

Technical report Q

Biodiversity development assessment report

Cleanaway & Macquarie Capital
**Western Sydney Energy and
Resource Recovery Centre**
Biodiversity Development
Assessment Report

WSERRC-ARU-SYD-ENFTT-RPT-0002

Final | 21 August 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Executive summary

Cleanaway and Macquarie Capital propose to construct and operate an energy-from-waste (EfW) facility at 339 Wallgrove Road, Eastern Creek. The facility will generate up to 55 megawatts (MW) of power by thermally treating up to 500,000 tonnes per year of residual municipal solid waste (MSW) and residual commercial and industrial (C&I) waste streams that would otherwise be sent to landfill.

This Biodiversity Development Assessment Report (BDAR) has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the Western Sydney Energy and Resource Recovery Centre for the purpose of seeking development consent under Division 4.7 of the EP&A Act.

The development is proposed within Lot 1 DP 1059698 at 339 Wallgrove Road, Eastern Creek. The study area for the biodiversity assessment includes the development site and a 1,500 m landscape assessment buffer. Lands within the study area intersect the Blacktown and Fairfield Local Government Areas (LGAs) and southwest parts of the Western Sydney Parklands (WSP).

The 8.23 ha development site is divided by a small strip of land not part of the proposal site, resulting in a 2.04 ha northern section and a 6.19 ha southern section. This dividing strip is part of the adjacent lot and includes a right of carriageway benefitting the proposal site allowing vehicles to move between the two parts of the site. The proposal area will be fully contained in the 6.19ha portion of the site. Works to occur on the 2.04 ha northern section of the site include the clearing of weeds and exotic vegetation within the existing overland flow channel which is confined to the eastern section of this parcel of land. The northern section will also be used temporarily to support construction works. It is not currently expected that any other works will occur on the 2.04 ha northern section of the site as part of this proposal.

A desktop review of publicly available datasets and documentation was completed to gather existing information on biodiversity values for the study area. Relevant landscape features identified for the study area include waterways, wetlands and connectivity features situated within a matrix of urban lands.

Approximately 134.18 ha (15%) of mapped native vegetation occurs within the study area. A 2.99 ha patch of native vegetation is located within and immediately adjacent to the north of the development site.

Approximately 0.88 ha of native vegetation comprising regrowth Cumberland Shale Plains Woodland (PCT 849) was identified for low-lying areas along the eastern property boundary. Native vegetation identified within the development site was considered consistent with the BC Act listed, critically endangered Cumberland Plain Woodland in the Sydney Basin Bioregion threatened ecological

community (TEC). The vegetation did not meet the key diagnostic features and condition thresholds for the EPBC Act listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC. No Groundwater Dependent Ecosystems were confirmed for the development site.

The assessment of habitat for threatened species within the site identified four threatened fauna species and thirteen threatened flora species as candidate species credit species requirements further survey to presence/ absence within the development site.

No threatened flora species were identified during targeted surveys carried out within the site between 17-20 February 2020. Areas of native vegetation at the proposal site were highly degraded and dominated by exotic species. Habitat quality for the candidate threatened flora species was generally poor.

Fauna habitats within the development site include 0.88 ha of eucalypt woodland, 0.26 ha of aquatic environments, 1.92 ha of exotic pasture and 5.62 ha of developed land. Surveys for candidate threatened fauna were carried out between 17-23 February 2020. An absence of large trees supporting hollows indicates these habitats are generally unsuitable for hollow-roosting mammals and microbats. A lack of leaf litter and woody debris also indicates habitat is marginal for Cumberland Land Snail and Dural Land Snail. Habitat for one candidate threatened fauna species (Southern Myotis) was confirmed for the site. Habitat for Southern Myotis includes 0.88ha of Eucalypt woodland within 200m of pools >3m wide. Other candidate fauna species were not recorded during targeted surveys.

Matters of National Environmental Significance identified as relevant to the project include Grey-headed Flying-fox and White-throated Needletail. Both of these species are listed as Vulnerable under the EPBC Act and White-throated Needletail is also listed as migratory. An additional listed marine species (Cattle Egret) was also observed. No Grey-headed Flying-fox camps or important foraging resources were identified during field surveys. White-throated Needletail is an aerial species and available habitat within the development site is not considered important habitat for this species. Project impacts to EPBC Act listed species are considered negligible and do not meet any significant impact criteria, as defined by the Commonwealth Significant Impact Guidelines (DoE, 2013). As such, works associated with the development do not require Commonwealth referral.

Direct impacts as a result of the development include a loss of 0.45 ha of Cumberland Shale Plains Woodland (PCT849), Cumberland Plain Woodland TEC and habitat for Southern Myotis. Indirect impacts resulting from the development are considered negligible, following the implementation of proposed design measures and construction mitigation and management strategies. Indirect

impacts to adjacent retained areas of fauna habitat, associated with construction noise is considered higher risk. However, these impacts will be temporary and are unlikely to permanently impact or displace any threatened fauna or significant species. Prescribed impacts associated with the loss of habitat connectivity and impacts to groundwater or surface water quality and flow are likely to be negligible.

Assessment against thresholds for the NSW Biodiversity Offsets Scheme (as outlined in Section 7.1 of the BC Regulation) indicates the project does not trigger any offset requirements. Assessment against Section 7.3 of the BC Act indicates the project is not likely to result in a significant impact to threatened species or ecological communities.

Cumberland Plain Woodland TEC has been identified as an entity for potential Serious and Irreversible Impacts (SAII) however no SAII thresholds have been set. Assessment against clause 6.7 of the BC Regulation indicates project impacts to the TEC are unlikely to constitute a SAII. Southern Myotis is not a potential SAII entity and impacts to the species as a result of the development are unlikely to contribute to any increased risk of extinction.

Biodiversity offsets are not required to address impacts associated with the proposal. In accordance with Section 7.14 of the BC Act, the Minister can grant consent or approval of the proposed development without offsets where the biodiversity offset scheme does not apply.

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Environmental assessment requirements

The below table lists the Secretary's environmental assessment requirements (SEARs) relevant to biodiversity and where they are addressed in this report.

Table 1: SEARs relevant to biodiversity

SEARs No.	Secretary's requirement	How addressed
General requirements 1(1)	<p>The EIS must include a detailed assessment of the key issues specified below, and any other significant issues identified in the risk assessment, which includes:</p> <ul style="list-style-type: none"> A description of the existing environment, using sufficient baseline data 	Existing biodiversity values and associated baseline data is presented in Sections 3 to 6 of this BDAR.
General requirements 1(3)	<ul style="list-style-type: none"> A description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/ or contingency plans to manage any significant risks to the environment. 	Measures to avoid and minimise impacts to biodiversity are documented in Section 7.1 of this BDAR. Section 7.3 of the BDAR identifies the proposed mitigation measures, including proposed management plans incorporating adaptive management processes and contingency measures, where relevant. Project offsets are addressed in Section 9.
General requirements 1(4)	<ul style="list-style-type: none"> A consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in this EIS. 	Measures for the management and monitoring of biodiversity are documented in Section 7.3 of this BDAR.
	<p>The EIS must include consideration of the likely impacts of any related development associated with the development, including any pre-processing infrastructure, ash management infrastructure and high voltage electricity connection.</p>	<p>Potential biodiversity impacts associated with related development are summarised in the EIS Related Developments Chapter.</p> <p>Related developments will be subject to a separate approval process.</p>
Key issues 8(1)	<p>A description of the existing baseline conditions including soil, water, groundwater resources, topography, hydrology, drainage lines, watercourses and riparian lands on or nearby to the site.</p>	Existing aquatic biodiversity values are documented in Section 5 of this BDAR.

SEARs No.	Secretary's requirement	How addressed
Key issues 8(2)	An assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, water courses and riparian lands and measures proposed to reduce and mitigate these impacts	Potential impacts to aquatic habitats are documented in Section 7.2.4 of this BDAR. Measures to avoid, minimise and mitigate impacts to biodiversity are documented in Section 7.1 and 7.3 of this BDAR, including measures for aquatic environments.
Key issues 18(1)	The EIS must address an assessment of biodiversity impacts in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report	The assessment of biodiversity impacts is documented in Section 7.2 of this BDAR.
Key issues 18(2)	The EIS must address measures to avoid, mitigate or offset all direct, indirect or prescribed impacts in accordance with the Biodiversity Assessment Method	Section 7.1, Section 7.2, Section 7.3 and Section 9 of this BDAR.

Table 2 details specific flora and fauna considerations relevant to the Blacktown City Council SEARS.

Table 2: Blacktown City Council requirements relevant to biodiversity

Blacktown City Council Requirement	How addressed
Undertake a fauna and flora survey of the site in accordance with the OEH Threatened Species Survey and Assessment Guidelines.	Methods implemented for the survey of flora and fauna are detailed in Section 4.2 of this BDAR. This includes relevant OEH Threatened Species Survey and Assessment Guidelines.
Address impacts on flora and fauna, including threatened species, populations and endangered ecological communities and their habitats and steps taken to mitigate any identified impacts to protect the environment.	Potential impacts to flora and fauna as a result of the proposal are outlined in Section 7.2 of this BDAR. Avoidance and minimisation measures to be implemented are summarised in Section 7.1. Other mitigation and management measures are discussed in Section 7.3.
Any impacts on threatened species, populations and endangered ecological communities that cannot be avoided or mitigated must be adequately offset in accordance with OEH principles for the use of biodiversity offsets in NSW.	Regulatory requirements for the project are set out in Section 1.4 of this BDAR. Offset requirements for the project have been determined in accordance with the relevant provisions of the <i>Biodiversity Conservation Act 2017</i> .

Table 3 details assessment requirements relevant to the Environment, Energy and Science (EES) Group in the Department of Planning, Industry and Environment.

Table 3: EES Group requirements relevant to biodiversity

EES Group Requirement	How addressed
<p>Biodiversity impacts related to the proposed development are to be assessed in accordance with Section 7.9 of the Biodiversity Conservation Act 2017 the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR).</p> <p>The BDAR must include information in the form detailed in the <i>Biodiversity Conservation Act 2016</i> (s6.12), <i>Biodiversity Conservation Regulation 2017</i> (s6.8) and Biodiversity Assessment Method, including an assessment of the impacts of the proposal (including an assessment of impacts prescribed by the regulations).</p>	<p>An assessment of the proposal has been carried out in accordance with the Biodiversity Assessment Method and is presented within this document.</p>
<p>The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.</p>	<p>Measures to avoid and minimise impacts associated with the proposal are detailed in Section 7.1 of this BDAR. Offsets are discussed in Section 8.1 and 9 of this BDAR. All direct, indirect and prescribed impacts associated with the proposal are detailed in Section 7.2 of this BDAR.</p>
<p>The BDAR must include details of the measures proposed to address the offset obligation as follows:</p> <ul style="list-style-type: none"> • The total number and classes of biodiversity credits required to be retired for the development/ project; • The number and classes of like-for-like biodiversity credits proposed to be retired; • The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; • Any proposal to fund a biodiversity conservation action; • Any proposal to conduct ecological rehabilitation (if a mining project); • Any proposal to make a payment to the Biodiversity Conservation Fund. <p>If seeking approval to use the variation rule, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.</p>	<p>This report has determined that no offsets are required from the outcomes of the impact assessment. This is discussed in Section 8 of this report.</p>
<p>The BDAR must be submitted with all spatial data associated with the survey and assessment as per Appendix 11 of the BAM.</p>	<p>Appendix 11 of the BAM refers to requirements for a Biodiversity Stewardship Site Assessment Report which is not relevant to the project. Rather the BDAR has addressed Appendix 10 of the BAM.</p>
<p>The BDAR must be prepared by a person accredited in accordance with the</p>	<p>This report has been prepared and reviewed by BAM accredited assessors. This BDAR</p>

EES Group Requirement	How addressed
Accreditation Scheme for the Application of the Biodiversity Assessment Methods Order 2017 under s6.10 of the <i>Biodiversity Conservation Act 2016</i> .	has been prepared by Chani Wheeler (BAAS19077) and reviewed by Matt Davis (BAAS18090).
The EIS must map the following features relevant to water and soils: <ul data-bbox="319 459 766 631" style="list-style-type: none"><li data-bbox="319 459 766 548">• Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method).<li data-bbox="319 560 766 631">• Wetlands as described in s4.2 of the Biodiversity Assessment Method.	These features are identified where relevant to the development site, within Section 2.1 of this BDAR.

Abbreviations and glossary

Abbreviations	
BAM	Biodiversity Assessment Method
BC Act	Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
BoM	Bureau of Meteorology
BVM	Biodiversity Values Map
EES	Environment, Energy and Science Group in the Department of Planning, Industry and Environment
EfW	Energy from Waste
DPIE	Department of Planning, Industry and Environment
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FM Act	Fisheries Management Act 1994
GDEs	Groundwater Dependent Ecosystems
IBRA	Interim Biogeographic Regionalisation for Australia
LGAs	Local Government Areas
OEH	Office of Environment and Heritage
PCT	Plant Community Type
Proposal (the)	The purpose of the proposal is to build an energy-from-waste (EfW) facility that can generate up to 55 megawatts (MW) of power by thermally treating up to 500,000 tonnes per year of residual municipal solid waste (MSW) and residual commercial and industrial (C&I) waste streams that would otherwise be sent to landfill.
SEAR's	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
Study area	The study area includes the development site at 339 Wallgrove Road, Eastern Creek plus a 1500 m buffer.
TEC	Threatened Ecological Community
VMP	Vegetation Management Plan
WSPs	Western Sydney Parklands

1 Introduction

This Biodiversity Development Assessment Report (BDAR) has been prepared in accordance with the requirements of the NSW Biodiversity Assessment Method (BAM)(OEH, 2017). Detailed methodology is provided within relevant sections throughout the document in accordance with OEH (2017). Briefly, the implemented approach included:

- Establishing the study area to be used for the BDAR which included a 1500m buffer surrounding the development site.
- Establishing the existing environment and biodiversity values through a desktop review of publicly available spatial datasets and documentation and site assessments to confirm habitat suitability for potentially occurring threatened species and ecological communities.
- Undertaking onsite targeted surveys to confirm the presence or absence of candidate threatened species.
- Documenting measures implemented to avoid and minimise impacts to biodiversity as a result of the proposal.
- Assessing the residual impacts of the proposal on existing biodiversity values.
- Developing mitigation measures including biodiversity offsetting.

1.1 Proposal description

Cleanaway and Macquarie Capital propose to construct and operate an energy-from-waste (EfW) facility at 339 Wallgrove Road, Eastern Creek. The facility will generate up to 55 megawatts (MW) of power by thermally treating up to 500,000 tonnes per year of residual municipal solid waste (MSW) and residual commercial and industrial (C&I) waste streams that would otherwise be sent to landfill. The proposal is described further in the following sections.

1.1.1 Site layout

The proposed facility will include the following main components:

- Fully-enclosed waste receiving hall and access ramp.
- Bunker to temporarily store the waste feedstock, which would include overhead cranes to mix and load the process lines.
- Boiler hall comprising the process lines, a moving grate, furnace, boiler, flue gas treatment plant and stack.
- Bag filter area.
- Steam turbine hall and generator set.
- Air-cooled steam condenser unit.
- Dedicated area including silos for storing consumables and materials for the flue gas cleaning process.
- Bottom ash storage area.

- Boiler ash and air pollution control residues storage area.
- Onsite water pumping station.
- Diesel generator.
- Visitor centre to help educate and inform the community on the circular economy, recycling, resource recovery and EfW.

The following associated site infrastructure would also be constructed at the site:

- Internal roads, car parking and hardstand areas.
- Weighbridges.
- A dedicated site access off the unnamed road located off Wallgrove Road.
- Stormwater and drainage infrastructure.
- Fencing and hard and soft landscaping

Figure 1 shows the location of the proposed facility.



Service Credits: DFSI, 2020

Figure 1: Proposed development

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C:\Users\Dmitry.Shalov\Desktop\WSEPRC_EIS\Site3_Site.mxd

1.1.2 Operational processes

A typical EfW process is illustrated in Figure 2 and described in Table 4.

Table 4: Steps in the operational process

Step	Description
Waste deliveries	<p>Waste will be delivered to site by enclosed waste delivery vehicles. The route taken to site will depend on the origin of the waste, however all vehicles would enter the site via the site entrance off the Austral Bricks Road.</p> <p>The vehicles will be weighed on arrival and electronically catalogued, including information on the type and source of waste.</p> <p>The facility has been designed to accept waste deliveries from compactor type vehicles, semi-trailer type vehicles and B-doubles.</p>
Waste receipt, intake and storage	<p>Enclosed waste delivery trucks will drive into the waste receiving hall, through fast acting roller shutter doors, located on the southern elevation of the building. Waste will be unloaded into chutes which convey the waste to the storage bunker.</p> <p>The EfW facility will apply procedures for the inspection, quarantine and rejection of non-compliant waste.</p> <p>Waste feedstock will be temporarily stored in the bunker. The bunker will have sufficient capacity to store about five to seven days' throughput of waste over normal operations.</p> <p>Bunker grab cranes will mix the waste, then feed it onto the boiler feed hopper.</p> <p>The receipt hall and bunker would be operated under negative pressure to contain odour within the building and to capture odour in the combustion process.</p> <p>All waste receipt and waste storage areas will be impermeable (including flooring and bunker). The waste itself is not wet thus will not generate a leachate.</p>
Combustion	<p>Waste is fed from the feed hopper to the combustion grate. Waste combustion will take place as the waste slowly moves along a grate.</p> <p>In the boiler, heat from the combustion of waste is transferred to the feedwater to generate steam. Within the furnace of each boiler, auxiliary burners will be installed. Auxiliary burners will use liquid fuel (diesel) that will be stored in bunded tanks on site.</p> <p>Steam will flow from the boiler section to the steam turbine. The steam turbine will service both boilers and is designed to generate about 58MW of electricity on a gross basis.</p> <p>Steam will exit the turbine at low temperature and low pressure and condensed to generate feedwater that can then be recycled and reused in the boilers.</p>
Flue Gas Treatment	<p>Combustion gases created through the combustion of waste are cleaned before being released from the stack. Key components of the Flue Gas Treatment process are outlined in Chapter 3 of the EIS.</p> <p>Continuous online monitoring of flue gas emissions will be undertaken with automatic adjustments made to the combustion system and injection rates, as needed.</p>

Step	Description
Ash management	<p>Three types of ash will be generated:</p> <ul style="list-style-type: none"> • Incinerator Bottom Ash (IBA)- This will be cooled in a water bath. Any bulky items or ferrous metals will be removed and moved to the storage bunker before being removed offsite. Remaining ash will be transferred offsite to a separate processing facility. • Boiler Fly Ash- This will be disposed of with the IBA where possible or diverted to the St Mary's hazardous solid waste treatment facility. • Flue Gas Treatment Residues- This is collected, stored in onsite silos and then transferred to St Mary's hazardous solid waste treatment facility.
Water use	<p>The main objective regarding water use is to reuse as much water as possible.</p> <p>The following water-saving techniques have been identified:</p> <ul style="list-style-type: none"> • Water from the wet scrubber outlet will be captured and used within the flue gas conditioning stage. • Rejected water from the make-up plant and from boiler blow-down will be used within the IBA quench. <p>This means that no process wastewater generated onsite will need treatment outside of the facility in normal operation. A water treatment plant will be installed to ensure that the water quality of feedwater is suitable for use within the boiler.</p>

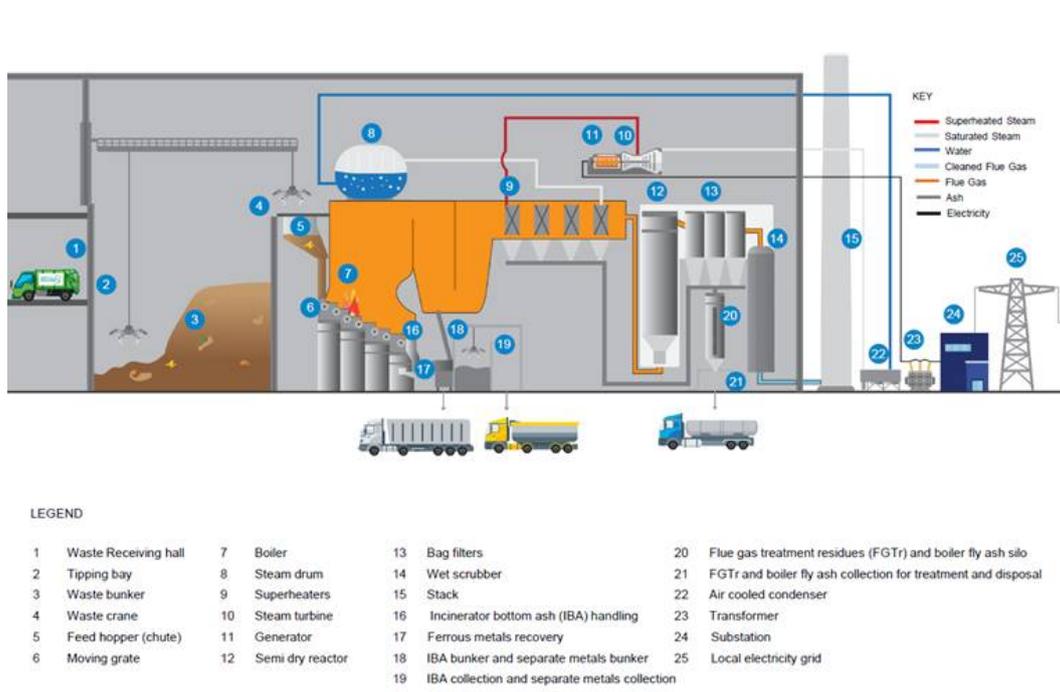


Figure 2: EfW facility indicative process

1.1.3 Construction

Pending approval, design and construction activities are expected to start in Q4-2021 and it would take up to 3 ¼ years (39 months) to complete, subject to any unforeseen delays.

The proposal would be likely built in five phases to reflect contractor needs, material and equipment availability, and program and delivery schedules.

Constructing in phases would also allow for effective site and environmental management. The key phases of construction comprise:

- Phase 1: Demolition
- Phase 2: Site establishment and enabling works
- Phase 3: Main construction works
- Phase 4: Testing and commission works
- Phase 5: Finishing and landscaping works

Clearing of existing vegetation within the development footprint is proposed to allow for construction of the facility and associated site infrastructure. The existing farm dam will be decommissioned and the existing stream channel will be reprofiled to incorporate a natural trapezoidal-shaped channel incorporating low flow.

1.2 Document purpose

This Biodiversity Development Assessment Report (BDAR) has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the Western Sydney Energy and Resource Recovery Centre for the purpose of seeking approval under Division 4.7 of the EP&A Act.

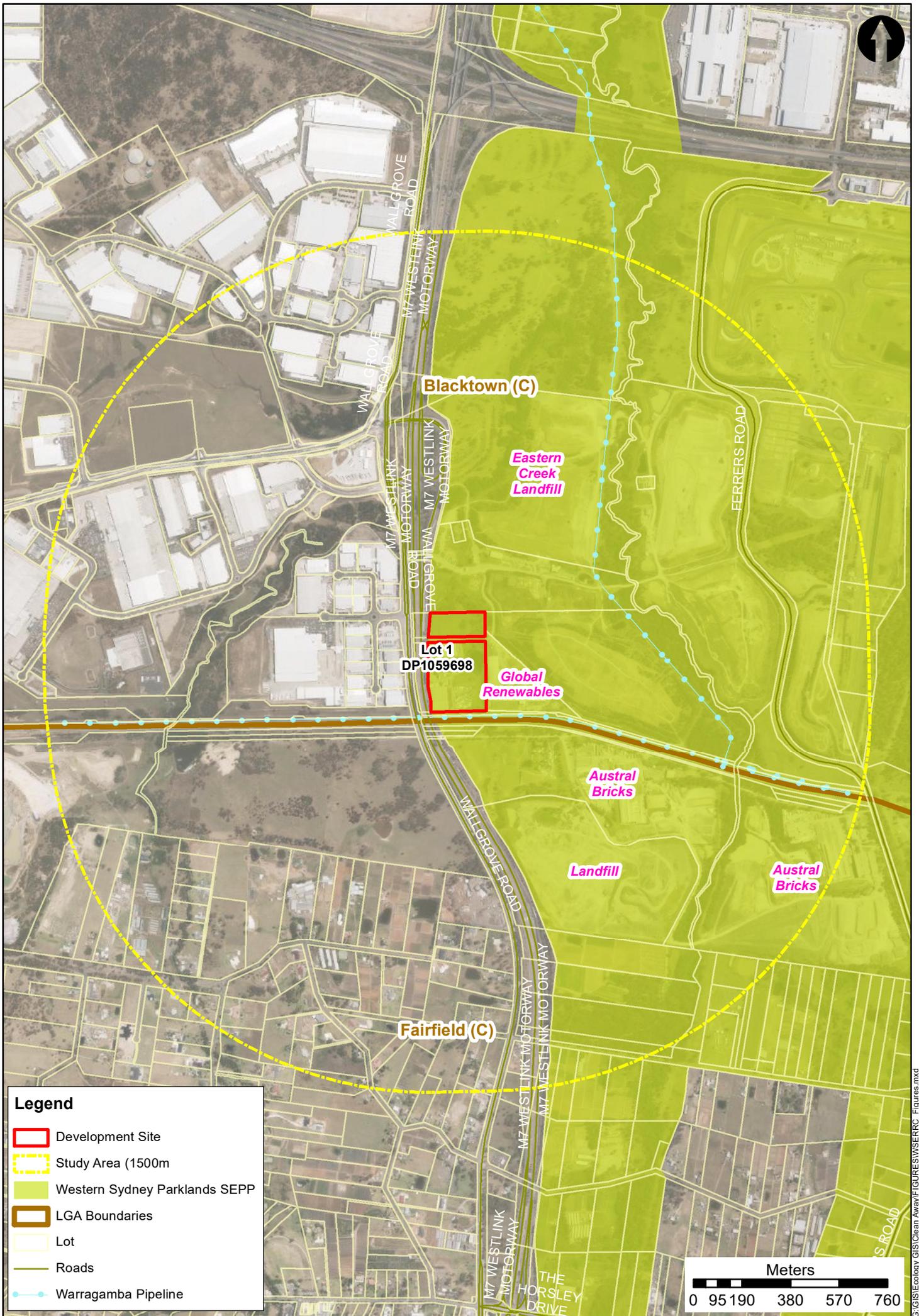
1.3 Study area

The development site includes approximately 8.23 ha of land at 339 Wallgrove Road, Eastern Creek. The study area for the assessment includes the development site and a 1500 m landscape assessment buffer, as shown in Figure 3.

The 8.23 ha site is divided by a small strip of land not part of the proposal site, resulting in a 2.04 ha northern section and a 6.19 ha southern section. This dividing strip is part of the adjacent lot and includes a right of carriageway benefitting the proposal site allowing vehicles to move between the two parts of the site. The proposal area will be fully contained in the 6.19 ha portion of the site.

Works to occur on the 2.04 ha northern section of the site include the clearing of weeds and exotic vegetation within the existing overland flow channel which is confined to the eastern section of this parcel of land. The northern section will also be used temporarily to support construction works. It is not currently expected that any other works will occur on the 2.04 ha northern section of the site as part of this proposal.

Lands within the study area intersect the Blacktown and Fairfield Local Government Areas (LGAs) and southwest parts of the Western Sydney Parklands (WSP). The area immediately surrounding the subject lands is characterised by industrial and transport infrastructure. The M7 Motorway bounds the development site to the west with the Eastern Creek industrial area located farther west. The now closed Eastern Creek landfill is located to the north and north-east with the operational Global Renewables waste management facility located immediately to the east. The Warragamba Pipeline Corridor abuts the southern boundary of the development site with the Austral Bricks site located farther south.



Legend

- Development Site
- Study Area (1500m)
- Western Sydney Parklands SEPP
- LGA Boundaries
- Lot
- Roads
- Warragamba Pipeline

Service Layer Credits:
Figure 3: Study area

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1.4 Legislative context

The application is categorised as State significant development (SSD) as it is electricity generating works with a capital investment value (CIV) greater than \$30 million for the purposes of Schedule 1 of the State and Regional Development (SRD) State Environmental Planning Policy (SEPP) (SRD SEPP) 2011. Approval under Division 4.7 of the EP&A Act is required with assessment and determination to be made by the Minister for Planning and Public Spaces or the Independent Planning Commission (IPC).

An Environmental Impact Statement (EIS) is a requirement of the approval process. The Planning Secretary's Environmental Assessment Requirements (SEARs) were issued by the NSW Department of Planning, Infrastructure and Environment on 12 December 2019, and state that biodiversity impacts must be assessed in accordance with the NSW Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR).

A summary of statutory documents relevant to the development is provided in the following sections.

1.4.1 *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) applies to those actions which are likely to have a significant impact on matters of national environmental significance (MNES). An EPBC Referral is triggered by undertaking an action that will have or is likely to have a significant impact on MNES or other protected matters. MNES that may be triggered as a result of the proposal include listed threatened species and ecological communities.

Two threatened species and one migratory species listed under the EPBC Act were recorded during field surveys. Assessment against the Commonwealth Significant Impact Guidelines 1.1 (DoE 2013), indicates the proposal will not significantly impact EPBC Act listed species. As such, works associated with the development do not require Commonwealth referral.

1.4.2 *Biodiversity Conservation Act 2016 (NSW)*

The *Biodiversity Conservation Act 2016* (BC Act) was introduced in 2017 to replace the *Threatened Species Conservation Act 1995* and those parts of the *National Parks and Wildlife Act 1974* that provide authorisation to undertaken activities that would otherwise be an offence. The BC Act provides a framework for the assessment of biodiversity and the implementation of the Biodiversity Offset Scheme (BOS) in NSW. The NSW Biodiversity Assessment Method

(BAM) supports the implementation of the BOS and establishes a consistent approach to assessing biodiversity values on lands within NSW.

Under the BC Act, impacts to biodiversity, including those associated with land clearing and development, must be assessed by an accredited person to determine proposal requirements for entry into the BOS. Entry into the BOS may be triggered where areas of outstanding biodiversity will be impacted, where land clearing exceeds area thresholds or where impacts to threatened species or ecological communities are likely to be significant. A proposal may also be refused where it is likely to result in serious or irreversible impacts to biodiversity, as defined by the BC Act.

This document has been prepared by an accredited biodiversity assessor (BAAS19077) in accordance with the BAM. It addresses requirements for the proposal under the BC Act including the assessment of proposal impacts to biodiversity and any offsets required to address residual significant impacts associated with the proposal.

1.4.3 State Environmental Planning Policy No.44 – Koala Habitat Protection

The State Environmental Planning Policy No.44- Koala Habitat Protection (SEPP 44) provides protection for koala habitat at a local government level to ensure permanent free-living koala populations in NSW. The SEPP applies to all Local Government Areas (LGAs) within the Land Application Map and triggers requirements the assessment of potential impacts to koala habitat where development or land clearing is proposed.

The proposal does not trigger requirements under SEPP44 as lands within the study area are not located within the Land Application Map.

1.4.4 State Environmental Planning Policy- Vegetation in Non-Rural Areas 2017 (Vegetation SEPP)

The Vegetation SEPP regulates clearing of native vegetation on urban land and land zones for environmental conservation and / or management that does not require development consent. The Vegetation SEPP applies to the Sydney and Newcastle metropolitan areas, and to all other land in NSW that is zoned for urban purposes or for environmental conservation / management under the Standard Instrument- Environmental Plan.

The Vegetation SEPP applies to the clearing of:

- Native vegetation above the BOS threshold where a proponent will require an approval from the Native Vegetation Panel established under the *Local Land Services Amendment Act 2016*.

- Vegetation below the BOS threshold where a proponent will require a permit from Council if that vegetation is identified in the Council's development control plan.

Clearing works associated with the proposal require development consent under Division 4.7 of the EP&A Act. As such, assessment and approval of proposed vegetation clearing is not required under Vegetation SEPP.

1.4.5 Fisheries Management Act 1994

The *Fisheries Management Act 1994* provides for the protection and management of aquatic species mainly fish in relation to commercial and recreational fishing. Part 7 of the FM Act deals with the protection of aquatic habitat, defined as *an area occupied, or periodically or occasionally occupied, by fish or marine vegetation (or both), and includes any biotic or abiotic component*. Part 7A of the FM Act deals with threatened species conservation.

The Policy and guidelines for fish habitat conservation and management (DPI 2013) support the implementation of the FM Act and provide the definition of Key Fish Habitats. Standard precautions and mitigation measures for development are set out within the document, including but not limited to:

- Requirements for erosion and sediment control for in-stream works to avoid impacts to water quality and fish passage
- Provisions for the protection of fish during the dewatering process of any coffer dams or the clearing of screens
- Directions for stockpiling of fill or excavated materials on flood prone lands
- Post-works rehabilitation requirements for aquatic habitats.

This document addresses permit requirements for the proposal under the FM Act, including proposed mitigation and management measures to minimise impacts to aquatic habitats within the study area.

1.4.6 State Groundwater Dependent Ecosystems Policy

The NSW Groundwater Dependent Ecosystems Policy (GDE Policy) provides for the protection of ecosystems reliant on groundwater for the maintenance of ecological processes. The GDE Policy sets out a number of principles to guide Groundwater Dependent Ecosystem (GDE) protection and management across the State. These principles are discussed within the document where relevant to the development.

1.5 Sources of information

A desktop review of publicly available spatial datasets and documentation was completed to gather existing information on biodiversity values for the study area. Information sources for the review included:

- EPBC Act Protected Matters Search Tool (PMST) search results for a 5 km radius to the study area (accessed 26 March 2020)
- NSW BioNet database results for a 10 km radius to the study area (accessed 21 January 2020)
- Commonwealth Species Profiles and Threats (SPRAT) database for relevant species
- Interim Biogeographic Regionalisation for Australia (IBRA) mapping
- NSW Mitchell Landscapes mapping, version 3.1 (DPIE 2016)
- NSW Key Fish Habitat mapping (DPI Fisheries 2007)
- High Ecological Value (HEV) Waterways and Water Dependent Ecosystems mapping (DPIE 2019)
- National Groundwater Dependent Ecosystems (GDE) Atlas (Bioregional Assessment Programme 2016)
- NSW Threatened Biodiversity Data Collection for relevant species (formerly known as the Threatened Species Profiles database)
- Remnant vegetation of the western Cumberland Plain subregion, 2013 mapping (DPIE 2015)
- Cumberland Subregion Biodiversity Investment Opportunities Map (BIO Map) Biodiversity Corridors of Regional Significance (OEH 2015)
- NSW Wetlands mapping (DECCW 2010)
- Ramsar Wetlands of NSW (DPIE 2012)
- Biodiversity Values Map and Threshold Tool (DPIE, accessed 21 January 2020)
- Spatial Information Exchange (SIX) maps 'Best' aerial imagery (Department of Finance, Services & Innovation 2018) (Best' imagery is defined as the smallest resolution and latest date imagery available over any area).
- Bureau of Meteorology (BOM) Commonwealth of Australia
- OEH online BAM calculator.

Relevant published literature as referenced in Section 9 of this report.

2 Landscape features

2.1 Identified features

Relevant landscape features identified for the study area are shown in Figure 4. These are detailed further in the following sections and include waterways, wetlands and connectivity features situated within a matrix of urban lands. No karst, caves, crevices, cliffs or areas of geological significance were identified.

2.1.1 IBRA bioregions and subregions

The study area is located entirely within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and the Cumberland IBRA subregion.

2.1.2 NSW landscape regions (Mitchell Landscapes)

The study area occurs across two soil types (Mitchell 2002), including:

- Cumberland Plain
- Hawkesbury – Nepean Channels and Floodplains.

Cumberland Plain soil landscape covers approximately 869.59 ha (97%) of the study area, occupying low rolling hills and valleys (30-120 m elevation) in the rain shadow between the Blue Mountains and the coast (Figure 4). Soils vary from red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys. Vegetation communities generally associated within the soil landscape comprise woodlands and open forest dominated by Grey Box *Eucalyptus moluccana*, Forest Red Gum *Eucalyptus tereticornis*, Narrow-leaved Ironbark *Eucalyptus crebra*, Thin-leaved Stringybark *Eucalyptus eugenioides*, Cabbage Gum *Eucalyptus amplifolia* and Broad-leaved Apple *Angophora subvelutina*. A grassy to shrubby understorey dominated by Australian Boxthorn *Bursaria spinosa* is generally associated with these communities with Swamp Oak *Casuarina glauca* and Paperbark *Melaleuca sp.* also present within poorly drained, often salt affected valley floors.

Hawkesbury – Nepean Channels and Floodplains cover only 27.22 ha (3%) of the study area (Figure 4). The soil landscape generally comprises Quaternary sand and gravel associated with the meandering channels and the moderately wide floodplain of the Hawkesbury and Nepean Rivers (0 to 20 m elevation). Typical vegetation communities include forests on river flats dominated by Blue Box *Eucalyptus baueriana*, Broad-leaved Apple *Angophora subvelutina*, Manna Gum *Eucalyptus viminalis* and River Peppermint *Eucalyptus elata* in upstream sections

with River Oak *Casuarina cunninghamiana* and rainforest species such as White Cedar *Melia azedarach* in lower sections.

2.1.3 Rivers and streams

The study area is located within the Hawkesbury – Nepean River catchment. The Hawkesbury – Nepean catchment covers about 21,400 km² and includes the coastal reaches from Turmetta Headland to Barrenjoey near its mouth, and catchments for the Warragamba, the Upper Nepean and the Mangrove Creek dams that are the main water supply reservoirs for the Sydney Metropolitan Area, including Gosford/ Wyong.

Although no watercourses are mapped for the development site, a discontinuous ephemeral stream was identified within low-lying areas adjacent to the eastern property boundary (Figure 4). The stream has been classified as an unmapped first order stream according to Strahler (1952). Other waterways within the study area have been classified based on stream order (Strahler 1952) and include:

- Reedy Creek (third order) and adjoining first and second order tributaries.
- Eastern Creek (third order) and adjoining first and second order tributaries.

Figure 4 shows waterways and associated riparian buffers within the study area, in accordance with Appendix 3 of the BAM.

Eastern Creek is situated approximately 500 m east of the development site and flows north to the Hawkesbury River. Reedy Creek is located approximately 400m to the west and north and joins Eastern Creek approximately 1.5 km north of the development site (Figure 4). Both waterways are mapped as key fish habitats (DPI Fisheries 2007).

According to the DPIE (2019), the study area supports High Ecological Value (HEV) waterways and water dependent ecosystems (Figure 4). These are mapped for Reedy Creek and Eastern Creek in the study area and the existing farm dam and adjacent vegetation within the development site.

2.1.4 Wetlands

No Ramsar wetlands or Nationally Important Wetlands have been mapped within the study area. The closest Ramsar Wetland is Towra Point Nature Reserve, located approximately 34 km southeast of the study area (DPIE 2012).

Review of the NSW Wetlands spatial layer (DECCW 2010) indicates two wetlands are located south east of the development within the Austral Bricks property boundary (Figure 4). Review of aerial imagery indicates an unmapped wetland is also located within the Austral Bricks site, approximately 160 m south of the development site (Figure 4). Following heavy rainfall, the wetland is likely

to drain to the north, across the Warragamba Pipeline Corridor and through eastern parts of the development site.

2.1.5 Connectivity features

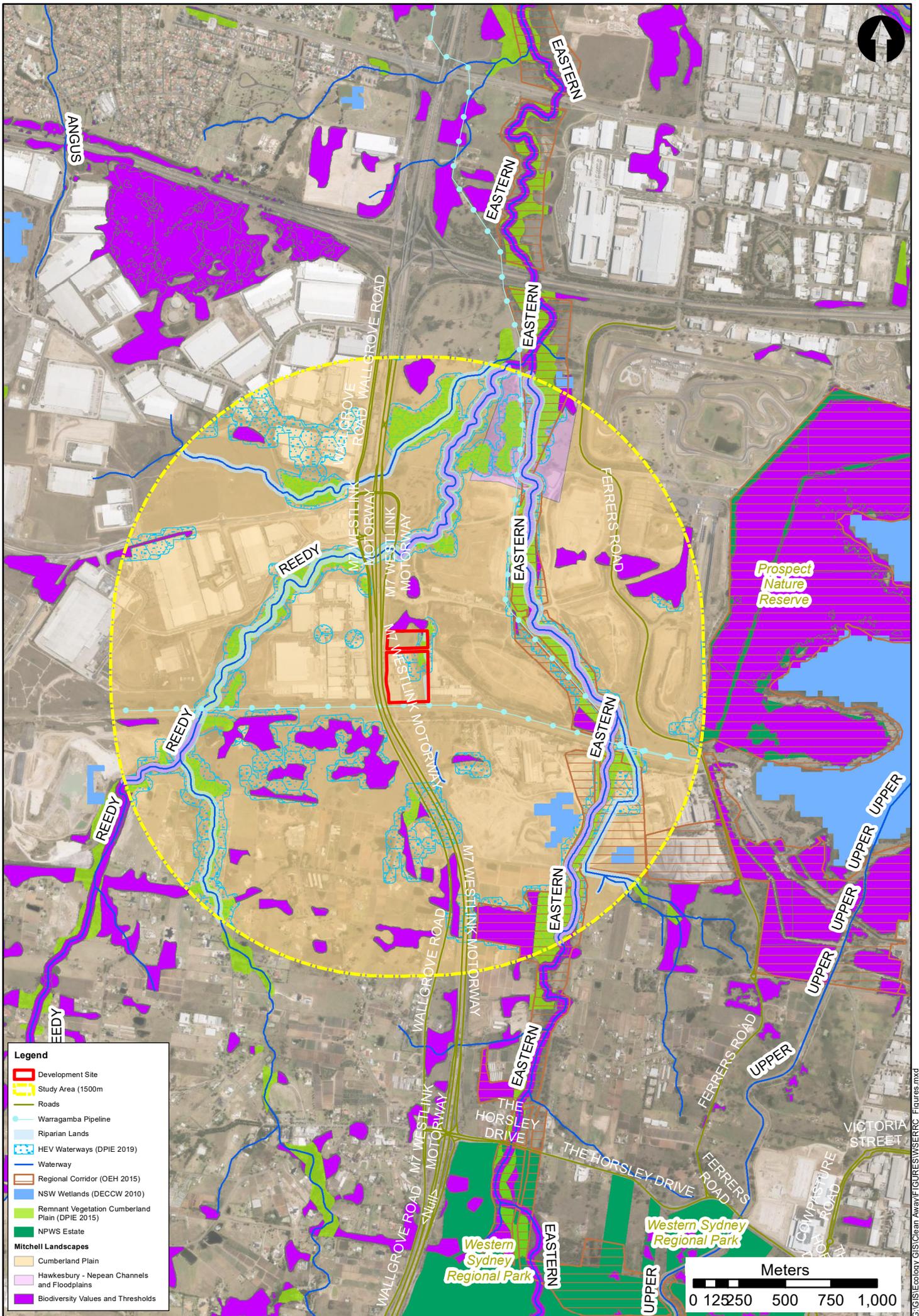
Biodiversity corridors are landscape connections between larger areas of fauna habitat. They are critical for maintaining ecological processes including fauna dispersal and the continuation of viable populations. Biodiversity corridors may include stepping stones such as discontinuous areas of habitat, paddock trees, wetlands or roadside vegetation or continuous linear strips of vegetation such as riparian corridors or ridgelines.

According to OEH (2015) BIO Map regional biodiversity corridor mapping, riparian vegetation associated with Eastern Creek forms a regionally significant biodiversity corridor connecting Prospect Reservoir (approximately 1.5 km to the east of the development site) with other National Parks estate in the landscape. Existing vegetation associated with Reedy Creek also offers some north-south connectivity with Eastern Creek.

Smaller stands of remnant vegetation and scattered trees are located within the development site and southern parts of the study area offering localised stepping stone connectivity between adjacent waterways and larger vegetated remnants to the north and south.

2.1.6 Biodiversity Values Map

Review of the Biodiversity Values Map and Thresholds Tool (DPIE, 2020) indicates mapped biodiversity values overlapping the northern boundary of the site (Figure 4). Other mapped biodiversity values within the study area include Eastern Creek riparian corridor, Reedy Creek riparian corridor to the north of the site and remnant vegetation to the north and south of the site.



Service Layer Credits:

Figure 4: Location map

2.2 Site context

Site context considerations include the assessment of native vegetation cover and patch size, in accordance with Section 4.3 of the BAM.

2.2.1 Native vegetation cover

The extent of native vegetation cover within the study area was determined using a combination of site-based vegetation mapping (Arup 2020) and DPIE (2015) remnant vegetation mapping for the western Cumberland Plain subregion.

Approximately 134.18 ha (15%) of mapped native vegetation was identified for the study area, as summarised in Table 5.

Table 5: Native vegetation cover

Native vegetation extent (ha)	% landscape assessment area	Native vegetation cover class
134.18	15%	10-30%

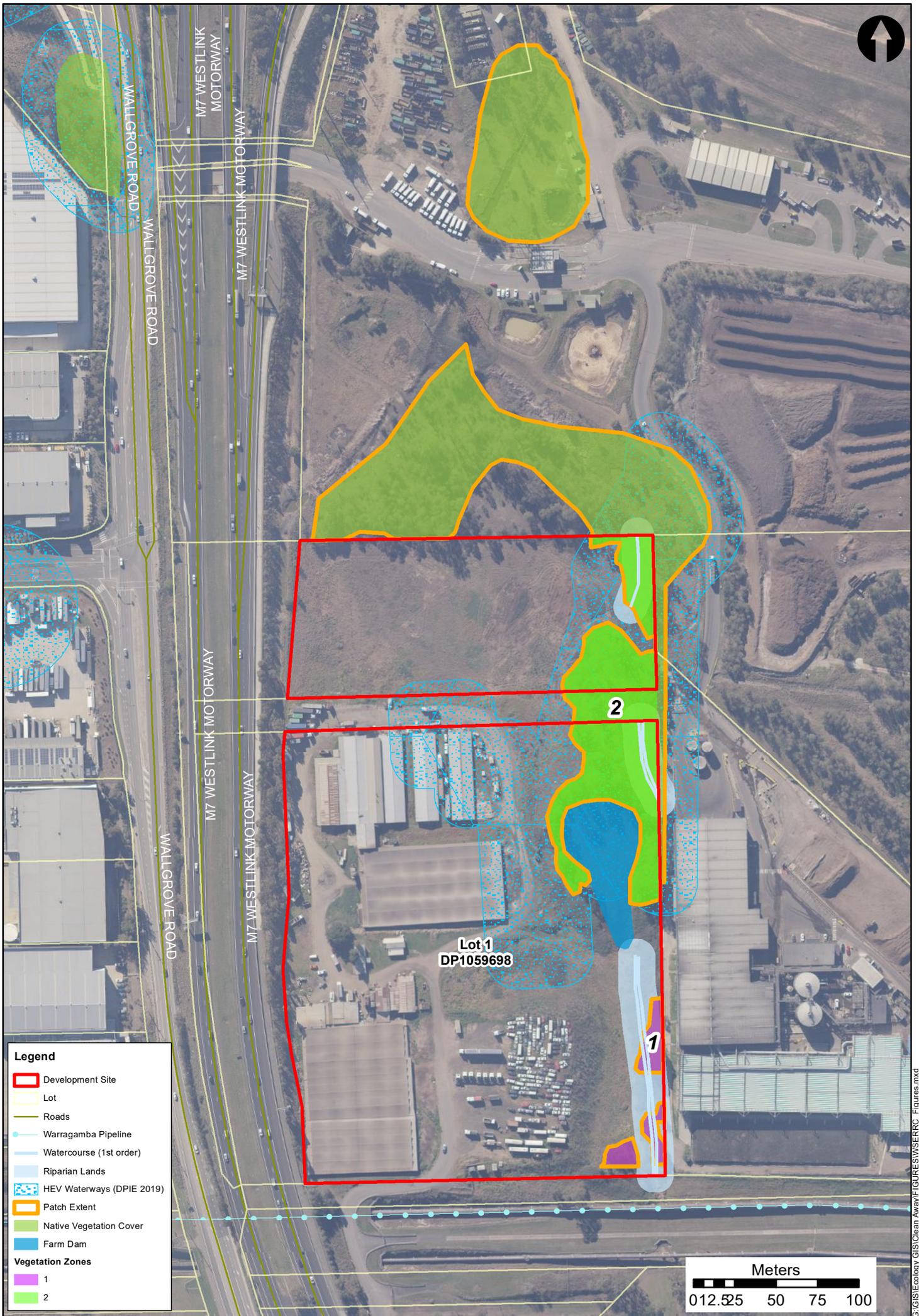
2.2.2 Patch size

A combination of site-based vegetation mapping (Arup 2020) and DPIE (2015) remnant vegetation mapping was used to assess patch size for each vegetation zone within the development site, in accordance with the BAM. Patch size classes are identified for each vegetation zone in Table 6. In accordance with Part 2 of the BAM, as vegetation zones within the development site occurred less than 100 m apart, they were assigned to the same patch.

Mapped vegetation located approximately 70 m to the north of the site was also assigned to the patch. A small stand occurring approximately 200 m to the northwest of the vegetation was not included in the patch (Figure 5).

Table 6: Patch size of each vegetation zone within the study area

Vegetation zone)	Patch size (ha)	Patch size class
1	2.99 ha	<5ha
2	2.99 ha	<5ha



Service Layer Credits:

Figure 5: Site map

3 Native vegetation

3.1 Methodology

3.1.1 Data gathering

Existing spatial datasets and documentation relevant to terrestrial vegetation communities within the study area was gathered to inform requirements for more targeted field surveys. Relevant information sources for the review are outlined in Section 1.6 of this document.

3.1.2 Vegetation surveys

Vegetation within the development site was initially surveyed to note the extent and structure of existing vegetation and dominant species within each stratum. Signs of disturbance such as clearing, fire damage or weed invasion were also noted. Native vegetation confirmed within the site was classified using the BioNet Vegetation Classification application and stratified according to broad condition state to inform targeted surveys.

Each PCT and associated condition class was mapped for the development site as a separate vegetation zone with minimum requirements for targeted survey determined in accordance with the BAM. Vegetation zones and minimum plot requirements are detailed in Table 7.

Table 7: Minimum targeted survey requirements

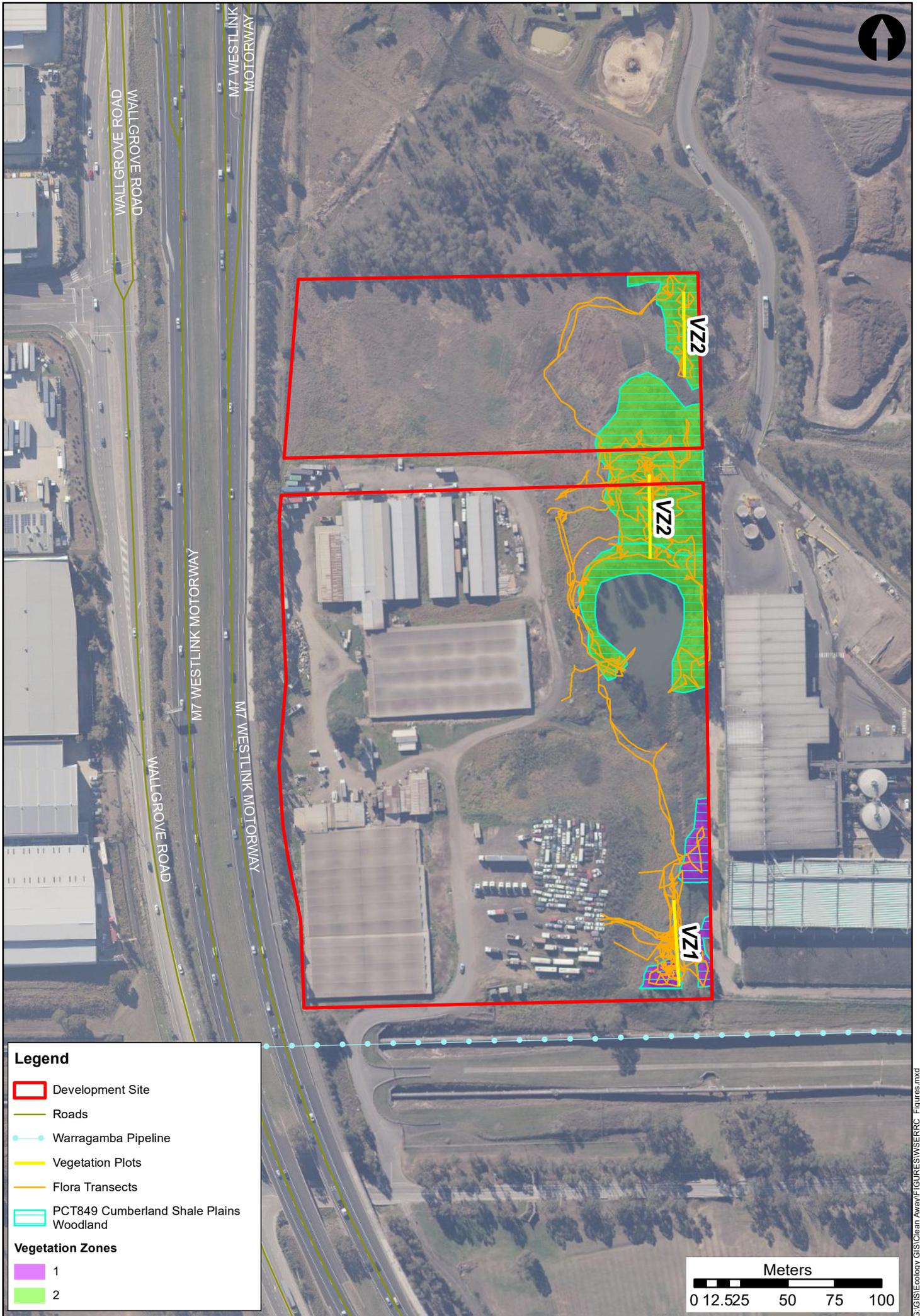
Vegetation Zone	Extent within the development site (ha)	Minimum plot requirements	No. plots surveyed
1	0.11	1	1
2	0.77	1	2

Targeted vegetation surveys were carried out for the development site in accordance with the BAM and included a total of three plots as shown in Figure 6. Plots were located wholly within vegetation zones wherever possible. However, small discontinuous patches associated with Vegetation Zone 1 comprised scattered trees and locating a plot wholly within these zones was difficult due to dense thickets of Blackberry *Rubus fruticosus* in the understorey (Photograph 1). A plot was instead located across these zones, where access permitted, so as to allow for the survey of as much of the zone as possible.

Plot data was imported into the BAM Calculator to generate a vegetation integrity score for each vegetation zone in accordance with the BAM.



Photograph 1: Photo taken adjacent to drainage channel looking southeast showing dense Blackberry thickets limiting access within some parts of the site



Service Layer Credits:

Figure 6: Native vegetation

3.2 Vegetation communities

The development site supports approximately 0.88 ha of native vegetation comprising one PCT with varying levels of disturbance and condition (Figure 6). Native vegetation within the subject lands generally comprises isolated patches of regrowth Cumberland Shale Plains Woodland (PCT 849) within low-lying areas along the eastern property boundary. Some sedges including Bulrush *Typha orientalis*, Giant Rush *Juncus pallidus* and Pampas grass *Cortaderia sp.* were also noted within the stream and farm dam perimeter. However these did not dominate the understorey and were limited to areas generally too small to map as discrete patches at the edge of standing water.

Vegetation within the site is subject to high levels of disturbance due to historical land clearing, agricultural land uses and ongoing industrial and transport activities within adjacent lands. A review of historical aerial imagery (Google Earth 2020) suggests much of the site has been historically cleared with only scattered mature trees being observed within the site prior to 2004. These were located adjacent to and to the north of the farm dam. Eucalypt woodland communities have since regenerated within low-lying areas along the eastern boundary of the site. However, vegetation structure is poor due to a young age class and a dominance of exotic species within the understorey strata. The balance of the development site supports developed areas and exotic pasture.

Table 8 identifies vegetation zones, condition, extent and TEC status for the subject lands. Table 8 also includes the vegetation integrity score for each vegetation zone, as calculated in the BAM Calculator. A full description of the floristic composition and structure of the confirmed PCT on the development site is provided within Table 9. A detailed flora schedule is provided in Appendix D.

Table 8: Vegetation zones within the study area

Vegetation Zone	PCT	Condition	TEC	Vegetation integrity score	Extent (ha)
1	PCT 849 Cumberland Shale Plains Woodland	Very Poor	Cumberland Plain Woodland	20.6	0.11
2	PCT 849 Cumberland Shale Plains Woodland	Poor	Cumberland Plain Woodland	31	0.77

Table 9: PCTs identified within the development site

PCT 849 Cumberland Shale Plains Woodland	
Vegetation formation	Grassy Woodlands
Vegetation class	Coastal Valley Grassy Woodlands
Conservation status	EPBC ACT: Critically endangered; BC Act: Critically endangered
Regional extent	93% cleared
Extent within subject lands	Approximately 0.88 ha of this PCT was recorded within the development site generally corresponding with riparian lands adjacent to the eastern property boundary.
Description	<p>A sparse (1-20% cover) regenerating canopy (T1: 6-22 m) dominated by Grey Box <i>Eucalyptus moluccana</i> and Forest Red Gum <i>Eucalyptus tereticornis</i> was observed.</p> <p>The shrub layer (S: 1.5-2.5 m) was generally sparse (~20%) and dominated by exotic species including African Boxthorn <i>Lycium ferocissimum</i>*, Fennel <i>Foeniculum vulgare</i>*, Common Sida <i>Sida rhombifolia</i>* and African Olive <i>Olea europaea subsp. suspidata</i> with some Native Blackthorn <i>Bursaria spinosa</i> observed. Dense thickets of Blackberry <i>Rubus fruticosus</i>* occurred throughout with Bulrush <i>Typha orientalis</i> and Giant Rush <i>Juncus pallidus</i> occurring in some small patches along the existing channel and around the perimeter of the farm dam.</p> <p>A dense (~85% cover) ground layer (U:<1 m) was observed dominated by Kikuyu Grass <i>Cenchrus clandestinus</i>* and Rhodes Grass <i>Chloris gayana</i>* with some Weeping Grass <i>Microlaena stipoides</i>, Ribwort Plantain <i>Plantago lanceolata</i>*, Curly Dock <i>Rumex crispus</i>* and Variable Glycine <i>Glycine tabacina</i>.</p> <p>*denotes exotic species</p>
Condition	<ul style="list-style-type: none"> • VZ1: Very Poor: This zone supports extremely poor floristic composition and structure as a result of historical clearing and weed invasion. The canopy layer (T: 5-8 m) is limited to scattered regenerating Grey Box and Forest Red. The shrub and ground layers were dominated by exotic species. • VZ2: Poor: This zone supports a more mature canopy (T12-22m) layer and higher levels of species richness in the shrub and ground layer.

**Cumberland
Shale Plains
Woodland**



Photograph 2: View looking east immediately north of the farm dam



Photograph 3: View looking north showing sedges within the stream

3.3 Threatened ecological communities

Native vegetation identified within the development site was considered consistent with the BC Act listed Cumberland Plain Woodland in the Sydney Basin Bioregion critically endangered ecological community (Table 10). The confirmed PCT also has the potential to be associated with the EPBC Act listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest Threatened Ecological Community (TEC). However as detailed below in this section it does not meet required key diagnostic features and condition thresholds.

Table 10: Threatened Ecological Communities (TECs) within the development site

PCT	TEC	Conservation status*		Regional extent	
		EPBC	BC	Estimate extent remaining	Estimate % cleared
PCT 849 Cumberland Shale Plains Woodland	Cumberland Plain Woodland	CE	CE	6800 ha	93%

*Table codes: E- Endangered, V- Vulnerable, C – Critical, CE- Critically Endangered, M- Marine/Migratory.

Key diagnostic features and condition thresholds for the EPBC Act listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC are provided in the *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest: A guide to identifying and protecting the nationally threatened ecological community EPBC ACT Policy Statement 3.31* ((DEWHA, 2010). According to DEWHA (2010), vegetation can be considered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC where one of the following scenarios are addressed:

- Criteria 1, 2 and 3 are all met.
- Criteria 3, 4 and 7 are all met.
- Criteria 3, 5 and 7 are all met.
- Criteria 3, 6 and 7 are all met.

An assessment against key diagnostic features and condition thresholds for the TEC is provided in Table 11. The results of the assessment indicate vegetation within the development site does not meet the requirements for the EPBC Act listed TEC.

Table 11: Assessment against key diagnostic features and condition thresholds

Criteria	Key diagnostic features and condition thresholds	Site observations	Key diagnostic feature or condition threshold met
1	Native tree species present with a minimum project foliage cover of 10%	Native trees species present and dominated by <i>E.tereticornis</i> and <i>E.mollucana</i> . Projected foliage cover 1-20% recorded.	Yes
2	The patch of the ecological community is 0.5ha or greater in size	A total of 0.88 ha of the vegetation community occurs within the site in five discrete patches. The largest individual patch is 0.43ha.	No
3	Perennial understorey vegetation cover comprises of 50% native species or more	Understorey cover comprised approximately 70% cover of exotic species and 30% native species cover	No
4	The patch is 5ha or more in size	A total of 0.88 ha of the vegetation community occurs within the site in five discrete patches. The largest patch is 0.43ha.	No
5	Patch contiguous with a native vegetation patch 5ha or more in size	Vegetation within the site is part of a larger patch size that extends 2.99ha	No
6	Does the patch contain at least one tree per ha that is large (>80cm dbh) or has a hollow?	No trees were recorded >50cm dbh or supporting hollows. Only one hollow was observed in the site within a stag.	No
7	Perennial understorey vegetation cover comprises 30% native species	Understorey cover comprised approximately 70% cover of exotic species and 30% native species cover	Yes

3.4 Groundwater dependent ecosystems

Review of the National Groundwater Dependent Ecosystems (GDE) Atlas (BAP 2016) indicates the development site does not support vegetation reliant on the surface expression of groundwater. Some parts of the study area are mapped as GDEs reliant on subsurface groundwater expression, as shown in Figure 7. Ground-truthing of mapping during field surveys indicates these features comprise exotic grassland only. No GDEs were confirmed for the development site.



Legend

- Development Site
- Roads
- Warragamba Pipeline
- Groundwater Dependent Ecosystem (BAP 2016)

Meters

0 12.525 50 75 100

Service Layer Credits:

Figure 7: Mapped groundwater dependent ecosystems

© Arup 2020

©GIS/Ecology GIS/Clean Away/FIGURES/WSERRC_Figures.mxd

4 Threatened species

4.1 Candidate species credit species

4.1.1 Identifying habitat suitability for threatened species

A preliminary assessment was undertaken using the BAM Calculator to identify threatened flora and fauna species with potential to occur within the study area. Ground-truthed PCTs were entered into the BAM calculator including maximum values for native vegetation cover, patch size and vegetation integrity. Ecosystem credit species and species credit species predicted for the study area are provided in Appendix A.

A search of relevant government databases was also carried out for a 10 km radius to the development site to identify any additional threatened species not identified by the BAM calculator. Desktop sources for the review are detailed in Section 1.6. Desktop search results are provided in Appendix B.

The suitability of habitat in the study area was assessed according to the steps outlined in BAM Section 6.4- *Steps for identifying habitat suitability for threatened species* (Appendix C). A summary of the assessment results is presented in Table 9 and forms the basis for the assignment of candidate status to species credit species.

Table 12: Consideration of species requiring further assessment and identification of candidate species

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Frogs						
Red-crowned Toadlet	<i>Pseudophryne australis</i>	V	-	No	Site does not contain sufficient native vegetation cover.	No
Green and Golden Bell Frog	<i>Litoria aurea</i>	E	V	Yes	Found in a wide range of water bodies except fast flowing streams including disturbed / contaminated sites. Suitable habitat within drainage line and near farm dam.	Yes
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	V	V	No	Site does not contain sufficient native vegetation cover. No burrowing frogs have been recorded in cleared lands. Occurs in hanging swamps on sandstone shelves and beside perennial creeks- not present on site.	No
Birds						
Glossy Black Cockatoo	<i>Calyptorhynchus lathami</i>	V	-	No	No suitable breeding habitat observed. Requires hollows greater than 15cm diameter and greater than 5m above ground Lack of suitable foraging resources (i.e. <i>Allocasuarina sp./ Casuarina sp.</i>) – only two single trees recorded	No
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	-	No	No suitable foraging habitat. No hollow-bearing trees of suitable size present.	No
Little Eagle	<i>Hieraetus morphnoides</i>	V	-	Yes	Marginal foraging habitat due to degradation. No suitable trees with nests identified on site.	No
Swift Parrot	<i>Lathamus discolor</i>	E	CE	No	Lives on edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Site not within mapped important habitat areas.	No
Powerful Owl	<i>Ninox strenua</i>	V	-	No	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. No suitable breeding habitat present.	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
					Common prey species unlikely to occur as no hollows present on site.	
Masked Owl	<i>Tyto novaehollandiae</i>	V	-	Yes	Lives in dry eucalypt forest and woodlands from sea level to 1100m. No suitable breeding habitat present. Marginal foraging habitat.	No
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	-	No	Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Marginal habitat unlikely to support the species – lacks native grasses and structural diversity.	No
Scarlet Robin	<i>Petroica boodang</i>	V	-	No	Dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. Marginal habitat unlikely to support the species – highly disturbed	No
Bush Stone-Curlew	<i>Burhinus grallarius</i>	E	-	No	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Site supports marginal habitat unlikely to support the species – highly disturbed. No significant fallen timber present.	No
Speckled Warbler	<i>Anthonicola sagittata</i>	V	-	No	Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. Marginal habitat unlikely to support the species – highly disturbed lacking typical habitat structure and diversity.	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Diamond Firetail	<i>Stagonopleura guttata</i>	V	-	No	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Marginal habitat unlikely to support the species – highly disturbed with no native grassland.	No
Black-chinned Honeyeater	<i>Melithreptus gularis gularis</i>	V	-	No	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Patch size insufficient to support the species.	No
Spotted Harrier	<i>Circus assimilis</i>	V	-	No	Occurs in grassy open woodland including <i>Acacia</i> 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. Marginal habitat unlikely to support the species – highly disturbed.	No
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-	No	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range. Fallen timber is an important habitat component for foraging. Marginal habitat unlikely to support the species – highly disturbed and lacks hollow-bearing trees.	No
Painted Honeyeater	<i>Grantiella picta</i>	V	V	No	Inhabits Boree/ Weeping Myall <i>Acacia pendula</i> , Brigalow <i>A. harpophylla</i> and Box-Gum Woodlands and Box-Ironbark Forests. Mistletoes not present at required density – not habitat	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	CE	No	Most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forests, but also inhabits riparian vegetation and lowland coastal forest. Site not within mapped important habitat areas.	No
Varied Sitella	<i>Daphoenositta chrysoptera</i>	V	-	No	Occupies eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Marginal habitats within the site unlikely to support the species – highly disturbed	No
Square-tailed Kite	<i>Lophoictinia isura</i>	V	-	Yes	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a preference for timbered watercourses. No nest trees observed. Marginal foraging habitat	No
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	V	-	No	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Breeding habitat includes stick nests in large emergent eucalypts often with emergent dead branches or large dead trees nearby which are used as 'guard roosts'. No stick nests present and foraging habitat within 1km of site is marginal, with small creeks and dams.	No
Barking Owl	<i>Ninox connivens</i>	V	-	No	Requires living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground. No suitable breeding habitat present. Common prey species unlikely to occur as no hollows present on site.	No
Eastern Osprey	<i>Pandion cristatus</i>	V	-	No	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Fish over open water. Habitat within the site is unsuitable for species.	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Snails						
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E	-	Yes	Primarily inhabits Cumberland Plain Woodland. Grassy, open woodland with occasional dense patches of shrubs. Species relies on a good cover of woody debris, is affected by rodent predation. Leaf litter and woody debris were generally sparse but present in some areas.	Yes
Dural Land Snail	<i>Pommerhelix duralensis</i>	E	E	No	Requires leaf litter and shed bark or within 50m of litter or bark. May also be found within 50m of rocky areas, fallen rocks or standing dead timber including logs including logs and bark. Leaf litter and woody debris were generally sparse but present in some areas.	Yes
Mammals						
Southern Myotis	<i>Myotis macropus</i>	V	-	Yes	Generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, underbridges and in dense foliage. Requires hollow-bearing trees: Within 200 m of riparian zone	Yes
Koala	<i>Phascolarctos cinereus</i>	V	V	No	Naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalypt species. Marginal habitat present due to small amount of food trees. No koala records occur within 2.5km of site.	No
Yellow-bellied Glider	<i>Petaurus australis</i>	V	-	No	Nest in hollows within tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. No hollow-bearing trees matching constraint were recorded on site	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	-	No	Nests in hollows within 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. No hollow-bearing trees suitable for this species recorded on site. Low abundance and diversity of food resource species.	No
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	No	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Degraded habitat unlikely to support prey species and provides no suitable den habitat.	No
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	No	Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is habitat of importance. Rainforest and most eucalypt forest at high elevation. No natural rocky habitat features were identified on site or within 2km during site survey and review of aerial mapping. No signs of roosting within disused structures on site.	No
Large Bent-winged Bat	<i>Miniopterus oriana oceanensis</i>	V	-	No	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Maternity caves have very specific temperature and humidity regimes. Hunt in forested areas, catching moths and other flying insects above the tree tops.	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
					Site contains potential foraging habitat. No habitat features suspected to be used for breeding were identified on site	
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	-	No	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Site contains potential foraging habitat. Disused buildings on site may also be used for roosting. No hollows present.	No
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	-	No	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. Patch size and native vegetation cover at site not sufficient to support the species.	No
Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	V	V	Yes	No camps were identified on the site or in the immediate surrounding area. Very limited foraging resources noted within proximity to the site.	No
Eastern Pygmy possum	<i>Cercartetus nanus</i>	V	-	No	Shelters in tree hollows, rotten stumps and other nests within rainforest and dry sclerophyll (including Box-Ironbark) forest and woodland to heath. Very limited foraging resources available and habitat very marginal, no hollow-bearing trees or suitable nest sites identified on site	No
Little Bentwing-bat	<i>Miniopterus australis</i>	V	-	No	Breeding habitat includes caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding. Site contains potential foraging habitat. No habitat features suspected to be used for breeding were identified on site	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-	No	Breeding habitat includes caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding. Site contains potential foraging habitat. No habitat features suspected to be used for breeding were identified on site	No
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	-	No	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. sufficient vegetation cover and hollows were not recorded within the site. No habitat features suspected to be used for breeding were identified on site	No
Greater Glider	<i>Petauroides volans</i>	-	V	No	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Sufficient vegetation cover and hollows were not recorded on site	No
Reptiles						
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	E	V	No	Habitat constraints include escarpments, outcrops and pagodas within the Sydney Sandstone geologies. No suitable habitat on site.	No
Plants						
Bynoe's Wattle	<i>Acacia bynoeana</i>	V	E	No	Heath or dry sclerophyll forest on sandy soils. Associated overstorey species include Red Bloodwood, Scribbly Gum, Paramatta Red Gum, Saw Banksia and Narrow-leaved Apple. No suitable habitat-vegetation is grassy woodland dominated by <i>E.tereticornis</i> and <i>E.mollucana</i> .	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
Downy Wattle	<i>Acacia pubescens</i>	V	V	Yes	Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Marginal habitat within PCT849	Yes
<i>Allocasuarina glareicola</i>	<i>Allocasuarina glareicola</i>	E	E	No	Grows in Castlereagh woodland on lateritic soil. Common associated understory species include <i>Melaleuca nodosa</i> , <i>Hakea dactyloides</i> , <i>H.sericea</i> , <i>Dillwynia tenuifolia</i> , <i>Micromyrtus minutiflora</i> , <i>Acacia elongata</i> . Restricted to Richmond district and unlikely to occur on the site.	No
Thick Lip Spider Orchid	<i>Caladenia tessellata</i>	E	V	No	Extant populations occur in two known locations; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Prefers low, dry sclerophyll woodland (for example open <i>Kunzea</i> woodland) with a heathy or sometimes grassy understorey on clay loams or sandy soils. Also known to occur in in dry, low Brittle Gum (<i>Eucalyptus mannifera</i>), Inland Scribbly Gum (<i>E. rossii</i>) and <i>Allocasuarina</i> spp. woodland with a sparse understorey and stony soil. No known populations in the vicinity of the development site. The site does not support suitable habitat for the species.	No
White-flowered Wax Plant	<i>Cynanchum elegans</i>	E	E	No	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted	Yes

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
					Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honey myrtle <i>Melaleuca armillaris</i> scrub to open scrub. Marginal habitat within PCT849	
<i>Dillwynia tenuifolia</i>	<i>Dillwynia tenuifolia</i>	V	-	No	Scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterite clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. Marginal habitat within PCT849	Yes
<i>Dillwynia tenuifolia</i> , Kemps Creek	<i>Dillwynia tenuifolia</i>	V	-	No	Endangered population restricted to Kemps Creek, Liverpool LGA	No
Camden White Gum	<i>Eucalyptus benthamii</i>	V	V	No	Occurs in open forest with deep alluvial soils and rivers and streams with bare silt deposits, typically 30-60m elevation. Suitable habitat restricted to the alluvial flats of the Kedumba/Cox/Nepean River system at altitudes of 140-750m. Habitat within the site is not suitable.	No
Yellow Gnat-orchid	<i>Genoplesium baueri</i>	E	E	No	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has a very limited geographic extent with most records from areas between Ulladulla and northern Sydney. This site is subject to considerable disturbance and unlikely to provide suitable habitat for the species.	No
Wingless Raspwort	<i>Haloragis exalata</i>	V	V	No	Occurs on edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100m.	Yes

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
					Habitat within the stream and near farm dam very marginal and subject to very high levels of disturbance	
Knotweed	<i>Persicaria elatior</i>	V	V	No	Within 50m of semi-permanent/ ephemeral wet areas, swamps or waterbodies including wetlands Marginal habitat within stream and near farm dam.	Yes
Bargo Geebung	<i>Persoonia bargoensis</i>	E	V	No	Woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils. Known to occur within Shale/Sandstone Transition Forest. Restricted to a small area south-west of Sydney bounded by Picton, Douglas Park, Yanderra and Cataract River. This site is subject to considerable disturbance and unlikely to provide suitable habitat for the species.	No
Hairy Geebung	<i>Persoonia hirsuta</i>	E	E	No	Found in sandy soils in dry sclerophyll open forest, in woodland and heath on sandstone. Marginal habitat within PCT849	Yes
Nodding Geebung	<i>Persoonia nutans</i>	E	E	No	Confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities. Known to occur in Castlereagh Ironbark Forests. Marginal habitat within PCT849	Yes
	<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	No	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodland. Marginal habitat within PCT849	Yes
Spiked Rice-flower	<i>Pimelea spicata</i>	E	E	Yes	On Cumberland Plain sites it is associated with Grey Box communities and in areas of iron bark. Co-occurring species in the Cumberland Plain sites are grey box, forest red gum and narrow-leaved iron bark.	Yes

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
					Suitable habitat within PCT849	
Rufous Pomaderris	<i>Pomaderris brunnea</i>	V	E	No	Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Site subject to considerable disturbance and does not provide suitable habitat. No known populations within proximity to the site.	No
Illawarra Greenhood	<i>Pterostylis gibbosa</i>	E	E	No	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. Grows in woodland dominated by Forest Red Gum and White Feather Honey-myrtle. The species is known from a small number of populations in the Hunter, Illawarra and Shoalhaven regions. According to Commonwealth conservation advice it is extinct on the Cumberland Plain. Habitat within the site is significantly disturbed and does not provide suitable habitat.	No
Sydney Plains Greenhood	<i>Pterostylis saxicola</i>	E	E	No	Species currently only known from five locations including Georges River National Park, near Yeramba Lagoon, Ingleburn, Holsworthy, Peter Meadows Creek and St Marys Towers near Douglas Park. Requires intact forest, sclerophyll forest or woodland in shallow sandy soil over flat sheets of sandstone rock shelves above cliff lines and also in crevices between sandstone boulders; often in close proximity to streams. Site not within known species location and does not support suitable habitat - no sandstone shelves or similar preferred habitats	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
	<i>Pultenaea parviflora</i>	V	E	Yes	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest. This species re-establishes from soil-stored seed and there is no evidence of vegetative spread. Marginal habitat within PCT849.	Yes
Matted Bush-pea	<i>Pultenaea pedunculata</i>	E	-	No	Woodland in clay or sandy-clay soils. Known within Cumberland Plain woodlands. Only known from two locations in the Sydney region at Villawood and Prestons. Site conditions unsuitable due to dense exotic dominated understorey.	No
Magenta Lilly Pilly	<i>Syzygium paniculatum</i>	V	E	No	Restricted mainly to remnant stands of littoral (coastal rainforest). Occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. Unsuitable habitat – no rainforest vegetation communities present	No
Netted Bottle Brush	<i>Callistemon linearifolius</i>	-	V	No	Grows in dry sclerophyll forest and adjacent ranges. Marginal habitat within PCT849	Yes
Austral Pillwort	<i>Pilularia novae-hollandiae</i>	-	E	No	Grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud. Only known extant populations in NSW are located at Lake Cowal and Oolambeyan National Park. Habitat within the site is subject to very high levels of disturbance and is unlikely to be suitable for the species.	No

Common name	Scientific name	BC Act*	EPBC Act*	Bionet records within 2.5km of site	Habitat suitability	Candidate species
	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	-	E	Yes	Occurs as very scatter plants in areas of remnant vegetation. Relatively recent records from Prospect Reservoir, located within the study area. Generally grows in vine thickets and open shale woodland. Site subject to historical clearing and marginal for the species	Yes
Marsdenia viridiflora subsp. Viridiflora-endangered population	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	E	-	Yes	Restricted to the Bankstown, Blacktown, Camden, Cambelltown, Fiarfield, Holroyd, Liverpool & Penrith LGAs Relatively recent records from Prospect Reservoir, located within the study area. Generally grows in vine thickets and open shale woodland. Site subject to historical clearing and marginal for the species	Yes
Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	-	V	No	Associated with species within Cumberland Plain Woodland and Shale/Gravel Transition Forest. PCT849 offers marginal habitat for the species	Yes
Austral Toadflax	<i>Thesium australe</i>	V	V	No	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass. No known populations within the area. Woodland within the site does not support preferred host grasses.	No

*Table codes: E- Endangered, V- Vulnerable, C – Critical, CE- Critically Endangered, M- Marine/Migratory.

4.1.2 Candidate species requiring targeted survey

Candidate species credit species identified as requiring further assessment include four threatened fauna species and thirteen threatened flora species. Table 13 identifies these species, including necessary targeted surveys and the appropriate targeted survey method used to survey them.

Table 13: Candidate species and targeted survey requirements

Species name	Credit class	Conservation status*		Targeted survey required?	BAM required survey period	Survey guidelines	Survey design employed
		BC Act	EPBC Act				
Fauna species							
Southern Myotis <i>Myotis macropus</i>	Species	V		Yes- potential breeding habitat	Oct-Mar	'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH, 2018)	Assessment of potential roosting, foraging and breeding habitat in the study area. Three SM2 song meters deployed for six nights, for a total of 18 detector nights (Minimum 16 detector nights required by guideline).
Green and Golden Bell Frog <i>Litoria aurea</i>	Species	E	V	Yes	Nov-Mar	Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the EPBC Act (DEWHA, 2010)	<p>Guidelines require the following:</p> <ul style="list-style-type: none"> • Survey conducted within one week of heavy rainfall (October–February)(heavy rainfall is >50 mm in seven days) • Incorporating habitat assessment, call recognition, call playback and spotlighting • Four nights minimum • Approximately one hour of searching per 50m of waterway <p>Surveys for this assessment were conducted across four nights in Mid-February (following rainfall</p>

Species name	Credit class	Conservation status*		Targeted survey required?	BAM required survey period	Survey guidelines	Survey design employed
		BC Act	EPBC Act				
							of 197mm in the preceding seven days). Active searching was limited to sections of the dam and drainage lines not overgrown with blackberries and where it was safe to approach the waters edge. Active searching was undertaken using handheld and head mounted spotlights. Call playback was conducted at three points around the dam minimum each night.
Cumberland Plain Land Snail <i>Meridolum corneovirens</i>	Species	E		Yes	Year-round	No standard survey guidelines exist.	Survey consisted of approximately two minutes of searching using trowels in leaf litter and woody debris at the base of most Forest Red Gums and Grey Boxes in the study area. All substantial areas of litter and pieces of debris were searched and replaced in the same position as far as possible.
Dural Land Snail <i>Pommerhelix duralensis</i>	Species	E	E	Yes	Year-round		
Flora species							
Downy Wattle <i>Acacia pubescens</i>	Species	V	V	Yes	Year-round	NSW Guide to Surveying Threatened Plants (OEH 2016)	Surveys involved parallel field traverses 5-10m apart, depending on the density of vegetation. All surveys were carried out during
White-flowered Wax Plant <i>Cynanchum elegans</i>	Species	E	E	Yes	Year-round		

Species name	Credit class	Conservation status*		Targeted survey required?	BAM required survey period	Survey guidelines	Survey design employed
		BC Act	EPBC Act				
<i>Dillwynia tenuifolia</i>	Species	V	-	Yes	Aug-Oct		<p>the suitable seasonal window for candidate flora except:</p> <ul style="list-style-type: none"> • <i>Dillwynia tenuifolia</i>: the species is best surveyed in September when abundantly flowering. However, the species can still be effectively detected during the flowering period from August to March. • <i>Pultenaea parviflora</i>: Although flowering and fruiting generally occurs from September to December, the shrub can be still be detected within habitats outside of this season. Flowers/ fruits not necessary for identification. • Netted Bottle Brush: surveys were undertaken two weeks following the prescribed seasonal window and conditions were still considered suitable for survey.
Wingless Raspwort <i>Haloragis exalata</i>	Species	V	V	Yes	Year-round		
Knotweed <i>Persicaria elatior</i>	Species	V	V	Yes	Dec-May		
Hairy Geebung <i>Persoonia hirsuta</i>	Species	E	E	Yes	Year-round		
Nodding Geebung <i>Persoonia nutans</i>	Species	E	E	Yes	Year-round		
<i>Pimelea curviflora</i> var. <i>curviflora</i>	Species	V	V		Oct-Mar		
Spiked Rice-flower <i>Pimelea spicata</i>	Species	E	E		Year-round		
<i>Pultenaea parviflora</i>	Species	V	E		Sep-Nov		
Netted Bottle Brush <i>Callistemon linearifolius</i>	Species		V		Oct-Jan		
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> , population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd,	Species	E			Nov-Feb		

Species name	Credit class	Conservation status*		Targeted survey required?	BAM required survey period	Survey guidelines	Survey design employed
		BC Act	EPBC Act				
Liverpool and Penrith local government areas							
Juniper-leaved Grevillea <i>Grevillea juniperina</i> <i>subsp. juniperina</i>	Species	-	V		Year-round		

*Table codes: E- Endangered, V- Vulnerable, C – Critical, CE- Critically Endangered, M- Marine/ Migratory.

4.2 Threatened species survey

4.2.1 Terrestrial flora surveys

Surveys for candidate threatened flora species were carried out for all lands within the development footprint during the field survey period of 17-20 February 2020. A summary of survey requirements and deployed field methods is provided for all candidate threatened flora in Table 13. Targeted surveys address the seasonal survey requirements for all candidate flora species except Netted Bottle Brush. Surveys fell two weeks beyond the prescribed survey window for this species, however conditions were still considered suitable for species detection.

Targeted surveys were carried out in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH, 2016) and involved parallel field traverses approximately 5m to 10m apart, depending on the density of vegetation. Surveys were carried out for all areas supporting potential habitat within the development site to detect the presence of any threatened flora species and to assess the quality of habitat present. The extent of targeted surveys for threatened flora is shown in Figure 6.

4.2.2 Terrestrial fauna surveys

Targeted surveys for terrestrial threatened fauna were conducted on 17-23 February 2020. The level of survey effort is summarised in Table 14 and included the following methods for targeting candidate species:

- Ultrasonic call detection for microchiropteran bat species
- Habitat assessment for:
 - Grey-headed Flying-fox (*Pteropus poliocephalus*) (presence of camps),
 - Masked Owl (*Tyto novaehollandiae*) (tree hollows suitable for breeding),
 - Microchiropteran bats (tree hollows suitable for roosting, caves housing breeding colonies, man-made habitat features including buildings, drainage structures and bridges)
 - Little Eagle (*Hieraaetus morphonoides*) and Square-tailed Kite (*Lophoictinia isura*) (stick nests)
- Observation of disused structures during bat fly out
- Spotlighting for nocturnal arboreal fauna
- Active searches and call playback for Green and Golden Bell Frog (*Litoria aurea*)

Weather conditions during the survey period were generally mild with some rainfall on two days (Table 15).

Further detail regarding the survey methodologies employed is provided below. Figure 8 shows the location of survey sites and overall field survey effort for the study area.

Table 14: Summary of total fauna survey effort. Times are approximate and cumulative of effort per person throughout each day

Survey activity	Survey date					
	17-2-20	18-2-20	19-2-20	20-2-20	21-2-20	22-2-20
Cumberland Plain Land Snail searches	0.5 hours	0.5 hours	0.5 hours	0.5 hours		
Ultrasonic call recordings	Dusk to dawn					
Bird habitat assessment	0.25 hours	0.25 hours	0.25 hours	0.25 hours		
Green and Golden Bell Frog active searches and call playback	1.5 hours	1.5 hours	1.5 hours	1.5 hours		
Pre-dusk bird survey and bat fly out observations	0.5 hours	0.5 hours	0.5 hours	0.5 hours		
Spotlighting	1 hour	1 hour				

4.2.2.1 Microchiropteran bat surveys

Candidate threatened microchiropteran bat (microbat) species were surveyed using ultrasonic call detection and an assessment of habitat available on the site. Three SM2 Song Meter units were deployed at three locations on the site (Figure 8) for six nights. The total acoustic detection effort was 18 nights, exceeding the 16 nights specified by OEH (2018).

During the field survey period, disused buildings and infrastructure were assessed for their potential as microbat habitat. The survey team watched for bats emerging from these buildings during bat fly out over four nights (17-20 February). The site was also searched for other potential habitat including drainage structures, caves and crevices, and hollow-bearing trees.

4.2.2.2 Assessment of threatened bird habitat

Limiting habitat (hollow-bearing trees and stick nests) for the candidate bird species identified in Table 13 was not recorded at the site. The lack of breeding habitat for these dual ecosystem/species credit species meant targeted surveys were not required as no species credit obligation would be generated by a development at the site.

4.2.2.3 Snail searches

Searches for Cumberland Plain Land Snail and Dural Land Snail were conducted during the four days of on-site survey activity. The survey team used trowels to dig through leaf litter deposits within one metre of the base of Forest Red Gum *Eucalyptus tereticornis* and Grey Box *Eucalyptus moluccana* trees on site. Each tree was surveyed for approximately two minutes. The search included checking beneath exfoliating bark at the bases of trees and beneath fallen timber and bark within remnant native vegetation in the study area. Searches for any Koala scats were also conducted at this time to confirm any potential presence of the species. The total survey effort was four person hours.

4.2.2.4 Green and Golden Bell Frog surveys

Surveys for Green and Golden Bell Frog were conducted according to the *Survey guidelines for Australia's threatened frogs* (DEWHA, 2010). Survey timing address rainfall requirements with approximately 197mm of rain being recorded in the week prior to the survey period (BOM, 2019). Call playback was undertaken at 3-4 sites per night using calls played through a 10 watt loud speaker at full volume (Figure 8). All potential habitats within the site were surveyed. Calls were also played through the fence in proximity to adjacent habitats on the eastern and northern boundary. Between call playback sessions, the survey team used spotlights and actively searched within vegetation along the edge of the dam and both upstream and downstream channels on the site. Approximately one and a half hours of active searching was undertaken each night. The total survey effort was 12 person hours.

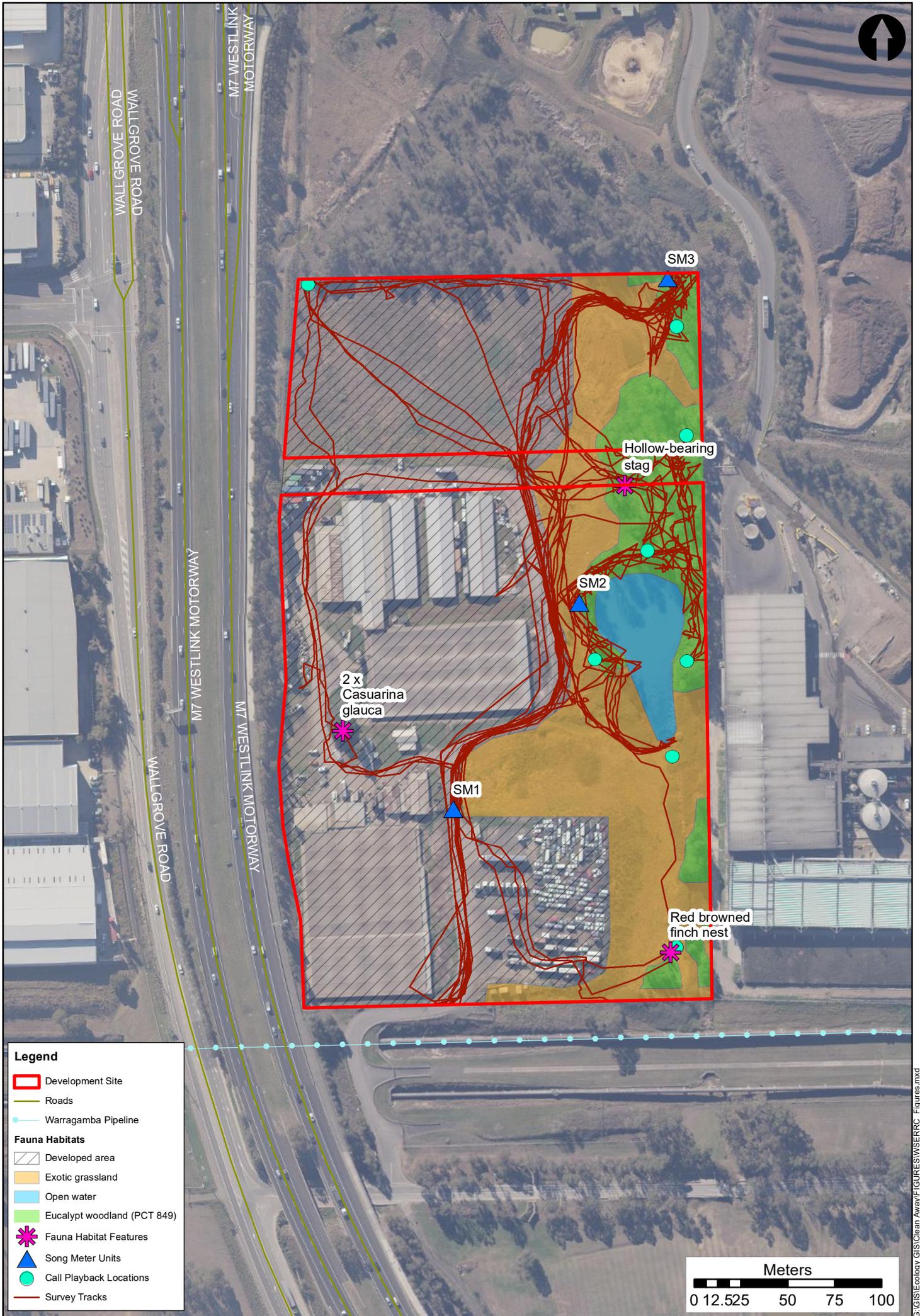


Figure 8: Fauna habitat

Table 15: Weather conditions during the survey period

Date of survey	Survey methods	Wind direction and max. speed (km/h)	Max. temperature (°C)	Rain (mm, recorded at Prospect Dam)	Relative humidity at 9am (%)
17 February 2020	<ul style="list-style-type: none"> Cumberland Plain Land Snails searches Green and Golden Bell Frog call playback and searches spotlighting bird survey and bat fly out observations 	W 2	24.5	0	87
18 February 2020	<ul style="list-style-type: none"> Cumberland Plain Land Snails searches Green and Golden Bell Frog call playback and searches spotlighting bird survey and bat fly out observations Ultrasonic bat call recording 	NW 6	33.5	10	86
19 February 2020	<ul style="list-style-type: none"> Cumberland Plain Land Snails searches Green and Golden Bell Frog call playback and searches spotlighting, bat fly out observations Ultrasonic bat call recording 	W 13	28.5	16	47
20 February 2020	<ul style="list-style-type: none"> Cumberland Plain Land Snails searches Green and Golden Bell Frog call playback and searches spotlighting bat fly out observations Ultrasonic bat call recording 	E 11	24.5	0	70
21 February 2020	Ultrasonic bat call recording	E 4	24.5	0	73
22 February 2020	Ultrasonic bat call recording	S 4	22.8	0	79
23 February 2020	Ultrasonic bat call recording	N 2	24.5	0	86

4.3 Limitations

Background noise levels from nearby highways and the neighbouring Global Renewable waste facility are likely to have affected the ultrasonic call detection and call playback surveys. Kaleidoscope call analysis software cannot detect bat calls that are quieter than the background noise level.

Background noise would also affect the audibility of frog calls. To minimise the impact of background noise on the call playback survey, calls were played at volumes far louder than frogs are able to produce. Call playback points were no more than 100m apart, as suggested by Commonwealth frog survey guidelines (DEWHA, 2010).

There is the potential that field surveys have failed to detect the presence of a threatened plant species that is actually present. This is especially prevalent for inconspicuous, non-showy species or species difficult to identify outside of flowering/fruitlet seasons. Notwithstanding, targeted flora surveys were carried within the seasonal window prescribed by the BAM for candidate flora species.

4.4 Threatened Species Results

4.4.1 Threatened flora

No threatened flora species were identified during random meander surveys across the site. Areas of native vegetation at the proposal site are highly degraded and dominated by exotic species. Habitat quality for the candidate threatened flora species was generally poor.

4.4.2 Threatened fauna

Fauna habitats

Native vegetation within the site consists of small patches of regenerating Eucalypt woodland subject to high levels of weed, noise and light disturbance due to historical and ongoing adjacent land uses, and offering limited connectivity to larger intact areas of habitat. Eucalypt woodland within the site is likely to provide habitat for mobile urban adapted species including Magpie *Gymnorhina tibicen*, Little Raven *Corvus mellori*, Lorikeet species *Trichoglossus sp.* and Noisy Miner *Manorina melanocephala*. Dense thickets of Blackberry and African Boxthorn *Lycium ferocissimum* present within the understorey may also provide habitat for small passerine birds such as Red-browed Finch *Neochmia temporalis* and Superb Fairy Wren *Malurus cyaneus*. An absence of large trees supporting hollows indicates these habitats are generally unsuitable for hollow-roosting mammals and microbats.

Waterbirds including Australian White Ibis *Threskiornis moluccus*, Cattle Egret *Ardea ibis* and Dusky Moorhen *Gallinula tenebrosa* may also utilise riparian environments associated with the farm dam. Bulrushes and sedges within the stream and at the periphery of the farm dam may also offer potential basking and foraging opportunities for frogs including Green and Golden Bell Frog.

Exotic grasslands and other developed areas of the site offer little value for native fauna. However, a number of disused buildings are present and may offer marginal roosting opportunities for microbat species.

The extent of fauna habitats identified for the development site is provided in Table 16 and Figure 8.

Table 16: Fauna habitats within the development site

Fauna habitat	Full Mapped Extent (ha)	Extent Within Development Footprint (ha)
Eucalypt woodland	0.88	0.45
Aquatic environments	0.26	0.26
Exotic grassland	1.92	1.44
Developed lands	5.62	5.01
Total	8.68	7.16

Targeted survey results

A total of six threatened fauna species were recorded during field surveys, including five listed under the BC Act and two listed under the EPBC Act (Table 17). Threatened species recorded during targeted fauna surveys are identified in Table 17 including any habitat observed within the site.

One candidate threatened fauna species (Southern Myotis) was confirmed for the site. Species credit polygons are mapped for the species in Figure 8 and include 0.88ha of Eucalypt woodland within the development site that is within 200m of the farm dam. Under the '*Species credit threatened bats and their habitats - NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018) suitable Southern Myotis habitat that is within 200m of a waterbody with pools/stretches 3m or wider must be included in the habitat polygon. Refer to the following section for a more detailed discussion regarding the microbat survey results. Other candidate fauna species were not recorded during targeted surveys.

A lack of leaf litter and woody debris was noted within the site during the survey indicating habitat is marginal for Cumberland Land Snail and Dural Land Snail. Suitable habitat for Green and Golden Bell Frog was located within bulrushes and sedges associated with the stream and at the periphery of the farm dam. However, these were very sparse and did not offer a large extent of potential habitat. Connectivity to larger areas of potential habitat upstream and downstream of the

site is also limited indicating the site is unlikely to offer important habitat the species.

Table 17. Threatened fauna and associated habitat within the site.

Common name	Scientific name	Status		Credit class	Biodiversity Risk Weighting	Sensitivity to loss	Sensitivity to potential gain	Survey observations	Habitat within the site
		BC Act	EPBC Act						
White-throated Needletail	<i>Hirundapus caudacutus</i>	-	V	N/A	N/A	N/A	N/A	Observed flying over the site	Suitable foraging habitat and potential roost sites. However not considered significant for species.
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	-	Ecosystem	N/A	Moderate	High	Calls detected during survey-search/ attack calls only No roosts observed	Suitable foraging habitat within Eucalypt woodland.
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	-	Species (breeding)/ ecosystem	3.00	Moderate	High (foraging)–very high (breeding)	Calls detected during survey-search/ attack calls only No roosts observed	Site does not support suitable breeding habitat.
Southern Myotis	<i>Myotis macropus</i>	V	-	Species	2.00	Moderate	High	Calls detected during survey-search/ attack calls only	Approximately 0.88ha of Eucalypt woodland within 200m of waterbodies/ pools >3m wide.
Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	V	V	Species (breeding)/ ecosystem	2.00	Moderate	High	Observed flying over the site	No Grey-headed Flying-fox camps or suitable breeding habitat

Common name	Scientific name	Status		Credit class	Biodiversity Risk Weighting	Sensitivity to loss	Sensitivity to potential gain	Survey observations	Habitat within the site
		BC Act	EPBC Act						
									observed. Site supports sparse/ sporadic foraging resources only
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	-	Ecosystem	N/A	Moderate	High	Calls detected during survey-search/ attack calls only No roosts observed	Suitable foraging habitat within Eucalypt woodland. No suitable breeding habitat.

*Table codes: E- Endangered, V- Vulnerable, C – Critical, CE- Critically Endangered, M- Marine/ Migratory.

Microbat survey results

The development site supports limited roosting opportunities for microbat species. No hollow-bearing trees were present. One stag located immediately north of the dam possessed a small hollow (<5cm diameter, depth <15cm). This may offer marginal roosting habitat for hollow-roosting microbat species. Disused buildings within the site may also offer marginal habitat for microbat species however no activity was observed during field surveys.

Microbat species detected within the site are detailed in Table 18, relative to survey site location. All microbat calls were recorded by two of the three Song Meter units (i.e. 2 and 3) as shown in (Figure 8). Song Meter Unit 1 was placed near the southern poultry shed, so as to record any calls made by bats moving between the shed and the farm dam. No calls were recorded at this location suggesting buildings on site are not being utilised as roosting sites.

The majority of microbat calls detected were search/attack calls recorded in the middle of the night, some time after dusk and before dawn. This suggests a lack of active roosts within proximity to the site with use of available habitats limited to foraging activities.

The overall number of calls recorded was relatively low for the length of the sampling period (i.e. only 394 calls over 18 survey nights). Although this may indicate low microbat activity within the site, it is also possible that background noise from vehicle traffic and the neighbouring Global Renewables facility impacted microbat call audibility. Microbat calls that are lower in volume than the background noise level cannot be easily detected by means of call analysis software. Species with lower volume calls, including Southern Myotis, are less detectable at noisy sites. As such, it is possible that microbat activity, particularly that of Southern Myotis, was higher for the study area than the survey data indicated. Species polygons are mapped for Southern Myotis in Figure 9.

Table 18: Microbat survey results

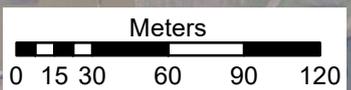
Scientific name	Common name	Confidence	No. of calls		
		Definite	Unit 1	Unit 2	Unit 3
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	Definite	0	0	6
<i>Mormopterus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Definite	0	1	5
<i>Myotis macropus</i>	Southern Myotis	Probable	0	1	0
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Probable	0	1	0
<i>Scotorepens rueppellii/ Scoteanax orion*</i>	Greater Broad-nosed Bat/ Eastern Broad-nosed Bat	Probable	0	3	11

*Needs Confirmation. Either the call quality was poor or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated. A trapping programme would be required to confirm the record.



Legend

- Development Site
- Roads
- Warragamba Pipeline
- Waterbody Buffer 200m
- Southern Myotis Habitat
- Waterbodies (>3m wide)



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Figure 9: Southern Myotis species credit polygons

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5 Aquatic habitat and threatened species

5.1 Aquatic habitat surveys

An assessment of aquatic habitats was completed on Wednesday 19 February 2020. The assessment consisted of two AUSRIVAS aquatic habitat assessments undertaken for the dam and upstream and downstream drainage lines. This methodology includes assessment of landform, stream morphology, vegetation, surrounding land uses and substrates, as well as measuring in situ water quality.

Visual assessment was completed using the NSW AUSRIVAS habitat assessment proforma. The survey is a rapid visual assessment used to describe the habitat based on the following parameters:

- Geomorphology
- Channel diversity
- Bank stability
- Riparian vegetation and adjacent land use
- Water quality
- Macrophytes
- Local impacts and land use practices.

Water quality included physio-chemical field measurements of the surface water quality measured in situ using a Yeokal 611 water quality probe at each site. The following variables were recorded:

- Temperature (°C)
- Conductivity (µS/cm)
- pH
- Dissolved oxygen (DO)(% saturation and mg/L)
- Turbidity (NTU).

Alkalinity (mg CaCO₃/L) was measured with a standard titration kit. Water quality data were compared with the ANZECC (2000) default trigger values (DTVs) of physical and chemical stressors for lowland stream in South-Eastern Australia.

5.1.1 Aquatic survey results

Aquatic features within the site are limited to a farm dam and an ephemeral first order stream located adjacent to the eastern boundary of the development site. The stream receives surface flows from the south, southwest of the property and flows north, connecting with Reedy Creek about 600m downstream of the site. Some

connectivity with the farm dam is also apparent. Waters eventually flow into Eastern Creek but do not connect to Prospect Reservoir.

Within the site, the stream is characterised by a discontinuous channel with some areas choked by exotic vegetation (i.e. Blackberry thickets) or supporting overland flow only. The channel and the farm dam are both manmade, supporting generally stable banks with a few areas susceptible to erosion. Stream beds were primarily of silt. Native macrophytes (Bulrush, *Juncus* spp., *Lemna* spp. and Slender Knotweed) were present at the margins of the dam, providing suitable amphibian habitat (Photograph 4). A discontinuous and degraded riparian zone was observed dominated by exotic shrubs, grasses and forbs and supporting some scattered native canopy trees. The width of the riparian corridor generally varied from 0 m to 10m with some areas north of the dam being approximately 35 m wide.

The aquatic habitat sites are shown in Figure 10, including the riparian lands buffer which is based on a 10m buffer.

No mapped habitat for threatened fish was identified within or adjacent to the site. Observed aquatic habitats do not meet the definition of Key Fish Habitat, as defined by the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).



Photograph 4. A) Farm dam, B) Upstream channel, C) Downstream channel, D) Overflow channel entering adjacent properties.

Water quality for the majority of measured parameters was generally consistent with ANZECC (2000) guidelines requirements however turbidity greatly exceeded default trigger values at the sites (Figure 10). Dissolved Oxygen (DO) and conductivity fell below the trigger values at site two (Table 19). The region experienced a significant rainfall event the week prior to the survey occurring. Water levels were higher than normal and extremely turbid (Photograph 4). On February 10, 2020 the Bankstown Airport AWS (66137) recorded 159.6 mm of rain in one day and 13mm on the day of the survey, where the month average was 380mm (BOM, 2020). Based on available aerial imagery, the high turbidity is due to upstream locations, e.g. the Austral Bricks to the southeast of the site and adjacent properties.

Table 19: In-situ water quality results from the aquatic ecology assessment

Site	Location	Temp (C°)	Conductivity (µS/cm)	Turbidity (NTU)	Dissolved Oxygen (% sat)	pH*	Alkalinity (mg CaCO ₃ /L)
DTV*	-	-	125-2200 µS/cm	6-50 NTU	80-110%	6.5-8	Soft (0-59) Moderate (60-119)
Site 1	Upstream	24.6	58	666.9	81.0%	7.74	40

Site 2	At farm dam	23.75	56	210.4	64.0%	7.51	60
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*ANZECC default trigger levels (DTVs) for lowland streams: Electrical conductivity (125-2200 μ S/cm), Turbidity (6-50 NTU), pH (6.5-8), Dissolved Oxygen (80-110%). Cells in grey indicate those variables that exceed or is outside of the default trigger values.

5.1.2 Threatened aquatic species

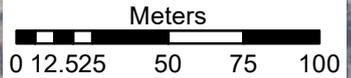
Review of the DPI Fisheries threatened species special data portal found that no threatened flora or fauna under the *Fisheries Management Act 1994* (FM Act) are mapped within the region and or are likely to occur.

No aquatic fauna were observed at the time of the inspection. However, turtles (most likely Eastern Snake-necked Turtle *Chelodina longicollis*) and elvers were observed during the targeted surveys for candidate threatened fauna species (refer to Section 4.2.2). These species are commonly associated with disturbed freshwater environments and are not listed as threatened. The introduced Eastern Mosquitofish *Gambusia holbrooki* was also observed during the survey.



Legend

- Aquatic Ecology Sites
- Development Site
- Roads
- - - ● - - - Warragamba Pipeline
- Watercourse (1st order)
- Waterbodies
- Riparian Lands



Service Layer Credits:

Figure 10: Aquatic habitat sites

6 Matters of National Environmental Significance

This Chapter identifies Matters of National Environmental Significance (MNES) that have been confirmed for the development site. Reference is also made to potentially occurring MNES, including threatened ecological communities and species, within Section 3.3 and Section 4.1.1 of this document.

Species listed under the EPBC Act recorded during field surveys completed for the development site are identified in Table 20. One Grey-headed Flying-fox and three White-throated Needletail individuals were observed flying over the site. Three Cattle Egret *Ardea ibis*, listed as marine under the EPBC Act, were also observed roosting in trees adjacent to the farm dam. Cattle Egret is not a listed threatened or migratory species and as such, is not considered a MNES.

Table 20: Commonwealth listed species confirmed for the study area

Scientific name	Common name	Conservation status*	
		EPBC	BC
<i>Ardea ibis</i>	Cattle Egret	M	-
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Hirundapus caudacutus</i>	White-throated Needletail	V/M	-

*Table codes: E- Endangered, V- Vulnerable, C – Critical, CE- Critically Endangered, M- Marine/ Migratory.

Observed MNES are considered to have a transient presence at the site only. No Grey-headed Flying-fox camps or food resources were identified during field surveys. White-throated Needletail is an aerial species that feeds on insects. Available habitat within the development site is not considered important for the species, especially considering the absence of roosting/ nesting sites for these species.

No nests for Cattle Egret were observed, although the survey period was outside the breeding season for these species. Roosting habitat within the study area is not considered important for the species given the availability of similar quality habitat within the surrounding landscape.

The *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE 2015) provides guidelines and thresholds for determining if proposal impacts are likely to significantly impact relevant bird species, including the White-throated Needletail. The study area lies within core non-breeding habitat for the White-throated Needletail. It has recently been established that large areas of native woodland may be important for supporting foraging, and the species has been recorded roosting in hollows or the bark of large trees and rock faces on ridgelines (DoE 2015). These important habitat features do not occur within the development site.

According to DoE (2015), an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species (DoE 2015). Approximately 0.1% of the White-throated Needletail population is considered to be ecologically significant at the national level, equating to 10 individuals. Given the lack of important habitat for the species within the development site and observations of fewer individuals than is considered ecologically significant, it is concluded that the proposal is unlikely to have a significant impact on the species.

An assessment of proposal impacts to each MNES is presented in Appendix F in accordance with the Commonwealth Significant Impact Guidelines (DoE, 2013). Based on the outcomes of the assessment impacts to MNES are considered negligible and are unlikely to trigger any Commonwealth referral requirement.

7 Measures to avoid and minimise impacts

Under Section 8 of the BAM, opportunities to avoid and minimise impacts to biodiversity values must be considered during the project planning and design phase of a proposal. This Chapter outlines proposed measures to avoid and minimise potential direct, indirect and prescribed impacts to biodiversity within the development site.

The results of the impact assessment are presented in Section 7.2. Direct impacts have been assessed for the development footprint, as shown in Figure 11. This includes approximately 6.09 ha of land within the southern portion of the site that will be impacted during construction of the facility (Figure 11). The 1.08 ha of existing paved area in the northern portion of the site has been included in the development footprint as this area will be used temporarily to support construction works.

7.1 Avoiding and minimising impacts

7.1.1 Proposal planning and site selection

An extensive selection process was implemented to identify a suitable site for the proposed facility. A long list of sites were considered against each of the following criteria:

- Environmental impact and approvals risk.
- Stakeholder impact.
- Access to infrastructure and utilities.
- Size and configuration.
- Synergies with surrounding land uses.
- Site constraints (i.e. geotechnical risks).

The initial focus was on sites close to the Western Sydney Aerotropolis Agribusiness Precinct given the potential to provide a source of energy and heat to the commercial activities planned for the precinct, while contributing to the management of waste for the wider Aerotropolis. However, the planning frameworks for airspace protection would restrict the location of tall structures, such as a stack, near the Airport.

Locating the proposal farther west to avoid airspace protection restrictions raised new risks in relation to impact on rural residential locations and raised conflicts with rural land uses and associated biodiversity values.

The proposed Wallgrove Road site was identified as the most suitable site as it would avoid existing and planned residential areas, rural land uses and future

airspace restrictions. Its location in the Western Sydney Parklands (WSP) Wallgrove Precinct would allow for the WSERRC to make use of existing industrial land. The WSERRC would also be in keeping with other existing waste sector operations located within the WSP Wallgrove Precinct, such as the Global Renewables waste management facility located to the east of the site. The location of the site next to the M7 Motorway and Wallgrove Road would also provide convenient road transport access to the facility to support ongoing operations.

An initial analysis of existing biodiversity values was carried out to confirm site suitability for the WSERRC. The assessment involved a desktop search of government databases including NSW BioNet, EPBC Act Protected Matters Search Tool (PMST) and Office of Environment and Heritage vegetation maps for the area. A site inspection was also carried out by an Arup ecologist on 25 July 2019 to broadly ground-truth mapped values identified for the site. The results of the assessment indicated the site was subject to high levels of disturbance due to historical land clearing and adjacent industrial land uses and was generally suitable for proposed development. Biodiversity values identified for the site were limited to regenerating Cumberland Plain Woodland and constructed aquatic environments situated within low-lying areas along the eastern property boundary. Design measures to further minimise impacts to these existing features were explored during later project stages and are discussed in the following section.

7.1.2 Design measures

Consolidation of the development footprint

The design of the proposed facility, including size, layout and requirements for associated infrastructure, has been informed by minimum function requirements for an EfW facility.

To minimise the disturbance of existing biodiversity values within the site the proposed facility and associated infrastructure have been sited within existing developed and/or disturbed lands wherever possible.

The northern section will also be used temporarily to support construction works (refer to the existing paved area shown in Figure 11). As such, this part of the development footprint is not a permanent footprint.



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Figure 11: Development footprint and extent of impacts

Realignment of the first order stream located within the eastern extent of the property will also be necessary to address flood planning requirements. Improvements in catchment water quality and the condition and connectivity of vegetation within the riparian zone would also be realised as a result of the proposed works. The installation of drainage basins will also be necessary to manage stormwater run-off from the site. These works will require additional vegetation clearing and the dewatering and demolition of the farm dam.

Design of the proposed drainage infrastructure, including the location and size of the channel and basins, has been informed by minimum planning requirements and modelling developed for the site. As such, there is little scope to minimise clearing requirements associated with the works.

Site landscaping and habitat restoration

Site landscaping and restoration of cleared native vegetation communities, ecological communities and impacted aquatic habitats is proposed following construction of the facility to minimise impacts to biodiversity. Approximately 1.02 ha of land within the development site immediately adjacent to the eastern property boundary will receive a mix of trees, shrubs and grasses, generally representative of the Cumberland Plain Woodland ecological community. Proposed restoration works will extend beyond the construction footprint and will involve weed removal and in-fill plantings within areas of retained vegetation to the east and north of the clearing footprint.

The existing stream will be realigned to maintain course within the development site, re-directing surface waters that would normally sheet flow across low-lying lands including some parts of the Global Renewables site to the east. A natural trapezoidal channel will be formalised to improve surface water conveyance, incorporating a 300mm deep low-flow meander in the base. Dense exotic vegetation currently choking the stream will be removed and riparian plantings will be installed along the proposed channel banks stabilising and restoring riparian values. Where practicable, instream features such as boulders and logs will also be installed offering habitat for aquatic fauna.

A Vegetation Management Plan (VMP) has been prepared to guide the delivery of the restoration works including the ongoing management and monitoring of restoration outcomes. This will be updated prior to construction to capture any changes associated with the detailed design including specific vegetation retention measures necessary.

The VMP is provided in Appendix G, including mapping of target vegetation communities and the key performance objectives and indicators.

7.1.3 Detailed design measures

Measures to minimise impacts associated with the development and to further consolidate works within existing disturbed / developed parts of the site will continue to be investigated as the design progresses. More specifically, the following opportunities will be fully explored as a part of the detailed design:

- Opportunities to reduce the bulk/scale of the facility and any necessary associated site infrastructure such as the number of vehicle weighbridges, configuration/ size of buildings, etc.
- Opportunities for resizing/ reshaping drainage infrastructure, reconfiguring the visitor centre and/or utilising different carpark batter treatments will be investigated so as to minimise vegetation clearing requirements.
- Size provisions for the substation are currently based on Endeavor Energy standard design requirements for a 132kV connection. However, there is opportunity to reduce the substation footprint where a 33kV connection can be utilised. This will be explored further during the detailed design.

7.2 Assessment of impacts

Table 21 details proposal impacts to biodiversity following the implementation of measures to avoid and minimise impacts. A tick has been used to identify where biodiversity impacts are relevant for each proposal phase. These are discussed further in the following sections.

Table 21: Potential impacts to biodiversity

Biodiversity value	Potential impact	Proposal phase	
		Construction	Operation
Direct impacts			
Native vegetation	Loss of 0.45 ha of Cumberland Shale Plains Woodland (PCT849)	✓	
Threatened Ecological Communities	Loss of 0.45 ha of BC Act listed Cumberland Plain Woodland	✓	
Threatened species	Loss of 0.45 ha of habitat for Southern Myotis	✓	
Indirect impacts			
Native vegetation, threatened ecological communities and habitat for threatened species	Disturbance from noise, light and litter	✓	✓
	Edge effects and impacts to habitat viability	✓	✓
	Dust and other air quality impacts	✓	✓
	Disturbance from weeds, pests and pathogens	✓	
Prescribed impacts			

Biodiversity value	Potential impact	Proposal phase	
		Construction	Operation
Native vegetation, threatened ecological communities and habitat for threatened species	Loss of habitat connectivity	✓	
	Impacts to hydrology and water quality	✓	
	Impacts to groundwater	✓	
	Fauna injury / mortality due to vehicle strike	✓	✓
Other impacts			
Aquatic habitats	Impacts to the downstream receiving environment habitat and water quality	✓	
	Impacts to hydrology	✓	
	Displacement of aquatic fauna (native and exotic)	✓	
	Impacts to water quality	✓	✓

7.2.1 Direct impacts

Direct impacts associated with the development are primarily related to the proposed site clearing works. Site clearing will be carried out for the development footprint as shown in Figure 12. The clearing of native vegetation is listed as a Key Threatening Process under Schedule 4 of the BC Act.

Loss of native vegetation

An area of 0.45 ha of native vegetation will be cleared to facilitate construction of the proposed facility and associated infrastructure (Figure 12). Table 22 identifies the extent of impacts including predicted change in vegetation integrity for vegetation communities within the development footprint.

A small area of vegetation will be retained immediately adjacent to the eastern boundary of the development site. This vegetation may be subject to direct impacts during construction where suitable mitigation measures are not implemented. These have been identified in Table 25.

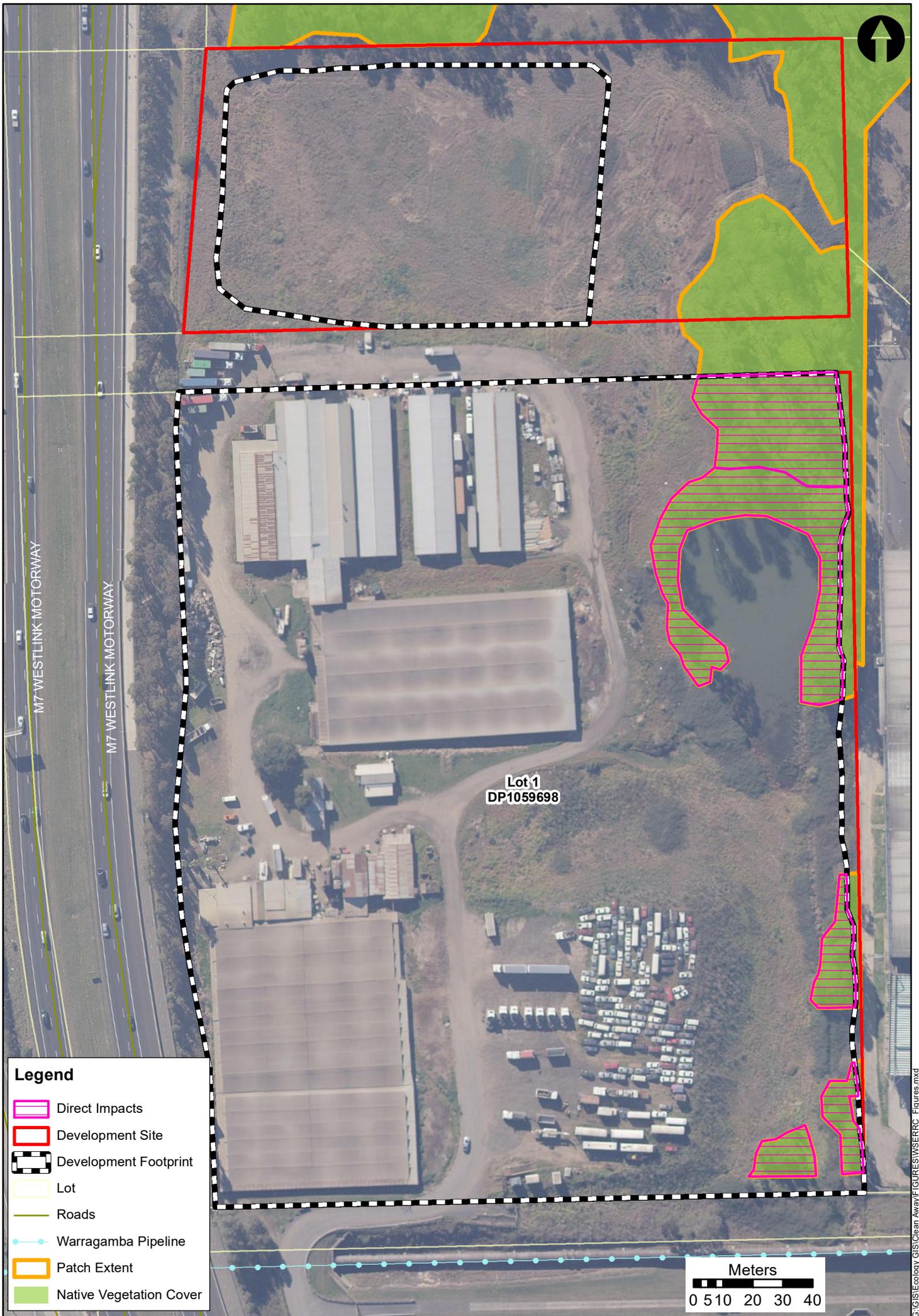
Table 22: Impacts to native vegetation

PCT	Condition	Proposed clearing extent (ha)	Current vegetation integrity score	Future vegetation integrity score	Regional extent	
					Estimate extent remaining*	Estimate % cleared**
PCT 849 Cumberland Shale Plains Woodland	Very Poor	0.09	20.6	0	6800 ha	93%
PCT 849 Cumberland	Poor	0.36	31	0	6800 ha	93%

PCT	Condition	Proposed clearing extent (ha)	Current vegetation integrity score	Future vegetation integrity score	Regional extent	
					Estimate extent remaining*	Estimate % cleared**
Shale Plains Woodland						

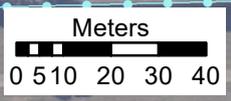
* Estimate of pre-European extent remaining modelled from known site or polygon data.

** Percent of pre-European extent cleared.



Legend

- Direct Impacts
- Development Site
- Development Footprint
- Lot
- Roads
- Warragamba Pipeline
- Patch Extent
- Native Vegetation Cover



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Figure 12: Proposal impacts to biodiversity values

Impacts to Threatened Ecological Communities

An area of 0.45 ha of Cumberland Plain Woodland, listed as critically endangered under the BC Act, will be cleared from within the development footprint (Figure 12). Impacts to the ecological community have been determined by means of change in vegetation integrity score as calculated in Table 22.

Cumberland Plain Woodland has been identified as an entity for potential Serious and Irreversible Impacts (SAII). An assessment of proposal impacts against relevant SAI thresholds and principles is presented in Section 8.2 for the ecological community.

Loss of habitat for threatened species

The development will result in a direct loss of 0.45 ha of Eucalypt woodland offering foraging and marginal roosting opportunities for Southern Myotis, listed as Vulnerable under the BC Act (Figure 12). Foraging habitats for candidate ecosystem credit fauna species will also be lost. A list of all impacted threatened fauna is provided in Table 23. No threatened flora species will be impacted as a result of the development.

One stag supporting a small hollow (<5cm diameter) will be impacted during site clearing works. However, site investigations indicate the stag does not support any active roosts. No hollow-bearing trees will be impacted as a result of site clearing.

Proposal impacts to threatened fauna habitat have been determined using change in vegetation integrity score as calculated in Table 22.

Table 23: Direct impacts to threatened species

Species name	Status		Credit class	Impacts	Impact extent (ha)
	BC Act	EPBC			
Southern Myotis <i>Myotis macropus</i>	V	-	Species	Loss of foraging and marginal roosting habitat	0.45
Eastern Coastal Free-tailed Bat <i>Micronomus norfolkensis</i>	V	-	Ecosystem	Loss of foraging habitat	0.45
Little Bentwing-bat <i>Miniopterus australis</i>	V	-	Ecosystem	Loss of foraging habitat	0.45
Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V	-	Ecosystem	Loss of foraging habitat	0.45

7.2.2 Indirect impacts

Potential indirect impacts associated with the construction and operation of the facility are detailed within this section. These impacts are generally considered to be negligible with the implementation of suitable design measures and construction controls, as detailed in Table 25 and discussed further within the following sections. Habitat disturbance associated with construction noise is considered higher risk. However, these impacts will be temporary and are unlikely to permanently impact or displace any threatened fauna or significant species.

Disturbance of remaining habitats due to increased noise, light and litter

Habitats within and adjacent to the development footprint are already subject to considerable disturbance as a result of adjacent industrial and transport land uses. This includes noise and light pollution from the adjacent Global Renewables site to the east and the M7 Motorway to the west. Despite this, retained habitats immediately adjacent to the development footprint are likely to be subject to some increased disturbance.

Operation of the facility will be 24 hours and will involve the use of machinery and equipment likely to generate some noise. Trucks will also be delivering waste to the site between 7am and 6pm. Based on the results of the noise assessment, operational noise impacts will be generally low with louder noises associated with truck deliveries. Noise levels at the eastern site perimeter will not exceed 74 dB but will more generally range from 62-66 dB. Operations will not generate noise with special audible characteristics (such as low frequency, metal on metal, high pitch). Noise impacts associated with construction are likely to be higher risk, with construction activities likely to involve noise intensive activities, such as piling and use of the rock hammer. However, this will be limited to daytime hours for the duration of the construction period.

Considerable amounts of litter are currently being deposited within the development site by means of surface water run-off from adjacent lands to the east and south (Photograph 5). These waste materials pose a risk to water quality and the health of common terrestrial and aquatic fauna likely to utilise habitats within the site. Construction of the facility and ongoing site operations are likely to increase the risks associated with litter deposition where suitable controls and procedures are not implemented.



Photograph 5: View of overland flow path north of the dam showing litter deposition from surface water run-off

Operation of the facility is likely to result in some increased light pollution within habitats immediately adjacent to the development footprint. However, this would be minimised wherever possible through the use of sensor lighting and/ or directional lighting for more heavily utilised parts of the facility. Construction activities will be carried out during daylight hours and are unlikely to require additional lighting.

Edge effects and impacts to habitat viability

Retained habitats immediately adjacent to the development site may be subject to some increased edge effects as a result of land-use intensification within the development footprint. However, these impacts are considered negligible given the existing high levels of disturbance due to historical clearing and weed invasion within areas supporting native vegetation. Restoration activities proposed following construction of the facility would improve the viability and ecological function of remaining habitats through weed management and improvements to the floristics and structure of associated vegetation communities.

Dust and other air quality impacts

An air quality assessment has been carried out for the construction and operational phases of the proposal (Air Quality Impact Assessment). The results of the assessment indicate proposed operations will have a negligible impact on air

quality, with the treatment and monitoring of emissions proposed by means of a stack.

Existing levels of dust and other particulates (i.e. PM_{2.5} and PM₁₀) within the site were determined to already exceed recommended criteria and an increase of less than 1% is predicted as a result of proposed operations. Some minor increases in Hydrogen Fluoride, Sulfur Dioxide and Nitrous Oxide levels are predicted to occur as a result of proposed operations. There is some evidence to suggest these emissions can impact soils and the health and vigour of native vegetation (Haidouti, et al 2003; Varshney, et al 2009; Rowland, et al 1985). However, modelled emission levels will not exceed guideline limits and proposed mitigation measures to address human health considerations are considered sufficient to address any risks to retained vegetation communities and habitats within and adjacent to the development footprint.

Much higher levels of dust and airborne particulates have been modelled for the construction phase and may temporarily impact vegetation communities and associated habitats adjacent to the development footprint. However, these impacts will be managed through the implementation of suitable erosion and sediment control measures during construction.

Disturbance from weeds, pests and pathogens

There is the potential for the introduction and spread of weeds and pathogens during construction as a result of machinery movements, increased foot traffic and landscaping activities.

High threat weed species confirmed for the site include Kikuyu Grass, Blackberry, Rhodes Grass, African Boxthorn, Paspalum, Moth Vine, African Olive and Lantana *Lantana camara*. These weeds will need to be controlled and managed during construction to prevent further spread throughout the site.

Pathogens, including Root Rot *Phytophthora cinnamomic*, Myrtle Rust *Austropuccinia psidii* and Chytrid Fungus *Batrachochytrium dendrobatidis*, have the potential to be introduced to the site during construction. Terrestrial and aquatic habitats within the development site could be impacted as a result. Despite this, the potential risks associated with pathogen introduction are considered relatively low risk and will be managed through construction hygiene protocols. Ongoing operation of the facility will pose little risk to biodiversity from pathogens with operations to be contained within developed areas of the site and permanent fencing, buffer plantings and batters delineating the extent of these areas from other vegetated parts of the site.

Habitats within the development site are already likely to be subject to disturbance from pest species including the Fox *Vulpes Vulpes* and feral Cat *Felis catus*. Development activities are unlikely to result in any increased risk of predation or

pests within retained habitats. Similarly, the risks associated with weeds, pests and pathogens are considered negligible during ongoing operation of the facility as activities will be contained within the developed areas of the site.

7.2.3 Prescribed impacts

Prescribed impacts are listed in Section 6.1 of the *Biodiversity Conservation Regulation 2017* (BC Regulation). Potential prescribed impacts associated with the development include:

- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development).
- Impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

These are discussed in further detail below. Following the implementation of appropriate mitigation measures, relevant prescribed impacts are considered to have a negligible impact on biodiversity within and adjacent to the development footprint.

Prescribed impacts that are not considered relevant to the proposal include:

- Impacts of development on the following habitat of threatened species or ecological communities:
 - Karst, caves, crevices, cliffs and other geological features of significance,
 - Rocks,
 - Human made structures
 - Non-native vegetation
- Impacts of development on the movement of threatened species that maintains their lifecycle.
- Impacts of wind turbine strikes on protected animals.

Loss of habitat connectivity and impacts to flight paths

Existing vegetation and habitats within the development site are already subject to high levels of fragmentation due to historical clearing and land uses. Despite this, remaining vegetation and scattered trees located within the development site are likely to offer some localised stepping stone connectivity between adjacent waterways and larger vegetated remnants to the north and south. Although these

are more likely to be utilised by highly mobile urban adapted fauna, they have the potential to facilitate the movement of Southern Myotis and other threatened bat species between habitat fragments within the landscape.

There is potential for the proposed clearing works associated with the development to impact habitat connectivity for observed fauna. An assessment of impacts to habitat connectivity as a result of the proposal was carried out comparing the existing patch with a design patch scenario (Table 24). The design patch incorporated areas of retained native vegetation within the existing patch plus any areas of proposed habitat restoration. The results of the assessment indicate habitat connectivity will be enhanced due to the development. This is facilitated through the augmentation of native vegetation cover along the eastern property boundary. Proposed restoration treatments are likely to improve the floristics and structure of target vegetation communities and will support increased habitat function and movement opportunities for fauna.

Table 24: Habitat connectivity assessment

Connectivity attributes	Existing	Design
Patch size (ha)	2.99	4.00
Patch perimeter (km)	1.95	2.10
Area to perimeter ratio (ha/km)	1.53	1.90

As the proposed facility will incorporate a stack reaching approximately 75 m above ground level, there is potential for the development to impact upon flight paths for threatened birds and bats where they exist. Based on the results of a plume rise assessment completed as a part of the project, the stack may generate a cloudy plume reaching velocities of around 75 km/hour and temperatures of up to 60 °C closest to the tip (Technical Report J: Preliminary Hazard Analysis). Despite this, proposal impacts to the flight paths for threatened birds or bats are considered negligible for the reasons discussed below.

No observed or predicted flight paths for threatened birds or bats were identified within the proposed location of the facility. Habitat within and adjacent to the development site is generally marginal for these species and fauna movements across the site generally favour north-south movement along retained and/or restored habitat fragments within the eastern part of the site. Regardless, in the unlikely event that a bird or bat were to fly into the plume, any impacts would be limited to localised updraught. This is considered unlikely to disorient or impact the flight of the individual given the nature of the plume. Similar stacks are located within the Austral Bricks and PGH Bricks facilities to the southeast and west of the site.

Impacts to hydrology and water quality

There is the potential for impacts to native vegetation, ecological communities and associated habitats as a result of changes in water quality during construction and operation of the facility.

Baseline water quality and soil investigations of the site have identified elevated concentrations of Ammonia, Copper, Zinc and as well as PAHs in soils (Douglas Partners, Detailed Investigation Report Draft 2020). The construction of the facility has the potential to mobilise these contaminants and impact downstream aquatic environments. However, the baseline results also suggest there is currently an increased level of these contaminants entering the system from the surrounding catchment area. Construction activities may also result in the movement of soils and suspend solids that could lead to increased turbidity within downstream environments. These impacts would be minimised and managed through the implementation of suitable construction controls, as detailed in Table 25.

Hydrological modelling completed for proposal based on a 5% and 1% AEP flood event indicates the proposal will not have any material impact on hydrology with no change in afflux noted upstream or downstream of the development footprint (Section 7.2.4).

Impacts to groundwater

Hydrogeological site characteristics and potential risks associated with the proposed development have been informed by site-based soil and water investigations and conceptual modelling, as detailed in the Soil and Water Technical Report (Soil and Water Assessment Report). The results of the assessment indicate a shallow/perched groundwater layer may be intercepted during construction of the waste bunker. The excavation pit will be up to 15m deep and may cause low intermittent groundwater drawdown during construction. Extremely low permeability of the shale and the overlying residual clays, greatly limits the potential for significant drawdown with groundwater flows likely to be intermittent and generally involving low volumes. As such, construction activities are considered to pose a relatively low risk to adjacent ecological communities and associated habitats.

The development is unlikely to result in any significant increase in hardstand/impermeable land surfaces and will not interfere with ongoing groundwater recharge. Similarly, the proposed waste bunker it is not expected to interfere or intercept groundwater flows within the deeper regional groundwater table.

Fauna injury/ mortality due to vehicle strike

There is an increased risk of fauna injury or death as a result of collision with vehicles and / or machinery during the construction and operation of the facility.

Permanent fencing will be installed at the interface between natural habitats and operational areas of the site and will assist in minimising any risk of fauna injury or death. Similarly, temporary fencing will be installed during construction to minimise the risk of vehicle strike as well as entrapment in deep excavations.

7.2.4 Aquatic impacts

Proposed works will not involve any waterway crossings and are limited to channel works within a first order stream only. As such, approval under the FM Act is not likely to be required. Despite this, there will likely be some impacts to aquatic habitats and fauna through the realignment of the channel and the removal of the farm dam. These works may also result in some impacts to riparian lands within and adjacent to the existing stream.

Realignment of the channel

The proposed channel works will result in a temporary loss of aquatic habitats and displacement of aquatic fauna observed within the site. However, this is likely to be limited to the construction phase. With onsite stream environments likely to be enhanced through improvements to stream connectivity and restoration of riparian and aquatic habitats post-construction (refer to Section 7.1.2 and the VMP in Appendix G).

The realignment of the channel and associated in-stream works has the potential to impact site hydrology. However, detailed hydrological modelling carried out for the site indicates long-term impacts will be limited to minor changes in the extent of surface water inundation within the riparian zone. No likely change in peak flood depth or velocity was determined for the 5% AEP (i.e. 1 in 20 year) and 1% AEP (1 in 100 year) flood events (refer to the Hydrology and Flooding Technical Report) as a result of the proposal.

Proposed in-stream works may impact water quality through stormwater runoff over exposed soils, where not appropriately monitored and managed during construction. Appropriate measures to mitigate any potential impacts are to be documented prior to the commencement of construction as a part of the Construction Environmental Management Plan (CEMP).

Dewatering of the farm dam

The decommissioning of the farm dam will inherently remove habitat and refuge for observed aquatic fauna and other species that rely on access to the water. In addition, the utilisation of the water through dust control and or draining during the dewatering process could suspend bottom sediments and or spread sediments to land and risk moving sediments into the receiving environment.

Given the baseline soil and water quality investigation results and the elevated presence such as ammonia, copper and zinc and PHA's in a number of the soil samples there is potential for the farm dam sediments to contain high and or elevated concentration of these analytes. Additional controls should be in place to manage potential risk and ensure no further worsening of the concentrations of these parameters. These would include requirements for the preparation of a Dewatering Management Plan prior to the commencement of construction, as identified in Table 25.

In addition, the farm dam does contain aquatic fauna including both of native and exotic species. Fauna management measures including the relocation of native species and removal of exotic species should be implemented during dam dewatering to minimise any risk of aquatic fauna injury or mortality and to ensure species such as the Eastern Mosquitofish are not released into the downstream environment.

Impacts to riparian lands

Much of the existing riparian zone south of the carriageway will be impacted during construction through the clearing of riparian vegetation and earthworks associated with the proposed channel realignment. However, a riparian corridor will be re-established post-construction incorporating improvements to stream connectivity and the restoration of riparian vegetation and aquatic habitats (refer to Section 7.1.2). The width of the restored riparian corridor will be about 9 m on the eastern bank and 11m on the eastern bank, increasing to 76 m wide in some locations (refer to the VMP in Appendix G). Connectivity will be restored from the southern boundary of the property through to the northern property boundary, with proposed restoration works (including weed management and restoration of riparian vegetation) to continue beyond the construction footprint north of the carriageway (refer to Section 7.1.2).

7.3 Mitigating and managing impacts

Table 25 identifies proposed measures to further mitigate and manage unavoidable impacts to biodiversity, following all efforts to avoid and minimise.

Table 25: Proposed mitigation measures

ID	Description	Mitigation measures	Timing	Responsibility
B1	Native vegetation, threatened ecological communities and habitat for threatened species	<p>A <i>flora and fauna management plan</i> would be prepared, implemented and audited as part of the CEMP. It would address terrestrial and aquatic matters by including:</p> <ul style="list-style-type: none"> • Plans for the development site and adjoining area showing native vegetation, flora and fauna habitat, threatened species and endangered ecological communities. • Plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features, and areas for native vegetation rehabilitation or re-establishment. • Pre-clearing protocols, including pre-clearing inspections, establishment of exclusion zones and on-ground identification of specific habitat features to be retained. • Vegetation clearing protocols, including staged habitat removal and any specified seasonal limits on clearing activities. • Protocols for the salvage and relocation of woody debris. • Requirements for temporary fencing to minimise the risk of fauna injury / mortality due to vehicle strike or entrapment in deep excavations. • Fauna handling and unexpected threatened species finds procedures. • Rehabilitation, revegetation, reuse of soils and other habitat management actions. • Weed, pest and pathogen management requirements • Monitoring during construction and post-construction • Adaptive management measures to be applied if monitoring indicates unexpected adverse impacts. 	Pre-construction/ construction	Contractor
B2	Native vegetation, threatened ecological communities and habitat for threatened species	<p>The <i>flora and fauna management plan (B1)</i> would include the following measures to protect native vegetation and habitats to be retained within the site:</p> <ul style="list-style-type: none"> • Marking-out and signing of clearing limits within the construction footprint. • Installation of barriers, which are identified on construction drawings and raised to site workers during induction training. • Clear identification of vegetation and habitat features to be retained and protected using suitable fencing, signage or markings. • Protection and management of trees proposed for retention in accordance with AS4970-2009 and AS4373-2007. 	Pre-construction/ construction	Contractor

ID	Description	Mitigation measures	Timing	Responsibility
		<ul style="list-style-type: none"> • Clearing of vegetation supporting habitat for Southern Myotis to occur outside of the breeding season for the species [Nov- Dec]. • Locating all site compounds, vehicle / machinery, material stockpiles, etc. within cleared or disturbed areas, outside of any exclusion zones or the Tree Protection Zone of vegetation to be retained as identified in the flora and fauna management plan (B1). 		
B3	Site workers and construction activity impacts	<p>All site workers would be trained to ensure awareness of requirements of the <i>flora and fauna management plan (B1)</i> and relevant statutory responsibilities.</p> <p>Site-specific training would be provided when specific work activities were taking place near areas of identified biodiversity value that are to be protected.</p>	Construction	Contractor
B4	Unexpected finds	<p>An <i>unexpected finds procedure</i> would be prepared and implemented. This would describe the process for identifying, dealing with, and managing any unexpected threatened flora or fauna species found during the construction process. It would include the measures for stopping work, engaging a qualified ecologist, contacting the regulators and restarting work.</p>	Construction	Contractor
B5	Native vegetation, threatened ecological communities and habitat for threatened species	<p>A <i>Vegetation Management Plan</i> will be prepared, implemented and audited as a part of the CEMP and will outline proposed measures for the restoration of native vegetation, ecological communities and associated habitats within the development site. The plan will be generally in accordance with the Concept Vegetation Management Plan (Arup 2020) and will address:</p> <ul style="list-style-type: none"> • Procedures for the protection and management of native vegetation prior to, during and post-construction. • Restoration objectives including target vegetation communities and measurable performance objectives. • Plans/ drawings showing the extent of retaining vegetation and proposed restoration treatments. • Specifications for rehabilitation actions including protocols for planting, weed management and habitat creation. • Description of management requirements including a suitable program for implementation. • Details of any created and restored aquatic environments including engineered channels and deeper pools. 	Construction and post-construction	Contractor

ID	Description	Mitigation measures	Timing	Responsibility
		<ul style="list-style-type: none"> • Specifications for permanent fencing including materials, finishes and extents. • A monitoring program to assess compliance and progress towards achieving the restoration objectives. 		
B6	Native vegetation, threatened ecological communities and habitat for threatened species	<p>The following measures to mitigate and manage impacts to native vegetation during construction are to be implemented as a part of the detailed design and documented within the <i>Vegetation Management Plan (B5)</i>:</p> <ul style="list-style-type: none"> • Design solutions are to be explored to minimise any impacts to vegetation proposed for retention during construction in accordance with AS4970-2009 and AS4373-2007. • Where works are proposed within the Tree Protection Zones of any trees to be retained, an arborist (min AQF level 5) is to be engaged to complete a tree health assessment and to provide recommendations for mitigating any impacts. The arborist is to assess alternative construction methods and prescribe suitable mitigation measures to maintain the health and long-term viability of any trees proposed for retention within the vicinity of proposed works. • The VMP is to identify appropriate contingency measures to be implemented in the event that any trees proposed for retention cannot be successfully retained. This may include compensatory plantings or offsets, where relevant. <p>The following opportunities to further minimise impacts to vegetation, ecological communities and habitat for threatened fauna would also be explored during detailed design:</p> <ul style="list-style-type: none"> • Opportunities to reduce the bulk/scale of the facility and any necessary associated site infrastructure such as the number of vehicle weighbridges, configuration/ size of buildings, etc. • Opportunities for resizing/ reshaping drainage infrastructure, reconfiguring the visitor centre and/ or utilising different carpark batter treatments so as to minimise vegetation clearing requirements • Opportunities to reduce / reconfigure the substation footprint so as to minimise requirements for vegetation clearing. 	Pre-construction and construction	Proponent and Contractor

ID	Description	Mitigation measures	Timing	Responsibility
B7	Spread of weeds, pests and pathogens	<p>Management measures would be prepared, implemented and audited to avoid and minimise the environmental risks associated with weeds, pests and pathogens. As a minimum, these would include:</p> <ul style="list-style-type: none"> • Completion of a site weed assessment and development of a <i>Weed Management Plan</i>. The Weed Management Plan would sit as a sub-plan to the Vegetation Management Plan (B5). • Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols. • Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks. • Disposal of any weed material at an appropriately licensed facility. • Implementation of appropriate hygiene protocols where there are potential or known pathogen risks. 	Construction	Contractor
B8	Noise impacts	<p>A Noise Management Plan is to be developed and implemented outlining suitable controls for the management and minimisation of noise during construction and operation. The plan would consider the use of the following measures, where appropriate:</p> <ul style="list-style-type: none"> • Construction staging, limiting construction activities to daylight hours and limiting the use of noise intensive construction methods where possible. • Placement of buildings or hard/ soft landscaping so as to dampen noise outputs from the facility. • Truck deliveries and use of external machinery restricted to daylight hours where possible. • Compliance with the Interim Construction Noise Guideline (ICNG, DECC, 2009) for specific construction activities including large concrete pours, delivery and installation of oversized plant is necessary outside of standard working hours. 	Construction and operation	Contractor/ Proponent
B9	Light disturbance	Light impacts are to be minimised as much as possible through the use of sensor lighting and/ or directional lighting for more heavily utilised parts of the facility.	Construction and operation	Contractor/ Proponent
B10	Dust and other air quality impacts	An Air Quality Management Plan would be prepared and developed outlining requirements for the management and monitoring of air quality emissions to ensure compliance with relevant standards.	Construction and operation	Contractor/ Proponent

ID	Description	Mitigation measures	Timing	Responsibility
B11	Impacts to water quality and hydrology	<p>A Soil and Water Management Plan would be developed outlining measures for the management and monitoring of surface water quality and hydrology during construction. The plan would also address any requirements for the management of potential acid sulfate soils or contaminated lands during construction so as to minimise impacts to terrestrial and aquatic habitats.</p> <p>The plan would include the implementation of a construction surface water quality monitoring to minimise impacts to surface water quality.</p>	Construction and operation	Contractor/ Proponent
B12		An Erosion and Sediment Control Plan would also be implemented outlining measures for the prevention of erosion and sedimentation during construction.		
B13	Groundwater impacts	A Groundwater Management Plan would be developed outlining strategies to be employed during construction to minimise and monitor impacts to groundwater.	Construction	Contractor
B14	Impacts associated with litter and solid waste	A Waste Management Strategy would be developed outlining strategies for waste management during construction. Strategies for the management of litter within the site should also be written into operational plans and programs.	Construction and operation	Contractor/ Proponent
B15	Aquatic habitats and fauna	<p>A Dewatering Management Plan would be developed outlining strategies for the use of the water within the dam, controls for reducing contamination risk in the form of suspended solids impacting on the receiving environment and completing aquatic fauna/ fish salvage. The management plan should include;</p> <ul style="list-style-type: none"> • Implementation of a construction Surface Water quality monitoring to manage and limit the exposure of suspended solids into the receiving environment. • Once use of water and sediments of the dam has been determined, sediment samples should be collected to determine the contamination risk for the dam sediments and confirm by the contractor if the sediments are adequate to be utilised on site or if additional remediation will be required to manage the potential risk elevated levels of Copper, Zinc and other present contaminants that are present in the surface water and soils on site to minimise the risk of impact to the downstream receiving environment. • Salvage of native aquatic fauna/ fish and/ or disposal of all exotic fauna during dam dewatering to minimise any risk of fauna injury or death and to address relevant biosecurity requirements. 	Construction	Contractor

ID	Description	Mitigation measures	Timing	Responsibility
B16	Effectiveness of mitigation and management measures	Consistent with any specific requirements of the approved <i>flora and fauna management plan (B1)</i> , a monitoring program would be implemented during construction to assess the effectiveness of mitigation and management measures implemented, to identify any unexpected impacts and appropriate contingency measures necessary for the protection of biodiversity. A register of inspections will be established.	Construction and post-construction	Contractor/ Proponent

8 Impact Summary

Impacts associated with the proposal are summarised in Section 7.2. Following the implementation of measures to avoid, minimise and/or mitigate impacts to biodiversity, the proposal is considered likely to result in a no-net-loss biodiversity outcome. This is discussed further in Section 8.1 and Section 8.2.

Table 26: Summary of proposal impacts

Relevant matter	Details	Direct impacts (ha)
Native vegetation communities	PCT 849 Cumberland Shale Plains Woodland	0.45
Threatened ecological communities	Cumberland Plain Woodland	0.45
Threatened species	Southern Myotis	0.45

8.1 Impacts requiring offsets

Offset thresholds for the BOS are detailed in Section 7.1 of the BC Regulation, and include:

- The clearing of native vegetation that exceeds the area-based thresholds for the relevant minimum lot size.
- The clearing of native vegetation, or prescribed impacts to biodiversity within land included on the Biodiversity Values Map (BVM).

Assessment of proposal impacts against the BOS thresholds indicates:

- Clearing impacts associated with the development will not exceed the area-based threshold of 0.5 ha relevant to the minimum lot size for the development site.
- No lands included within the BVM will be impacted as a result of the development. Vegetation immediately to the north of the development site is included within the BVM however, the development will occur more than 100 m to the south and is unlikely to result in any impacts.

Under Section 7.3 of the BC Act, offsets may also be required for a development where it is likely to have a significant affect on threatened species or ecological communities, or their habitats. An assessment against Section 7.3 of the BC Act is provided in Table 27 for biodiversity matters relevant to the proposal. The results of the assessment indicate the proposal is not likely to result in any significant impacts to these matters.

Table 27: Test for determining likely significant impacts to threatened species or ecological communities or their habitats

Relevant matter	Significance criteria	Assessment results
Threatened species	The proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	Only marginal breeding habitat for Southern Myotis exists within the site. No hollow-bearing trees will be removed and only 0.45ha of habitat will be removed. This is not considered significant given the disturbed nature of the habitat and the availability of larger more intact habitat areas within the surrounding landscape.
Endangered or critically endangered ecological community	The proposed development or activity is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction	<p>The total extent of Cumberland Plain Woodland estimated by Tozer (2003) is 11,054(±1,564) ha, representing 8.8(±1.2)% of the pre-European (pre-1788) distribution of the TEC. East of the Hawkesbury-Nepean River, less than 6% (6,420ha) of the TEC has been estimated as remaining. An update in 2007 indicated an additional 15.2±0.6% (442±46ha) reduction in 9 years. These estimates indicate that the geographic distribution of the community has undergone a very large reduction with continuing decline due to pressure from urban development.</p> <p>An area of 0.45ha of the TEC will be impacted as a result of the proposal. This equates to a reduction of less than a 1% of the total TEC extent east of the Hawkesbury-Nepean River.</p> <p>This loss is considered unlikely to result in the extinction of the ecological community given the availability of larger, more intact TEC stands within the surrounding landscape.</p> <p>Lands within the development site do not comprise priority lands for conservation of the TEC, as identified by the Cumberland Plain Recovery Plan (DECCW 2010).</p>
	The proposed development or activity is likely to substantially or adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	<p>TEC patches within the development site are severely fragmented and weed disturbed due historical clearing and agricultural land uses. TEC stands support poor floristics and largely comprise scattered trees lacking hollows and with an exotic dominated understorey. These are also subject to ongoing disturbance from adjacent industrial and transport land uses by means of noise, light, litter, air quality and other impacts.</p> <p>Despite this, TEC stands retain some viability and value offering stepping stone connectivity between other larger fragments within the landscape.</p> <p>The loss of 0.45ha of the TEC is unlikely to result in any significant impact to the TEC. Proposed weed management and restoration works are likely to improve the condition, function and ongoing viability of the TEC within the site and</p>

Relevant matter	Significance criteria	Assessment results
		will maintain existing levels of habitat connectivity.
Habitat for threatened species or ecological community	<ul style="list-style-type: none"> • The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity; and • Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity; and • The importance of the habitats to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality 	<p>An area of 0.45ha of the TEC will be impacted due to the WSERRC development. TEC patches within the development site are severely fragmented and support poor floristic composition and vegetative structure, offering relatively low value for threatened flora and fauna generally known to be associated with the TEC. However, proposed weed management and site restoration works are likely to improve the condition, function and ongoing viability of the TEC within the site and will maintain existing levels of habitat connectivity.</p> <p>Lands within the development site do not comprise priority lands for conservation of the TEC, as identified by the Cumberland Plain Recovery Plan (DECCW 2010).</p>
Declared areas of outstanding biodiversity value	The proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)	The development will not impact on any areas of outstanding biodiversity.
Key threatening processes	The proposed development or activity is or is part of a key threatening process (KTP) or is likely to increase the impact on a key threatening process	<p>Existing vegetation within the development site is subject to disturbance from historical land clearing and invasion from Lantana, African Olive. These KTPs have impacted the condition and function of the existing critically endangered Cumberland Plain Woodland with ongoing encroachment of high threat exotic species likely to occur without the implementation of appropriate weed management measures.</p> <p>The proposed development will involve the clearing of 0.45 ha only and impacts associated with clearing will be mitigated by means of the proposed restoration activities. These are likely to improve the condition and function of the TEC.</p> <p>The introduction of pathogens including Chytrid Fungus, Root Rot and Myrtle Rust is KTP that may pose a risk during construction. However, pathogens management protocols will be implemented during construction including hygiene measures such as vehicle wash-down facilities and the use of clean soils. Operations are unlikely to pose any pathogen risk.</p>

Relevant matter	Significance criteria	Assessment results
		<p>Relevant KTP are unlikely to significantly impact TECs within the development site, nor will they contribute to any SAI.</p> <p>Habitat within the site is marginal for Southern Myotis and KTPs are unlikely to significantly impact the species.</p>

8.2 Assessment of serious and irreversible impacts

An impact is to be regarded as serious and irreversible (SAII) if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct. Principles for determining potential SAIIs are identified in clause 6.7 of the BC Regulation with thresholds assigned to SAI entities within BioNet.

The Cumberland Plain Woodland has been identified as an entity for potential SAI. However, no SAI thresholds have currently been set for the Cumberland Plain Woodland. The Cumberland Plain Recovery Plan (DECCW, 2011) and the NSW Scientific Committee final determination for the ecological community have been used to assess proposal impacts against each of the SAI principles, as set out in clause 6.7 of the BC Regulation. Additional guidance for each thresholds has been taken from the Guidance to assist a decision-maker to determine a serious and irreversible impact (DPIE 2019). The results of the assessment are presented in Table 28 and indicate proposal impacts to the TEC are unlikely to constitute a SAI.

Southern Myotis is not a potential SAI entity and impacts to the species as a result of the development are unlikely to contribute to any increased risk of extinction.

Table 28: Assessment of potential SAIIs for the Cumberland Plain Woodland TEC

SAII criteria	Guidance to assist decision-maker to determine SAI	Assessment results
<p>Principle 1: Rapid decline</p> <p>The proposal is likely to cause further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline</p>	<p>Ecological community listed as critically endangered under the BC Act where the reason for that listing is a very large reduction in population size.</p> <p>Relevant for ecological community that has been observed, estimated, inferred or reasonably suspected to have undergone a very large reduction in distribution; being:</p>	<p>The total extent of Cumberland Plain Woodland estimated by Tozer (2003) is 11,054(±1,564) ha, representing 8.8(±1.2)% of the pre-European (pre-1788) distribution of the TEC. East of the Hawkesbury-Nepean River, less than 6% (6,420ha) of the TEC has been estimated as remaining. An update in 2007 indicated an additional 5.2±0.6% (442±46ha) reduction in 9 years. These estimates indicate that the geographic distribution of the community has undergone a very large reduction</p>

SAII criteria	Guidance to assist decision-maker to determine SAI	Assessment results
	<ul style="list-style-type: none"> - >90% reduction since 1750; or - >80% reduction where the reduction is over 50-year period either in past, present or future. 	<p>with continuing decline due to pressure from urban development.</p> <p>An area of 0.45ha of the TEC will be impacted due to the proposal. This equates to a reduction of less than a 1% of the total TEC extent east of the Hawkesbury-Nepean River. This loss is considered unlikely to result in the extinction of the ecological community given the availability of larger, more intact TEC stands within the surrounding landscape.</p> <p>Lands within the development site do not comprise priority lands for conservation of the TEC, as identified by the Cumberland Plain Recovery Plan (DECCW 2010).</p>
<p>Principle 2: Small population size</p> <p>The proposal will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size</p>	<p>Ecological community listed as critically endangered under the BC Act where the reason for that listing is a very small size or very high environmental degradation and / or very large disruption of biotic processes or interactions.</p> <p>Relevant for ecological communities that are considered to have a very large degree of environmental degradation or disruption of biotic processes or interactions are those with:</p> <ul style="list-style-type: none"> - >90% extent and severity where the disruption or impacts are measured since 1970 - >80% extent and severity where the disruption or impacts are over a 50-year period, either in the past, present or future. 	<p>Fragmentation of habitat due to land clearing has resulted in a very large reduction in the ecological function of Cumberland Plain Woodland. The TEC remains severely fragmented with more than half of mapped remnant patches being <3ha in size. The integrity and viability of these smaller patches is impaired due to the small population size of many species, disruption to pollination/ seed dispersal and susceptibility to further disturbance. Despite this, some very small and apparently degraded stands may contain a high diversity of species including rare flora and fauna.</p> <p>TEC patches within the development site are severely fragmented and weed disturbed due historical clearing and agricultural land uses. TEC stands support poor floristics and largely comprise scattered trees lacking hollows and with an exotic dominated understorey. These are also subject to ongoing disturbance from adjacent industrial and transport land uses by means of noise, light, litter, air quality and other impacts. Despite this, TEC stands retain some viability and value due to existing stepping stone connectivity with other larger fragments within the landscape.</p> <p>Loss of 0.45ha of the TEC is unlikely to result in any significant impact in</p>

SAII criteria	Guidance to assist decision-maker to determine SAI	Assessment results
		the condition or viability of the TEC. Proposed weed management and restoration works are likely to improve the condition, function and ongoing viability of the TEC within the site and will maintain existing levels of habitat connectivity.
<p><i>Principle 3: Limited geographic distribution</i></p> <p>The proposal will impact on the habitat of the species or ecological community that is currently observed, estimated inferred or reasonably suspected to have a very limited geographic distribution</p>	<p>Ecological community listed as critically endangered under the BC Act where the reason for that listing is their very highly restricted geographic distribution.</p> <p>Ecological communities with very limited geographic distribution that have an area of occupancy of less than or equal to two 10x10 km grid cells or an extent of occurrence of <1000km² and one of the following:</p> <ul style="list-style-type: none"> - An observed or inferred continuing decline in spatial extent, environmental quality or disruption of biotic interactions - Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or disruption of biotic interactions within the next 20 years - An ecological community exists at one location. 	<p>Cumberland Plain Woodland is known from a number of LGAs within the Sydney Basin Bioregion. These include the Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly LGAs.</p> <p>The TEC does not support a highly restricted geographic distribution despite the rapid rate of recent decline.</p> <p>An area of 0.45ha of the TEC will be impacted due to the proposal. This equates to a reduction of less than 1% of the total TEC extent east of the Hawkesbury-Nepean River. This loss is considered unlikely to result in the extinction of the ecological community given the availability of larger, more intact TEC stands within the surrounding landscape.</p> <p>Lands within the development site do not comprise priority lands for conservation of the TEC, as identified by the Cumberland Plain Recovery Plan (DECCW 2010).</p>
<p><i>Principle 4: Poor response to management</i></p> <p>The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.</p>	<p>Ecological communities that cannot be offset as it is unlikely to respond to management due to the presence of ongoing key threatening processes or due to a limitation in reproductive/population recovery capability.</p>	<p>Conservation of Cumberland Plain Woodland at a number of sites (including Mt Annan Botanic Gardens, Scheyville National Park, Western Sydney Regional Park, Orchid Hills Defence Site, etc) indicates the TEC is capable of some recovery. However restoration is known to be problematic within sites that have been exposed to soil disturbance by earthworks, cultivation, fertiliser application or other measures of nutrient enrichment.</p>

SAII criteria	Guidance to assist decision-maker to determine SAI	Assessment results
		<p>TEC patches within the development site are severely fragmented and weed disturbed due historical clearing and agricultural land uses.</p> <p>Review of the Cumberland Plain Recovery Plan (DECCW 2010) indicates these stands are not important for the conservation of the TEC.</p> <p>Impacts to the TEC have been avoided and minimised where practicable and are unlikely to trigger offset requirements.</p>

An assessment of residual impacts resulting from the development is provided in Section 8. The assessment indicates the proposal does not trigger offsets requirements under the NSW Biodiversity Offset Scheme. A Biodiversity Credit Report taken from the BAM Calculator and is provided Appendix E.

9 References

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Appendix A

BAM Candidate Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00019887/BAAS19077/20/00019888	Western Sydney Energy and Resource Recovery Centre	26/11/2019
Assessor Name	Report Created	BAM Data version *
	08/04/2020	22
Assessor Number	Assessment Type	BAM Case Status
	Part 4 Developments (General)	Open
	Assessment Revision	Date Finalised
	0	To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Diamond Firetail	Stagonopleura guttata	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Dusky Woodswallow	Artamus cyanopterus cyanopterus	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Eastern False Pipistrelle	Falsistrellus tasmaniensis	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Flame Robin	Petroica phoenicea	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Gang-gang Cockatoo	Callocephalon fimbriatum	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

BAM Predicted Species Report

Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Koala	<i>Phascolarctos cinereus</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Little Bent-winged Bat	<i>Miniopterus australis</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Little Eagle	<i>Hieraaetus morphnoides</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Little Lorikeet	<i>Glossopsitta pusilla</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Masked Owl	<i>Tyto novaehollandiae</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Painted Honeyeater	<i>Grantiella picta</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Powerful Owl	<i>Ninox strenua</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Regent Honeyeater	<i>Anthochaera phrygia</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Scarlet Robin	<i>Petroica boodang</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Speckled Warbler	<i>Chthonicola sagittata</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Spotted Harrier	<i>Circus assimilis</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Square-tailed Kite	<i>Lophoictinia isura</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Swift Parrot	<i>Lathamus discolor</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Turquoise Parrot	<i>Neophema pulchella</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Varied Sittella	<i>Daphoenositta chrysoptera</i>	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

BAM Predicted Species Report

White-bellied Sea-Eagle	Haliaeetus leucogaster	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Yellow-bellied Sheath-tail-bat	Saccolaimus flaviventris	849-Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

Proposal Details

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Assessor Number	Assessment Type	BAM Case Status
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	Assessment Revision	Date Finalised
	0	To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

List of Species Requiring Survey

Name	Presence	Survey Months												
<i>Acacia bynoeana</i> Bynoe's Wattle		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<i>Acacia pubescens</i> Downy Wattle		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<i>Burhinus grallarius</i> Bush Stone-curlew		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<i>Caladenia tessellata</i> Thick Lip Spider Orchid		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<i>Cynanchum elegans</i> White-flowered Wax Plant		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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BAM Candidate Species Report

<i>Cercartetus nanus</i> Eastern Pygmy-possum		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Eucalyptus benthamii</i> Camden White Gum		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Dillwynia tenuifolia</i> Dillwynia tenuifolia		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Grevillea juniperina subsp. juniperina</i> Juniper-leaved Grevillea		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Hieraaetus morphnoides</i> Little Eagle		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Pommerhelix duralensis</i> Dural Land Snail		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Dillwynia tenuifolia - endangered population</i> Dillwynia tenuifolia, Kemps Creek		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

<p><i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Lathamus discolor</i> Swift Parrot</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Litoria aurea</i> Green and Golden Bell Frog</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Lophoictinia isura</i> Square-tailed Kite</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Meridolum corneovirens</i> Cumberland Plain Land Snail</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Miniopterus australis</i> Little Bent-winged Bat</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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<p><i>Myotis macropus</i> Southern Myotis</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Jul	Aug	Sep	Oct	Nov	Dec									
<p><i>Ninox strenua</i> Powerful Owl</p>		<table border="1"> <tr> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td> </tr> <tr> <td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td> </tr> </table>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Jul	Aug	Sep	Oct	Nov	Dec									

BAM Candidate Species Report

<i>Persoonia bargoensis</i> Bargo Geebung		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Petaurus norfolcensis</i> Squirrel Glider		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Phascolarctos cinereus</i> Koala		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Pimelea curviflora var. curviflora</i> Pimelea curviflora var. curviflora		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Pimelea spicata</i> Spiked Rice-flower		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Pterostylis saxicola</i> Sydney Plains Greenhood		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Pultenaea pedunculata</i> Matted Bush-pea		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Thesium australe</i> Austral Toadflax		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Tyto novaehollandiae</i> Masked Owl		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
<i>Anthochaera phrygia</i> Regent Honeyeater		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

***Callocephalon fimbriatum* -
endangered population**
Gang-gang Cockatoo population in
the Hornsby and Ku-ring-gai Local
Government Areas

Jan	Feb	Mar	Apr	May	Jun
Jul	Aug	Sep	Oct	Nov	Dec

Appendix B

EPBC Act PMST Search Results



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 26/03/20 12:42:44

[Summary](#)

[Details](#)

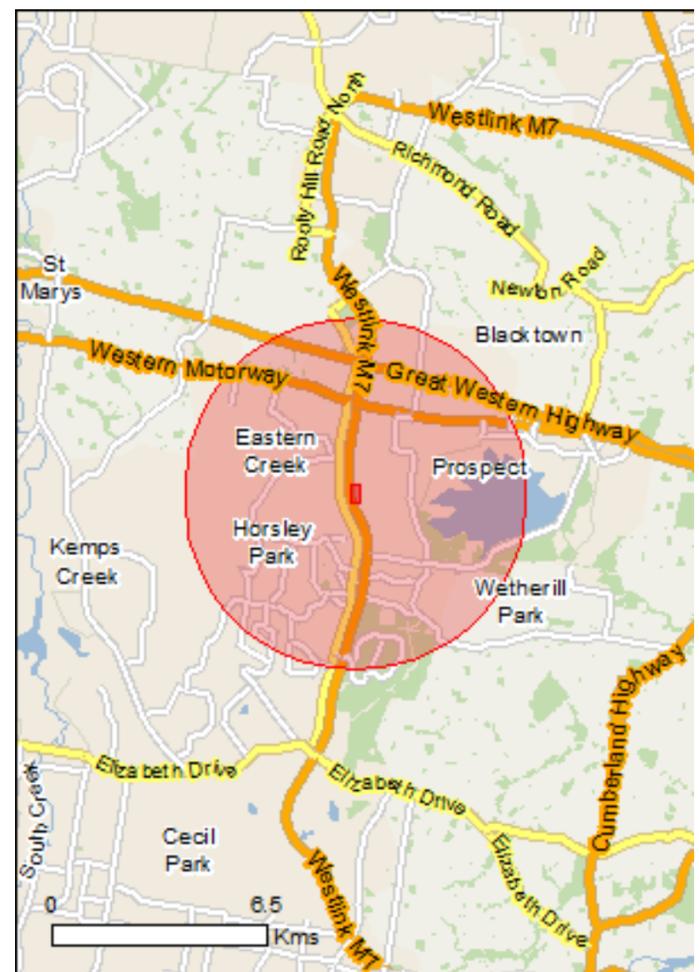
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

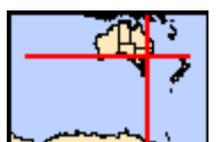
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	40
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	4
Commonwealth Heritage Places:	None
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	49
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community likely to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species

Name	Status	Type of Presence
Fish		
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat may occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat known to occur within area
Allocasuarina glareicola [21932]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat may occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat likely to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat likely to occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area
Pomaderris brunnea Rufous Pomaderris [16845]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat likely to occur within area
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat likely to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Commonwealth Land - Defence Housing Authority Commonwealth Land - Director of War Service Homes Commonwealth Land - Telstra Corporation Limited

Listed Marine Species

[\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Prospect	NSW

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
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Birds

Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Reptiles

Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
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Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.81698 150.85245,-33.81698 150.85483,-33.82064 150.85483,-33.82064 150.85245,-33.81698 150.85245

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix C

Threatened species habitat suitability assessment

Table 29: Consideration of species requiring further assessment and identification of candidate species

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
Frogs											
Red-crowned Toadlet <i>Pseudophryne australis</i>	Species	N/A	No	11-30%	<5ha	No	N/A	Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter within periodically wet drainage lines in open forest.	No	Site does not contain sufficient native vegetation cover.	Unlikely
Green and Golden Bell Frog <i>Litoria aurea</i>	Species	N/A	Yes	≤10%	<5ha	Yes	Within 1km of wet areas, swamps, waterbodies	Found in a wide range of water bodies except fast flowing streams including disturbed / contaminated sites.	Yes	Low-moderate quality habitat present. Site contains a dam with emergent macrophytes and drainage lines. Site within 1km of Eastern Creek. <i>Gambusia</i> were observed in the downstream drainage line.	Likely
Giant Burrowing Frog <i>Heleioporus australiacus</i>	Species	N/A	No	31-70%	5-24 ha	No	N/A	Occurs in hanging swamps on sandstone shelves and beside perennial creeks.	No	Site does not contain sufficient native vegetation cover. No burrowing frogs have been recorded in cleared lands.	Unlikely
Birds											
Glossy Black Cockatoo <i>Calyptorhynchus lathami</i>	Species/ Ecosystem	N/A	No	≤10%	<5ha	No	Foraging: <i>Allocasuarina</i> and <i>Casuarina</i> species Breeding: Requires hollows > 15cm	Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>)	No	Lack of suitable foraging resources (i.e. <i>Allocasuarina sp./Casuarina sp.</i>) – only	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
							diameter and > 5m above ground	and Forest Sheoak (<i>A. torulosa</i>) are important foods.		two singles trees recorded	
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	Species/ Ecosystem	N/A	Yes	11-30%	<5ha	Yes	Foraging: No constraints listed Breeding: Requires <i>Eucalyptus</i> species with hollows >9cm diameter	Tall mountain forests and woodlands in spring and summer. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (<i>Eucalyptus pauciflora</i>) woodland and occasionally in temperate rainforests.	No	No suitable foraging habitat. No hollow-bearing trees of suitable size present.	Unlikely
Little Eagle <i>Hieraaetus morphnoides</i>	Species/ Ecosystem	N/A	Yes	11-30%	<5ha	Yes	Foraging: No constraints listed Breeding: Nest trees - live (occasionally dead) large old trees within vegetation	Open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	No	Marginal foraging habitat due to degradation. No suitable trees with nests identified on site.	Unlikely
Swift Parrot <i>Lathamus discolor</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Foraging: No constraints listed Mapped important habitat areas	Lives on edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	No	Site not within mapped important habitat areas.	Unlikely
Powerful Owl <i>Ninox strenua</i>	Species/ Ecosystem	N/A	Yes	11-30%	<5ha	Yes	Foraging: No constraints listed Breeding: Living or dead trees with hollow	Inhabits a range of vegetation types, from woodland and open	No	No suitable breeding habitat present. Common prey species	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
							greater than 20cm diameter	sclerophyll forest to tall open wet forest and rainforest.		unlikely to occur as no hollows present on site.	
Masked Owl <i>Tyto novaehollandiae</i>	Species/ Ecosystem	N/A	Yes	11-30%	<5ha	Yes	Foraging: No constraints listed Breeding: Living or dead trees with hollow greater than 20cm diameter	Lives in dry eucalypt forest and woodlands from sea level to 1100m.	Yes	No suitable breeding habitat present. Marginal foraging habitat.	Unlikely
Hooded Robin (south-eastern form) <i>Melanodryas cucullata cucullata</i>	Ecosystem	N/A	Yes	≤10%	<5ha	Yes	None listed	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	No	Marginal habitat unlikely to support the species – lacks native grasses and structural diversity.	Unlikely
Scarlet Robin <i>Petroica boodang</i>	Ecosystem	N/A	Yes	≤10%	<5ha	Yes	None listed	Dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs	No	Marginal habitat unlikely to support the species – highly disturbed	Unlikely
Bush Stone-Curlew <i>Burhinus grallarius</i>	Species	N/A	Yes	11-30%	<5ha	Yes	Fallen/standing dead timber including logs	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber.	No	Marginal habitat unlikely to support the species – highly disturbed. No significant fallen timber present.	Unlikely
Speckled Warbler	Ecosystem	N/A	No	≤10%	<5ha	No	None listed	The Speckled Warbler lives in a wide range of	No	Marginal habitat unlikely to support the	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
<i>Cnthonicola sagittata</i>								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 regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.		species – highly disturbed lacking typical habitat structure and diversity.	
Diamond Firetail <i>Stagonopleura guttata</i>	Ecosystem	N/A	Yes	≤10%	<5ha	Yes	None listed	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	No	Marginal habitat unlikely to support the species – highly disturbed with no native grassland.	Unlikely
Black-chinned Honeyeater <i>Melithreptus gularis gularis</i>	Ecosystem	N/A	Yes	11-30%	5-24 ha	No	None listed	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark	No	Patch size insufficient to support the species.	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
								(Eucalyptus sideroxylon), White Box (E. albens), Inland Grey Box (E. microcarpa), Yellow Box (E. melliodora), Blakely's Red Gum (E. blakelyi) and Forest Red Gum (E. tereticornis). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.			
Spotted Harrier <i>Circus assimilis</i>	Ecosystem	N/A	Yes	11-30%	<5ha	Yes	None listed	Occurs in grassy open woodland including <i>Acacia</i> 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	No	Marginal habitat unlikely to support the species – highly disturbed.	Unlikely
Brown Treecreeper (eastern subspecies) <i>Climacteris picumnus victoriae</i>	Ecosystem	N/A	Yes	≤10%	<5ha	Yes	None listed	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	No	Marginal habitat unlikely to support the species – highly disturbed and lacks hollow-bearing trees..	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
								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.			
Painted Honeyeater <i>Grantiella picta</i>	Ecosystem	N/A	Yes	11-30%	<5ha	Yes	Mistletoes present at a density of greater than five mistletoes per hectare	Inhabits Boree/Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests.	No	Mistletoes not present at required density – not habitat	Unlikely
Regent Honeyeater <i>Anthochaera phrygia</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Mapped important areas	Most commonly associated with box-ironbark eucalypt woodland and dry sclerophyl forests, but also inhabits riparian vegetation and lowland coastal forest.	No	Site not within mapped important habitat areas. Forest Red Gums and Grey Boxes may be significant food resources for Regent Honeyeaters as both species can flower	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
										during winter months. Site lacks large mature trees likely to flower prolifically.	
Varied Sitella <i>Daphoenositta chrysoptera</i>	Ecosystem	N/A	Yes	11-30%	<5ha	Yes	None listed	Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	No	Marginal habitat unlikely to support the species – highly disturbed	Unlikely
Square-tailed Kite <i>Lophoictinia isura</i>	Species/ Ecosystem	N/A	Yes	11-30%	<5ha	Yes	Breeding: Nest trees	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Yes	No nest trees observed. Marginal foraging habitat	Unlikely
White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Foraging: Within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines Breeding: Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large	No	A stick nest is required to confirm breeding habitat – none present at site. Foraging habitat within 1km of site is marginal, with small creeks and dams.	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
								structures built from sticks and lined with leaves or grass.			
Barking Owl <i>Ninox connivens</i>	Species/ Ecosystem	N/A	Yes	11-30%	25-100 ha	No	Foraging: no constraints listed Breeding: Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	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. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils.	No	No suitable breeding habitat present. Common prey species unlikely to occur as no hollows present on site.	Unlikely
Eastern Osprey <i>Pandion cristatus</i>	Species/ Ecosystem	N/A	No	≤10%	<5ha	No	Breeding: Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Fish over open water.	No	No suitable habitat on site.	Unlikely
Snails											
Cumberland Plain Land Snail <i>Meridolum comeovirens</i>	Species	N/A	Yes	≤10%	<5ha	Yes	None listed, however TBDC record notes that the species relies on a good cover of woody debris, is affected by rodent predation	Primarily inhabits Cumberland Plain Woodland. Grassy, open woodland with occasional dense patches of shrubs.	Yes	Leaf litter and woody debris were generally sparse but present in some areas.	Likely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
Dural Land Snail <i>Pommerhelix duralensis</i>	Species	N/A	Yes	≤10%	<5ha	Yes	Leaf litter and shed bark or within 50m of litter or bark Rocky areas: rocks or within 50m of rocks Fallen/standing dead timber including logs: Including logs and bark or within 50m of logs or bark	The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb.	No	Leaf litter and woody debris were generally sparse but present in some areas.	Possible
Mammals											
Southern Myotis <i>Myotis macropus</i>	Species	N/A	Yes	≤10%	<5ha	Yes	Hollow-bearing trees: Within 200 m of riparian zone	Generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage.	Yes	One small stag with one hollow <5cm diameter, depth <15cm was recorded on site.	Possible
Koala <i>Phascolarctos cinereus</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Site contains 'important' habitat,	Naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalypt species.	No	Marginal habitat due to small amount of food trees. No koala records occur within 2.5km of site.	Unlikely
Yellow-bellied Glider <i>Petaurus australis</i>	Ecosystem	N/A	Yes	31-70%	25 - 100 ha	No	Hollow-bearing trees: Hollows >25cm diameter	Nest in hollows within tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils	No	No hollow-bearing trees matching constraint were recorded on site	Unlikely
Squirrel Glider	Species	N/A	Yes	≤10%	<5ha	Yes	None listed, however the TBDC record notes that large old	Nests in hollows within mature or old growth Box, Box-Ironbark woodlands	No	No hollow-bearing trees suitable for this species recorded on	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
<i>Petaurus norfolcensis</i>							trees with hollows are essential for breeding, nesting and movement.	and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.		site. Low abundance and diversity of food resource species.	
Spotted-tailed Quoll <i>Dasyurus maculatus</i>	Ecosystem	N/A	Yes	≤10%	<5ha	Yes	None listed	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.	No	Degraded habitat unlikely to support prey species and provides no suitable den habitat.	Unlikely
Grey-headed Flying Fox <i>Pteropus poliocephalus</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Foraging: None listed Breeding: presence of camps	Utilised vegetation communities including rainforests, open forests, closed and open woodlands. Also feeds on commercial fruit crops and on introduced tree species in urban areas.	Yes	No camps were identified on the site or in the immediate surrounding area. Sparse availability of foraging resources.	Unlikely
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	Species	N/A	Yes	11-30%	<5ha	Yes	Cliffs: Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within	Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is habitat of importance. Rainforest and	No	No natural rocky habitat features were identified on site or within 2km during site survey and review of aerial mapping. No signs of roosting	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
							two kilometres of old mines or tunnels.	most eucalypt forest at high elevation.		within disused structures on site.	
Eastern Pygmy possum <i>Cercartetus nanus</i>	Species	N/A	Yes	11-30%	<5ha	Yes	None listed	Shelters in tree hollows, rotten stumps and holes in the ground or abandoned nests and thickets within 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.	No	Very limited foraging resources available and habitat very marginal, no hollow-bearing trees or suitable nest sites identified on site	Unlikely
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	Ecosystem	N/A	Yes	31-70%	5-24 ha	No	None listed	Prefers moist habitats, with trees taller than 20m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	No	Patch size and native vegetation cover at site not sufficient to support the species.	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
Eastern Coastal Free-tailed Bat <i>Micronomus norfolkensis</i>	Ecosystem	N/A	Yes	≤10%	<5ha	Yes	None listed	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	Yes	Site contains potential foraging habitat. Disused buildings on site may also be used for roosting. No hollows present.	Possible
Little Bentwing-bat <i>Miniopterus australis</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Breeding: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC - in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	No	Site contains potential foraging habitat. No habitat features suspected to be used for breeding were identified on site	Possible
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	N/A		≤10%	<5ha	Yes	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Maternity caves have very specific temperature and humidity regimes. Hunt in forested areas, catching moths and other	No	Site contains potential foraging habitat. No habitat features suspected to be used for breeding were identified on site	Possible

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								flying insects above the tree tops.			
Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	Species/ Ecosystem	N/A	Yes	≤10%	<5ha	Yes	Breeding: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	No	No habitat features suspected to be used for breeding were identified on site	Possible-non-breeding
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	Ecosystem	N/A	No	31-70%	5-24 ha	No	None listed	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.	No	Sufficient vegetation cover and hollows were not recorded within the site. No habitat features suspected to be used for breeding were identified on site	Unlikely
Greater Glider <i>Petauroides volans</i>	Species	N/A	No	31-70%	5-24 ha	No	Hollow-bearing trees	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.	No	Sufficient vegetation cover and hollows were not recorded on site	Unlikely
Reptiles											

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Broad-headed Snake <i>Hoplocephalus bungaroides</i>	Species/ Ecosystem	N/A	No	31-70%	5-24 ha	No	Including escarpments, outcrops and pagodas within the Sydney Sandstone geologies	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer.	No	No suitable rocky habitats occur within the site.	Unlikely
Plants											
Bynoe's Wattle <i>Acacia bynoeana</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Heath or dry sclerophyll forest on sandy soils. Associated overstorey species include Red Bloodwood, Scribbly Gum, Paramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	No	No suitable habitat-site supports grassy woodland dominated by <i>E.tereticornis</i> and <i>E.mollucana</i> . and subject to high levels of disturbance.	Unlikely
Downy Wattle <i>Acacia pubescens</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.	Yes	Marginal habitat within PCT849	Possible
<i>Allocasuarina glareicola</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Grows in Castlereagh woodland on lateritic soil. Common associated understorey species include <i>Melaleuca nodosa</i> , <i>Hakea</i>	No	Primarily restricted to Richmond district. Vegetation and soils within the site not suitable.	Unlikely

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								<i>dactyloides</i> , <i>H.sericea</i> , <i>Dillwynia tenuifolia</i> , <i>Micromyrtus minutiflora</i> , <i>Acacia elongata</i> .			
Thick Lip Spider Orchid <i>Caladenia tessellata</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	<p>Prefers low, dry sclerophyll woodland (for example open Kunzea woodland) with a heathy or sometimes grassy understorey on clay loams or sandy soils. Also known to occur in in dry, low Brittle Gum (Eucalyptus mannifera), Inland Scribbly Gum (E. rossii) and Allocasuarina spp. woodland with a sparse understorey and stony soil.</p> <p>Extant populations occur in two known locations; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast.</p>	No	No known populations in the vicinity of the development site. The site does not support suitable habitat for the species.	Unlikely
White-flowered Wax Plant <i>Cynanchum elegans</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub;	No	Site subject to considerable disturbance and provides marginal habitat	Possible

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								Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honeymyrtle <i>Melaleuca armillaris</i> scrub to open scrub.			
<i>Dillwynia tenuifolia</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	No	Site subject to considerable disturbance and provides marginal habitat	Possible
<i>Dillwynia tenuifolia</i> , Kemps Creek	Species	Kemps Creek, Liverpool LGA	N/A	N/A	N/A	No	N/A	N/A	No	N/A	Unlikely
Camden White Gum <i>Eucalyptus benthamii</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Occurs in open forest with deep alluvial soils and rivers and streams with bare silt deposits, typically 30-60m elevation.	No	Suitable habitat restricted to the alluvial flats of the Kedumba/Cox/Nepean River system at altitudes of 140-750m. Habitat within the site is not suitable.	Unlikely

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Yellow Gnat-orchid <i>Genoplesium baueri</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Grows in dry sclerophyll forest and moss gardens over sandstone.	No	The species has a very limited geographic extent with most records from areas between Ulladulla and northern Sydney. The site is subject to considerable disturbance and unlikely to provide suitable habitat for the species.	Unlikely
Wingless Raspwort <i>Haloragis exalata</i>	Species	N/A	N/A	N/A	N/A	Yes	Edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100m	Occurs in a variety of vegetation types. Appears to require protected and shaded damp situation in riparian habitats.	No	Habitat within stream and near farm dam very marginal and subject to very high levels of disturbance	Possible
Knotweed <i>Persicaria elatior</i>	Species	N/A	N/A	N/A	N/A	Yes	Within 50m of semi-permanent/ ephemeral wet areas, swamps or waterbodies including wetlands	Normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	No	Marginal habitat within stream and near farm dam.	Possible
Bargo Geebung <i>Persoonia bargoensis</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy,	No	Restricted to a small area south-west of Sydney bounded by Picton, Douglas Park,	Possible

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								gravelly soils. Known to occur within Shale/Sandstone Transition Forest.		Yanderra and Cataract River. The site is subject to considerable disturbance and unlikely to provide suitable habitat for the species.	
Hairy Geebung <i>Persoonia hirsuta</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Found in sandy soils in dry sclerophyll open forest, in woodland and heath on sandstone.	No	Some marginal habitat within PCT849	Possible
Nodding Geebung <i>Persoonia nutans</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities. Known to occur in Castlereagh Ironbark Forests.	No	Marginal habitat within PCT849.	Possible
<i>Pimelea curviflora</i> var. <i>curviflora</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodland.	No	Habitat unsuitable and subject to high levels of disturbance	Unlikely
Spiked Rice-flower <i>Pimelea spicata</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	On Cumberland Plain sites it is associated with Grey Box communities and in areas of iron bark. Co occurring species in the Cumberland Plain sites are grey box, forest red gum	Yes	Marginal habitat within PCT849.	Possible

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
								and narrow-leaved iron bark.			
Rufous Pomaderris <i>Pomaderris brunnea</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	No	Site subject to considerable disturbance and does not provide suitable habitat. No known populations within proximity to the site.	Unlikely
Illawarra Greenhood <i>Pterostylis gibbosa</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. Grows in woodland dominated by Forest Red Gum and White Feather Honey-myrtle.	No	The species is known from a small number of populations in the Hunter, Illawarra and Shoalhaven regions. According to Commonwealth conservation advice it is extinct on the Cumberland Plain. Habitat within the site is significantly disturbed and does not provide suitable habitat.	Unlikely
Sydney Plains Greenhood <i>Pterostylis saxicola</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Species currently only known from five locations including Georges River National Park, near Yeramba Lagoon, Ingleburn, Holsworthy, Peter Meadows Creek and St Marys Towers near Douglas Park. Requires intact forest, sclerophyll	No	Site not within known species location and does not support suitable habitat - no sandstone shelves or similar preferred habitats	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
								forest or woodland in shallow sandy soil over flat sheets of sandstone rock shelves above cliff lines and also in crevices between sandstone boulders; often in close proximity to streams.			
<i>Pultenaea parviflora</i> <i>Pultenaea parviflora</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest. This species re-establishes from soil-stored seed and there is no evidence of vegetative spread.	Yes	Marginal habitat within PCT849	Possible
Matted Bush-pea <i>Pultenaea pedunculata</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Woodland in clay or sandy-clay soils. Known within Cumberland Plain woodlands. Only known from two locations in the Sydney region at Villawood and Prestons.	No	Site conditions unsuitable due to dense exotic dominated understorey.	Unlikely
Magenta Lilly Pilly <i>Syzygium paniculatum</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Restricted mainly to remnant stands of littoral (coastal rainforest). Occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	No	Unsuitable habitat – no rainforest vegetation communities present	Unlikely

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
Netted Bottle Brush <i>Callistemon linearifolius</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Grows in dry sclerophyll forest and adjacent ranges.	No	Marginal habitat present within PCT849	Possible
Austral Pillwort <i>Pilularia novae-hollandiae</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Only known extant populations in NSW are located at Lake Cowal and Oolambeyan National Park. Grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud.	No	Habitat within the site is subject to very high levels of disturbance and is unlikely to be suitable for the species.	Unlikely
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Occurs as very scatter plants in areas of remnant vegetation. Relatively recent records from Prospect Reservoir, located within the study area. Generally grows in vine thickets and open shale woodland.	Yes	Site subject to historical clearing and marginal for the species	Possible
<i>Marsdenia viridiflora</i> subsp. <i>Viridiflora</i> -endangered population	Species	Bankstown, Blacktown, Camden, Cambelltown, Fiarfield, Holroyd, Liverpool & Penrith LGA	N/A	N/A	N/A	Yes	N/A	Grows in vine thickets and open shale woodland.	Yes	Marginal habitat within PCT849	Possible

BAM candidate species identification		Step 1					Step 2	Step 3			
Common name	Credit class	Species geographic constraints	Species associated with site PCT?	Native vegetation cover required	Required patch size	Requires further assessment?	Habitat constraints	Suitable habitat*	BioNet records within 2.5km of the site	Habitat assessment	Likelihood of occurrence
Juniper-leaved Grevillea <i>Grevillea juniperina subsp. juniperina</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Associated with species within Cumberland Plain Woodland and Shale/Gravel Transition Forest	No	PCT849 offers marginal habitat for the species	Possible
Austral Toadflax <i>Thesium australe</i>	Species	N/A	N/A	N/A	N/A	Yes	N/A	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass.	No	No known populations within the area. Woodland within the site does not support preferred host grasses (<i>Themeda triandra</i>)	Unlikely

* Conservation advice taken from BioNet and Commonwealth SPRAT databases.

Appendix D

Flora schedule

Table 30: Detailed flora schedule

Scientific Name	Common Name	Status	Plot		
			1	2	3
<i>Chloris gayana</i>	Rhodes Grass	E	x	x	x
<i>Sida rhombifolia</i>	Common Sida	E	x	x	x
<i>Eucalyptus moluccana</i>	Grey Box	N	x	x	x
<i>Lycium ferocissimum</i>	African Boxthorn	HTE	x	x	
<i>Plantago lanceolata</i>	Ribwort Plantain	E	x	x	x
<i>Bursaria spinosa</i>	Blackthorn	N	x		
<i>Persicaria decipiens</i>	Slender Knotweed	N	x		
<i>Foeniculum vulgare</i>	Fennel	E	x		x
<i>Cynodon dactylon</i>	Couch Grass	N	x	x	x
<i>Lactuca serriola</i>	Prickly Lettuce	E	x		
<i>Oxalis sp.</i>		N	x		
<i>Modiola caroliniana</i>	Red-flowered Mallow	E	x		
<i>Einadia trigonos</i>	Fishweed	N	x	x	
<i>Rubus fruticosus</i>	European Blackberry	HTE	x		x
<i>Dichondra repens</i>	Kidney Weed	N	x		
<i>Glycine tabacina</i>	Variable Glycine	N	x	x	x
<i>Typha orientalis</i>	Bulrush	N	x		x
<i>Araujia sericifera</i>	Moth Plant	HTE	x		
<i>Solanum americanum</i>	American Black Nightshade	N	x	x	
<i>Microlaena stipoides</i>	Weeping Grass	N	x	x	
<i>Lolium perenne</i>	Perennial Ryegrass	E	x	x	x
<i>Paspalum dilatatum</i>	Paspalum	HTE	x	x	
<i>Verbena bonariensis</i>	Purple Vervain	E	x	x	x
<i>Taraxacum officinale</i>	Common Dandelion	E	x		
<i>Pseuderanthemum variable</i>	Pastel Flower	N	x		
<i>Rumex crispus</i>	Curly Dock	E		x	x
<i>Cenchrus clandestinum</i>	Kikuyu Grass	HTE		x	x
<i>Onopordum acanthum</i>	Scotch Thistle	E		x	
<i>Commelina cyanea</i>	Scurvy weed	N		x	
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark	N		x	
<i>Cyperus difformis</i>	Variable Flat-sedge	N		x	
<i>Solanum prinophyllum</i>	Forest Nightshade	N		x	
<i>Senecio sp.</i>		HTE		x	

<i>Alternanthera denticulata</i>	Lesser Joyweed	N		x	
<i>Juncus pallidus</i>	Great Soft-rush	N			x
<i>Eucalyptus terreticornis</i>	Forest Red Gum	N			x
Unknown delicate forb					x

Appendix E

Biodiversity Credit Report



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00019887/BAAS19077/20/00019888	Western Sydney Energy and Resource Recovery Centre	20/08/2020
Assessor Name	Assessor Number	BAM Data version *
		30
Proponent Names	Report Created	BAM Case Status
c/- Chani Wheeler	21/08/2020	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Part 4 Developments (General)	21/08/2020

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	849-Cumberland shale plains woodland

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

Name
Climacteris picumnus victoriae / Brown Treecreeper (eastern subspecies)
Dasyurus maculatus / Spotted-tailed Quoll
Grantiella picta / Painted Honeyeater
Callocephalon fimbriatum / Gang-gang Cockatoo
Glossopsitta pusilla / Little Lorikeet
Petroica phoenicea / Flame Robin
Petroica boodang / Scarlet Robin
Hieraaetus morphnoides / Little Eagle
Circus assimilis / Spotted Harrier
Daphoenositta chrysoptera / Varied Sittella
Artamus cyanopterus cyanopterus / Dusky Woodswallow
Haliaeetus leucogaster / White-bellied Sea-Eagle
Lathamus discolor / Swift Parrot
Lophoictinia isura / Square-tailed Kite
Melanodryas cucullata cucullata / Hooded Robin (south-eastern form)
Neophema pulchella / Turquoise Parrot
Ninox strenua / Powerful Owl

BAM Biodiversity Credit Report (Like for like)

Phascolarctos cinereus / Koala
Chthonicola sagittata / Speckled Warbler
Saccolaimus flaviventris / Yellow-bellied Sheath-tail-bat
Stagonopleura guttata / Diamond Firetail
Tyto novaehollandiae / Masked Owl
Anthochaera phrygia / Regent Honeyeater
Melithreptus gularis gularis / Black-chinned Honeyeater (eastern subspecies)

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.5	8.00

849-Cumberland shale plains woodland	Like-for-like credit retirement options			
	Name of offset trading group	Trading group	HBT	IBRA region
	Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	-	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary



BAM Biodiversity Credit Report (Like for like)

Species	Area	Credits
Myotis macropus / Southern Myotis	0.5	7.00

Myotis macropus/ Southern Myotis	849_Poor	Like-for-like credit retirement options	
		Spp	IBRA region
	Myotis macropus/Southern Myotis	Any in NSW	
	849_Very_Poor	Like-for-like credit retirement options	
		Spp	IBRA region
	Myotis macropus/Southern Myotis	Any in NSW	

Appendix F

EPBC Significant Impact Assessment

F1 Grey-headed Flying Fox

An assessment of proposal impacts to the species is presented in Table 31 in accordance with the Commonwealth Significant Impact Criteria 1.1 (DoE 2013) for a Vulnerable species. No recovery plan has been prepared for the species. Rather the Species Profile and Threats Database (DAWE, accessed 2020) was used to guide the assessment. The results of the assessment indicate the proposal is unlikely to result in a significant impact to the species.

Table 31: Significant impact criteria for Grey-headed Flying-fox

Significant impact assessment criteria	Assessment
Lead to a long-term decrease in the size of an important population of a species	<p>The national population of the Grey-headed Flying-fox is spatially structured into colonies however, there are no separate or distinct populations due to the constant genetic exchange and movement between camps throughout the species' entire geographic range. The 2005 national count indicates a population size of approximately 674,000 individuals.</p> <p>Habitat within the development site is limited to 0.88 ha of marginal foraging habitat, with native vegetation communities offering only sparse / sporadic foraging resources due to low native tree cover. No suitable breeding habitat is located within the site. No known camps are located within proximity to the site with the nearest being the Wetherill Park camp (approximately 5.7km southeast) and Ropes Creek camp (approximately 6.2km northwest).</p> <p>In consideration of potential impacts associated with the project, a temporary loss of 0.45ha of marginal foraging habitat for the species is unlikely to result in any long-term decrease in the size of the population.</p>
Reduce the area of occupancy of an important population	<p>The Grey-headed Flying-fox occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria however, only a small proportion of this range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. Brisbane, Newcastle, Sydney and Melbourne are generally occupied year-round.</p> <p>Only 0.45ha of marginal foraging habitat for the species will be impacted within the development site. The clearing will be temporary with impacted habitats to be restored post-construction. Regardless, the works are unlikely to result in any reduction in the area of occupancy of the species, particularly given the small scale of proposed clearing works, the availability of alternative habitat within the surrounding landscape and the highly mobile nature of the species.</p>
Fragment an existing important population into two or more populations	<p>The species is highly mobile and is capable of nightly flights of up to 50 km from their roosts to forage.</p>

Significant impact assessment criteria	Assessment
	<p>Only 0.45ha of marginal foraging habitat for the species will be impacted within the development site. The clearing will be temporary with impacted habitats to be restored post-construction. Regardless, the works are unlikely to result in the fragmentation of the population, particularly given the small scale of proposed clearing works and the highly mobile nature of the species.</p>
<p>Adversely affect habitat critical to the survival of a species</p>	<p>The Grey-headed Flying-fox requires foraging resources and roosting sites. Roost sites are typically located within rainforest patches, stands of Melaleuca, mangroves and riparian vegetation near water, such as lakes, rivers or the coast.</p> <p>Habitat loss has resulted in a decrease in the variety of flowering and fruiting tree species used for foraging, particularly those that usually have a high nectar output. Over 70% of Melaleuca forests have been cleared since European settlement. This tree species usually provides an important food source for flying-foxes. Also, extensive areas containing Forest Red Gum and Spotted Gum have been cleared, both of which are important wintering flower tree species. Spring foraging resources are considered to be critical to the survival of the species.</p> <p>The development site supports some marginal foraging habitat for the species, supporting only sparse/ sporadic foraging resources due to low native tree cover. No breeding habitat was identified within the site. Habitat within the site is not considered critical to the survival of the species.</p>
<p>Disrupt the breeding cycle of an important population</p>	<p>No breeding habitat is located within the site. No known camps are located within proximity to the site with the nearest being the Wetherill Park camp (approximately 5.7km southeast) and Ropes Creek camp (approximately 6.2km northwest).</p> <p>As such, the development is unlikely to impact the breeding cycle of the species.</p>
<p>Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The development site supports 0.88ha of marginal foraging habitat for the species. Habitats are subject to high levels of disturbance from historical land clearing and weed invasion and support low amounts of native tree cover. Scattered native trees within the site offer sparse/ sporadic winter foraging resources for the species only. No breeding habitats are located within the site.</p> <p>Only 0.45ha of marginal foraging habitat for the species will be impacted within the development site. The clearing will be temporary with impacted habitats to be restored post-construction. Proposed restoration works will result in an increase in native tree cover and the availability of winter foraging resources for the species.</p>
<p>Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</p>	<p>The development is located within existing agricultural / industrial lands subject to high levels of disturbance from invasive plant species.</p> <p>Risks associated with increase weed disturbance are considered low and will be managed during construction. Post-construction site restoration works will involve weed</p>

Significant impact assessment criteria	Assessment
	management activities and native vegetation restoration resulting in an improvement in habitat condition and function on site.
Introduce disease that may cause the species to decline	The development is located within existing agricultural/ industrial lands already subject to potential risks associated with pathogens. Some increased risk of pathogens may be associated with construction, however this will be managed through the implementation of suitable hygiene measures during construction.
Interfere substantially with the recovery of the species	The development site supports 0.88ha of marginal foraging habitat for the species. Habitats are subject to high levels of disturbance from historical land clearing and weed invasion and support low amounts of native tree cover. Scattered native trees within the site offer sparse/ sporadic winter foraging resources for the species only. No breeding habitats are located within the site. Only 0.45ha of marginal foraging habitat for the species will be impacted within the development site. The clearing will be temporary with impacted habitats to be restored post-construction. Regardless, the works are unlikely to interfere with the recovery of the species, particularly given the small scale of proposed clearing works and the availability of alternative habitat within the surrounding landscape.

F2 White-throated Needle-tail

White-throated Needle-tail is listed as Vulnerable and Migratory under the EPBC Act. An assessment of proposal impacts to the species in accordance with the Commonwealth Significant Impact Criteria 1.1 (DoE 2013) is presented in Table 32 for a Vulnerable species and Table 33 for migratory species. No recovery plan is planned to be prepared for the species. Rather the Species Profile and Threats Database (DAWE, accessed 2020) was used to guide the assessment. The results of the assessment indicate the proposal is unlikely to result in a significant impact to the species.

Table 32: Significant impact criteria for Vulnerable species (White-throated Needle-tail)

Significant impact assessment criteria	Assessment
Lead to a long-term decrease in the size of an important population of a species	The species' total population is unknown. It is described as abundant in some regions of Australia during the non-breeding season. Though the two subspecies of White-throated Needle-tails breed in separate populations in the Northern Hemisphere, only one occurs in Australia, where they do not exist as smaller populations. The number of Needle-tails recorded in eastern and south-eastern Australia may vary between years, but it is unclear whether this reflects fluctuations in the actual overall population numbers. White-throated Needle-tail is an aerial species that feeds on insects. Available habitat within the development site is not considered important for the species, especially

Significant impact assessment criteria	Assessment
	<p>considering the absence of roosting/ nesting sites for these species. The presence of the species within the site is consider transient only.</p> <p>A loss of 0.45ha of transient habitat for the species is unlikely to lead to any long-term decrease in the population size of the species. Particularly given cleared habitats will be restored post-construction.</p>
Reduce the area of occupancy of an important population	<p>The White-throated Needletail is widespread in eastern and south-eastern Australia. It is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. The area of occupancy of the White-throated Needletail in Australia has been estimated at 126 200 km². The breeding distribution of the White-throated Needletail is fragmented, with two subspecies occurring in different parts of Asia. The nominate subspecies <i>H.c. caudacutus</i> breeds from northern Japan west to central and eastern Siberia, while subspecies <i>H.c. nudipes</i> breeds from south-western China to northern Pakistan, and is largely resident. When wintering in eastern and south-eastern Australia, the species is widespread and numerous at many sites. Important habitats for the species occurring within Australia have been identified and are already protected.</p> <p>Within the development site, a available habitat is not considered important for the species, especially considering the absence of roosting/ nesting sites. A loss of 0.45ha of transient habitat for the species is unlikely to lead to any reduction in the area of occupancy of the species. Particularly given cleared habitats will be restored post-construction.</p>
Fragment an existing important population into two or more populations	<p>The species is highly mobile migrating from Asia to Australasia for foraging during winter. Within the development site, a available habitat supports high levels of existing disturbance and fragmentation due to historical land clearing. Habitats are not considered important for the species, especially considering the absence of roosting/ nesting sites. A loss of 0.45ha of transient habitat for the species is unlikely to result in the fragmentation of any important population of the species</p>
Adversely affect habitat critical to the survival of a species	<p>The study area lies within core non-breeding habitat for the White-throated Needletail. It has recently been established that large areas of native woodland may be important for supporting foraging, and the species has been recorded roosting in hollows or the bark of large trees and rock faces on ridgelines (DoE 2015). These important habitat features do not occur within the development site.</p>
Disrupt the breeding cycle of an important population	<p>The nominate subspecies <i>H.c. caudacutus</i> breeds from northern Japan west to central and eastern Siberia, while subspecies <i>H.c. nudipes</i> breeds from south-western China to northern Pakistan, and is largely resident. When wintering in eastern and south-eastern Australia, the species is widespread and numerous at many sites.</p> <p>Within the development site, a available habitat supports high levels of existing disturbance and fragmentation due</p>

Significant impact assessment criteria	Assessment
	to historical land clearing. Habitats are not considered important for the species, especially considering the absence of roosting/ nesting sites. A loss of 0.45ha of transient habitat for the species is unlikely to impact the breeding cycle of an important population of the species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	<p>Within the development site, a available habitat supports high levels of existing disturbance and fragmentation due to historical land clearing. Habitats are not considered important for the species, especially considering the absence of roosting/ nesting sites.</p> <p>It has recently been established that large areas of native woodland may be important for supporting foraging, and the species has been recorded roosting in hollows or the bark of large trees and rock faces on ridgelines (DoE 2015). These important habitat features do not occur within the development site.</p> <p>A loss of 0.45ha of transient habitat for the species is unlikely significant impact the species given the availability of habitat within the surrounding landscape.</p>
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	<p>The development is located within existing agricultural / industrial lands subject to high levels of disturbance from invasive plant species.</p> <p>Risks associated with increase weed disturbance are considered low and will be managed during construction. Post-construction site restoration works will involve weed management activities and native vegetation restoration resulting in an improvement in habitat condition and function on site.</p>
Introduce disease that may cause the species to decline	The development is located within existing agricultural/ industrial lands already subject to potential risks associated with pathogens. Some increased risk of pathogens may be associated with construction, however this will be managed through the implementation of suitable hygiene measures during construction.
Interfere substantially with the recovery of the species	A recovery plan is not proposed to be developed for the species. Conservation priorities with Australia largely comprise survey and monitoring activities at key habitat sites. Proposed works are not likely to interfere with the recovery of the species.

Table 33: Significant impact assessment for migratory species (White-throated Needletail)

Significant impact criteria	Assessment
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	<p>Within the development site, a available habitat supports high levels of existing disturbance and fragmentation due to historical land clearing. Habitats are not considered important for the species, especially considering the absence of roosting/ nesting sites.</p> <p>It has recently been established that large areas of native woodland may be important for supporting foraging, and the species has been recorded roosting in hollows or the bark of large trees and rock faces on ridgelines (DoE 2015). These</p>

Significant impact criteria	Assessment
	<p>important habitat features do not occur within the development site.</p> <p>A loss of 0.45ha of transient habitat for the species is unlikely significant impact the species given the availability of habitat within the surrounding landscape.</p>
<p>Result in an invasive species that is harmful to migratory species becoming established in an area of important habitat for the migratory species</p>	<p>The development site does not support important habitat for the species. The development is located within existing agricultural / industrial lands subject to high levels of disturbance from invasive species.</p> <p>The proposal is unlikely to result in any increased risks associated with pest species. The risks associated with weed invasion as a result of the proposal are considered low and will be managed during construction. Post-construction site restoration works will involve weed management activities and native vegetation restoration resulting in an improvement in habitat condition and function on site.</p>
<p>Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species</p>	<p>Approximately 0.1% of the White-throated Needletail population is considered to be ecologically significant at the national level, equating to 10 individuals (DoE, 2015). Given the lack of important habitat for the species within the development site and observations of fewer individuals than is considered ecologically significant, it is concluded that the proposal is unlikely to have a significant impact on the species.</p>

Appendix G

Vegetation Management Plan

Cleanaway & Macquarie Capital
**Western Sydney Energy and
Resource Recovery Centre**
Vegetation Management Plan

WSERRC-ARU-SYD-ENFTT-RPT-0002

Final | 24 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264039

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ARUP

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Table 1: Revegetation treatment zones.

Table 2: Maintenance and monitoring activity schedule

Table 3: Indicative implementation schedule.

Figures

Figure 1: Proposal Site.

Figure 2: Existing vegetation communities at the proposal site.

Figure 3. Cross-section of the new channel alignment.

Figure 4: Revegetation treatment zones.

Figure 5: Vegetation topography survey at the proposal site.

Appendices

Appendix A

Rehabilitation Treatment Zone Planting Lists

1 Introduction

1.1 Background

Cleanaway and Macquarie Capital are jointly developing an energy-from-waste (EfW) facility known as the Western Sydney Energy and Resource Recovery Centre (WSERRC) (the proposal).

The proposal will be designed to thermally treat up to 500,000 tonnes per year of residual Municipal Solid Waste (MSW) and residual Commercial and Industrial (C&I) waste streams that would otherwise be sent to landfill. This process would generate up to 58 megawatts (MW) of base load electricity some of which would be used to power the facility itself with the remaining 55MW exported to the grid. The proposal involves the building of all onsite infrastructure needed to support the facility including site utilities, internal roads, weighbridges, parking and hardstand areas, storm water infrastructure, fencing and landscaping.

The proposal site is located at 339 Wallgrove Road in Eastern Creek, NSW (Lot 1 DP 1059698) which is in the Blacktown local government area (LGA). The proposal site is in the Wallgrove Precinct of the Western Sydney Parklands (WSP) Plan of Management.

This Vegetation Management Plan (VMP) has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the Western Sydney Energy and Resource Recovery Centre (WSERRC). The SEARs includes the following:

Preparation of a vegetation management plan and restoration of the riparian corridor over the full extent of the site.

The riparian corridor is associated with a discontinuous, first order stream and overland flow path, described in Section 2.3 below. This VMP addresses restoration of the riparian corridor through channel realignment including natural channel design principles and revegetation actions. Restoration of the riparian zone and habitats will be achieved on the new channel alignment, ultimately resulting in improvement from the current riparian corridor's vegetation and habitat quality.

1.2 Report Purpose

Typically, a management plan responds to an impact identified in the project Environmental Impact Statement (EIS) and is prepared following approval and prior to construction or operation commencing.

This VMP is not intended to contain detailed specifications for the implementation of on-ground vegetation rehabilitation works, rather it is to guide the finalised VMP that will be updated and refined during preparation of the CEMP by the Contractor for the works. The implementation of vegetation

rehabilitation works in the finalised VMP will also be informed by detailed design of other infrastructure elements, such as drainage infrastructure and pathways.

This VMP includes:

- The existing proposal site context and a conceptual layout map of the existing vegetation communities;
- Restoration objectives including target vegetation communities;
- Restoration treatments to achieve the target vegetation communities;
- Details of created or restored aquatic environments;
- Procedures for the protection and management of native vegetation prior to, during and post-construction (i.e. retention of mature trees);
- Specifications for rehabilitation actions including protocols for plant establishment and weed management during maintenance;
- Description of management requirements including a suitable program for implementation; and
- A monitoring program and performance indicators to assess progress towards achieving the restoration objectives.

1.3 Proposal description

The main elements of the proposal will include the facility building housing all process plant and equipment, administration building and visitor centre, substation, utilities connections, waste bunker, drainage, foundation design, internal roads and hard standing.

The proposal involves the building of all onsite infrastructure needed to support the facility including site utilities, internal roads, weighbridges, parking and hardstand areas, storm water infrastructure, fencing and landscaping.

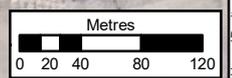
The 8.23 ha proposal site is divided by a small strip of land not part of the proposal site, resulting in a 2.04 ha northern section and a 6.19 ha southern section. This dividing strip is part of the adjacent lot and includes a right of carriageway benefitting the proposal site allowing vehicles to move between the two parts of the site. The proposal area will be fully contained in the 6.19 ha portion of the site.

Works to occur on the 2.04 ha northern portion of the site include the clearing of weeds and exotic vegetation within the existing overland flow channel which is confined to the eastern section of this parcel of land. The northern portion will also be used temporarily to support construction works. It is not currently expected that any other works will occur on the 2.04 ha northern section of the site as part of this proposal.

The current design layout for the proposed facility and associated site infrastructure are shown in Figure 1.



	Roads
	Site Boundary
	Right of Carriageway
	Water Pipeline
	Roads



Service Credits: DFSI, 2020
 Figure 1: Proposal site

2 Site Context and Existing Vegetation

2.1 Site Location and Context

The proposal site is located at 339 Wallgrove Road in Eastern Creek, NSW (Lot 1 DP 1059698) which is in the Blacktown Local Government Area (LGA). The site is in the Wallgrove Precinct of the Western Sydney Parklands (WSP) Plan of Management.

As described above, the proposal site is divided by a small strip of land not part of the proposal site, resulting in a northern portion and southern portion divided by a right of carriageway.

There is also an existing water main owned by Sydney Water that passes under the northern portion of the lot (Figure 4).

The area immediately surrounding the subject lands is characterised by industrial and transport infrastructure. The M7 Motorway bounds the proposal site to the west with the Eastern Creek industrial area located farther west. The now closed Eastern Creek landfill is located to the north and north-east with the operational Global Renewables waste management facility located immediately to the east. The Warragamba Pipeline Corridor abuts the southern boundary of the proposal site.

The proposal site has historically had land uses which have contributed to contamination on site, the most recent being poultry farming and the proposal site is surrounded predominantly by industrial and commercial businesses. Soil testing has indicated exceedances of environmental based criteria for copper, zinc benzo(a)pyrene and total recoverable hydrocarbons (TRH) in the soils.

Small stands of remnant vegetation and scattered trees are located within the proposal site, with the southern section offering stepping stone connectivity between adjacent waterways and larger vegetated remnants to the north and south.

Aquatic features within the proposal site consist of a farm dam, overland flow path and a discontinuous, ephemeral first order stream (classified using the Strahler stream ordering system), located adjacent to the eastern boundary of the proposal site.

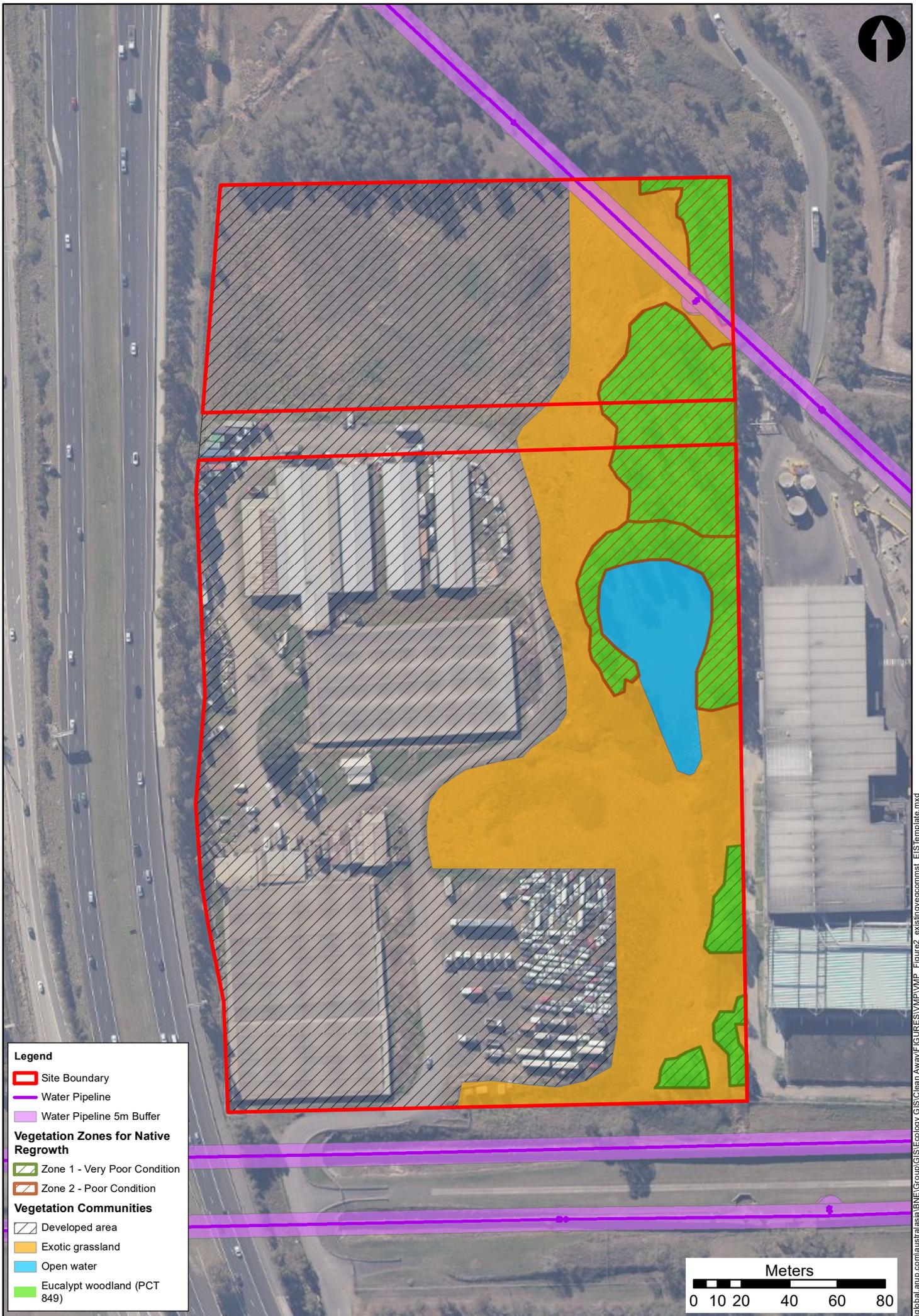
According to OEH (2015) BIO Map regional biodiversity corridor mapping, riparian vegetation associated with Eastern Creek forms a regionally significant biodiversity corridor connecting Prospect Reservoir (1.5 km to the east) with other National Parks estate in the landscape. Existing vegetation associated with Reedy Creek also offers some north-south connectivity with Eastern Creek and provides a stepping stone connection between Eastern Creek and Ropes Creek to the west.

2.2 Existing Vegetation Communities

Baseline floristic data was collected from targeted vegetation surveys carried out on the proposal site, in accordance with the NSW Biodiversity Assessment Method (BAM), and documented in a Biodiversity Development Assessment Report (BDAR). Prior to the targeted vegetation surveys, native vegetation confirmed within the site was classified using the BioNet Vegetation Classification application and stratified according to broad condition state to inform targeted surveys. Each Plant Community Type (PCT) and associated condition class was mapped for the proposal site as a separate vegetation zone. Two vegetation zones were identified on the proposal site.

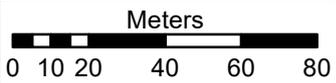
The proposal site supports approximately 0.88 ha of native vegetation comprising one PCT (Figure 2). Native vegetation within the subject land comprises isolated patches of regrowth PCT 849 Cumberland Shale Plains Woodland within low-lying areas along the eastern property boundary. Some sedges including Bulrush *Typha orientalis*, Giant Rush *Juncus pallidus* and Pampas grass *Cortaderia sp.* were also noted within the stream and farm dam perimeter. However, these did not dominate the understorey and were limited to areas generally too small to map as discrete patches at the edge of standing water.

Vegetation within the proposal site has been subject to high levels of disturbance due to historical land clearing, agricultural land uses and ongoing industrial and transport activities within adjacent lands. A review of historical aerial imagery (Google Earth 2020) was conducted for the BDAR, which indicated much of the site has been historically cleared with only scattered mature trees being observed within the site prior to 2004. These were located adjacent to and to the north of the farm dam. Eucalypt woodland communities have since regenerated within low-lying areas along the eastern boundary of the site. However, vegetation structure is poor, with a young age class and dominance of exotic species in the understorey. The rest of the proposal site supports developed areas and exotic pasture.



Legend

- Site Boundary
- Water Pipeline
- Water Pipeline 5m Buffer
- Vegetation Zones for Native Regrowth**
- Zone 1 - Very Poor Condition
- Zone 2 - Poor Condition
- Vegetation Communities**
- Developed area
- Exotic grassland
- Open water
- Eucalypt woodland (PCT 849)



Service Layer Credits:

Figure 2: Existing vegetation communities at the proposal site

2.3 Existing Aquatic Environments

Aquatic features within the site are limited to a farm dam and an ephemeral first order stream located adjacent to the eastern boundary of the proposal site. The stream receives surface flows from the south, southwest of the property and flows north, connecting with Reedy Creek about 600m downstream of the site. Some connectivity with the farm dam is also apparent. Waters eventually flow into Eastern Creek but do not connect to Prospect Reservoir.

Within the site, the stream is characterised by a discontinuous channel with some areas choked by exotic vegetation (i.e. Blackberry thickets) or supporting overland flow only. The channel and the farm dam are both manmade, supporting generally stable banks with a few areas susceptible to erosion. Stream beds were primarily of silt. Native macrophytes (Bulrush, *Juncus* spp., *Lemna* spp. and Slender Knotweed) were present at the margins of the dam, providing suitable amphibian habitat. A discontinuous and degraded riparian zone was observed dominated by exotic shrubs, grasses and forbs and supporting some scattered native canopy trees. The width of the riparian corridor generally varied from 0 m to 10m with some areas north of the dam being about 35 m wide.

No mapped habitat for threatened fish was identified within or adjacent to the site. Observed aquatic habitats do not meet the definition of Key Fish Habitat, as defined by the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).

The proposal will include removal of the farm dam and realignment of the first order stream which is necessary to address flood planning requirements. The realignment works will be consistent with natural channel design principles and revegetation actions as provided in the following sections of this VMP, as discussed further in Section 3.

3 Relevant Design Elements

The existing farm dam will be decommissioned and the stream and overland flow path will be reprofiled to incorporate a channel ('overland flow channel') with flows separated from site runoff, located along the eastern boundary of the proposal site (Figure 4). There will also be a constructed bioretention basin, from which water will overflow into an on-site detention (OSD) basin that is expected to be dry at times depending on local rainfall.

The design of the new overland flow channel includes the following approach to provide riparian zone restoration (Figure 3):

- Meandering low channel with rocky substrate, reflecting the original channel and creating a more natural flow path;
- The channel will be planted with suitable native vegetation and lined with suitable rock erosion protection.

The landscaping design approach also includes important elements of the riparian zone restoration and these are reflected in this VMP, including:

- The landscaping design will use native plant species from the vegetation community 'PCT849 Cumberland Shale Plains Woodland';
- Canopy trees will allow connectivity through the proposal site for native fauna;
- Retention of existing vegetation (i.e. mature trees) where possible;
- Ephemeral swale is proposed along the overland flow channel and the embankments are to be stabilised with a geotextile;
- To create a natural appearance and to assist with slowing water flow, rocks and logs of varying sizes are to be placed along the base of the swale and native canopy trees are to be planted either side including some on the western embankment;
- A riparian zone will be instated along the new overland flow channel which will include native groundcovers, sedges, shrubs and trees (Figure 3); and
- Suitable plant species to be installed at the edges of the bioretention basin and OSD basin.

This VMP is to be read in conjunction with the landscaping design and the Landscaping Design Strategy outlined within the WSERRC Architectural and Landscape Design Strategy Report (refer to Appendix B of the EIS, Volume 1).

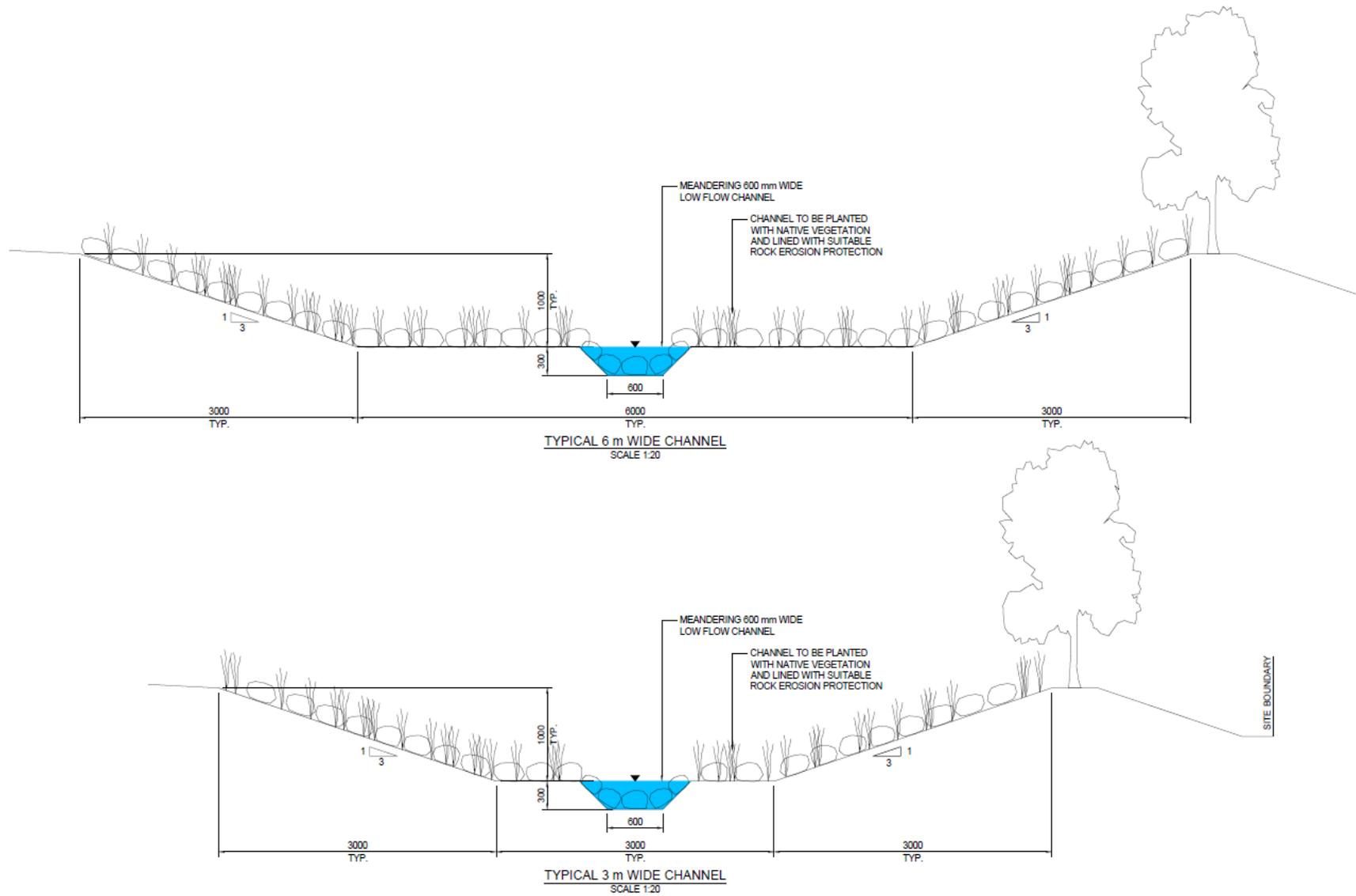


Figure 3. Cross-section of the new channel alignment.

4 Opportunities and Constraints

4.1 Regeneration in the Northern Portion of the Lot

The existing proposal site contains some areas of resilience and regeneration capacity, including existing native regrowth (although currently in poor to very poor condition due to weed infestations).

4.2 Soil and Groundwater Testing

The soil and groundwater resources available in the proposal site will have an influence on revegetation success. Given the historical use of the site, soil and groundwater sampling and analysis would help to set a baseline of soil condition and composition prior to revegetation works, especially as the northern portion of the lot will have assisted regeneration occur while the southern portion of the lot will have reconstruction of the target vegetation communities.

It is recommended that prior to commencement of revegetation works, soils are to be analysed to determine soil conditions on site, including if there are any nutrient deficiencies or soil toxicity issues present that may impact plant growth, as well as to identify whether soil ameliorants are required to correct physical or chemical soil imbalances.

4.3 Infrastructure/Access

Constraints on landscaping and revegetation works considering the proposal infrastructure and access will include the following:

- For areas near the proposed substation, planting of larger canopy trees should account for a 10m offset from the substation, or alternatively select only smaller tree/shrub species within those areas;
- Areas within operational space in the southern part of the proposal site will contain significant buried utilities and stormwater infrastructure, and therefore should not contain trees;
- Given the narrow area between the new overland flow channel and the eastern boundary, it is likely that plantings here will be limited to smaller trees or shrubs rather than large tree species like *Eucalyptus* species;
- Plantings for areas with drainage lines and retaining walls will also be limited to smaller trees or shrubs;
- Vegetation within 5m of the Sydney Water pipeline in the northern portion of the lot and the right of carriageway will be limited to groundcover species only; and
- In relation to the area of hardstand within the northern portion of the lot (Figure 4), trees will be set back from the toe of the batter in order to avoid constraining future use of the hardstand area.

4.4 Restriction of Public Access

During the reconstruction stage and maintenance stage if required, there will be effective restriction of access by pedestrians, vehicles and domestic and feral animals into the RTZs.

Public access to the proposal site will be restricted to the visitor centre, which will be managed and limited to certain areas only. Preventing public access to the RTZs may also be achieved through actions such as:

- Signage to identify rehabilitation areas, which could involve educational material regarding the environmental value of the vegetation.;
- Exclusion fencing erected from the commencement of rehabilitation works until the success of rehabilitation is evident; and
- Checking for signs of disturbance during monitoring events.

5 Rehabilitation Treatment Zones

5.1 Rehabilitation Treatment Zones and Target Vegetation Communities

Areas of the proposal site to be revegetated into self-sustaining vegetation communities have been mapped into distinct Rehabilitation Treatment Zones (RTZ) (Table 1 and Figure 4). The RTZs are also designed to be consistent with the Landscaping Design Strategy outlined within the WSERRC Architectural and Landscape Design Strategy Report (refer to Appendix B of the EIS, Volume 1). The final selection of target vegetation communities and their locations/extents in the proposal site will be subject to the detailed design for the proposal and will be incorporated in the finalised VMP.

The species lists for plantings in the RTZs are provided in Appendix A, reflecting the species lists from the WSERRC Architectural and Landscape Design Strategy Report.

Table 1: Revegetation treatment zones.

RTZ	Treatment	Target Community	Approximate Area (Ha)
1	Reconstruction	Species generally representative of PCT849 Cumberland Shale Plains Woodland	0.65
2	Reconstruction	Native grasses and riparian plants appropriate for predicted water levels at the edges of the bioretention basin and OSD basin	0.31
3	Reconstruction	Ephemeral swale	0.18
4	Rehabilitation	Species generally representative of PCT849 Cumberland Shale Plains Woodland	0.37
5	Rehabilitation	Shrubs buffer	0.04
6	Rehabilitation	Ephemeral swale	0.16
7	Rehabilitation	Groundcovers (grasses and sedges) around the Sydney Water pipeline and in right of carriageway	0.18
Total			1.89 ha

5.1.1 RTZs in the Southern Portion of the Lot

Works in the southern portion of the lot will involve reconstruction of the target vegetation communities.

5.1.1.1 RTZ 1

Shale Plains Woodland is the most widely distributed community on the Cumberland Plain. A description for Shale Plains Woodland is as follows, based on the community classification in Map Unit 10 by Tozer (2003):

Shale Plains Woodland is dominated by *Eucalyptus moluccana* and *E. tereticornis* with *E. crebra*, *E. eugenioides* and *Corymbia maculata* occurring less frequently. These species often form a separate small tree stratum, occasionally including other species such as *Exocarpos cupressiformis*, *Acacia parramattensis* subsp. *parramattensis* and *Acacia decurrens*. A shrub stratum is usually present and dominated by *Bursaria spinosa*. Common ground stratum species include *Dichondra repens*, *Aristida vagans*, *Microlaena stipoides* var *stipoides*, *Themeda australis*, *Brunoniella australis*, *Desmodium varians*, *Opercularia diphylla*, *Wahlenbergia gracilis* and *Dichelachne micrantha*.

As shown in Table 1, RTZ 1 is to contain species generally representative of PCT849 Cumberland Shale Plains Woodland. It is unlikely that the RTZ can be assessed to achieve the same community benchmarks for the PCT (e.g. stratum foliage cover and full known species diversity). This is due to the small size of this RTZ and the RTZ including narrow strips situated between areas of landscaping such as maintained lawn and screen plantings, as well as aquatic environments.

As shown in the planting list in Appendix A, dominant or frequent species of the PCT849 Cumberland Shale Plains Woodland community will be prioritised for plantings and should be more abundant than other species in the rehabilitated community, consistent with the natural composition of PCT849 Cumberland Shale Plains Woodland.

The existing proposal site contains small patches of poor to very poor condition regrowth, which are limited to the eastern side of the proposal site and degraded by existing weed infestations. It is also likely that weeds are spread from the proposal site to other lands and watercourses downstream via overland flow. Overall, the rehabilitation works in RTZ 1 will restore vegetation that is more consistent with Cumberland Shale Plains Woodland in native species abundance and diversity. The restoration and weed management will improve the condition of vegetation on the proposal site and also improve habitat quality for native fauna.

Where possible, existing native trees will be retained (discussed in Section 7.2 of this VMP).

5.1.1.2 RTZ 2 and 3

The proposed aquatic environments and riparian zones to be restored/constructed on the proposal site are within RTZ 2 and 3, where the bioretention basin, OSD basin and overland flow channel are sited.

The bioretention basin is expected to have a generally permanent, shallow (circa 500mm deep) pool of water however it may dry out in prolonged periods without rainfall. The deeper OSD basin is expected to be empty and dry for long periods, commensurate with local rainfall levels.

The overland flow channel, whilst providing a pathway for water flows, is predicted to be dry most of the time and will not become a permanent

watercourse. It will convey flows during heavier periods of rain when larger flows move down from the upstream catchment. Embankments will have native grasses and toe of swale to contain riparian plantings.

The basins' edges and overland flow channel will have plantings of recommended species for shallow marsh and riparian edge plantings, as provided in Appendix A. The plantings list in Appendix A reflects the WSERRC Architectural and Landscape Design Strategy Report contained in Appendix B of the EIS, Volume 1. Species selection was based on the Blacktown City Council planting guides for bioretention, riparian and wetland areas, creating a species palette of local native plants that are considered appropriate for predicted water levels in the basins and providing ecosystem services such as filtering pollutants from the water. The basins and the channel would be considered ephemeral, which is common for the majority of waterways and many wetlands of Australia. Most 'wetland' plants will survive extended periods of being 'dry'; while wetlands require a period of inundation, many wetlands can be 'dry' for most of the year.

The revegetation works will not only restore the riparian corridor but also improve its ecological functions:

- Improvement from the existing riparian corridor's vegetation and habitat quality by achieving the target native vegetation communities (compared to the existing neglect of the proposal site's natural areas and degraded condition of the existing drainage channel from exotic weeds);
- Provisions of water quality benefits to downstream watercourses from revegetation with suitable native species and rock erosion protection, in particular the function of riparian plants in filtering sediments and pollutants in run-off; and
- Weed removal and management at the proposal site will improve the habitat quality for native flora and fauna species (e.g. suppression of dense exotic grasses which out-compete native plants and create a barrier to frog movement). Weed management in the new riparian corridor will also avoid/reduce the spread of weeds downstream.

Consideration for the placement of rocks and logs to be placed along the base of the swale (RTZ 3) will be included in the design where possible, to create a natural appearance and assist with slowing water flow. Rocks and logs provide native fauna with shelter and nest sites, and a greater variety of such habitat features is likely to support more native fauna species (although this would be limited by the size of the site). Rock and log structures may also help to reduce soil disturbance.

The installed rocks and logs shall be:

- Of varying sizes; and
- Strategically placed to help slow water flow and create variability in the aquatic habitat within the overland flow channel.

Retention of existing mature trees and planting of native tree species along the embankments of the overland flow channel will result in some canopy cover

within RTZ 2 and 3, contributing to a more natural riparian area. Weed management in the RTZs will also improve vegetation condition and habitat quality.

5.1.1.3 Other Landscaping Areas

The design for landscaping also proposes native grass lawn in areas that will be maintained (mown) and areas of screening plantings using appropriate shrub species. These landscaping areas are outside of the RTZs and are not included in this VMP; further details will be provided in the landscaping design for the proposal.

5.1.2 RTZs in the Northern Portion of the Lot

Works in the northern portion of the lot will involve assisted regeneration to achieve the target vegetation communities.

5.1.2.1 RTZ 4

RTZ 4 is aimed to contain species generally representative of PCT849 Cumberland Shale Plains Woodland, as described for RTZ 1 above and shown in the planting list in Appendix A.

It is unlikely that this RTZ can be assessed to achieve the same community benchmarks for the PCT, due to the small size of this RTZ and intersections by other target vegetation communities in the northern portion of the lot.

The areas of RTZ 4 and RTZ 1 are divided by the right of carriageway between the northern and southern portions of the lot.

Where possible, existing native trees will be retained (discussed in Section 7.2 of this VMP).

5.1.2.2 RTZ 5

RTZ 5 is situated beside the hardstand area and will provide a buffer area between trees in RTZ 4 and the toe of the batter of the hardstand.

RTZ 5 is aimed to contain a native understorey only with dense shrubs (no tree species). Shrub and groundcover species are to be selected from the planting list in Appendix A which contains the species generally representative of PCT849 Cumberland Shale Plains Woodland vegetation community.

5.1.2.3 RTZ 6

The target vegetation community for RTZ 6 is ephemeral swale, as described for RTZ 3 above. The intention is that this area of ephemeral swale will be a continuation of the swale within the overland flow channel in the southern portion of the lot.

This RTZ will have weed management and plantings only. Other actions in RTZ 3 including construction of a channel and installation of rocks and logs do not apply to RTZ 6.

5.1.3 RTZ 7

RTZ 7 is located on the right of carriageway and within a 5m buffer area of the Sydney Water pipeline traversing the northern portion of the lot. This RTZ will contain groundcover species only, i.e. native grasses and sedges.

Where sedges are included in the seed mix, the mix will contain sedges able to withstand infrequent mowing and ensure that species will persist where moist patches and standing water occur. Shrub and tree species must not be included in any seed mixes for RTZ 7.

5.2 Rehabilitation Treatments

The proposal site is generally highly degraded or modified and the majority of the site does not have existing native vegetation communities (Figure 2), rehabilitation treatments will consist of reconstruction to create new areas of native vegetation and assisted regeneration to improve or enhance the condition of existing native vegetation.

5.2.1 Reconstruction

The eastern part of the proposal site contains some regrowth that is in poor or very poor condition. In the southern portion of the lot, this eastern area has been sited for water capture and treatment infrastructure, with reconstruction of vegetation communities in the later stages of the construction phase (including native woodland, native grass species, local riparian species and ephemeral swale). Understorey vegetation and shrubs on the proposal site will be cleared during construction, while retaining existing mature trees identified prior to construction.

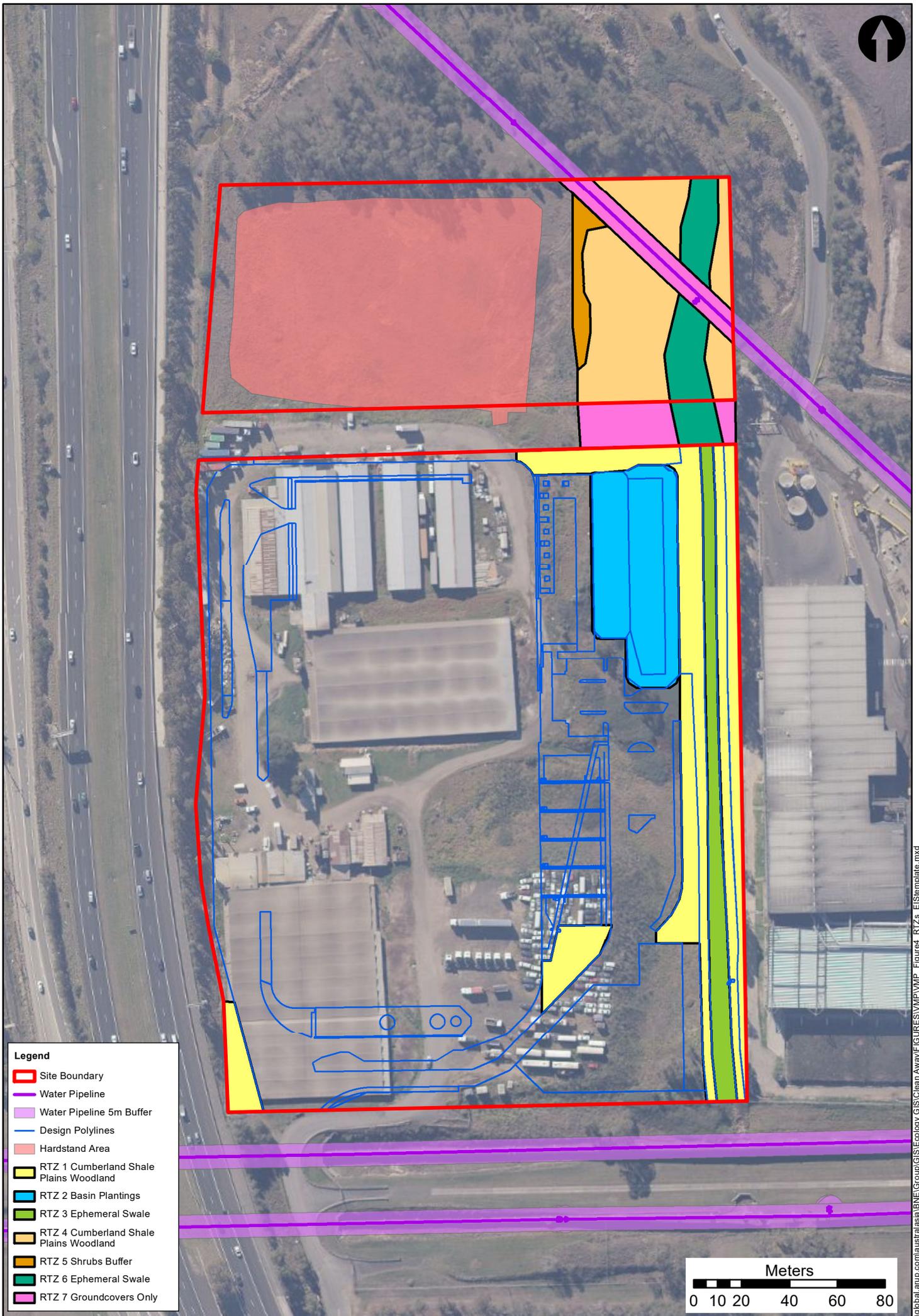
Human intervention will be required to revegetate the southern portion of the lot during and post-construction, such as plantings, weed management and amelioration of soil conditions where needed. Natural regeneration and recruitment would be insufficient to initially re-establish the original vegetation, and installation of native species to the proposal site is required.

5.2.2 Assisted Regeneration

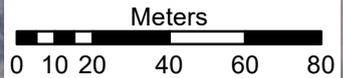
This treatment applies to areas where native plant seed is still stored in the soil or will be able to reach the site from nearby natural areas, by birds or other animals, wind or water. Natural regeneration processes (seedling germination, root suckering, etc.) are being inhibited by biotic factors, such as weed invasion, soil compaction, human land uses, activities like slashing etc.

The eastern part of the northern portion of the lot is dominated by exotic grassland and poor or very poor condition regrowth, similar to the existing conditions of the southern portion. There is not proposed infrastructure in the northern portion for

the WSERRC. Human intervention such as integrated weed management and minor amelioration of soil conditions will be enough to trigger the recovery processes through natural regeneration. Seeding or infill/reinforcement plantings are likely to be required to achieve the target vegetation communities here.



- Legend**
- ▭ Site Boundary
 - ▬ Water Pipeline
 - ▭ Water Pipeline 5m Buffer
 - ▬ Design Polylines
 - ▭ Hardstand Area
 - ▭ RTZ 1 Cumberland Shale Plains Woodland
 - ▭ RTZ 2 Basin Plantings
 - ▭ RTZ 3 Ephemeral Swale
 - ▭ RTZ 4 Cumberland Shale Plains Woodland
 - ▭ RTZ 5 Shrubs Buffer
 - ▭ RTZ 6 Ephemeral Swale
 - ▭ RTZ 7 Groundcovers Only



Service Layer Credits:

Figure 4: Revegetation treatment zones

6 Rehabilitation Performance Objectives and Indicators

6.1 Key Performance Objectives

The key performance objectives across the proposal site are as follows:

- The reconstruction of vegetation communities that are the target vegetation communities identified in Section 5.1 above;
- The existing mature trees that are to be retained are protected during construction;
- Weeds are controlled such that they do not impede native plant growth in the RTZs;
- The site is stable and not subject to erosion; and
- Restoration of the ecological functions of the degraded riparian corridor through the establishment of RTZ 3 in accordance with this VMP.

6.2 Key Performance Indicators

This section provides measurable performance indicators to be monitored post-establishment, in order to assess progress towards achieving the performance objectives.

The key performance indicators for all RTZ include:

- Planted stock meets the guidelines provided in Appendix A;
- High (> 70%) survival rate of planted stock. All failed plantings are replaced;
- Growth of >1 metre by year three and 1.5 metres by year five for Cumberland Shale Plains Woodland tree and shrub plantings;
- Mature trees to be retained are protected during construction through implementation of the strategies provided in Section 7 below;
- Primary treatment of all weed species in the RTZs by the end of year three;
- Each RTZ is dominated by native species with low weed cover (less than 10%);
- Natural recruitment of native species; and
- Erosion management activities are triggered where the subsoil and topsoil are eroded until the site is stable.

7 Rehabilitation Actions

7.1 Assisted Regeneration

7.1.1 General methods

It is expected that the general techniques will follow the principals of:

1. Identifying nodes of resilience (e.g. existing native regrowth and mature trees);
2. Working to strengthen identified nodes and protect/encourage all existing and naturally regenerating species; and
3. Working outwards from nodes of resilience to increase their size and gradually connect to other nodes.

It is likely that the most significant impediments to natural regeneration on the site are competition from weeds and limitations of soils resources (e.g. topsoil condition, soil moisture levels and seed sources). Weed management is discussed in Section 8.1.2 and Section 9.2.2 of this VMP.

7.1.2 Reinforcement plantings

Weed management is the primary action in assisted regeneration and the native regrowth is to be managed to achieve the target vegetation community. However, it is also expected that the Contractor will identify areas that will benefit from infill or reinforcement plantings and adapt the management techniques accordingly.

Intervention criteria are suggested below, however the areas that will have planting activities are to be based on the on-site assessment by the Contractor (and considering the target vegetation community to be established):

- Where natural recruitment in assisted regeneration zones is below 3 – 5 plants per 10 square metres; and
- Where areas of native regrowth are actively eroding or lacking flora species or structural integrity.

Plant species are to be selected from the planting lists provided in Appendix A and should be species suitable for the in-situ soil and drainage conditions.

7.2 Reconstruction

7.2.1 Reconstruction Methodology

RTZs for vegetation community reconstruction have been sited within the southern portion of the lot which will be cleared for the proposal (except for natives trees to be retained) and will not have existing vegetation communities.

Reconstruction is generally to occur as follows:

- Site preparation for planting of tubestock;
- Ongoing weed control across the proposal site, particularly around planted tubestock, would be required to manage weed cover and maximise native plant growth during the plant establishment and monitoring periods;
- Planting and watering as required below;
- Installation of weed mats, mulch and tree guards as required below; and
- Follow-up watering if needed.

Planting should be undertaken in 2 distinct stages:

- Stage 1 involves the planting of pioneer and fast-growing climax phase species. This can commence immediately following initial site preparation.
- Stage 2 involves the planting of successional species and slower growing climax phase species. This can commence approximately 12 months after Stage 1 planting or once a canopy is established. Thinning of some of the pioneer species may be necessary during successional planting works.

7.2.2 Site Preparation

Soil and groundwater investigations prior to the revegetation works may identify soil ameliorants required to correct physical or chemical soil imbalances. The findings of these investigations must be taken into consideration for site preparation.

Cultivation of soils may be undertaken by preparing individual tubestock locations for planting.

7.2.3 Planting Specifications

7.2.3.1 Tubestock Requirements

As a minimum, all tubestock are required to:

- Be of local provenance;
- Have a significantly established root system;
- Be healthy and display signs of active growth;
- Not display signs of ‘yellowing’, leaf or stem damage, disease, root curling or restriction related to being ‘pot bound’;
- Be free of weeds in the container;
- Be a minimum of 25 cm tall for 50 mm tubestock; and
- Be sun hardened.

Not all species may be commercially available at the desired time of planting. Once plants have been sourced and availability confirmed, the Contractor is to submit the list and numbers of species available for approval.

7.2.3.2 Planting and Watering

As a minimum, planting and watering are to occur as follows:

- Planting must not occur unless soil moisture is adequate;
- All stock must be watered immediately prior to planting;
- All planting holes are to be pre-watered prior to installation of tubestock;
- Apply an initial establishment watering; and
- Maximum of 2 follow-up watering events in the first 6 weeks (depending upon weather and rainfall conditions, species requirements, etc.).

It is not anticipated that further watering would be required beyond 6 weeks.

Planting should not occur in unsuitable weather conditions such as extreme heat, extreme cold, extreme wet (flooding or saturated soils) or in windy weather, where possible.

7.2.3.3 Geotextile and Mulch

One approach that may be followed is for all plants to have a coir fibre mat with a single fastening pin installed. Organic, weed-free mulch should then be laid over the coir mat to a depth of 100 mm.

The swale within the overland flow channel is proposed to have slopes at a grade of 1V:3H, which shall be stabilised with a geotextile and planted with native and riparian grasses.

7.2.3.4 Specific Treatments/Fertilisation

Soil investigations prior to revegetation works will determine the baseline soil conditions on site and identify whether soil ameliorants/fertilisers or soil top dressing will be required for the successful establishment of plants.

7.2.3.5 Tree guards

Suitable tree guards are to be installed with each plant.

For example, a typical approach that may be used is to install a corflute tree guard (280mm x 250mm x 600mm) with each plant with the use of hardwood timber stakes (minimum dimensions of 23mm x 13mm x 900mm).

7.2.3.6 Additional tubestock protection

The contractor is responsible for monitoring of tubestock during the establishment phase and where excessive browsing of tubestock by fauna is observed, additional protection such as applications of 'Deter' may be required and any plants that have been destroyed are to be replaced.

8 Vegetation Protection and Management

8.1 Biosecurity Management Measures

8.1.1 Biosecurity Risks

Biosecurity risks from clearing activities and the proposal more generally include:

- Spread of weeds around the proposal site from clearing weed plants and handling/disposal of weed material during construction; and
- Introduction of pathogens such as myrtle rust, root rot and chytrid fungus into the proposal site during construction.

There is significant weed invasion at the proposal site and weed impacts have contributed to the poor floristic structure and composition of the native regrowth on site. Site inspection has found the shrub and ground stratum dominated by exotic weed species such as African Boxthorn *Lycium ferocissimum*, Fennel *Foeniculum vulgare*, Common Sida *Sida rhombifolia*, Kikuyu Grass *Cenchrus clandestinus* and Rhodes Grass *Chloris gayana*. There are also dense thickets of exotic Blackberry *Rubus fruticosus* and some Lantana *Lantana camara*. These weeds will need to be controlled to prevent further spread on the proposal site and impacts on the success of the rehabilitation works.

There is the potential for introduction of pathogens, including Root Rot *Phytophthora cinnamomic*, Myrtle Rust *Austropuccinia psidii* and Chytrid Fungus *Batrachochytrium dendrobatidis* during construction. These pathogens can cause disease in native flora and native fauna such as native frogs. However, this is considered to be low risk.

Habitats within the proposal site are already likely to be subject to impacts from pest species including Fox *Vulpes Vulpes* and feral Cat *Felis catus*. The proposal is considered unlikely to result in any increased risk of pests at the proposal site.

8.1.2 Biosecurity Management

The *Biosecurity Act 2015* aims to protect natural resources from the adverse impact of pests, disease, weeds and contaminants. All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose.

Under the *Biosecurity Act 2015*, there is a general obligation on people to be aware of their surroundings and take action to prevent the introduction and spread of pests, diseases, weeds and contaminants.

Standard biosecurity obligations as listed in the *Biosecurity Act 2015* will be applied to the proposal site during the construction phase and rehabilitation works. During construction, management measures would be implemented and audited to avoid and minimise the environmental and biosecurity risks associated with weeds, pests and pathogens. As a minimum, these would include:

- Completion of a site weed assessment and development of a weed management plan;
- Implementation of appropriate weed control and weed disposal in accordance with Biosecurity protocols (e.g. wheel washing prior to entering the proposal site to avoid/reduce introduction of weeds and pathogens);
- Any soil or other materials imported to the site for use in restoration or rehabilitation would be certified free from weeds and pathogens or obtained from sources that demonstrate best practice management to minimise weed and pathogen risks;
- Disposal of any weed material at an appropriately licensed facility; and
- Implementation of appropriate hygiene protocols where there are potential or known pathogen risks.

Prior to rehabilitation works, scalping is generally effective for controlling certain perennial weeds (including grasses) and may be a good option for preparing the areas of intensive revegetation in the RTZs during the site preparation phase. Scalping will remove the upper layer of the soil profile, where the underground parts of perennial weeds and weed seed are stored.

After the proposal site has been cleared, regrowth or new growth of weeds shall be controlled, including standard weed management procedures such as:

- New or increased occurrences of weed species will be addressed using a combination of manual removal and spot-spraying of herbicides where required;
- Care will be taken to avoid off-target damage to native plantings and native plant recruitment during weed control;
- Imported fill or mulch material should be certified free of environmental weeds; and
- Following plant installation and the commencement of the maintenance phase, weed monitoring shall occur as set out in Section 8.

8.2 Native Tree Retention and Management

Mature native trees mostly located along the eastern boundary of the proposal site will be retained where possible. The results of a vegetation topography survey at the proposal site are mapped in Figure 5, however not all of these trees are mature native trees and tree inspection will be required to confirm suitability for retention.

The following general management actions are to be implemented for the protection of mature trees that will be retained. This VMP will not address requirements for individual tree retention and management at this stage. This will be addressed through plan revision prior to construction, with input from a consulting arborist.

The following measures to mitigate and manage impacts to native vegetation during construction will be implemented as a part of the detailed design phase:

- Design solutions are to be explored to minimise any impacts to vegetation proposed for retention during construction in accordance with Australian Standard (AS) 4970-2009 and AS4373-2007;
- Where works are proposed within the Tree Protection Zones (TPZ) of any trees to be retained, an arborist (min AQF level 5) is to be engaged to complete a tree health assessment and to provide recommendations for mitigating any impacts. The arborist is to assess alternative construction methods and prescribe suitable mitigation measures to maintain the health and long-term viability of any trees proposed for retention within the vicinity of proposed works; and
- Trees nominated for retention or removal will be clearly marked as such on site plans and drawings, as well as the TPZ of each tree.

Prior to construction:

- Trees nominated for retention or removal will be clearly marked on site; and
- Tree protection fencing established at the interface between all works areas and the tree protection zones.

During construction:

- Vegetation removal shall be undertaken by suitably qualified Contractors;
- Tree protection fencing shall be maintained until construction is completed; and
- Where possible/appropriate, vegetation clearing is staged or takes place sequentially to allow animals to move to adjoining habitats (though this is not likely to be necessary given the small size of the site and condition of existing vegetation).

During and upon completion of construction:

- The viability of large trees for retention may change depending on other variables (e.g. bank erosion or significant rain events causing tree root exposure or vibrations from construction works) and result in the tree needing to be removed for works to proceed safely. The Contractor will visually monitor the trees during the construction works, including vegetation rehabilitation works, and report any significant changes. Further inspection by an arborist may be required to confirm the tree is sufficiently sound for works and can be retained.

In the event that any trees proposed for retention cannot be successfully retained, contingency measures may include:

- Compensatory or additional planting of the tree species on the proposal site; and
- A contingency plan to indicate locations where trees can be planted in the event of loss of trees that were proposed for retention, to maintain the diversity and canopy coverage on site.

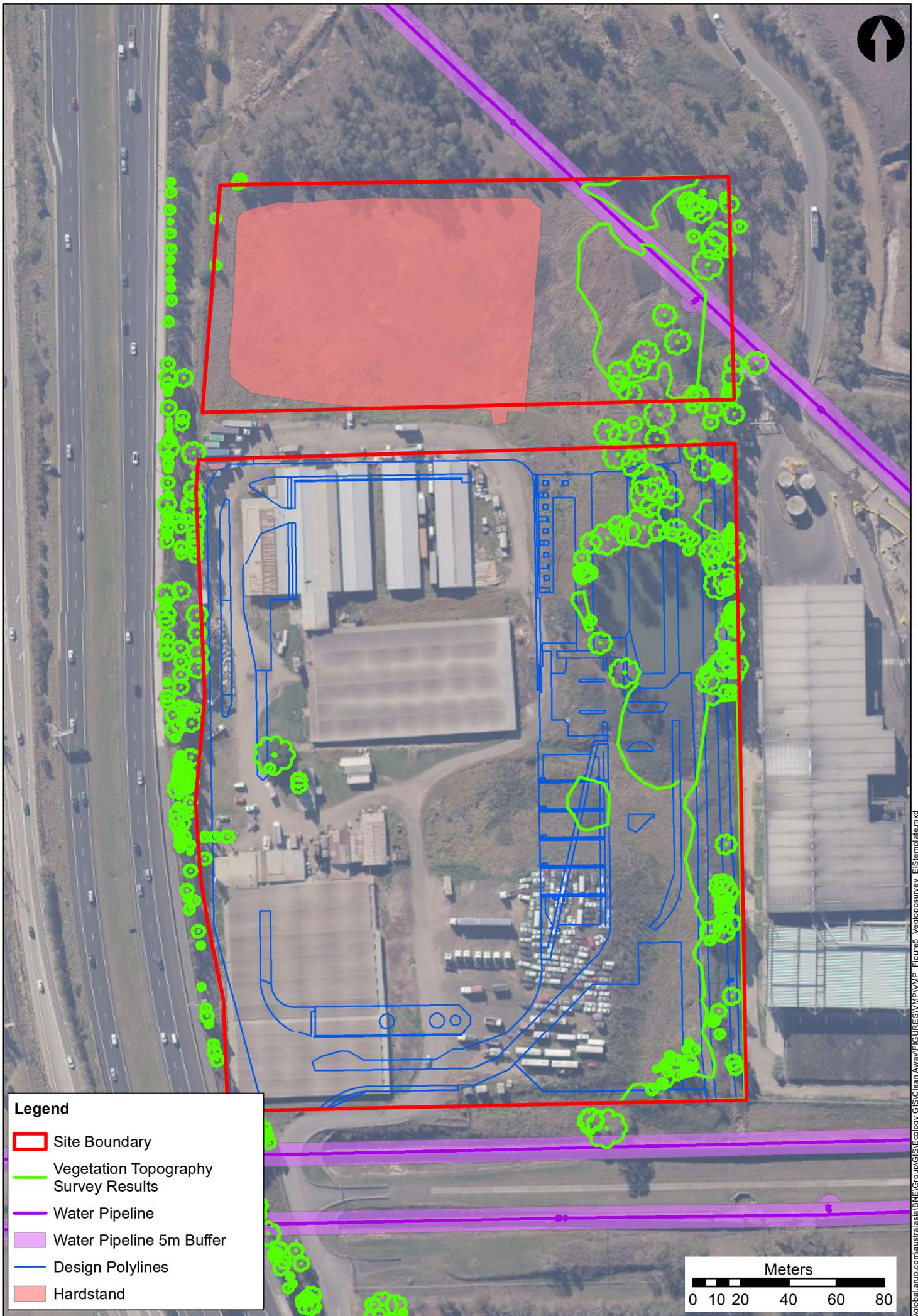


Figure 5: Vegetation topography survey at the site

9 Maintenance and Monitoring

9.1 Maintenance Strategy

Rehabilitation will be maintained for a minimum of 5 years post-construction and the key tasks will include:

- Maintaining the RTZs (e.g. replacement plantings where needed);
- Weed management;
- Erosion management; and
- Site maintenance activities.

Table 2 below outlines these key tasks, time frames and proposed actions.

Table 2: Maintenance and monitoring activity schedule

Task	Timeframe/Frequency	Activities
Maintain revegetation zones	1 month after initial installation, every 3 months after initial installation for first 2 years, every 6 months in the following 3 years.	All plantings shall be assessed to determine survival rate and replaced as required. Tubestock protection also to be removed as required.
Weed management	Biannually for 24 months following plant establishment. Annually for the balance of the monitoring period.	Weed control shall be triggered by new outbreaks of weeds or increases in the extent of existing infestations detected during weed monitoring events. Weed control will involve implementation of a herbicide program and/or hand weeding techniques appropriate to the occurrence of weeds. Weed monitoring and reporting to occur as further outlined below.
Erosion management	As required.	Where subsoil and topsoil is eroded, the Contractor will repair and re-ameliorate subsoil, re-apply topsoil and reinstall vegetation treatment.
Site maintenance	As required.	Removal of all anthropogenic rubbish observed during revegetation works and monitoring events. Contractors will report all instances of illegal dumping, fires, camping, fence damage or vandalism as soon as practicable (and include photos).

9.2 Monitoring and Reporting

9.2.1 Revegetation Monitoring

Monitoring of the rehabilitation works will be undertaken following the establishment until the completion of the maintenance period.

The monitoring will be required to:

- Assess the vegetation communities against the performance objectives and whether the measurable performance indicators are met;
- Identify any issues or constraints in meeting the performance indicators; and
- Address and specify any corrective actions required.

An annual report will be prepared that describes the results of the monitoring events, compliance with performance objectives and performance indicators.

As a guide, the monitoring proforma may include (but not be limited to) the following for each RTZ:

- Planting density and species composition, and whether they appear consistent with Appendix A;
- Survival rate of planted stock;
- Survival rate of existing mature trees to be retained during construction;
- Dominant species, height range and percentage cover of native species and exotic species for each stratum (e.g. canopy, mid-stratum and ground-stratum);
- Weed species present in each stratum;
- Observations of natural recruitment of native species;
- Fauna habitat features such as leaf litter, rocks and logs (particularly installed rocks and logs in RTZ 3);
- Signs of disturbance or erosion;
- Management notes (e.g. erosion control, replacing failed plantings and rubbish removal).

9.2.2 Weed Monitoring

Reporting from biannual targeted weed surveys is to continue for 24 months following plant establishment in the RTZs.

The report need only be in the form of a short memo/report and should include:

- Survey methods and results;
- Documentation of deviation from the results of previous weed monitoring events; and
- Clearly indication of whether further weed control actions are necessary.

In subsequent years, weed monitoring need not be as vigorous and only low-level weed surveillance would be required, i.e. annual targeted weed surveys.

9.3 Adaptive Management

The Contractor must be committed to adaptively manage the site. This includes adapting vegetation and land management practices in response to results from the monitoring program and to unforeseen or unplanned management threats and issues, as well as to reflect advances in ecological research and land management technologies. It is expected that in instances where the contractor observes vacancies within revegetation areas (e.g. due to weed control, previously unobserved vacancies or canopy gaps created from tree fall, etc.), reinforcement plantings will occur to speed up the ecological succession process.

10 Program for Rehabilitation Works

An indicative program for the rehabilitation works is provided below. This shall be refined and expected timeframes for the rehabilitation phases shall be specified prior to the commencement of rehabilitation works.

Table 3: Indicative implementation schedule.

Task	Time Period	Year
Weed control activities and monitoring.	Throughout the rehabilitation works and includes management actions to address biosecurity risks during clearing activities.	Commences during construction, up to handover at the end of Year 5
Tree retention and protection.	Throughout the rehabilitation works and includes management actions before and during construction and at completion of construction.	Year 1 until completion of construction
Soil and water investigations (if needed) as part of site preparations.	Site preparation phase.	Year 1
Site preparation actions for installing tubestock or seed mix, such as preparing individual tubestock locations.	Site preparation phase.	Year 1
Planting tubestock and direct seeding.	Plant installation phase, following rains.	Year 1
Revegetation monitoring and corrective actions as required (e.g. replacement of failed tubestock or seeding as required).	Maintenance phase.	Year 1, following plant installation, up to the end of Year 5
Annual reporting.	Maintenance phase.	End of each year
Final evaluation of the rehabilitation works including confirming the performance objectives and performance indicators have been met.	Prior to final handover to the relevant land manager at the end of the maintenance phase.	End of Year 5

11 References

- Blacktown City Council (2019) Bioretention Planting Guide. Accessed online from the *Developers toolkit for water sensitive urban design (WSUD)* at <<https://www.blacktown.nsw.gov.au/Plan-build/Stage-2-plans-and-guidelines/Developers-toolkit-for-water-sensitive-urban-design-WSUD>>.
- Blacktown City Council (2019) Riparian Planting Guide 2019. Accessed online from the *Developers toolkit for water sensitive urban design (WSUD)* at <<https://www.blacktown.nsw.gov.au/Plan-build/Stage-2-plans-and-guidelines/Developers-toolkit-for-water-sensitive-urban-design-WSUD>>.
- Blacktown City Council (2019) Wetland Planting Guide 2019. Accessed online from the *Developers toolkit for water sensitive urban design (WSUD)* at <<https://www.blacktown.nsw.gov.au/Plan-build/Stage-2-plans-and-guidelines/Developers-toolkit-for-water-sensitive-urban-design-WSUD>>.
- Tozer, M. (2003) The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities. *Cunninghamia* (2003) 8(1): 1–75.

Appendix A

Rehabilitation Treatment Zone Planting Lists

Rehabilitation Planting Lists

The planting lists contained here reflect the species provided in the Landscaping Design Strategy, which is outlined within the WSERRC Architectural and Landscape Design Strategy Report (refer to Appendix B of the EIS, Volume 1).

RTZs 1, 4 and 5 (PCT849 Cumberland Shale Plains Woodland Species)

Common Name and Species Name	Indicative Planting Density**	Relevant Strata
Grey Box* <i>Eucalyptus moluccana</i>	1 per 10 metre-square	Tree / Canopy
Forest Red Gum* <i>Eucalyptus tereticornis</i>		
Narrow-leaved Ironbark* <i>Eucalyptus crebra</i>		
Spotted Gum* <i>Corymbia maculata</i>		
Thin-leaved Stringy bark* <i>Eucalyptus eugenioides</i>		
White-feathered Honey-myrtle <i>Melaleuca decora</i>		
Water Gum <i>Tristaniopsis laurina</i>		Medium Tree
Blackthorn* <i>Bursaria spinosa</i>	Where possible, including along the eastern and western boundaries, recommend 1 per 5 metre-square	Shrub
<i>Dodonaea viscosa subsp.cuneata</i> *		
Cypress Cherry <i>Exocarpos cupressiformis</i>		
Lemon-scented Tea Tree <i>Leptospermum petersonii</i>		
Juniper-leaved Grevillea <i>Grevillea junipera subsp. junipera</i>		
Flax Lily* <i>Dianella longifolia</i>	Recommend 3 per 1 metre-square	Understorey / Groundcover
Knobby Club Rush <i>Ficinia nodosa</i>		
Wattle Mat-rush* <i>Lomandra filiformis subsp.filiformis</i>		
Spiny-headed Mat-rush <i>Lomandra longifolia</i>		
Common Matrush*		

Common Name and Species Name	Indicative Planting Density**	Relevant Strata
<i>Lomandra multiflora</i>		
Thyme Honey-myrtle <i>Melaleuca thymifolia</i>	Recommend 2 per 1 metre-square	
Tussock Grass <i>Poa labillardieri</i>		
Coastal Rosemary <i>Westringia fruticosa</i>		
Kidney Weed <i>Dichondra repens</i>		
Australian Bluebell <i>Wahlenbergia gracilis</i>		
Red Grass* <i>Bothriochloa macra</i>		
Wallaby Grass* <i>Austrodanthonia racemose</i> <i>var.racemosa</i>		
Weeping Meadow Grass* <i>Microlaena stipoides var.stipoides</i>	Grasses usually 300 kg per hectare for full coverage	
Kangaroo Grass <i>Themeda australis</i>		

* Cumberland Plain Woodland species. To be prioritised for selection and form the majority of plantings, though this may depend on availability. In particular, two tree species that are most important for prioritisation in RTZ 1 and 4 are Grey Box and Forest Red Gum, and one shrub species that is most important for prioritisation in RTZ 1, 4 and 5 is Blackthorn (refer to the description of Cumberland Shale Plains Woodland provided in the Vegetation Management Plan (VMP)). **It is critical that tree species are not to be planted in RTZ 5.**

** The planting densities provided are consistent with the current Landscaping Design Strategy. These are rough indicators and should be revisited in the finalised VMP from future design phases. The recommended planting density for shrubs (1 per 4 metre-square) is the minimum planting density for RTZ 5.

RTZs 2, 3 and 6 (Basins and Ephemeral Swale)

Common Name and Species Name	Inundation Depth*	Planting Location and Indicative Planting Density*
Knobby Club Rush <i>Isolepis nodosa</i>	-	Edge (dry) 8-10 plants per 1 metre-square
Spiny-headed Mat-rush <i>Lomandra longifolia</i>	-	
Tussock Grass <i>Poa labillardieri</i>	-	
Tall Sedge <i>Carex appressa</i>	-	Edge (wet) 8-10 plants per 1 metre-square
Cyperus <i>Cyperus exaltatus</i>	-	

Common Name and Species Name	Inundation Depth*	Planting Location and Indicative Planting Density*
Juncus <i>Juncus usitatus</i>	-	
Jointed Rush <i>Baumea articulata</i>	0-800	Shallow marsh 8-10 plants per 1 metre-square
Marsh Club Rush <i>Bolboschoenus caldwellii</i>	0-300	
River Bulrush <i>Bolboschoenus fluviatilis</i>	0-300	
Spike-rush <i>Eleocharis acuta</i>	0-200	
Woolly Frogsmouth <i>Philydrum lanuginosum</i>	0-300	

*Inundation depth, planting location and planting densities are in accordance with the Wetland Planting Guide 2019 by Blacktown City Council. Given that dry periods are expected to occur, the more water-reliant species for 'deep marsh' plantings (e.g. Water Lily) have been omitted from this planting list.

RTZ 7

RTZ 7 is to include a mix of grass and sedge species, as per the landscaping design strategy. As provided in the Vegetation Management Plan for the proposal, where sedges are included in the seed mix, the mix will contain sedges able to withstand infrequent mowing and ensure that species will persist where moist patches and standing water occur. Shrub and tree species must not be included in any seed mixes for RTZ 7.