramosissima | Stout Bamboo Grass |  |  | True |
| Poaceae | Austrostipa sp. |  |  |  | True |
| Poaceae | Axonopus fissifolius | Narrow-leafed Carpet Grass |  |  | False |
| Poaceae | Bothriochloa macra | Red Grass |  |  | True |
| Poaceae | Briza subaristata |  |  |  | False |
| Poaceae | Chloris gayana | Rhodes Grass |  |  | False |
| Poaceae | Chloris virgata | Feathertop Rhodes Grass |  |  | False |
| Poaceae | Cymbopogon refractus | Barbed Wire Grass |  |  | True |
| Poaceae | Cynodon dactylon | Common Couch |  |  | True |
| Poaceae | Dactyloctenium radulans | Button Grass |  |  | True |
| Poaceae | Dichelachne sp. |  |  |  | True |
| Poaceae | Digitaria didactyla | Queensland Blue Couch |  |  | True |
| Poaceae | Digitaria parviflora | Small-flowered Finger Grass |  |  | True |
| Poaceae | Echinopogon caespitosus |  |  |  | True |
| Poaceae | Echinopogon ovatus | Forest Hedgehog Grass |  |  | True |
| Poaceae | Ehrharta erecta | Panic Veldtgrass |  |  | False |
| Poaceae | Entolasia marginata | Bordered Panic |  |  | True |
| Poaceae | Entolasia stricta | Wiry Panic |  |  | True |
| Poaceae | Eragrostis brownii | Browns Lovegrass |  |  | True |
| Poaceae | Eragrostis curvula | African Lovegrass |  |  | False |
| Poaceae | Eragrostis sp. |  |  |  | True |
| Poaceae | Hemarthria uncinata | Matgrass |  |  | True |
| Poaceae | Imperata cylindrica | Bladey Grass |  |  | True |
| Poaceae | Lachnagrostis filiformis | Common Blown-grass |  |  | True |
| Poaceae | Microlaena stipoides |  |  |  | True |
| Poaceae | Oplismenus aemulus |  |  |  | True |
| Poaceae | Oplismenus imbecillis | Creeping Beard Grass |  |  | True |
| Poaceae | Panicum simile | Two-colour Panic |  |  | True |
| Poaceae | Paspalidium distans | Spreading Panic-grass |  |  | True |
| Poaceae | Paspalum dilatatum | Paspalum |  |  | False |
| Poaceae | Paspalum urvillei | Vasey Grass |  |  | False |


| Family Name | Scientific Name | Common Name | EPBC <br> $A c t^{(1)}$ | TSC | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Poaceae | Pennisetum clandestinum | Kikuyu Grass |  |  | False |
| Poaceae | Poa labillardierei var. labillardierei | Tussock |  |  | True |
| Poaceae | Rytidosperma sp. |  |  |  | True |
| Poaceae | Setaria gracilis | Slender Pigeon Grass |  |  | False |
| Poaceae | Sporobolus africanus | Parramatta Grass |  |  | False |
| Poaceae | Sporobolus creber | Slender Rats Tail Grass |  |  | True |
| Poaceae | Sporobolus elongatus | Slender Rats Tail Grass |  |  | True |
| Poaceae | Sporobolus sp. |  |  |  | True |
| Poaceae | Themeda australis | Kangaroo Grass |  |  | True |
| Polygonaceae | Acetosa sagittata | Rambling Dock |  |  | False |
| Polygonaceae | Persicaria decipiens | Slender Knotweed |  |  | True |
| Polygonaceae | Persicaria sp. |  |  |  | True |
| Pontederiaceae | Eichhornia crassipes | Water Hyacinth |  |  | False |
| Proteaceae | Banksia integrifolia |  |  |  | True |
| Proteaceae | Banksia oblongifolia |  |  |  | True |
| Proteaceae | Banksia spinulosa |  |  |  | True |
| Proteaceae | Grevillea parviflora subsp. parviflora | Small-flower Grevillea | V | $\begin{gathered} \text { V( } \\ \text { NSW ) } \end{gathered}$ | True |
| Proteaceae | Grevillea robusta | Silky Oak |  |  | True |
| Proteaceae | Hakea dactyloides | Broad-leaved Hakea |  |  | True |
| Proteaceae | Hakea sericea |  |  |  | True |
| Proteaceae | Isopogon anemonifolius |  |  |  | True |
| Proteaceae | Lomatia silaifolia | Crinkle Bush |  |  | True |
| Proteaceae | Persoonia lanceolata |  |  |  | True |
| Proteaceae | Persoonia levis | Broad-leaved Geebung |  |  | True |
| Proteaceae | Persoonia linearis | Narrow-leaved Geebung |  |  | True |
| Proteaceae | Persoonia nutans | Nodding Geebung | E | $\begin{gathered} \text { E1 ( } \\ \text { NSW ) } \end{gathered}$ | True |
| Proteaceae | Petrophile sessilis |  |  |  | True |
| Ranunculaceae | Clematis aristata | Mountain Clematis |  |  | True |
| Restionaceae | Empodisma minus | Spreading Rope-rush |  |  | True |
| Restionaceae | Lepyrodia scariosa |  |  |  | True |
| Rosaceae | Rubus fruiticosus | Blackberry complex |  |  | False |
| Rosaceae | Rubus parvifolius | Native Raspberry |  |  | True |
| Rosaceae | Rubus ulmifolius | Blackberry |  |  | False |
| Rubiaceae | Opercularia aspera | Coarse Stinkweed |  |  | True |


| Family Name | Scientific Name | Common Name | EPBC <br> $A c t^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | Native |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Rubiaceae | Opercularia diphylla |  |  |  | True |
| Rubiaceae | Opercularia sp. |  |  |  | True |
| Rubiaceae | Pomax umbellata | Pomax |  |  | True |
| Rubiaceae | Richardia stellaris |  |  |  | False |
| Rutaceae | Phebalium dentatum | Toothed Phebalium |  |  | True |
| Santalaceae | Exocarpos cupressiformis | Native Cherry |  |  | True |
| Sapindaceae | Cardiospermum grandiflorum | Balloon Vine |  |  | False |
| Scrophulariaceae | Veronica plebeia | Trailing Speedwell |  |  | True |
| Solanaceae | Cestrum parqui | Green Cestrum |  |  | False |
| Solanaceae | Solanum americanum | Glossy Nightshade |  |  | True |
| Solanaceae | Solanum chenopodioides | Whitetip Nightshade |  |  | False |
| Solanaceae | Solanum mauritianum | Wild Tobacco Bush |  |  | False |
| Thymelaeaceae | Pimelea linifolia | Slender Rice-flower |  |  | True |
| Typhaceae | Typha orientalis | Broad-leaved Cumbungi |  |  | True |
| Verbenaceae | Lantana camara | Lantana |  |  | False |
| Verbenaceae | Verbena bonariensis | Purpletop |  |  | False |
| Verbenaceae | Verbena rigida | Veined Verbena |  |  | False |
| Vitaceae | Cayratia clematidea | Slender Grape |  |  | True |
| Xanthorrhoeaceae | Xanthorrhoea minor |  |  |  | True |
| Xanthorrhoeaceae | Xanthorrhoea spp. |  |  |  | True |

[^2]

## Appendix B

Threatened species of plant


## Appendix B - Threatened species of plant

Likelihood of occurrence of Threatened species and populations of plants previously recorded, or predicted to occur within 10 km of the study area.

BABSOMS
B BMNGME
BRINCKERHOFF

| Family | Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\underset{\mathrm{Act}^{(2)}}{\text { TSC }}$ | Recorded in locality ${ }^{3}$ | Preferred Habitat | Likelihood of occurrence in study area |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Orchidaceae | Cryptostylis hunteriana | Leafless Tongue Orchid | V | V | No | Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite \& sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats (Harden 1993; NSW National Parks and Wildlife Service 1999b). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Asclepiadaceae | Cynanchum elegans | White-flowered Wax Plant | E | E1 | Yes <br> 2 records in Western Sydney Regional Parklands | Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes (Harden 1992). This species typically occurs at the ecotone between dry subtropical forest/woodland communities (James 1997b; NSW National Parks and Wildlife Service 2002b). | Low <br> No suitable habitat for this species exists in the study area. |
| Myrtaceae | Darwinia biflora |  | v | V | No | Occurs from Cheltenham to Hawkesbury River where it grows in heath on sandstone or in the understorey of woodland on shale-capped ridges (Harden 2002). Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include Eucalyptus haemastoma, Corymbia gummifera and/or Eucalyptus squamosa. The vegetation structure is usually woodland, open forest or scrub-heath (Office of Environment and Heritage 2011c). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Poaceae | Deyeuxia appressa |  | E | E1 | Yes <br> 1 record exists near Revesby from 1930 | Occurs in the Hornsby area on wet ground (Harden 1993; Sharp \& Simon 2002). | Low <br> No suitable habitat for this species exists in the study area. Thought to be restricted to the Hornsby area |
| Fabaceae (Faboideae) | Dillwynia tenuifolia |  | v | v | Yes <br> 1 record exists near Kemps Creek | Occurs on the Cumberland Plain from the Blue Mountains to Howes Valley area where it grows in dry sclerophyll woodland on sandstone, shale or laterite (Harden 2002). Specifically, occurs within Castlereagh woodlands, particularly in shale gravel transition forest. Associated species include Eucalyptus fibrosa, Eucalyptus sclerophylla, Melaleuca decora, Daviesia ulicifolia, Dillwynia juniperina and Allocasuarina littoralis (James 1997b). | Moderate <br> One record of this species in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland along within the Wattle Grove Offset Area. |
| Orchidaceae | Diuris aequalis | Buttercup Doubletail | V | E1 | Yes <br> 1 record exists from 1905 near Hoxton Park | Occurs chiefly in the ranges and tablelands from Braidwood to Kanangra and Liverpool where it grows among grass in sclerophyll forest (Harden 1993). It typically occurs on gentle slopes, in gravely clay-loam soil within montane eucalypt forest with a grass or heath understorey (Bishop 2000). Three small populations are known to occur within Kanangra Boyd National Park, other populations are restricted to remnant vegetation within roadsides and agricultural lands (NSW Scientific Committee 2002b). | Low <br> No suitable habitat for this species exists in the study area and this species hasn't been found nearby since 1905. |
| Ericaceae | Epacris purpurascens var purpurascens |  |  | v | Yes <br> 4 records exist nearby at Bankstown | Occurs in the Gosford and Sydney districts where it grows in sclerophyll forest, scrub and swamps (Harden 1992). Usually found in sites with a strong shale influence (NSW National Parks and Wildlife Service 2002c). | Low <br> Species not associated with the vegetation communities of the site. |
| Myrtaceae | Eucalyptus camfieldii | Heart-leaved Stringybark | v | v | Yes <br> 1 record exists in the Georges River NP in Sutherland | Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park (Office of Environment and Heritage 2011b). Occurs within poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. | Low <br> No suitable habitat for this species exists in the study area. |
| Myrtaceae | Eucalyptus nicholii | Narrow-leaved Black Peppermint | v | V | Yes <br> 1 record exists near Warwick Farm | Occurs from Niangala to Glenn Innes where it grows in grassy sclerophyll woodland on shallow relatively infertile soils on shales and slates, mainly on granite. Endemic on the NSW Northern Tablelands, of limited occurrence, particularly in the area from Walcha to Glen Innes; often on porphyry or granite (Brooker \& Kleinig 1999; Office of Environment and Heritage 2011a). | Low <br> This New England Tableland species is not native to the Sydney area and is planted near Warwick Farm. |


| Family | Scientific Name | Common Name | $\begin{gathered} \text { EPBC } \\ \text { Act }^{(1)} \end{gathered}$ | $\underset{\mathrm{Act}^{(2)}}{\text { TSC }}$ | Recorded in locality ${ }^{3}$ | Preferred Habitat | Likelihood of occurrence in study area |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Myrtaceae | Eucalyptus scoparia |  | V | E1 | Yes <br> 1 record exists near Hoxton Park | Occurs in Queensland and reaches its southern limit in NSW. In NSW it is known from three locations all near Tenterfield in the far northern New England Tableland Bioregion where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland (Royal Botanic Gardens 2011). | Low <br> This New England Tableland species is not native to the Sydney area and is planted near Hoxton Park. |
| Orchidaceae | Genoplesium baueri | Bauer's Midge Orchid |  | v | No | Grows in sparse sclerophyll forest and moss gardens over sandstone; from the Hunter Valley to Nowra district (Royal Botanic Gardens 2011). | Low <br> No suitable habitat or historic records of this species exist in the locality |
| Grammitaceae | Grammitis stenophylla | Narrow-leaf Finger Fern |  | E1 | No | Fern which occurs in coastal regions from Queensland to the NSW south coast where it grows in moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest (Harden 2000). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Proteaceae | Grevillea parviflora subsp. parviflora | Small-flower Grevillea | v | V | Yes <br> 2 records exist near the study area with a recent record from 2002 | Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct populations near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Harden 2002; NSW Scientific Committee 1998a). | Recorded <br> Recorded in Castlereagh Scribbly Gum Woodland within the Wattle Grove Offset Area. Unlikely to occur elsewhere in study area. |
| Gyrostemonaceae | Gyrostemon thesioides |  |  | E1 | Yes <br> 31 records exist with the closest to the study area from Ingleburn | Confined to the Colo, Georges and Nepean Rivers where it occurred on river banks. It is a fire-opportunist (James 1997b; NSW Scientific Committee 1998b; Royal Botanic Gardens 2011). | Low <br> Not recorded on the Georges River for 30 years despite searches (Office of Environment and Heritage 2011c). |
| Haloragaceae | Haloragodendron lucasii |  | E | E1 | No | Confined to the Sydney area where it grows in dry sclerophyll open forest on sheltered slopes near creeks on sandstone (Harden 2002). Reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Associated with high soil moisture and relatively high soil-phosphorus levels (Office of Environment and Heritage 2011c). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Dilleniaceae | Hibbertia sp. Bankstown |  | CE | E4A | Yes <br> 1 record exists nearby at Bankstown Airport | Endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown LGA. The species is not known from any conservation reserves. The population comprises fewer than 50 individuals. | Low <br> The only population is known from Bankstown Airport. |
| Dilleniaceae | Hibbertia superans |  |  | E1 | No | Occurs from Castle Hill to South Maroota where it grows in ridgetop woodlands usually near Shale/Sandstone Transition Forest. It is often associated with other threatened flora including Pimelea curviflora var. curviflora, Darwinia biflora, Epacris purpurascens var. purpurascens, Leucopogon fletcheri subsp. fletcheri, Acacia bynoeana, Eucalyptus sp. Cattai and Persoonia hirsuta (NSW Scientific Committee 2001). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Hygrophoraceae | Hygrocybe anomala var. ianthinomarginata |  |  | v | No | Small, brightly-coloured gilled fungus and has been found in Lane Cove Bushland Park in the Lane Cove LGA in Sydney, and from Royal and Blue Mountains National Parks (NSW National Parks and Wildlife Service 2002d) | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Hygrophoraceae | Hygrocybe aurantipes |  |  | V | No | Small, brightly-coloured gilled fungus known only from its type locality in the Lane Cove Bushland Park in the Lane Cove LGA in Sydney and from the Blue Mountains National Park and Hazelbrook (NSW National Parks and Wildlife Service 2002e). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Hygrophoraceae | Hygrocybe austropratensis |  |  | E1 | No | Small, brightly-coloured gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove LGA in Sydney (NSW National Parks and Wildlife Service 2002f). | Low <br> No suitable habitat or historic records of this species exist in the locality |
| Hygrophoraceae | Hygrocybe collucera |  |  | E1 | No | Small, brightly-coloured red gilled fungus known only from its type locality in the Lane Cove Bushland Park in the Lane Cove LGA in Sydney (NSW National Parks and Wildlife Service 2002g). | Low <br> No suitable habitat or historic records of this species exist in the locality. |


| Family | Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\underset{\mathrm{Act}^{(2)}}{\text { TSC }}$ | Recorded in locality ${ }^{3}$ | Preferred Habitat | Likelihood of occurrence in study area |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Hygrophoraceae | Hygrocybe griseoramosa |  |  | E1 | No | Small, buff to brown gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove LGA in Sydney (NSW National Parks and Wildlife Service 2002h). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Hygrophoraceae | Hygrocybe lanecovensis |  |  | E1 | No | Small, brightly-coloured gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove LGA in Sydney (NSW National Parks and Wildlife Service 2002i). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Hygrophoraceae | Hygrocybe reesiae |  |  | v | No | Small, lilac coloured gilled fungus known in New South Wales only from its type locality in the Lane Cove Bushland Park in the Lane Cove LGA in Sydney, and from the Blue Mountains National Park. It is also found in Tasmania (NSW National Parks and Wildlife Service 2002j). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Hygrophoraceae | Hygrocybe rubronivea |  |  | V | No | Small, brightly-coloured gilled fungus and is known only from its type locality in the Lane Cove Bushland Park in the Lane Cove LGA in Sydney (NSW National Parks and Wildlife Service 2002k). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Lobeliaceae | Hypsela sessiliflora |  | x | E1 | No | Previously thought to be extinct, recently rediscovered in Erskine Park on the Cumberland Plain in western Sydney. Past records include Homebush and South Creek in Blacktown LGA (James 1997b). It has been reported from damp places (NSW Scientific Committee 2003a) such as river banks (James 1997b). Specifically it is known to occur within Sydney Coastal River-flat Forest (Upper Parramatta River Catchment Trust 1999). | Low <br> Marginal habitat present, however no historic records of this species exist in the locality. |
| Ericaceae | Leucopogon exolasius | Woronora Beard-heath | V | v | Yes <br> 3 records exist nearby with a record near the study area from the year 2000 | Restricted chiefly to the Woronora and Grose Rivers and Stokes Creek, Sydney catchments and the Royal National Park. One old record from the Grose River. Grows in woodland on sandstone (Royal Botanic Gardens 2011). | Moderate <br> Marginal habitat for this species exists in the Castlereagh Scribbly Gum Woodland within the Wattle Grove Offset Area. <br> Unlikely to occur elsewhere in study area. |
| Ericaceae | Leucopogon fletcheri subsp. fletcheri |  |  | E1 | Yes <br> 1 record exists on the Holsworthy prohibited area | Grows in dry eucalypt woodland or in shrubland on clay, lateritic soils or Hawkesbury sandstone (Fairley, Alan 2004). Found on sandstone ridges and upper slopes in heath or woodland, sometimes in or below sandstone-shale ecotone; often associated with lateritic soils with some clay influence (James 1997a; James et al. 1999). | Low <br> Species not associated with the vegetation communities of the site. |
| Asclepiadaceae | Marsdenia viridiflora subsp. viridiflora Endangered population | Marsdenia viridiflora subsp. viridiflora population in the Bankstown, Blacktown, Camden, <br> Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs |  | E2 | Yes <br> 10 records from Hoxton Park, Prestons and Potts Hill | Marsdenia viridiflora subsp. viridiflora has a wide distribution in subcoastal and southern Queensland but has been recorded rarely in NSW and from a disjunct occurrence near Sydney. The Endangered Marsdenia viridiflora subsp. viridifiora population occurs as very scattered plants in areas of remnant vegetation (NSW Scientific Committee 2000a). | Moderate <br> Suitable habitat (HN512 and HN531) was recorded within the Wattle Grove Offset Area. Unlikely to occur elsewhere in study area. |
| Juncaginaceae | Maundia triglochinoides | - |  | v | No | Occurs north from Sydney. Grows in swamps, creeks or shallow freshwater 30 to 60 cm deep on heavy clay, low nutrients. Associated with wetland species such as Triglochin procerum (Harden 1993). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Myrtaceae | Melaleuca biconvexa | Biconvex Paperbark | V | V | No | Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area (NSW Scientific Committee 1998c). Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects (Harden 2002). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Myrtaceae | Melaleuca deanei | Deane's Paperbark | V | V | Yes <br> 14 records exist in the locality with 6 occurring at Sandy Point | Occurs in coastal districts, including western Sydney (e.g. Baulkham Hills, Liverpool shires) from Berowra to Nowra where it grows in wet heath on sandstone and shallow/skeletal soils near streams or perched swamps (Harden 2002; James 1997b). | Low <br> No suitable habitat for this species exists in the study area. |


| Family | Scientific Name | Common Name | $\begin{gathered} \text { EPBC } \\ \text { Act }^{(1)} \end{gathered}$ | $\underset{\mathrm{Act}^{(2)}}{\text { TSC }}$ | Recorded in locality ${ }^{3}$ | Preferred Habitat | Likelihood of occurrence in study area |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Proteaceae | Persoonia hirsuta | Hairy Geebung | E | E1 | Yes <br> 3 records exist near Holsworthy | Occurs in central coast and central tableland districts where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) and rarely shale (NSW Scientific Committee 1998d). Often occurs in areas with clay influence, in the ecotone between shale and sandstone (James 1997b; Office of Environment and Heritage 2011c). | Moderate <br> Historic records of this species exist in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland within the Wattle Grove Offset Area. <br> Unlikely to occur elsewhere in study area. |
| Proteaceae | Persoonia nutans | Nodding Geebung | E | E1 | Yes <br> 31 records exist near the study area including a recent record from 2002 | Confined to the western Sydney where it grows in Castlereagh Scribbly Gum Woodlands and Agnes Banks Woodlands (Harden 2002; James 1997b; NSW National Parks and Wildlife Service 2001). | Recorded <br> Recorded in Castlereagh Scribbly Gum Woodland within the Wattle Grove Offset Area. Unlikely to occur elsewhere in study area. |
| Thymelaeaceae | Pimelea curviflora var. curviflora |  | V | V | No | Confined to coastal areas around Sydney where it grows on sandstone and laterite soils. It is found between South Maroota, Cowan, Narrabeen, Allambie Heights, Northmead and Kellyville. Usually occurs in woodland in the transition between shale and sandstone (Harden 2000; James 1997b; James et al. 1999; NSW Scientific Committee 1998e). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Thymelaeaceae | Pimelea spicata | Spiked Rice-flower | E | E1 | Yes <br> 39 records exist in the locality with records from Glenfield in 2004. | In western Sydney, Pimelea spicata grows on Wianamatta Shales in Greybox - Ironbark Woodland with Bursaria spinosa and Themeda australis (Harden 2000; James 1997b; NSW National Parks and Wildlife Service 2000). | Low <br> Species not associated with the vegetation communities of the site |
| Rhamnaceae | Pomaderris brunnea |  | V | V | No | Confined to the Colo and Upper Nepean Rivers where it grows in open forest (Harden 2000); in western Sydney (Camden to Picton area) known from sandy alluvium on levee and creek banks (James 1997b). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Rhamnaceae | Pomaderris prunifolia Endangered population | Pomaderris prunifolia population in the Parramatta, Auburn, Strathfield and Bankstown LGAs |  | E2 | Yes <br> 3 records exist near Bankstown Airport and in Sutherland | Occurs on rocky slopes, often along creeks (Harden 2000). Within Parramatta, Auburn, Strathfield and Bankstown LGAs, the only recent record of this species is from Rydalmere, where only 3 plants occur (NSW Scientific Committee 1999b). | Low <br> N/A - The Endangered population is restricted to the Parramatta, Auburn, Strathfield and Bankstown LGAs |
| Orchidaceae | Pterostylis gibbosa |  | E | E1 | Yes <br> 1 record exists near Menai found in 1949 | Occurs in the southern part of the Central Coast region with a disjunct population in the Hunter Valley. Grows among grass in sclerophyll forest (Harden 2002). | Low <br> No suitable habitat for this species exists in the study area. |
| Orchidaceae | Pterostylis nigricans | Dark Greenhood |  | V | Yes <br> 1 record exists near Prestons from 1967 | Grows in coastal heathland with Banksia ericifolia, and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils (Bishop 2000; Royal Botanic Gardens 2011) | Low <br> No suitable habitat for this species exists in the study area |
| Orchidaceae | Pterostylis saxicola | Sydney Plains Greenhood | E | E1 | Yes <br> 5 records exist near the Holsworthy restricted area including a record from 2007 | Grows in Sydney Sandstone Gully Forest in shallow or skeletal soils over sandstone shelves, often near streams (Harden 1993; James 1997b; Office of Environment and Heritage 2011c) | Low <br> No suitable habitat for this species exists in the study area. |
| Fabaceae (Faboideae) | Pultenaea parviflora | Sydney Bush-pea | v | E1 | Yes <br> 1 record exists at Potts Hill | Restricted to the Cumberland Plain where it grows in dry sclerophyll forest on Wianamatta shale, laterite or alluvium (Harden 2002). Locally abundant within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays (James 1997b; NSW National Parks and Wildlife Service 2002I). | Moderate <br> Historic records of this species exist in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland within the Wattle Grove Offset Area. <br> Unlikely to occur elsewhere in study area. |
| Fabaceae (Faboideae) | Pultenaea pedunculata | Matted Bush-pea |  | E1 | Yes <br> 23 records exist near Hoxton Park, Prestons and Potts Hill | Restricted to Wianamatta Shales of the Cumberland Plain from Bankstown to Liverpool and on the South Coast in the Southeast Corner Bioregion at Bournda. It grows on a variety of soils in dry sclerophyll forest and disturbed sites (Harden 2000; NSW National Parks and Wildlife Service 2002m; NSW Scientific Committee 1999c). | Moderate <br> Suitable habitat (HN512 and HN531) was recorded within the Wattle Grove Offset Area. Unlikely to occur elsewhere in study area. |

BRINCKERHOFF

| Family | Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act } \end{aligned}$ | $\begin{aligned} & \text { TSC } \\ & \mathrm{Act}^{(2)} \end{aligned}$ | Recorded in locality ${ }^{3}$ | Preferred Habitat | Likelihood of occurrence in study area |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Myrtaceae | Syzygium paniculatum | Magenta Lilly Pilly | V | E1 | No | Occurs between Buladelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden 2002). On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (Office of Environment and Heritage 2011c). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Elaeocarpaceae | Tetratheca glandulosa |  | v | v | No | Occurs from Mangrove Mountain to the Blue Mountains where it grows in sandy or rocky heath or scrub (Harden 1992). Associated with shalesandstone transition habitat where shale-cappings occur over sandstone. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest (Office of Environment and Heritage 2011c) | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Orchidaceae | Thelymitra sp. Kangaloon | Kangaloon Sun Orchid | CE |  | No | The Kangaloon Sun-orchid is known from three locations near Robertson in the Southern Highlands. The Kangaloon Sun-orchid has an estimated area of occupancy of $10 \mathrm{~km}^{2}$. The three localities are Butler's Swamp, Stockyard Swamp (once known as Molly Morgan Swamp) and Wildes Meadow Swamp. All swamps are located above what is known as the Kangaloon Aquifer (Department of the Environment Water Heritage and the Arts 2009). | Low <br> No suitable habitat or historic records of this species exist in the locality. Thelymitra sp. Kangaloon is only found in upland swamps near the town of Kangaloon. |
| Campanulaceae | Wahlenbergia multicaulis Endangered population | Tadgell's Bluebell population in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield LGAs |  | E2 | No | Occurs in coastal and tableland districts south from Sydney and the Blue Mountains west along the Murray River to Mathoura where it grows in a variety of habitats including forest, woodland, grassland (Harden 1992), forest, scrub and the edges of watercourses and wetlands. It is a coloniser and typically occurs in damp, disturbed sites (NSW Scientific Committee 2003b). | Low <br> N/A - Only considered Endangered in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield LGAs |
| Convolvulaceae | Wilsonia backhousei | Narrow-leafed Wilsonia |  | v | Yes <br> 2 records exist near Bankstown Airport and Revesby | Occurs chiefly in the Sydney district but also common at Jervis Bay (Harden 2000). A salt tolerant species, it is found in intertidal saltmarshes and sometimes on seacliffs (NSW Scientific Committee 2000b). | Low <br> No suitable habitat for this species exists in the study area. |

[^3]
## Appendix B References

Bishop, T 2000, Field guide to the orchids of New South Wales and Victoria, Second edn, University of New South Wales Press Pty. Ltd., Sydney.

Brooker, MIH \& Kleinig, DA 1999, Field guide to Eucalypts, Volume 1: South-eastern Australia, Blooming Books, Hawthorn, Australia.

Department of the Environment Water Heritage and the Arts 2009, Thelymitra sp. Kangaloon (D.L.Jones 18108) in Species Profile and Threats Database, Department of the Environment Water Heritage and the Arts, viewed 21 August 2009 2009, <http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon id=81971>.

Fairley, A 2004, Seldom Seen: Rare Plants of Greater Sydney., 1st edn, Reed New Holland, Sydney.
Fairley, A \& Moore, P 2002, Native plants of the Sydney district. An identification guide, Revised Edition edn, Kangaroo Press, Sydney.

Harden, G 1992, Flora of New South Wales Volume 3, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, Flora of New South Wales Volume 4, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, Flora of New South Wales Volume 1 (Revised Edition), University of New South Wales Press Ltd., Kensington.

Harden, G 2002, Flora of New South Wales Volume 2 (Revised Edition), 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

James, T 1997a, Urban bushland biodiversity survey. Flora appendices., NSW National Parks and Wildlife Service, Hurstville,

James, T 1997b, Urban bushland biodiversity survey. Native flora in western Sydney., NSW National Parks and Wildlife Service, Hurstville,

James, T, McDougall, L \& Benson, D 1999, Rare bushland plants of western Sydney, Royal Botanic Gardens, Sydney.

Lunt, ID 1997, 'Germinable soil seed banks of anthropogenic native grasslands and grassy forest remnants in temperate south-eastern Australia', Plant Ecology, vol. 130, no. 1, pp. 21-34.

NSW National Parks and Wildlife Service 1999a, Acacia bynoeana threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999b, Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.,

NSW National Parks and Wildlife Service 2000, Pimelea spicata threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001, Persoonia nutans threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002a, Camarophyllopsis kearneyi (an agaric fungus) endangered species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002b, Cynanchum elegans threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002c, Epacris purpurascens var. purpurascens threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002d, Hygrocybe anomala var. ianthinomarginata (an agaric fungus) - vulnerable species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002e, Hygrocybe aurantipes (an agaric fungus) - vulnerable species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002f, Hygrocybe austropratensis (an agaric fungus) - endangered species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002g, Hygrocybe collucera (an agaric fungus) - endangered species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002h, Hygrocybe griseoramosa (an agaric fungus) - endangered species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002i, Hygrocybe lanecovensis (an agaric fungus) - endangered species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002j, Hygrocybe reesiae (an agaric fungus) - vulnerable species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002k, Hygrocybe rubronivea (an agaric fungus) - vulnerable species listing, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002I, Pultenaea parviflora threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002m, Pultenaea pedunculata threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003, Acacia pubescens threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998a, Final determination to list Grevillea parvilfora ssp. parviflora as a vulnerable species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998b, Final determination to list Gyrostemon thesioides as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998c, Final determination to list Melaleuca biconvexa as a vulnerable species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998d, Final determination to list Persoonia hirsuta as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998e, Final determination to list Pimelea curviflora var curviflora as a vulnerable species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999a, Final determination to list Callistemon linearifolius as a vulnerable species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999b, Final determination to list Pomaderris prunifolia as an endangered population in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas., NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999c, Final determination to list Pultenaea pedunculata as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2000a, Final determination to list Marsdenia viridiflora ssp. viridiflora as an endangered population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2000b, Final determination to list Wilsonia backhousei as a vulnerable species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2001, Final Determination to list Hibbertia superans (a low spreading shrub) as an Endangered species, Department of Environment and Conservation, <http://www.environment.nsw.gov.au/determinations/HibbertiaSuperansALowSpreadingShrubEndSpListing. htm $>$.

NSW Scientific Committee 2002a, Final determination to list Caladenia tessellata as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2002b, Final determination to list the Diuris aequalis as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2003a, Final determination to list Hypsela sessiliflora as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2003b, Final determination to list Wahlenbergia multicaulis as an endangered population in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield., NSW National Parks and Wildlife Service, Hurstville.

Office of Environment and Heritage 2011a, Narrow-leaved Black Peppermint - profile, Office of Environment and Heritage, 2011,
[http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10302](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10302).
Office of Environment and Heritage 2011b, Threatened Species Profile: Eucalyptus camfieldii Office of Environment and Heritage, viewed April 2011
[http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10287](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10287).
Office of Environment and Heritage 2011c, Threatened species, populations and ecological communities of NSW online database, NSW Government,
[http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx).
Robinson, L 1994, Field guide to the native plants of Sydney, Kangaroo Press, Sydney.
Royal Botanic Gardens 2011, PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0), [http://plantnet.rbgsyd.nsw.gov.au/](http://plantnet.rbgsyd.nsw.gov.au/).

Sharp, D \& Simon, BK 2002, AusGrass: Grasses of Australia, CD-ROM, Version 1.0, Australian Biological Resources Study, Canberra, and Environmental Protection Agency, Queensland.,

Upper Parramatta River Catchment Trust 1999, Green corridors management strategy, Upper Parramatta River Catchment Trust, [http://www.uprct.nsw.gov.au/vegetation/publications/greencorridors/GreenCorr/](http://www.uprct.nsw.gov.au/vegetation/publications/greencorridors/GreenCorr/).


## Appendix C

Threatened species of animal


## Appendix C - Threatened species of animal

Likelihood of occurrence of Threatened species and populations of animals previously recorded, or predicted to occur within 10 km of the study area.

| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | $\underset{\mathrm{Act}^{(3)}}{ }$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Amphibians |  |  |  |  |  |  |  |
| Heleioporus australiacus | Giant Burrowing Frog | V | v |  | Yes <br> 2 records exist in the locality in the Holsworthy restricted area | The Giant Burrowing Frog has a marked preference for sandstone ridgetop habitat and broader upland valleys. In these locations, the frog is associated with small headwater creeklines and along slow flowing to intermittent creeklines. They have also been observed occupying artificial ponded structures including dams, detention basins and box drains that are still surrounded by undisturbed habitat. Does not appear to inhabit areas that have been cleared for agriculture or for urban development. (Cogger 2000; NSW National Parks and Wildlife Service 2001a). | Low <br> Habitat unsuitable |
| Litoria aurea | Green and Golden Bell Frog | v | E1 |  | Yes <br> 30 records exist in the locality including 2 near the study area | For breeding the Green and Golden Bell Frog uses waterbodies including natural and manmade structures (marshes, dams and stream sides, and ephemeral pools). Also, found in small pockets of habitat in developed areas. Habitat attributes associated with preferred waterbodies include that the water body is shallow, still or slow flowing, ephemeral and/or widely fluctuating, unpolluted and without heavy shading. Permanent waterbodies are also known to be used (Department of Environment and Conservation 2004, 2005) | Low <br> Marginal habitat and local records in Holsworthy area however local population considered likely to be extinct (White \& Pyke 2010). |
| Litoria littlejohni | Heath Frog | v | v |  | No | Distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in noth-eastern Victoria. It is restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats (NSW Scientific Committee 2000). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Litoria raniformis | Southern Bell Frog | V | E1 |  | No | Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat (Office of Environment and Heritage 2011c) | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Mixophyes balbus | Stuttering Frog | V | E1 |  | No | A Terrestrial species, found in rainforest, Antarctic beech forest or wet sclerophyll forest. The species depends on freshwater streams and riparian vegetation for breeding and habitation. No records are known from riparian habitat that has been disturbed (Cogger 2000; NSW Scientific Committee 2003). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Pseudophryne australis | Red-crowned Toadlet |  | v |  | Yes <br> 7 records exist in the locality in the Holsworthy restricted area | Occurs within 160 km of Sydney where it is restricted to Hawkesbury Sandstone. It breeds in deep grass and debris adjacent to ephemeral drainage lines. When not breeding individuals are found scattered on sandstone ridges under rocks and logs (Cogger 2000) | Low <br> Habitat unsuitable |
| Fish |  |  |  |  |  |  |  |
| Macquaria australasica | Macquarie Perch | E |  | E | No | The natural range of Macquarie Perch included the upper and middle reaches of the Murray-Darling basin as well as the Shoalhaven and Hawkesbury Rivers. However, this species has recently been sighted in only a few localities within these river systems. Preferred habitat is deep holes covered with rocks, and spawning occurs above shallow running water. Macquarie Perch is a schooling species (Department of the Environment and Heritage 2004). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Prototroctes maraena | Australian Grayling | V |  | P | No | It is a mid-water, freshwater species that occurs most commonly in clear, gravelly streams with a moderate flow. Prefers deep, slow flowing pools (NSW Fisheries 2004). | Low <br> No suitable habitat or historic records of this species exist in the locality. Unlikely to occur in the Georges River. |


| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\begin{gathered} \mathrm{TSC} \\ \mathrm{Act}^{(2)} \end{gathered}$ | $\underset{\mathrm{Act}^{(3)}}{\mathrm{FM}}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Invertebrates |  |  |  |  |  |  |  |
| Meridolum corneovirens | Cumberland Land Snail |  | E1 |  | Yes <br> 208 records exist within the locality including records within the study area | Restricted to the Cumberland Plain and Castlereagh Woodlands of Western Sydney and also along the fringes of River Flat Forest, especially where it meets Cumberland Plain Woodland. It is typically found under logs and other debris, amongst leaf litter and bark around bases of trees. It is also sometimes found under grass clumps and where possible it will burrow into loose soil (NSW National Parks and Wildlife Service 1999b). | Moderate <br> Species was apparently recorded on site in 2006 (Office of Environment and Heritage 2012a) however it was not detected in targeted surveys in 2010. May be present on site in low numbers or have gone extinct on site. Mistaken identity is also a possibility as this species is sometimes confused with some colour variants of the exotic Asian Tramp Snail Bradybaena similaris which was recorded on the site in 2010 surveys. |
| Archaeophya adamsi | Adam's Emerald Dragonfly |  |  | E | No | Only five adults have ever been collected, and the species is only known from a few sites in the greater Sydney region. Larvae have been found in small creeks with gravel or sandy bottoms, in narrow, shaded riffle zones with moss and rich riparian vegetation (Department of Primary industries 2014). | Low <br> No suitable habitat or historic records of this species exist in the locality. Unlikely to occur in the degraded sections of the Georges River or Anzac Creek within or adjacent to the Project site. |
| Austrocordulia leonardi | Sydney Hawk Dragonfly |  |  | E | No | The Sydney Hawk dragonfly has specific habitat requirements, and has only ever been collected from deep and shady river pools with cooler water. Larvae are found under rocks where they coexist with the Eastern Hawk dragonfly. It has a very restricted distribution including three locations in a small area south of Sydney, from Audley to Picton. The species is known from the Hawkesbury-Nepean, Georges River, Port Hacking and Karuah drainages (Department of Trade and Investment Regional Infrastructure and Services 2011). | Low <br> No suitable habitat or historic records of this species exist in the locality. Unlikely to occur in the degraded sections of the Georges River or Anzac Creek within or adjacent to the Project site. |
| Birds |  |  |  |  |  |  |  |
| Anthochaera phrygia | Regent Honeyeater | EM | CE |  | Yes <br> 6 records exist in the locality including near Warwick farm and Revesby | Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with Casuarina cunninghamiana and Amyema cambagei are important for feeding and breeding. Important food trees include Eucalyptus sideroxylon, Eucalyptus albens, Eucalyptus melliodora and Eucalyptus leucoxylon (Garnett \& Crowley 2000a). | Moderate <br> Marginal habitat present in the Alluvial Woodland of the Georges River riparian corridor, Wattle Grove Offset area and local records are present. May forage sporadically on the site in winter but unlikely to breed locally. <br> Unlikely elsewhere in the study area. |
| Apus pacificus | Fork-tailed Swift | M |  |  | No | Breeds from central Siberia eastwards through Asia, and is migratory, wintering south to Australia. Individuals never settle voluntarily on the ground and spend most of their lives in the air, living on the insects they catch in their beaks (Higgins 1999). | Moderate <br> Marginal habitat present. |
| Ardea ibis | Cattle Egret | M |  |  | Yes <br> 2 records exist near the study area | The Cattle Egret is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan 2005). | Moderate <br> Marginal habitat and local records present. |
| Ardea modesta | Eastern Great Egret | M |  |  | Yes <br> 11 records exist in the locality near the Georges River | Great Egrets are common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species (Australian Museum 2003). | Moderate <br> Marginal habitat and local records present. |


| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act } \end{aligned}$ | $\underset{\operatorname{Act}^{(2)}}{\text { TSC }}$ | $\underset{\mathrm{Act}^{(3)}}{\mathrm{FM}}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(\sqrt{()}}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Burhinus grallarius | Bush Stone-curlew |  | E1 |  | Yes <br> 4 records exist in the locality near Bankstown Airport in 1996 and Hoxton Park in 1950 | Require sparsely grassed, lightly timbered, open forest of woodland. In southern Australia they often occur where there is a well-structured litter layer and fallen timber debris. Feed on a range of invertebrates and small vertebrates, as well as seeds and shoots (NSW National Parks and Wildlife Service 1999a, 2003b). | Low <br> Poor quality habitat and few recent records of this species exist in the locality. |
| Callocephalon fimbriatum | Gang-gang Cockatoo |  | v |  | Yes <br> 3 records exist in the locality with a record near the Georges River from 2006. | Occurs in wetter forests and woodland from sea level to an altitude over 2000 metres, timbered foothills and valleys, coastal scrubs, farmlands and suburban gardens (Pizzey \& Knight 2007). | Moderate <br> Marginal habitat present in the Alluvial Woodland of the Georges River riparian corridor, Wattle Gove Offset Area and local records present. May forage sporadically on the site, particularly in winter but unlikely to breed locally |
| Callocephalon fimbriatum Endangered population | Gang-gang Cockatoo population in the Hornsby and Ku-ringgai LGAs |  | E2 |  | No | A population of Gang-gang Cockatoos found in the Hornsby and Ku-ring-gai LGAs. | N/A <br> Endangered population is only listed in the Hornsby and Ku-ring-gai LGAs but birds are likely to disperse to other areas including the study area. |
| Calyptorhynchus lathami | Glossy Black-Cockatoo |  | v |  | No | Occurs in eucalypt woodland and forest with Casuarina/Allocasuarina spp Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key Allocasuarina species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garnett \& Crowley 2000a; NSW National Parks and Wildlife Service 1999c). | Low <br> Although marginal habitat recorded within the Wattle Grove Offset Area, no historic records of this species exist in the locality |
| Circus assimilis | Spotted Harrier |  | v |  | $\begin{aligned} & \text { Yes } \\ & 1 \text { record exists at Hoxton } \\ & \text { Park } \end{aligned}$ | The Spotted Harrier occurs throughout the Australian mainland in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant \& Higgins 1993). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (Department of Environment Climate Change and Water 2010c) | Moderate <br> Marginal potential breeding habitat present in the Alluvial Woodland of the Georges River riparian corridor and foraging habitat along forest edges. May forage occasionally on the site as part of a much larger territory extending well beyond the study area. |
| Climacteris picumnus victoriae | Brown Treecreeper (eastern subsp) |  | v |  | Yes <br> 1 record exists near Menai | Found in eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly in habits woodlands dominated by stringybarks or other rough-barked eucalypts. Nesting occurs in tree hollows (Office of Environment and Heritage 2011b) | Low <br> One local record only. Species likely to be extinct in the locality as it is considered to be virtually extinct on the Cumberland Plain (Department of Environment and Climate Change 2007) |
| Daphoenositta chrysoptera | Varied Sittella |  | v |  | Yes <br> 28 records exist in the locality with recent records near the study area | The Varied Sittella inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (Department of Environment Climate Change and Water 2010d). | Moderate <br> The Varied Sittella is relatively common within the Greater Southern Sydney Region (Department of Environment and Climate Change 2007). May occur in the the woodland vegetation throughout the offset areas. Unlikely elsewhere in the study area |
| Ephippiorhynchus asiaticus | Black-necked Stork |  | E1 |  | Yes <br> 1 record exists near Revesby from 1978 | Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garnett \& Crowley 2000a). | Low <br> No suitable habitat for this species exists in the study area |


| Scientific Name | Common Name | EPBC <br> $A c t^{(1)}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | $\begin{gathered} \mathrm{FM} \\ \mathrm{Act}^{(3)} \end{gathered}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Epthianura albifrons | White-fronted Chat |  | V |  | Yes <br> 2 records exist from the Holsworthy restricted area and the Georges River NP at Sutherland | The White-fronted Chat occupies foothills and lowlands below 1000 m above sea level. In New South Wales, the White-fronted Chat occurs mostly in the southern half of the state, occurring in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, White-fronted Chats are found predominantly in saltmarsh vegetation although they are also observed in open grasslands and sometimes in low shrubs bordering wetland areas (Department of Environment Climate Change and Water 2009; Higgins et al. 2001; Pizzey \& Knight 2007). | Low <br> No suitable habitat for this species exists in the study area. |
| Epthianura albifrons Endangered population | White-fronted Chat in the Sydney Metropolitan Catchment Management Authority Area |  | E2 |  | Yes <br> 2 records exist from the Holsworthy restricted area and the Georges River NP at Sutherland | As above for the White-fronted Chat | Low <br> No suitable habitat for this species exists in the study area. |
| Gallinago hardwickii | Latham's Snipe | M |  |  | Yes <br> 51 records exist in the locality around the Bankstown Airport | Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed (Garnett \& Crowley 2000a). | Moderate <br> Marginal habitat and local records present. |
| Glossopsitta pusilla | Little Lorikeet |  | V |  | Yes <br> 13 records exist in the locality with 5 records near the study area from 2006. | The Little Lorikeet is found in forests, woodland, and in treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria (Higgins 1999). | Recorded <br> Recorded within Castlereagh Scribbly Gum Woodland within the Wattle Grove Offset Area. <br> Potential habitat and local records present. A nomadic species which may forage in the study area, particularly in the areas that contains flowering Eucalypts. |
| Grantiella picta | Painted Honeyeater |  | V |  | No | Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees (Garnett \& Crowley 2000a). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Haliaeetus leucogaster | White-bellied Sea-Eagle | M |  |  | Yes <br> 3 records exist in the locality along the Georges River | Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a large nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey \& Knight 2007). | Moderate <br> Marginal habitat and local records present. |
| Hieraaetus morphnoides | Little Eagle |  | v |  | Yes <br> 19 records exist in the locality with a record near the study area from 2006 | The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. She-oak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites, it requires a tall living tree within a remnant patch (Marchant \& Higgins 1993). | Recorded |
| Hirundapus caudacutus | White-throated Needletail | M |  |  | Yes <br> 4 records exist in the locality near the Georges River and near the study area | Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey \& Knight 2007). | High <br> Potential habitat and local records present. |
| Lathamus discolor | Swift Parrot | E | E1 |  | Yes <br> 11 records exist in the locality with a record near the study area from 1998 | Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, overwintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. On mainland Australia, the Swift Parrot is seminomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering Acacia pycnantha, is indicated. Sites used vary from year to year. (Garnett \& Crowley 2000a; Swift Parrot Recovery Team 2001). | Moderate <br> Marginal habitat present in the Alluvial Woodland of the Georges River riparian corridor and Wattle Grove Offset Area and local records present. May forage sporadically on the site in winter but extremely unlikely to breed locally. |


| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\underset{\text { Act }^{(2)}}{\text { TSC }}$ | $\underset{\mathrm{Act}^{(3)}}{\mathrm{FM}}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Limosa limosa | Black-tailed Godwit | M | V |  | No | A coastal species found on tidal mudflats, swamps, shallow river margins and sewage farms. Also, found inland on larger shallow fresh or brackish waters. A migratory species visiting Australia between September and May (Pizzey \& Knight 2007). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Lophoictinia isura | Square-tailed Kite |  | V |  | Yes <br> 2 records exist in the locality from near Revesby and the Holsworthy restricted area as recently as 2006 | The Square-tailed Kite hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects and seems to prefer structurally diverse landscapes (Garnett $\&$ Crowley 2000a). The species shows a particular preference for timbered watercourses and appears to occupy large hunting ranges of more than 100km2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs (Office of Environment and Heritage 2012b). | Moderate <br> Marginal potential breeding habitat present in the Alluvial Woodland of the Georges River riparian corridor and foraging habitat along forest edges. May forage occasionally on the site as part of a much larger territory extending well beyond the study area. |
| Melanodryas cucullata | Hooded Robin |  | V |  | No | Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett \& Crowley 2000a). | Low <br> Marginal quality habitat and no historic records of this species exist in the locality. Considered near extinct on the Cumberland Plain (Department of Environment and Climate Change 2007). |
| Melithreptus gularis gularis | Black-chinned Honeyeater |  | v |  | Yes <br> 7 records exist in the locality near Warwick Farm | Occurs within areas of annual rainfall between $400-700 \mathrm{~mm}$. Feed on insects, nectar and lerps (Garnett \& Crowley 2000b). It occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, Blakely's Red Gum and Forest Red Gum. Also inhabits open forests of smooth-barked gums, stringybarks, river sheoaks (nesting habitat) and tea-trees. Feeding territories are large making the species locally nomadic. It tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares (Office of Environment and Heritage 2012b). | Moderate <br> Marginal quality habitat in Alluvial Woodland. Considered rare in the region and is nomadic (Department of Environment and Climate Change 2007). May forage in the study area when dominant eucalypts are in flower and possibly breed along the Georges River, unlikely elsewhere in the study area. |
| Merops ornatus | Rainbow Bee-eater | M |  |  | No | Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999). | Low <br> Marginal habitat and no historic records of this species exist in the locality. |
| Monarcha melanopsis | Black-faced Monarch | M |  |  | Yes <br> 8 records exist in the locality along the Georges River | Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating (Pizzey \& Knight 1997). | Moderate <br> Marginal habitat and local records present. |
| Myiagra cyanoleuca | Satin Flycatcher | M |  |  | Yes <br> 2 records exist in the locality at Hoxton Park and Warwick Farm | Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey \& Knight 1997). | Moderate <br> Marginal habitat and local records present. |
| Ninox connivens | Barking Owl |  | V |  | Yes <br> 1 record exists in the locality near Warwick Farm | Occurs in dry sclerophyll woodland. In the south west, it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett \& Crowley 2000a). | Moderate <br> Very rare in the region but considered to be widespread (Department of Environment and Climate Change 2007). Marginal potential breeding habitat present in the Alluvial Woodland of the Georges River riparian corridor and foraging habitat along forest edges. May forage occasionally on the site as part of a much larger territory extending well beyond the study area. |


| Scientific Name | Common Name | $\begin{gathered} \text { EPBC } \\ \text { Act }^{(1)} \end{gathered}$ | $\underset{\text { Act }^{\text {T(2) }}}{ }$ | $\underset{\operatorname{Act}^{(3)}}{ }$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Ninox strenua | Powerful Owl |  | V |  | Yes <br> 7 records exist in the locality with a record near the study area (Leacock Regional Park) from 2006 | A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, casuarina or callitris pine forest and woodland. It often roosts in dense vegetation including rainforest and exotic pine plantations. Generally feeds on mediumsized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett \& Crowley 2000a). | Moderate <br> Relatively common in the region (Department of Environment and Climate Change 2007) . Potential breeding and foraging habitat present in the Alluvial Woodland of the Georges River riparian corridor as part of a much larger territory extending well beyond the study area. |
| Petroica boodang | Scarlet Robin |  | V |  | Yes <br> 2 records exist in the locality in the Holsworthy restricted area near the study area from 2006 | In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. It prefers an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter, it migrates to open habitats such as grassy open woodland or paddocks with scattered trees (Department of Environment Climate Change and Water 2010b; Higgins \& Peter 2002). | Recorded |
| Petroica phoenicea | Flame Robin |  | V |  | Yes <br> 3 records exist in the locality near Revesby in 1992 and the Holsworthy restricted area from 1996 | In NSW, the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats (Higgins \& Peter 2002). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank (Department of Environment Climate Change and Water 2010a). | Moderate <br> Marginal habitat and local records present (Department of Environment and Climate Change 2007). Likely only as a nonbreeding migrant. Likely in the Alluvial Woodland of the study area only. |
| Petroica rodinogaster | Pink Robin |  | V |  | Yes <br> 1 record exists in the locality the Georges River NP from 1972 | Found in open forest and woodland including native tea-tree scrubs. Rarely found in open cleared areas. Breeds in dense gullies in temperate rainforests (Pizzey \& Knight 1997). | Low <br> One local record only. Species likely to occur in the locality as very rare visitor only (Department of Environment and Climate Change 2007). |
| Pyrrholaemus sagittatus | Speckled Warbler |  | V |  | Yes <br> 1 record exists in the locality near Hoxton Park | The Speckled Warbler occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett \& Crowley 2000a). | Low <br> One local record only. Species very rare in the locality (Department of Environment and Climate Change 2007). Likely to be locally extinct. |
| Rhipidura rufifrons | Rufous Fantail | M |  |  | Yes <br> 54 records exist in the locality near the Georges River and in Sutherland | Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range (Pizzey \& Knight 1997). | High <br> Potential habitat and local records present. |
| Rostratula australis | Australian Painted Snipe | VM | E1 |  | No | Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as Eucalyptus camaldulensis, Eucalyptus populnea or shrubs such as Muehlenbeckia florulenta or Sarcocornia quinqueflora. Feeds at the water's edge and on mud flats, on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett \& Crowley 2000a). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Stagonopleura guttata | Diamond Firetail |  | V |  | No | Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett \& Crowley 2000a). | Low <br> Poor quality habitat and no historic records of this species exist in the locality. |


| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \mathrm{Act}^{(1)} \end{aligned}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | $\begin{gathered} \mathrm{FM} \\ \mathrm{Act} \end{gathered}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Mammals |  |  |  |  |  |  |  |
| Cercartetus nanus | Eastern Pygmy-possum |  | V |  | Yes <br> 2 records exists in the locality near the Georges River, recorded in 1993 | Found in a range of habitats from rainforest through sclerophyll forest to tree heath. It feeds largely on the nectar and pollen of banksias, eucalypts and bottlebrushes and sometimes soft fruits. It nests in very small tree hollows, between the wood and bark of a tree, abandoned birds' nests and/or shredded bark in the fork of trees (Turner \& Ward 1995). | Moderate <br> Marginal habitat and local records present. Likely only along the Georges River. Other vegetation unlikely to be occupied due to fragmentation. |
| Chalinolobus dwyeri | Large-eared Pied Bat | V | V |  | No | Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 2008). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Dasyurus maculatus | Spotted-tailed Quoll | E | V |  | Yes <br> 4 records occur in the Holsworthy restricted area and in the Georges Rover National Park | In NSW, the Spotted-tailed Quoll occurs on both sides of the Great Dividing Range. Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heath. Nests in rock caves and hollow logs or trees (NSW National Parks and Wildlife Service 1999e, 1999g). | Moderate <br> Marginal habitat and local records present. Moderately likely only along the Georges River and within Wattle Grove Offset Area. Other vegetation unlikely to be occupied due to fragmentation. |
| Falsistrellus tasmaniensis | Eastern False Pipistrelle |  | V |  | Yes <br> 9 records exist in the locality near Sandy Point and to the east of the study area | Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill 2008). | Moderate <br> Species recorded locally from ultrasonic calls only which may be misidentifications and predictive habitat quality mapping shows the locality with a low probability of occurrence (Department of Environment and Climate Change 2007). |
| Miniopterus schreibersii | Eastern Bent-wing Bat | c | V |  | Yes <br> 11 records exist in the locality near Glenfield, Warwick Farm and Sutherland | Usually found in well-timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill 2008). | High <br> The Eastern Bentwing-bat is common and widespread within the greater southern Sydney Region and is a lower conservation priority overall, with the exception of roosting and nursery sites (Department of Environment and Climate Change 2007). <br> Potential foraging habitat present. Marginal roosting habitat may be present in artificial structures. Nursery sites very unlikely. |
| Mormopterus norfolkensis | Eastern Free-tail bat |  | V |  | Yes <br> 26 records exist in the locality near the study area and at Glenfield | The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures (Churchill 2008). It will travel and forage in open country or along creek lines and may utilise remnants too isolated or disturbed for many other species. (Department of Environment and Climate Change 2007). | High <br> Local records exist in the locality and potential habitat present, chiefly in Alluvial Woodland along the Georges River Corridor however may also occur elsewhere in the site including in mature isolated trees and patches of disturbed woodland. <br> The Eastern Free-tail bat is rarely recorded within the greater southern Sydney Region and predictive habitat quality mapping shows the locality with a medium to high probability of occurrence (Department of Environment and Climate Change 2007). <br> Potential foraging and roost/breeding habitat present mainly in Alluvial woodland along the Georges River. |

BRINCKERHOFF

| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }^{(1)} \end{aligned}$ | $\underset{\text { Act }^{(2)}}{\text { TSC }}$ | $\underset{\operatorname{Act}^{(3)}}{ }$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Myotis adversus | Large-footed Myotis |  | V |  | Yes <br> 10 records exist in the locality including at Glenfield | Colonies occur in caves, mines, tunnels, under bridges and buildings. Colonies always occur close to bodies of water where this species feeds on aquatic insects (Churchill 2008). | High <br> Within the Greater Southern Sydney Region, the Large-footed Myotis is strongly associated with the Cumberland Plain where it utilises waterways in relatively disturbed environments including the Georges River catchment around Liverpool and Campbelltown (Department of Environment and Climate Change 2007). <br> Potential foraging and roost/breeding habitat present mainly in Alluvial woodland along the Georges River. |
| Perameles nasuta Endangered Inner Western Sydney population | Long-nosed Bandicoot population, Inner Western Sydney |  | E2 |  | Yes <br> Restricted to the Marrickville and Canada Bay LGAs. May also be found in Canterbury, Ashfield and Leichardt LGAs | Occurs in a range of habitats from rainforest through wet and dry woodland areas with little ground cover. Nests in a shallow hollow on the surface of the ground (Strahan 1995). The Endangered Inner Western Sydney population is restricted to the LGAs of Marrickville and Canada Bay, with the likelihood that it also includes Canterbury, Ashfield and Leichhardt LGAs. | N/A <br> While Long-nosed Bandicoots are likely to occur in the study area they would not be considered part of the Endangered Inner Western Sydney Population |
| Petaurus australis | Yellow-bellied Glider |  | v |  | Yes <br> 1 record exists in the locality on the Georges River National Park near Menai | Restricted to tall, mature eucalypt forest in high rainfall areas of temperate to sub-tropical eastern Australia. Feeds on nectar, pollen, the sap of eucalypts and sometimes insects. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and year round food resources are available from a mixture of eucalypt species (NSW National Parks and Wildlife Service 1999h, 2003d). | Low <br> One local record only. Species likely to be extinct in the study area or record a misidentification. Predictive habitat modelling shows to area with a low probability of occurrence (Department of Environment and Climate Change 2007). |
| Petaurus norfolcensis | Squirrel Glider |  | V |  | Yes <br> 1 record exists in the locality near the study area along the Georges River. | Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999f). | Moderate <br> Marginal habitat and one local record only. Comprehensive surveys of the Cumberland Plain detected this species at only two locations one of which was at Holsworthy Army Reserve (Department of Environment and Climate Change 2007). <br> If present, likely to be restricted to the Georges River Corridor or Wattle Grove Offset Area as other areas too disturbed and fragmented. |
| Petrogale penicillata | Brush-tailed Rockwallaby | V | E1 |  | Yes <br> 1 record exists in the locality in the Holsworthy restricted area | Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003a). | Low <br> Inappropriate habitat and one local record only. Likely to be locally extinct. |
| Phascolarctos cinereus | Koala | V | V |  | Yes <br> 97 records exist in the locality including a record near the study area from 2005 | Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Eucalyptus tereticornis, Eucalyptus punctata, Eucalyptus cypellocarpa and Eucalyptus viminalis (NSW National Parks and Wildlife Service 1999d, 2003c). | Moderate <br> The species is frequently recorded in the locality along the transition of the Cumberland Plain and coastal sandstone areas in an area known as the Cumberland Koala Linkage which includes areas immediately adjacent to the southern end of the site (Department of Environment and Climate Change 2007). |

BRINCKERHOFF
Preferred Habitaf ${ }^{(\text {() }}$
Service 1999 g ).
The New Holland
The New Holland Mouse is a small, burrowing native rodent. The species is similar in size
distinguished by its slightly larger ears and eyes, the absence of a notch on the upper
incisors and the absence of a distinctive 'mousy odour. Known to inhabit open heathen
open woodlands with a heathland understorey, and vegetated sand dunes (Threatened
Species Scientific Committee 2010).
Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands,
heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this $\quad$ Within the Greater Southern Sydney Region ox camp site on Cabramatta Creek (Department of Environment and Climate
Change 2007).
forage throughout the study area.
Vegetation along the Georges River is most
suitable as foraging habitat and may have Moderate
A rarely detected species however, Anabat ultrasonic call records have been made
around the Holsworthy Military Area. The habitat and distribution of this species is
very poorly known and it may occur very poorly known and it may occur
regularly within the locality or only occur as
a summer visitor (Department of a summer visitor (Department of
Environment and Climate Change 2007).
High
Local records exist in the locality and
Lorg
River Corridor.
Rarely recorded within the greater southern mapping shows the locality with a medium to high probability of occurrence. Change 2007).

| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act }{ }^{(1)} \end{aligned}$ | $\begin{gathered} \text { TSC } \\ \text { Act }^{(2)} \end{gathered}$ | $\begin{gathered} F M^{(3)} \\ A^{3} \end{gathered}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Potorous tridactylus | Long-nosed Potoroo | V | V |  | No | In NSW, the Long-nosed Potoroo is found throughout coastal and subcoastal areas. Occurs in a range of habitats: coastal forest and woodland with a moderately dense heathy understorey, dense coastal scrubs or heath, wet and dry sclerophyll forest and sub-tropical, warm temperate and cool temperate rainforest of the eastern slopes and highlands. Often associated with gullies and forest ecotones. Open areas are used for foraging while areas of dense groundcover or understorey provide areas for shelter and protection from predators. Relatively thick ground cover is a major habitat requirement and it seems to prefer areas with light sandy soils (Johnston 1995; NSW National Parks and Wildlife Service 1999g). | Low <br> No suitable habitat or historic records of this species exist in the locality. |
| Pseudomys novaehollandiae | New Holland Mouse | E |  |  | No | The New Holland Mouse is a small, burrowing native rodent. The species is similar in size and appearance to the introduced house mouse (Mus musculus), although it can be distinguished by its slightly larger ears and eyes, the absence of a notch on the upper incisors and the absence of a distinctive 'mousy' odour. Known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes (Threatened Species Scientific Committee 2010). | Low <br> Marginal habitat and no local records present. |
| Pteropus poliocephalus | Grey-headed Flying-fox | v | V |  | Yes <br> 88 records exist in the locality including many near the study area | Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lilly pillies. It roosts in the branches of large trees in forests or mangroves (Churchill 2008; NSW National Parks and Wildlife Service 2001b) | Recorded <br> Within the Greater Southern Sydney Region there is one large and regularly used Flyingfox camp site on Cabramatta Creek (Department of Environment and Climate Change 2007). <br> Recorded flying overhead and likely to forage throughout the study area. Vegetation along the Georges River is most suitable as foraging habitat and may have potential for roosting. |
| Saccolaimus flaviventris | Yellow-bellied Sheathtail Bat |  | v |  | Yes <br> 4 records exist in the locality including at Sandy Point and to the south east of the study area | Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be migratory (Churchill 2008). | Moderate <br> A rarely detected species however, Anabat ultrasonic call records have been made around the Holsworthy Military Area. The habitat and distribution of this species is very poorly known and it may occur regularly within the locality or only occur as a summer visitor (Department of Environment and Climate Change 2007). |
| Scoteanax rueppellii | Greater Broad-nosed Bat |  | V |  | Yes <br> 12 records exist in the locality with 5 records near the study area along the Georges River and at Glenfield | The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically, it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 2008). | High <br> Local records exist in the locality and potential habitat present along the Georges River Corridor. <br> Rarely recorded within the greater southern Sydney Region and predictive habitat quality mapping shows the locality with a medium to high probability of occurrence. (Department of Environment and Climate Change 2007). |

BioBanking Biodiversity Report
Moorebank Intermodal Terminal

| Scientific Name | Common Name | $\begin{aligned} & \text { EPBC } \\ & \text { Act } \end{aligned}$ | $\begin{aligned} & \text { TSC } \\ & \text { Act }^{(2)} \end{aligned}$ | $\begin{gathered} F M \\ \mathrm{Act}^{(3)} \end{gathered}$ | Recorded in locality ${ }^{(4)}$ | Preferred Habitat ${ }^{(5)}$ | Likelihood of occurrence |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Reptiles |  |  |  |  |  |  |  |
| Hoplocephalus bungaroides | Broad-headed Snake | V | E1 |  | No <br> However, records exist in the Holsworthy restricted area | A nocturnal species that occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb \& Shine 1998). | Low <br> Marginal habitat local records restricted to sandstone soils of the Holsworthy range. Study site within an area mapped with low probability of occurrence (Department of Environment and Climate Change 2007). |
| Varanus rosenbergi | Heath Monitor |  | V |  | Yes <br> 2 records exist in the locality near Menai and Lucas Heights | Found in coastal heaths, humid woodlands, and wet and dry sclerophyll forests. Mostly a terrestrial species it shelters in burrows, hollow logs and rock crevices (Cogger 2000). | Low <br> Marginal habitat and few local records present. Site mapped as having medium probability of occurrence in predictive habitat modelling (Department of Environment and Climate Change 2007). |

(3) $\mathrm{E}=$ Endangered, $\mathrm{P}=$ protected (Fisheries Management Act 1994) (4) Previously recorded' refers to records of Threate
(5) Based on database searches and field surveys

## Attachment C References

Australian Museum 2003, Great Egret factsheet, Australian Museum,
Churchill, S 2008, Australian Bats, 2nd edn, Allen \& Unwin, Sydney.
Cogger, HG 2000, Reptiles and Amphibians of Australia, Reed Books, Sydney.

Department of Environment and Climate Change 2007, Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region: Volume 2 Fauna of Conservation Concern and Priority Pest Species, Sydney Catchment Authority and the Department of Environment and Climate Change (NSW), Hurstville.

Department of Environment and Conservation 2004, Green and Golden Bell Frog environmental impact assessment guidelines Department of Environment and Conservation (NSW), Hurstville.

Department of Environment and Conservation 2005, Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea), Department of Environment and Conservation (NSW), Hurstville, NSW,

Department of Environment Climate Change and Water 2009, White-fronted Chat Population in the Sydney Metropolitan Catchment Management Authority Area - profile, Department of Environment Climate Change and Water, viewed 27 August 2010 2010, [http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=20144](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=20144).

Department of Environment Climate Change and Water 2010a, Flame Robin Petroica phoenicea (Gould 1837) - vulnerable species listing, Department of Environment Climate Change and Water, viewed 20 April 2010, [http://www.environment.nsw.gov.au/determinations/flamerobinFD.htm](http://www.environment.nsw.gov.au/determinations/flamerobinFD.htm).

Department of Environment Climate Change and Water 2010b, Scarlet Robin Petroica boodang - proposed vulnerable species listing, Department of Environment Climate Change and Water, viewed 20 April 2010, [http://www.environment.nsw.gov.au/determinations/scarletrobinpd.htm](http://www.environment.nsw.gov.au/determinations/scarletrobinpd.htm).

Department of Environment Climate Change and Water 2010c, Spotted Harrier Circus assimilis - proposed vulnerable species listing, Department of Environment Climate Change and Water, viewed 20 April 2010, [http://npws.nsw.gov.au/determinations/spottedharrierpd.htm](http://npws.nsw.gov.au/determinations/spottedharrierpd.htm).

Department of Environment Climate Change and Water 2010d, Varied Sittella Daphoenositta chrysoptera (Latham 1802) - vulnerable species listing, Department of Environment Climate Change and Water, viewed 20 April 2010, [http://www.environment.nsw.gov.au/determinations/variedsittellaFD.htm](http://www.environment.nsw.gov.au/determinations/variedsittellaFD.htm).

Department of Primary industries 2014, Endangered species - Adams Emerald Dragonfly, viewed 8 July 2014, <http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current/endangered-species/adams-emerald-dragonfly $>$.

Department of the Environment and Heritage 2004, Macquarie Perch- Species profiles and threats database, Department of the Environment and Heritage. Http://www.deh.gov.au/cgi-
bin/sprat/public/publicspecies.pl?taxon id=66632, Canberra
Department of Trade and Investment Regional Infrastructure and Services 2011, Threatened Species Priorities Action Statement - Profiles for species, populations and ecological communities, Department of Trade and Investment Regional Infrastructure and Services,
<http://pas.dpi.nsw.gov.au/Species/Species Home.aspx>.
Garnett, ST \& Crowley, GM 2000a, The Action Plan for Australian Birds, Environment Australia, Canberra.
Garnett, ST \& Crowley, GM (eds) 2000b, The Action Plan for Australian Birds, Canberra.

Higgins, PJ (ed.) 1999, Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, PJ \& Peter, JM (eds) 2002, Handbook of Australian, New Zealand and Antarctic Birds, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM \& Steele, WK (eds) 2001, Handbook of Australian, New Zealand and Antarctic Birds Volume 5: Tyrant-flycatchers to Chats, Oxford University Press, Melbourne.

Johnston, PG 1995, 'Long-nosed Potoroo', in R Strahan (ed.), The Mammals of Australia, Reed New Holland, Sydney, pp. 301-2.

Marchant, S \& Higgins, PJ (eds) 1993, Handbook of Australian, New Zealand and Antarctic Birds Volume 2: Raptors to Lapwings, vol. 2, Volume 2: Raptors to Lapwings, Oxford University Press, Melbourne.

McKilligan, N 2005, Herons, egrets and bitterns: their biology and conservation in Australia, CSIRO Publishing, Collingwood, Victoria.

NSW Fisheries 2004, Status and monitoring of the Australian Grayling in NSW, NSW Fisheries.
NSW National Parks and Wildlife Service 1999a, Bush Stone-curlew threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999b, Cumberland Plain Large Land Snail threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999c, Glossy Black-cockatoo threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999d, Koala threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999e, Spotted-tailed Quoll threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999f, Squirrel Glider threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999g, Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.,

NSW National Parks and Wildlife Service 1999h, Yellow-bellied Glider threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001a, Giant Burrowing Frog threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001b, Grey-headed Flying Fox threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003a, Brush-tailed Rock Wallaby Warrumbungles endangered population threatened species information, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003b, Draft Recovery Plan for the Bush Stone-curlew Burhinus grallarius, National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003c, Draft Recovery Plan for the Koala, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003d, Recovery Plan for the Yellow-bellied Glider (Petaurus australis), NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2000, Final determination to list Littlejohn's tree Frog as a vulnerable species, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2003, Final determination to list the Stuttering Frog as an endangered species, NSW National Parks and Wildlife Service, Hurstville.

Office of Environment and Heritage 2011a, Atlas of NSW Wildlife, [http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp](http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp).

Office of Environment and Heritage 2011b, Brown Treecreeper (eastern subspecies) - Profile, Office of Environment and Heritage, 2011, [http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10171](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10171).

Office of Environment and Heritage 2011c, Threatened species, populations and ecological communities of NSW online database, NSW Government, [http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx).

Office of Environment and Heritage 2012a, Bionet Atlas of NSW Wildlife website, [http://www.bionet.nsw.gov.au/](http://www.bionet.nsw.gov.au/).

Office of Environment and Heritage 2012b, Threatened species, populations and ecological communities of NSW online database, NSW Government, [http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx).

Pizzey, G \& Knight, F 1997, Field Guide to the Birds of Australia, Harper and Collins, Sydney.
Pizzey, G \& Knight, F 2007, Field Guide to the Birds of Australia, Harper and Collins, Sydney.
Strahan, R 1995, The Mammals of Australia, Reed New Holland, Sydney.
Swift Parrot Recovery Team 2001, Swift Parrot Recovery Plan, Department of Primary Industries, Water and Environment, Hobart.

Threatened Species Scientific Committee 2010, Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendment to the list of Threatened Species under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Pseudomys novaehollandiae, Threatened Species Scientific Committee, Canberra.

Turner, V \& Ward, SJ 1995, 'Eastern Pygmy-possum', in R Strahan (ed.), The Mammals of Australia, Reed New Holland, Sydney, pp. 217-8.

Webb, JK \& Shine, R 1998, 'Ecological characteristic of an endangered snake species Hoplocephalus bungaroides (Serpentes: Elapidae)', Animal Conservation, vol. 1, pp. 185-93.

White, A \& Pyke, G 2010, 'Green and Golden Bell Frogs in New South Wales: Current status and future prospects', Australian Zoologist, vol. 34, no. 3, pp. 319-33.


## Appendix D

BioBanking credit report


This report identifies the number and type of credits required at a BIOBANK SITE
Date of report: 16/06/2015 Time: 1:21:15PM Calculator version: v4.0

## Biobank details

| Proposal ID: | $0058 / 2015 / 1917 B$ |
| :--- | :--- |
| Proposal name: | Moorebank Offset |
| Proposal address: | Moorebank Avenue Moorebank NSW |
| Proponent name: | Moorebank Intermodal Company |
| Proponent address: | 2, Level 27, 1 O'Connell Street, Sydney NSW 2000 |
| Proponent phone: | 0282655600 |
| Assessor name: | Alexander Cockerill |
| Assessor address: | PO Box 1162 Newcastle NSW 2300 |
| Assessor phone: | 49298333 |
| Assessor accreditation: | 0058 |

Additional information required for approval:


Use of local benchmark


Expert report...Request for additional gain in site value

Ecosystem credits summary

| Plant Community type | Area (ha) | Credits created |
| :--- | :---: | ---: |
| Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy <br> open forest on clay/gravel soils of the Cumberland Plain, <br> Sydney Basin Bioregion | 13.72 | 176.00 |
| Broad-leaved Ironbark - Melaleuca decora shrubby open <br> forest on clay soils of the Cumberland Plain, Sydney Basin <br> Bioregion | 13.07 |  |
| Forest Red Gum - Rough-barked Apple grassy woodland on <br> alluvial flats of the Cumberland Plain, Sydney Basin <br> Bioregion | 5.65 | 172.00 |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy <br> woodland of the Cumberland Plain, Sydney Basin Bioregion | 23.96 |  |
| Parramatta Red Gum woodland on moist alluvium of the <br> Cumberland Plain, Sydney Basin Bioregion | 23.54 | 459.00 |
| Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in <br> gullies and on sheltered slopes, southern Sydney Basin <br> Bioregion | 16.24 | 278.00 |
| Total | 106.18 | 216.00 |

## Credit profiles

1. Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion, (ME044)
$\begin{array}{lc}\text { Number of ecosystem credits created } & 216 \\ \text { IBRA sub-region } & \text { Cumberland - Sydney Metro }\end{array}$
2. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018)

| Number of ecosystem credits created | 63 |
| :--- | :--- |
| IBRA sub-region | Cumberland - Sydney Metro |

3. Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002)

Number of ecosystem credits created
IBRA sub-region

172

Cumberland - Sydney Metro
4. Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (ME004)

Number of ecosystem credits created 176

IBRA sub-region
Cumberland - Sydney Metro
5. Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)

Number of ecosystem credits created 278
IBRA sub-region Cumberland - Sydney Metro
6. Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)

Number of ecosystem credits created 459

IBRA sub-region

Cumberland - Sydney Metro

## Species credits summary

| Common name | Scientific name | Extent of impact <br> Ha or individuals | Number of <br> species credits <br> created |
| :--- | :--- | ---: | ---: |
| Downy Wattle | Acacia pubescens | 100.00 | 710 |
| Nodding Geebung | Persoonia nutans | 175.00 | 1,242 |
| Small-flower Grevillea | Grevillea parviflora subsp. parviflora | $13,600.00$ | 96,560 |

## Additional management actions

Additional management actions are required for:

| Vegetation type or threatened species | Management action details |
| :--- | :--- |
| Broad-leaved Ironbark - Grey Box - Melaleuca decora <br> grassy open forest on clay/gravel soils of the Cumberland <br> Plain, Sydney Basin Bioregion | Exclude commercial apiaries |
| Broad-leaved Ironbark - Grey Box - Melaleuca decora <br> grassy open forest on clay/gravel soils of the Cumberland <br> Plain, Sydney Basin Bioregion | Exclude miscellaneous feral species |
| Broad-leaved Ironbark - Grey Box - Melaleuca decora <br> grassy open forest on clay/gravel soils of the Cumberland <br> Plain, Sydney Basin Bioregion | Feral and/or over-abundant native herbivore control |
| Broad-leaved Ironbark - Grey Box - Melaleuca decora <br> grassy open forest on clay/gravel soils of the Cumberland <br> Plain, Sydney Basin Bioregion | Fox control |
| Broad-leaved Ironbark - Melaleuca decora shrubby open <br> forest on clay soils of the Cumberland Plain, Sydney Basin <br> Bioregion | Exclude commercial apiaries |
| Broad-leaved Ironbark - Melaleuca decora shrubby open <br> forest on clay soils of the Cumberland Plain, Sydney Basin <br> Bioregion | Exclude miscellaneous feral species |
| Broad-leaved Ironbark - Melaleuca decora shrubby open |  |
| forest on clay soils of the Cumberland Plain, Sydney Basin |  |
| Bioregion |  |


| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy <br> woodland of the Cumberland Plain, Sydney Basin <br> Bioregion | Control of feral pigs |
| :--- | :--- |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy <br> woodland of the Cumberland Plain, Sydney Basin <br> Bioregion | Exclude commercial apiaries |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy <br> woodland of the Cumberland Plain, Sydney Basin <br> Bioregion | Exclude miscellaneous feral species |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy <br> woodland of the Cumberland Plain, Sydney Basin <br> Bioregion | Feral and/or over-abundant native herbivore control |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy <br> woodland of the Cumberland Plain, Sydney Basin <br> Bioregion | Fox control |
| Nodding Geebung | Fox control |
| Parramatta Red Gum woodland on moist alluvium of the <br> Cumberland Plain, Sydney Basin Bioregion | Control of feral pigs |
| Parramatta Red Gum woodland on moist alluvium of the <br> Cumberland Plain, Sydney Basin Bioregion | Exclude commercial apiaries |
| Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in <br> gullies and on sheltered slopes, Southern Sydney Basin <br> Bioregion | Fover-abundant native herbivore control |
| Cumberland Plain, Sydney Basin Bioregion |  |


[^0]:    

[^1]:    (1) TSC Act = Threatened Species Conservation Act 1995, V = Vulnerable, E1 = Endangered, E2 = Endangered population in the Liverpool LGA.
    (2) EPBC Act = Environment Protection and Biodiversity Conservation Act 1999, E = Endangered.

[^2]:    (1) EPBC Act - Environment Protection and Biodiversity Conservation Act 1999. $\mathrm{X}=$ Extinct, $\mathrm{CE}=$ Critically Endangered, $\mathrm{E}=$ Endangered $\mathrm{V}=$ Vulnerable
    (2) TSC Act - Threatened Species and Conservation Act 1995. E4A = Extinct, CE = Critically Endangered, E1 = Endangered V = Vulnerable E2= Endangered Population,

[^3]:    
    (3) Based on database searches and field surveys

