

Appendix C. Biodiversity Impact Assessment



Vales Point Solar Project

Sunset Power International Pty Ltd (Trading as Delta Electricity)

Biodiversity Assessment Report

IA155900_02 | 04

21 December 2017



Vales Point Solar Project

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Executive summary

Sunset Power International Pty Ltd trading as Delta Electricity (Delta) are seeking to develop an up to 55 megawatt (MW) solar photovoltaic generation facility and associated infrastructure in the local government areas (LGA) of Lake Macquarie and the Central Coast (the project). The project would be located within the land holding of the existing Vales Point Power Station and specifically on the rehabilitated area of the Vales Point Ash Dam. The project is a State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011. As a SSD, an application for the project is required to be submitted under Part 4, Division 4.1 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). The NSW Minister for Planning (or the Minister's delegate) is the consent authority. Jacobs Group (Australia) Pty Ltd (Jacobs) was commissioned by Delta to undertake an assessment of the potential environmental impacts of the project, and prepare an Environmental Impact Statement (EIS) in accordance with the EP&A Act that adequately addresses the Secretary's Environmental Assessment Requirements (SEARS).

This document is the Biodiversity Assessment Report (BAR) component of the EIS as required in the SEARs and has been prepared in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the Framework for Biodiversity Assessment (FBA). The information presented in this BAR assesses the potential biodiversity impacts of the project in accordance with the relevant State and Commonwealth environmental and threatened species legislation and policies. This report follows the format for a BAR specified by the FBA. This BAR has been prepared by persons accredited in accordance with s142B (1) (c) of the Threatened Species Conservation Act 1995 (TSC Act).

The development site comprises three artificial ash dams (Ponds 1-3) that were created by the construction of an earthen wall across Mannering Creek and have been progressively filled with ash slurry. The ash ponds are nine metres above the mean high tide mark of Mannering Bay and there is no tidal connection to the lake. The development site also includes the area of a disused conveyor and operational pipeline easement which will be used for a connection to the National Electricity Market via a short 33 kV transmission line (mainly overhead with an option for some underground cabling) to the Vales Point Zone Substation.

In accordance with Chapter 4 of the FBA, this BAR identifies and assesses the landscape features (such as the IBRA region, IBRA sub-region, Mitchell landscape, rivers and streams, and extent of native vegetation in the area) for the development site. Comprehensive mapping of vegetation and field surveys were completed within the study area in accordance with the requirements of the FBA. The vegetation surveys were completed using field survey methods in line with Chapter 5 of the FBA. The field surveys were undertaken over three seasons. Initial field surveys were undertaken in winter on 11 July 2017 with further surveys undertaken in spring on 12 and 13 October 2017. Habitat assessment and targeted surveys for threatened species were undertaken in spring on the 17 September, from 23-26 October 2017, 14 November and in summer on 1 and 6 December 2017 in accordance with Chapter 6 of the FBA.

While the ash dams are artificial landforms, native vegetation exists within the study area, predominantly as regrowth as well as small disturbed remnant patches. Three Plant Community Types (PCTs) as described by the Vegetation Information System (VIS) were identified within the study area:

- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636);
- Saltmarsh Estuarine Complex (PCT 1746); and
- Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071).

The majority of this vegetation has established through deliberate rehabilitation efforts on the ash ponds with the saltmarsh and freshwater wetlands establishing naturally and natural regrowth occurring in the disused conveyor easement.. None of these PCTs as they occur within the study area correspond to threatened ecological communities listed under the TSC Act or Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The majority of the study area is classed as a highly disturbed area without any native vegetation.

The habitat assessment identified that the habitat components for most threatened species were absent from the development site and/or the habitat was substantially degraded such that most threatened species were unlikely to utilise the development site. Furthermore, targeted surveys for threatened plants, frogs and wading/wetland birds did not locate any threatened species in the development site. The targeted surveys did however confirm the presence of one bird species listed under the marine and migratory status of the EPBC Act. The Pacific Golden Plover (*Pluvialis fulva*) was recorded during 6 of the 8 targeted surveys on Pond 2 using the Saltmarsh Estuarine Complex (PCT 1746) habitat. The development site was determined not to constitute 'important habitat' for this species as defined under the EPBC Act Policy Statement 1.1 Significant Impact Guidelines. As such, it is unlikely that the project would significantly affect migratory species.

Combined with appropriate mitigation measures and safeguards during construction and operation of the project (which will be outlined in the project's Construction Environmental Management Plan (CEMP), the siting and planning of the project is expected to be sufficient to ensure that the requirements to avoid and minimise impacts on biodiversity values as set out in Chapter 8 of the FBA are met. Delta proposes to develop the project on existing areas of the Vales Point ash dams associated with the operation of the Vales Point Power Station. Importantly, the project will not impact on:

- Endangered Ecological Communities (EECs) or Critically Endangered Ecological Communities (CEECs);
- PCTs that contain threatened species habitat (for species credit species);
- Critical habitat;
- The riparian areas of 4th order or higher streams and rivers, important wetlands or estuaries; or
- State significant biodiversity links.

The selection of the site, on artificially created ash ponds, has avoided the need to impact any high quality PCTs. Further to this, the targeted surveys indicate the absence of threatened species from the modified ash pond environment selected for the placement of the solar array. Areas of the *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071) and Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636) have been excluded from the development site to avoid impacts. The ash dams are considered the most appropriate location for site selection to avoid impacts to adjacent areas of known high biodiversity value. When considering alternative locations for the project within the Vales Point Power Station lands, the study area is the most appropriate location for the project from a biodiversity perspective.

Despite avoidance and minimisation, removal of native vegetation will be required. The construction footprint would impact on approximately 19.19 hectares of native regrowth vegetation. While all groundcover vegetation may not be totally removed as the photovoltaic array will be mounted above the ground, portions beneath the array will likely be damaged during construction and will be shaded resulting in altered micro-climatic conditions. The short transmission line connection would occupy an easement of approximately 7 metres wide. Two immature trees would be removed to establish a clear zone within the easement but the bulk of the lower growing shrubs and all groundcover vegetation will be retained. Access tracks would be provided inside and around the perimeter of the site on existing roadways to allow for maintenance and access.

The impacts have been quantified based on a concept design development footprint and take into consideration potential temporary disturbance during construction including compound sites and upgrading of drainage. The impacts in vegetation zones presented is based on a worst case scenario, and a detailed design has not been assessed. The actual disturbance to the saltmarsh PCT will be less due to the fact that the linear drain across the ash pond will remain to facilitate drainage of surface water. This drain contains a large portion of the saltmarsh vegetation that would remain in situ. A range of mitigation measures will be put in place to minimise the impacts to biodiversity during construction and operation.

There are no impacts that require further consideration by the consent authority in accordance with Section 9.2 of the FBA. According to the impact thresholds Table 4 in Section 9 of the FBA, the impacts to native vegetation as outlined in Section 8 of this report do not require an offset under the FBA as they are not associated with threatened species habitat and are not identified as critically endangered or endangered ecological communities. One vegetation zone provides potential habitat for a number of threatened insectivorous bats species due to the presence of isolated scattered dead trees within the ash dam, some with hollows, and also the presence of insect prey. However, the site value score for this zone is <17 and therefore an offset is not required. There are expected to be no impacts to species and populations as outlined in Section 5.4 of this report. As such, an offset for species and populations is not required. The impacts to highly disturbed areas without any native vegetation do not require assessment according to Section 9.5 of the FBA.

1. Introduction

1.1 Project background

Sunset Power International Pty Ltd trading as Delta Electricity (Delta) are seeking to develop an up to 55 megawatt (MW) solar photovoltaic generation facility and associated infrastructure in the local government areas (LGA) of Lake Macquarie and the Central Coast (the project). The project would be located within the land holding of the existing Vales Point Power Station and specifically on the rehabilitated area of the Vales Point Ash Dam.

The project is a State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011. As a SSD, an application for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning (or the Minister's delegate) is the consent authority.

Jacobs Group (Australia) Pty Ltd (Jacobs) was commissioned by Delta to undertake an assessment of the potential environmental impacts of the project, and prepare an Environmental Impact Statement (EIS) in accordance with the EP&A Act that adequately addresses the *Secretary's Environmental Assessment Requirements (Application number SSD 8533, 29 June 2017)* (SEARS).

The EIS is subject to a range of legislative and policy requirements as set out in the SEARs (29 June 2017) and. The SEARs specific for this assessment are:

'Biodiversity – including an assessment of the likely biodiversity impacts of the development, having regard to the NSW Biodiversity Offsets Policy for Major Projects, and in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by the Department'.

1.1.1 Key project features

The project area covers approximately 80 hectares (Ha) of land. Key components of the project are:

- Construction and operation of up to 55 megawatt (MW) capacity solar facility delivering an annual output of approximately 110 gigawatt hours (GWh);
- Installation of approximately 220,000 solar panel modules supported by either steel piles or concrete ballasted footings;
- Installation of ancillary electrical control equipment and switchyard for distribution;
- Connection to the National Electricity Market (NEM) via a short 33 kV transmission line (mainly overhead with some underground cabling) to the Vales Point Zone Substation;
- Approximately 100 full time equivalent (FTE) jobs during a 12 to 18-month construction program; and
- An estimated 30-year design life with ongoing employment for up to five people.

1.2 Study aims

This document is the Biodiversity Assessment Report (BAR) for the project as required under the Framework for Biodiversity Assessment (FBA). The information presented in this BAR assesses the potential biodiversity impacts of the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BAR has been prepared by and under the supervision of a person accredited in accordance with s142B (1) (c) of the *Threatened Species Conservation Act 1995* (TSC Act): Lukas Clews (accreditation number 170) and Chris Thomson (accreditation number 179).

1.3 Context of the BAR

The NSW *Biodiversity Offsets Policy for Major Projects* (BOPMP) (Office of Environment and Heritage, 2014) provides a standard method for assessing impacts of major projects on biodiversity and determines offsetting requirements. In the SSD application process, the EIS must address the SEARs requested by the Department of Planning and Environment (DP&E) and apply the FBA. The BAR must also address any Commonwealth EIS guidelines.

The FBA adopts the BOPMP and provides an assessment methodology to identify terrestrial biodiversity values, assess impacts and quantify and describe biodiversity offsets required for unavoidable impacts. This involves three stages:

- Stage 1 - Biodiversity assessment.
- Stage 2 - Impact assessment (biodiversity values).
- Stage 3 - Biodiversity Offset Strategy.

This BAR consists of Stage 1 and Stage 2 of the FBA. A Biodiversity Offset Strategy is not proposed (see Section 11 for rationale and offset measures).

The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and ecological communities (i.e. Matters of National Environmental Significance).

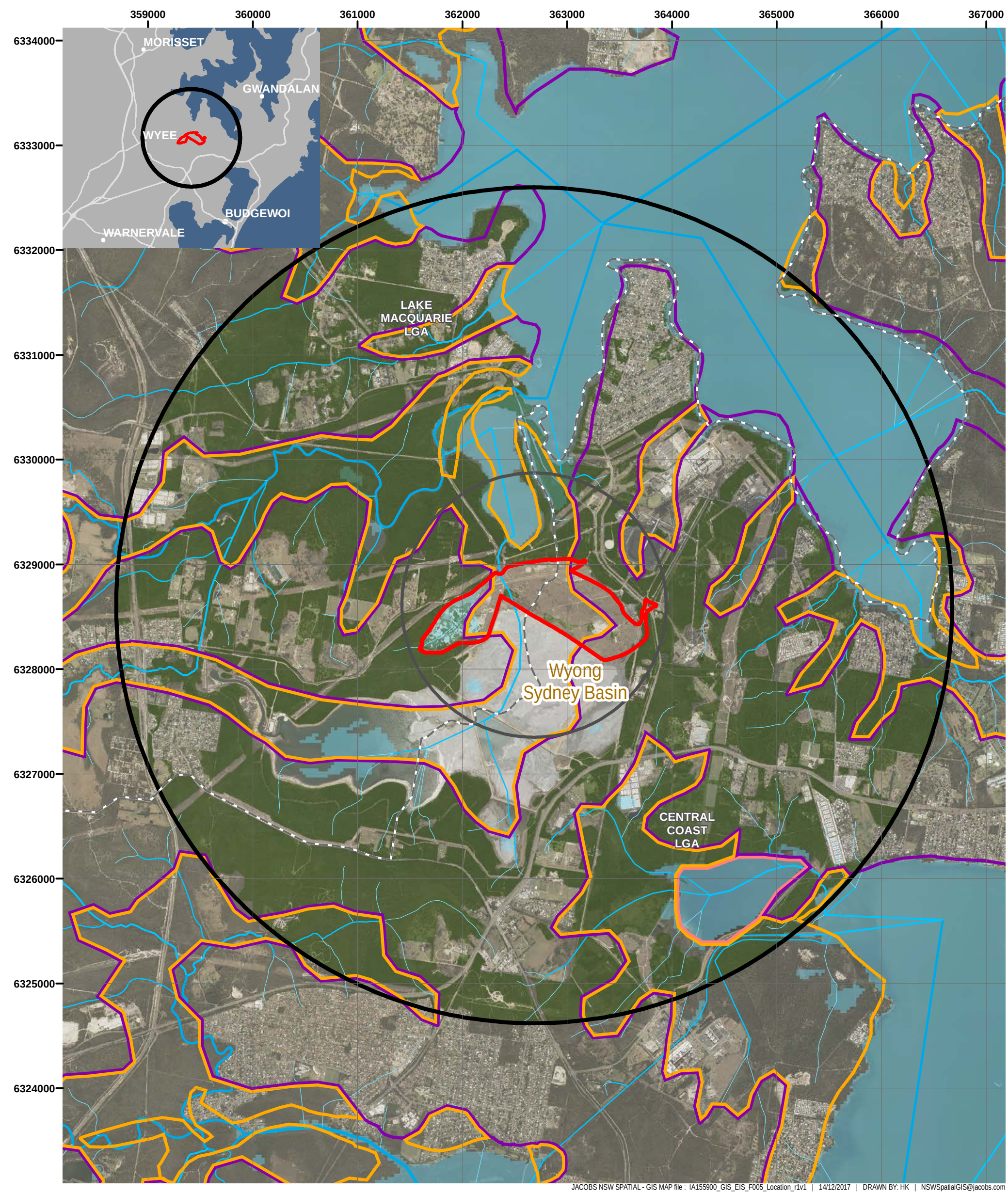
1.4 Site location and study area

The project is located across the Central Coast and Lake Macquarie local government areas (LGAs) and across the suburbs of Wyee and Mannering Park (see Figure 1.1). The study area is located within the Wyong sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995). The study area is located across two Mitchell Landscapes as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008): the Sydney – Newcastle Coastal Alluvial Plains and the Gosford – Cooranbong Coastal Slopes (see Figure 1.1).

The study area contains the development footprint which includes the construction footprint and operational footprint. A map of the study area is presented in Figure 1.2.

The construction footprint (see Figure 8.1 in Section 8) (also referred to as the development footprint) is the area proposed to be impacted, cleared and/or disturbed during construction. For the purposes of this BAR, it is assumed that there would be complete vegetation clearance within the construction footprint. This precautionary approach has been taken to the assessment to ensure all potential impacts are captured and assessed. The construction footprint has the same meaning as 'development site' for the purposes of the FBA.

The operational footprint for the project is the area that would be physically impacted by the operation of the project, including all operational ancillary infrastructures. The operational footprint is fully contained within the construction footprint.



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Legend

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> Study area Inner assessment area Outer assessment area Wyong IBRA subregion, Sydney Basin IBRA region (boundary not visible at current map scale) LGA boundary % Native vegetation Wetlands | <p>Strahler stream order</p> <ul style="list-style-type: none"> 1 2 3 4 5 | <p>Mitchell Landscapes</p> <ul style="list-style-type: none"> Estuary/Water Added Gosford - Cooranbong Coastal Slopes Sydney - Newcastle Coastal Alluvial Plains |
|--|---|---|

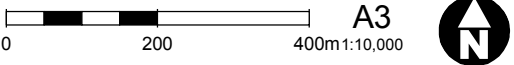
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Legend

- | | | |
|---|---|--|
|  Study area |  1 |  Gosford - Cooranbong Coastal Slopes |
|  Cadastre |  2 |  Sydney - Newcastle Coastal Alluvial Plains |
|  % Native vegetation |  3 | |
| |  4 | |



2. Methodology

2.1 Personnel

This BAR has been prepared by persons accredited in accordance with s142B (1) (c) of the *Threatened Species Conservation Act 1995*: Lukas Clews (accreditation number 170) and Chris Thomson (accreditation number 179).

The fieldwork undertaken during the preparation of this BAR was undertaken by Lukas Clews, Paul Rossington, Chris Thomson, and Brenton Hays, ecologists with strong botanical and zoological skills gained from a combination of academic qualifications and field experience in New South Wales.

2.2 Background research

A background review of existing information was undertaken to identify the existing environment of the proposed development site and locality. The review focussed on database searches, relevant reports pertaining to the study area, property boundaries, and relevant GIS layers. Relevant databases and literature included:

- EPBC Act Protected Matters Search Tool;
- DoEE Species Profile and Threats (SPRAT) database;
- Atlas of NSW Wildlife and OEH Threatened Species Profile Database;
- OEH vegetation information system (VIS) database;
- Atlas of Living Australia;
- Available regional vegetation mapping including the mapping from the Lower Hunter Central Coast Regional Environmental Management Strategy (LHCCREMS) (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2003); and
- Geology and soil landscapes mapping.

2.3 Vegetation survey

The vegetation surveys were completed using field survey methods in accordance with Chapter 5 of the FBA. The field surveys were undertaken over three seasons. Initial field surveys were undertaken in winter on the 11 July 2017 with further surveys undertaken in spring on the 12 and 13 October 2017. Targeted surveys were undertaken in spring on 17 September, from 23-26 October 2017, 14 November and in summer on 1 and 6 December.

2.3.1 Stratification of native vegetation

The native vegetation within the Development site was identified according to the Plant Community Types (PCTs) classification as described in the NSW Vegetation Information System (VIS) Classification database. The extent of each PCT within the Development site was firstly mapped in a GIS using high-resolution digital aerial photography as a base. Broad scale vegetation mapping of the area including mapping from the Lower Hunter Central Coast Regional Environmental Management Strategy (LHCCREMS) (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2003) were used to inform the identification of PCTs.

Once an initial examination of PCTs had been conducted within the GIS, the PCTs were verified and refined with the data from the detailed floristic assessment collected in the field. Once the identification of PCTs had been finalised, each PCT was then further divided into vegetation zones (an area of native vegetation on the development site that is the same PCT and has a similar broad condition state). The PCTs identified within the development site are outlined in detail in Section 4.1.

Native vegetation has the same meaning as in Section 6 of the *Native Vegetation Act 2003* (NV Act).

2.3.1.1 Assessment of vegetation zones

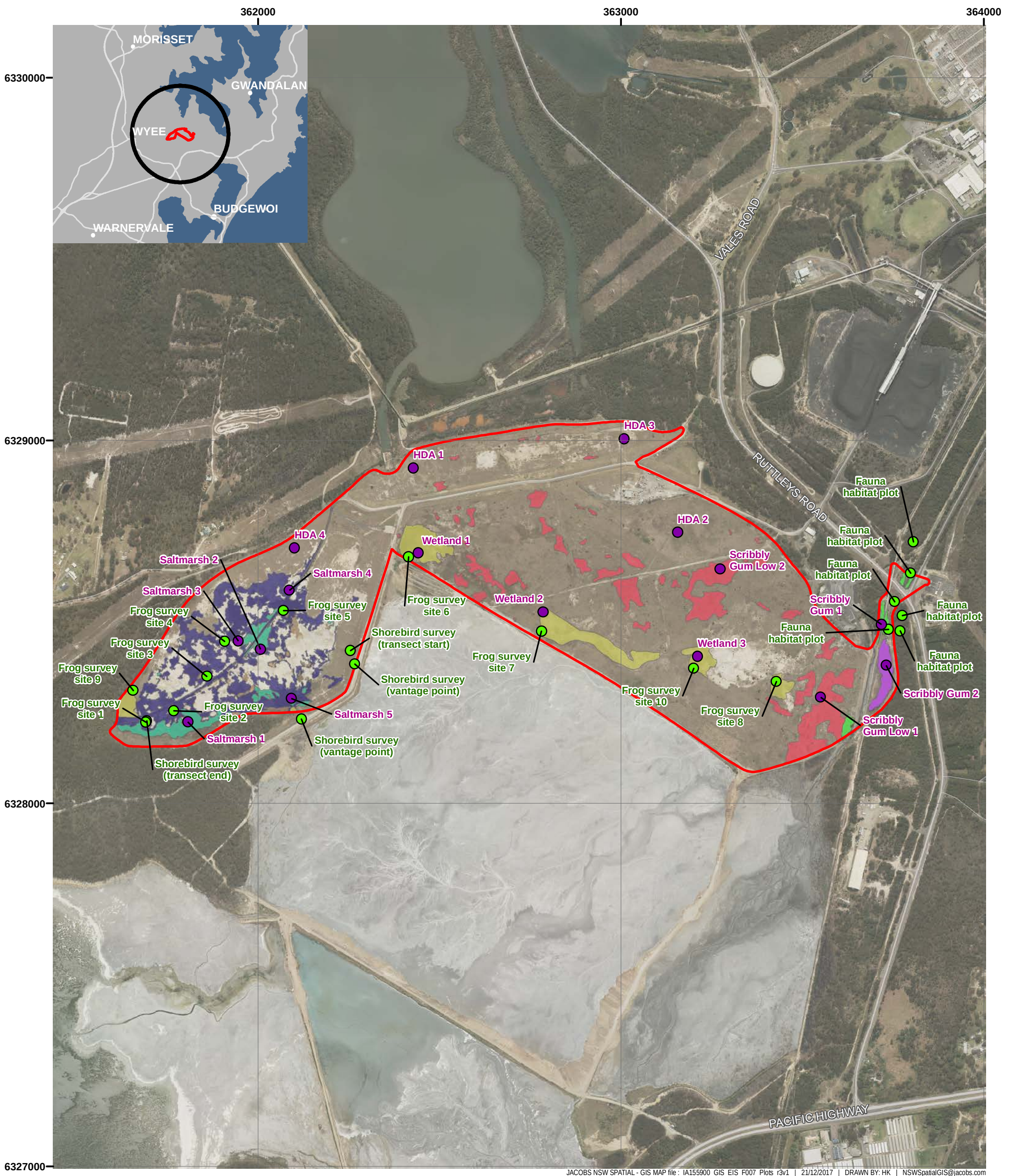
The field surveys were designed to assess the environmental variation within the proposed development site. The condition of PCTs for the development site was assessed in accordance with Chapter 5 of the FBA and vegetation zones assigned by comparing the dominant species, the general description of location, soil type and other attributes as described in the VIS classification database.

Six vegetation zones were identified on the development site (see Table 2.1) based on the PCT and broad condition state. Five of the vegetation zones were assigned to the Moderate to Good condition class and one zone falls under the Low condition class as defined in the FBA. The vegetation zones assigned as Moderate to Good were classified into a sub-condition class based on observable differences.

The minimum number of transects/plots required per vegetation zone area were completed according to the FBA (see Table 2.1). The location of each transect/plot undertaken during the survey is illustrated in Figure 2.1.

Table 2.1: Number of transects / plots completed per vegetation zone

Plant Community Type ID	Plant Community Type name	Vegetation zone (condition)	Vegetation zone area (ha)	FBA survey requirement (minimum number of transects/plots)	Number of transects/plots completed
Native vegetation					
1636	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	Moderate/Good	0.58	1 transect/plot per 2 ha (or part thereof)	1 transects/plots
1636	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	Moderate/Good_Poor	0.38	1 transect/plot per 2 ha (or part thereof)	1 transects/plots
1636	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	Low	6.65	2 transect/plot if vegetation is in low condition	4 transects/plots
1746	Saltmarsh Estuarine Complex	Moderate/Good	8.36	3 transects/plots	3 transects/plots
1746	Saltmarsh Estuarine Complex	Moderate/Good_Poor	1.54	1 transect/plot per 2 ha (or part thereof)	2 transects/plots
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate/Good_Poor	3.76	2 transects/plots	3 transects/plots
Non-native vegetation					
NA	Highly disturbed areas - road verges, table drains, road embankments, ploughed paddocks etc.	NA	Remainder of study area	NA	3 transects/plots



Legend

Study area

- Fauna survey point
- Plots transect

Vegetation Zone

- Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion Moderate/Good_Poor
- Saltmarsh Estuarine Complex Moderate/Good
- Saltmarsh Estuarine Complex Moderate/Good_Poor

- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Low
- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Moderate/Good
- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Moderate/Good_Poor

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Figure 2.1 : Location of each transect /plots at the development site Vales Point BAR

2.3.2 Plot-based floristic survey

The plot-based full floristic survey was undertaken according to the FBA using a series of 20 x 20 metre quadrats (or equivalent 400 m² equivalent area) nested inside a 20 x 50 metre transect. The plots / transects were completed to record the following information:

- Stratum & layer - in which each species occurs;
- Growth form - for each recorded species;
- Species name - above ground vascular plant species were identified to the lowest taxonomic order possible using nomenclature consistent with PlantNet NSW;
- Cover - a measure or estimate of the appropriate cover measure for each recorded species; recorded from 1–5 per cent and then to the nearest 5 per cent. If the cover of a species is less than 1 per cent and the species is considered important, then the estimated cover should be entered (e.g. 0.4); and
- Abundance rating – A relative measure of the number of individuals or shoots of a species within the plot. The following intervals were used; numbers above about 20 are estimates only: 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000. Numbers between 20 and 1000 individuals were estimated only as it is not possible to accurately count large numbers of some species in the plot.

2.3.3 Assessment site value (vegetation condition)

The following site attributes were assessed at each transect/plot to obtain a quantitative measure of vegetation condition to be applied for each vegetation zone within the study area:

- Native species richness (measured in a 20 × 20 metre quadrat);
- Native overstorey cover (measured along a 50 metre line transect);
- Native midstorey cover (measured along a 50 metre line transect);
- Native ground cover (grasses) (measured along a 50 metre line transect);
- Native ground cover (shrubs) (measured along a 50 metre line transect);
- Native ground cover (other) (measured along a 50 metre line transect);
- Exotic plant cover (measured along a 50 metre line transect);
- Number of trees with hollows (estimated by counting the number of trees with hollows visible from the ground in the 50 x 20 metre plot);
- Proportion of over-storey species occurring as regeneration (assessed across the entire vegetation zone); and
- Total length of fallen logs (the total length of woody material greater than 10 centimetres in diameter within the 50 x 20 metre plot).

These 10 site attributes listed above were ranked against benchmark data for the relevant PCT and a site value score for each vegetation zone was determined in accordance with Subsection 5.3 of the FBA.

3. Landscape features

In accordance with Chapter 4 of the FBA, the BAR is required to identify a number of landscape features such as the IBRA region, IBRA sub-region, Mitchell landscape, rivers and streams, and extent of native vegetation in the area assessed for the Development site. The landscape features of the Development site are shown in Figure 3.1.

The IBRA subregion and Mitchell landscape mapping projects are broad scale and care must be taken when using this mapping to assign a site to a particular IBRA subregion or Mitchell Landscape, as the mapped boundaries do not always exactly match on ground conditions.

3.1.1 IBRA Bioregions and Subregions

The development site is located within the Wyong subregion of the Sydney Basin Bioregion as defined by the Interim Biogeographic Regionalisation for Australia (IBRA 7) (SA Department of Environment Water and Natural Resources, 2015).

3.1.2 NSW Landscape Regions (Mitchell landscapes)

The development site is situated across two Mitchell Landscapes as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008): the Sydney – Newcastle Coastal Alluvial Plains and the Gosford – Cooranbong Coastal Slopes (see Figure 1.1). The majority of the development site is located within the Sydney – Newcastle Coastal Alluvial Plain.

3.1.3 Rivers and Streams

The proposed development site is located in the Lake Macquarie/Tuggerah Lakes catchment.

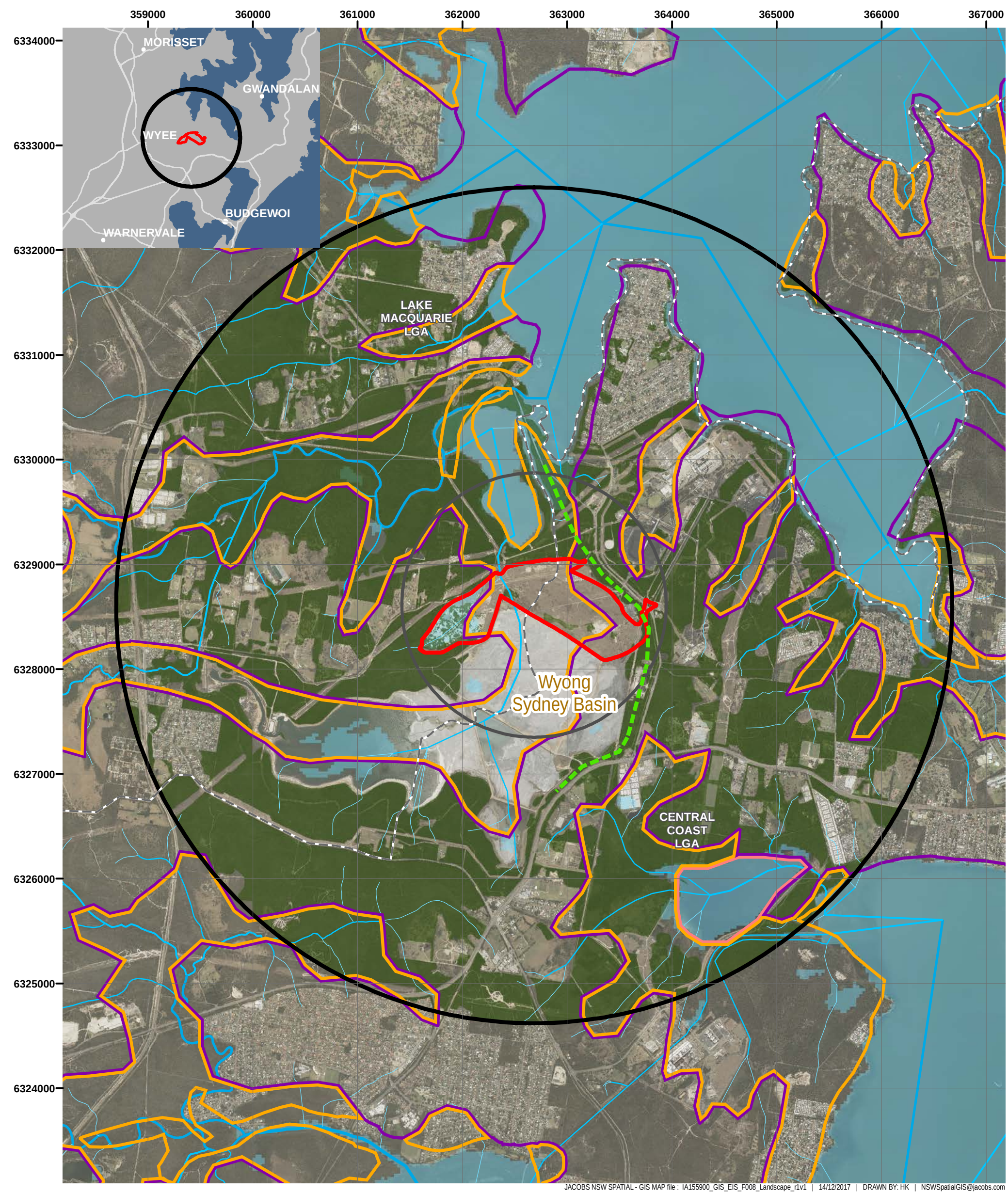
Buffer areas to streams are applied to a development site according to Appendix 2 of the FBA. First order streams should have a riparian corridor width of 10 metres applied to them but as there are no defined streams within the study area, no riparian buffers have been applied for this assessment. The key hydrological features of the area are shown in Figure 3.1.

3.1.4 Wetlands

The development site comprises three artificial ash dams (Ponds 1-3) that were created by the construction of an earthen wall across Mannering Creek and have been progressively filled with ash slurry. The ash ponds are nine metres above the mean high tide mark of Mannering Bay and there is no tidal connection to the lake.

The development site is within close proximity to the Lake Macquarie Wetlands (approximately 200 metres to the edge of Mannering Bay), which are listed on the National Directory of Important Wetlands (NSW189). The Lake Macquarie Wetlands are also an estuarine area as defined under the FBA. The development site is also within close proximity (approximately 350 metres) to State Environmental Protection Policy 14 Coastal Wetlands at the edge of Mannering Bay. These wetlands are considered 'important wetlands' under the FBA.

Buffers to important wetlands and estuarine areas are applied to a development site according to Appendix 2 of the FBA. While the development site is located near Mannering Bay it is not within the 50 metre buffer of an important wetland or estuarine area.



JACOBS NSW SPATIAL - GIS MAP file : IA155900_GIS_EIS_F008_Landscape_r1v1 | 14/12/2017 | DRAWN BY: HK | NSWSpatialGIS@jacobs.com

Legend

- Study area
- Inner assessment area
- Outer assessment area
- Wyong IBRA subregion, Sydney Basin IBRA region (boundary not visible at current map scale)
- LGA boundary
- Biodiversity link
- % Native vegetation
- Wetlands

Strahler stream order

- 1
- 2
- 3
- 4
- 5

Mitchell Landscapes

- Estuary/Water Added
- Gosford - Cooranbong Coastal Slopes
- Sydney - Newcastle Coastal Alluvial Plains



A3
1:35,000



3.1.5 State or regionally significant biodiversity links

A state significant biodiversity link or regionally significant biodiversity link is a biodiversity corridor that is important at a state or regional scale and is identified in a plan approved by the Chief Executive of OEH. At the time of writing, the development site was not part of a state significant biodiversity link or regionally significant biodiversity link. The development site is not part of the riparian buffer of a third order stream or higher and is not in the buffer area of an important wetland or estuarine area (see section 3.1.4).

The operational areas of the Vales Point Station and the ash dams are surrounded by areas identified as a green corridor and habitat network and are bypassed by the major conservation links identified in the *North Wyong Structure Plan 2012* and more recently in the *Central Coast and Hunter Regional Development Plans*. The *Hunter Regional Development Plan* identifies the corridor as the Jilliby to Wallarah Peninsula Link and Inter-Regional Landscape Break. This link recognises corridors previously identified in the *Lower Hunter Regional Strategy 2006-2031* and the *North Wyong Shire Structure Plan 2012*. The ash dams are not currently identified as a part of any green corridor or habitat network.

The proposed development site is not located in a strategic location as defined under the FBA.

3.1.6 Percent native vegetation cover

To assess percent current extent of native vegetation cover, an inner and outer landscape assessment circle of 500 ha and 5,000 ha (ratio of 1:10) were placed over the site (see Figure 1.1) in accordance with Appendix 4 of the FBA.

The *Lower Hunter Central Coast Extant Vegetation Community Map* (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2003) was used to determine the extent of native vegetation cover within each assessment circle. The vegetation mapping was checked for errors and areas of vegetation that had been recently cleared were removed from the mapping to achieve a more accurate calculation (the calculations are however subject to a degree of error based on the accuracy of the mapping). The extent of native vegetation cover within the assessment circles was then calculated in a GIS. The percent native score as determined by the BioBanking credit calculator is 0.60.

The assessment of current and future percent native vegetation cover is summarised in Table 3.1. The extent of native vegetation within the assessment circles is illustrated in Figure 3.1.

Table 3.1: Percent native vegetation cover assessment summary

Area	Percent native vegetation cover	
	Current extent	Future extent
500 ha inner circle	235.9 ha (47.18% cover)	216.7 ha (43.34% cover)
5,000 ha outer circle	3,311.6 ha (66.23% cover)	3,292.4 ha (65.85% cover)

3.1.7 Connectivity value

The FBA defines connectivity as the measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation. For the purposes of the FBA, native vegetation on the development site is part of a connecting link when it is linked to adjoining vegetation and the vegetation on the development site:

- is in moderate to good condition, and
- has a patch size >1 ha, and
- is separated by a distance of <100 m (or <30 m for non-woody ecosystems), and
- is not separated by a large water body, dual carriageway, wider highway or similar hostile link.

The development site has one connecting link (woody vegetation) that is approximately 18 metres wide at its narrowest point (see Figure 3.1) which is classed as a narrow link. There will be no decrease to the linkage width or condition of the connecting link from the project. Average condition of the overstorey and mid-storey is estimated to be at benchmark levels for this assessment. The score for connectivity value as determined by the BioBanking credit calculator is 0.00.

3.1.8 Patch size

The FBA defines patch size as an area of native vegetation that:

- a) occurs on the development 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 condition native vegetation (or ≤ 30 m for non-woody ecosystems).

Patch size may extend onto adjoining land that is not part of the development site or development site.

The patch size for the development site has been determined in accordance with Table 15 of Appendix 4 of the FBA. The Sydney – Newcastle Coastal Alluvial Plain Mitchell Landscape has had 62 % of the native vegetation removed. The vegetation at the development site is part of an extra-large patch (>1,000 ha in size) that is contiguous with bushland in the suburbs of Doyalson, Wyee, Bushells Ridge and Charmhaven. The patch size score as determined by the BioBanking credit calculator is 12.

3.1.9 Landscape value score

The landscape value score as determined by the BioBanking credit calculator is 12.60.

4. Native vegetation

4.1 Plant Community Types

A description of each Plant Community Type (PCT) at the development site is provided in this section. Table 4.1 summarises each PCT, noting that none of these are threatened ecological communities. A vegetation condition assessment table is provided in Appendix A. The distribution of PCTs within the Development site is outlined in Figure 4.1 to Figure 4.4.

Table 4.1: Plant community types at the Development site

Plant community type name	Vegetation formation	Percent cleared	Corresponding EEC	Area (ha)
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636)	Dry Sclerophyll Forests (Shrubby sub-formation)	58	Not listed as an EEC	7.61
Saltmarsh Estuarine Complex (PCT 1746)	Saline Wetlands	16	Not listed as an EEC	9.90
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)	Freshwater Wetlands	75	Not listed as an EEC	3.76

The saltmarsh estuarine complex is a saline wetland formation. Section 5.2.1.12 of the FBA indicates that PCTs that are classified in the saline wetlands formation must be assessed according to the Fisheries NSW policy and guidelines, as the FBA only applies to native vegetation as defined under the Native Vegetation Act 2003. In this regard, for the purposes of the NV Act, native vegetation does not include any mangroves, seagrasses or any other type of marine vegetation to which Section 205 of the *Fisheries Management Act 1994* (FM Act) applies.

Section 205 of the FM Act was reviewed for applicability to the Vales Point project. This states that saltmarsh in a protected area is classed as marine vegetation to which Section 205 of the FM Act applies. Protected areas are defined as foreshores and waterways. As the saltmarsh in the study area is not in a foreshore or waterway (i.e. a protected area in accordance with the FM Act), this suggests that the impact assessment would default back to being classed as native vegetation as defined under the NV Act and has been assessed as such. Further to this, the saltmarsh habitat on site does not align with key fish habitat as defined in the FM Act due to its location on an artificial pond and disconnection from an intertidal area.

Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636)

The Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast PCT (PCT 1636) is a eucalypt dominated dry sclerophyll forest (shrubby sub-formation) that occurs on the coastal lowlands and low ranges mainly on sandy substrates.

This PCT corresponds with the Coastal Plains Scribbly Gum Woodland as mapped by the LHCCREMS and the vegetation in the study area fits the description of this community well. This PCT is situated on the Doyalson soil landscape which is generally loose loamy sand topsoil with a hard setting clayey sand to clay subsoil overlying the Munmorah Conglomerate (Narrabeen Group) geology. This vegetation has some affinities with the Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands PCT (PCT 1619) but is considered most likely representative of PCT 1636 for the following reasons:

- Characteristic species in the upper stratum including *Eucalyptus haemastoma* and *Corymbia gummifera*;
- Characteristic middle stratum including *Banksia oblongifolia*, *Leptospermum trinervium*, *Lambertia formosa*, *Xanthorrhoea latifolia*, *Petrophile pulchella* and *Hakea dactyloides*; and

Characteristic ground stratum including *Epacris pulchella*, *Lomandra obliqua*, *Themeda australis*, and *Lepyrodia scariosa*.

The vegetation does contain some species that suggest that the vegetation is ecotonal with the Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands PCT (PCT 1619) including *Angophora costata* and *Eucalyptus capitellata* in the upper stratum and characteristic middle stratum species including *Allocasuarina littoralis*, *Persoonia levis*, *Acacia myrtifolia*, *Billardiera scandens*, and *Leptospermum polygalifolium* are present. The vegetation in the study area occurs in small patches in varying states of disturbance which makes definitive identification of the PCT difficult. It is likely that the vegetation in the study area represents an ecotone between PCT 1636 and PCT 1619.

The areas of young regrowth vegetation on Pond 3 are considered to most likely be representative of this PCT.

This PCT does not correspond to any threatened ecological community.

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Sydney Coastal Dry Sclerophyll Forests

PCT: 1636

Vegetation structure and dominant species:

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus capitellata</i> , <i>Eucalyptus haemastoma</i> , <i>Corymbia gummiifera</i> , <i>Angophora costata</i>
Midstorey (mid-stratum)	<i>Allocasuarina littoralis</i> , <i>Acacia myrtifolia</i> , <i>Acacia terminalis</i> , <i>Acacia suaveolens</i> , <i>Kunzea ambigua</i> , <i>Dodonaea triquetra</i> , <i>Dillwynia retorta</i> , <i>Pultenaea paleacea</i> , <i>Persoonia levis</i> , <i>Xanthorrhoea latifolia</i> , <i>Gompholobium pinnatum</i> , <i>Mirbelia rubifolia</i> , <i>Daviesia ulicifolia</i> , <i>Bossiaea heterophylla</i> , <i>Conospermum ericinum</i> , <i>Gompholobium latifolius</i> , <i>Pimelea linifolia</i> , <i>Hovea linearis</i> , <i>Banksia oblongifolia</i> , <i>Banksia spinulosa</i> , <i>Lambertia formosa</i> , <i>Petrophile pulchella</i> , <i>Hakea dactyloides</i> , <i>Leptospermum trinervium</i> , <i>Leptospermum polygalifolium</i> , <i>Acacia longifolia</i> , <i>Bossiaea stephensonii</i> , <i>Melaleuca sieberi</i> , <i>Isopogon anemonifolius</i> , <i>Cinnamomum camphora</i> , <i>Acacia ulicifolia</i>
Groundcovers (ground stratum)	<i>Entolasia stricta</i> , <i>Entolasia marginata</i> , <i>Themeda australis</i> , <i>Lomandra longifolia</i> , <i>Epacris pulchella</i> , <i>Gompholobium minus</i> , <i>Stylidium graminifolium</i> , <i>Opercularia diphylla</i> , <i>Lomandra obliqua</i> , <i>Andropogon virginicus</i> , <i>Dianella revoluta</i> , <i>Gonocarpus tetragynus</i> , <i>Centella asiatica</i> , <i>Schizaea bifida</i> , <i>Opercularia aspera</i> , <i>Cyathochaeta diandra</i> , <i>Eragrostis brownii</i> , <i>Coreopsis lanceolata</i> , <i>Laxmannia gracilis</i> , <i>Austrostipa pubescens</i> , <i>Hibbertia pedunculata</i> , <i>Lepyrodia scariosa</i> , <i>Lindsaea linearis</i> , <i>Pomax umbellata</i> , <i>Cryptostylis subulata</i> , <i>Pseuderanthemum variabile</i> , <i>Panicum simile</i> , <i>Patersonia glabrata</i> , <i>Actinotus minor</i> , <i>Dampiera stricta</i>
Vines and twiners	<i>Hardenbergia violacea</i> , <i>Billardiera scandens</i> , <i>Cassytha glabella</i> , <i>Parsonsia straminea</i>

Saltmarsh Estuarine Complex

The Saltmarsh Estuarine Complex PCT (PCT 1746) is a rarely inundated salt tolerant herbaceous community which may be dominated by chenopods or grasses depending on local conditions. This PCT usually occurs on semi-tidal saline muds; usually on the landward side of mangrove stands along the length of the coast.

Within the study area, this PCT occurs in an unusual situation as it has colonised a saline mud habitat present on the ash disposal Pond 2 that is occasionally inundated following heavy rainfall periods. Pond 2 was created by deposition of ash slurry (developed through the combustion of coal) that was then progressively capped with 100 mm of natural material and rehabilitated via seeding with grasses. Pond 2 was filled in the mid-1990s and sits at nine metres above the Mannering Bay high water level, such

that it is isolated without any intertidal influence. Pond 2 has an open linear drain that collects surface/stormwater and feeds a rip rap channel which eventually discharges to Mannering Bay at the spillway. There is no tidal influence and the pond is not connected to the estuary.

The lower lying areas of Pond 2 have developed a saltmarsh community that is dominated by saltmarsh species including *Sarcocornia quinqueflora*, *Triglochin striatum*, *Juncus kraussii*, *Spergularia marina* and *Lythrum hyssopifolia* with extensive 'mud flats'. Bare sediment areas are a common feature of saltmarsh communities and the saltmarsh vegetation on Pond 2 is arranged in a typical NSW saltmarsh structure with *Sarcocornia quinqueflora* and *Triglochin striatum* dominant in the lower lying wetter areas with *Juncus kraussii* at edges towards the 'landward' side. There is also a significant infestation of *Juncus acutus* which is a typical saltmarsh weed. Some areas also contain a significant component of exotic grass which has survived from the initial pond rehabilitation.

This PCT does not correspond to any threatened ecological community. While the PCT in the study area is composed of characteristic vascular plant species found in the Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions endangered ecological community listed under the BC Act (i.e. *Sarcocornia quinqueflora*, *Triglochin striatum*, and *Juncus kraussii*) the PCT within the study area does not occur in the intertidal zone on the shores of estuaries and lagoons. As such, this PCT is not considered to be part of this EEC.

According to the *Commonwealth Conservation Advice for Subtropical and Temperate Coastal Saltmarsh* (Threatened Species Scientific Committee, 2013) the physical environment for the ecological community is coastal areas under regular or intermittent tidal influence. As the saltmarsh in the study area is not under tidal influence it is not considered to form part of the Subtropical and Temperate Coastal Saltmarsh which is listed as a Vulnerable ecological community under the EPBC Act.

Vegetation formation: Saline Wetlands

Vegetation class: Saltmarshes

PCT: 1746

Vegetation structure and dominant species:

Vegetation layer	Dominant species
Tree canopy (upper stratum)	Absent
Midstorey (mid-stratum)	Absent
Groundcovers (ground stratum)	<i>Sarcocornia quinqueflora</i> , <i>Triglochin striatum</i> , <i>Juncus kraussii</i> , <i>Juncus acutus</i> , <i>Cynodon dactylon</i> , <i>Chloris gayana</i> , <i>Hydrocotyle bonariensis</i> , <i>Centaurium erythraea</i> , <i>Eclipta platyglossa</i> , <i>Lachnagrostis filiformis</i> , <i>Lythrum hyssopifolia</i> , <i>Cotula coronopifolia</i> , <i>Atriplex prostrata</i> , <i>Spergularia marina</i>
Vines and twiners	Absent

Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

This PCT occurs in its original form in wide variety of situations associated with coastal plains, valleys, lagoons and other sites of poor drainage and is also commonly found in man-made water bodies, drainage lines and depressions across a wide variety of environments. Within the study area, the *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion PCT (PCT 1071) is primarily found on Pond 3 in the low lying areas along the overland flow path, and also in Pond 2 in the west and in the east at the edge of the embankment.

The structure, composition and spatial extent of the PCT within the study area is dynamic and varies spatially and temporally depending on rainfall. This PCT is subject to regular inundation and drying and

was sampled at various points in winter, spring and summer 2017 to gain insight into this variability. The vegetation of the *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion PCT is dominated by *Cynodon dactylon*, *Bolboschoenus caldwellii*, *Phragmites australis*, *Typha orientalis* and *Juncus usitatus*. Scattered clumps of *Melaleuca sieberi* and *Casuarina glauca* occur at edges.

Artificial wetlands (such as the PCT in the study area) created on previously dry land for purposes such as sewerage treatment, stormwater management and farm production, are not regarded as part of the Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC as listed under the BC Act. The PCT is present in depressions on man-made ash ponds and in drainage culverts and is not present on a natural floodplain. The PCT is present in areas that were previously dry land. As such, the examples of this PCT within the study area are not considered to be part of the EEC as listed under the BC Act.

Vegetation formation: Freshwater Wetlands

Vegetation class: Coastal Freshwater Lagoons

PCT: 1071

Vegetation structure and dominant species:

Vegetation layer	Dominant species
Tree canopy (upper stratum)	Absent
Midstorey (mid-stratum)	Occasional <i>Melaleuca sieberi</i> , <i>Casuarina glauca</i>
Groundcovers (ground stratum)	<i>Phragmites australis</i> , <i>Typha orientalis</i> , <i>Bolboschoenus caldwellii</i> , <i>Cynodon dactylon</i> , <i>Chloris gayana</i> , <i>Hydrocotyle bonariensis</i> , <i>Centaurium erythraea</i> , <i>Lachnagrostis filiformis</i> , <i>Lythrum hyssopifolia</i> , <i>Eleusine gratioloides</i> , <i>Paspalum distichum</i> , <i>Centella asiatica</i> , <i>Juncus usitatus</i> , <i>Velleia lyrata</i> , <i>Schoenoplectiella mucronata</i> , <i>Andropogon virginicus</i> , <i>Juncus acutus</i> , <i>Cyperus eragrostis</i>
Vines and twiners	Absent



Legend

- Study area
- LGA boundary
- Hollow bearing Tree
- % Native vegetation

Vegetation Zone

- Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion Moderate/Good_Poor
- Saltmarsh Estuarine Complex Moderate/Good
- Saltmarsh Estuarine Complex Moderate/Good_Poor

- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Low
- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Moderate/Good
- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Moderate/Good_Poor

0 200 400m 1:10,000

A3



4.2 Non-native vegetation

The majority of the study area is classed as a highly disturbed area. The study area is primarily composed of three ash dams that were progressively filled with ash slurry from the 1960s through the 1990s, capped with material then revegetated with grasses. The embankments and pond walls are also included as are disturbed areas around the disused conveyor.

The original vegetation in these areas has been removed and the original soil has either been removed, buried or greatly disturbed. These areas are now dominated by a range of exotic grass and herbaceous species with Pond 1 and the edges of Pond 2 dominated by a dense sward of the exotic grass *Hyparrhenia hirta*. Pond 3 is dominated by a more diverse mixture of exotic grasses most notably *Chloris gayana*, *Briza* spp. and *Andropogon virginicus*.

Vegetation structure and dominant species:

Vegetation layer	Dominant species
Tree canopy (upper stratum)	Scattered <i>Pinus radiata</i> , <i>Casuarina glauca</i>
Midstorey (mid-stratum)	Scattered isolated <i>Acacia longifolia</i> , <i>Acacia saligna</i> , <i>Pinus radiata</i> , <i>Casuarina glauca</i>
Groundcovers (ground stratum)	<i>Hyparrhenia hirta</i> , <i>Briza subaristata</i> , <i>Briza maxima</i> , <i>Briza minor</i> , <i>Pennisetum clandestinum</i> , <i>Stenotaphrum secundatum</i> , <i>Cynodon dactylon</i> , <i>Chloris gayana</i> , <i>Hydrocotyle bonariensis</i> , <i>Centaurium erythraea</i> , <i>Lythrum hyssopifolia</i> , <i>Senecio madagascariensis</i> , <i>Anagallis arvensis</i> , <i>Andropogon virginicus</i> , <i>Oenothera lindheimeri</i> , <i>Vicia sativa</i> , <i>Paspalum dilatatum</i> , <i>Verbena bonariensis</i> , <i>Sonchus oleraceus</i> , <i>Lactuca serriola</i> , <i>Plantago lanceolata</i> , <i>Conyza bonariensis</i> , <i>Hypochaeris radicata</i> , <i>Medicago</i> spp., <i>Gamochaeta</i> sp.
Vines and twiners	Absent

4.3 Vegetation zones

Vegetation zones are defined under the FBA as a relatively homogenous area of native vegetation on a Development site that is the same PCT and broad condition state. The vegetation was first split into PCTs then the broad condition states of the PCTs were investigated on ground to determine the number of vegetation zones within the Development site.

Each vegetation zone contains PCT that are in a similar condition state. The vegetation zones that have been identified are different in terms of vegetation structure and species composition. The historical disturbance and current management regimes within the proposed Development site has influenced the condition of the PCTs and seven distinct vegetation zones could be identified. The seven vegetation zones are summarised in Table 4.2.

Highly disturbed areas - road verges, table drains, road embankments, ploughed paddocks etc. are not identified as a vegetation zone but are discussed to provide context to the quality of these disturbed areas. An example of these areas is provided in Photo 7.

Table 4.2: Vegetation zones identified in the Development site

Vegetation zone No.	Plant Community Type name	Plant Community Type code	Vegetation zone (condition)	Vegetation zone area (ha)	Site value score
1	Scribbly Gum - Red Bloodwood - Angophora inopinata heathy woodland on lowlands of the Central Coast	1636	Moderate/Good	0.58	82.29

Vegetation zone No.	Plant Community Type name	Plant Community Type code	Vegetation zone (condition)	Vegetation zone area (ha)	Site value score
2	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	1636	Moderate/Good_Poor	0.38	62.50
3	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	1636	Low	6.65	13.02
4	Saltmarsh Estuarine Complex	1746	Moderate/Good	8.36	61.11
5	Saltmarsh Estuarine Complex	1746	Moderate/Good_Poor	1.54	37.04
6	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	1071	Moderate/Good_Poor	3.76	53.49

Vegetation Zone 1 – Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) Moderate/Good

This vegetation zone is in good condition as evidenced by high native species richness for this PCT (45 species), an intact canopy within benchmark levels, and native midstorey just below benchmark. Native groundcover grass was within benchmark levels. Native groundcover shrubs were below benchmark while native groundcover other exceeded the benchmark. Exotic plant cover was absent along the transect. Hollow-bearing trees were at benchmark levels. Overstorey species regeneration was at 100%. The 55m of fallen logs is below the benchmark of 70m for this PCT.

This vegetation zone contains the highest quality vegetation within the study area with a site score of 82.29 out of 100. This vegetation zone is illustrated in Photo 1.

Vegetation Zone 2 – Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) Moderate/Good_Poor

This vegetation zone is placed into moderate/good_poor condition due to the disturbance this area has suffered from construction of the old conveyor system and associated access tracks and disturbance to the ash pond. This vegetation zone is considered distinct from Vegetation Zone 1 due to the level of disturbance. Native species richness is above benchmark (37 species) but the native overstorey cover has been reduced to below benchmark levels. Native midstorey is intact and within the benchmark for this PCT. All native groundcover variables were within benchmark levels. Exotic plant cover was 10% along the transect. Hollow-bearing trees were absent from the plot. Overstorey species regeneration was at 100%. The 7m of fallen logs is well below the benchmark of 70m for this PCT.

This vegetation zone is in poor condition but still contains good native species richness, vegetation structure and function. The site score is 62.5 out of 100. This vegetation zone is illustrated in Photo 2.

Vegetation Zone 3 – Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) Low

This vegetation zone is highly disturbed and exists as scattered areas of regrowth on Pond 3 and Pond 1. The plots sampled in this vegetation zone had very low native species richness (6 - 18 species). Native over-storey cover along the transects was absent. Native midstorey cover varied from 0% to within benchmark levels in denser areas. Native groundcover grass was variable with one plot within benchmark levels (28% cover) and the other plots with 0% cover along the transect. Native groundcover shrubs were absent along the transects. Native groundcover other varied from 6% to within benchmark levels along the transects. Exotic plant cover varied from 56% – 94%. No hollow-bearing trees were

present in the plots. No regeneration of overstorey species was found. One plot contained 2m of fallen logs (the other plot had none) which is well below the benchmark of 77m for this PCT.

This vegetation zone is in Low condition as defined by the FBA. It is woody native vegetation with a 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 (the plots scored 0% over-storey cover along the transect), and less than 50% of ground cover vegetation is indigenous species and/or greater than 90% of the ground cover vegetation has been cleared. The site score is 13.02 out of 100. This vegetation zone is illustrated in Photo 3.

Vegetation Zone 4 – Saltmarsh Estuarine Complex (PCT 1746) Moderate/Good

This vegetation zone occurs only on Pond 2 where saltmarsh has colonised a saline mud habitat present on Pond 2 that is occasionally inundated with water. Native species richness is generally above benchmark levels with the exception of one plot. This PCT has no over-storey or mid-storey cover so the vegetation zone meets the benchmark condition. The benchmark for native groundcover grass and shrubs is zero so the vegetation zone meets the benchmark condition. Native groundcover other varies from 42% - 78% so is within or above benchmark levels for this PCT. Exotic plant cover varies from 0% - 18% along the transect. Hollow-bearing trees were absent from the plot (as is typical of saltmarsh). Overstorey species regeneration was at 0%. No fallen logs were present which is typical of this PCT.

This vegetation zone is in good condition displaying typical native species richness, vegetation structure and function for a saltmarsh. The site score is 61.11 out of 100. This vegetation zone is illustrated in Photo 4.

Vegetation Zone 5 – Saltmarsh Estuarine Complex (PCT 1746) Moderate/Good_Poor

This vegetation zone occurs only on Pond 2 where saltmarsh has colonised a saline mud habitat present on Pond 2 that is occasionally inundated with water. Exotic species typical of saltmarsh areas, notably *Juncus acutus* are dominant in this vegetation zone. Native species richness is below benchmark levels for this PCT. This PCT has no over-storey or mid-storey cover so the vegetation zone meets the benchmark condition. The benchmark for native groundcover grass and shrubs is zero so the vegetation zone meets the benchmark condition. Native groundcover other varies from 0% - 8% (one plot is below benchmark for this variable). Exotic plant cover varies from 52% - 92% along the transect. Hollow-bearing trees were absent from the plot (as is typical of saltmarsh). Overstorey species regeneration was at 0%. No fallen logs were present which is typical of this PCT.

This vegetation zone is in poor condition displaying some native saltmarsh species but it is dominated by exotic species notably *Juncus acutus*. Vegetation structure and function are still typical for a saltmarsh. The site score is 37.04 out of 100. This vegetation zone is illustrated in Photo 5.

Vegetation Zone 6 – *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071) Moderate/Good_Poor

This vegetation zone occurs on Pond 2 and Pond 3 in low lying areas along the overland flow path. This PCT adjoins the highly disturbed areas on Pond 3 and the Saltmarsh on Pond 2 and intergrades with these areas depending on rainfall. Native species richness is within benchmark levels for this PCT with the exception of one plot (the sample was undertaken in dry conditions which may explain this result). Native over-storey cover is at 0% along the transects which is below benchmark levels. Mid-storey cover ranges from 0% - 2% which is within benchmark levels. Native ground cover grass exceeds the benchmarks for this PCT considerably varying from 50% - 76% (benchmark is 1% - 5%) which is likely a consequence of the dry conditions at the time of sampling. The benchmark for native groundcover shrubs is zero so the vegetation zone meets the benchmark condition. Native groundcover other varies from 22% - 30% which is below the benchmark for this variable (likely a consequence of dry conditions during sampling). Exotic plant cover is very low varying from 0% - 2% along the transect. Hollow-bearing trees were absent from the plot (as is typical). Overstorey species regeneration was at 0% (below benchmark). No fallen logs were present which is typical of this PCT.

This vegetation zone is in poor condition as it occurs on man-made substrate and the vegetation structure and function varies with rainfall. The components of this vegetation zone are not permanent wetlands. The site score is 53.49 out of 100. This vegetation zone is illustrated in Photo 6.



Photo 1: Vegetation Zone 1 – Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) Moderate/Good



Photo 2: Vegetation Zone 2 – Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636) Moderate/Good_Poor



Photo 3: Vegetation Zone 3 – Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636) Low



Photo 4: Vegetation Zone 4 – Saltmarsh Estuarine Complex (PCT 1746) Moderate/Good



Photo 5: Vegetation Zone 5 – Saltmarsh Estuarine Complex (PCT 1746) Moderate/Good_Poor



Photo 6: Vegetation Zone 6 – *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071) Moderate/Good_Poor



Photo 7: Highly disturbed areas - road verges, table drains, road embankments, ploughed paddocks etc. dominated by weeds

5. Threatened species

5.1 Background review

The candidate species for assessment in the BAR were identified via the BioBanking Credit Calculator (BBCC) and search of the following databases:

- BioNet- the website for the Atlas of NSW Wildlife;
- OEH BioBanking Threatened Species Profile Database; and
<http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer>
- The federal Department of Environment's Protected Matters Search Tool (PMST).

Exiting reports from previous surveys at the wider Vales Point power station lands were also reviewed which included Ecotone Ecological Consultants Pty Ltd, 2010 and the *Vales Point Ash Dam Vegetation Management Plan* (Eco Logical Australia, 2011). The Ecotone (2010) report focused on the perimeter lands surrounding the ash dams and not the cleared ash dams. A number of threatened mammals were recorded including Southern Myotis, Little Bent-wing Bat, East Coast Freetail-Bat and Squirrel Glider. Habitat within the perimeter lands comprise a wide diversity of high quality habitats that are not represented in the current study area.

The list of candidate species was reviewed and the species potential presence within the development area considered in context of the different vegetation zones identified from the development area and habitat assessment data collected at the site in addition to review of the habitat preferences of each species as documented in the Threatened Species Profile Database (TSPD).

5.2 Geographic/habitat features

An assessment of the presence of important geographic habitat features for predicted threatened species identified in the BBCC has been undertaken in accordance with Section 6.3 of the FBA. The results of this assessment are shown in Table 5.1.

Table 5.1: Assessment of geographic habitat features within the development site

Common name	Scientific name	Habitat features described from the threatened species database	Features present on site	Justification
Zannichellia palustris	<i>Zannichellia palustris</i>	Land containing freshwater bodies	No	Freshwater bodies are present in the form of several ephemeral depressions that are charged by rainfall and do not retain water for long period. These depressions completely dry out during dry periods which would affect the ability of the species to persist
Comb-crested Jacana	<i>Irediparra gallinacea</i>	Land within 40 m of permanent wetlands with a good surface cover of floating vegetation	No	There are no permanent wetlands the saltmarsh and depressions on the ash ponds do not retain permanent water
Black Bittern	<i>Ixobrychus flavicollis</i>	Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation	No	There are no areas of permanent water, the saltmarsh and depressions on the ash ponds do not retain permanent water
Eastern Osprey	<i>Pandion cristatus</i>	Land within 40 m of fresh/brackish/saline waters or larger rivers or creeks, estuaries,	No	Lake Macquarie and its associated bays and inlets in known habitat for this species, however these are greater than 40 m from the site. The

Common name	Scientific name	Habitat features described from the threatened species database	Features present on site	Justification
		coastal lagoons, lakes and/or inshore marine waters		shallow, ephemeral freshwater bodies on site are not considered potential habitat
Giant Dragonfly	<i>Petalura gigantea</i>	Land within 100 m of coastal or upland swamps, bogs or wetlands	No	There are shallow saline swamps between the site and Mannering Bay, however these are highly saline and this species is associated with freshwater swamps and wetlands
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	Land within 40 m of freshwater or saline wetlands (e.g. saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)	Yes	There are shallow saline swamps between the site and Mannering Bay; saline saltmarsh wetlands on Pond 2 and ephemeral freshwater wetlands on Pond 3. This species is a vagrant in the study area.
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	Intertidal mudflats or sandflats within inlets, bays, harbours, estuaries, lagoons, ocean beaches and/or sandy spits	No	The rehabilitated ash ponds are not in an intertidal zone, there is no connection with the Lake Macquarie tidal environment
Green and Golden Bell Frog	<i>Litoria aurea</i>	Land within 100 m of emergent aquatic or riparian vegetation	Yes	The ephemeral wetland depressions on Pond 3 contain emergent aquatic vegetation
Green-thighed Frog	<i>Litoria brevipalmata</i>	Land within 100 of semi-permanent or ephemeral ponds or depressions containing leaf litter	No	There are ephemeral ponds and depressions on Pond 3, however as there is no canopy of trees or shrubs, there is no leaf litter. These exist as open disturbed depressions well away from the forest and stream habitats preferred by this species
Maundia triglochinos	<i>Maundia triglochinos</i>	Swamps or shallow freshwater on clay	No	Freshwater bodies are present in the form of several ephemeral depressions that are charged by rainfall and do not retain water for long period. These depressions completely dry out during dry periods which would affect the ability of the species to persist
Wallum Froglet	<i>Crinia tinnula</i>	Land within 40 m of swamps, wet or dry heaths or sedge grassland	No	These open forest habitats occur to the north of Pond 2
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Land within 40 m of heath, woodland or forest with sandy or friable soils	Yes	These open forest habitats occur to the north of Pond 2, however are off the site
Biconvex Paperbark	<i>Melaleuca biconvexa</i>	Swamps, swamp margins or creek edges	No	There are no freshwater swamps within or surrounding the site
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Land containing brackish or freshwater wetlands	Yes	Pond 2 and 3 contain brackish and freshwater wetlands, albeit ephemeral in nature
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	No	None of these features suitable for roosting are present
Heath Wrinklewort	<i>Rutidosia heterogama</i>	Heath on sandy soils or moist areas in open forest	No	No heath present and open forest on the site is dry

Common name	Scientific name	Habitat features described from the threatened species database	Features present on site	Justification
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	Land within 40 m of watercourse, containing hollow-bearing trees, loose bark and/or fallen timber	No	No watercourse within 40 m of the site
Brush-tailed Rock Wallaby	<i>Petrogale penicillata</i>	Land within 1 km of rock outcrops or cliff lines	No	These features are not present within 1 km of the site
Common Planigale	<i>Planigale maculata</i>	Rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	No	Eucalypt forest present, however the area subject to disturbance has been assessed for important habitat features for this species and found not suitable (refer Section 5.3.1)
Terek Sandpiper	<i>Xenus cinereus</i>	Mangroves and intertidal mudflats or sandflats within inlets, bays, harbours, estuaries, ocean beaches and/or sand spits	No	The rehabilitated ash ponds are not in an intertidal zone, there is no connection with the Lake Macquarie tidal environment
Pied Oystercatcher	<i>Haematopus longirostris</i>	Land within 40 m of high water mark on beaches, sandbars, margins of estuaries and lagoons	No	At its nearest point Mannering Creek is over 60 m from the site and Mannering Bay is over 180 m
Greater Sand-plover	<i>Charadrius leschenaultii</i>	Intertidal mudflats or sandflats within inlets, bays, harbours, estuaries, lagoons, ocean beaches and/or sandy spits	No	The rehabilitated ash ponds are not in an intertidal zone, there is no connection with the Lake Macquarie tidal environment
Lesser Sand-plover	<i>Charadrius mongolus</i>	Intertidal mudflats or sandflats within inlets, bays, harbours, estuaries, lagoons, ocean beaches and/or sandy spits	No	The rehabilitated ash ponds are not in an intertidal zone, there is no connection with the Lake Macquarie tidal environment
Little Tern	<i>Sternula albifrons</i>	Land within 40 m of inshore coastal waters or shallow waters of estuaries, coastal lagoons and/or lakes	No	At its nearest point Mannering Creek is over 60 m from the site and Mannering Bay is over 180 m
Narrow-leafed Wiltonia	<i>Wiltonia backhousei</i>	Margins of salt marshes and lakes, both coastal and inland	Yes	Salt marsh is present on Pond 2

The assessment of geographic habitat features has identified four threatened fauna species and one threatened flora species that could potentially occur. These species were considered further from a targeted habitat assessment and survey.

5.3 Candidate species

5.3.1 Targeted habitat assessment

Rapid habitat assessments were conducted at vegetation plot sites to gather information on the type and condition of the fauna habitats present with a focus on identifying the suitability of the habitat for the list of predicted threatened species and species credit species generated from the BBCC BioBanking. At each survey site, an assessment was made of the fauna habitat features including the:

- Type and structure of the vegetation, including an assessment of the 'naturalness' in terms of the presence of remnant vegetation or planted and re-growth areas and the extent of modification;
- Presence and frequency of large mature trees, tree hollows, standing dead trees (snags) and logs;
- Presence of significant keystone species and critical habitat elements for threatened fauna;
- Disturbance regimes, both past and ongoing including grazing and weed abundance;
- Density of each vegetation strata (structural diversity);
- Presence and quality of wet areas or waterbodies, significant aquatic habitats where present; and

- Size of remnant patches and extent of connectivity, movement corridors and refuge value.

The habitat assessment data were used to identify the likelihood for the predicted species and credit species to occur and inform the detailed survey.

Seven of the species credit species identified in the assessment are mammals which are typically found in remnant forest habitats that are part of contiguous areas of connected forest and have specific habitat requirements, this included Common Planigale, Eastern Chestnut Mouse, Eastern Pygmy Possum, Brush-tailed Phascogale, Koala and Golden-tipped Bat. The area of remnant forest habitat in the proposed disturbance area that is consistent with these requirements is limited to a small patch of Scribbly Gum open forest less than 400m² in size. A targeted habitat assessment was conducted at this location to assess the likelihood of these species credit species occurring and therefore inform the need for targeted survey effort.

The detailed habitat assessment for forest fauna measured general landscape, habitat and floristic structure and levels of disturbance, comparing sites within the proposed impact area of the transmission easement with adjacent remnant areas of forest outside the project footprint as reference areas. Habitat and floristic data were collected from 3 impact sites and 3 paired reference sites using a 50 x 7 m transect (350m²). Measurements were recorded in categories, absolute values and percentage derivatives.

The connecting 33kV transmission line would require three poles < 100 metres apart and a 7 m wide easement constructed within an existing and previously maintained APZ associated with the conveyor and pipeline infrastructure. The easement would be maintained to remove taller regrowth however shrubs and ground cover vegetation would remain *in situ*. The aim of the detailed habitat assessment was to assess characteristics of the habitat for the five species credit species list above within the area to be disturbed for construction of the 33kV connector. Adjacent remnant woodland sites were also sampled to provide a reference condition for the habitat within the same plant community type for comparison of habitat availability.

Table 5.2: Habitat attributes measured at each transect (n=6) and survey methods used

Method	Description (50 x 7 m transect)
Large tree hollows (trunk) and small tree hollows (branch)	Counted and recorded the percentage of trees within the transect using scale of 0; <5%; 5-25%; 50-75%; 75-100%
Flowering/fruiting trees	% projected foliage cover
Logged stumps with hollows, large stags (>10cm dbh), large rocks / logs suitable as shelter sites	Counted and recorded actual number using a scale of 0; 1-2; 3-5; 6-9; >10
Fire history	Visual assessment of time since fire recorded in years
Tree species and crown composition	Recorded tree species in canopy, tree height, estimate of crown cover and proportion of each species
Mid-storey species	Recorded all midstorey tree species and estimated cover for each species and overall cover of shrubs within the transect
Shrub layer	Recorded all shrub species and estimated the cover of shrubs for each species and overall shrub cover within
Dominant ground cover	Recorded as percentage cover for proportion of vegetation, soil, litter, rock, logs and bare ground
Mean litter depth	Litter profile measured with ruler at five locations (10 m intervals) along the transect
Soil Type	Clay, loam or sand
Koala feed tree species	No of feed tree species present and proportion of the total tree species. A search for koala scats was conducted around the base of each tree

In accordance with Section 6.5.1.1 of the FBA a 'candidate species is not considered to be present on the development site where:

- a) After carrying out an assessment of the habitat components the assessor determines that the habitat is substantially degraded such that the particular species is unlikely to utilise the development site; or
- b) An expert report prepared states that the species is unlikely to be present at the development site; or
- c) The species is a vagrant species and unlikely to use the habitat on the development site; or
- d) Records of the species presence in relation to the location of the development site are at least 20 years old or, in the opinion of the assessor have doubtful authenticity.

Further consideration of these statements in relation to the list of fauna species identified in the BioBanking calculator and the results of the habitat assessment is provided below.

Forest fauna (Common Planigale, Eastern Chestnut Mouse, Common Planigale, Brush-tailed Phascogale, Eastern Pygmy Possum, Koala and Golden-tipped Bat)

Seven of the species credit species identified in the assessment are mammals which are typically found in remnant forest habitats that are part of contiguous areas of connected forest and have specific habitat requirements. The area of remnant forest habitat in the study area that is consistent with these requirements is limited to a small patch of Scribbly Gum open forest (Zone 2). Zone 3 is a low condition regrowth of this community, although does contain some scattered dead trees with hollows. Zone 2 will be avoided.

A targeted habitat assessment was conducted in Zone 2 to assess the likelihood of these species credit species occurring. The following provides some context in relation to the preferred habitats of the species.

- The Common Planigale is found within a broad range of habitats including rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas (Menkhorst and Knight, 2004, Andrew and Settle, 1982). Such areas tend to have similar habitat components which include dense ground covers, a close association with water and areas of ecotonal forest (Menkhorst and Knight, 2004, Denny, 1982).
- The Eastern Chestnut Mouse prefers coastal wet heathlands particularly sites that have been recently burnt as it is an early successional stage species.
- The Eastern Pygmy Possum is associated most strongly with the abundance of certain plants in the Proteaceae and Myrtaceae. In particular, the species prefers *Banksia* spp. (for food) and *Eucalyptus* and *Xanthorrhoea* spp. (for shelter). The species appears to be generally more common in open woodland and heathland with a dense shrub layer and an abundance of flowers. It is likely that any preference shown by *C. nanus* for shrubby, mid-storey habitat reflects access to these diverse food sources.
- The Brush-tailed Phascogale is typically a tree-hollow-dependent marsupial that occurs in dry, forested habitats in south-eastern Australia.
- Koala feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.
- Golden-tipped Bat – the species is found in rainforest and wet sclerophyll forest which is not present in the study area.

The targeted habitat assessment sampled three impact sites and three paired control sites using a 50 x 7 m transect (350m²). Measurements were recorded in categories, absolute values and percentage derivatives.

The impact transects were positioned at three locations along the proposed seven metre transmission easement. Common characteristics of the habitat within the impact areas are a lack of tree canopy and subsequent tree hollows, sparse midstorey dominated by species regenerating after disturbance such as *Acacia longifolia* and *Casuarina glauca*, a lack of native species diversity overall particularly in the ground layer which was dominated by exotic plant species and bare ground.

The Eastern Pygmy-possum is known to be associated most strongly with the abundance of certain plants in the Proteaceae and Myrtaceae. The mean number of plant species from both families is shown in Figure 5.1. *C. nanus* shows a preference for shrubby, mid-storey habitat which reflects access to these diverse food sources. The abundance of shrubs in the midstorey is significantly reduced in the disturbed impact area (Figure 5.2).

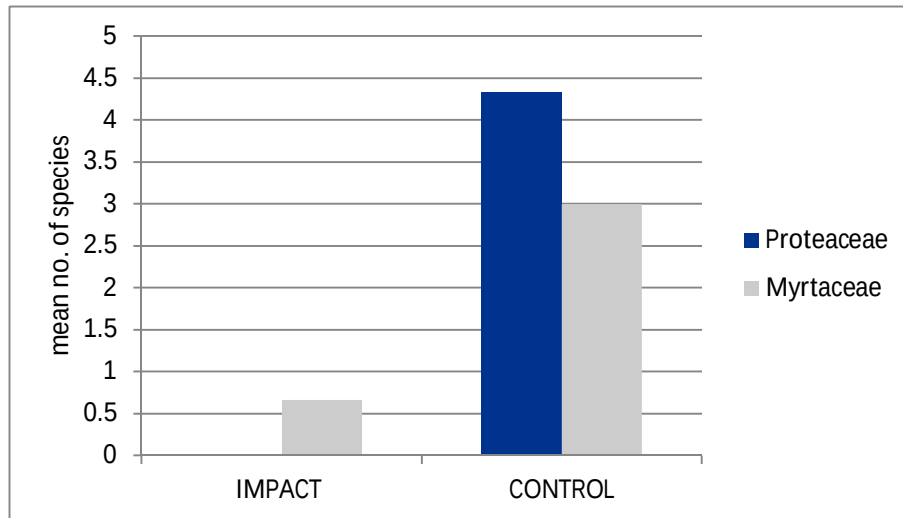


Figure 5.1: Mean number of plant species from the Proteaceae and Myrtaceae families, comparing the canopy and midstorey for impact versus remnant habitat outside the project (control)

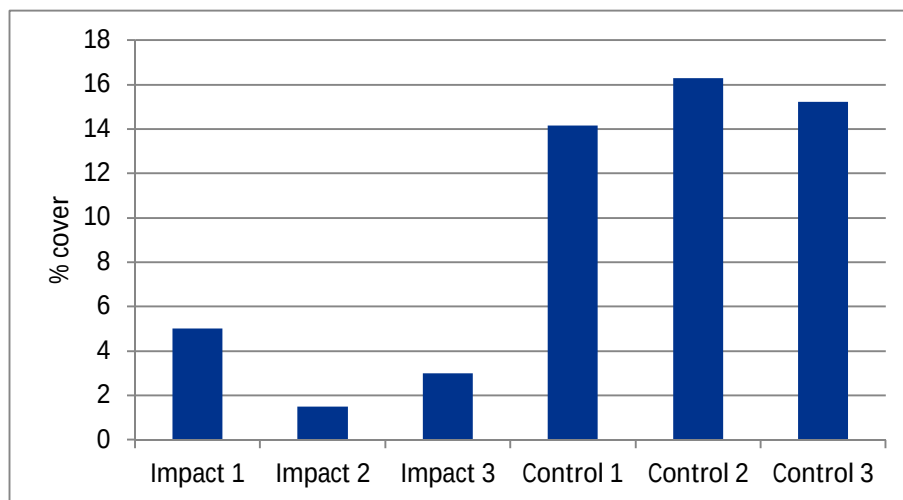


Figure 5.2: Density of tall shrubs in the midstorey habitat comparing impact versus adjacent remnant habitat outside the project (control)

In terms of dominant native vegetation ground cover, the three impact sites scored zero percent and were dominated by exotic grasses (Whiskey Grass and Coolatai Grass) and bare ground. In contrast the groundcover of native species ranged from 75-80% with no areas of bare ground. Figure 5.3 refers to the cover characteristics for litter, logs and rocks and the proportion of bare ground

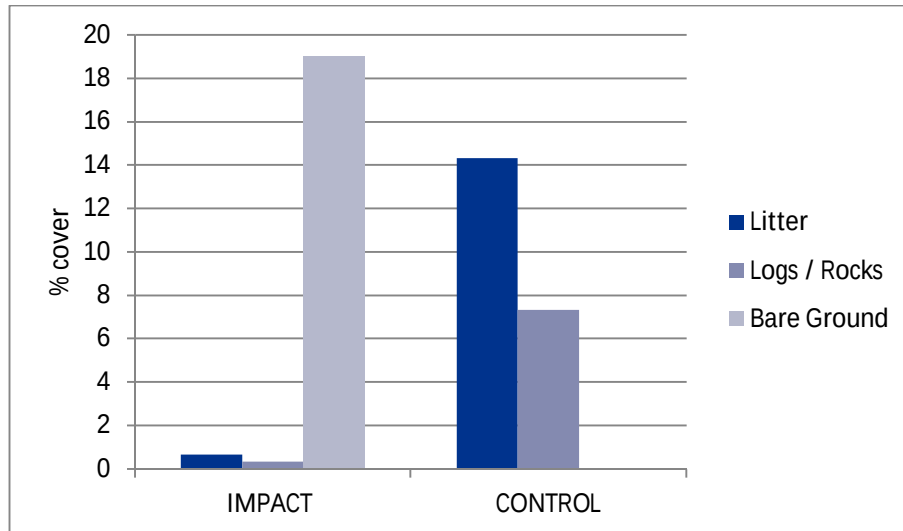


Figure 5.3: Comparison of the cover of leaf litter, logs or large rocks and bare ground in impact area versus adjacent remnant habitats

Opportunities for shelter and breeding sites for Brush-tailed Phascogale, Eastern Pygmy-possum, Brush-tailed Rock Wallaby and Pale-headed Snake are absent from the proposed transmission easement (Table 5.1). The Eastern Pygmy-possum may also shelter in hollow stumps and logs, while both species may also shelter in dead trees with hollow (stags). A comparison of the presence of these characteristics is shown in Table 5.3 and 5.4.

Table 5.3: Percentage of trees with hollow cavities suitable for shelter and breeding

Location		Habitat characteristics	0	<5%	5-25%	25-50%	50-75%	75-100%
Impact	Plot 1	Large tree hollows						
		small tree hollows						
	Plot 2	Large tree hollows						
		small tree hollows						
	Plot 5	Large tree hollows						
		small tree hollows						
Control	Plot 3	Large tree hollows						
		small tree hollows						
	Plot 4	Large tree hollows						
		small tree hollows						
	Plot 6	Large tree hollows						
		small tree hollows						

Table 5.4: Other potential shelter sites in hollow stumps, dead trees and logs or large rocks

Location		Habitat characteristics	none	1 to 2	3 to 5	6 to 9	>10
Impact	Plot 1	Logged stumps					
		Large stags					
		Rocks / Logs					
	Plot 2	Logged stumps					
		Large stags					
		Rocks / Logs					
	Plot 5	Logged stumps					
		Large stags					
		Rocks / Logs					
Control	Plot 3	Logged stumps					
		Large stags					
		Rocks / Logs					
	Plot 4	Logged stumps					
		Large stags					
		Rocks / Logs					
	Plot 6	Logged stumps					
		Large stags					
		Rocks / Logs					

One koala feed tree species was found to be present in the study area, namely Scribbly Gum (*Eucalyptus haemastoma*). This species was present with each of the three transects sampled from the remnant habitat (100 %) and comprised 25 % of the total tree species. The presence of *E. haemastoma* within the impact areas was restricted to one site (33 %) where it comprised 16.6 % of the tree species present. The data shows that areas of potential koala habitat exist in the remnant habitats surrounding the study area, although is poorly represented within the impact areas. There were no koala scats found from a search of all koala feed trees within the 4 transects identified.

The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site. As such no targeted field surveys were conducted.

Wetland birds (Australasian Bittern, Black Bittern, Black-necked Stork, Cotton Pygmy Goose)

There are no records for these species within a 10 km radius of the site, freshwater habitat is restricted to the ephemeral depressions on Pond 3. These depressions exhibit a wetting and drying regime, filling only after significant rainfall events. They are small, and largely devoid of any tall emergent vegetation and considered substantially degraded such that these freshwater wetland bird species are unlikely to utilise the development site. There may be potential for the Black-necked Stork to occur with the saline wetlands on Pond 3 as this species may also use saline wetlands, however it is not preferred habitat. This species is retained as a candidate species and this habitat was targeted for wetland bird species which included these suite of species.

Red-backed Button Quail

The species is only linked to the PCTs identified in Section 4 of the BAR as 1071 (*Phragmites australis* and *Typha orientalis* coastal freshwater wetlands). This habitat occurs in the rehabilitated Pond 3 and is ephemeral in nature, degraded and with very limited emergent vegetation. the habitat is considered too degraded to attract and sustain a population of this ground-dwelling bird.

5.3.2 Ecosystem credit species

The predicted ecosystem credit species returned from the BBCC are shown in Table 5.5. An assessment of whether each species is likely to occur on site has been undertaken in accordance with Section 6.3 of the FBA based on the habitat components present on the site using the habitat information in the profile for the species and any other habitat information in the TSPD (the habitat assessment for these species is provided in Appendix B). Details of targeted surveys and habitat assessments as they relate to ecosystem species are described in Section 5.4.

The list of ecosystem species was refined in the context of all desktop data, and field data collected for vegetation and fauna surveys to produce a list of threatened species that are predicted to occur, using information on:

- whether the species is known to live in the area
- whether it is associated with the vegetation type
- whether the percentage cover and condition of the vegetation are adequate for the species
- whether the vegetation patch size is large enough for the species.

The presence of a number species was discounted using the methodology outlined in section 6.3 of the FBA and considering the results of the targeted surveys for wetland birds. This was largely due to the absence of a tidal saline wetland environment and also considering the artificial nature of the freshwater wetlands, their poor condition and limited size and value associated with the ephemeral nature.

From the list and the results of the targeted surveys, the only species that could be predicted to occur would be a number of threatened insectivorous bat species. There are scattered hollow-bearing trees present in the low condition regrowth on Pond 2 (Zone 3) which provide potential roost sites.

Table 5.5: Assessment of ecosystem credit species

Common name	Scientific name	TS offset multiplier	Habitat on site / potential presence
Australian Painted Snipe	<i>Rostratula australis</i>	1.3	No – the habitats were surveyed and this species was not located.
Barking Owl	<i>Ninox connivens</i>	2.2	No, habitat patch sizes are too small, and degraded, lack of resources. Hollow-bearing trees present in Zone 3
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis</i> subsp. <i>gularis</i>	1.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Black-tailed Godwit	<i>Limosa limosa</i>	2.6	No – the habitats were surveyed and this species was not located.
Blue-billed Duck	<i>Oxyura australis</i>	1.3	Low – the habitats were surveyed and this species was not located.
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus</i> subsp. <i>victoriae</i>	2.0	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Bush Stone-curlew	<i>Burhinus grallarius</i>	2.6	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	2.2	Yes, may be associated with Zone 3 given density of dead standing trees as potential roost sites
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	2.2	Yes, may be associated with Zone 3 given density of dead standing trees as potential roost sites
Freckled Duck	<i>Stictonetta naevosa</i>	1.3	No – the habitats were surveyed and this species was not located.

Common name	Scientific name	TS offset multiplier	Habitat on site / potential presence
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	2.0	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>	1.8	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded.
Great Knot	<i>Calidris tenuirostris</i>	2.6	No – the habitats were surveyed and this species was not located.
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	2.2	Yes, may be associated with Zone 3 given density of dead standing trees as potential roost sites
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis</i> subsp. <i>temporalis</i>	1.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Little Eagle	<i>Hieraaetus morphnoides</i>	1.4	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Little Lorikeet	<i>Glossopsitta pusilla</i>	1.8	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Long-nosed Potoroo	<i>Potorous tridactylus</i>	1.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Magpie Goose	<i>Anseranas semipalmata</i>	1.3	No – the habitats were surveyed and this species was not located.
Masked Owl	<i>Tyto novaehollandiae</i>	2.2	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Painted Honeyeater	<i>Grantiella picta</i>	1.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Powerful Owl	<i>Ninox strenua</i>	2.2	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Sanderling	<i>Calidris alba</i>	2.6	No – the habitats were surveyed and this species was not located.
Scarlet Robin	<i>Petroica boodang</i>	1.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Speckled Warbler	<i>Chthonicola sagittata</i>	2.6	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Spotted Harrier	<i>Circus assimilis</i>	1.4	No, the habitats were surveyed and this species was not recorded.
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	2.6	No, too degraded and small patch size
Square-tailed Kite	<i>Lophoictinia isura</i>	1.4	No, the habitats were surveyed and this species was not recorded
Squirrel Glider	<i>Petaurus norfolcensis</i>	2.2	No, too degraded and small patch size, no hollow-bearing trees in forest area
Swift Parrot	<i>Lathamus discolor</i>	1.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Turquoise Parrot	<i>Neophema pulchella</i>	1.8	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Varied Sittella	<i>Daphoenositta chrysoptera</i>	1.3	No too degraded and small patch size

Common name	Scientific name	TS offset multiplier	Habitat on site / potential presence
White-fronted Chat	<i>Epthianura albifrons</i>	0.8	No, the habitats were surveyed and this species was not recorded
Yellow-bellied Glider	<i>Petaurus australis</i>	2.3	No, would not be expected over the ash dams, and the area of low condition forest impacted is too small and degraded
Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	2.2	Yes, may be associated with Zone 3 given density of dead standing trees as potential roost sites

Note: shaded rows are species that may occur

5.3.3 Species credit species

Likelihood of occurrence

The BBCC identifies 26 species credit species (11 fauna and 15 flora). Further assessment was conducted to produce a list of species that are known or are likely to occur on the development site, based on the following two criteria:

- the geographic distribution of the species is known to include the Catchment Management Authority subregion in which the site is located
- the site contains suitable habitat features for the species and is not degraded to the point that it is unlikely to be used.

A number of species were removed from the list on the basis that the habitats within the development site and artificial, or too small and degraded, and lacking important habitat features for the subject species (refer habitat assessment Section 5.3.1). This included Australasian Bittern, Brush-tailed Phascogale, Cotton Pygmy-goose, Eastern Chestnut Mouse, Eastern Pygmy Possum, Golden-tipped Bat, Koala, and Red-backed Button Quail.

Candidate species

Targeted on-ground surveys were conducted for the remaining species credit species to confirm whether they are present. These surveys included appropriate timing and effort consistent with survey guidelines for all candidate species as described in Section 5.4.3. The candidate species for targeted survey included 18 species, including 15 plant species and 3 fauna species (Table 5.6).

Table 5.6: Candidate species and required survey periods

Common name	Scientific name	J	F	M	A	M	J	J	A	S	O	N	D
Black-eyed Susan	<i>Tetradlea juncea</i>							Ö		Ö	Ö	Ö	Ö
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>										Ö	Ö	Ö
Bynoe's Wattle	<i>Acacia bynoeana</i>									Ö	Ö	Ö	Ö
Camfield's Stringybark	<i>Eucalyptus camfieldii</i>									Ö	Ö	Ö	Ö
Charmhaven Apple	<i>Angophora inopina</i>									Ö	Ö	Ö	Ö
Giant Burrowing Frog	<i>Heleioporus australiacus</i>										Ö	Ö	Ö
Green and Golden Bell Frog	<i>Litoria aurea</i>										Ö	Ö	Ö
Grove's Paperbark	<i>Melaleuca groveana</i>									Ö	Ö	Ö	Ö
Leafless Tongue Orchid	<i>Cryptostylis hunteriana</i>							Ö	Ö	Ö	Ö	Ö	Ö
Narrow-leafed Wilsonia	<i>Wilsonia backhousei</i>									Ö	Ö	Ö	Ö
Netted Bottle Brush	<i>Callistemon linearifolius</i>									Ö	Ö	Ö	Ö
Rough Doubletail	<i>Diuris praecox</i>							Ö	Ö	Ö	Ö	Ö	Ö
Small-flower Grevillea	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>									Ö	Ö	Ö	Ö
Tall Knotweed	<i>Persicaria elatior</i>							Ö			Ö		Ö
Tetradlea glandulosa	<i>Tetradlea glandulosa</i>							Ö		Ö	Ö	Ö	Ö
Thick-leaf Star-hair	<i>Astrotricha crassifolia</i>									Ö	Ö	Ö	Ö
Tranquility Mintbush	<i>Prostanthera askania</i>									Ö	Ö	Ö	Ö
Variable Midge Orchid	<i>Genoplesium insigne</i>							Ö		Ö	Ö	Ö	Ö

Note: Tick indicates survey timing described in 5.4.3.1

Targeted threatened flora surveys

The targeted flora surveys followed the methods described in the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016) and the survey timing adhered to the months detailed in the BioBanking credit calculator for each candidate flora species as described in Table 5.3. The targeted flora survey used a systematic approach including targeting the species at the optimal time of year, identifying potential habitats, and then undertaking a survey using parallel field traverses. Where possible, advice was gained on whether nearby orchid populations were flowering at the time of survey (e.g. *Diuris praecox* at Glenrock Nature Reserve which was flowering during the survey period).

Targeted surveys were completed for all identified candidate flora species with suitable habitat in the study area. After the habitat assessment, the list of candidate species was refined based on the presence or absence of key habitat features including associated PCTs and taxa, topographic, soil and geological preferences, microhabitats (e.g. damp areas, table drains), and disturbance regime of the habitat in the study area. The survey effort expended for threatened flora species is outlined in Table 5.4. The following species were targeted during the survey:

- *Tetradlea juncea*;
- *Acacia bynoeana*;
- *Eucalyptus camfieldii* and *Angophora inopina*;
- *Melaleuca groveana*, *Callistemon linearifolius* and *Grevillea parviflora* subsp. *parviflora*;
- *Cryptostylis hunteriana*, *Diuris praecox* and *Genoplesium insigne*;
- *Persicaria elatior*; and
- *Wilsonia backhousei*.

Table 5.7: Targeted flora survey details

Common Name (Scientific Name)	BC Act	EPBC Act	Minimum survey requirements (Office of Environment and Heritage 2016)	Survey completed
Black-eyed Susan (<i>Tetralochea juncea</i>)	V	V	<i>Tetralochea juncea</i> and <i>Acacia bynoeana</i> are small plants with cryptic habits that require considerable survey to locate. The recommended approach is the parallel field traverse (i.e. parallel transects) as used by Cropper (1993). The recommended maximum distance between parallel field traverses for herbs is 10 m in open vegetation and 5 m in dense vegetation. The recommended maximum distance between parallel field traverses for sub shrubs is 15 m in open vegetation and 10 m in dense vegetation. The potential habitat for <i>Tetralochea juncea</i> and <i>Acacia bynoeana</i> was estimated at approximately 0.96 ha being the areas of Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) in the area of the conveyor easement. 0.5 hours of survey is required for a herb in dense vegetation where the habitat is up to 1 ha in size. 0.25 hours of survey is required for a sub-shrub. The length of the traverses should be 1 – 2 km.	The potential habitat for <i>Tetralochea juncea</i> and <i>Acacia bynoeana</i> was surveyed in July, September, October, November and December. This allowed for a repeat sample of the habitat to be taken from winter to summer 2017. The length of the traverses was at least 1 km. Over 2 hours was spent surveying this habitat. To aid in determining whether <i>Tetralochea juncea</i> was flowering, a known reference site at Wyee was visited on 26 October 2017.
Bynoes Wattle (<i>Acacia bynoeana</i>)	E	V		
Camfield's Stringybark (<i>Eucalyptus camfieldii</i>)	V	V	<i>Eucalyptus camfieldii</i> and <i>Angophora inopina</i> are relatively large trees that are easily detectable. The recommended approach is the parallel field traverse (i.e. parallel transects) as used by Cropper (1993). The recommended maximum distance between parallel field traverses for a tree is 40 m in open vegetation and 20 m in dense vegetation. The potential habitat for <i>Eucalyptus camfieldii</i> and <i>Angophora inopina</i> was estimated at approximately 0.96 ha being the areas of Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) in the area of the conveyor easement. 0.13 hours of survey is required for these species in dense vegetation where the habitat is up to 1 ha in size. The length of the traverses should be 0.5 km.	The potential habitat for <i>Eucalyptus camfieldii</i> and <i>Angophora inopina</i> was surveyed in July, September, October, November and December. The length of the traverses was at least 1 km. Over 2 hours was spent surveying this habitat.
Charmhaven Apple (<i>Angophora inopina</i>)	V	V		
Groves Paperbark (<i>Melaleuca groveana</i>)	V	-	<i>Melaleuca groveana</i>, <i>Callistemon linearifolius</i> and <i>Grevillea parviflora</i> subsp. <i>parviflora</i> are medium shrubs that are easily detectable. The recommended	The potential habitat for <i>Melaleuca groveana</i>, <i>Callistemon linearifolius</i> and <i>Grevillea parviflora</i> subsp. <i>parviflora</i> was surveyed in July, September, October,

Common Name (Scientific Name)	BC Act	EPBC Act	Minimum survey requirements (Office of Environment and Heritage 2016)	Survey completed
Netted Bottle Brush (<i>Callistemon linearifolius</i>)	V	-	approach is the parallel field traverse (i.e. parallel transects) as used by Cropper (1993). The recommended maximum distance between parallel field traverses for a medium shrub 1 to 6 m tall is 20 m in open vegetation and 10 m in dense vegetation. The potential habitat for <i>Melaleuca groveana</i> and <i>Callistemon linearifolius</i> was estimated at approximately 0.96 ha being the areas of Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) in the area of the conveyor easement. 0.25 hours of survey is required for these species in dense vegetation where the habitat is up to 1 ha in size. The length of the traverses should be 1 km.	November and December. The length of the traverses was at least 1 km. Over 2 hours was spent surveying this habitat.
Small-flower Grevillea (<i>Grevillea parviflora</i> subsp. <i>parviflora</i>)	V	V		
Leafless Tongue Orchid (<i>Cryptostylis hunteriana</i>)	V	V	For orchids the recommended approach is the parallel field traverse (i.e. parallel transects) as used by Cropper (1993). The recommended maximum distance between parallel field traverses for orchids 10 m in open vegetation and 5 m in dense vegetation. The potential habitat for <i>Cryptostylis hunteriana</i> , <i>Diuris praecox</i> and <i>Genoplesium insigne</i> was estimated at approximately 0.96 ha being the areas of Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636) in the area of the conveyor easement.	The potential habitat for <i>Cryptostylis hunteriana</i> , <i>Diuris praecox</i> and <i>Genoplesium insigne</i> was surveyed in July, August, September, October, November and December. This allowed for a repeat sample of the habitat to be taken from winter to summer 2017. The length of the traverses was at least 1 km. Over 2 hours was spent surveying this habitat. Surveys in the adjacent open forest habitat to the east of the site were conducted as a reference site due to the high quality condition of these habitats compared with the study area.
Rough Doubletail (<i>Diuris praecox</i>)	V	V	0.5 hours of survey is required for these species in dense vegetation where the habitat is up to 1 ha in size. The length of the traverses should be 2 km.	Information on reference sites where both species are known to be flowering at this time was provided by Steve Lewer (OEH). <i>Diuris praecox</i> was observed flowering (14 Aug 2017) in Glenrock SCA and at Merewether, and <i>Genoplesium insigne</i> had started flowering at Chain Valley Bay by 15 Aug 2017.
Variable Midge Orchid (<i>Genoplesium insigne</i>)	CE	CE		
Narrow-leaved Wilsonia (<i>Wilsonia backhousei</i>)	V	-	<i>Wilsonia backhousei</i> is a small matted shrub less than 15cm tall. The recommended approach is the parallel field traverse (i.e. parallel transects) as used by Cropper (1993). The recommended maximum distance between parallel field traverses for sub shrubs is 15 m in open vegetation and 10 m in dense vegetation. The potential habitat for <i>Wilsonia backhousei</i> was limited to the areas of saltmarsh and estimated at approximately 9.9 ha on Pond 2.	The potential habitat for <i>Wilsonia backhousei</i> was surveyed in July and October 2017. The areas of saltmarsh were walked with over 4 km of traverses undertaken and over 7 hours spent within the habitat.

Common Name (Scientific Name)	BC Act	EPBC Act	Minimum survey requirements (Office of Environment and Heritage 2016)	Survey completed
			1.88 hours of survey is required for a sub-shrub in open habitats. The length of the traverses should be 7.5 km.	
Tall Knotweed (<i>Persicaria elatior</i>)	V	V	For an aquatic plant, the survey guidelines indicate that a search of the appropriate parts of the water body by using a traverse coverage appropriate for the species' growth form must be undertaken. A suitable distance apart for traverses for <i>Persicaria elatior</i> is 15 m in open vegetation and 10 m in dense vegetation. The potential habitat for <i>Persicaria elatior</i> was estimated at approximately 3.76 ha being the area of PCT 1071. 0.19 hours of survey is required for these species in dense vegetation where the habitat is up to 1 ha in size. The length of the traverses should be 0.75 km.	The potential habitat for <i>Persicaria elatior</i> was surveyed in July, October and December 2017. The areas of wetland were walked with over 1 km of traverses undertaken and over 1.5 hours spent within the habitat.

Targeted threatened fauna surveys

The results of the habitat assessment were used to refine the list of target species. The fauna species that were identified from the background review and detailed habitat assessments that were targeted during the survey are discussed in Table 5.8. These relate to threatened frogs.

Table 5.8: Targeted fauna survey details

Species	Minimum survey requirements (OEH 2009; Commonwealth of Australia 2011; 2017)	Survey effort completed
Targeted Green and Golden Bell Frog, methods used were also targeted at Wallum Froglet, Giant Burrowing Frog and Green-thighed Frog	All surveys should be undertaken within one week of heavy rainfall (>50 mm in seven days) during the period October – March which is the peak activity period for this species. Initial habitat assessment - surveys using a combination of call detection, call playback and spotlighting. A minimum of four nights under ideal conditions. Small wetlands (<50m at greatest length) should be covered in about one hour. Large sites should be sampled systematically.	Initial habitat survey and stratification was used to identify all potential ponds for Green and Golden Bell Frog. Potential ponds were then surveyed over 4 nights following sufficient rainfall using call detection, call playback and spotlighting. Survey conducted in October
Shorebirds and wetland bird species	Survey effort for migratory shorebirds is comprehensive and involves 8 visits to the site, this was considered adequate for any wetland birds that are not migratory. Surveys guidelines comprise a minimum of eight surveys including: - Four surveys for roosting shorebirds during the period when the majority of shorebirds are present in the area, and - Four surveys for foraging shorebirds, including two surveys at spring low tide and two surveys at neap low tide	A total of eight surveys were undertaken over a period of 3 months during the spring-early summer period (Oct-Dec) (i.e. 4 high tide foraging surveys and 4 low tide roosting surveys)

The survey approach and methods were designed to address the methods described in the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft 2004 and the following guidelines:

- Amphibians – Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (Department of Environment and Climate Change, 2009) <http://www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf>
- Threatened frogs – Survey Guidelines for Australia's Threatened Frogs (Department of the Environment Water Heritage and the Arts, 2010) <http://www.environment.gov.au/system/files/resources/ff3eb752-482d-417f-8971-f93a84211518/files/survey-guidelines-frogs.pdf>.
- Migratory shorebird species - EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species, Commonwealth of Australia 2017. <http://www.environment.gov.au/system/files/resources/67d7eab4-95a5-4c13-a35e-e74cca47c376/files/bio4190517-shorebirds-guidelines.pdf>

Stratification and site selection

Fauna surveys and habitat assessment were conducted at stratified sampling locations within and around the proposed project footprint. The study area was stratified by PCT/habitat type for targeted surveys (i.e. freshwater wetlands and saltmarsh and any adjoining suitable habitat). Opportunistic surveys were also conducted within cleared and modified land which comprises the majority of the study area. The specific number and location of survey sites is described in the species-specific methods following.

Frog survey method

The survey focused primarily on the Green and Golden Bell Frog (*Litoria aurea*) which was considered to have the greatest potential to occur. There are numerous records of the Wallum Froglet (*Crinia tinnula*) in the wider locality and the BioBanking calculator has also identified the Giant Burrowing Frog (*Heleioporus australiacus*) and Green-thighed Frog (*Litoria brevipalmata*) as potential candidate species. Mahoney's Toadlet (*Uperoleia mahonyi*) is also known from the Central Coast region. The disturbed ephemeral habitats on the relict ash dams were not considered preferred habitat for these species. Nonetheless call playback and active searches were conducted across the entire study area and focused on recording all five species. The conditions were optimum for detection of all species.

Numerous low lying areas prone to inundation after periods of sustained rainfall were identified within the study area by topography and flora assemblages. These areas are all of various dimensions and depths, however during sufficient rainfall would be connected. The presence of emergent and surrounding vegetation also varies, from low lying drainage areas of exotic grasses to regenerating forested wetlands with a scattered tree canopy. To determine areas of suitable habitat within the study area, a review of literature on the habitat requirements of the Green and Golden Bell Frog was conducted, namely Pyke and White (1996). These authors document the criteria found most consistently at sites that support breeding and non-breeding populations, this included the following:

- Presence of emergent vegetation providing shelter sites;
- Moderate to high level disturbance;
- Aquatic plant species present (especially *Typha* spp.);
- Still or low flowing water;
- Run-off urban / industrial / grazing or parkland;
- Substrate sand, or rock;
- Shallow water depth <50 cm;
- Nearby vegetation low, grassland, or shrubland or woodland;
- Unshaded or partial shade;
- Areas of grass nearby;
- No visible signs of pollution;
- *Crinia signifera* or *Limnodynastes peronii* present; and
- *Gambusia holbrooki* absent.

A total of 10 sites were identified for targeted survey effort, each of these were ephemeral depressions that filled only following the rainfall event. These depressions were dry at the first inspection in early October 2017, and later all filled with water following 73.4 mm of rainfall which fell in the period 20-23 October. Surveys commenced on the 24 October and a further 46.6 mm was experienced during the 4-day survey period for a total of 120 mm during an 8-day period (refer Table 5.9). The location of the survey sites is shown in Figure 2.1.

The 10 sites were each searched by one or two ecologists with surveys replicated at least twice per site across the four nights with some larger areas searched on more than two occasions (i.e. site 6 and 10). The duration of each survey night extended between 3 and 4 hours. The survey technique involved a spotlight and headlight search of the entire perimeter of each site, focusing on the upper water column and within emergent vegetation

and debris (rocks and logs), for a minimum of 30 minutes per site. Call playback was used at each site during the search, which involved playing calls through a portable speaker (3W) at random locations around the perimeter of the pond each for a total of 2 minutes followed by quiet listening. Total call playback time equated to between 10-20 minutes during each survey. Smaller habitat areas involved a single broadcast point, while larger areas and densely vegetated areas used the multiple call site approach whilst searching the perimeter of the habitat.

In addition, a reference site to the north of Pond 2 (c.50 m) near the conveyor was visited to survey for the presence of *Crinia tinnula*, as records of this species are common in areas surrounding the ash ponds, up to 10 km from the site. The open forest habitats at the reference site were in contrast to the open rehabilitated ash ponds in terms of water quality and floristic structure, however provided an opportunity to test whether the species was calling and active during the survey period.

Table 5.9: Weather and rainfall conditions during and prior to the targeted frog survey

Date	Min Temp (°C)	Max Temp (°C)	Wind (3pm)	Rainfall (24 hours)	Total rainfall in 7 days prior to survey
24/10/2017	7.1	26.1	E 30 km/hr	25.6 mm	73.4 mm
25/10/2017	13.3	32.2	N 39 km/hr	0 mm	73.4 mm
26/10/2017	17.8	26.5	SSE 26 km/hr	0.6 mm	73.4 mm
27/10/2017	14.3	24.6	WSW 31 km/hr	20.4 mm	74 mm

Wetland bird survey method

Surveys focused on the larger ash Pond 2 which contains both freshwater and saltmarsh habitat. The smaller depressions on Pond 3 were visited on several occasions during other survey activities and found to be not suitable for the target species. Pond 2 was created by deposition of ash slurry (developed through the combustion of coal) that was then progressively capped with 100 mm of natural material and rehabilitated via seeding with grasses. The occasional inundation of this area by rainfall and subsequent evaporation combined with a saline water table has created a saline mudflat habitat, stimulating the development of a community that is dominated by saltmarsh species and shallow ephemeral ponds, with an area of fresher water at the western end. Although this community is not influenced by tide, it exhibits characteristics of tidal mudflat habitat that presents as potential roosting and foraging habitat for threatened and migratory shorebird species. Considering the proximity and availability of similar habitat at Lake Macquarie, a number of shorebird species may also utilise the Ash Pond 2. Table 5.10 describes the acceptable methods for survey of shorebird species as documented in the Commonwealth of Australia (2011; 2017). Table 5.11 lists the species identified as having a moderate to high likelihood of occurring and were targeted by the survey.

Table 5.10: Survey requirements and survey effort for migratory shorebirds and wetland birds

Minimum survey requirements (OEH 2009; Commonwealth of Australia 2011; 2017)	Survey effort completed
Survey effort should be comprised of a minimum of eight surveys including: - Four surveys for roosting shorebirds during the period when the majority of shorebirds are present in the area, and - Four surveys for foraging shorebirds, including two surveys at spring low tide and two surveys at neap low tide	A total of eight surveys were undertaken over a period of 3 months during the spring-early summer period (Oct-Dec) (i.e. 4 high tide foraging surveys and 4 low tide roosting surveys)

Table 5.11: Shorebird / wetland species targeted in site surveys

Species		EPBC Act	BC Act	Biodiversity credit class
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E	Ecosystem
<i>Calidris tenuirostris</i>	Great Knot	M	V	Ecosystem
<i>Charadrius leschenaultii</i>	Greater Sand plover	-	V	Species
<i>Charadrius mongolus</i>	Lesser Sand Plover	-	V	Species
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	E	Ecosystem
<i>Epthianura albifrons</i>	White-fronted Chat	-	V	Ecosystem
<i>Haematopus longirostris</i>	Pied Oystercatcher	-	E	Species
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	-	V	Species
<i>Limosa lapponica</i>	Bar-tailed Godwit	M	-	-
<i>Limosa lapponica baueri</i>	Bar-tailed godwit (western Alaskan)	V	-	Ecosystem
<i>Limosa limosa</i>	Black-tailed Godwit	M	V	Ecosystem
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, M	-	Ecosystem
<i>Pluvialis fulva</i>	Pacific Golden Plover	M	-	-
<i>Xenus cinereus</i>	Terek Sandpiper	M	V	Ecosystem

Targeted shorebird surveys were conducted over eight separate survey dates targeted between 10 October and 5 December 2017 to sample a wide temporal range within the peak period of presence of migratory birds in eastern Australia. While the habitat is not tidal, survey effort and timing was planned around tides in accordance with EPBC Act Policy Statement 3.21—*Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Commonwealth of Australia 2017). This was to investigate presence and activity of birds. The majority of the surveys were conducted following the rainfall event described above at a time when water was present on the pond (refer Table 6.3).

Table 5.12: Weather, timing and tide during bird surveys

Date	Survey time	Min Temp (°C)	Max Temp (°C)	Wind (3pm)	Rainfall (24 hours)	Tide height
10/10/2017	0645	15.4	32.8	NNE 22 km/hr	0.2 mm	1.46 m (High)
25/10/2017	1800	13.3	32.2	N 39 km/hr	0 mm	0.56 m (Low)
26/10/2017	1800	17.8	26.5	SSE 26 km/hr	0.6 mm	0.58 m (Low)
14/11/2017	0900	8.3	22.7	ESE 30 km/hr	0 mm	1.48 m (High)
17/11/2017	0800	14	24.8	ESE 30 km/hr	19.8 mm	1.68 m (High)
27/11/2017	1630	17.5	24.3	ESE 6 km/hr	0.2 mm	1.43 m (High)
1/12/2017	1300	16.4	30	ESE 17 km/hr	0 mm	0.41 m (Low)
5/12/2017	1600	16.9	24.1	SW 6km/hr	8.6 mm	0.12 m (Low)

Two approaches were used, which included a point count survey taken from two separate vantage locations on the western and southern sides of the pond, high on a road embankment that looks over the pond. The second

approach was a walked transect approximately 700 m in length. All birds seen or heard with 50 metres of the transect were targeted (the location of both methods is shown on Figure 2.1)

The point count was conducted for 20-minutes at each location on each of the 8 survey days using a telescope and binoculars, while the transect was walked steadily over approximately 30 minutes on each of the 8 survey days. Surveys were conducted by one or two ecologists experienced with shorebird identification. During each survey all bird species and number of individuals observed on Pond 2 was recorded (birds flying over were not recorded). Also, species utilising wetland vegetation on the edge of the pond were also recorded.

Limitations

The vegetation field survey was able to provide good spatial coverage and survey effort of each component of the Development site, meeting the requirements of the FBA. The vegetation within the study area has been assigned to a PCT as listed in the VIS database based on the observed species composition, landscape position, and underlying geology and soils. The mapping for this project is supported by on ground observations and quantitative data. The boundaries of vegetation zones have been mapped as they were observed during the field survey and it is possible that the boundaries of vegetation zones will change with time.

The list of species recorded in each PCT during this study should not be seen to be fully comprehensive, but rather an indication of the species present at the time of the survey. A period of several seasons or years is needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (e.g. orchids, annual herbs and grasses). Some species require specific weather conditions for optimum detection.

The conclusions of this report are based upon available data and the field surveys and are therefore indicative of the environmental condition of the study area at the time of the survey. It should be recognised that conditions, including the presence of threatened species, can change with time.

5.3.4 Survey results

Threatened flora

No threatened plant species were identified from the targeted surveys.

In many cases the habitats within the study area are too degraded for the target species to persist. This is particularly the case for the regrowth habitats on the ash ponds. Species including *Astrotricha crassifolia*, *Prostanthera askania*, *Melaleuca groveana* and *Tetratheca glandulosa* are not known from the locality and are considered unlikely to occur considering the extent of survey that has been undertaken in the locality. These species were not found in the study area during the survey.

Of the candidate species returned from the calculator for survey, the orchids *Cryptostylis hunteriana*, *Diuris praecox*, and *Genoplesium insigne* were considered the most likely to occur in the study area, in particular the conveyor easement, as these species can tolerate disturbance. Autumn, spring and summer surveys failed to locate any of these three orchid species within the study area.

Tetratheca juncea is known to be present in the habitats in the locality so was targeted for survey. This species was not recorded in the study area during the survey. Likewise, *Acacia bynoeana* is known to occur in the surrounding habitats but was not recorded in the study area during the survey.

Angophora inopina is known to occur in habitats adjacent to the study area but was not recorded within the study area during the surveys. *Eucalyptus camfieldii*, *Callistemon linearifolius* and *Grevillea parviflora* subsp. *parviflora* are known from the locality but was not recorded in the study area during the surveys.

Wilsonia backhousei is not known to occur in the locality but the saltmarsh habitats were surveyed for this species. *Wilsonia backhousei* was not found in the study area during the surveys.

Persicaria elatior was not recorded in the study area in any wetland habitats or other wet areas during the survey.

Threatened fauna

No threatened fauna species were recorded from the targeted surveys.

Targeted surveys for threatened frogs were conducted over 4 nights (24 person hours) during optimum conditions for detection of frogs. These surveys confirm the absence of the threatened frog species (i.e. *Litoria aurea*, *Crinia tinnula*, *Litoria brevipalmata* and *Heleioporus australiacus*). Frog activity was high during the survey, reflecting the optimum conditions and a total of seven common frog species were recorded within the site boundaries (see Table 5.10). The results of the threatened species assessment are outlined in Table 5.11.

Crinia tinnula was heard calling from outside the project area at the reference site to the north-east of Pond 2 near the conveyor during the survey period. There are numerous accounts of this species within a 10 km radius of the site, including records < less than 2 km from the site. Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedge lands and wet heathlands and swamp forests. The key to the habitat of this species is slightly acidic water (pH of <6) for fulfilling its life-cycle components. The surveys targeted all ten pond areas within the project site and confirm that the freshwater habitats on the site were not occupied by this species despite confirming evidence of calling individuals to the north, outside the site. A small number of individuals were heard calling around 40-50 m north of Pond 3 and it is considered that the freshwater habitats on the ash ponds are too degraded for this species. Similarly, the open disturbed ephemeral habitats within the ash ponds are not suited to *Litoria brevipalmata* or *Heleioporus australiacus*.

Many of the site characteristics of the ephemeral ponds are suited to *Litoria aurea* despite their disturbed condition, however the species was not heard calling or observed from an intensive survey of all ten possible sites within the ash ponds. The conditions were optimum for the detection of this species, and *Litoria aurea* is considered not present. Further to this, there are no known populations surrounding the site

Table 5.10: Results of targeted frog survey

Species	Survey site									
	1	2	3	4	5	6	7	8	9	10
Common Eastern Froglet (<i>Crinia signifera</i>)					^	^			^	
Eastern Dwarf Tree Frog (<i>Litoria fallax</i>)		~				^			~	
Striped Rocket Frog (<i>Litoria nasuta</i>)			^							^
Broad-palmed Frog (<i>Litoria latopalmata</i>)				^	^					^
Striped Marsh Frog (<i>Limnodynastes peronii</i>)		~		~						~
Spotted Grass Frog (<i>Limnodynastes tasmaniensis</i>)	^					^			^	
Red-groined Toadlet (<i>Uperoleia laevisgata</i>)		~			~				~	
KEY										
	abundant									
^	common									
~	uncommon									
+	heard calling from off-site, in surrounding forest									

No threatened shorebird or wetland bird species listed under the BC Act or EPBC Act were recorded from the targeted surveys.

The targeted surveys confirmed the presence of one bird species listed under the marine and migratory status of the EPBC Act. The Pacific Golden Plover (*Pluvialis fulva*) was recorded from 6 of the 8 surveys, occurring at both high tide and low tide times. Note the Pond 2 habitat is not tidal and not connected to Lake Macquarie.

According to the EPBC Act SPRAT database Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as *Sarcocornia*, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, or ploughed or recently burnt areas, and they are very occasionally recorded well away from water (Marchant & Higgins 1993). The species does not breed in Australia.

Individuals were observed foraging and were also observed at dusk, where they were likely roosting at the pond. A group of 8 birds were regularly observed and on one occasion a group of 20 birds was observed. These birds were also seen leaving the site to the west and are likely to frequent a number of similar habitats in the region.

6. Matters of National Environmental Significance

6.1 Listed ecological communities

There are no national listed threatened ecological communities present in the study area.

6.2 Listed threatened flora species

There are no national listed threatened flora species present in the study area.

6.3 Listed terrestrial fauna species

The targeted surveys did not record and nationally listed threatened fauna species in the study area.

6.4 Listed migratory species

The search of the PMST identified 13 listed migratory species or their habitat as occurring within 10 kilometres of the proposed action. A habitat assessment and targeted survey was undertaken to determine the likelihood of occurrence of listed migratory species within the study area (refer methods Section 2.3.4).

6.4.1 Targeted shorebird survey

Ash Pond 2 was created by deposition of ash slurry (developed through the combustion of coal) that was then progressively capped with 100 mm of natural material and rehabilitated via seeding with grasses. The occasional inundation of this area by rainfall and subsequent evaporation combined with a saline water table has created a saline mudflat habitat, stimulating the development of a community that is dominated by saltmarsh species and shallow ephemeral ponds. Although this community is not influenced by tide, it exhibits characteristics of tidal mudflat habitat that presents as potential roosting and foraging habitat for threatened and migratory shorebird species. Considering the proximity and availability of similar habitat at Lake Macquarie, a number of shorebird species may also utilise the Ash Pond 2. Table 6.1 describes the acceptable methods for survey of shorebird species as documented in the Commonwealth of Australia (2011; 2017). Table 6.2 lists the species identified as having a moderate to high likelihood of occurring and were targeted by the survey.

Table 6.1: Survey requirements and survey effort for migratory shorebirds and wetland birds

Minimum survey requirements (OEH 2009; Commonwealth of Australia 2011; 2017)	Survey effort completed
Survey effort should be comprised of a minimum of eight surveys including: - Four surveys for roosting shorebirds during the period when the majority of shorebirds are present in the area, and - Four surveys for foraging shorebirds, including two surveys at spring low tide and two surveys at neap low tide	A total of eight surveys were undertaken over a period of 3 months during the spring-early summer period (Oct-Dec) (i.e. 4 high tide foraging surveys and 4 low tide roosting surveys)

Table 6.2: Migratory shorebird species targeted in site surveys (reference DEWHA 2009)

No.	Scientific name	Common name
	Scolopacidae	Sandpipers and related birds
1	<i>Gallinago hardwickii</i>	Latham's snipe
2	<i>Gallinago stenura</i>	Pin-tailed snipe
3	<i>Gallinago megala</i>	Swinhoe's snipe
4	<i>Limosa limosa</i>	Black-tailed godwit
5	<i>Limosa lapponica</i>	Bar-tailed godwit
6	<i>Numenius minutus</i>	Little curlew
7	<i>Numenius phaeopus</i>	Whimbrel
8	<i>Numenius madagascariensis</i>	Eastern curlew
9	<i>Tringa totanus</i>	Common redshank
10	<i>Tringa stagnatilis</i>	Marsh sandpiper
11	<i>Tringa nebularia</i>	Common greenshank
12	<i>Tringa glareola</i>	Wood sandpiper
13	<i>Xenus cinereus</i>	Terek sandpiper
14	<i>Actitis hypoleucos</i>	Common sandpiper
15	<i>Heteroscelus brevipes</i>	Grey-tailed tattler
16	<i>Heteroscelus incanus</i>	Wandering tattler
17	<i>Arenaria interpres</i>	Ruddy turnstone
18	<i>Limnodromus semipalmatus</i>	Asian dowitcher
19	<i>Calidris tenuirostris</i>	Great knot
20	<i>Calidris canutus</i>	Red knot
21	<i>Calidris alba</i>	Sanderling
22	<i>Calidris ruficollis</i>	Red-necked stint
23	<i>Calidris subminuta</i>	Long-toed stint
24	<i>Calidris melanotos</i>	Pectoral sandpiper
25	<i>Calidris acuminata</i>	Sharp-tailed sandpiper
26	<i>Calidris ferruginea</i>	Curlew sandpiper
27	<i>Limicola falcinellus</i>	Broad-billed sandpiper
28	<i>Philomachus pugnax</i>	Ruff
29	<i>Phalaropus lobatus</i>	Red-necked phalarope
	Charadriidae	Plovers and lapwings
30	<i>Pluvialis fulva</i>	Golden plover
31	<i>Pluvialis squatarola</i>	Grey plover
32	<i>Charadrius bicinctus</i>	Double-banded plover
33	<i>Charadrius mongolus</i>	Lesser sand plover
34	<i>Charadrius leschenaultii</i>	Greater sand plover
35	<i>Charadrius veredus</i>	Oriental plover
	Glareolidae	Pratincoles
36	<i>Glareola maldivarum</i>	Oriental pratincole

Targeted shorebird surveys were conducted over eight separate survey dates targeted between 10 October and 5 December 2017 to sample a wide temporal range within the peak period of presence of migratory birds in eastern Australia. While the habitat is not tidal, survey effort and timing was planned around tides in accordance with *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Commonwealth of Australia 2017). This was to investigate presence and activity of birds. The majority of the surveys were conducted following the rainfall event described above at a time when water was present on the pond (refer Table 6.3).

Table 6.3: Weather, timing and tide during bird surveys

Date	Survey time	Min Temp (°C)	Max Temp (°C)	Wind (3pm)	Rainfall (24 hours)	Tide height
10/10/2017	0645	15.4	32.8	NNE 22 km/hr	0.2 mm	1.46 m (High)
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5/12/2017	1600	16.9	24.1	SW 6km/hr	8.6 mm	0.12 m (Low)

Two approaches were used, which included a point count survey taken from two separate vantage locations on the western and southern sides of the pond, high on a road embankment that looks over the pond. The second approach was a walked transect approximately 700 m in length. All birds seen or heard with 50 metres of the transect were targeted (the location of both methods is shown on Figure 2.1)

The point count was conducted for 20-minutes at each location on each of the 8 survey days using a telescope and binoculars, while the transect was walked steadily over approximately 30 minutes on each of the 8 survey days. Surveys were conducted by one or two ecologists experienced with shorebird identification. During each survey all bird species and number of individuals observed on Pond 2 was recorded (birds flying over were not recorded). Also, species utilising wetland vegetation on the edge of the pond were also recorded.

6.4.2 Survey results

No threatened shorebird species listed under the EPBC Act were recorded from the targeted surveys.

The targeted surveys confirmed the presence of one bird species listed under the marine and migratory status of the EPBC Act. The Pacific Golden Plover (*Pluvialis fulva*) was recorded from 6 of the 8 surveys, occurring at both high tide and low tide times. Note the Pond 2 habitat is not tidal and not connected to Lake Macquarie.

According to the EPBC Act SPRAT database Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as *Sarcocornia*, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, or ploughed or recently burnt areas, and they are very occasionally recorded well away from water (Marchant & Higgins 1993). The species does not breed in Australia.

Individuals were observed foraging and were also observed at dusk, where they were likely roosting at the pond. A group of 8 birds were regularly observed and on one occasion a group of 20 birds was observed. These birds were also seen leaving the site to the west and are likely to frequent a number of similar habitats in the region.

6.4.3 Assessment of impact

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- 1) Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a Migratory species;
- 2) Result in an invasive species that is harmful to the Migratory species becoming established in an area of important habitat for the Migratory species; or
- 3) Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species.

Under the EPBC Act, 'important habitat' is a key concept for migratory species. According to the EPBC Act Significant Impact Guidelines (SIG 1.1) (Commonwealth of Australia 2013), an area of 'important habitat' for a migratory species is defined as:

- habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat used by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

The widely accepted and applied approach to identifying internationally important shorebird sites throughout the world has been through the use of criteria adopted under the Ramsar Convention on Wetlands (Commonwealth of Australia 2009). According to this approach, a wetland should be considered internationally important if it regularly supports:

- one per cent of the individuals in a population of one species or subspecies of waterbird; or
- a total abundance of at least 20,000 waterbirds; or
- or 0.1 % of the flyway population.

The Vales Point ash ponds are not identified as an internationally important site for this species. Hansen *et al* (2016) estimate the Pacific Golden Plover population at 120,000 birds and the 0.1 % flyway population at 120 birds. The maximum number of birds observed using the saltmarsh habitat at the Vales Point ash dam from the survey was 20 individuals.

On this basis it is concluded that the site does not constitute 'important habitat' for this species as defined under the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (DoE 2013), in that the study area does not contain:

- a region that supports an ecologically significant proportion of a population of migratory species; or
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining.

As such, it is unlikely that the action would significantly affect migratory species.

7. Avoidance and minimisation of impacts

This section of the BAR demonstrates the efforts taken to avoid and minimise impacts on biodiversity values in accordance with Section 8.3 of the FBA.

Combined with appropriate mitigation measures and safeguards during construction and operation of the project (which will be outlined in the project's Construction Environmental Management Plan (CEMP)), the siting and planning of the project is expected to be sufficient to ensure that the requirements to avoid and minimise impacts on biodiversity values as set out in Chapter 8 of the FBA are met. The site selection and planning process is detailed further below.

7.1 Site selection and planning

Delta proposes to develop the project on existing areas of the Vales Point ash dams associated with the operation of the Vales Point Power Station. Importantly, the project will not impact on:

- Endangered Ecological Communities (EECs) or Critically Endangered Ecological Communities (CEECs);
- PCTs that contain threatened species habitat;
- An area of land that the Minister for Environment has declared as an area of outstanding biodiversity value in accordance with section 3.1 of the BC Act;
- The riparian areas of 4th order or higher streams and rivers, important wetlands or estuaries; or
- State significant biodiversity links.

The selection of the site, on artificially created ash ponds, has avoided the need to impact any high quality PCTs. Further to this the targeted surveys confirm the absence of threatened species from the completely modified ash pond environment selected for the placement of the solar array. The adjacent high quality habitats in the perimeter lands are known to provide habitat for a range of threatened fauna species including the Koala, Squirrel Glider, Glossy Black-Cockatoo, Little Lorikeet, Varied Sittella, Little Eagle, White-bellied Sea-eagle, Grey-headed Flying-fox, Eastern Freetail-bat, Large-footed Myotis, Greater Broad-nosed Bat, and Wallum Froglet. The adjacent habitats are also expected to provide habitat for threatened plant species including *Cryptostylis hunteriana*, *Acacia bynoeana*, *Angophora inopina*, and *Tetratheca juncea*.

Site selection was informed by a Preliminary Environmental Assessment undertaken in March 2017 (Jacobs, 2017). This work involved a desktop assessment of biodiversity values which was based off the substantial biodiversity survey work that has been undertaken at the Vales Point Power station and perimeter lands (Ecotone Ecological Consultants Pty Ltd, 2010) and the *Vales Point Ash Dam Vegetation Management Plan* (Eco Logical Australia, 2011). The native vegetation communities and habitats surrounding the Vales Point Ash Dam were recognised as high value and habitat for a range of threatened species. As such, the ash dams were considered the most appropriate location for site selection to avoid impacts to areas of known high biodiversity value.

During Stage 1 of the FBA process, the study area was visited by Jacobs ecologists and initial work was undertaken to investigate the values of the proposed development area. This work provided preliminary information to inform this BAR. Although no native vegetation had been identified during the Preliminary Environmental Assessment or in any of the biodiversity assessments or vegetation management plans that had been prepared for the study area to date, the study area was found to contain native vegetation from several PCTs and in a range of condition classes. This vegetation may have established since the *Vales Point Ash Dam Vegetation Management Plan* was written in 2011. The native vegetation identified in the study area included regrowth shrublands, ephemeral freshwater wetlands and saltmarsh. A subsequent site inspection was undertaken with Steve Lewer, Regional Biodiversity Conservation Officer at the OEH, to discuss the particular biodiversity issues faced by the project.

The native vegetation that is present in the study area is considered to be of less constraint to the project than a greenfield site, such as the other areas of perimeter land, that contains remnant native vegetation in a relatively

undisturbed state. When considering alternative locations for the project within the Vales Point Power Station lands, the study area is the most appropriate location for the project from a biodiversity perspective.

7.2 Avoidance

While the site selection was the primary avoidance measure, following selection of the ash dams as the appropriate site for development of the project, further localised avoidance strategies were used. This included siting of the short transmission easement along the existing and disused coal conveyor easement to avoid any disturbance to adjacent high quality habitat types. Other vegetation zones on the edge of the ash dams were also avoided. Further to this, the impacts in vegetation zones presented is based on a worst case scenario, and a detailed design has not been assessed. The actual disturbance to the saltmarsh PCT will be less due to the fact that the linear drain across the ash pond will remain to facilitate drainage of surface water. This drain contains a large portion of the saltmarsh vegetation that would remain in situ.

8. Potential impacts

8.1 Confirming the development footprint

After site selection and planning was completed, the proposed development footprint was refined to further avoid impacts to native vegetation (see Figure 8.1).

The development footprint has been designed to avoid impacts to some areas of the *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion PCT on Pond 3 and a small area of Scribbly Gum woodland in low condition at the eastern end of Pond 3. The 33kV easement to the Vales Point zone substation has been situated so that it is located within the old conveyor easement and avoids areas of intact vegetation. Not all vegetation in this area will be cleared. The vegetation within a 2 metre radius of poles will be cleared and there is a requirement for 3.5 metre clearance in all directions from the conductor. The conductors will be 10 metres off the ground so the under storey (<6 m) could be retained, there is a sparse ground cover in this location and high proportion of bare earth. There are no tall mature trees within this alignment.

The development footprint is restricted to the disturbed ash dams and conveyor easement and avoids impacts to the adjacent high quality vegetation. Hollow-bearing trees close to the transmission easement will be retained and understorey removal will be minimised between transmission poles. The scenario presented in this BAR represents a worst case impact and the impacts will be minimised during the detailed design phase as the development footprint is refined.

8.2 Construction phase

8.2.1 Direct impacts on biodiversity values

8.2.1.1 Removal of native vegetation

Despite avoidance and minimisation at the planning phase, removal of native vegetation will be required to develop the project. While all groundcover vegetation may not be totally removed as the photovoltaic array will be mounted above the ground, the area beneath the array will likely be damaged during construction and will be shaded resulting in altered micro-climatic conditions. The effects of shading are likely to result in death of some species due to a lack of sunlight and moisture but the absolute impact is not known. As such, the assessment has taken a precautionary approach and all vegetation under the footprint of the photovoltaic array is assumed to be removed. This impact would be removal of approximately 19.14 ha of native regrowth vegetation.

The transmission line would occupy an easement of approximately 7 metres wide. Two immature trees would be removed to establish a clear zone within the easement but the bulk of the lower growing shrubs and all groundcover vegetation will be retained. Total vegetation removal is not required along the easement and total clearing of vegetation is only required within a 2 m radius around the location of each pole. The approximate vegetation removal associated with the easement is small at 0.052 ha.

Access tracks would be provided inside and around the perimeter of the site on existing roadways to allow for maintenance and access. Construction activities would commence with the building of site offices and facilities. Services such as power, water, septic and communications would be connected to the site facilities. The entire site would be temporarily fenced to provide a secure work area and access roads to the site would be upgraded. Once site works are complete, all temporary facilities and roadworks would be removed, services would be decommissioned, and the site would be reinstated, as appropriate.

The potential loss of vegetation and habitat associated with the project is summarised in Table 8.1. The construction footprint would impact on approximately 19.19 hectares of native regrowth vegetation (see Table 8.1). These impacts have been quantified based on a concept design development footprint and take into consideration potential temporary disturbance during construction including compound sites and upgrading of drainage.



The impacts in vegetation zones presented is based on a worst case scenario, and a detailed design has not been assessed. The actual disturbance to the saltmarsh PCT will be less due to the fact that the linear drain across the ash pond will remain to facilitate drainage of surface water. This drain contains a large portion of the saltmarsh vegetation that would remain in situ.

Mitigation measures designed to reduce the impact of vegetation removal are provided in Section 9.

Table 8.1: Impacts to native vegetation

Vegetation zone	PCT	Condition	Percent cleared in CMA	Area to be impacted (ha)
1	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	Moderate/Good	58	0.002 (trimming only)
2	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	Moderate/Good_Poor	58	0.17
3	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	Low	58	6.52
4	Saltmarsh Estuarine Complex	Moderate/Good	16	8.36
5	Saltmarsh Estuarine Complex	Moderate/Good_Poor	16	1.54
6	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate/Good_Poor	75	2.60
Total vegetation removal				19.19 ha

8.2.1.2 Removal of habitat features

While direct vegetation disturbance would be minimal, there will be removal of habitats and individual features that are currently utilised by common native fauna and provide potential to be used. This includes a variety of habitats that have established in the study area including disturbed grass, regrowth shrublands, ephemeral freshwater and saline wetlands, and mud flats (see Photo 9). These habitats provide sheltering, feeding and breeding sites for common frog species, foraging and roosting habitat for some wetland dependent birds, hollow-bearing trees and dead standing trees (stags) that provide potential roost and breeding sites for insectivorous bats and hollow-dependent birds and reptiles.

The artificial ash pond habitats are in poor condition and ephemeral, these were observed to only fill with water after a significant rainfall event, and at other times were completely dry. These habitats represent potentially important breeding sites for common frogs, although are not occupied year round or likely to be important as refuge areas during dry periods. The targeted surveys were conducted during optimum periods and confirm that no threatened fauna species are utilising the artificial habitats on the ash dams.

At least 32 dead trees and hollow-bearing trees have been mapped at the site, mostly at the southern edge of Pond 3 (see Photo 10). Those in the pond are mature trees that were obviously left standing during the modification to the site for disposal of ash and subsequently the change in hydrology has led to die-back. These trees will need to be removed to accommodate the solar panel array. These trees present with a number of trunk and branch hollows and decorticated bark. The trees are isolated from nearby open forest habitat and therefore are unlikely to be used by arboreal mammal species, however could be used by tree-roosting bats, as well as frogs, reptiles and birds that are dependent on hollows.

The saltmarsh and disturbed wetland habitats do not provide particularly important or unique habitats for microbats due to the absence of hollow-bearing trees which would provide potential roost and sheltering microhabitat. They are likely to form part of the overall foraging range for local populations and are a source of breeding habitat for insect prey.

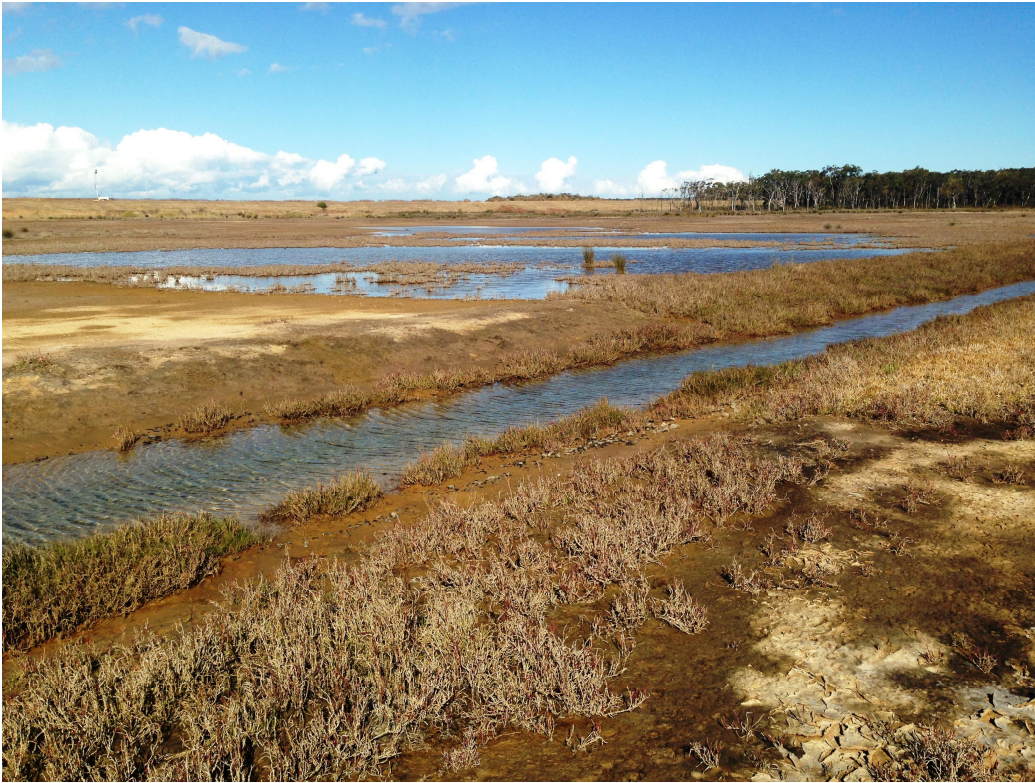


Photo 9: Saltmarsh habitat with shallow ponds and mudflats on Pond 2



Photo 10: Stags at the edge of Pond 3 (Zone 3 these provide potential roosting opportunities for microbats)

8.2.1.3 Injury and mortality of fauna

Fauna injury or death has the greatest potential to occur during vegetation clearing and the extent of this impact will be proportionate to the extent of vegetation that is cleared. Some mobile species, such as birds, may be able to move away from the path of clearing and may not be greatly affected unless they are nesting. However, other species that are less mobile (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to move rapidly when disturbed. Common fauna species such as possums, reptiles and frogs are the most likely to be affected. The greatest chance of fauna mortality during construction will be when stags are removed as these dead standing trees may be providing den sites or roosts for fauna.

Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in machinery that is stored in the study area overnight that may result in injury or death.

Mitigation measures designed to reduce an injury and death of fauna are provided in Section 9.

8.2.2 Indirect impacts on biodiversity values

8.2.2.1 Sedimentation and run-off

Sedimentation and run-off can lead to a reduction in productivity and loss of ecosystem services. The construction and operation of the project has the potential to result in sedimentation and run-off that may impact on adjacent vegetation and water quality. Stockpiling of soil and earthworks during construction pose the greatest risk during wet weather if not managed appropriately.

Sediment and run-off will be managed with the measures outlined in the Erosion and Sediment Control Plan. Sedimentation and run-off is not predicted to be a major impact of the project. Mitigation measures designed to reduce sedimentation and run-off are provided in Section 9.

8.2.2.2 Noise, dust or light spill

Anthropogenic noise can alter the behaviour of animals or interfere with their normal functioning (Bowles, 1997). During all phases of the project there will be increased noise and vibration levels in the study area and immediate surrounds due to vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence. The predicted noise and vibration created by the project is outlined in the Noise and Vibration assessment and Section 5.4 of the EIS. The noise and vibration from construction activities associated with the project will potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. The impacts from noise emissions are likely to be localised to the construction areas and are not considered likely to have a significant, long-term, impact on wildlife populations outside the area of impact.

Elevated levels of dust may be deposited onto the foliage of vegetation adjacent to the project activities. This has the potential to reduce photosynthesis and transpiration and cause abrasion and radioactive heating resulting in reduced growth rates and decreases in overall health of the vegetation. Consequently, changes in the structure and composition of plant communities and consequently the grazing patterns of fauna may occur. Dust is likely to be generated throughout the lifecycle of the project, although dust pollution is likely to be greatest during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and decommissioning activities and during adverse weather conditions. However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary (particularly during the wetter seasons) and is therefore not considered likely to be a major impact of the project.

Ecological light pollution in the form of direct glare, chronic or periodic increased illumination, or temporary unexpected fluctuations in lighting (including lights from a passing vehicles) is unlikely to be a major impact of the project. The project does not involve night lighting or night works.

Mitigation measures designed to reduce noise, dust and light spill are provided in Section 9.

8.2.2.3 Inadvertent impacts on adjacent habitat or vegetation

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. These new environmental conditions along the habitat edges can promote the growth of different vegetation types (including weeds), promote invasion by pest animals specialising in edge habitats, or change the behaviour of resident animals (Moenting and Morris, 2006).

With a project of this type there is a low potential for edge effects, habitat fragmentation or barrier effects due to the impact footprint and perimeter. There are no high quality intact areas of habitat within the study area that would suffer from the effects of reduced habitat quality and reduced patch size after the project is constructed. The project does not involve fragmenting an area of habitat and will not introduce new edge habitats into previously undisturbed habitat.

Within the study area, and construction footprint, the patches of native vegetation are small, irregularly shaped, and fragmented. As such, many areas of vegetation within and directly adjacent to the construction footprint are already subject to considerable edge effects. No unaffected core habitat exists in the study area and adjacent habitats will be unaffected as the existing perimeter roads will be used. Consequently, it is unlikely that the project would increase the overall extent of edge effects across the study area.

8.2.2.4 Feral pest, weed and/or pathogen encroachment

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of project activities) that may have cumulative effects as each project activity may act together to increase the chances of weed and pest proliferation throughout the study area. Proliferation of weed and pest species is likely to occur during construction and operation, although impacts will be greatest as a result of vegetation clearing during the construction phase. The effects of proliferation of weed and pest species may not be experienced immediately or even in the short-term, however, will likely commence a few months after the construction phase commences and gradually increase over months and seasons.

The study area, particularly Pond 1, 2 and 3, contains a significant quantity and variety of weed species, including Priority Weeds identified for the Greater Sydney and Hunter regions listed under the *Biosecurity Act 2015* such as *Rubus fruticosus* species aggregate, *Hyparrhenia hirta*, *Senecio madagascariensis* and *Cortaderia selloana*. Without implementation of appropriate management strategies, project activities have the potential to disperse weeds into adjacent areas of remnant vegetation where weed species are currently limited or in low density. Project activities also have the potential to import new weed species into the study area. The most likely causes of weed dispersal and importation associated with the project include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases.

The study area is currently habitat for a range of pest species including rabbits. Project activities have the potential to disperse pest species out of the project footprint across the surrounding landscape and increase the ability of pest species to utilise habitats due to habitat removal, noise, and human presence during construction and operation. However, in the context of the project this impact is predicted to be minimal as all habitats in locality are likely to be impacted by pests and once the project has been constructed pests are expected to resume using the site as habitat so displacement into surrounding areas will be temporary. The magnitude of this impact will be low.

Several pathogens known from NSW have potential to impact on biodiversity as a result their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- Dieback caused by *Phytophthora* (Root Rot; EPBC Act and BC Act);
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act); and
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation associated with the project include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all project phases (construction and operation).

Weeds, pests and pathogens will be managed within the project site according to the measures outlined in Section 9.

8.2.3 Impacts that are infrequent, cumulative or difficult to measure

The potential biodiversity impacts of the project must be considered as a consequence of the construction and operation of the project within the existing environment. The project will not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the project within a strategic context.

The accumulating impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure will likely include continued loss of biodiversity on the Sydney - Newcastle Coastal Alluvial Plains and the Gosford - Cooranbong Coastal Slopes. The Sydney – Newcastle Coastal Alluvial Plain Mitchell Landscape has had 62% of the native vegetation removed. Due to likely urban expansion in the Central Coast and Lake Macquarie regions and associated infrastructure, further impacts to biodiversity are likely to result in this region.

The project would be built in a man-made landscape and will not involve clearing of remnant vegetation or high quality habitats. The project is considered unlikely to contribute significantly to any cumulative impacts in the region as it is to be constructed over rehabilitated ash dams and will not reduce woody native vegetation cover in the region.

8.3 Operational phase

Once complete, the project is expected to have low operational impact on flora and fauna. Of note is the fact that there will be limited staff or vehicles on site during operation, albeit for occasional maintenance during daylight hours. There will be no artificial night lights required or noise as a consequence of the project's operation.

8.3.1 Direct impacts on biodiversity values

8.3.1.1 Injury and mortality of fauna

Glare and dazzle effects due to reflection causing disorientation of flying birds could potentially impact on the movements of birds over the site. Species such as the White-bellied Sea-eagle and wetland birds may be most affected. Reflective surfaces can act as attractants for approaching birds and these surfaces may be confused for large water bodies. This issue is termed as the "lake effect" or "mirror effect", where water birds and their insect prey can mistake a reflective photovoltaic array for a water body, or spot water ponds at the site, then fly in to land. The birds may collide with the photovoltaic array resulting in injury and/or death. Due to the location of the project adjacent to a water body this may be an impact to consider during operation. However, this impact is likely to be very low when compared to other anthropogenic sources of injury and mortality to fauna.

Electrocution of birds and collision caused when perching on, or flying into, power line infrastructure may also be a direct impact of the operational phase. However, the magnitude of this impact is considered low.

Mitigation measures designed to reduce an injury and death of fauna are provided in Section 9.

8.3.2 Shading by solar array infrastructure

Vegetation underneath the photovoltaic array may decline initially due to shading and associated effects including reduced soil moisture. The area of highly disturbed land is dominated by exotic grasses so the impact to these areas will be of little consequence to biodiversity. The native groundcover in areas of Vegetation Zones

3 and 4 may suffer from shading effects and a decline in native species may be experienced. The greatest shading effects will be to the areas of Saltmarsh on Pond 2.

Saltmarsh is known to be detrimentally affected by shading. Studies on the impacts of dock construction in Massachusetts (Logan et al., 2014, Logan et al., 2017) show that saltmarsh density under shaded areas declined relative to unshaded areas with the cause associated with reduced light availability and cooler temperatures underneath the docks. A reduction in biomass and stem density can be expected to occur underneath the photovoltaic array. A shift in species composition towards shade tolerant grasses may occur. Bare ground underneath the photovoltaic array may also increase susceptibility of the soil to erosion. A groundcover management plan should be prepared for the site and include regular monitoring of soil condition and vegetation cover beneath the array.

8.3.3 Indirect impacts on biodiversity values

Indirect impacts during operation are likely to be the same as that experienced during construction include:

- Sedimentation and run-off;
- Inadvertent impacts on adjacent habitat or vegetation; and
- Feral pest, weed and/or pathogen encroachment.

Mitigation measures designed to reduce these indirect impacts are provided in Section 9.

9. Mitigation

Once all practicable steps to avoid or minimise impacts have been implemented at the design phase, mitigation measures will be implemented to further lessen the potential ecological impacts of the project. Mitigation measures are to be undertaken during the construction and operational phases. The range of mitigation techniques to be applied are outlined in Table 9.1

Table 9.1: Proposed mitigation measures

Impact addressed	Mitigation measure	Timing and duration	Residual impact anticipated
Construction phase			
Removal of native vegetation and habitat features	Native vegetation removal would be minimised through detailed design.	Detailed design phase and micro siting of infrastructure.	The predicted residual impact to native vegetation and habitat removal is estimated at 19.19 ha.
	There will be minimal actual clearance of vegetation associated with the proposal, particular in Pond 2 which is all low vegetation. Pre-construction surveys would be undertaken by an experienced ecologist to investigate potential presence of Pacific Golden Plover prior to entering the dam for construction. An unexpected threatened species finds procedure will be developed that contains stop work provisions. Habitat features to be protected during construction will be marked on ground and on maps. The location of all hollow-bearing trees will be confirmed.	Before construction.	
	In the area of the powerline easement a method of clearing that avoids damage to retained native vegetation and reduces soil disturbance will be used. For example, removal of native vegetation by chain-saw is preferable as only partial clearing is proposed in this area.	During construction.	
	Re-establishment of vegetation will be considered where practicable in areas disturbed by construction. It is proposed to establish a linear drain across Pond 3, to facilitate surface water drainage. This would be planted with macrophyte vegetation and effectively replace the shallow ephemeral depressions on the site. In the provision of compensatory habitat for common frogs and birds.	Post construction.	
Injury and mortality of fauna	Minimising direct harm to native fauna during actual construction operations through onsite measures such as undertaking pre-clearing surveys, daily fauna surveys and the presence of a trained ecologist during clearing events. This is particularly relevant to the standing dead trees in Pond 3.	Before and during construction.	The mitigation measures should be effective but injury or death may still occur. Quantification of injury and mortality of fauna cannot be undertaken.
	Allow fauna to leave an area without intervention as much as possible.	During construction.	
	Use a licensed fauna ecologist or wildlife carer with specific animal handling experience to carry out any fauna handling. Contact an animal rescue agency/wildlife care group or vet before works start to ensure they are willing and available to be involved in fauna rescue and assist with injured animals.	During construction.	

Impact addressed	Mitigation measure	Timing and duration	Residual impact anticipated
Sedimentation and run-off	Sediment barriers or sedimentation ponds to minimise impacts on biodiversity values on land that is adjoining the development site, and waterways downstream of the development site.	Before and during construction.	No residual impacts expected.
Noise, dust or light spill	Undertake construction during daylight hours to avoid impacts from noise and light spill where this may be detrimental to species habitat on adjoining lands. Use dust suppression measures such as a water cart to water access tracks.	During construction.	Some localised impacts from noise and light spill will remain.
Inadvertent impacts on adjacent habitat or vegetation	Appropriately training and inducted project staff and contractors so that they can implement all measures that minimise inadvertent adverse impacts of the project on biodiversity values.	Before and during construction.	No residual impact is anticipated.
	Installing temporary fencing around native vegetation adjacent to the power line easement that is to be retained to protect these features. Exclusion zones will be established to mark clearing limits. This would include the two hollow-bearing trees adjacent to the easement.		
Operation phase			
Sedimentation and run-off	Sediment barriers or sedimentation ponds to minimise impacts on biodiversity values on land that is adjoining the development site, and waterways downstream of the development site.	Post construction.	No residual impact is anticipated.
Feral pest, weed and/or pathogen encroachment	Use mechanical weed control methods such as slashing or mowing, as well as a range of herbicides to avoid the development of herbicide resistance. Grazing may be an option to consider.	Post construction.	No residual impact is anticipated.

10. Impact summary

10.1 Impacts that require further consideration by the consent authority

There are no impacts that require further consideration in accordance with Section 9.2 of the FBA. The project is not expected to result in an impact on biodiversity that is severe or complicated that requires further consideration as outlined in Section 9.2.1.3 of the FBA. Specifically, the project will not:

- a) impact on landscape features, being:
 - i. impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas, or
 - ii. impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state, and
- b) impact on native vegetation that is likely to cause the extinction of an endangered ecological community (EEC) / critically endangered ecological community (CEEC) from an IBRA subregion or significantly reduce its viability, and
- c) impact on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability.

10.2 Impacts that require an offset

10.2.1 Impacts on native vegetation

According to Section 9.3.1.1 of the FBA, the assessor is required to determine an offset for impacts of development on PCTs that:

- a) are identified as a CEEC that is specifically nominated in the SEARS for the Major Project as a CEEC for which an impact does not require further consideration according to Section 9.2 of the FBA
- b) are identified as an EEC, unless it is an EEC that is specifically nominated in the SEARS for the Major Project as an EEC for which an impact requires further consideration according to Section 9.2 of the FBA
- c) are associated with threatened species habitat and in a vegetation zone that has a site value score ≥ 17 .

There are no EECs/CEECs identified within the study area, and no EECs/CEECs identified in the SEARS.

Three PCTs have been identified representing six vegetation zones. Ecosystem credits were not generated for Zones 1,2 and 3 on the basis of low site values scores (<17) and / or negligible impacts on threatened species. Ecosystem credits were however generated for the Saltmarsh PCT (i.e. Zone 4 and Zone 5) and for the artificial freshwater wetlands PCT (Zone 6). While, there are two predicted ecosystem species that are associated with these habitats (i.e. Eastern Freetail-Bat and Greater Broad-nosed Bat), the BBCC has not identified these species as a threatened species multiplier).

Zone 3 provides potential habitat for a number of threatened insectivorous bats species due to the presence of isolated scattered dead trees within the ash dam, some with hollows, and also the presence of insect prey. However, the site value score for zone 3 is <17 and therefore an offset is not required.

The saltmarsh and disturbed wetland habitats are associated with two threatened microbats presented as ecosystem species in the BBCC (i.e. Eastern Freetail-Bat and Greater Broad-nosed Bat). These habitats provide some value for microbats although are not particularly important or high value habitats for microbats. This is due to the absence of hollow-bearing trees which would provide potential roost and sheltering opportunities. They are likely to form part of the overall foraging range for local populations and are a source of breeding habitat for insect prey.

10.2.2 Impacts on species and populations

According to Section 9.3.2.1 of the FBA, the assessor is required to determine an offset for threatened species, populations and species habitat for the impacts of development on:

- a) a critically endangered species that is specifically nominated in the SEARS for the Major Project as a critically endangered species for which an impact does not require further consideration according to Section 9.2 of the FBA
- b) any other threatened species or population that was not specifically nominated in the SEARs for the Major Project as a threatened species or population for which an impact requires further consideration
- c) threatened species habitat associated with a PCT in a vegetation zone with a site value score of ≥ 17 .

At the time of the assessment, the study area did not provide habitat for any critically endangered species and the SEARs did not specifically nominate a threatened species or population for which an impact requires further consideration. There are expected to be no impacts to species and populations as outlined in Section 5.4 of this report. As such, an offset for species and populations is not required.

10.3 Impacts that do not require an offset

10.3.1 Impacts on native vegetation

According to Section 9.4.1.1 of the FBA, the assessor is not required to determine an offset for the impacts of development on PCTs that are:

- a) in a vegetation zone with a site value score of < 17 , and the PCT has not been identified as a CEEC or EEC
- b) not associated with threatened species habitat according to Section 6.4 of the FBA, and are not identified as a CEEC or EEC.

The expected impacts to PCTs are not expected to require an offset as they are not considered to be associated with threatened species habitat (i.e. habitat for species credit species – see Section 5.4 of this report) and are not identified as a CEEC or EEC (see Figure 10.2 for areas not requiring an offset).

10.3.2 Impacts on species and populations

According to Section 9.4.2.1 of the FBA, the assessor is not required to determine an offset for the impacts of development on species, populations and species habitat that are:

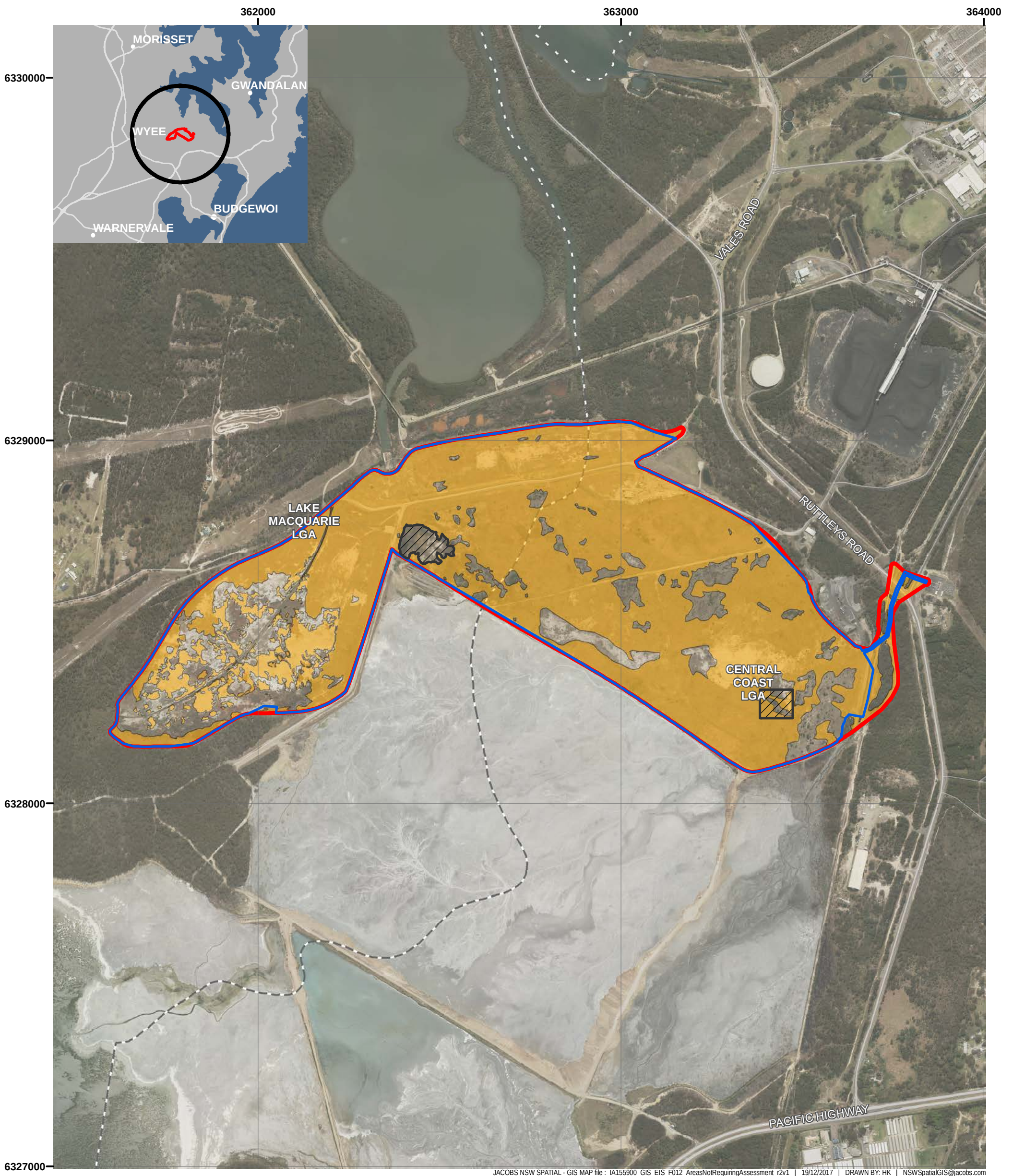
- a) threatened species habitat associated with a PCT within a vegetation zone that has a site value score of < 17 , or
- b) species or populations that are not threatened and do not form part of a CEEC or EEC.

There are expected to be no impacts to species and populations as outlined in Section 5.4 of this report. As such, an offset for species and populations is not required.

10.4 Areas that do not require further assessment

Under the FBA, an assessor is not required to assess areas of land on the development site without native vegetation under Chapter 4 or Chapter 5, unless the SEARs issued for the project require an assessment of the land in accordance with those chapters. The SEARs do not require the assessment of land on the development site without native vegetation so these areas have not been assessed (see Figure 10.1).

Areas of land that do not contain native vegetation must still be assessed for threatened species, in accordance with Chapter 6 of the FBA. The areas of land that do not contain native vegetation within the study area have been assessed for threatened species, even if they do not contain native vegetation. An example of this is the habitat provided by mud flats on Pond 2.



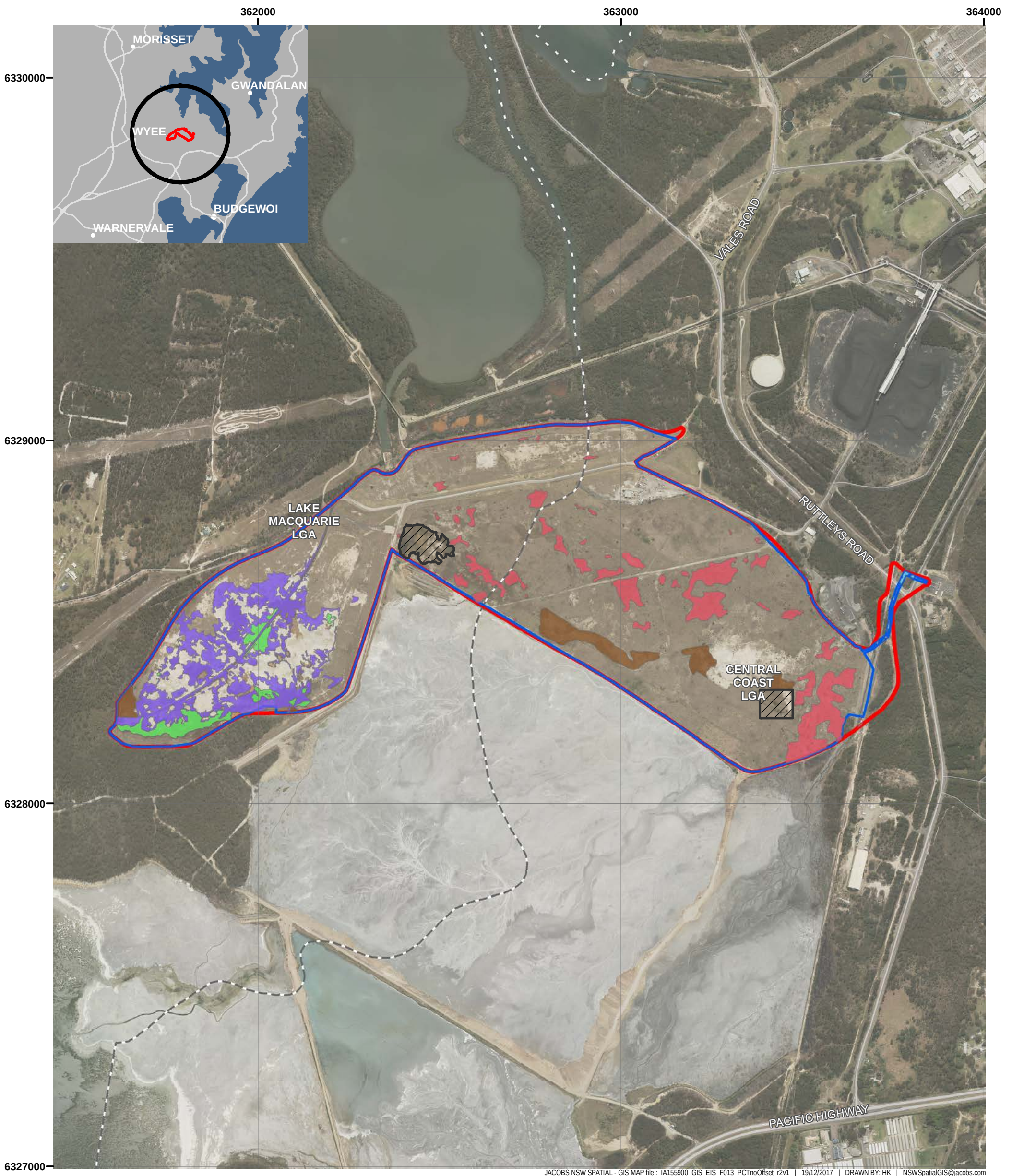
Legend

- Study area
- Development footprint
- Exclusion zone
- LGA boundary
- Areas not requiring assessment

0 200 400m 1:10,000

A3





Legend

- Study area
- Development footprint
- Exclusion zone
- LGA boundary

PCT not requiring offset

- Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion Moderate/Good_Poor
- Saltmarsh Estuarine Complex Moderate/Good
- Saltmarsh Estuarine Complex Moderate/Good_Poor

- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Low
- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Moderate/Good
- Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast Moderate/Good_Poor

0 200 400m 1:10,000

A3



Figure 10.2 : Plant community types and species polygons not requiring offset
Vales Point BAR

11. Biodiversity offsets

The following section provides relevant information relating to biodiversity offset requirements of the project. These considerations are provided in the context of Section 9 of the FBA, the identified existing environmental conditions of the project site and the desired outcomes of the proponent.

11.1 Ecosystem credits

Section 9.4.1.1 (b) of the FBA indicates that biodiversity offsets for the impacts of development are not required if the Plant Community Types (PCTs) being impacted are:

- (a) Represented in a vegetation zone with a site value score of <17, and the PCT as not been identified as a CEEC or EEC.
- (b) Not associated with threatened species habitat according to Section 6.4 of the FBA, and are not identified as a CEEC or EEC.

The investigations for the BAR confirm that none of the PCTs identified in the study area are associated with a Critically Endangered Ecological Community (CEEC) or Endangered Ecological Community (EEC).

Three PCTs have been identified representing six vegetation zones. Ecosystem credits were not generated for Zones 1,2 and 3 on the basis of low site values scores (<17) and / or negligible impacts on threatened species. Ecosystem credits were however generated for the Saltmarsh PCT (i.e. Zone 4 and Zone 5) and for the artificial freshwater wetlands PCT (Zone 6). These credits are shown in Table 11.1. While, there are two predicted ecosystem species that are associated with these habitats (i.e. Eastern Freetail-Bat and Greater Broad-nosed Bat), the BBCC has not identified these species as a threatened species multiplier).

Table 11.1: Summary of PCT status, impacts and offset appraisal

Plant Community Type	Area (ha)	CEEC / EEC (TSC Act or EPBC Act)	Threatened species habitat (in accordance with s.6.4)	Habitat for predicted species	BBCC credit created
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	6.55	No	No	Yes	0
Saltmarsh Estuarine Complex	9.90	No	No	Yes	173
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	42.96	No	No	Yes	43

11.2 Species credits

The BBCC identified a number of species credit species for consideration, these were subject to detailed habitat assessment and targeted survey. All surveys adequately met the set survey times and survey guidelines. The outcome was that no species credit species were found to occur in the study area or are considered likely to occur (see Section 5.4 of this report). Accordingly, species offsets are not required.

11.3 Biodiversity offset strategy

A biodiversity offset strategy in accordance with Stage 3 of the FBA is not proposed. This is due to the purposeful siting of the project on artificial ash dams, that have been approved and utilised for capping and the avoidance of higher quality habitats including artificial wetlands. To offset the impact of the project the proponent is proposing on site compensation and protection of habitat in situ.

As compensation for the loss of the small artificial freshwater wetland depressions, the proponent is proposing to develop a drainage channel across the ash dam to facilitate surface water runoff. The drainage structure

would be planted with low aquatic plants and would provide shelter, refuge and breeding habitat for amphibians and birds found to occur at the site and would be of comparable size to the wetland PCT impact.

The impacts to vegetation zones presented is based on a worst case scenario, and a detailed design has not been prepared or assessed. The actual disturbance to the saltmarsh PCT will be less due to the fact that the linear drain across the ash pond will remain to facilitate drainage of surface water. This drain comprises a portion of the saltmarsh vegetation that would remain in situ and continue to provide biodiversity value and the area of impact would be further reduced.

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Appendix A. Field data sheets

Vales Pt

Plot 8 X

Survey Site Form - BioBanking				Site ID:	Vegetation zone:			
Date				Surveyor(s):				
Waypoint ID				Photo numbers				
Coordinates		E	N	Photo direction		N	E	S
Mapped Vegetation type:				Condition:		Low		Mod-good
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):			Altitude:			
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace								
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?								
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill				
Remnant / Old growth (uncleared): Yes / No / Undecided?								
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =				
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance				
E	-							
T1	-							
T2	-							
T3	-							
S1	-							
S2	-							
G	-							
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest								
50m Transect		10 Points - Foliage Projective Cover		Ground cover tally sheet, 50 points along 50m transect				
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point				
5m	0	0	0	Native grass tally -				Total (hits/50)
10m				6				0
15m				Native other (herb, fern, sedge, etc) tally -				Total (hits/50)
20m				1, 1, 1				6
25m				Native shrub tally -				Total (hits/50)
30m				0				0
35m				Exotic tally -				Total (hits/50)
40m				5, 5, 5, 5, 5, 5, 5				80
45m								
50m								
Total (sum / 10) =								
Larger 50 x 20m plot								
Length of woody debris >10cm wide & >0.5m long		2						0
Proportion of canopy sp. regeneration		No regen						
Number of trees with hollows >5cm		1						

Vales Pt

Plot 8 X

Site ID:			Survey type: Quadrat 20m x 20m					
Species	Cover	Abund.	Species	Cover	Abund.			
1 <i>Canarina glauca</i>	5	1	41					
2 <i>Angophora costata</i>	2	1	42					
3 <i>Leucadendron longifolium</i>	5	6	43					
4 <i>Corleodora seloana</i>	1	1	44					
5 <i>Paspalum dilatatum</i>	7	100	45					
6 <i>Stylotegium secundum</i>	10	100	46					
7 <i>Juncus</i> hollow with sept	1	10	47					
8 <i>Hydrocotyle bonariensis</i>	4	10	48					
9 <i>Juncus</i> sp# (weed?)	2	100	49					
10 <i>Andropogon virginicus</i>			50					
11 <i>Rumex crispus</i>			51					
12 <i>Cyperus compositus</i>			52					
13 <i>Cotus villosus</i>			53					
14 <i>Aster</i> sp.			54					
15 <i>Fimbristylis dichotoma</i>			55					
16 <i>Vicia sativa</i>			56					
17 <i>Arche floribunda</i>			57					
18 <i>Plantago lanceolata</i>			58					
19 <i>Centaurea asiatica</i>			59					
20 <i>Veronica bonariensis</i>			60					
21 <i>Kikuyu</i>			61					
22			62					
23			63					
24			64					
25			65					
26			66					
27			67					
28			68					
29			69					
30			70					
31			71					
32			72					
33			73					
34			74					
35			75					
36			76					
37			77					
38			78					
39			79					
40			80					
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
Tree	6		Native perennial grass					
Shrub			Native other grass					
Grass (annual)			Native forb & other					
Grass (perennial)			Native shrub (<1m)					
Other (annual)			Exotic grass					
Other (perennial)			Exotic forb & other					
Cover abundance scale Modified Braun-blauquet 6 scale 1 <5% - rare 2 <5% - common 3 5 - 25% 4 25 - 50% 5 50 - 75% 6 75 - 100%			Leaf & stick litter					
			Rocks					
			Bare ground					
			Cryptogams					
			Total	100	100	100	100	100
			Plot Disturbance	Fire damage:				
			Clearing (inc. logging):	Storm damage:				
			Cultivation (inc. pasture):	Trampling:				
			Soil erosion:	Flood damage:				
			Firewood collection:	Feral herbivores:				
			Stock grazing:	Other:				

Survey Site Form - BioBanking				Site ID:		Vegetation zone:							
Date				Surveyor(s):									
Waypoint ID				Photo numbers									
Coordinates		E N		Photo direction		N		E		S		W	
Mapped Vegetation type:				Condition:		Low		Mod-good					
Slope: Gentle, Mod, Steep				Aspect (degrees or cardinal):		Altitude:							
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace													
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?													
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill									
Remnant / Old growth (uncleared): Yes / No / Undecided?													
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =									
Strata		Height interval		Median		Est. cover		Dominant Species & Dominance					
E		-											
T1		-											
T2		-											
T3		-											
S1		-											
S2		-											
G		-											
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%)													
Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest													
50m Transect		10 Points - Foliage Projective Cover				Ground cover tally sheet, 50 points along 50m transect							
Point		Canopy % (photos)		Midstorey %		Exotic %		- every 1m record if plant intersects (hits) point					
5m		0		20				Native grass tally -					
10m								25					
15m													
20m													
25m													
30m								Native other (herb, fern, sedge, etc) tally -					
35m								15					
40m													
45m													
50m													
Total (sum / 10) =		0		2		0		Native shrub tally -					
Larger 50 x 20m plot										Total (hits/50)			
Length of woody debris >10cm wide & >0.5m long						0				0			
Proportion of canopy sp. regeneration						0 0				Exotic tally -			
Number of trees with hollows >5cm										Total (hits/50)			
										2			

Vales Freshwater
Wetland

Crunia signata

Yabby Claws

Site ID:			Survey type: Quadrat 20m x 20m						
Species			Cover	Abund.	Species			Cover	Abund.
1	<i>Melaleuca</i>		15	100ish	41				
2	<i>Cynodon dactylon</i>		1	10	42				
3	<i>Isotria medeolae</i>		5	400+	43				
4	<i>Eleusine galloides</i>		5	400+	44				
5	<i>Lyttrus hyssopifolia</i>		2	50	45				
6	<i>Cyperus sp. (diffinis?)</i>		2	100+	46				
7	<i>Bolboschoenus coddinii</i>		15	50	47				
8	<i>Paspalum distichum</i>		15	100+	48				
9	<i>Cenchrus ciliaris</i>		7	30	49				
10	<i>Hydrocotyle bonariensis</i>		6.4	1	50				
11	<i>Stenotaphrum secundatum</i>		0.4	1	51				
12	<i>Gnaphalium polyanthum</i>		0.4	5	52				
13	<i>Typha orientalis</i>		30		53				
14					54				
15					55				
16					56				
17					57				
18					58				
19					59				
20					60				
21					61				
22					62				
23					63				
24					64				
25					65				
26					66				
27					67				
28					68				
29					69				
30					70				
31					71				
32					72				
33					73				
34					74				
35					75				
36					76				
37					77				
38					78				
39					79				
40					80				
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots		Q1	Q2	Q3	Q4	Q5
Tree			Native perennial grass						
Shrub			Native other grass						
Grass (annual)			Native forb & other						
Grass (perennial)			Native shrub (<1m)						
Other (annual)			Exotic grass						
Other (perennial)			Exotic forb & other						
Cover abundance scale Modified Braun-blauquet 6 scale			Leaf & stick litter						
			Rocks						
			Bare ground						
			Cryptogams						
			Total		100	100	100	100	100
1			<5% - rare		Plot Disturbance			Fire damage:	
2			<5% - common		Clearing (inc. logging):			Storm damage:	
3			5 - 25%		Cultivation (inc. pasture):			Trampling:	
4			25 - 50%		Soil erosion:			Flood damage:	
5			50 - 75%		Firewood collection:			Feral herbivores:	
6			75 - 100%		Stock grazing:			Other:	

Scribbly Gum 1

Survey Site Form - BioBanking				Site ID: Plot 2	Vegetation zone: regrowth			
Date	11/7/2017			Surveyor(s):	LC & PR			
Waypoint ID	Plot 2			Photo numbers				
Coordinates	E	363717		Photo direction	N	E	S	W
	N	6328493						
Mapped Vegetation type:				Condition:	Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace								
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?								
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill				
Remnant / Old growth (uncleared): Yes / No / Undecided?								
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =				
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance				
E								
T1								
T2								
T3								
S1								
S2								
G								
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest								
50m Transect				Ground cover tally sheet, 50 points along 50m transect				
10 Points - Foliage Projective Cover				- every 1m record if plant intersects (hits) point				
Point	Canopy % (photos)	Midstorey %	Exotic %					Total (hits/50)
5m	1	20		Native grass tally -				26
10m	0	60						
15m	0	50						
20m	0	30						
25m	0	30						
30m	0	40		Native other (herb, fern, sedge, etc) tally -				Total (hits/50)
35m	0	25						10
40m	20	10						
45m	40	30						
50m	10	15						
Total (sum / 10) =	10.1	31	0	Native shrub tally -				Total (hits/50)
Larger 50 x 20m plot								6
Length of woody debris >10cm wide & >0.5m long				6				
Proportion of canopy sp. regeneration				1				10
Number of trees with hollows >5cm				0				
Exotic tally -								Total (hits/50)

Vale Point

Site ID: Plot 2		Survey type: Quadrat 20m x 20m			
Species	Cover	Abund.	Species	Cover	Abund.
1 Pinus radiata	5	3	41 Lumnice gracilis	0.4	1
2 Allocasuarina uluhalis	35	20+	42 Austrotype pithoscur	0.4	1
3 Ptilinota reborta	5	20+	43		
4 Pultanea palacea	0.4	1	44		
5 Dodonaea frigitata	0.4	1	45		
6 Kunzea ambigua	10	20+	46		
7 Acacia suaveolens	0.4	1	47		
8 Comptosia pinnatifida	0.4	1	48		
9 Acacia terminalis	1	4	49		
10 Leonardia laurifolia	1	10	50		
11 Mirabilis rubicunda	0.4	2	51		
12 Daviesia uluhalis	1	5	52		
13 Eragrostis pulchella	1	10	53		
14 Gonolobium minus	0.4	2	54		
15 Acacia myrtifolia	0.4	1	55		
16 Bonatea heterophylla	0.4	1	56		
17 Persoonia laevis	1	4	57		
18 Conospermum ericifolium	0.4	2	58		
19 Acacia suaveolens	0.4	1	59		
20 Comptosia latifolia	1	3	60		
21 Pinus uluhalis	0.4	1	61		
22 Canochloa sp.	0.4	1	62		
23 Stylidium gracile	1	1	63		
24 Opercularia diphylla	1	20+	64		
25 Leonardia obliqua	5	20+	65		
26 Andropogon virginicus	5	20+	66		
27 Phacelia australis	5	20+	67		
28 Dianella revoluta	5	20+	68		
29 Conospermum tetragynum	5	20+	69		
30 Centaurea eratostea	1	10	70		
31 Hovea linearis	1	1	71		
32 Schizaea lufide	2	20+	72		
33 Eutolara marginata	3	20+	73		
34 Eutolara stricta	3	20+	74		
35 Cyathochaete	0.4	1	75		
36 Billardiera scandens	1	2	76		
37 Opercularia aspera	1	2	77		
38 Hardenbergia violacea	1	2	78		
39 Eragrostis blanda	1	1	79		
40 Conospermum laevis	1	1	80		

Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
Tree			Native perennial grass					
Shrub			Native other grass					
Grass (annual)			Native forb & other					
Grass (perennial)			Native shrub (<1m)					
Other (annual)			Exotic grass					
Other (perennial)			Exotic forb & other					
Cover abundance scale Modified Braun-blauquet 6 scale 1 <5% - rare 2 <5% - common 3 5 - 25% 4 25 - 50% 5 50 - 75% 6 75 - 100%			Leaf & stick litter					
			Rocks					
			Bare ground					
			Cryptogams					
			Total	100	100	100	100	100
			Plot Disturbance					
			Clearing (inc. logging):					
			Cultivation (inc. pasture):					
			Soil erosion:					
			Firewood collection:					
			Stock grazing:					
			Fire damage:					
			Storm damage:					
			Trampling:					
			Flood damage:					
			Feral herbivores:					
			Other:					

Voles Point

Survey Site Form - BioBanking				Site ID: Plot 1		Vegetation zone: costata / stringybale	
Date	11/7/2017			Surveyor(s): LC & PR			
Waypoint ID	Plot 1			Photo numbers			
Coordinates	E	363731		Photo direction	N	E	S
	N	6328380					W
Mapped Vegetation type:				Condition:		Low	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:			
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace							
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?							
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill			
Remnant / Old growth (uncleared): Yes / No / Undecided?							
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =			
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance			
E							
T1	10-2m	10m	30%	A. costata C. capitellata C. guineensis Allocas littoralis			
T2							
T3							
S1				Allocas littoralis Banksia sp. Lecanostictis			
S2							
G				Allocas littoralis Xanthorrhoea Cephaelis			
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest							
50m Transect				Ground cover tally sheet, 50 points along 50m transect			
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point			
5m	30	10	0	Native grass tally - III			
10m	10	0	0				
15m	30	10	0				
20m	20	20	0				
25m	40	10	0				
30m	45	0	0	Native other (herb, fern, sedge, etc) tally - III			
35m	50	20	0	III III III III			
40m	40	0	0	III III III I			
45m	50	20	0				
50m	40	10	0				
Total (sum / 10) =	35.5	10	0	Native shrub tally -			
Larger 50 x 20m plot				Total (hits/50)			
Length of woody debris >10cm wide & >0.5m long			55m	0			
Proportion of canopy sp. regeneration			100%	Exotic tally -			
Number of trees with hollows >5cm			3	Total (hits/50)			
				0			

Voles Point

Site ID: Plot 1			Survey type: Quadrat 20m x 20m					
Species	Cover	Abund.	Species	Cover	Abund.			
1 <i>Corchorus quinquefolius</i>	10	4	41 <i>Eragrostis leucomelaena</i>	1	1			
2 <i>E. hirsutissima</i>	1	2	42 <i>Phytolacca americana</i>	1	2			
3 <i>E. capitellata</i>	5	2	43 <i>Pinella mitis</i>	1	1			
4 <i>Banksia oblongifolia</i>	5	2	44 <i>Pultenaea pallescens</i>	1	1			
5 <i>Lambertia canescens</i>	5	4	45 <i>Thamnosia hirsuta</i>	1	1			
6 <i>Acacia senilis</i>	5	5	46 <i>Dampiera stricta</i>	1	1			
7 <i>Petrophile pulchella</i>	1	1	47					
8 <i>Banksia integrifolia</i>	1	2	48					
9 <i>Hakea dactyloides</i>	5	3	49					
10 <i>Epacris pulchella</i>	1	5	50					
11 <i>Leptospermum laurum</i>	1	3	51					
12 <i>Allocasuarina littoralis</i>	30%	14	52					
13 <i>Personia laevis</i>	1	2	53					
14 <i>Acacia laevis</i>	1	1	54					
15 <i>Banksia repens</i>	1	5	55					
16 <i>Cassipouera pauciflora</i>	5	10+	56					
17 <i>Hibbertia pedunculata</i>	1	1	57					
18 <i>Xanthorrhoea laevis</i>	5	20+	58					
19 <i>Lepidodermis scariosa</i>	5	20+	59					
20 <i>Cyathochaeta diandra</i>	20%	20+	60					
21 <i>Entolasia stricta</i>	20%	20+	61					
22 <i>Podium</i>	5%	20+	62					
23 <i>Brassia subulata</i>	1	1	63					
24 <i>Conocarpus tetragynus</i>	1	1	64					
25 <i>Cryptanthus subulata</i>	1	20+	65					
26 <i>Pseudanthus subulata</i>	1	2	66					
27 <i>Leptospermum polygalifolium</i>	5	10	67					
28 <i>Banksia stricta</i>	1	1	68					
29 <i>Personia laevis</i>	1	2	69					
30 <i>Personia glabra</i>	1	1	70					
31 <i>Metaleuca sieberi</i>	1	1	71					
32 <i>Lamandra sp.</i>	1	2	72					
33 <i>Lopanthus menziesii</i>	1	1	73					
34 <i>Phytolacca americana</i>	1	1	74					
35 <i>Heliotropium</i>	1	20+	75					
36 <i>Lamandra alba</i>	1	20+	76					
37 <i>Conyza laevis</i>	1	1	77					
38 <i>Griffithsia stricta</i>	1	1	78					
39 <i>Acacia ulicifolia</i>	1	1	79					
40 <i>Lamandra sp. th...</i>	1	1	80					
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
Tree			Native perennial grass					
Shrub			Native other grass					
Grass (annual)			Native forb & other					
Grass (perennial)			Native shrub (<1m)					
Other (annual)			Exotic grass					
Other (perennial)			Exotic forb & other					
Cover abundance scale Modified Braun-blauquet 6 scale			Leaf & stick litter					
			Rocks					
			Bare ground					
			Cryptogams					
			Total	100	100	100	100	100
1 <5% - rare 2 <5% - common 3 5 - 25% 4 25 - 50% 5 50 - 75% 6 75 - 100%			Plot Disturbance	Fire damage:				
			Clearing (inc. logging):	Storm damage:				
			Cultivation (inc. pasture):	Trampling:				
			Soil erosion:	Flood damage:				
			Firewood collection:	Feral herbivores:				
			Stock grazing:	Other:				

Survey Site Form - BBAM / BAM				Site ID: <i>Plot 5</i>		Vegetation zone: <i>Saltmarsh</i>	
Date: <i>14/7/2017</i>		Surveyor(s): <i>LC & PR</i>					
Waypoint ID: <i>Plot 5</i>		Photo numbers					
Coordinates: E N		Photo direction		N	E	S	W
Mapped Vegetation type:				Condition:		Low	Mod-good
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:			
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace							
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?							
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill			
Remnant / Old growth (uncleared): Yes / No / Undecided?							
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =			
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance			
E							
T1				<i>none</i>			
T2							
T3							
S1				<i>none</i>			
S2							
G			<i>80%</i>	<i>Tenax Frawsie S. albus Triglochin Sarcocolla</i>			
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest							
50m Transect		10 Points - Foliage Projective Cover		Ground cover tally sheet, 50 points along 50m transect			
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point			
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally -			
10m	<i>↓</i>	<i>↓</i>	<i>↓</i>	<i>none</i>			
15m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
20m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
25m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
30m	<i>↓</i>	<i>↓</i>	<i>↓</i>	Native other (herb, fern, sedge, etc) tally -			
35m	<i>↓</i>	<i>↓</i>	<i>↓</i>	<i> </i>			
40m	<i>↓</i>	<i>↓</i>	<i>↓</i>	<i> 1</i>			
45m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
50m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
Total (sum / 10) =	<i>none</i>	<i>none</i>	<i>none</i>	Native shrub tally -			
Larger 50 x 20m plot				Total (hits/50)			
Length of woody debris >10cm wide & >0.5m long			<i>0m</i>	<i>none</i>			
Proportion of canopy sp. regeneration			<i>0%</i>	Exotic tally -			
Number of trees with hollows >5cm (live or dead)			<i>0</i>	<i> </i>			
				Total (hits/50)			
				<i>18%</i>			

Site ID: Plot 5			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Stenopus kraussii</i>	40	100+	41						
2 <i>Tinurus notatus</i>	10	30	42						
3 <i>Triglochin striatum</i>	20	100+	43						
4 <i>Syntherisma</i>	5	30	44						
5			45						
6			46						
7			47						
8			48						
9			49						
10			50						
11			51						
12			52						
13			53						
14			54						
15			55						
16			56						
17			57						
18			58						
19			59						
20			60						
21			61						
22			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
			Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
			Native shrub (<1m)						
			Exotic grass						
			Exotic forb & other						
			Leaf & stick litter						
			Rocks						
			Bare ground						
			Cryptogams						
			Total	100	100	100	100	100	
						Plot Disturbance			Fire damage:
30 - 49cm:			Clearing (inc. logging):			Storm damage:			
50 - 79cm:			Cultivation (inc. pasture):			Trampling:			
80+cm:			Soil erosion:			Flood damage:			
			Firewood collection:			Feral herbivores:			
			Stock grazing:			Other:			

Saltmarsh

Survey Site Form - BBAM / BAM				Site ID: Plot 4	Vegetation zone: Saltmarsh			
Date	11/7/2017			Surveyor(s):	LC x RR			
Waypoint ID	Plot 4			Photo numbers				
Coordinates	E			Photo direction	N	E	S	W
Mapped Vegetation type:				Condition:	Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace								
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?								
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill				
Remnant / Old growth (uncleared):				Yes / No / Undecided?				
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =				
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance				
E								
T1				none				
T2								
T3								
S1				none				
S2								
G			40%	Sarcocornia Triglochin Juncus kraussii Juncus sp.				
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest								
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect				
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point				
5m	0	0	0	Native grass tally -				Total (hits/50)
10m	↓	↓	↓	none				0
15m								
20m								
25m								
30m				Native other (herb, fern, sedge, etc) tally -				Total (hits/50)
35m								42%
40m	↓	↓	↓					
45m								
50m								
Total (sum / 10) =	none	none	none	Native shrub tally -				Total (hits/50)
Larger 50 x 20m plot				none				0
Length of woody debris >10cm wide & >0.5m long	0m							
Proportion of canopy sp. regeneration	0%			Exotic tally -				Total (hits/50)
Number of trees with hollows >5cm (live or dead)	0			none				0

Saltmarsh

Site ID: Plot 4			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Sarcocolla</i>	35	200+	41						
2 <i>Trinacra Kraussii</i>	0.1	1	42						
3 <i>Chloris gayana</i>	0.3	10	43						
4 <i>Triglochin striata</i>	5	200+	44						
5 <i>Cyperus congestus</i>	0.1	1	45						
6 <i>Centropus affinis</i>	0.1	3	46						
7 <i>Trinacra affinis</i>	0.1	1	47						
8 <i>Eclipta, dasydosa</i>	0.1	2	48						
9 <i>Hydrocotyle malabarica</i>	0.1	2	49						
10 <i>Trinacra sp.</i>	0.3	100+	50						
11			51						
12			52						
13			53						
14			54						
15			55						
16			56						
17			57						
18			58						
19			59						
20			60						
21			61						
22			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
5			Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
<5cm:			Native shrub (<1m)						
5 - 9cm:			Exotic grass						
10 - 19cm:			Exotic forb & other						
20 - 29cm:			Leaf & stick litter						
30 - 49cm:			Rocks						
50 - 79cm:			Bare ground						
80+cm:			Cryptogams						
			Total	100	100	100	100	100	
			Plot Disturbance	Fire damage:					
			Clearing (inc. logging):	Storm damage:					
			Cultivation (inc. pasture):	Trampling:					
			Soil erosion:	Flood damage:					
			Firewood collection:	Feral herbivores:					
			Stock grazing:	Other:					

Survey Site Form - BBAM / BAM				Site ID: Plot 3		Vegetation zone: Sathorn	
Date		11/2/2017		Surveyor(s): LC & PR			
Waypoint ID		Plot 3		Photo numbers			
Coordinates		E N		Photo direction		N E S W	
Mapped Vegetation type:				Condition:		Low Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:			
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace							
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?							
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill			
Remnant / Old growth (uncleared): Yes / No / Undecided?							
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =			
Strata		Height interval		Median		Est. cover	
E		-					
T1		-				none	
T2		-					
T3		-					
S1		-				none	
S2		-					
G		-		80%		Sarcocolla Lycium hyssagifolia Tucay aculeata Triglochin	
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%)							
Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%)							
Definitions							
Dominance d = dominant; c = co-dominant; s = subdominant; a = associated							
Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%)							
Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall							
W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest							
50m Transect		10 Points - Foliage Projective Cover		Ground cover tally sheet, 50 points along 50m transect			
Point		Canopy % (photos)		Midstorey %		Exotic %	
5m		0		0		0	
10m		↓		↓		↓	
15m		↓		↓		↓	
20m		↓		↓		↓	
25m		↓		↓		↓	
30m		↓		↓		↓	
35m		↓		↓		↓	
40m		↓		↓		↓	
45m		↓		↓		↓	
50m		↓		↓		↓	
Total (sum / 10) =		none		none		none	
Larger 50 x 20m plot				Ground cover tally sheet, 50 points along 50m transect			
Length of woody debris >10cm wide & >0.5m long				0m			
Proportion of canopy sp. regeneration				0%			
Number of trees with hollows >5cm (live or dead)				none			
				Exotic tally - 1			
				Total (hits/50) 2%			

Salt marsh

Site ID: Plot 3			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Juncus acutus</i>	10	20+	41						
2 <i>Juncus kraussii</i>	40	300+	42						
3 <i>Sarcocornia</i>	20	400+	43						
4 <i>Triplachia striatum</i>	5	800+	44						
5 <i>Cynodon dactylon</i>	0.1	1	45						
6 <i>Cyperus vaginatus</i>	0.1	1	46						
7 <i>Lachnagrostis</i>	0.1	1	47						
8 <i>Colula coronopifolia</i>	0.3	20+	48						
9 <i>Juncus</i> sp.	0.1	1	49						
10 <i>Lythrum hyssopifolia</i>	0.3	20+	50						
11			51						
12			52						
13			53						
14			54						
15			55						
16			56						
17			57						
18			58						
19			59						
20			60						
21			61						
22			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
7			Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
			Native shrub (<1m)						
			Exotic grass						
			Exotic forb & other						
			Leaf & stick litter						
			Rocks						
			Bare ground						
			Cryptogams						
			20 - 29cm:	Total	100	100	100	100	100
			30 - 49cm:	Plot Disturbance	Fire damage:				
50 - 79cm:	Clearing (inc. logging):	Storm damage:							
	Cultivation (inc. pasture):	Trampling:							
80+cm:	Soil erosion:	Flood damage:							
	Firewood collection:	Feral herbivores:							
	Stock grazing:	Other:							

Survey Site Form - BBAM / BAM				Site ID: Salt Marsh	Vegetation zone: Salt Marsh
Date	12/10/2017			Surveyor(s): LUKAS	Ueue
Waypoint ID	1411			Photo numbers	
Coordinates	E 0361867	N 6328225	Photo direction	N	E S W
Mapped Vegetation type: nothing				Condition:	Low ← Mod-good
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal): SE		Altitude: 23m	
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace					
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ? Ash dam					
Soil type: sand, loam, clay, organic, gravel, skeletal, ? muddy				Soil disturbance: intact, topsoil removed, fill	
Remnant / Old growth (uncleared): Yes / No / Undecided?					
Vegetative Structure (formation) = saltmarsh				Ecologically Dominant Layer (EDL) - most biomass = around	
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance	
E					
T1				nothing	
T2					
T3					
S1				nothing	
S2					
G			60%	Juncus acutus (dominant) S. Kraussii (o) sarcocornia, Triglochin	
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest					
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect	
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point	
5m	0	0	0	Native grass tally -	
10m				none	
15m				Total (hits/50)	
20m				0%	
25m				Native other (herb, fern, sedge, etc) tally -	
30m					
35m				Total (hits/50)	
40m				8%	
45m				Native shrub tally -	
50m				Total (hits/50)	
Total (sum / 10) =	no canopy	no mid	none	none	
Larger 50 x 20m plot				Total (hits/50)	
Length of woody debris >10cm wide & >0.5m long			0	0%	
Proportion of canopy sp. regeneration			0	Exotic tally -	
Number of trees with hollows >5cm (live or dead)			0		
				Total (hits/50)	
				54%	

bare ground - ||||| ||| - 26%

Litter - ||||| ||||| | - 22%

Site ID: <i>Acutus</i>			Survey type: Quadrat 20m x 20m, 10m x 40m, etc					
Species	Cover	Abund.	Species	Cover	Abund.			
1 <i>Juncus acutus</i>	70%	20+	41					
2 <i>Triplaris striatum</i>	10%	20+	42					
3 <i>Sporobolus</i>	5%	20+	43					
4 <i>Juncus kraussii</i>	0.1	1	44					
5 <i>Spergularia maritima</i>	0.1	1	45					
6 <i>Atriplex prostrata</i>	0.1	2	46					
7			47					
8			48					
9			49					
10 Very low sp. richness			50					
11 <i>Acutus laevigatus</i>			51					
12			52					
13			53					
14			54					
15			55					
16			56					
17			57					
18			58					
19			59					
20			60					
21			61					
22			62					
23			63					
24			64					
25			65					
26			66					
27			67					
28			68					
29			69					
30			70					
31			71					
32			72					
33			73					
34			74					
35			75					
36			76					
37			77					
38			78					
39			79					
40			80					
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
	4		Native perennial grass					
			Native other grass					
Tree size class assessment tally:			Native forb & other					
<5cm:			Native shrub (<1m)					
5 - 9cm:			Exotic grass					
10 - 19cm:			Exotic forb & other					
20 - 29cm:			Leaf & stick litter					
30 - 49cm:			Rocks					
50 - 79cm:			Bare ground					
80+cm:			Cryptogams					
			Total	100	100	100	100	100
			Plot Disturbance	Fire damage:				
			Clearing (inc. logging):	Storm damage:				
			Cultivation (inc. pasture):	Trampling:				
			Soil erosion:	Flood damage:				
			Firewood collection:	Feral herbivores:				
			Stock grazing:	Other:				

Survey Site Form - BBAM / BAM				Site ID: <i>saltmarsh</i>	Vegetation zone: <i>grass</i>
Date	<i>12/10/2017</i>			Surveyor(s): <i>LC</i>	
Waypoint ID	<i>1590</i>			Photo numbers	
Coordinates	E	<i>0367002</i>		Photo direction	N E S W
	N	<i>6329437</i>			
Mapped Vegetation type: <i>none</i>				Condition:	Low Mod-good
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:	
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace					
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?					
Soil type: sand, loam, clay, organic, gravel, skeletal, ?			Soil disturbance: intact, topsoil removed, fill		
Remnant / Old growth (uncleared): Yes / No / Undecided?					
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =	
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance	
E					
T1				<i>none</i>	
T2				<i>^</i>	
T3					
S1				<i>none</i>	
S2					
G				<i>chlois grasses Andropogon Medicago Hydrocotyle Centaurium cynosuroides</i>	
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest					
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect	
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point	
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally -	Total (hits/50)
10m	<i>1</i>	<i>1</i>	<i>1</i>		<i>0/</i>
15m	<i>1</i>	<i>1</i>	<i>1</i>		
20m	<i>1</i>	<i>1</i>	<i>1</i>		
25m	<i>1</i>	<i>1</i>	<i>1</i>		
30m	<i>1</i>	<i>1</i>	<i>1</i>	Native other (herb, fern, sedge, etc) tally -	Total (hits/50)
35m	<i>1</i>	<i>1</i>	<i>1</i>		<i>0/</i>
40m	<i>1</i>	<i>1</i>	<i>1</i>		
45m	<i>1</i>	<i>1</i>	<i>1</i>		
50m	<i>1</i>	<i>1</i>	<i>1</i>	Native shrub tally -	Total (hits/50)
Total (sum / 10) =	<i>10</i>	<i>10</i>	<i>10</i>		<i>0/</i>
Larger 50 x 20m plot					
Length of woody debris >10cm wide & >0.5m long			<i>0</i>		
Proportion of canopy sp. regeneration			<i>0</i>	Exotic tally -	Total (hits/50)
Number of trees with hollows >5cm (live or dead)			<i>0</i>	<i>### ### ### ### ### ### ### ### ### ###</i>	<i>92/</i>

Site ID:			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1. <i>Chenopodium</i>	20%	20+	41						
2. <i>Medicago</i>	2	20+	42						
3. <i>Leucanthemum</i>	0.3	20+	43						
4. Fireweed	0.1	1	44						
5. <i>Andropogon</i>	20%	20+	45						
6. <i>Plantago lanceolata</i>	5	20+	46						
7. <i>Rumex</i>	0.3	20+	47						
8. <i>Hypochaeris</i>	5	20+	48						
9. <i>Cirsium</i>	10	20+	49						
10. <i>Briza media</i>	0.3	20+	50						
11. <i>Verbena</i>	0.1	1	51						
12. <i>Centella asiatica</i>	0.1	20+	52						
13. <i>Briza subaristata</i>	2	20+	53						
14. <i>Hydrocotyle</i>	2	20+	54						
15. Pine tree	0.1	1	55						
16. <i>Tinacrus acutus</i>	0.1	1	56						
17. <i>Spergularia</i> weed	0.1	1	57						
18. <i>Sporobolus</i>	0.2	20+	58						
19. <i>Centocaria</i>	0.1	10	59						
20. <i>Phalaris</i> sp.	0.1	20+	60						
21. <i>Stenotaphrum secundatum</i>	0.1	1	61						
22. <i>Trifolium repens</i>	0.1	1	62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
	4		Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
			Native shrub (<1m)						
<5cm:			Exotic grass						
5 - 9cm:			Exotic forb & other						
			Leaf & stick litter						
10 - 19cm:			Rocks						
			Bare ground						
20 - 29cm:			Cryptogams						
			Total	100	100	100	100	100	
30 - 49cm:			Plot Disturbance	Fire damage:					
			Clearing (inc. logging):	Storm damage:					
50 - 79cm:			Cultivation (inc. pasture):	Trampling:					
			Soil erosion:	Flood damage:					
80+cm:			Firewood collection:	Feral herbivores:					
			Stock grazing:	Other:					

Survey Site Form - BBAM / BAM				Site ID: <u>cleared 1</u>	Vegetation zone:			
Date	<u>12/16/2017</u>			Surveyor(s): <u>Wheas Clews</u>				
Waypoint ID	<u>Plot</u>			Photo numbers				
Coordinates	E	<u>0362429</u>		Photo direction	N	E	S	W
	N	<u>6328925</u>						
Mapped Vegetation type:				Condition:	Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace								
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?								
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill				
Remnant / Old growth (uncleared):				Yes / No / Undecided?				
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =				
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance				
E	.							
T1	.			<u>nae</u> <u>casuarina glauca</u> scattered.				
T2	.							
T3	.							
S1	.			<u>nae</u>				
S2	.							
G	.		<u>90%</u>	<u>Hypochaeris hirta</u> <u>Buttalo</u> <u>couch</u>				
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest								
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect				
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point				
5m	0	0	0	Native grass tally -				Total (hits/50)
10m	↓	↓	↓					
15m	↓	↓	↓					
20m	↓	↓	↓					
25m	↓	↓	↓					
30m	↓	↓	↓	Native other (herb, fern, sedge, etc) tally -				Total (hits/50)
35m	↓	↓	↓					
40m	↓	↓	↓					
45m	↓	↓	↓					
50m	0	0	0	Native shrub tally -				Total (hits/50)
Total (sum / 10) =								
Larger 50 x 20m plot								
Length of woody debris >10cm wide & >0.5m long			0					
Proportion of canopy sp. regeneration			0	Exotic tally -				Total (hits/50)
Number of trees with hollows >5cm (live or dead)			0	<u>###</u> <u>###</u> <u>###</u> <u>###</u> <u>###</u> <u>###</u> <u>###</u> <u>###</u> <u>###</u> <u>###</u>				100%

100% Coolatai Grass
 Buttalo & couch

Site ID: <u>Cleared 1</u>			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Hyparrhenia hirta</i>	80	100+	41						
2 <i>Pennisetum grass k. hyp</i>	10	100+	42						
3 <i>Briza subaristata</i>	5	100+	43						
4 <i>Pharus</i>	0.1	1	44						
5 <i>Will. flower weed</i>	0.2	20+	45						
6 <i>Cenchrus ciliaris</i>	0.1	1	46						
7 <i>Couch</i>	5	100+	47						
8 <i>Anagallis arvensis</i>	0.1	1	48						
9			49						
10			50						
11			51						
12			52						
13			53						
14			54						
15			55						
16			56						
17			57						
18			58						
19			59						
20			60						
21			61						
22			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
			Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
<5cm:			Native shrub (<1m)						
5 - 9cm:			Exotic grass						
10 - 19cm:			Exotic forb & other						
20 - 29cm:			Leaf & stick litter						
30 - 49cm:			Rocks						
50 - 79cm:			Bare ground						
80+cm:			Cryptogams						
			Total	100	100	100	100	100	
			Plot Disturbance			Fire damage:			
			Clearing (inc. logging):			Storm damage:			
			Cultivation (inc. pasture):			Trampling:			
			Soil erosion:			Flood damage:			
			Firewood collection:			Feral herbivores:			
			Stock grazing:			Other:			

Site ID: cleared 2			Survey type: Quadrat 20m x 20m, 10m x 40m, etc					
Species	Cover	Abund.	Species	Cover	Abund.			
1 <i>Chloris gayana</i>	60%	100+	41					
2 <i>Hypochaeris glabra</i>	10%	100%	42					
3 <i>Urtica</i>	0.1	1	43					
4 <i>Paspalum dilatatum</i>	0.1	1	44					
5 <i>Veronica longifolia</i>	0.3	10	45					
6 <i>Juncus urticatus</i>	0.3	10	46					
7 <i>Couch</i>	5	100+	47					
8 <i>Timothy</i>	0.1	1	48					
9 <i>Plantago lanceolata</i>	0.1	1	49					
10 <i>Andropogon virginicus</i>	0.1	1	50					
11 <i>Cyperus diandra</i>	0.1	1	51					
12 <i>Scirpus cleverleyi</i>	0.1	1	52					
13			53					
14			54					
15			55					
16			56					
17			57					
18			58					
19			59					
20			60					
21			61					
22			62					
23			63					
24			64					
25			65					
26			66					
27			67					
28			68					
29			69					
30			70					
31			71					
32			72					
33			73					
34			74					
35			75					
36			76					
37			77					
38			78					
39			79					
40			80					
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
	2		Native perennial grass					
			Native other grass					
Tree size class assessment tally:			Native forb & other					
<5cm:			Native shrub (<1m)					
5 - 9cm:			Exotic grass					
10 - 19cm:			Exotic forb & other					
20 - 29cm:			Leaf & stick litter					
30 - 49cm:			Rocks					
50 - 79cm:			Bare ground					
80+cm:			Cryptogams					
			Total	100	100	100	100	100
			Plot Disturbance	Fire damage:				
			Clearing (inc. logging):	Storm damage:				
			Cultivation (inc. pasture):	Trampling:				
			Soil erosion:	Flood damage:				
			Firewood collection:	Feral herbivores:				
			Stock grazing:	Other:				

Survey Site Form - BBAM / BAM				Site ID: <i>cleared 2</i>	Vegetation zone: <i>cleared</i>				
Date	<i>13/10/2017</i>			Surveyor(s): <i>Lukas Clews</i>					
Waypoint ID	<i>024</i>			Photo numbers					
Coordinates	E	<i>0363157</i>		Photo direction	N	E	S	W	
	N	<i>6328747</i>							
Mapped Vegetation type:				Condition:		Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):			Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace									
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?									
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill					
Remnant / Old growth (uncleared): Yes / No / Undecided?									
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =					
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance					
E	-								
T1	-			<i>Scattered Casuarina</i>					
T2	-								
T3	-								
S1	-			<i>Acacia ligifolia scattered.</i>					
S2	-								
G	-			<i>Chloris gayana, Vahana, Hydrocotyle bonariensis</i>					
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%)									
Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall									
W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest									
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect					
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point					
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally -				Total (hits/50)	
10m	<i>↓</i>	<i>↓</i>	<i>↓</i>					<i>0%</i>	
15m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
20m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
25m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
30m	<i>↓</i>	<i>↓</i>	<i>↓</i>	Native other (herb, fern, sedge, etc) tally -				Total (hits/50)	
35m	<i>↓</i>	<i>↓</i>	<i>↓</i>					<i>0%</i>	
40m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
45m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
50m	<i>↓</i>	<i>↓</i>	<i>↓</i>	Native shrub tally -				Total (hits/50)	
Total (sum / 10) =	<i>0%</i>	<i>0</i>	<i>0%</i>					<i>0%</i>	
Larger 50 x 20m plot									
Length of woody debris >10cm wide & >0.5m long			<i>0</i>						
Proportion of canopy sp. regeneration			<i>0%</i>	Exotic tally - <i> </i>					Total (hits/50)
Number of trees with hollows >5cm (live or dead)			<i>0</i>	<i> </i>					<i>100%</i>

Survey Site Form - BBAM / BAM				Site ID: <i>cleared 3</i>	Vegetation zone: <i>cleared</i>				
Date	<i>13/10/2017</i>			Surveyor(s): <i>LC</i>					
Waypoint ID	<i>025</i>			Photo numbers					
Coordinates	E	<i>0363009</i>			Photo direction	N	E	S	W
	N	<i>6329005</i>							
Mapped Vegetation type:				Condition:		Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):			Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace									
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?									
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill					
Remnant / Old growth (uncleared):				Yes / No / Undecided?					
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =					
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance					
E	.								
T1	.		<i>1%</i>	<i>scattered Casuarina</i>					
T2	.								
T3	.								
S1	.		<i>1%</i>	<i>scattered Acacia longifolia</i>					
S2	.								
G	.		<i>80%</i>	<i>Hyperbaia hirta</i> <i>K. pyc</i> <i>Crotalaria antheraea</i>					
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest									
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect					
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point					
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally -				Total (hits/50)	
10m	<i>↓</i>	<i>↓</i>	<i>↓</i>					<i>0</i>	
15m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
20m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
25m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
30m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
35m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
40m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
45m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
50m	<i>↓</i>	<i>↓</i>	<i>↓</i>						
Total (sum / 10) =	<i>0</i>	<i>0</i>	<i>0</i>	Native shrub tally -				Total (hits/50)	
Larger 50 x 20m plot								<i>0</i>	
Length of woody debris >10cm wide & >0.5m long			<i>0</i>						
Proportion of canopy sp. regeneration			<i>100</i>	Exotic tally -				Total (hits/50)	
Number of trees with hollows >5cm (live or dead)			<i>0</i>	<i> </i>				<i>100%</i>	

Cleared 3

Site ID: <u>cleared 3</u>			Survey type: Quadrat 20m x 20m, 10m x 40m, etc					
Species	Cover	Abund.	Species	Cover	Abund.			
1 <i>Hyperbanis lirta</i>	20%	100+	41					
2 <i>Kikuyu</i>	10%	100+	42					
3 <i>Cenchrus ciliaris</i>	0-1	10	43					
4 couch	5	100+	44					
5 <i>Briza subaristata</i>	5	100+	45					
6 <i>Briza maxima</i>	0-1	1	46					
7 <i>Briza media</i>	0-1	1	47					
8 <i>Andropogon virginicus</i>	0-1	1	48					
9 <i>Casuarina glauca</i>	5	10	49					
10 <i>Platago lanceolata</i>	0-1	10	50					
11 <i>Myrica laevis</i>	0-1	10	51					
12 <i>Eleusine</i>	0-1	1	52					
13 <i>Acacia longifolia</i>	100	2	53					
14 <i>Medicago</i>	0-1	1	54					
15 <i>Ceanothus</i>	0-1	1	55					
16			56					
17			57					
18			58					
19			59					
20			60					
21			61					
22			62					
23			63					
24			64					
25			65					
26			66					
27			67					
28			68					
29			69					
30			70					
31			71					
32			72					
33			73					
34			74					
35			75					
36			76					
37			77					
38			78					
39			79					
40			80					
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
	3		Native perennial grass					
			Native other grass					
Tree size class assessment tally:			Native forb & other					
<5cm:			Native shrub (<1m)					
5 - 9cm:			Exotic grass					
10 - 19cm:			Exotic forb & other					
20 - 29cm:			Leaf & stick litter					
30 - 49cm:			Rocks					
50 - 79cm:			Bare ground					
80+cm:			Cryptogams					
			Total	100	100	100	100	100
			Plot Disturbance	Fire damage:				
			Clearing (inc. logging):	Storm damage:				
			Cultivation (inc. pasture):	Trampling:				
			Soil erosion:	Flood damage:				
			Firewood collection:	Feral herbivores:				
			Stock grazing:	Other:				

Survey Site Form - BBAM / BAM				Site ID: <i>cleared 4</i>		Vegetation zone: <i>cleared</i>	
Date		<i>12/10/2017</i>		Surveyor(s):			
Waypoint ID		<i>026</i>		Photo numbers			
Coordinates		<i>E 0362101</i> <i>N 6322704</i>		Photo direction		N E S W	
Mapped Vegetation type:				Condition:		Low Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:			
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace							
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?							
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill			
Remnant / Old growth (uncleared): Yes / No / Undecided?							
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =			
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance			
E	.						
T1	.			<i>none</i>			
T2	.						
T3	.						
S1	.		<i>1%</i>	<i>Scots pine tree & Acacia longifolia, Acacia decurrens</i>			
S2	.						
G	.		<i>80%</i>	<i>Hyperbaea hirta, Bliza subaristata, couch</i>			
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%)							
Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall							
W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest							
50m Transect		10 Points - Foliage Projective Cover		Ground cover tally sheet, 50 points along 50m transect			
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point			
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally -		Total (hits/50)	
10m	<i>↓</i>	<i>↓</i>	<i>↓</i>			<i>0</i>	
15m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
20m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
25m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
30m	<i>↓</i>	<i>↓</i>	<i>↓</i>	Native other (herb, fern, sedge, etc) tally -		Total (hits/50)	
35m	<i>↓</i>	<i>↓</i>	<i>↓</i>			<i>0</i>	
40m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
45m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
50m	<i>↓</i>	<i>↓</i>	<i>↓</i>				
Total (sum / 10) =		<i>0</i>	<i>0</i>	Native shrub tally -		Total (hits/50)	
Larger 50 x 20m plot						<i>0</i>	
Length of woody debris >10cm wide & >0.5m long		<i>0</i>					
Proportion of canopy sp. regeneration		<i>0</i>		Exotic tally -		Total (hits/50)	
Number of trees with hollows >5cm (live or dead)		<i>0</i>		<i> </i>		<i>100%</i>	

Site ID: <i>deard 4</i>			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Hyparrhenia hirta</i>	70	100+	41						
2 <i>Briza subaristata</i>	5	100+	42						
3 <i>Briza media</i>	0.1	1	43						
4 <i>Fleurodium</i>	0.1	10	44						
5 <i>Cenchrus</i>	0.1	1	45						
6 <i>Hypochaeris radicata</i>	0.3	10	46						
7 <i>Medicago</i>	0.1	1	47						
8 <i>Centaurium anthrac</i>	0.1	10	48						
9 <i>Valeriana karstensis</i>	0.1	1	49						
10 <i>Acacia imbricata</i>	1	1	50						
11 <i>Couch</i>	10	100+	51						
12 <i>Indropogon virginicus</i>	1	20	52						
13 <i>Kikuyu</i>	1	20+	53						
14			54						
15			55						
16			56						
17			57						
18			58						
19			59						
20			60						
21			61						
22			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
			Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
			Native shrub (<1m)						
<5cm:			Exotic grass						
5 - 9cm:			Exotic forb & other						
			Leaf & stick litter						
10 - 19cm:			Rocks						
			Bare ground						
20 - 29cm:			Cryptogams						
			Total	100	100	100	100	100	
30 - 49cm:			Plot Disturbance	Fire damage:					
			Clearing (inc. logging):	Storm damage:					
50 - 79cm:			Cultivation (inc. pasture):	Trampling:					
			Soil erosion:	Flood damage:					
80+cm:			Firewood collection:	Feral herbivores:					
			Stock grazing:	Other:					

Scribbly Gum Low 2

Survey Site Form - BBAM / BAM				Site ID: <i>Acacia</i>	Vegetation zone: <i>Acacia</i>
Date	<i>12/10/2017</i>			Surveyor(s): <i>Ulews</i>	<i>clums</i>
Waypoint ID	<i>022</i>			Photo numbers	
Coordinates	E	<i>0363273</i>	N	<i>6328645</i>	Photo direction
				N	E S W
Mapped Vegetation type:				Condition:	Low Mod-good
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:	
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace					
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?					
Soil type: sand, loam, clay, organic, gravel, skeletal, ?			Soil disturbance: intact, topsoil removed, fill		
Remnant / Old growth (uncleared): Yes / No / Undecided?					
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =	
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance	
E					
T1					
T2					
T3					
S1				<i>Acacia longituba</i> <i>Erythrina sphaeroloba</i>	
S2					
G				<i>Delonix regia</i> <i>Braha subaristata</i> <i>Couch</i> <i>Centella</i>	
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest					
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect	
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point	
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally -	Total (hits/50)
10m	<i>1</i>	<i>60</i>	<i>0</i>		<i>0</i>
15m	<i>1</i>	<i>50</i>	<i>0</i>		
20m	<i>1</i>	<i>40</i>	<i>0</i>		
25m	<i>1</i>	<i>20</i>	<i>0</i>		
30m	<i>1</i>	<i>0</i>	<i>0</i>		
35m	<i>1</i>	<i>0</i>	<i>0</i>	Native other (herb, fern, sedge, etc) tally - <i>11</i>	Total (hits/50)
40m	<i>1</i>	<i>0</i>	<i>0</i>		<i>6%</i>
45m	<i>1</i>	<i>0</i>	<i>0</i>		
50m	<i>1</i>	<i>0</i>	<i>0</i>		
Total (sum / 10) =	<i>0</i>	<i>17</i>	<i>0</i>	Native shrub tally -	Total (hits/50)
Larger 50 x 20m plot					<i>0</i>
Length of woody debris >10cm wide & >0.5m long			<i>0</i>		
Proportion of canopy sp. regeneration			<i>0</i>		
Number of trees with hollows >5cm (live or dead)			<i>0</i>		
				Exotic tally - <i>11 11 11 11 11 11 11 11 11 11</i>	Total (hits/50)
					<i>94%</i>

Site ID: <i>Acacia</i>			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Acacia longifolia</i>			41						
2 <i>Hydrocotyle</i>	5	100+	42						
3 <i>Andropogon virginicus</i>	0.1	10	43						
4 <i>Chloris</i>	50	100+	44						
5 <i>Cover</i>	30%	100+	45						
6 <i>Cenchrus</i>	0.2	10	46						
7 <i>Urtica</i>	0.3	30	47						
8 <i>Thymus</i>	10	100+	48						
9 <i>Braza</i>	5	100+	49						
10 <i>Platanus</i>	0.2	20	50						
11 <i>Flower</i>	0.1	1	51						
12 <i>Pine tree</i>	0.1	1	52						
13 <i>Kennedia</i>	0.1	1	53						
14 <i>Acacia podalyrifolia</i>	0.1	1	54						
15 <i>Centaurea</i>	0.1	20	55						
16 <i>Stachys</i>	0.2	20	56						
17			57						
18			58						
19			59						
20			60						
21			61						
22			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
	6		Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
<5cm:			Native shrub (<1m)						
5 - 9cm:			Exotic grass						
10 - 19cm:			Exotic forb & other						
20 - 29cm:			Leaf & stick litter						
30 - 49cm:			Rocks						
50 - 79cm:			Bare ground						
80+cm:			Cryptogams						
			Total	100	100	100	100	100	
			Plot Disturbance	Fire damage:					
			Clearing (inc. logging):	Storm damage:					
			Cultivation (inc. pasture):	Trampling:					
			Soil erosion:	Flood damage:					
			Firewood collection:	Feral herbivores:					
			Stock grazing:	Other:					

Survey Site Form - BBAM / BAM				Site ID: <i>Wetland 2</i>	Vegetation zone: <i>Wetland</i>				
Date	<i>13/10/2017</i>			Surveyor(s):					
Waypoint ID	<i>029</i>			Photo numbers					
Coordinates	E	<i>0362787</i>			Photo direction	N	E	S	W
	N	<i>6328527</i>							
Mapped Vegetation type:				Condition:		Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):			Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace									
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?									
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill					
Remnant / Old growth (uncleared):				Yes / No / Undecided?					
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =					
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance					
E									
T1									
T2									
T3									
S1				<i>scattered Casuarina</i>					
S2									
G				<i>coaly Palboschoenus</i>					
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest									
50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect					
Point	Canopy % (photos)	Midstorey %	Exotic %	- every 1m record if plant intersects (hits) point					
5m	<i>0</i>	<i>0</i>	<i>0</i>	Native grass tally - <i> </i> <i> </i>					Total (hits/50)
10m									
15m									
20m									
25m									
30m				Native other (herb, fern, sedge, etc) tally - <i> </i> <i>1</i>					Total (hits/50)
35m									
40m									
45m									
50m									
Total (sum / 10) =	<i>0</i>	<i>0</i>	<i>0</i>	Native shrub tally -					Total (hits/50)
Larger 50 x 20m plot									
Length of woody debris >10cm wide & >0.5m long			<i>0</i>						
Proportion of canopy sp. regeneration			<i>0</i>						Total (hits/50)
Number of trees with hollows >5cm (live or dead)			<i>0</i>						

Site ID: <u>Wellad 2</u>			Survey type: Quadrat 20m x 20m, 10m x 40m, etc						
Species	Cover	Abund.	Species	Cover	Abund.				
1 <i>Lythrum hyssopifolia</i>	1	20+	41						
2 <i>Couch</i>	20	100+	42						
3 <i>Centurus exfoliae</i>	0.1	20	43						
4 <i>Stuccus usitatus</i>	51	100+	44						
5 <i>Bolboschoenus caldwelli</i>	5	100+	45						
6 <i>Cyperus eragrostis</i>	0.1	1	46						
7			47						
8			48						
9			49						
10			50						
11			51						
12			52						
13			53						
14			54						
15 <i>Very Dry</i>			55						
16 <i>expect Bolboschoenus to</i>			56						
17 <i>be more dominant with</i>			57						
18 <i>rainfall.</i>			58						
19			59						
20 <i>Couch dominates</i>			60						
21			61						
22 <i>cracking soil - dried out</i>			62						
23			63						
24			64						
25			65						
26			66						
27			67						
28			68						
29			69						
30			70						
31			71						
32			72						
33			73						
34			74						
35			75						
36			76						
37			77						
38			78						
39			79						
40			80						
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5	
			Native perennial grass						
			Native other grass						
Tree size class assessment tally:			Native forb & other						
			Native shrub (<1m)						
			Exotic grass						
			Exotic forb & other						
			Leaf & stick litter						
			Rocks						
			Bare ground						
			Cryptogams						
			Total	100	100	100	100	100	
			Plot Disturbance						
<5cm:			Clearing (inc. logging):				Fire damage:		
5 - 9cm:			Cultivation (inc. pasture):				Storm damage:		
10 - 19cm:			Soil erosion:				Trampling:		
20 - 29cm:			Firewood collection:				Flood damage:		
30 - 49cm:			Stock grazing:				Feral herbivores:		
50 - 79cm:							Other:		
80+cm:									

Survey Site Form - BBAM / BAM				Site ID: <u>Walled 3</u>	Vegetation zone: <u>Wetland</u>			
Date	<u>13/10/2017</u>			Surveyor(s):	<u>LC</u>			
Waypoint ID	<u>30</u>			Photo numbers				
Coordinates	E <u>0363211</u> N <u>6328405</u>			Photo direction	N	E	S	W
Mapped Vegetation type:				Condition:	Low		Mod-good	
Slope: Gentle, Mod, Steep		Aspect (degrees or cardinal):		Altitude:				
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace								
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?								
Soil type: sand, loam, clay, organic, gravel, skeletal, ?				Soil disturbance: intact, topsoil removed, fill				
Remnant / Old growth (uncleared):				Yes / No / Undecided?				
Vegetative Structure (formation) =				Ecologically Dominant Layer (EDL) - most biomass =				
Strata	Height interval	Median	Est. cover	Dominant Species & Dominance				
E	-							
T1	-			<u>Scattered Casuarina</u>				
T2	-							
T3	-							
S1	-							
S2	-							
G	-			<u>Juncus ustulatus</u> <u>Phragmites</u> <u>Couch</u>				
Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%) Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%) Definitions Dominance d = dominant; c = co-dominant; s = subdominant; a = associated Estimated cover l = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%) Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest								
50m Transect				10 Points - Foliage Projective Cover				
Point	Canopy % (photos)	Midstorey %	Exotic %	Ground cover tally sheet, 50 points along 50m transect				
5m	0	0	0	- every 1m record if plant intersects (hits) point				
10m				Native grass tally - <u> </u> <u> </u> <u> </u> <u> </u>				
15m								
20m								
25m								
30m				Native other (herb, fern, sedge, etc) tally - <u> </u> <u> </u> <u> </u>				
35m								
40m								
45m								
50m								
Total (sum / 10) =				Native shrub tally -				
Larger 50 x 20m plot				Total (hits/50)				
Length of woody debris >10cm wide & >0.5m long				0				
Proportion of canopy sp. regeneration				0				
Number of trees with hollows >5cm (live or dead)				0				
				Exotic tally -				
				Total (hits/50)				

Site ID: <u>Wetland 3</u>			Survey type: <u>Quadrat 20m x 20m, 10m x 40m, etc</u>					
Species	Cover	Abund.	Species	Cover	Abund.			
1 <u>Phragmites</u>	<u>45</u>	<u>100+</u>	41					
2 <u>Cyperus</u>	<u>20</u>	<u>100+</u>	42					
3 <u>Schoenoplectus</u>	<u>10</u>	<u>200</u>	43					
4 <u>Baccharis</u> sp.	<u>5</u>	<u>100+</u>	44					
5 <u>Stenotaphrum secundatum</u>	<u>10</u>	<u>100+</u>	45					
6 <u>Lectyocarpus</u>	<u>0-1</u>	<u>1</u>	46					
7 <u>Cyperus</u> <u>lyxipitellus</u>	<u>0-2</u>	<u>20</u>	47					
8 <u>Andropogon</u>	<u>0-1</u>	<u>3</u>	48					
9 <u>Tenax</u> <u>caeruleus</u>	<u>1</u>	<u>5</u>	49					
10			50					
11			51					
12			52					
13 <u>Dry</u>			53					
14			54					
15 <u>rice sedge composition</u>			55					
16 <u>& phragmites</u>			56					
17			57					
18 <u>deep soil cracks.</u>			58					
19			59					
20			60					
21 <u>expect to be dominated</u>			61					
22 <u>by sedges & phragmites</u>			62					
23 <u>with rainfall.</u>			63					
24			64					
25			65					
26			66					
27			67					
28			68					
29			69					
30			70					
31			71					
32			72					
33			73					
34			74					
35			75					
36			76					
37			77					
38			78					
39			79					
40			80					
Sp. Richness	Native	Exotic	Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
			Native perennial grass					
			Native other grass					
Tree size class assessment tally:			Native forb & other					
<5cm:			Native shrub (<1m)					
5 - 9cm:			Exotic grass					
10 - 19cm:			Exotic forb & other					
20 - 29cm:			Leaf & stick litter					
30 - 49cm:			Rocks					
50 - 79cm:			Bare ground					
80+cm:			Cryptogams					
			Total	100	100	100	100	100
			Plot Disturbance	Fire damage:				
			Clearing (inc. logging):	Storm damage:				
			Cultivation (inc. pasture):	Trampling:				
			Soil erosion:	Flood damage:				
			Firewood collection:	Feral herbivores:				
			Stock grazing:	Other:				

Appendix B. Likelihood of occurrence assessment for threatened species and populations

State and nationally listed threatened species identified from the background review were considered in terms of their likelihood to occur in the habitats present on the biobank site based on identified habitat requirements for each species. The results of this review are provided in Table B-2 for threatened flora and Table B-3 for threatened fauna. The likelihood of occurrence was classified according to the criteria described in Table B-1.

Table B-1 Likelihood of occurrence includes one or more of the following criteria

Likelihood of Occurrence	Criteria
Unlikely	Species not recorded during field surveys and fit one or more of the following criteria: - Species highly restricted to certain geographical areas not within the works footprint - Specific habitat requirements are not present in the study area
Low	Species not recorded during field surveys and fit one or more of the following criteria: - Have not been recorded previously in the study area/surrounds and for which the study area is beyond the current distribution range - Use specific habitats or resources not present in the study area - Are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded
Moderate	Species not recorded during the field surveys that fit one or more of the following criteria: - Have infrequently been recorded previously in the study area/surrounds - Use specific habitats or resources present in the study area but in a poor or modified condition - Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration - Are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded
High	Species recorded during the field surveys or species not recorded that fit one or more of the following criteria: - Have frequently been recorded previously in the study area/surrounds - Use habitat types or resources that are present in the study area that are abundance and/or in good condition within the study area - Are known or likely to maintain resident populations surrounding the study area - Are known or likely to visit the site during regular seasonal movements or migration

Table B-2 Known or potentially occurring threatened flora species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Acacia bynoeana</i>	Bynoe's Wattle	V	E	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (<i>Corymbia gummifera</i>), Scribbly Gum (<i>Eucalyptus haemastoma</i>), Drooping Red Gum (<i>E. parramattensis</i>), Old Man Banksia (<i>Banksia serrata</i>) and Small-leaved Apple (<i>Angophora bakeri</i>).	48 – OEH PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Angophora inopina</i>	Charmhaven Apple	V	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. There is an unconfirmed record of the species near Bulahdelah. Approximately 1250 ha of occupied habitat has been mapped in the Wyong–southern Lake Macquarie area. This species is a member of the <i>A. bakeri</i> complex, which also includes <i>A. crassifolia</i> , <i>A. paludosa</i> and <i>A. exul</i> . It is most similar to <i>A. crassifolia</i> from which it is distinguished by the broader leaves with shorter petioles. None of these related species are known from the same area as <i>A. inopina</i> , although <i>A. bakeri</i> does occur sporadically in the ranges to the west, and near Kurri Kurri. Occurs most frequently in four main vegetation communities: (i) <i>Eucalyptus haemastoma</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest; (ii) <i>Hakea teretifolia</i> – <i>Banksia oblongifolia</i> wet heath; (iii) <i>Eucalyptus resinifera</i> – <i>Melaleuca sieberi</i> – <i>Angophora inopina</i> sedge woodland; (iv) <i>Eucalyptus capitellata</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest.	418 – OEH PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	V	V	Occurs near Patonga (Gosford LGA), and in Royal NP and on the Woronora Plateau (Sutherland and Campbelltown LGAs). There is also a record from near Glen Davis (Lithgow LGA). Occurs in dry sclerophyll woodland on sandstone. Flowers in spring.	BBCC	Low – marginal habitat. No local records.	Species
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	V	E	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally, found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	PMST	Low – the habitats were surveyed and this species was not located.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Callistemon linearifolius</i>	Netted Bottlebrush	-	V	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Was more widespread across its distribution in the past. Some populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park and Werakata National Park. Grows in dry sclerophyll forest on the coast and adjacent ranges.	BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Genoplesium insigne</i> (<i>Corunastylis insignis</i>)	Variable Midge Orchid	CE	CE	Recorded from four localities between Chain Valley Bay and Wyong in Wyong local government area. Grows in patches of <i>Themeda australis</i> (Kangaroo Grass) amongst shrubs and sedges in heathland and forest. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by <i>Eucalyptus haemastoma</i> (Scribbly Gum), <i>Corymbia gummifera</i> (Red Bloodwood), <i>Angophora costata</i> (Smooth-barked Apple) and <i>Allocasuarina littoralis</i> (Black She-oak). Fewer than twenty plants are recorded from three localities, while the number of plants present at the fourth locality (Chain Valley Bay) is not recorded. Flowering period is September to October.	PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Corunastylis</i> sp. Charmhaven (NSW896673)		CE	CE	<i>Corunastylis</i> sp. Charmhaven (NSW896673) is currently only known from the Wyong Shire of NSW where it is restricted to a few locations in the Charmhaven, Warnervale and Tooheys Road (Bushells Ridge) areas. It occurs within low woodland to heathland with a shrubby understorey and ground layer. Dominants include Black She-oak (<i>Allocasuarina littoralis</i>), Prickly Tea-tree (<i>Leptospermum juniperinum</i>), Prickly-leaved Paperbark (<i>Melaleuca nodosa</i>), Narrow-leaved Bottlebrush (<i>Callistemon linearis</i>) and Zig-zag Bog-rush (<i>Schoenus brevifolius</i>).	3 – OEH PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park and Ben Boyd National Park. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland.	24 – OEH PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Diuris praecox</i>	Rough Doubletail	V	V	Known from between Bateau Bay and Smiths Lake. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	1 – OEH PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of <i>E. oblonga</i> Narrow-leaved Stringybark, <i>E. capitellata</i> Brown Stringybark and <i>E. haemastoma</i> Scribbly Gum.	PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Drooping Red Gum	V	V	There are two separate meta-populations of <i>E. parramattensis</i> subsp. <i>decadens</i>. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Aberdare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamstown and Tomago in the south. Generally, occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, <i>E. parramattensis</i> subsp. <i>decadens</i> is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the BC Act. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000). Very little is known about the biology or ecology of this species. Flowers from November to January. Propagation mechanisms are currently poorly known. Seed dispersal is likely to be effected by wind and animals.	5 – OEH PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone	PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast, and Cessnock and Kurri Kurri in the Lower Hunter. Grows in sandy or	14 – OEH PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.			
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	-	V	Swamps, swamp margins or creek edges.	13 – OEH PMST	Unlikely – no suitable habitat in study area.	Species
<i>Melaleuca groveana</i>	Grove's Paperbark	-	V	Widespread, scattered populations in coastal districts north of Yengo National Park to southeast Queensland. Also found as a disjunct population near Torrington on the northern tablelands. Grove's Paperbark grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone on rocky outcrops and cliffs. It also occurs in dry shrubby open forest and woodlands.	BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Pelargonium</i> sp. G.W. Carr 10345	Omeo Storksbill	E	E	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. It sometimes colonises exposed lake beds during dry periods.	PMST	Unlikely – no suitable habitat in study area.	Species
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Prostanthera askania</i>	Tranquillity Mintbush	E	E	Tranquillity mintbush occurs in moist sclerophyll forest and warm temperate rainforest communities, as well as the ecotone between them. These communities are generally tall forest with a mesic understorey. Canopy species include <i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i> (turpentine), <i>Allocasuarina torulosa</i> (forest oak), <i>Eucalyptus acmenoides</i> (white mahogany), <i>Eucalyptus saligna</i> (Sydney blue gum),	BBCC	Low – no suitable habitat in study area.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				<i>Eucalyptus agglomerata</i> (blue-leaved Stringybark) and <i>Eucalyptus pilularis</i> (blackbutt). Understory species vary considerably at each site			
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	E	V	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Rutidosis heterogama</i>	Heath Wrinklewort	V	V	Recorded from near Cessnock to Kurri Kurri with an outlying occurrence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Woolli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	PMST BBCC	Low – the habitats were surveyed and this species was not located. No heath on sandy soils, or moist areas in open forest	Species
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	5 – OEH PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Tetradlea glandulosa</i>	Glandular-pink Bell	V	V	Endemic to NSW, with around about 150 populations from Yengo National Park to Lane Cove National Park. Associates in areas with shale cappings over sandstone. Occurs in heath, scrublands to woodlands and open forest. Common woodland tree species include: <i>Corymbia gummiifera</i> , <i>C. eximia</i> , <i>Eucalyptus haemastoma</i> , <i>E. punctata</i> , <i>E. racemosa</i> , and/or <i>E. sparsifolia</i> , with an understorey dominated by species from the families Proteaceae, Fabaceae, and Ericaceae.	BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of	136 – OEH PMST BBCC	Low – the habitats were surveyed and this species was not located.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies.			
<i>Thelymitra</i> sp. <i>adorata</i>	Wyong Sun Orchid	CE	CE	Currently known from a few localised occurrences in the area bounded by the towns of Wyong, Warnervale and Wyongah on the New South Wales Central Coast, within the Wyong Local Government Area. Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs.	PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Thesium australe</i>	Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>).	PMST	Low – the habitats were surveyed and this species was not located.	Species
<i>Wilsonia backhousei</i>	Narrow-leaved Wilsonia	-	V	Found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney. It grows in all southern states. This is a species of the margins of salt marshes and lakes, both coastal and inland.	BBCC	Low – the habitats were surveyed and this species was not located.	Species
<i>Zannichellia palustris</i>	-	-	E	A submerged aquatic plant. In NSW, known from the lower Hunter and in Sydney Olympic Park. Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months. NSW populations behave as annuals, dying back completely every summer.	BBCC	Low – the habitats were surveyed and this species was not located.	Species

Table B-3 Threatened fauna species potentially occurring in the study area

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
Birds							
<i>Anseranas semipalmata</i>	Magpie Goose	-	V	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW.	BBCC	Low – wetland habitat in study area not suitably vegetated for this species.	Ecosystem
<i>Anthochaera phrygia</i> (<i>Xanthomyza phrygia</i>)	Regent Honeyeater	E	CE	Temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and She oaks.	21 – OEH PMST	Low – vegetation along the proposed powerline easement is unlikely to provide suitable habitat for the Regent Honeyeater.	Species
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	V	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands, and may be seen along roadsides and on golf courses.	4 – OEH	Low– vegetation along the proposed powerline easement is too degraded for this species.	Ecosystem
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	PMST BBCC	Low – wetland habitat in study area not suitable for this species. It is too small, degraded' lacks dense vegetation and is ephemeral	Species
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	E	Open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	BBCC	Low – this species is not known from the area.	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
						Unlikely to use habitat in the study area.	
<i>Calidris alba</i>	Sanderling	M	V	A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common, arriving from September and leaving by May (some may overwinter in Australia). Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.	BBCC	Low – study area does not offer suitable habitat for this species.	Ecosystem
<i>Calidris canutus</i>	Red Knot	E, M	-	Common in all the main suitable habitats around the coast of Australia. Mainly inhabit intertidal mudflats, sand flats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs.	1 – OEH PMST	Low – study area does not offer suitable habitat for this species.	Ecosystem
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E	The breeding range of the Curlew Sandpiper is mainly restricted to the Arctic of northern Siberia, including Yamal Peninsula east to Kolyuchiskaya Gulf, Chokotka Peninsula, and also New Siberian Island. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in salt works and sewage farms.	1 – OEH PMST	Low – species not recorded on site during targeted surveys	Ecosystem
<i>Calidris tenuirostris</i>	Great Knot	M	V	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.	PMST BBCC	Low – species not recorded on site during targeted surveys	Ecosystem
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	-	V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	1 – OEH BBCC	Low – this species has only been recorded once in the locality and vegetation in the study area not suitable.	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Calyptrorhynchus lathamii</i>	Glossy-black Cockatoo	-	V	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of She oaks, including Drooping Sheoak, <i>Allocasuarina diminuta</i> , and <i>A. gymnanthera</i> . Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (<i>Casuarina cristata</i>).	20 – OEH BBCC	Low –vegetation in the study area not suitable for this species.	Ecosystem
<i>Charadrius leschenaultii</i>	Greater Sand plover	-	V	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	BBCC	Low – species not recorded on site during targeted surveys	Species
<i>Charadrius mongolus</i>	Lesser Sand Plover	-	V	The Lesser Sand-plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sand flats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.	PMST BBCC	Low – species not recorded on site during targeted surveys	Species
<i>Chthonicola sagittata</i> (<i>Pyrholaemus sagittatus</i>)	Speckled Warbler	-	V	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	1 – OEH BBCC	Low – no large, relatively undisturbed remnants near study area.	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Circus assimilis</i>	Spotted Harrier	-	V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	BBCC	Low – no suitable habitat and no records in locality.	Ecosystem
<i>Climacteris picumnus victorae</i>	Brown Treecreeper (eastern subspecies)	-	V	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	2 – OEH BBCC	Low – local records dubious. No suitable habitat for this species.	Ecosystem
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	20 – OEH BBCC	Moderate - marginal habitat in study area. Local records to west and north of site.	Ecosystem
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	PMST	Low – no suitable habitat for this species.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	E	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	4 – OEH BBCC	Low – habitat marginal. This species is rare in the area. Lots of higher quality habitat surrounding the study area.	Species
<i>Epthianura albifrons</i>	White-fronted Chat	-	V	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).	2 – OEH BBCC	Moderate – saltmarsh habitat is marginal for this species when ponds retain water after rainfall.	Ecosystem
<i>Falco subniger</i>	Black Falcon	-	V	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	1 – OEH	Low – No suitable habitat for this species. Single record likely a misidentification.	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (angophora sp.), paperbarks (melaleuca sp.) and other tree species. Riparian habitats are particularly used, due	17 – OEH BBCC	Low - habitat along proposed powerline	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.		easement is very marginal.	
<i>Grantiella picta</i>	Painted Honeyeater	-	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	PMST BBCC	Low – marginal habitat in study area. No local records.	Ecosystem
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	V	Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels.	1 – OEH	Low – species not recorded on site during targeted surveys.	Species
<i>Haematopus longirostris</i>	Pied Oystercatcher	-	E	The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish. Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.	2 – OEH BBCC	Low – species not recorded on site during targeted surveys	Species
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	V	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea).	26 – OEH	Low – this species may fly over but is unlikely to use habitat within the study area.	Species
<i>Hieraaetus morphnoides</i>	Little Eagle	-	V	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	2 – OEH BBCC	Low – no suitable habitat in study area.	Ecosystem
<i>Ixobrychus flavicollis</i>	Black Bittern	-	V	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely been recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern	4 – OEH BBCC	Low – wetland habitat in study area not suitably	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.		vegetated for this species	
<i>Lathamus discolor</i>	Swift Parrot	CE	E	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>).	17 – OEH PMST BBCC	Low – this species may use vegetation along proposed powerline easement though not considered important.	Ecosystem
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	-	V	The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW. Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sand flats and mudflats, harbours, embayment, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	BBCC	Low – species not recorded on site during targeted surveys.	Species
<i>Limosa lapponica</i>	Bar-tailed Godwit	M	-	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sand flats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	PMST	Low – species not recorded on site during targeted surveys	-
<i>Limosa lapponica baueri</i>	Bar-tailed godwit (western Alaskan)	V	-	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of bar-tailed godwit (western Alaskan) is predominately New Zealand, northern and eastern Australia. The migratory bar-tailed godwit (western Alaskan) does not breed in Australia. The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	PMST	Low – species not recorded on site during targeted surveys	Ecosystem
<i>Limosa limosa</i>	Black-tailed Godwit	M	V	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	BBCC	Low – species not recorded on site during targeted surveys	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Lophoictinia isura</i>	Square-tailed Kite	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km ² . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	BBCC	Low – no suitable habitat in study area. No records in locality.	Ecosystem
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subsp.)	-	V	Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river she oaks (nesting habitat) and tea-trees.	BBCC	Low – no suitable habitat in study area. No records in locality.	Ecosystem
<i>Neophema pulchella</i>	Turquoise Parrot	-	V	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	1 – OEH BBCC	Low – no suitable habitat in study area	Ecosystem
<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	-	E	Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-Goose is now only a rare visitor to NSW. Uncommon in Queensland. Occupies freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. The Cotton Pygmy-goose uses standing dead trees with hollows close to water for roosting and breeding.	BBCC	Low – no suitable habitat in study area	Species
<i>Ninox connivens</i>	Barking Owl	-	V	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	1 – OEH BBCC	Low - foraging habitat in open forest areas surrounding the study area, however the area within the project footprint is too degraded.	Ecosystem
<i>Ninox strenua</i>	Powerful Owl	-	V	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low	13 – OEH BBCC	Low - suitable foraging habitat in forest areas	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angophora floribunda</i> , Cherry Ballart <i>Exocarpus cupressiformis</i> and a number of eucalypt species.		surrounding the study area, however the area within the project footprint.	
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, M	-	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	1 – OEH PMST	Low – species not recorded on site during targeted surveys	Ecosystem
<i>Oxyura australis</i>	Blue-billed Duck	-	V	Endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.	BBCC	Low – no suitable habitat in study area	Ecosystem
<i>Pandion cristatus</i>	Eastern Osprey	-	V	Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters.	4 – OEH BBCC	Low – this species may fly over the study area however there is no suitable habitat in study area.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Petroica boodang</i>	Scarlet Robin	-	V	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.	2 – OEH BBCC	Low – one >20yr old record in west of site. Marginal habitat in study area.	Ecosystem
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	-	V	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	1 – OEH BBCC	Low - marginal habitat in study area. Only one local record.	Ecosystem
<i>Pterodroma leucophaea leucophaea</i>	Gould's Petrel	E, M	V	Breeds on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown. The first arrival of Gould's petrel on cabbage tree Island occurs from mid to late September. Principal nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. They nest predominantly in natural rock crevices among the rock scree and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees.	1 – OEH	Low – no suitable habitat in study area	EEC/Marine
<i>Ptilinopus regina</i>	Rose-crowned Fruit Dove	-	V	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	1 – OEH	Low – no suitable habitat in study area.	Ecosystem
<i>Ptilinopus superbus</i>	Superb Fruit-dove	-	V	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	2 – OEH	Low – no suitable habitat in study area.	Ecosystem
<i>Rostratula australis</i>	Australian Painted Snipe	E, M	E	Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	PMST BBCC	Low – wetland habitat in study area not suitable vegetated for this species.	Ecosystem
<i>Stagonopleura guttata</i>	Diamond Firetail	-	V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland	1 – OEH	Low - marginal habitat in study area. No local records.	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.			
<i>Sternula albigula</i>	Little Tern	M	E	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney. Almost exclusively coastal, preferring sheltered environments; however, may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	2 – OEH BBCC	Low – no suitable habitat in study area.	Species
<i>Stictonetta naevosa</i>	Freckled Duck	-	V	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	BBCC	Low – no suitable habitat in study area.	Ecosystem
<i>Turnix maculosus</i>	Red-backed Button-quail	-	V	Over their Australian range, Red-backed Button-quail inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm. In NSW, said to occur in grasslands, heath and crops. Said to prefer sites close to water, especially when breeding. The species has been observed associated with the following grasses (in various vegetation formations): <i>Heteropogon</i> , <i>Imperata cylindrica</i> , <i>Triodia</i> , <i>Cenchrus ciliaris</i> .	1 – OEH BBCC	Low – no suitable habitat in study area.	Species
<i>Tyto novaehollandiae</i>	Masked Owl	-	V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	9 – OEH BBCC	Moderate - suitable foraging habitat in study area.	Ecosystem
<i>Tyto tenebricosa</i>	Sooty Owl	-	V	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	1 – OEH	Low – no suitable habitat in study area.	Ecosystem
<i>Xenus cinereus</i>	Terek Sandpiper	M	V	A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. The latter has been identified as nationally and internationally important for the species. In Australia, has been recorded on coastal mudflats, lagoons, creeks	BBCC	Low – species not recorded on site during targeted surveys	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				and estuaries. Favours mud banks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.			
Mammals							
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	-	V	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	2 – OEH BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Species
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	PMST	Low - suitable foraging habitat in study area however no roosting habitat in the locality.	Species and Ecosystem
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	E	V	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	5 – OEH PMST BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
						are unlikely to utilise the development site.	
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	Prefers moist habitats, with trees taller than 20 m. Generally, roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	4 – OEH BBCC	Moderate - suitable habitat in study area. Only one local record from the 1980's.	Ecosystem
<i>Kerivoula papuensis</i>	Golden-tipped Bat	-	V	The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. It also occurs in New Guinea. Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes.	BBCC	Low – habitat in study area is not suitable for this species.	Species
<i>Miniopterus australis</i>	Little Bentwing-bat	-	V	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	38 – OEH	Moderate - suitable habitat in study area. No roosting habitat. Local records surrounding the site.	Species and Ecosystem
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	-	V	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	31 – OEH	Moderate – suitable foraging habitat in study area. No roosting habitat. Local records surrounding the site.	Species and Ecosystem
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	-	V	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.	44 – OEH BBCC	Moderate – suitable foraging habitat in study area. No roosting habitat. Local records surrounding the site.	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Myotis macropus</i> (<i>Myotis adversus</i>)	Southern Myotis	-	V	Generally, roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	28 – OEH	Moderate – suitable foraging habitat in study area. No roosting habitat. Local records surrounding the site.	Species and Ecosystem
<i>Petaurus australis</i>	Yellow-bellied Glider	-	V	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Ecosystem
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	106 – OEH BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Petauroides volans</i>	Greater Glider	V	-	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria from sea level to 1200 m altitude. It feeds exclusively on eucalypt leaves, buds, flowers and mistletoe and favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. It roosts in tree hollows, with a particular selection for large hollows in large, old trees. Individuals use multiple hollows and a relatively high abundance of tree hollows (at least 4-8 suitable hollows per hectare) seems to be needed for the species to persist. Individuals occupy relatively small home ranges with an average size of 1 to 3 ha but the species has relatively low persistence in small forest fragments, and disperses poorly across vegetation that is not native forest. Forest patches of at least 160 km ² may be required to maintain viable populations.	PMST	Low – no records in locality.	-
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	E	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	PMST	Unlikely – no suitable habitat in study area.	Species
<i>Phascolarctos cinereus</i>	Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	4 – OEH PMST BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Species
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	-	V	Patchy distribution around the coast of Australia. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
						forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	
<i>Planigale maculata</i>	Common Planigale	-	V	Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney. Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks.	BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Species
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. There are geographically isolated populations in western Victoria. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	PMST	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed	Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
						are unlikely to utilise the development site.	
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	-	V	In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. There are however isolated records in the Jervis bay area. In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands.	2 – OEH BBCC	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Species
<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	-	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	PMST	Low – The results of the targeted habitat assessment confirm that the small areas of regrowth and disturbed forest habitat impacted by the project are substantially degraded such that the forest fauna species assessed are unlikely to utilise the development site.	Ecosystem
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Generally, found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food	23 – OEH PMST	Low - suitable foraging habitat in forest surrounding the study area, where it is likely to	Species and Ecosystem

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.		occur, although very limited opportunity for foraging within the development footprint. No roost camps in study area	
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	-	V	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	4 – OEH BBCC	Moderate - suitable habitat in study area.	Ecosystem
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	21 – OEH BBCC	Moderate - suitable foraging habitat in study area. Local records surrounding the study area.	Ecosystem
Reptiles							
<i>Chelonia mydas</i>	Green Turtle	V, M	V	Widely distributed in tropical and sub-tropical seas. Usually found in tropical waters around Australia but also occurs in coastal waters of NSW, where it is generally seen on the north or central coast, with occasional records from the south coast. Ocean-dwelling species spending most of its life at sea. Carnivorous when young but as adults they feed only on marine plant material.	4 – OEH	Unlikely – no suitable habitat in the study area. Not applicable	EEC/Marine
<i>Hoplocephalus stephensii</i>	Stephens' banded snake	-	V	Coast and ranges from Southern Queensland to Gosford in NSW. Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Stephens' Banded Snake is nocturnal, and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day.	1 – OEH	Low – no suitable habitat in the study area.	Species
Amphibians							
<i>Crinia tinnula</i>	Wallum Froglet	-	V	Wallum Froglets are found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney. Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgeland and wet heathlands. They can also be found along	52 – OEH PMST BBCC	Low - Targeted surveys were conducted over 4 nights (24 person hours)	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
				drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. The species breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Breeding is thought to peak in the colder months, but can occur throughout the year following rain. Eggs of 1.1-1.2mm are deposited in water with a pH of <6 and tadpoles take 2-6 months to develop into frogs. Wallum Froglets shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge. Males may call throughout the year and at any time of day, peaking following rain.		during optimum conditions for detection of frogs. These surveys confirm the absence of the threatened frog species.	
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	BBCC	Low - Targeted surveys were conducted over 4 nights (24 person hours) during optimum conditions for detection of frogs. These surveys confirm the absence of the threatened frog species.	Species
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.	1 – OEH PMST BBCC	Low - Targeted surveys were conducted over 4 nights (24 person hours) during optimum conditions for detection of frogs. These surveys confirm the absence of the threatened frog species.	Species
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	PMST	Low – marginal habitat in study area. No local records.	Species

Species		EPBC Act	BC Act	Distribution and habitat	No. of records - Data Source	Likelihood of occurrence in the study area	Biodiversity credit class
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	PMST	Unlikely – no suitable habitat in study area. No local records.	Species
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer.	PMST	Unlikely – no suitable habitat in study area. No local records.	Species
Fish							
<i>Epinephelus daemeli</i>	Black Cod	V	-	In Australia, the distribution of black cod ranges from southern Queensland through NSW to northern Victoria. However, records from Queensland and Victoria are rare, and the NSW coastline forms the species' main range, both in Australia and internationally. It generally inhabits near-shore reefs at depths down to 50 m from southern Queensland through NSW to northern Victoria. Small juvenile black cod are often found in coastal rock pools while slightly older juveniles are often found in estuary systems. The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters.	PMST	Unlikely – no suitable habitat in study area. No local records.	-
<i>Prototroctes maraena</i>	Australian Grayling	V	-	The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones. The species has also recorded in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea. It has been recorded from many rivers across its range, particularly in Tasmania and Victoria. In NSW it is found from the Shoalhaven River south, with important river systems for the species including the Shoalhaven River, Bega River and Clyde River systems.	PMST	Unlikely – no suitable habitat in study area. No local records.	-

Appendix C. Biodiversity Credit Report

Biodiversity credit report



This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 20/12/2017

Time: 3:02:57PM

Calculator version: v4.0

Major Project details

Proposal ID: 170/2017/4489MP

Proposal name: Vales Point Solar Project

Proposal address: Rutleys Road Mannering Park NSW 2259

Proponent name: Sunset Power International Pty Ltd (Trading as Delta Electricity)

Proponent address:

Proponent phone: 02 4352 6111

Assessor name: Lukas Clews

Assessor address: 100 Christie St St Leonards NSW 2065

Assessor phone: 02 9928 2291

Assessor accreditation: 170

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	2.60	42.96
Saltmarsh Estuarine Complex	9.90	173.16
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	6.55	0.23
Total	19.05	216

Credit profiles

1. Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast, (HU850)

Number of ecosystem credits created	0
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast, (HU850) Scribbly Gum - Smooth-barked Apple - Red Bloodwood shrubby forest of the Lower Hunter, Sydney Basin Bioregion, (HU715) Red Bloodwood - Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast, (HU839) Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast, (HU852)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast, (HU850)

Number of ecosystem credits created	54
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Scribbly Gum - Smooth-barked Apple - Red Bloodwood shrubby forest of the Lower Hunter, Sydney Basin Bioregion, (HU715) Red Bloodwood - Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast, (HU839) Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast, (HU850) Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast, (HU852)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion, (HU673)

Number of ecosystem credits created	43
IBRA sub-region	Wyang

Offset options - Plant Community types	Offset options - IBRA sub-regions
<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion, (HU673) <i>Cladium procerum</i> coastal freshwater wetland, (HU949) Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter, (HU950)	Wyang and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Saltmarsh Estuarine Complex, (HU960)

Number of ecosystem credits created	173
IBRA sub-region	Wyang

Offset options - Plant Community types	Offset options - IBRA sub-regions
Saltmarsh Estuarine Complex, (HU960) Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, (HU606)	Wyang and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required