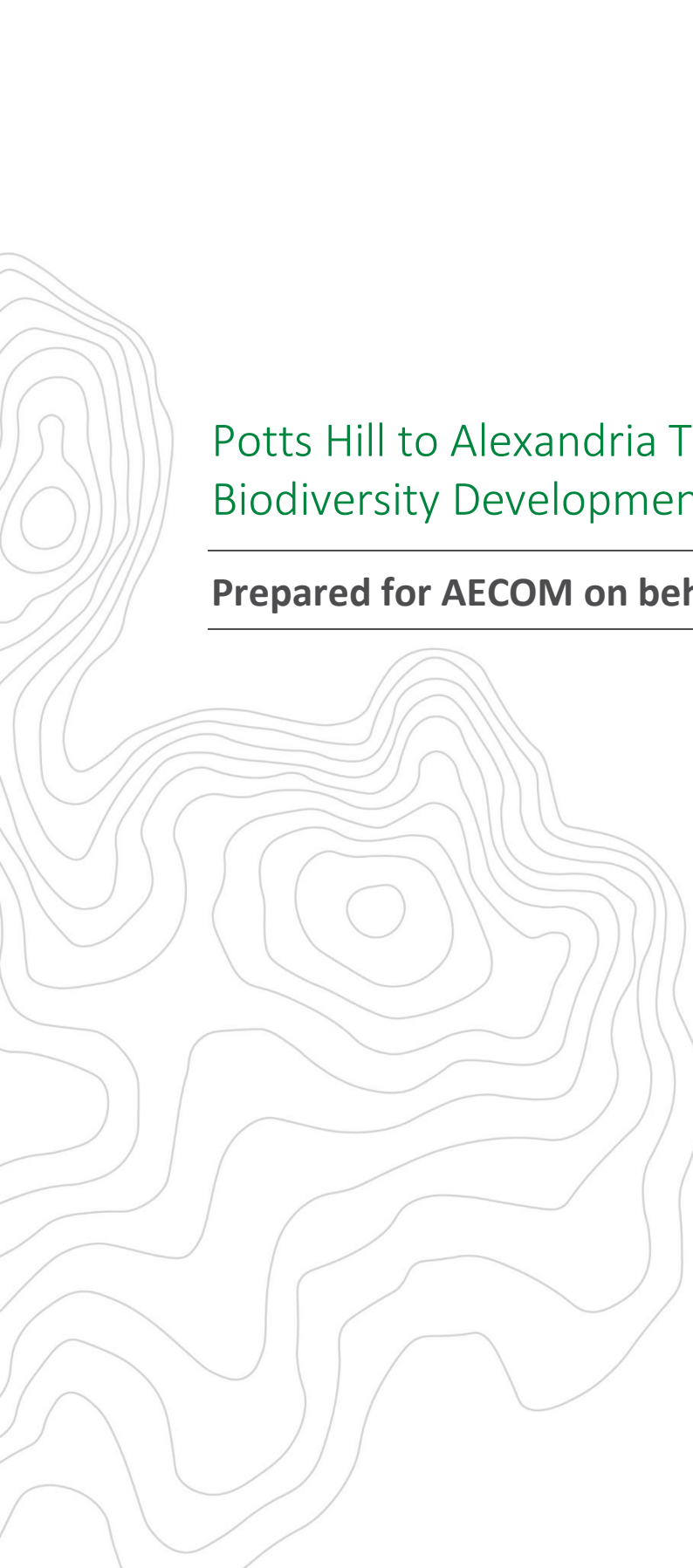


Appendix H

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

A stylized topographic map with green contour lines is positioned on the left side of the page, extending from the top left towards the bottom left.

Potts Hill to Alexandria Transmission Cable Project Biodiversity Development Assessment Report

Prepared for AECOM on behalf of TransGrid

DOCUMENT TRACKING

Project Name	Potts Hill to Alexandria Transmission Cable Project BDAR
Project Number	19SUT13258
Project Manager	Kirsten Velthuis
Prepared by	Kirsten Velthuis
Reviewed by	Nicole McVicar
Approved by	Beth Medway
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Template 2.8.1

Executive Summary

Eco Logical Australia (ELA) was commissioned by AECOM on behalf of TransGrid to compile a Biodiversity Development Assessment Report (BDAR) for the proposed construction and operation of a new 330 kilovolt (kV) underground transmission cable circuit between Rookwood Road substation in Potts Hill and Beaconsfield West substation in Alexandria (the project). The project comprises the construction and operation of a transmission cable circuit, substation upgrades and use of temporary construction laydown areas. This report addresses the Secretary's Environmental Assessment Requirements (SEARs) for Application Number SSI 17_8583, to provide a BDAR prepared in accordance with the Biodiversity Assessment Method (BAM) to assess the impacts of the project on biodiversity. The project area (as shown in Figure 2 to 10) is largely located in urban and disturbed areas, including within existing road reserves, open space areas and at existing substation sites. No Threatened Ecological Communities (TECs) or threatened species listed under the *Biodiversity Conservation Act 2016* or under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* were recorded within the project area. Within the project area, 93% (9.9 ha) of vegetation is classified as 'urban exotics and natives'. The remaining 7% of vegetation within the project area is classified as Plant Community Types (PCTs), as defined by the NSW Bionet Vegetation Classification System. Two PCTs were identified as occurring within the project area:

- *Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion*, PCT 920 (0.76 ha); and
- *Sydney Turpentine-Grey Ironbark Open Forest on shale in the lower Blue Mountains and Sydney Basin Bioregion* PCT 1281 (0.2ha). This PCT was not validated quantitatively through the collection of BAM plots as the site was inaccessible at the time of the survey, owing to its location in an active rail corridor (Dulwich Hill Light Rail line). It is understood that the project will avoid clearing PCT 1281 through underboring.

The project area intersects the Cooks River, Coxs Creek and two unnamed streams. The project area does not contain any mapped important wetlands.

PCT 920 *Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion* provides potential foraging habitat for ecosystem credit species *Pteropus poliocephalus* (Grey-headed Flying-fox), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (Little Bentwing-bat) and *Haliaeetus leucogaster* (White-bellied Sea-eagle).

One species credit species, *Myotis Macropus* (Southern Myotis) has potential to occur within the project area at PCT 920. This species is listed as vulnerable under the BC Act. This species was assumed present and no further assessment was undertaken.

Additionally, non-native vegetation within the project area provides potential foraging habitat for the Grey-headed Flying-fox. It is considered there is a low potential for roosting habitat for the Eastern Bentwing-bat and Little Bentwing-bat in some of the culverts and stormwater pipes in the project area, given that the affected sections of culverts and stormwater pipes are short and exposed to light. These species have been considered under prescribed impacts, which the BAM details are impacts on biodiversity values in addition to or instead of clearing native vegetation.

This report assessed a worst-case scenario of impact to all vegetation and prescribed impacts within the project area including:

- removal of 0.76 hectares of PCT 920 (mangrove forest), and associated ecosystem credit species (Grey-headed Flying-fox, Eastern Bentwing-bat; Little Bentwing-bat and White-bellied Sea-eagle) and species credit species (Southern Myotis);
- removal of 9.9 hectares of urban exotics and natives, and associated urban exotic foraging habitat for Grey-headed Flying Fox; and
- prescribed impacts relating to potential impact on culverts and stormwater pipes (through trenching or temporary relocation of stormwater infrastructure) and associated impact on potential habitat for Eastern Bentwing-bat and Little Bentwing-bat. A survey for Eastern Bentwing-bat and Little Bentwing-bat should be undertaken prior to construction in impacted culverts and stormwater pipes.

As this report assesses a worst-case scenario of impact, impacts to vegetation and prescribed impacts are expected to be reduced as the design of the project progresses and the project area is refined.

The BAM calculator determined that 14 ecosystem credits are required to offset the impact of the proposed project on PCT 920; and 14 species credits are required to offset the residual impacts of the proposed project on Southern Myotis.

One Matter of National Environmental Significance (MNES), the Grey-Headed Flying-fox, listed as Vulnerable under the EPBC Act, was identified as potentially affected by the project. An assessment under the Significant Impact Criteria (Department of the Environment (DoE) 2013) was undertaken and concluded that a significant impact would not occur. As such, a referral to the Commonwealth is not required.

Potential indirect impacts of the project would include sediment runoff, weed spread, dust, vibration, and light spill during construction. Considering the urban nature of the project area, absence of remnant, native vegetation and limited habitat for threatened species, these indirect impacts would be minor. Direct and indirect impacts would be managed through the implementation of environmental management and mitigation measures.

Serious and Irreversible Impacts (SII) values have been considered in this assessment. No candidate entities for SII were identified in the project area.

The BAM applies only to terrestrial impacts. However, an assessment of impact on key fish habitat, marine vegetation and threatened fish, and a description of measures to minimise and rehabilitate impacts, as required by the SEARS and in accordance with the *Fisheries Management Act 1994*, is provided as an annex to this BDAR (Annexure E). This assessment identified that no species of threatened fish are likely to be impacted by the development, however approximately 7,651 m² of Grey Mangroves may be subject to direct and indirect impacts associated with proposed cable installation at the Cooks River (Figure 6). Grey Mangrove is protected under the *Fisheries Management Act 1994*. As per Department of Primary Industries-(DPI) Fisheries guidelines, impact to Grey Mangrove is required to be offset at a 2:1 ratio to ensure that no net loss of key fish habitat occurs. The assessment includes mitigation measures to minimise impact on the environment and recommends that TransGrid liaise with DPI Fisheries to determine the preferred method of habitat offset.

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
CEEC	Critically Endangered Ecological Community
DNG	Derived Native Grassland
DoEE	Commonwealth Department of Environment and Energy

Abbreviation	Description
DPI	Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FM Act	NSW Fisheries Management Act 1994
GHFF	Grey headed Flying Fox
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
NSW	New South Wales
NOW	NSW Office of Water
OEH	NSW Office of Environment and Heritage (now the Department of Planning, Industry and Environment)
PCT	Plant Community Type
SAII	Serious and irreversible impact
SEARS	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
STIF	Sydney Turpentine Ironbark Forest
TEC	Threatened Ecological Community
VIS	Vegetation Information System
WM Act	NSW Water Management Act 2000

Definitions

Terminology	Definition
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a project area, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
BioNet Atlas	The BioNet Atlas (formerly known as the NSW Wildlife Atlas) is the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails) and some fish

Terminology	Definition
Broad condition state:	Areas of the same PCT that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same PCT into a vegetation zone for the purpose of determining the vegetation integrity score.
Connectivity	The measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation.
Credit Calculator	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Development	Has the same meaning as development at section 4 of the EP&A Act, or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act.
Ecosystem credits	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a project area and the gain in biodiversity values at a biodiversity stewardship site.
High threat exotic plant cover	Plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species.
Hollow bearing tree	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles.
Important wetland	A wetland that is listed in the Directory of Important Wetlands of Australia (DIWA) and SEPP 14 Coastal Wetlands
Linear shaped development	Development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately.
Local wetland	Any wetland that is not identified as an important wetland (refer to definition of Important wetland).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.
Multiple fragmentation impact development	Developments such as wind farms and coal seam gas extraction that require multiple extraction points (wells) or turbines and a network of associated development including roads, tracks, gathering systems/flow lines, transmission lines
Operational Manual	The Operational Manual published from time to time by OEH, which is a guide to assist assessors when using the BAM
Patch size	An area of intact native vegetation that: a) occurs on the project area or biodiversity stewardship site, and b) includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the project area or stewardship site.
Prescribed Impacts	Impacts on biodiversity values in addition to or instead of clearing native vegetation. Prescribed impacts include impacts to non-native vegetation within the project area classified as ' <i>urban exotics and natives</i> ' and resulting impacts to threatened species and TECs for which non-native vegetation provides habitat.

Terminology	Definition
Project area	The project area comprises the overall potential area of direct disturbance by the project, which may be temporary (for construction) or permanent (for operational infrastructure) and extend below the ground surface.
Proponent	A person who intends to apply for consent to carry out development or for approval for an activity.
Reference sites	The relatively unmodified sites that are assessed to obtain local benchmark information when benchmarks in the Vegetation Benchmarks Database are too broad or otherwise incorrect for the PCT and/or local situation. Benchmarks can also be obtained from published sources.
Regeneration	The proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height <5 cm within a vegetation zone.
Remaining impact	An impact on biodiversity values after all reasonable measures have been taken to avoid and minimise the impacts of development. Under the BAM, an offset requirement is calculated for the remaining impacts on biodiversity values.
Retirement of credits	The purchase and retirement of biodiversity credits from an already-established biobank site or a biodiversity stewardship site secured by a biodiversity stewardship agreement.
Riparian buffer	Riparian buffers applied to water bodies in accordance with the BAM
Sensitive biodiversity values land map	Development within an area identified on the map requires assessment using the BAM.
Site attributes	The matters assessed to determine vegetation integrity. They include: native plant species richness, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover (as a percentage of total ground and mid-storey cover), number of trees with hollows, proportion of over-storey species occurring as regeneration, and total length of fallen logs.
Site-based development	A development other than a linear shaped development, or a multiple fragmentation impact development.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates.
Subject land	Is land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a project area, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website.
Threatened species	Critically Endangered, Endangered or Vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as Critically Endangered, Endangered or Vulnerable.
Vegetation Benchmarks Database	A database of benchmarks for vegetation classes and some PCTs. The Vegetation Benchmarks Database is published by OEH and is part of the BioNet Vegetation Classification.
Vegetation zone	A relatively homogenous area of native vegetation on a project area, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state.

Terminology	Definition
Wetland	An area of land that is wet by surface water or ground water, or both, for long enough periods that the plants and animals in it are adapted to, and depend on, moist conditions for at least part of their life cycle. Wetlands may exhibit wet and dry phases and may be wet permanently, cyclically or intermittently with fresh, brackish or saline water
Woody native vegetation	Native vegetation that contains an over-storey and/or mid-storey that predominantly consists of trees and/or shrubs

1. Stage 1: Biodiversity assessment

1.1 Introduction

TransGrid is the manager and operator of the major high-voltage electricity transmission network in New South Wales (NSW) and the Australian Capital Territory (ACT). TransGrid is seeking approval under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of a new 330-kilovolt (kV) underground transmission cable circuit between the existing Rookwood Road substation in Potts Hill and the Beaconsfield West substation in Alexandria.

The project has been identified as a solution to address existing issues in the electricity supply network for inner Sydney, which is characterised by ageing and deteriorating electricity infrastructure and forecast increases in consumer demand.

Key components of the project include:

- cable works connecting Rookwood Road substation with the Beaconsfield West substation comprising:
 - a 330 kV underground transmission cable circuit comprising three cables installed in three conduits;
 - another set of three conduits for a possible future 330 kV transmission cable circuit if it is required;
 - four smaller conduits for carrying optical fibres;
 - around 26-30 joint bays, per circuit, where sections of cable would be joined together, located approximately every 600-800 metres along the transmission cable route;
 - link boxes and sensor boxes associated with each joint bay to allow cable testing and maintenance;
- seven special crossings of infrastructure or watercourses including two rail lines (at Chullora and St Peters), one freight rail line (Enfield Intermodal rail line at Belfield), one light rail line (at Dulwich Hill), the Cooks River and its associated cycleway (at Campsie/Croydon Park), a playground (at Marrickville) and the southern wetland at Sydney Park (at Alexandria);
- upgrade works at the Rookwood Road and Beaconsfield West substations to facilitate the new 330 kV transmission cable circuit;
- conversion works at the Beaconsfield West and Sydney South substations to transition the existing Cable 41 from a 330 kV connection to a 132 kV connection; and
- five temporary construction laydown areas to facilitate construction of the project.

As the project is State Significant Infrastructure (SSI) under section 5.12 of the EP&A Act, an Environmental Impact Statement (EIS) has been prepared to assess the impacts of the project. Revised Secretary's Environmental Assessment Requirements (SEARs) was issued for the project on [TBC] by the Planning Secretary of the NSW Department of Planning, Industry and Environment (DPIE). The SEARs states "*Provide a Biodiversity Development Assessment Report prepared in accordance with the Biodiversity Assessment Method (BAM) to assess the impacts of the project on biodiversity*".

This Biodiversity Development Assessment Report (BDAR) has been prepared by Kirsten Velthuis, Senior Environmental Consultant and Nicole McVicar, Senior Ecologist, who is an Accredited Person (BAAS 18077) under the NSW *Biodiversity Conservation Act 2016* (BC Act).

This BDAR follows the structure and addresses the information requirements as outlined in the BAM (OEI 2017). The BAM outlines the assessment methodology to quantify and describe the biodiversity values of the project area, and the biodiversity offsets required for any unavoidable impacts.

The SEARS also requires an assessment of the likely impacts on key fish habitat, marine vegetation and threatened species of fish, in accordance with the *Fisheries Management Act 1994*, and a description of the measures to minimise and rehabilitate impacts. The BAM applies only to terrestrial impacts. However, an assessment of impact on key fish habitat, marine vegetation and threatened fish, and a description of measures to minimise and rehabilitate impacts is provided as an annex to this BDAR (Annexure E).

1.1.1 General description of the project location

The project would be located in the suburbs of Potts Hill, Yagoona, Chullora, Greenacre, Lakemba, Belmore, Belfield, Campsie, Croydon Park, Ashbury, Ashfield, Dulwich Hill, Marrickville, Newtown, St Peters, Alexandria and Picnic Point.

The project would be located in the following local government areas (LGAs):

- City of Canterbury-Bankstown;
- Strathfield;
- Inner West; and
- City of Sydney.

The project would be located primarily within road reserves, at existing electrical infrastructure sites, within public open space and on previously disturbed areas. Land uses adjacent to the road reserves are mainly residential with relatively short sections of commercial and mixed uses in the suburbs of Belfield, Croydon Park and Petersham. The project would be located close to industrial areas towards the western and eastern ends of the project area around Potts Hill, Chullora, Greenacre, Marrickville, St Peters and Alexandria. This report includes a location map (Figure 1) and detailed site maps (Figure 2 to Figure 10).

1.1.2 The project area

The project area comprises the overall potential area of direct disturbance by the project, which may be temporary (for construction) or permanent (for operational infrastructure) and extend below the ground surface. While the boundaries of the project area represent the physical extent of where project infrastructure may be located, or construction works undertaken, it does not mean that this entire area would be physically disturbed. This project area includes several route options and crossing type options, all of which are included in the project area shown in the detailed site maps. This report assesses all these options.

The project area includes the location of operational infrastructure and construction work sites for:

- the transmission cable route (including the entire road reserve of roads traversed);
- special crossings of infrastructure or watercourses;

- substation sites requiring upgrades (noting that all works would be contained within the existing site boundaries); and
- construction laydown areas.

Temporary construction laydown areas are proposed at five locations along the transmission cable route:

- 12 Muir Road, Chullora;
- Cooke Park, Belfield;
- Peace Park, Ashbury;
- Camdenville Park, St Peters; and
- Beaconsfield West substation, Alexandria.

At Campsie, the project would cross the Cooks River, the main watercourse within the project area. In the east, it would extend through Sydney Park north of Campbell Road. There are a number of major transport corridors that would be crossed by the project, including the Sydney Trains network, the Dulwich Hill Light Rail line and freight rail infrastructure at the southern end of the Enfield Intermodal Logistics Centre.

The locations of the proposed special crossings are provided in Table 1.

Table 1: Proposed special crossings locations

Location	Suburb	Infrastructure or waterbody crossed	Proposed crossing type
Muir Road	Chullora	Rail line	Cable bridge
Enfield Intermodal Terminal	Belfield	Freight rail line	Underbore
Cooks River	Croydon Park/ Campsie	Cooks River and cycleway	Cable bridge or underbore
Arlington Light Rail Station	Dulwich Hill	Dulwich Hill Light Rail line	Underbore
Bedwin Road	St Peters	Rail Line	Cable Bridge
Sydney Park	Alexandria	Wetland	Underbore

1.1.3 Sources of information used

The following data sources were reviewed as part of this report:

- BioNet Vegetation Classification;
- BioNet Atlas 5 kilometre database search (OEH 2019);
- Threatened Biodiversity Data Collection;
- Directory of Important Wetlands Australia;
- Sydney Metropolitan Catchment Management Authority Vegetation Mapping v 3.0 (Office of Environment and Heritage (OEH) 2016);
- Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy 1989);
- EPBC Act Protected Matters Search Tool (5 kilometre radius linear search) (DoEE 2017);
- Greenway Biodiversity Strategy (AWC 2012);
- Rookwood Road to Beaconsfield West 330 kV Transmission Supply Upgrade (ELA 2014);
- Bushcare Sites (Inner West Environment Group, 2019);
- State Environmental Planning Policy (Infrastructure) 2007;

- State Environmental Planning Policy (State and Regional Project) 2011;
- State Environmental Planning Policy No. 19 – Bushland in Urban Areas;
- State Environmental Planning Policy No. 55 – Remediation of Land;
- Ashfield Local Environmental Plan 2013;
- Bankstown Local Environmental Plan 2015;
- Canterbury Local Environmental Plan 2012;
- Marrickville Local Environmental Plan 2011;
- Sydney Local Environmental Plan 2012; and
- Strathfield Local Environmental Plan 2012.

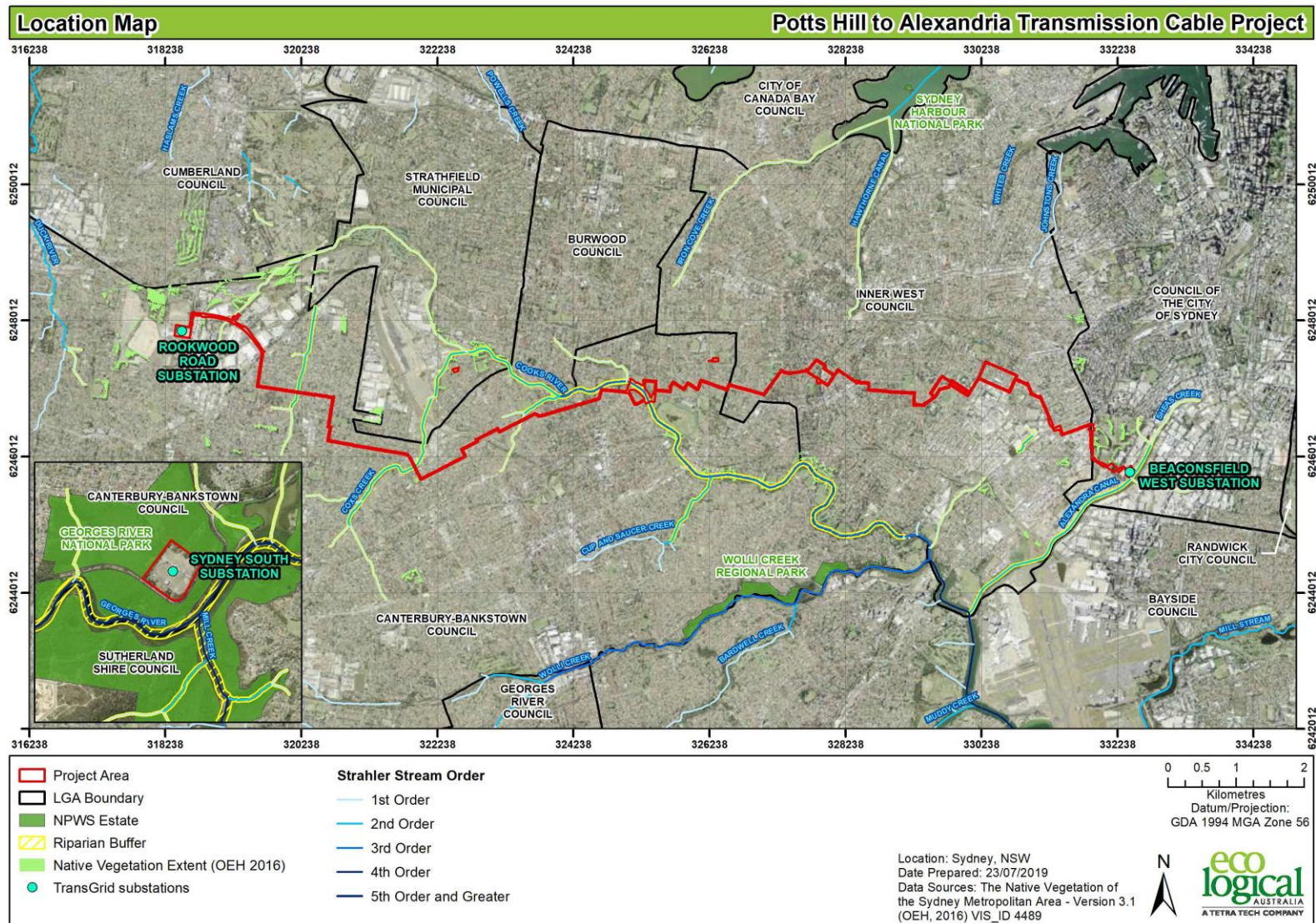


Figure 1: Location Map

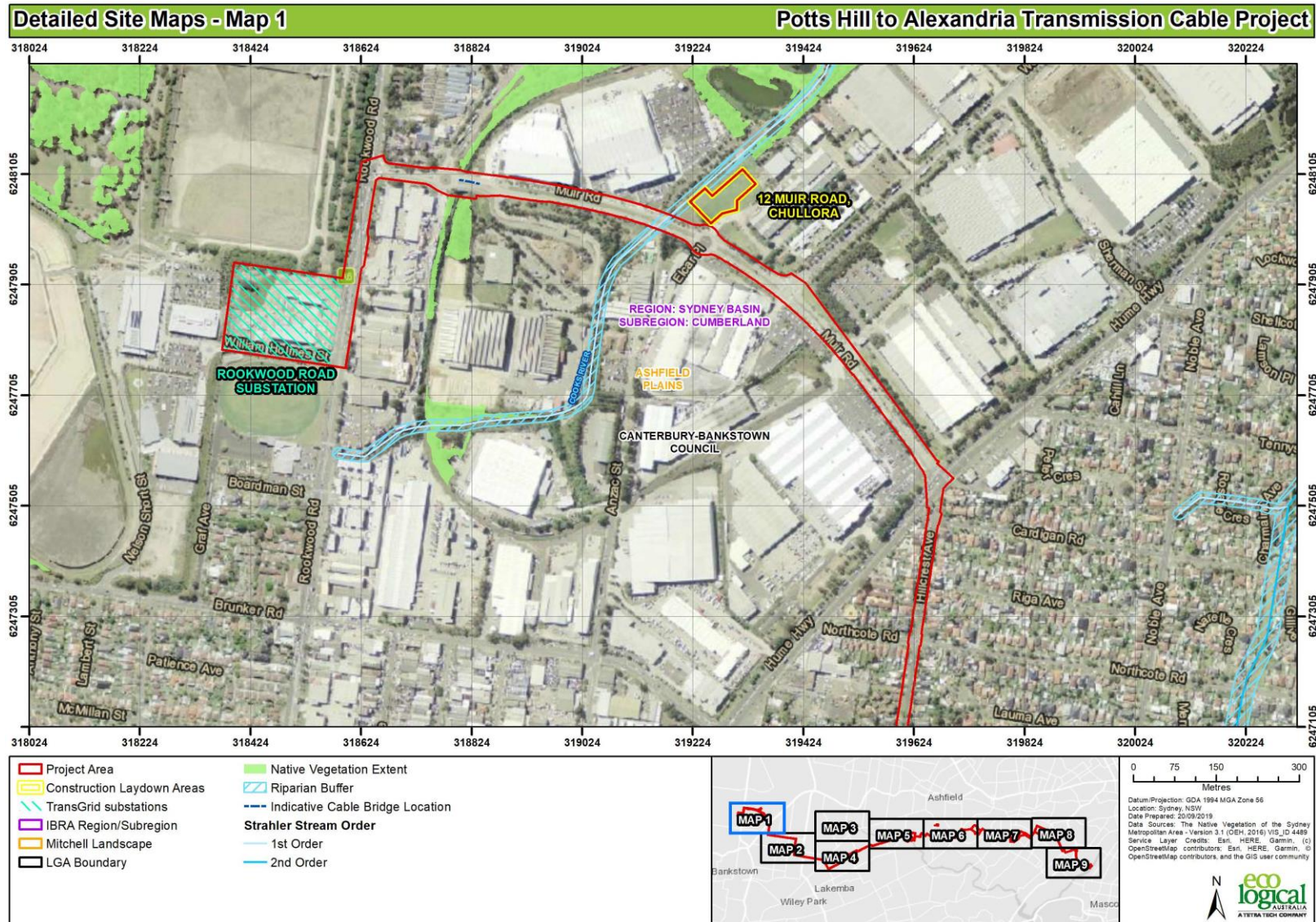


Figure 2: Detailed site map 1

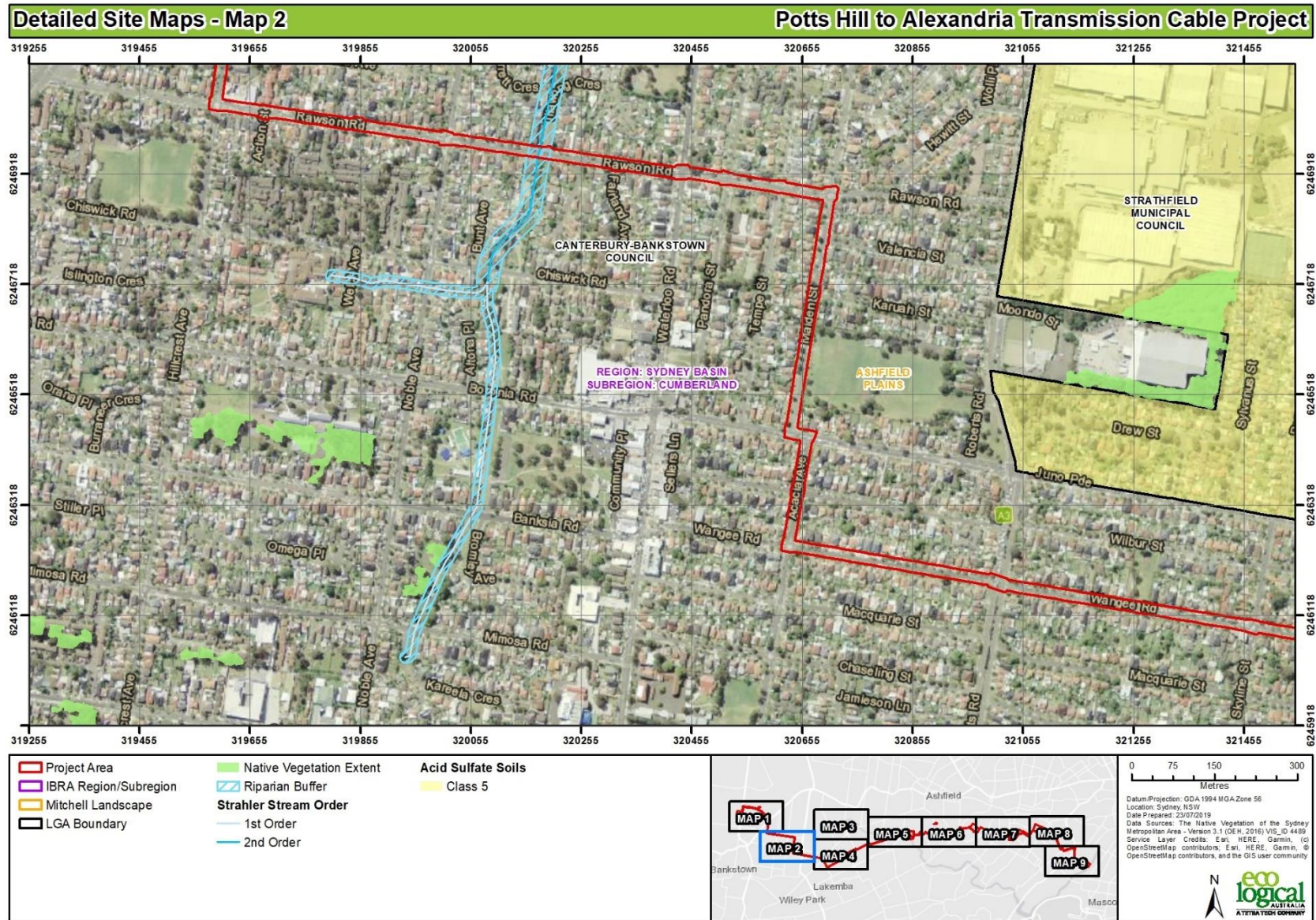


Figure 3: Detailed site map 2

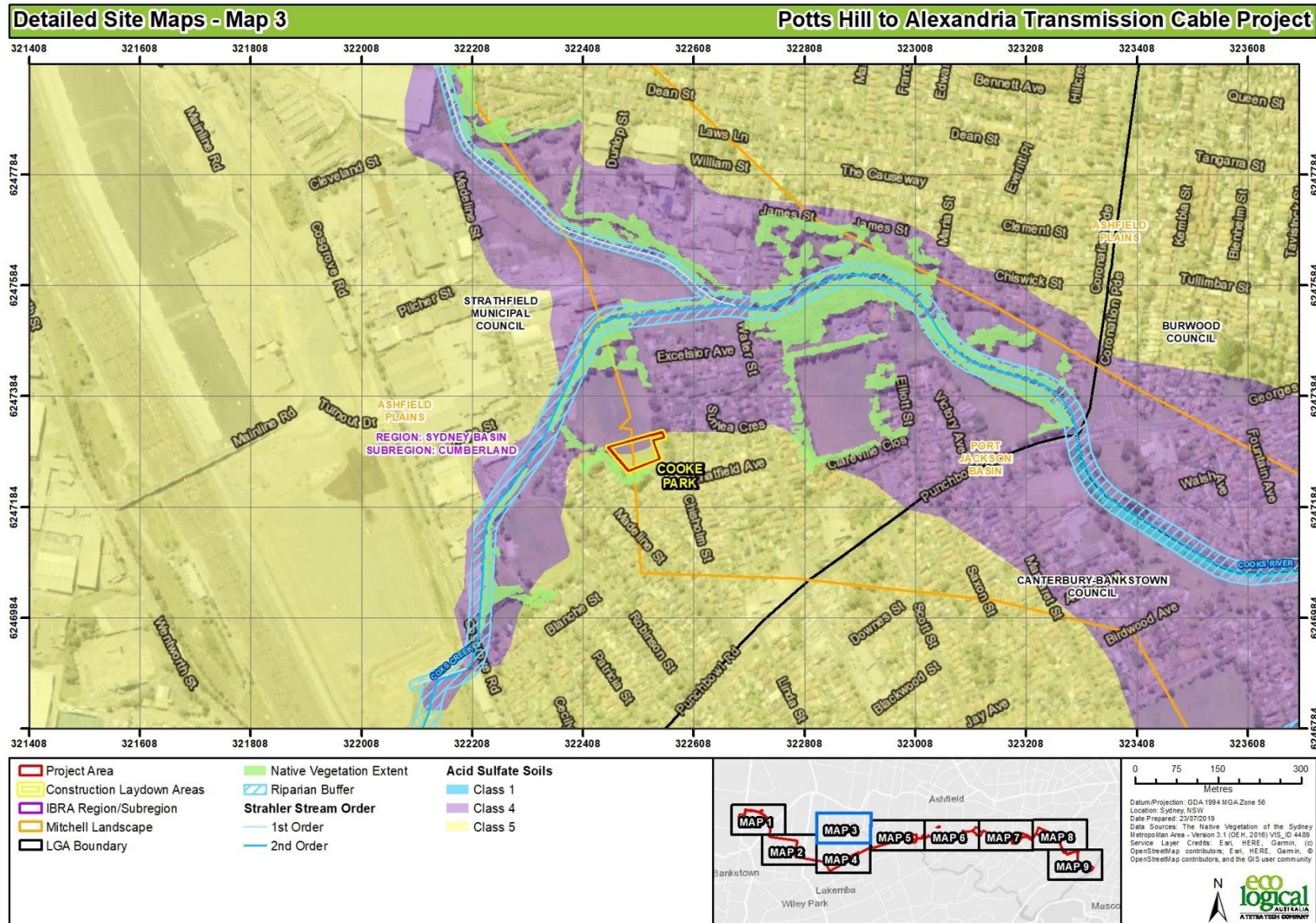


Figure 4: Detailed site map 3

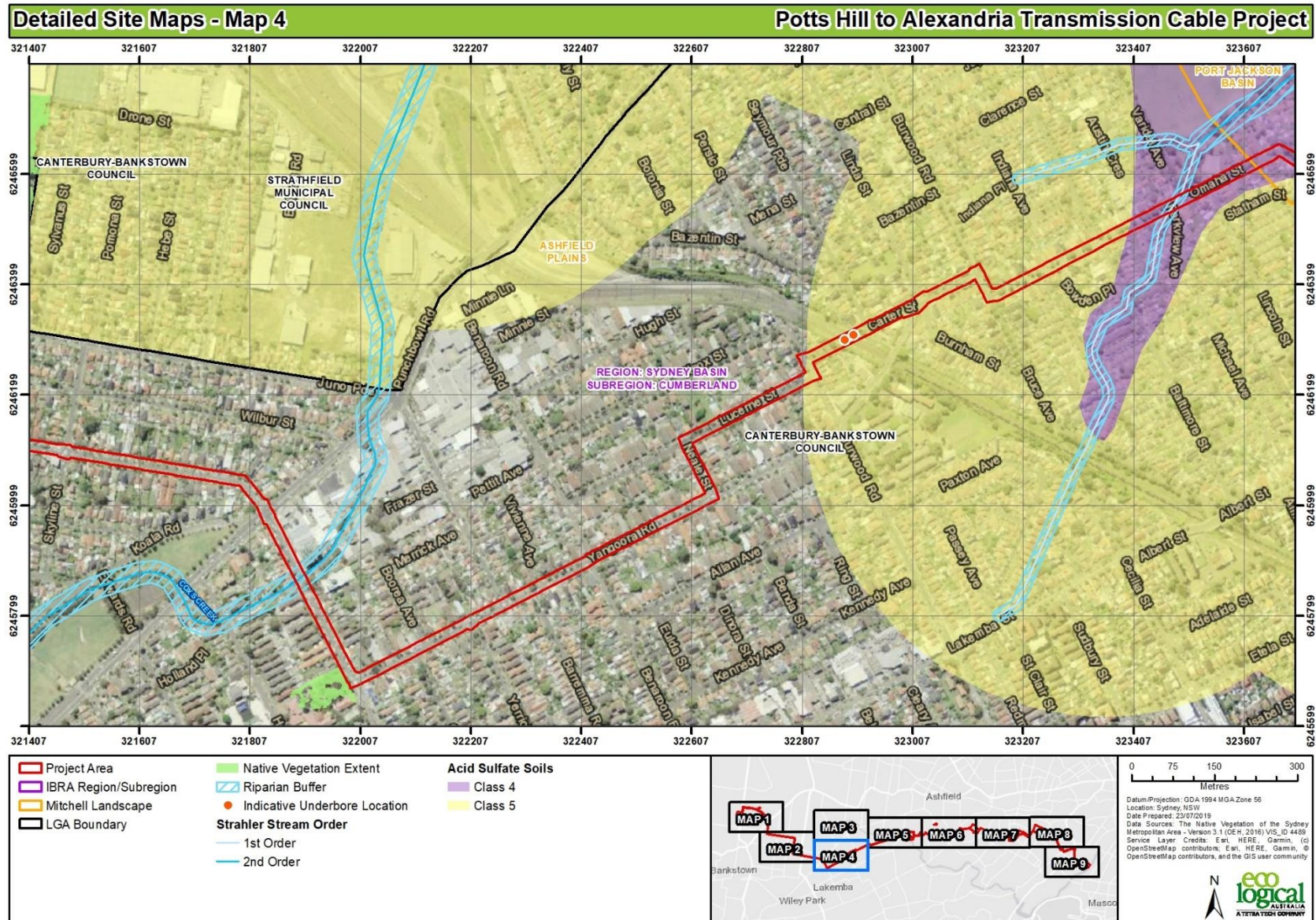


Figure 5: Detailed site map 4

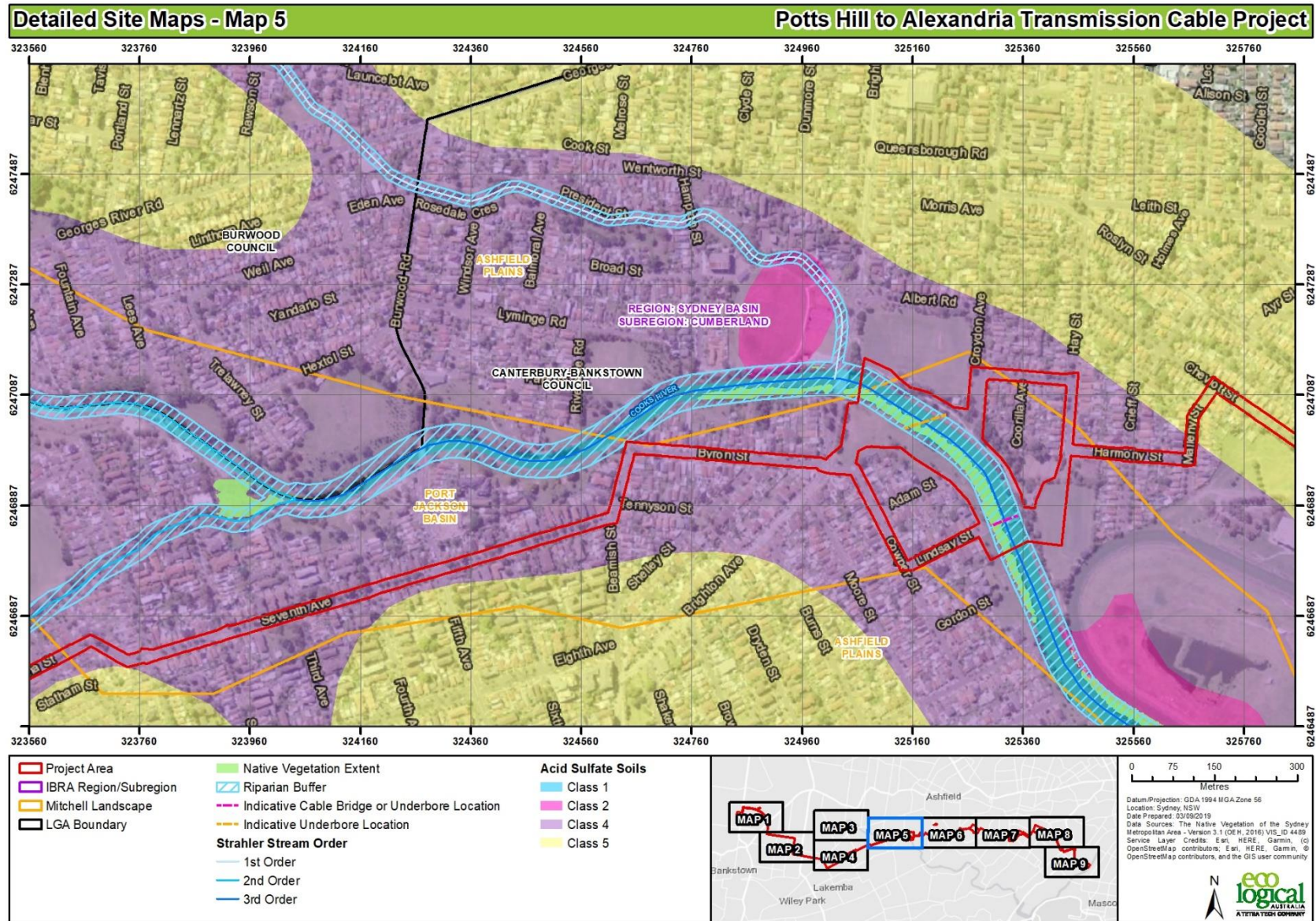


Figure 6: Detailed site map 5

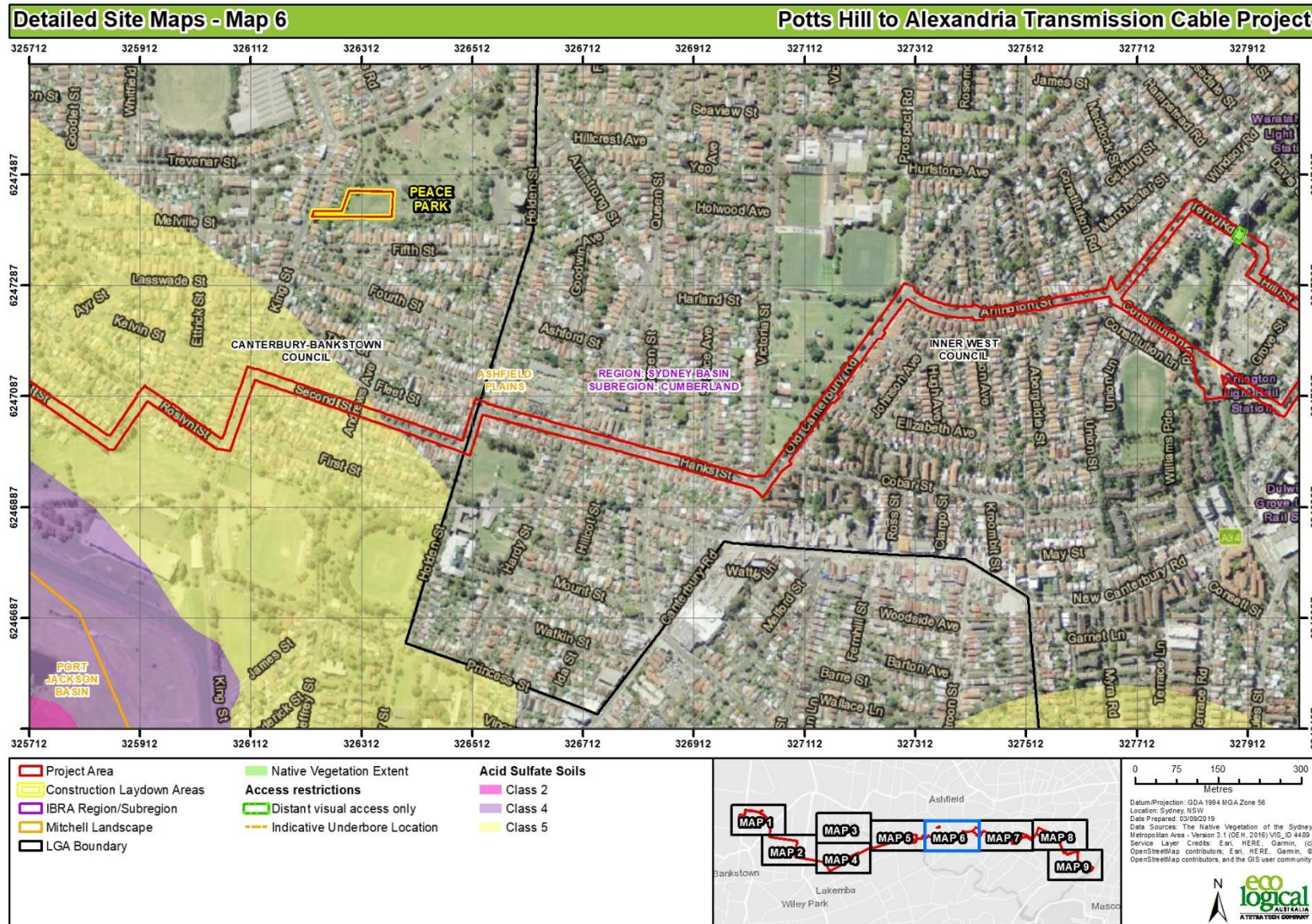


Figure 7: Detailed site map 6

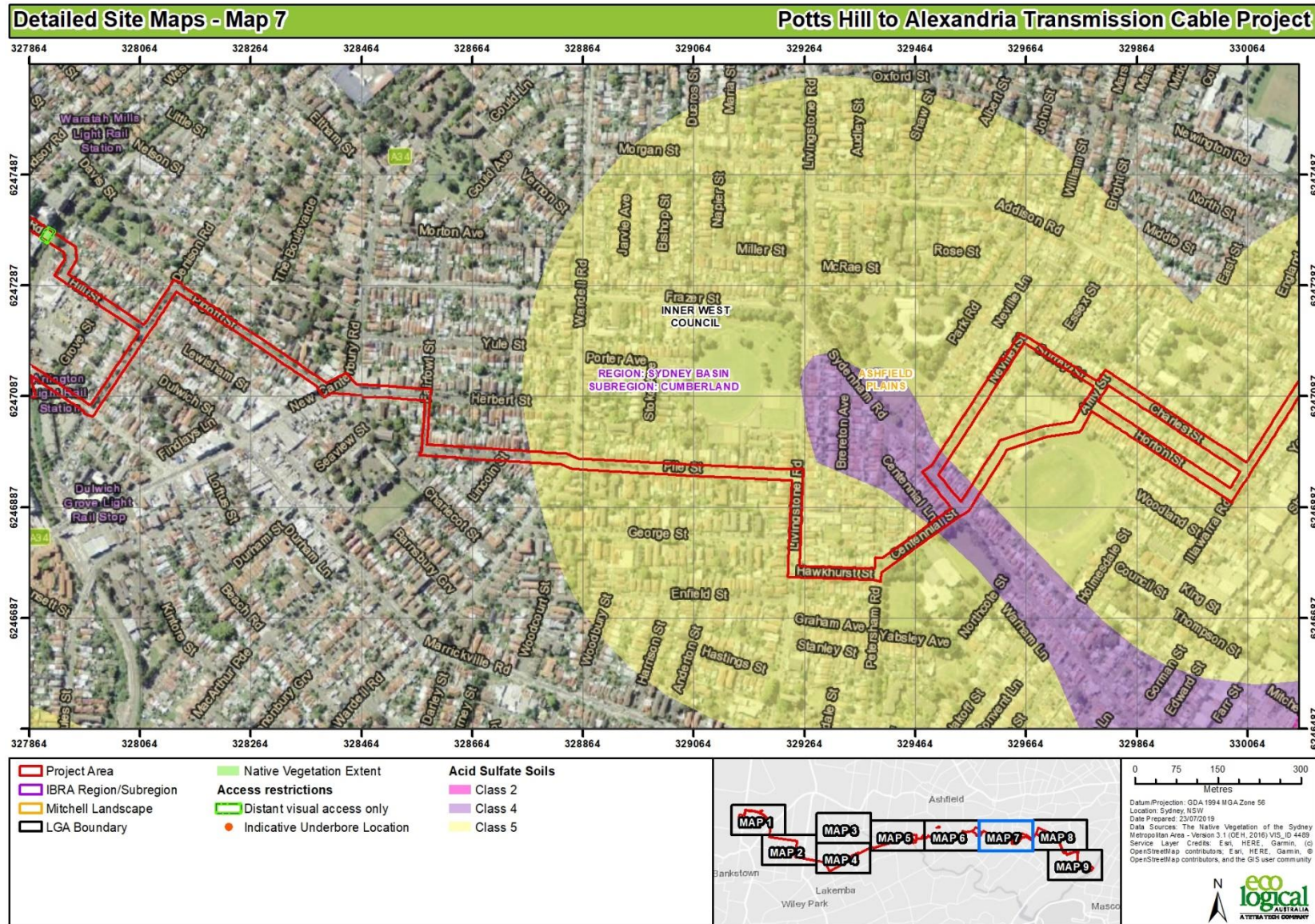


Figure 8: Detailed site map 7

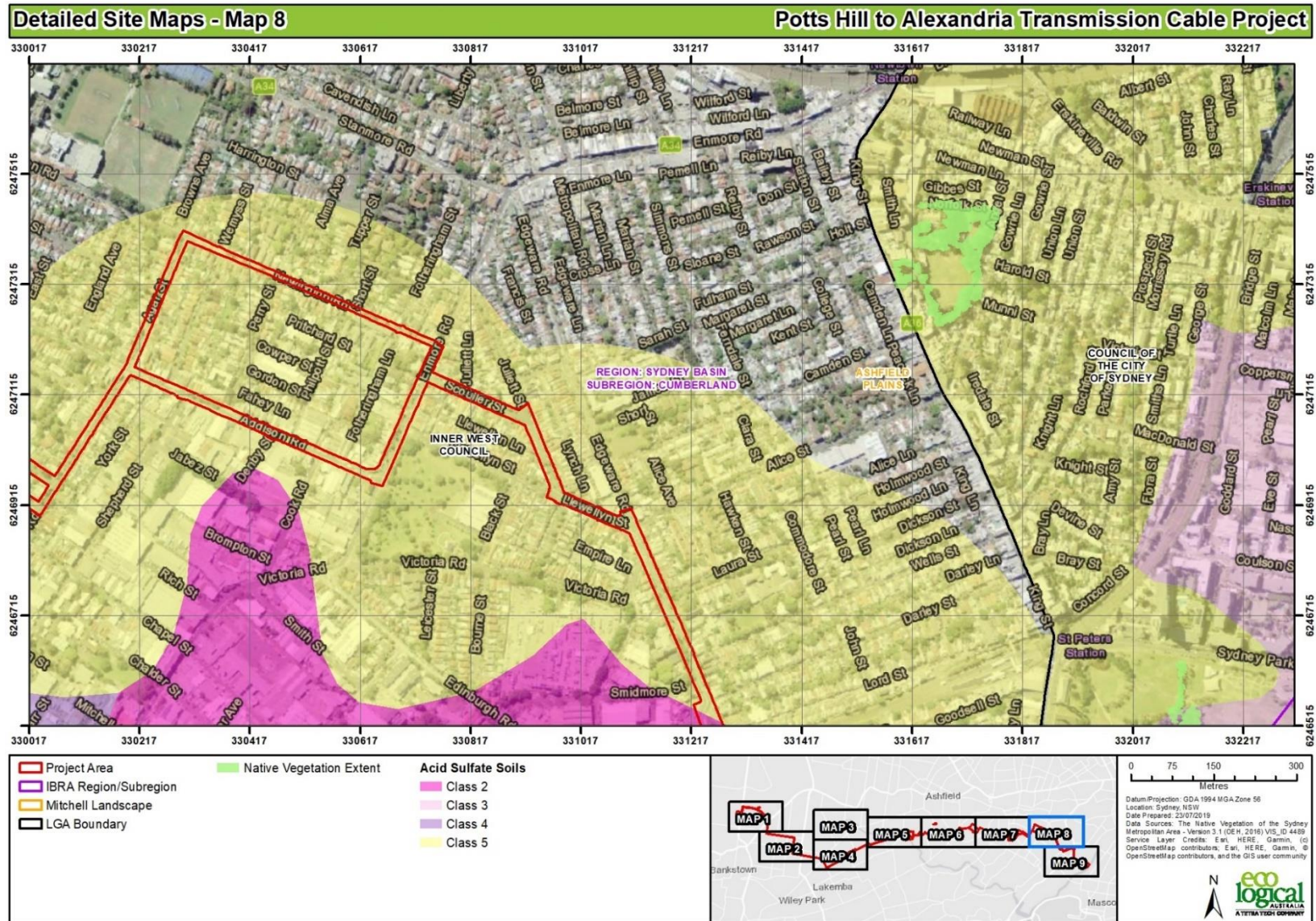


Figure 9: Detailed site map 8

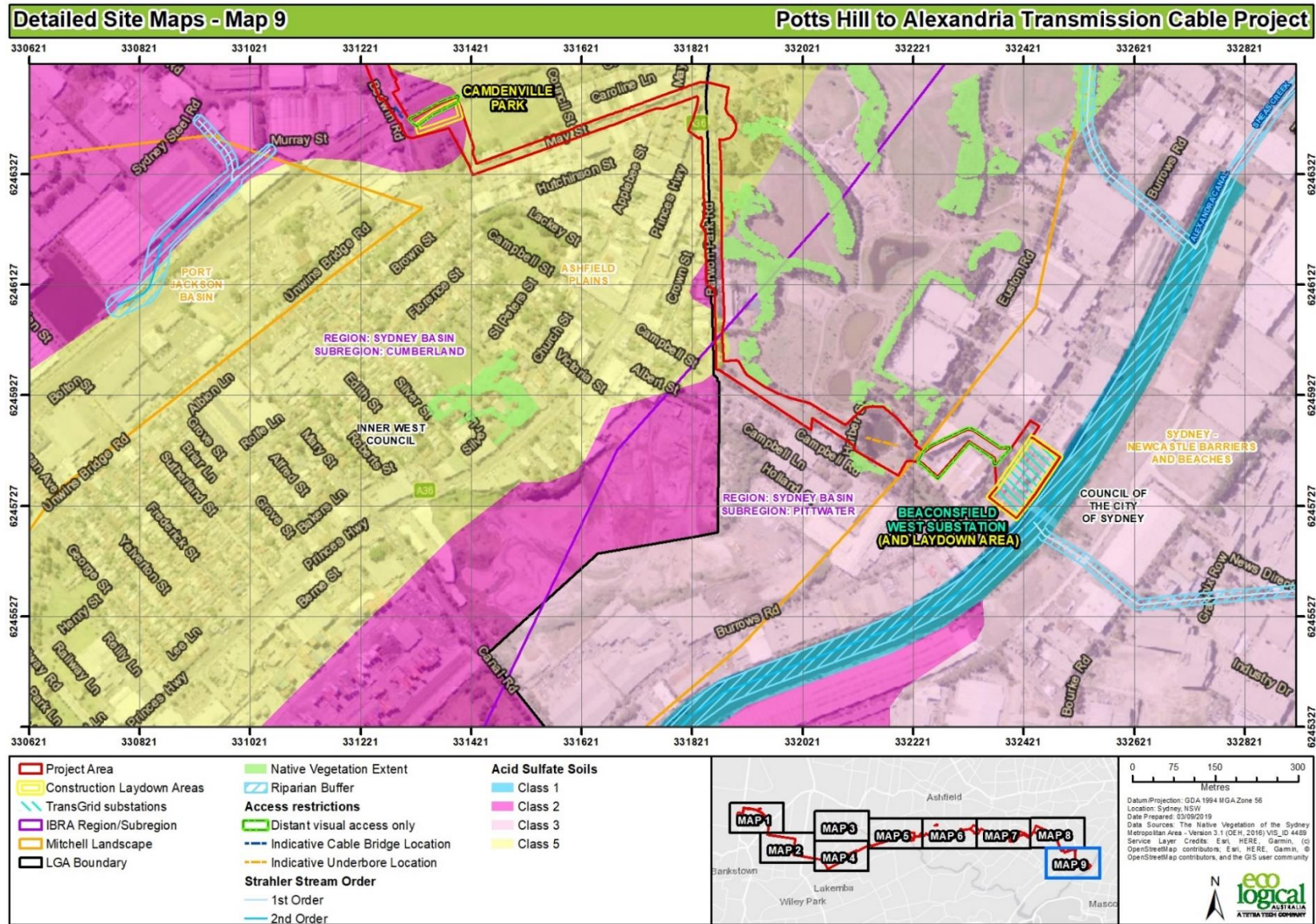


Figure 10: Detailed site map 9

1.2 Legislative context

Table 2: Legislative context

Name	Relevance to the project	Report Section
Commonwealth		
<i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>	<p>The EPBC Act establishes a process for assessing the environmental impact of activities and developments where “Matters of National Environmental Significance” (MNES) may be affected. If an activity has the potential for a significant impact, the activity will require approval from the Commonwealth under Part 9 of the EPBC Act.</p> <p>Potential habitat for one MNES have been identified within the project area; the Grey-headed Flying Fox, listed as Vulnerable under the Act. A Significance Assessment for this species has been prepared in Annexure D of this report in accordance with significant impact guidelines (Department of the Environment, 2013).</p>	Annexure D
State		
<i>Environmental Planning and Assessment Act 1979 (EP&A Act)</i>	<p>The proposed development is State Significant Infrastructure (SSI) and is to be assessed under Part 5.1 of the EP&A Act. SEARs have been issued and require assessment of:</p> <ul style="list-style-type: none"> an assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the <i>Biodiversity Conservation Act 2016</i>, the BAM and documented in a BDAR, unless OEH and DPIE determine that the proposed development is not likely to have any significant impacts on biodiversity values; 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 BAM; and an assessment of the likely impacts on key fish habitat, marine vegetation and threatened species of fish, in accordance with the <i>Fisheries Management Act 1994</i>, and a description of the measures to minimise and rehabilitate impacts. 	This report
<i>Biodiversity Conservation Act 2016 (BC Act)</i>	<p>Section 7.9 of the BC Act states that an application for SSI must be accompanied by a BDAR unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values. This report satisfies this requirement.</p>	This report
<i>Fisheries Management Act 1994 (FM Act)</i>	<p>The objectives of the FM Act are to conserve fish stocks and key fish habitats, conserve threatened species, populations and ecological communities of fish and marine vegetation and to promote ecologically sustainable development. The FM Act also regulates activities involving dredging and/or reclamation of aquatic habitats, obstruction of fish passage, harming marine vegetation and use of explosives within a waterway. In accordance with Part 4, Division 4.7, Section 4.41 (b) of the EP&A Act, applications for separate permits under Sections 201, 205 or 219 of the FM Act are not required for SSI however an assessment of impacts to key fish habitat and marine vegetation is still required.</p>	Annexure F
<i>Local Land Services Amendment Act 2016 (LLS Act)</i>	<p>The LLS Act does not apply to this project.</p>	N/A
<i>Water Management Act 2000 (WM Act)</i>	<p>The Act requires approval for water use (s89), water management works (s90) and for controlled activities on waterfront land (s91). While the project would occur on waterfront land, section 5.23(1)(g) of the EP&A Act states that such approvals are not required for SSI. Therefore, no further approval under the WM Act is required.</p>	N/A

Name	Relevance to the project	Report Section
Planning Instruments		
State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP)	This is not relevant as environmental planning instruments (EPIs) do not apply to State significant infrastructure projects, as per Section 5.22 of the EP&A Act.	N/A
Coastal Management SEPP 2018	The Coastal Management SEPP 2018 is not relevant as environmental planning instruments (EPIs) do not apply to State significant infrastructure projects, as per Section 5.22 of the EP&A Act.	N/A
SEPP 44 – Koala Habitat Protection	The proposed development is not located within an LGA to which SEPP 44 applies.	N/A
Local Environment Plans:	Under s5.22(2) of the EP&A Act, environmental planning instruments (including Local Environment Plans) do not apply in respect of State significant infrastructure.	N/A
<ul style="list-style-type: none"> • Strathfield; • Canterbury-Bankstown; • Inner West; and • City of Sydney 		

1.3 Landscape features

In accordance with Chapter 4 of the BAM, the BDAR is required to identify landscape features such as:

- Interim Biogeographic Regionalisation for Australia (IBRA) region;
- IBRA sub-region;
- Mitchell Landscape;
- rivers and streams; and
- the extent of native vegetation in the area assessed i.e. the project area and 1,500 metre buffer around the project area.

The landscape features of the project area are shown in Figure 11: Landscape features.

1.3.1 Method applied

Although most of the project is linear, the inclusion of temporary laydown areas adds potential multiple fragmented impacts. Accordingly, it was determined that the 'site-based development' rather than the 'linear shaped development' BAM definition best fits the project. Consequently a 1,500 m buffer required for a 'site-based development' was applied to the outside boundary of the project area to assess the extent of native vegetation cover.

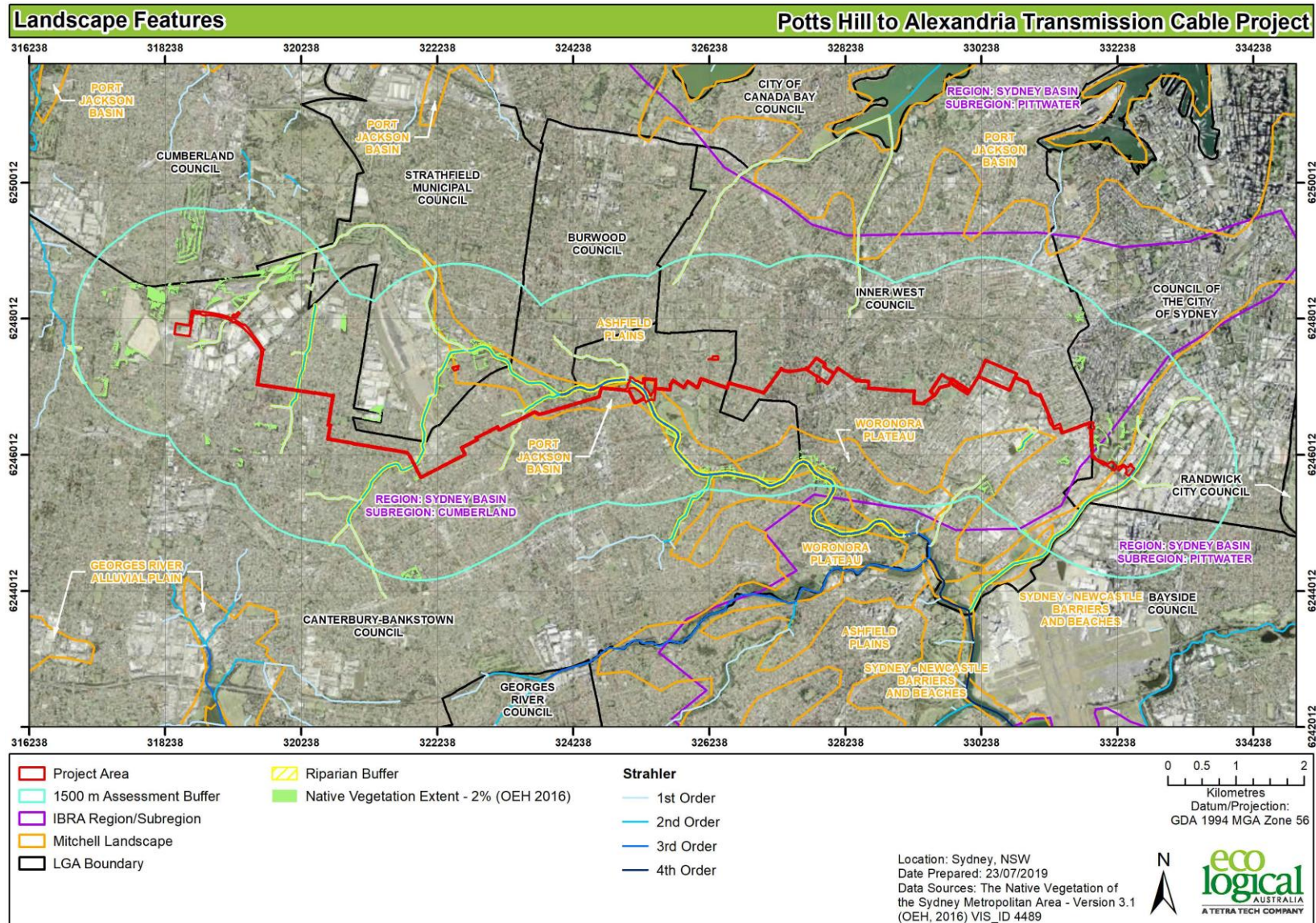


Figure 11: Landscape features

1.3.2 IBRA regions and subregions

The project area falls within the IBRA region and subregions as outlined in Table 3 and Table 4.

Table 3: IBRA regions

IBRA region	Area within project area (ha)
Sydney Basin	58.34

Table 4: IBRA subregions

IBRA subregion	Area within project area (ha)
Pittwater	3.38
Cumberland	54.96

1.3.3 Rivers and streams

The project area contains rivers and streams as outlined in Table 5.

Table 5: Rivers and streams

River/stream	Location	Strahler Stream Order	Riparian buffer (m) as per BAM Table 14)
Cooks River	Muir Road	1	10
Un-named	Rawson Road	2	20
Un-named	Omaha Street/Varidel Avenue	1	10
Coxs Creek	Wangee Road	2	20
Cooks River	Lees Park	3	30

1.3.4 Wetlands

The project area does not contain any natural wetlands. A waterbody is situated within the project area in Sydney Park, but this is a constructed waterbody which is not listed in the Directory of Important Wetlands of Australia (DIWA) or the Coastal Management SEPP. The waterbody also does not confirm to a Plant Community Type identified in the NSW BioNet Vegetation Classification System and has therefore not been included in wetland mapping for the project area.

1.3.5 Connectivity features

The project area contains limited connectivity features. The highly fragmented nature of the mapped native vegetation extent (OEH 2016) limits ecological connectivity and the movement of threatened species would be restricted to highly mobile species.

1.3.6 Areas of geological significance and soil hazard features

Acid sulphate soils occur at five locations within the project area as detailed in Table 6.

Table 6: Acid sulfate soil risk and class

Acid sulfate soil location	Probability	Acid sulfate soil risk classification
Along Omaha Street east of Baltimore Street, Seventh Avenue Campsie to Hay Street/Harmony Street intersection in Canterbury (2.2 kilometre length)	Low	Class 4
Cooks River (35 metre length)	High	Class 1
Centennial Street, Sydenham Road and Neville Street, Marrickville (130 metre length)	Low	Class 4
Transmission cable route along Edgeware Road between Darley Street, Marrickville and May Street, St Peters (360 metre length)	Low	Class 2
Princes Highway to Alexandra Canal (1.3 kilometre length)	Low	Class 3

The project area does not contain areas of geological significance (karst, caves, crevices, cliffs).

1.3.7 Percent native vegetation cover in the landscape

The current percent native vegetation cover in the landscape (within the project area and within a 1,500 metre buffer around the project area) was assessed in a Geographic Information System (GIS) using aerial imagery sourced from SIX Maps using increments of 5%. The results of this analysis are shown in Table 7.

Table 7: Percent native vegetation cover in the landscape

Area of native vegetation in the project area and a 1,500 m buffer of the project area	Percentage of native vegetation cover within the project area and a 1,500 m buffer of the project area
95.2 ha	1.56 %

1.3.8 Patch size

The patch size is an area of intact native vegetation that occurs within the project area and includes native vegetation with a gap of less than 100 metres from the next area of moderate to good condition native vegetation (or less than 30 metres for non-woody ecosystems). The patch size is 8.72 hectares.

1.4 Native vegetation

1.4.1 Survey effort

Vegetation survey in line with BAM requirements was undertaken by Toni Frecker and Stacey Wilson on 29 March 2018, Toni Frecker on 19 and 20 April 2018; Danielle Adams-Bennett on 5 July 2018; and Kirsten Velthuis between 27 and 31 May 2019.

Surveys included:

- rapid vegetation validation along the project area for the identification of street trees and planted native and non-native vegetation;
- two vegetation integrity survey (VIS) plots at Mildura Reserve in Campsie to identify PCTs and TECs within the project area, in accordance with the BAM; and

- identification of any habitat that could be potential habitat for threatened fauna species, such as the presence of hollow-bearing trees.

A distant visual assessment was undertaken in three small areas within the project area which were inaccessible:

- within the Dulwich Hill Light Rail (DHLR) corridor near Terry Street;
- between a construction laydown area and a rail corridor near Camdenville Park; and
- within an industrial estate off Euston Rd, Beaconsfield.

Survey findings are shown in Figure 12 to Figure 36.

1.4.1.1 Urban exotics and natives

The baseline OEH vegetation mapping data for vegetation (OEH 2016) within the project area identifies a class of vegetation labelled '*urban exotics and natives*' in several generally disconnected patches throughout the project area. The OEH label '*urban exotics and natives*' is applied to vegetation patches where there is evidence of both exotic and native species in the upper or lower strata. Typically, these areas include vegetation such as backyard trees, street trees, gardens and median strips.

The vegetation within the project area is largely modified and disturbed containing exotic plant species such as *Lagerstroemia indica* (Crepe Myrtle), *Fraxinus griffithii* (Evergreen Ash), *Pyrus calleryana* (Callery Pear) and *Triadica sebifera* (Chinese Tallow); and native tree species such as *Lophostemon confertus* (Brush Box), *Callistemon viminalis* (weeping Bottlebrush); *Tristaniaopsis laurina* (Kanooka), and various *Melaleuca* (Paperbark) and *Eucalyptus* (Eucalypt) species. This mix of urban exotic and native species occur as street trees and as scattered landscape plantings within urban park areas such as Sydney Park and Mildura Reserve. In these parks, as well as in Cooke Park and Peace Park, groundcover vegetation is generally restricted to mostly exotic mown lawn grass, such as *Cenchrus clandestinum* (Kikuyu), *Cynodon dactylon* (Couch) and *Paspalum dilatatum* (Paspalum). This vegetation has been validated during the rapid validation survey as '*urban exotics and natives*', keeping the class label in line with OEH labelling. Most of the vegetation (9.9 hectares) within the project area falls under this class of vegetation. Trees within this class have been further assessed for their retention value in the Potts Hill to Alexandria Transmission Cable Route Arboriculture Assessment Report (ELA 2019). Remaining vegetation falls within PCTs, as described in Section 1.4.1.2 and Section 1.4.1.3.

1.4.1.2 PCT 1281 Sydney Turpentine-Grey Ironbark Open Forest on shale in the lower Blue Mountains and Sydney Basin Bioregion (unvalidated)

During the rapid vegetation validation survey, a small area of native vegetation was identified to occur within the project area at Dulwich Hill, between Terry Road and the DHLR (Figure 26). The area is associated with the Johnson Park Bushcare site and has been planted with native vegetation. Inner West Environment Group (2019) encourages planting of the Johnson Park Bushcare site to include species associated with Sydney Turpentine-Ironbark Forest (STIF). STIF is also a TEC listed as Critically Endangered under the BC Act and EPBC Act. The native vegetation is not mapped as a PCT in the OEH baseline mapping data (OEH 2016).

The Johnson Park Bushcare site could not be accessed during the survey due to its location within the DHLR corridor, and hence no quantitative survey was undertaken. Based on distant visual assessment and on a desktop review of plantlistings of the Johnson Park Bushcare site (Inner West Environment

Group, 2019), this vegetation has been assigned as PCT 1281 'Sydney Turpentine-Grey Ironbark Open Forest on shale in the lower Blue Mountains and Sydney Basin Bioregion (unvalidated)' as a best fit PCT. The area of PCT 1281 is around 0.2 ha.

It is considered unlikely that vegetation within the bushcare site would meet the TEC STIF criteria, as the vegetation consists of planted rather than remnant vegetation and lacks a canopy. The focus for planting in the bushcare site has been the creation of small bird habitat, focussing on a native grass and shrub layer (Inner West Environment Group, 2019).

1.4.1.3 PCT 920- Mangrove Forest in the estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

The baseline OEH vegetation mapping data for vegetation (OEH 2016) identified an area of native vegetation on the southern bank of Cooks River in Campsie as 'Estuarine Mangrove Forest'. Two BAM survey plots were undertaken in accordance with the BAM methodology. The vegetation has been assigned to PCT 920 'Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion' as a best fit PCT (Table 8 and Figure 37: Vegetation zones and plot locations). Justification for the selection of this PCT is provided below in Table 8.

Six isolated mangrove plants identified on the northern bank of the Cooks River have not been included in this PCT as these were seedling or juvenile plants of less than 1.5 metres height, growing in isolation from one another.

Table 8: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area (ha)	Percent of PCT cleared as identified in Bionet Vegetation Classification
920	Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangrove Swamps	Saline Wetlands	0.76	86

Table 9: PCT selection justification

PCT ID	PCT Name	PCT selection justification	Species relied upon for identification of vegetation type and relative abundance
920	Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	<p>Potential PCTs within the IBRA region which include Mangroves are PCTs 916, 920, 1746 and 1747. Of these, PCT 920 is the only one occurring within IBRA subregion Cumberland, where the project is located. Additionally, <i>Avicennia marina</i> (Grey Mangrove) is the only native species identified in the BAM plots, forming a pure stand with no other species in the canopy or understorey. This meets the description of PCT 920 which states:</p> <p><i>'Stands of mangroves form a low closed to open forest on mudflats in Sydney's harbour, river coves and estuaries. (..) Grey mangrove (Avicennia marina) is the taller and more common [of the two-mangrove species in Sydney], often seen in pure stands. Stands of grey mangrove comprise very few</i></p>	<i>Avicennia marina</i>

PCT ID	PCT Name	PCT selection justification	Species relied upon for identification of vegetation type and relative abundance
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species other than the canopy, with the understorey mostly an open mudflat sometimes with scattered saltmarsh herbs.'

Bionet Vegetation Classification lists PCT 920 as a 'partially subset of' Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as Endangered under the BC Act and Vulnerable under the EPBC Act. Bionet Vegetation Classification also lists PCT 920 as 'partially containing' the Shorebird Community occurring on the relict tidal delta sands at Taren Point, which is listed as Endangered under the BC Act. However, PCT 920 within the project area does not meet the criteria of any of the above listed TECs under the BC or EPBC Act as detailed in Table 9.

Table 10: Assessment of PCT 920 against TEC criteria

TEC Name	Listing	Selection criteria	Features of PCT 920 within project area:	Does PCT 920 within project area meet TEC listing?
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	BC Act	Coastal Saltmarsh is a mostly treeless plant community recognised by a low mosaic of succulent herbs, salt tolerant grasses and sedges, found in the tidal flats of estuaries and on edges of intermittently opened coastal lagoons (Office of Environment and Heritage, 2007).	Contains dense stand of trees.	No
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (also referred to as Subtropical and Temperate Coastal Saltmarsh).	EPBC Act	The ecological community consists of dense to patchy areas of mainly salt-tolerant vegetation including grasses, herbs, sedges and shrubs. Characteristic plant species include <i>Gahnia filum</i> , <i>G. trifida</i> , <i>Juncus kraussii</i> , <i>Samolus repens</i> , <i>Sarcocornia quinqueflora</i> , <i>Sporobolus virginicus</i> , <i>Suaeda australis</i> , <i>Tecticornia pergranulata</i> , <i>T. arbuscula</i> , <i>Triglochin striata</i> , <i>Wilsonia backousei</i> and <i>W. rotundifolia</i> (Commonwealth of Australia, 2013).	Contains none of the characteristic plant species of the TEC.	No
Shorebird Community occurring on the relict tidal delta sands at Taren Point	BC Act	Community of shorebirds that uniquely occurs on the relict marginal shoal of the Georges River that occurs between Taren Point and Shell Point in Botany Bay (NSW Scientific Committee, 1998).	Not located between Taren Point and Shell Point, Botany Bay	No

1.4.2 Vegetation integrity assessment

A vegetation integrity assessment using the BAM Credit Calculator was undertaken for PCT 920 and the results are outlined in Table 11.

Table 11: Vegetation integrity

Vegetation Zone	PCT ID	Condition	Area (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
1	920	Moderate	0.76	14.7	94.4	N/A	37.3

1.4.3 Use of local data

No local data was used.

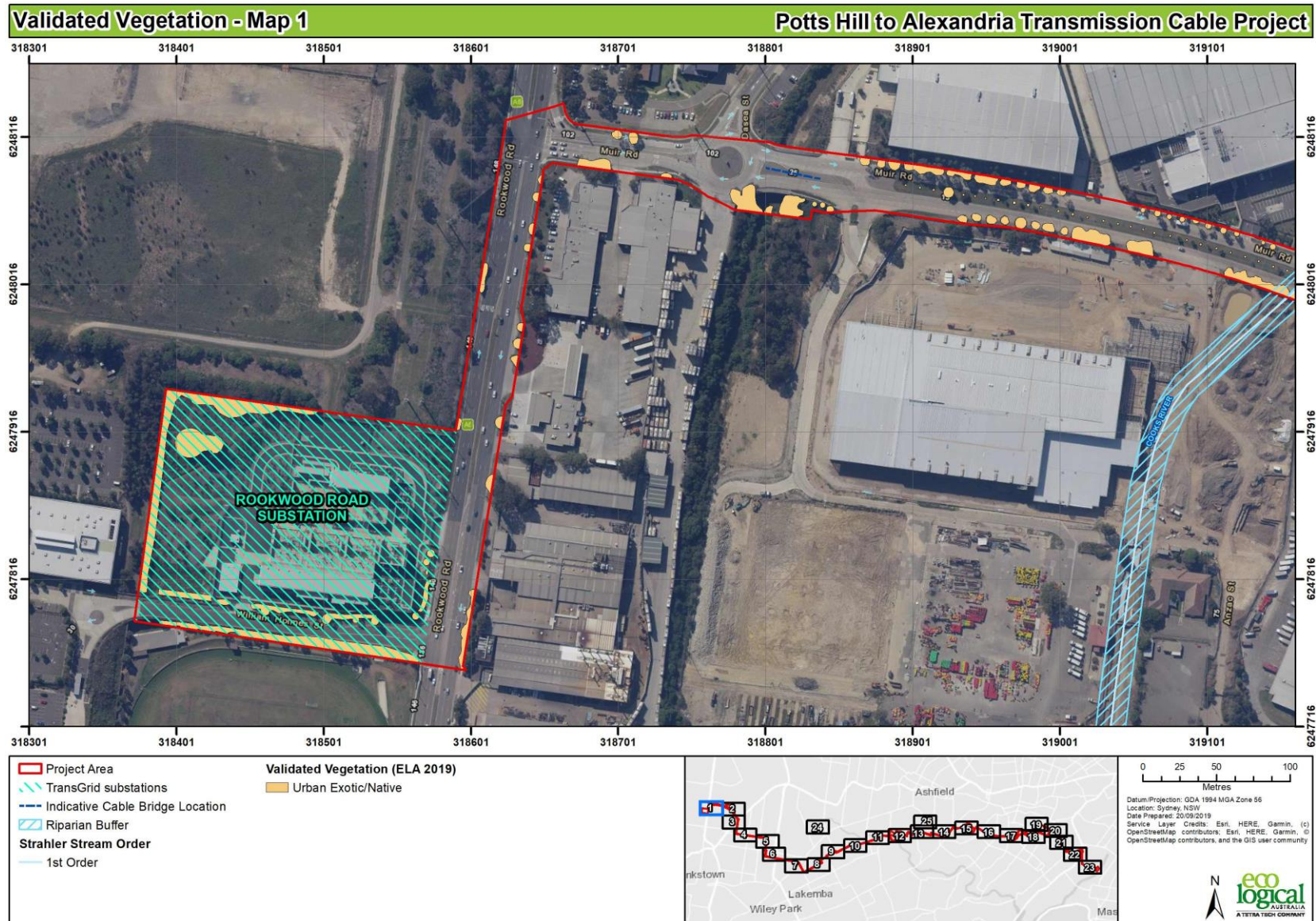


Figure 12: Validated vegetation map 1

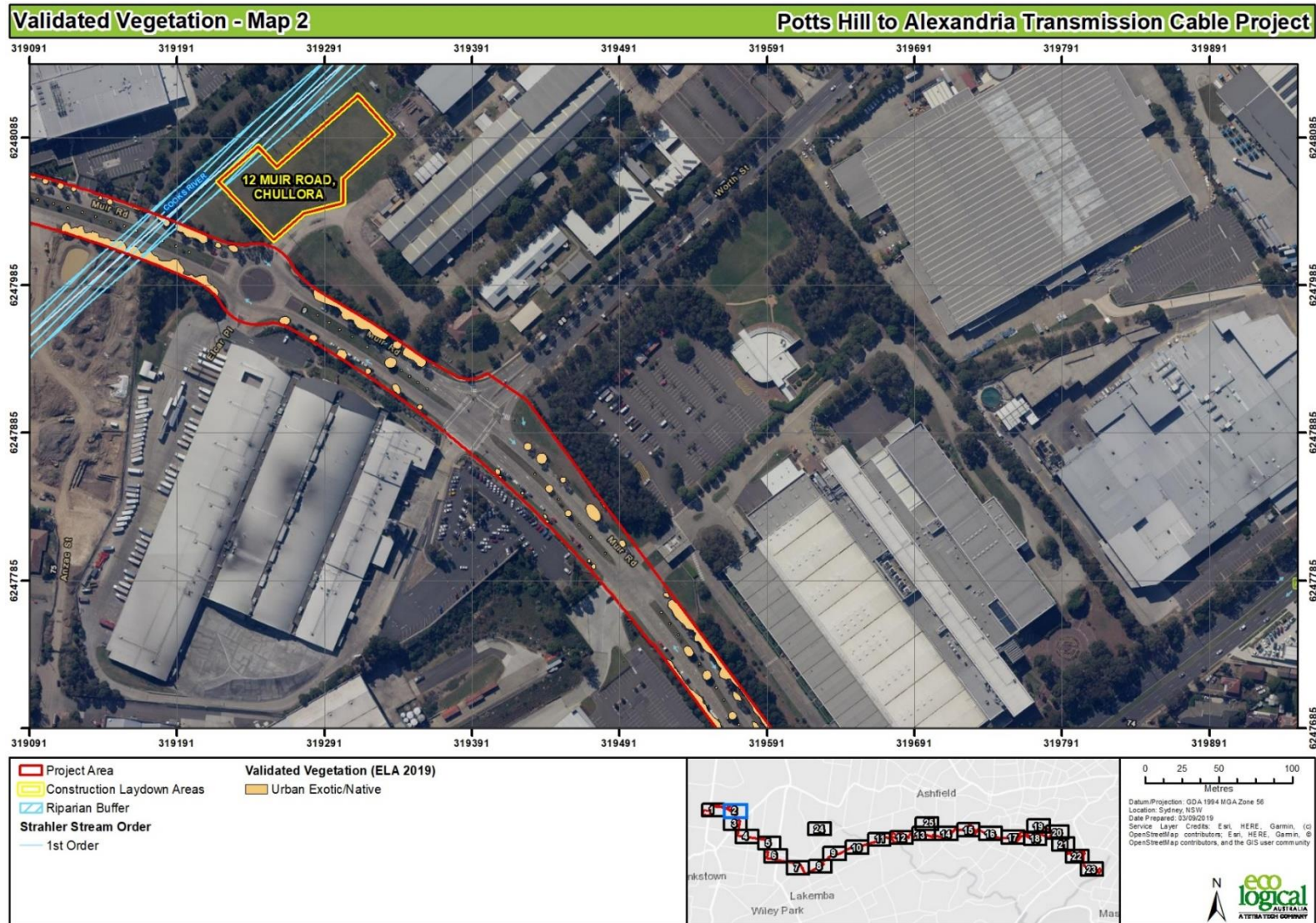


Figure 13: Validated vegetation map 2

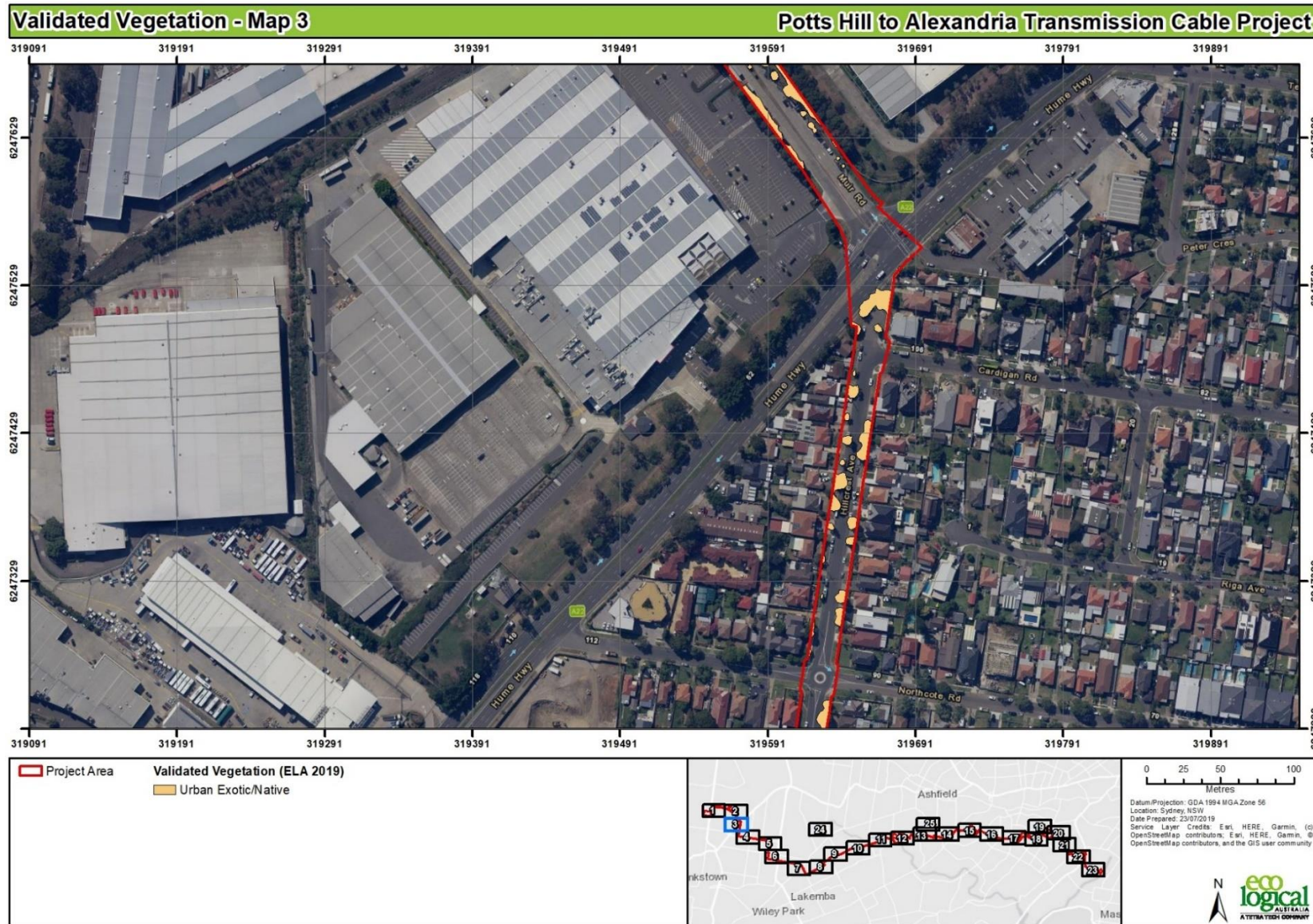


Figure 14: Validated vegetation map 3

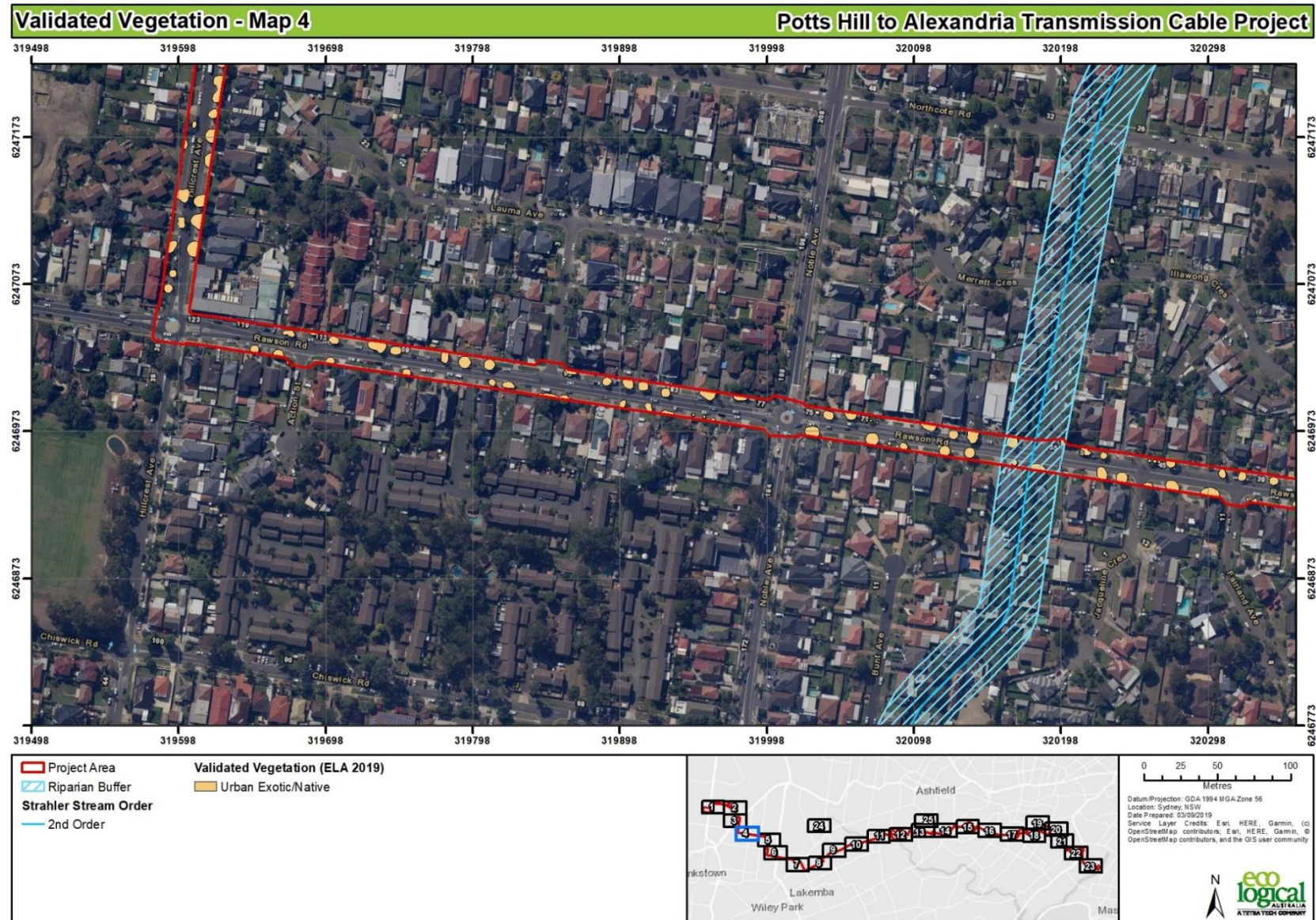


Figure 15: Validated vegetation map 4

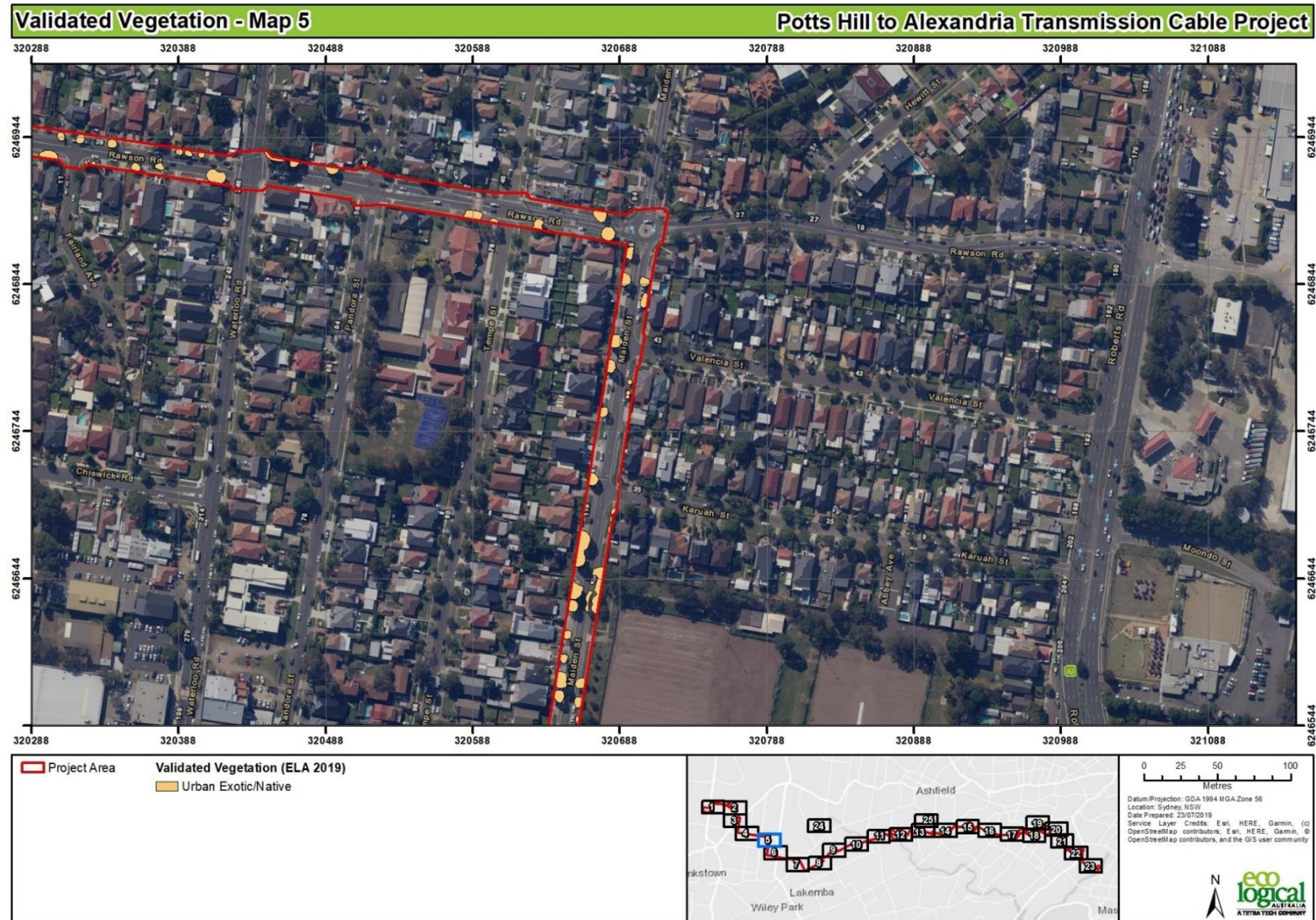


Figure 16: Validated vegetation map 5

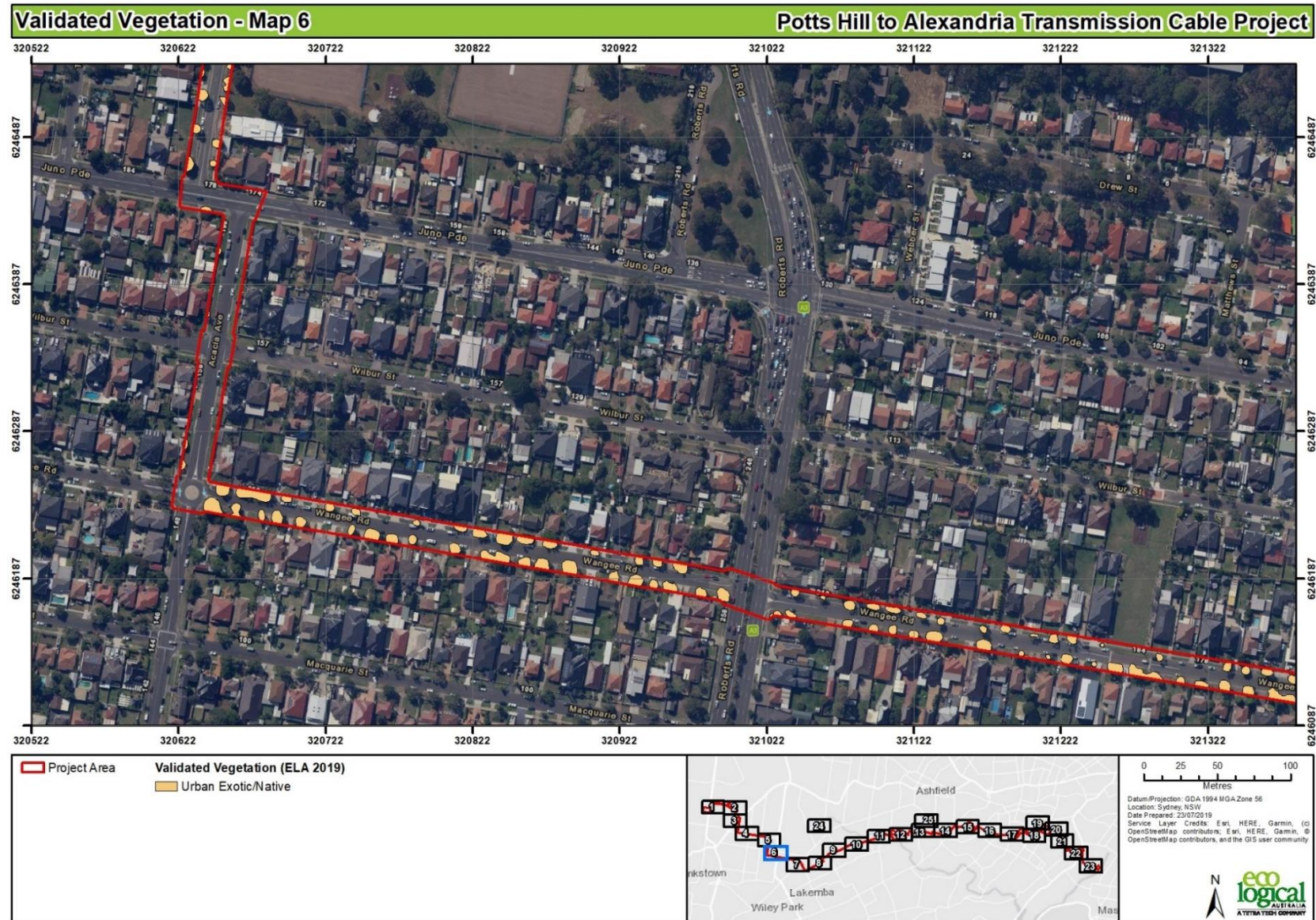


Figure 17: Validated vegetation map 6

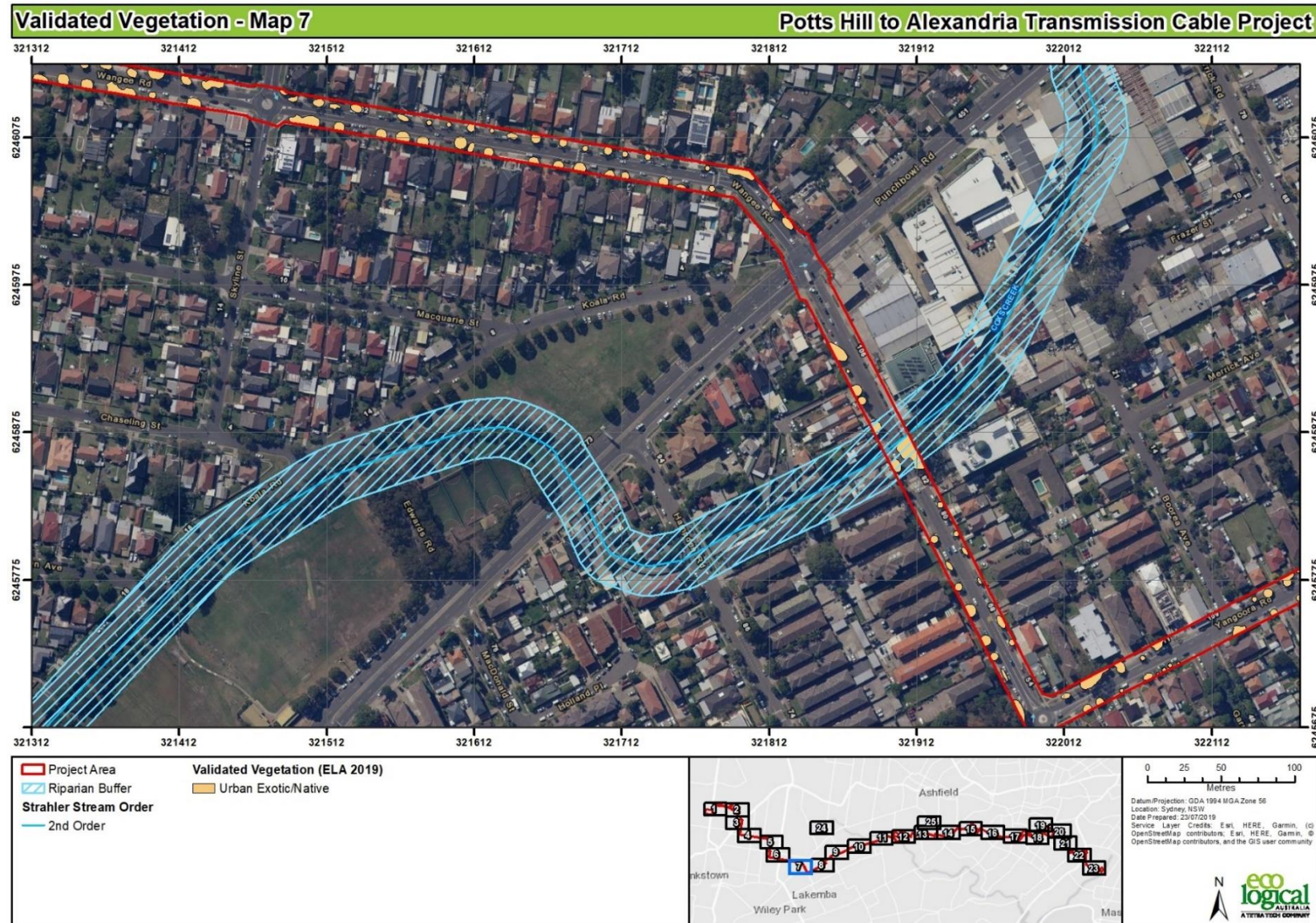


Figure 18: Validated vegetation map 7

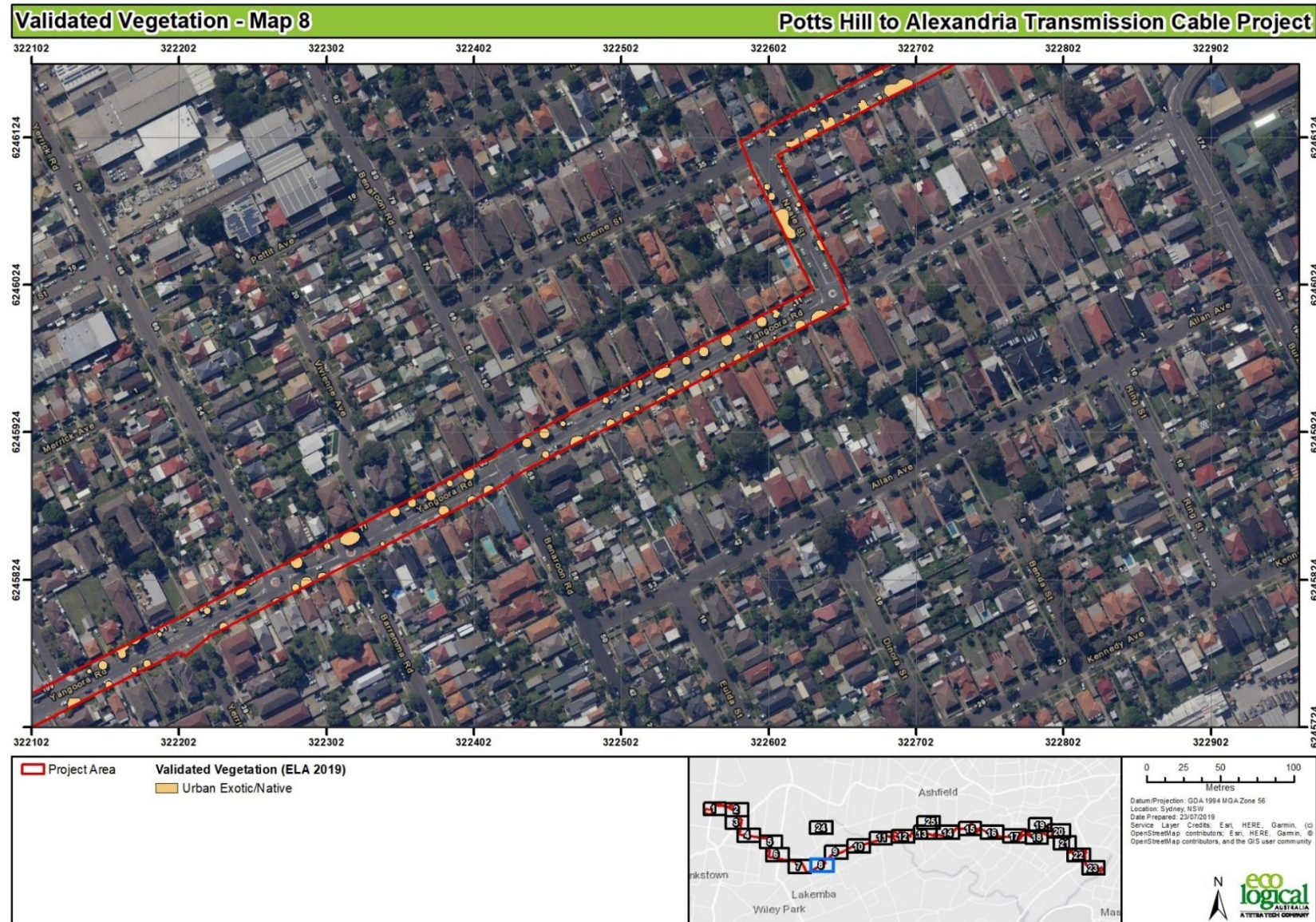


Figure 19: Validated vegetation map 8



Figure 20: Validated vegetation map 9

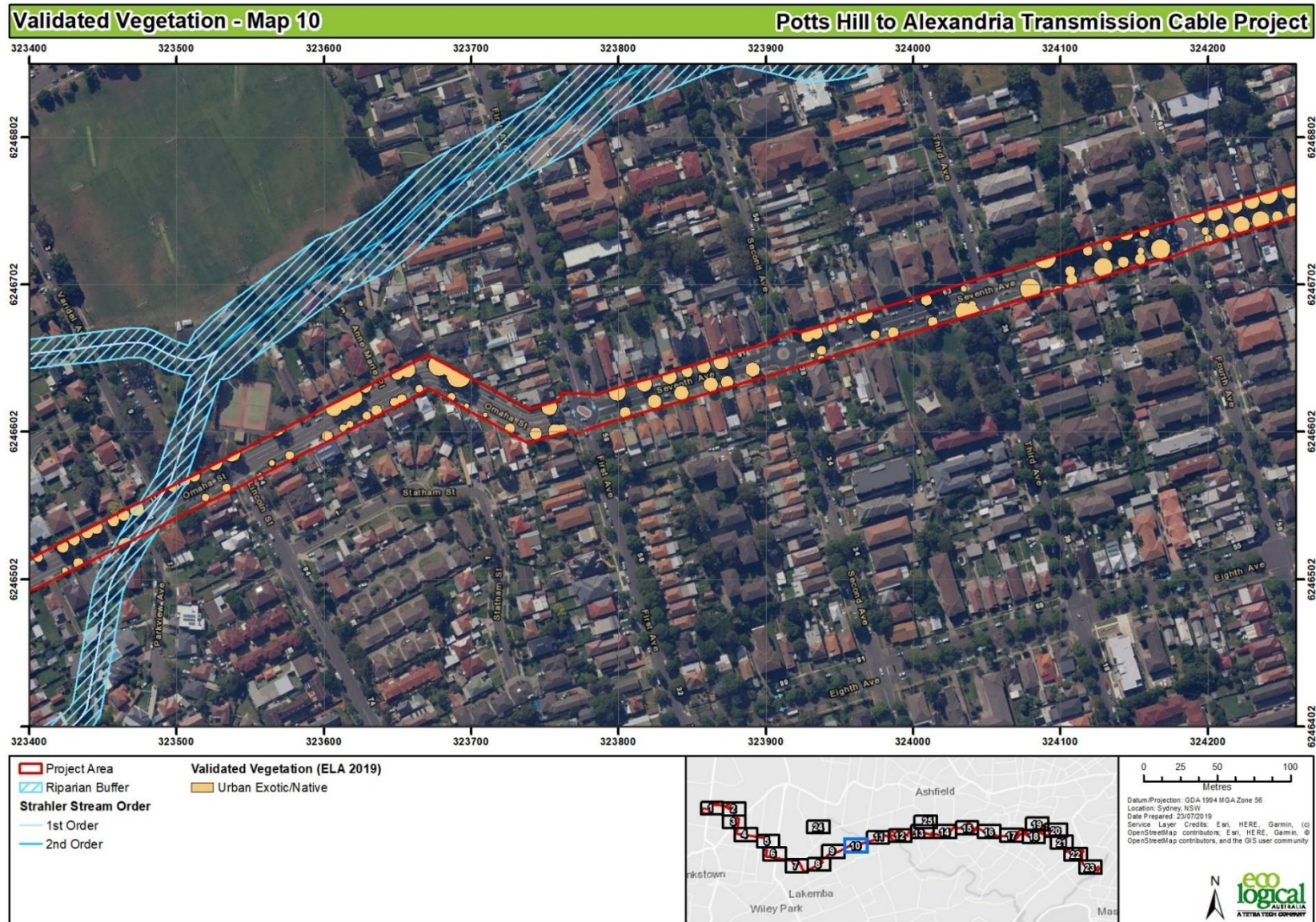
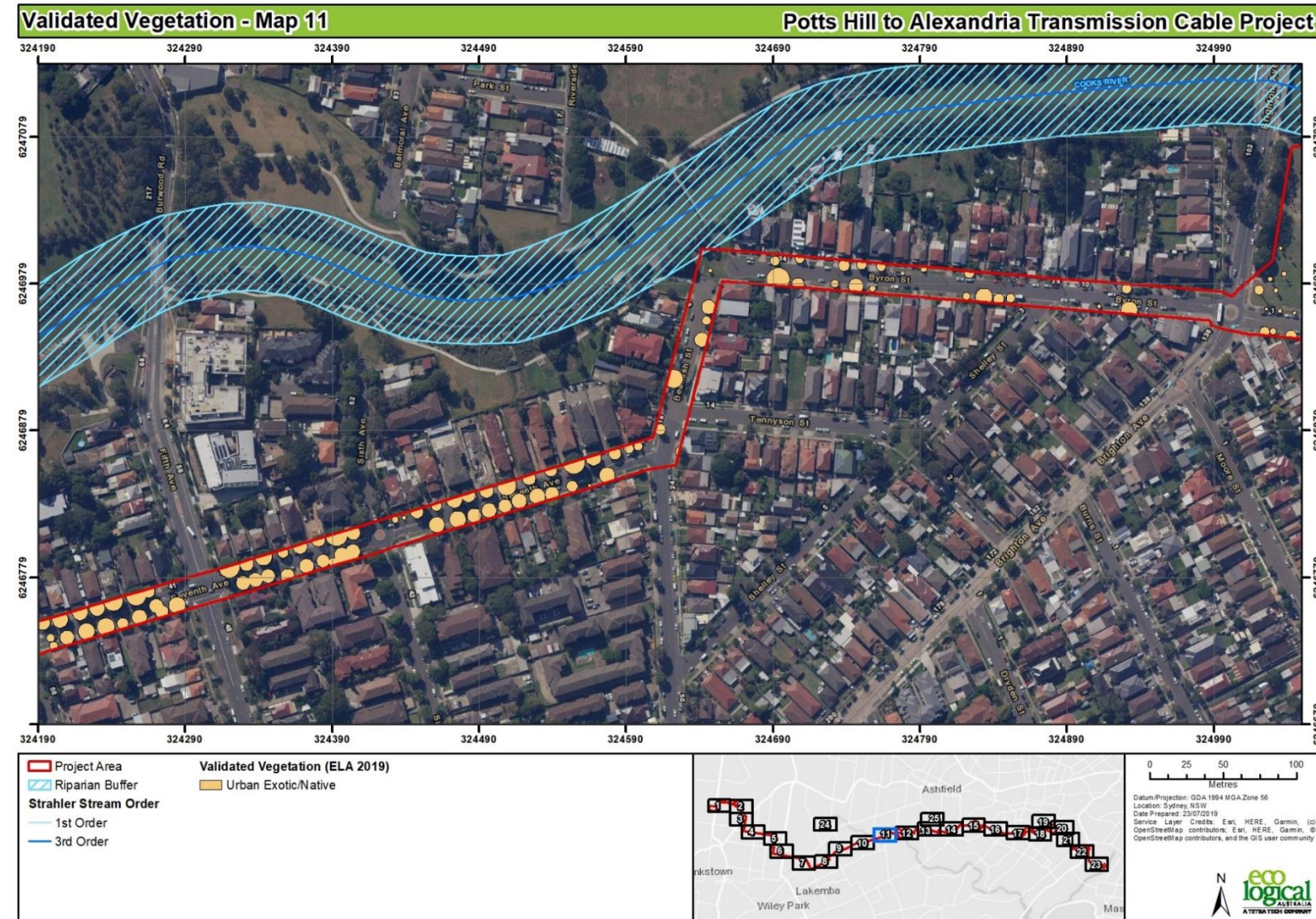


Figure 21: Validated vegetation map 10



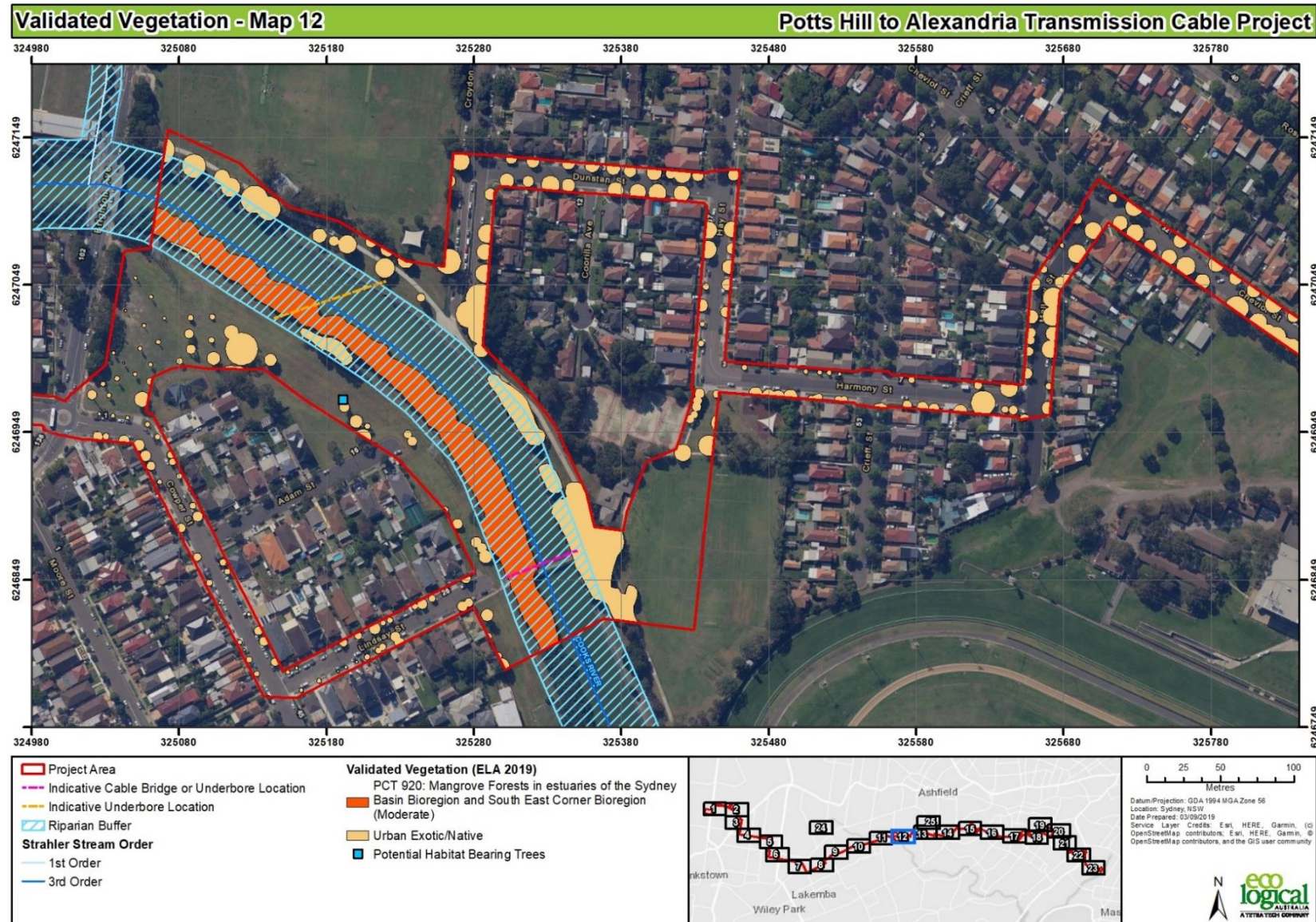


Figure 23: Validated vegetation map 12



Figure 24: Validated vegetation map 13

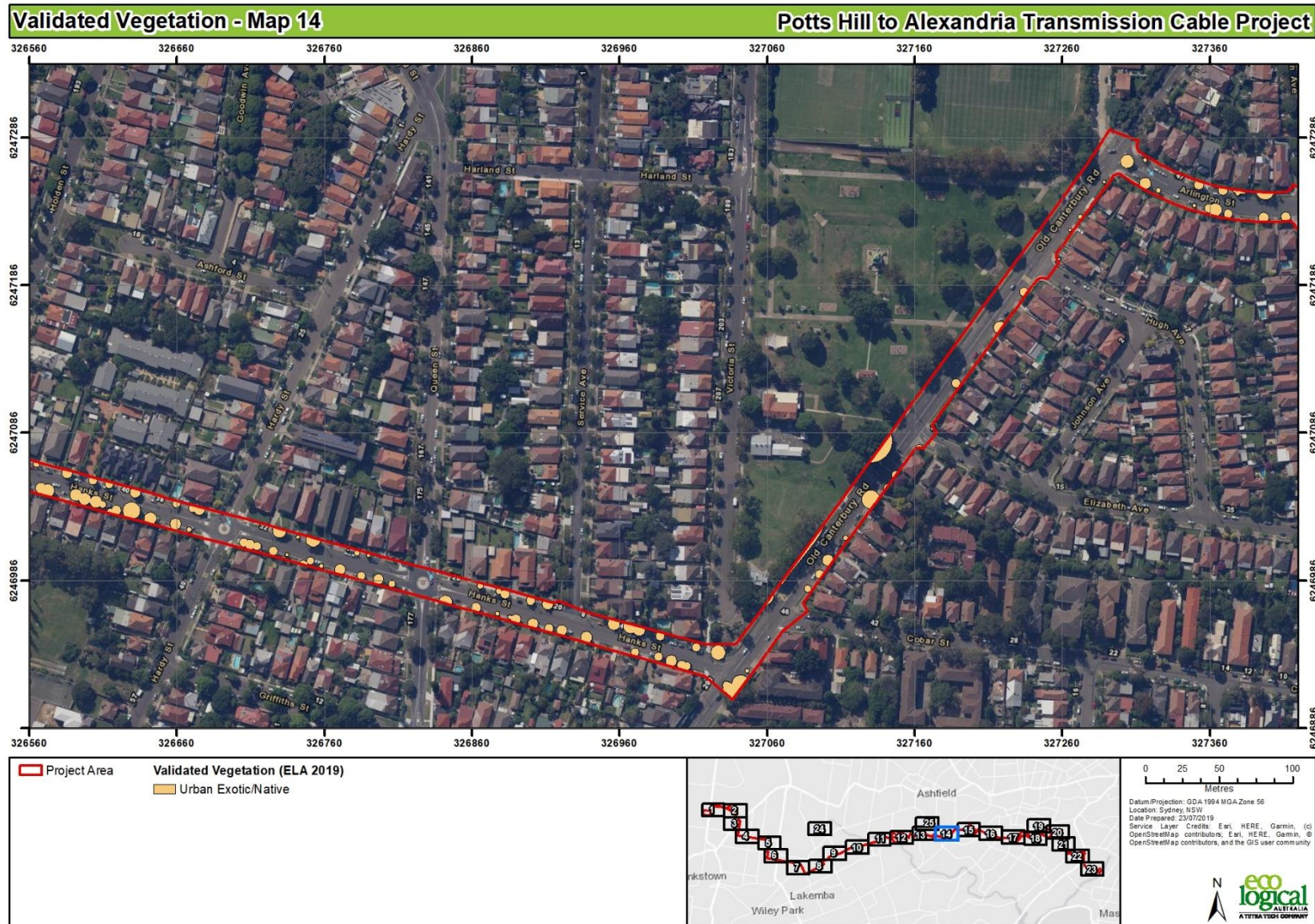


Figure 25: Validated vegetation map 14

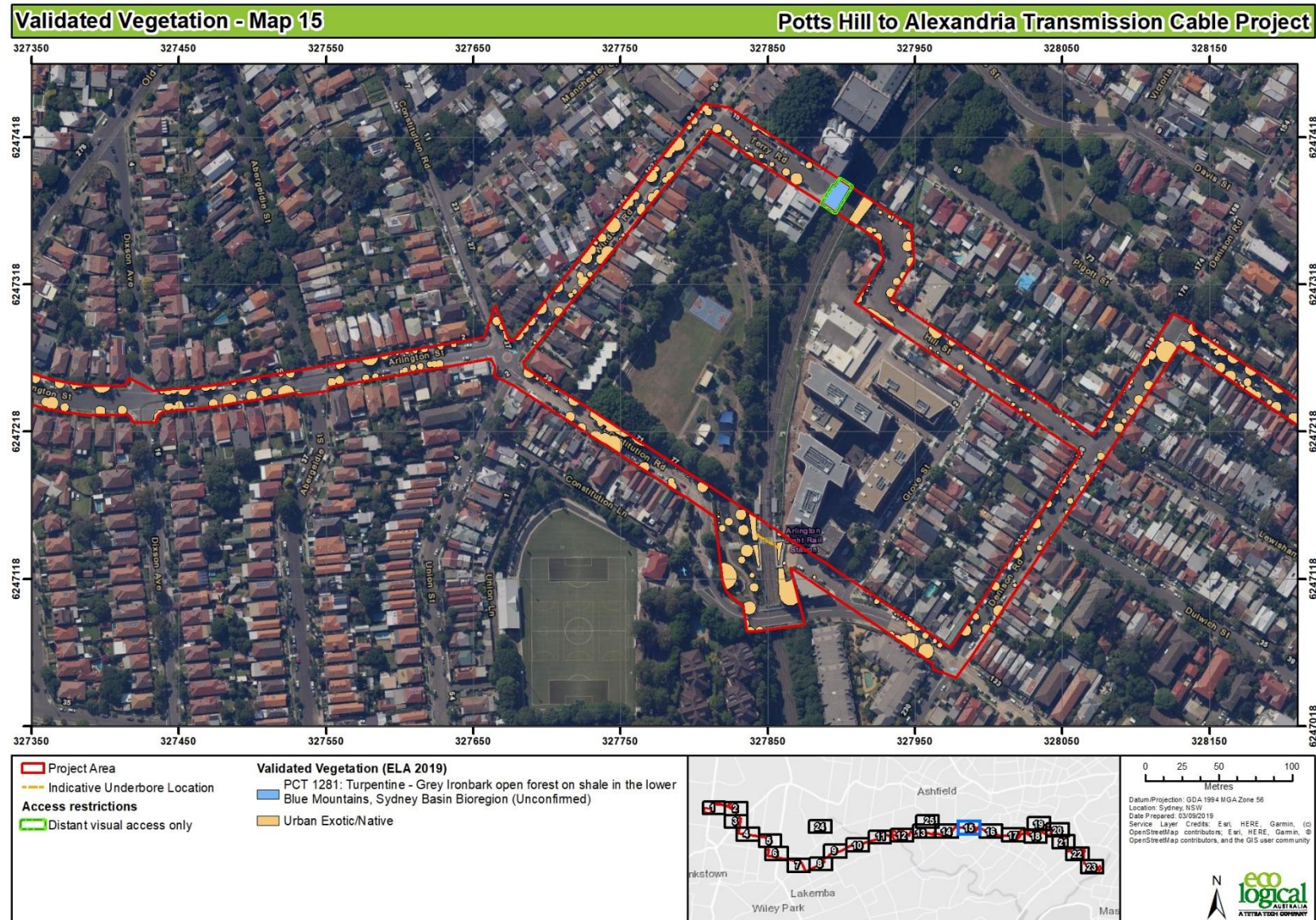


Figure 26: Validated vegetation map 15

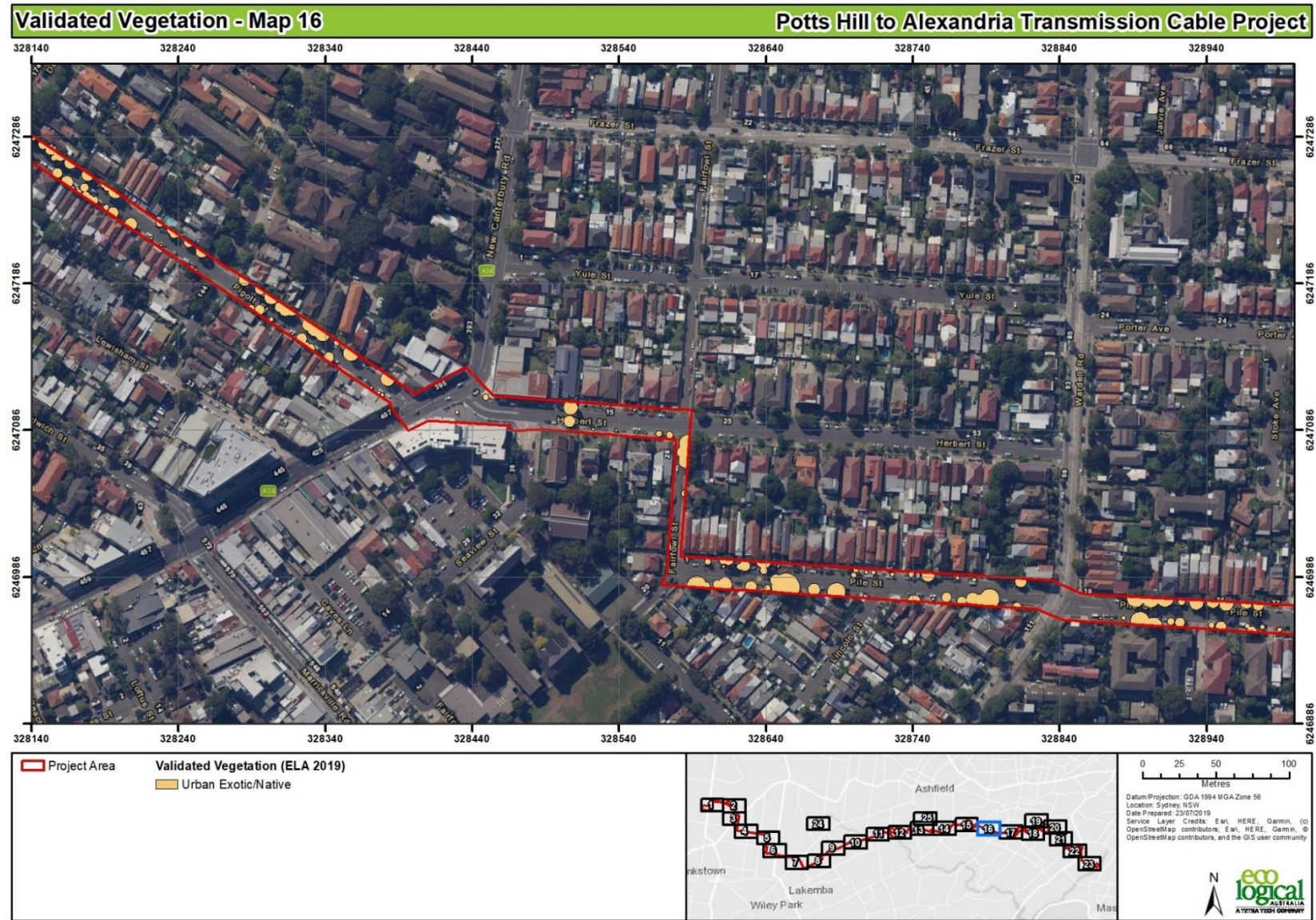


Figure 27: Validated vegetation map 16

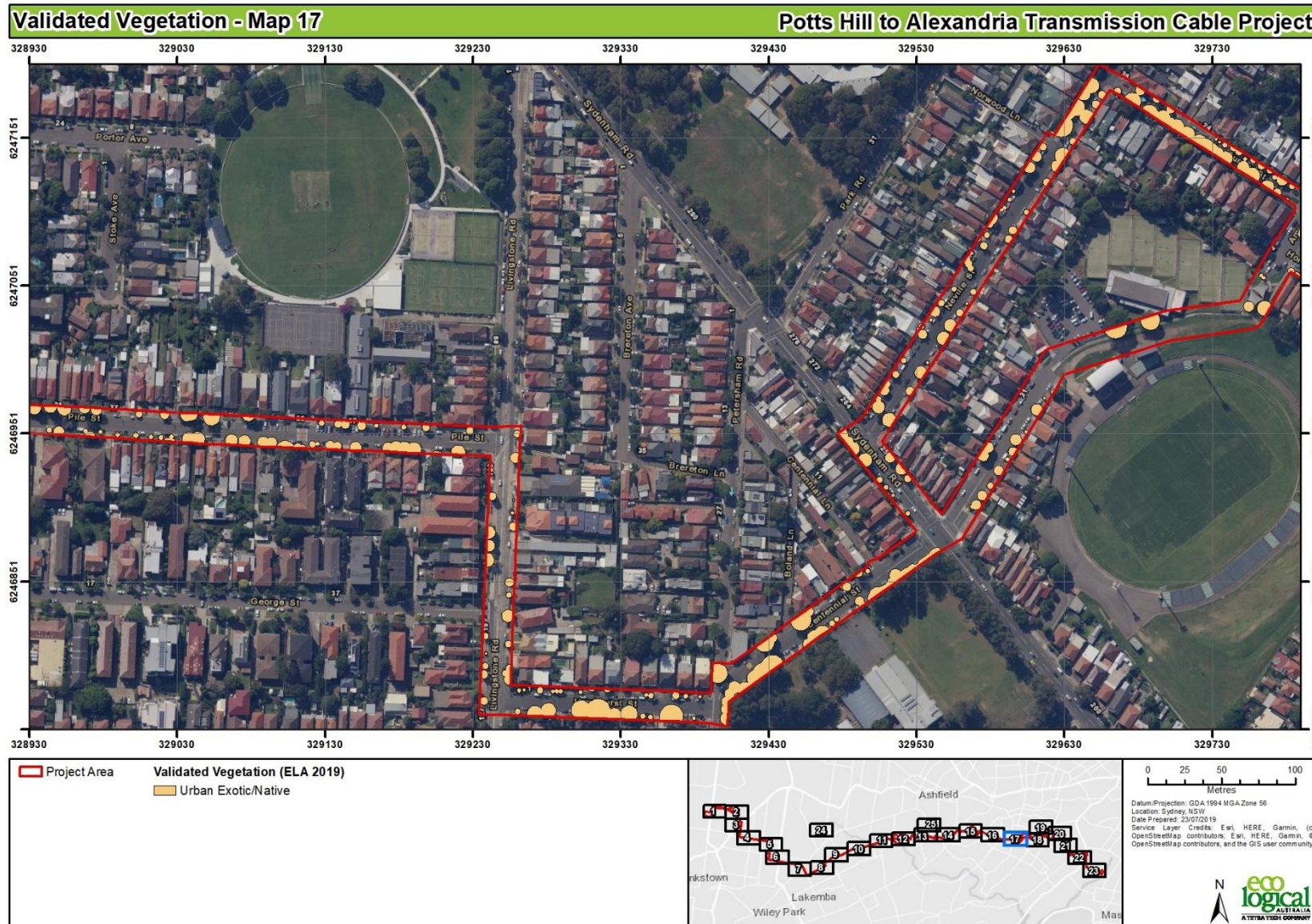


Figure 28: Validated vegetation map 17

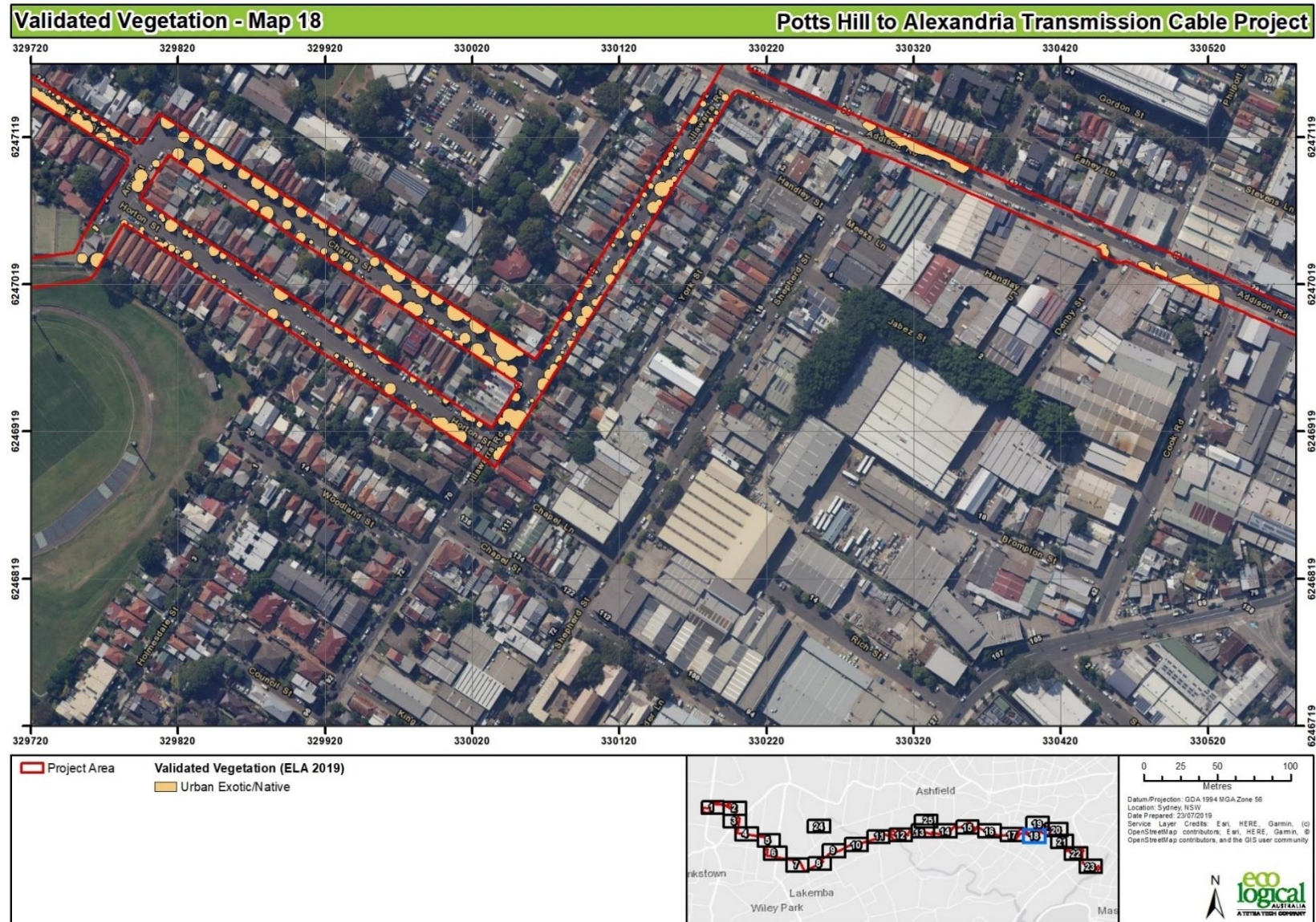


Figure 29: Validated vegetation map 18

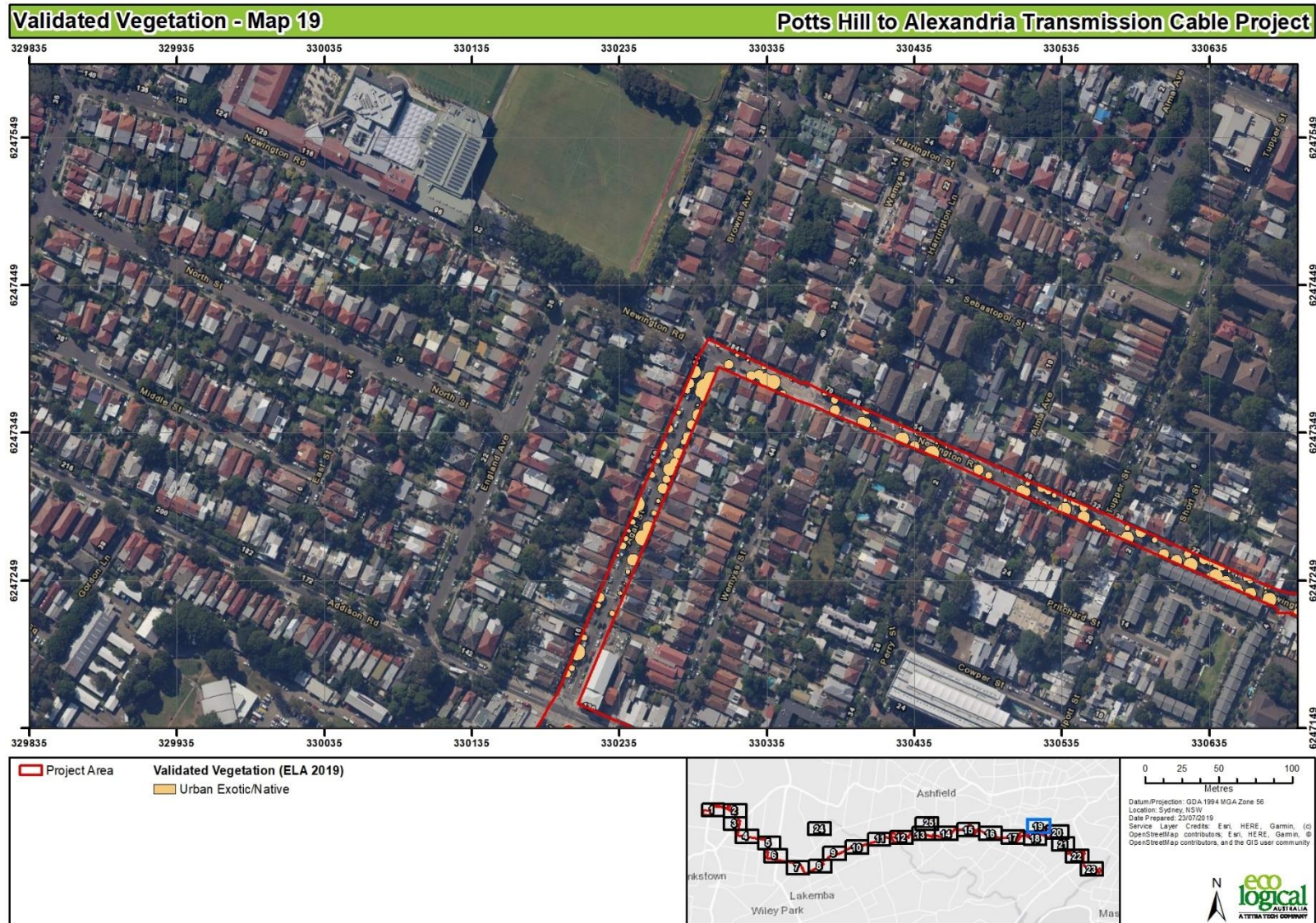


Figure 30: Validated vegetation map 19

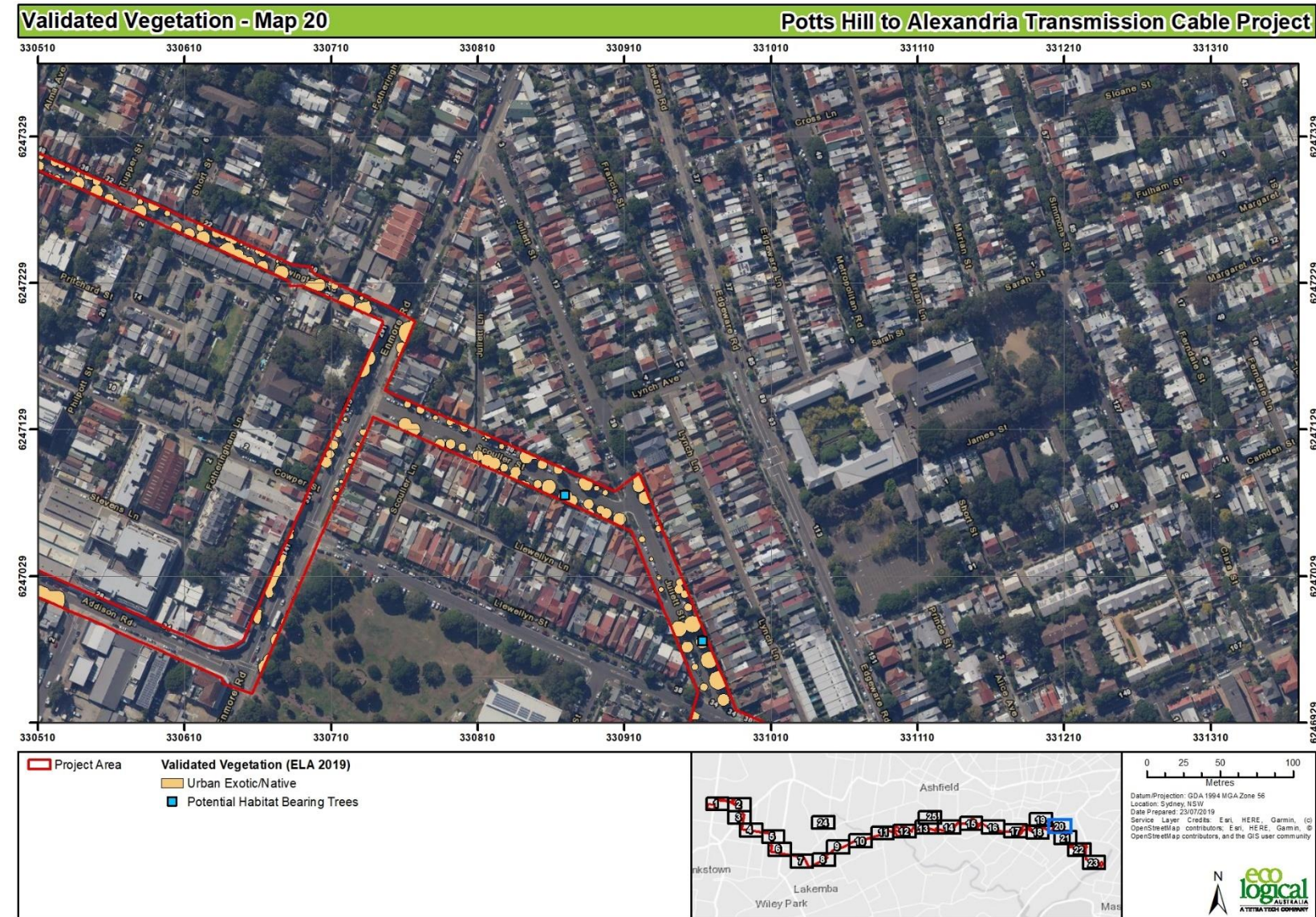


Figure 31: Validated vegetation map 20

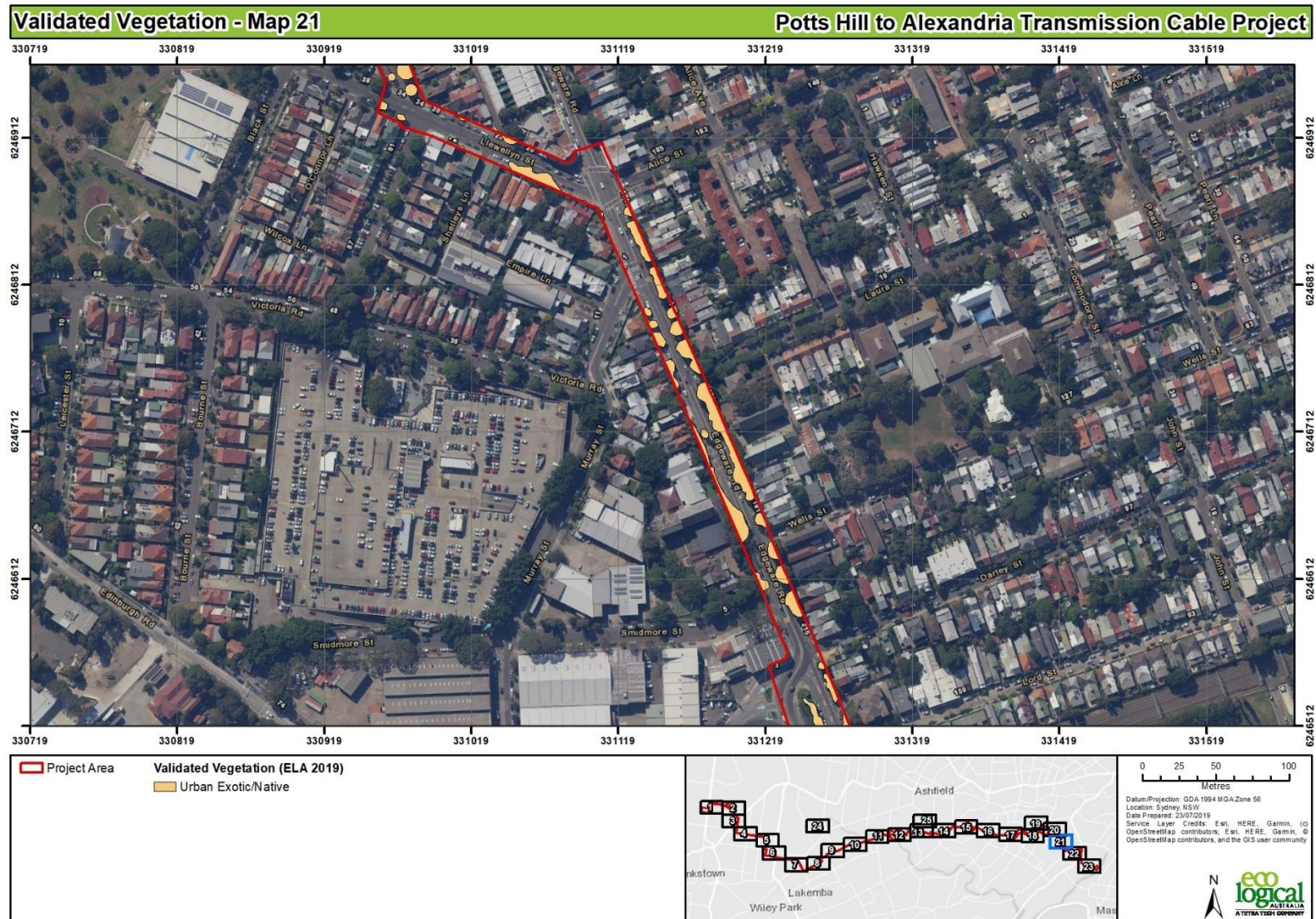


Figure 32: Validated vegetation map 21

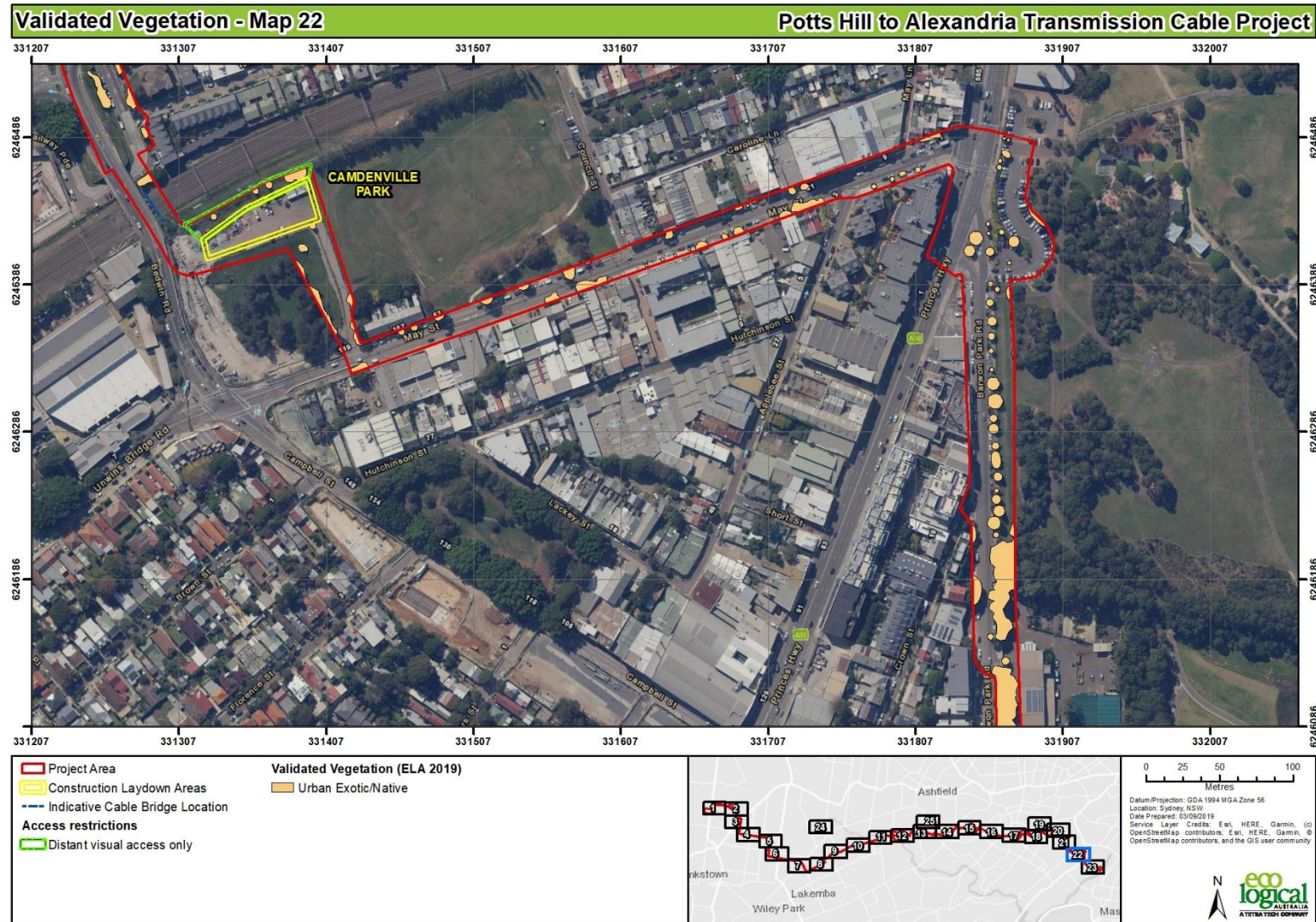


Figure 33: Validated vegetation map 22

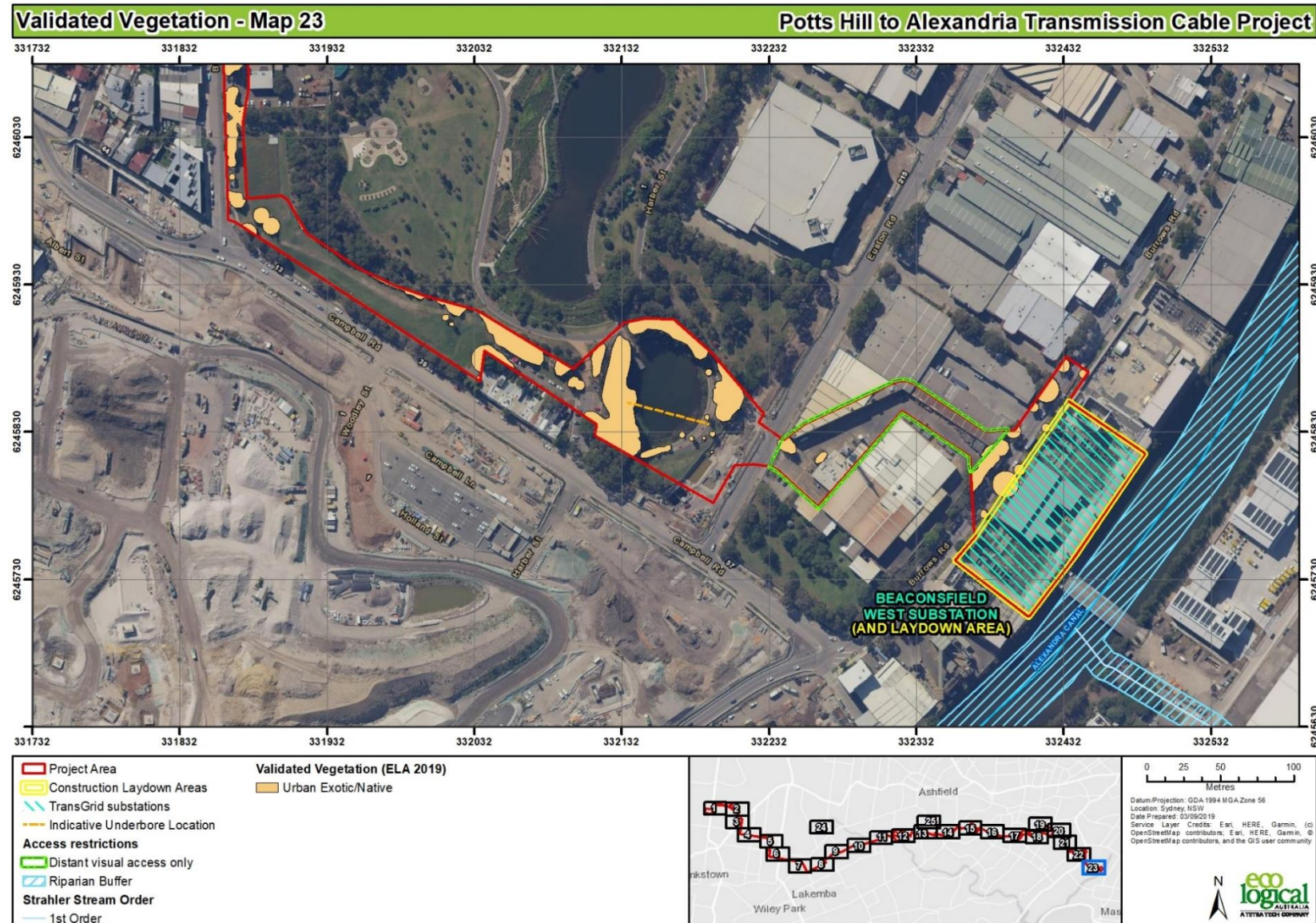


Figure 34: Validated vegetation map 23

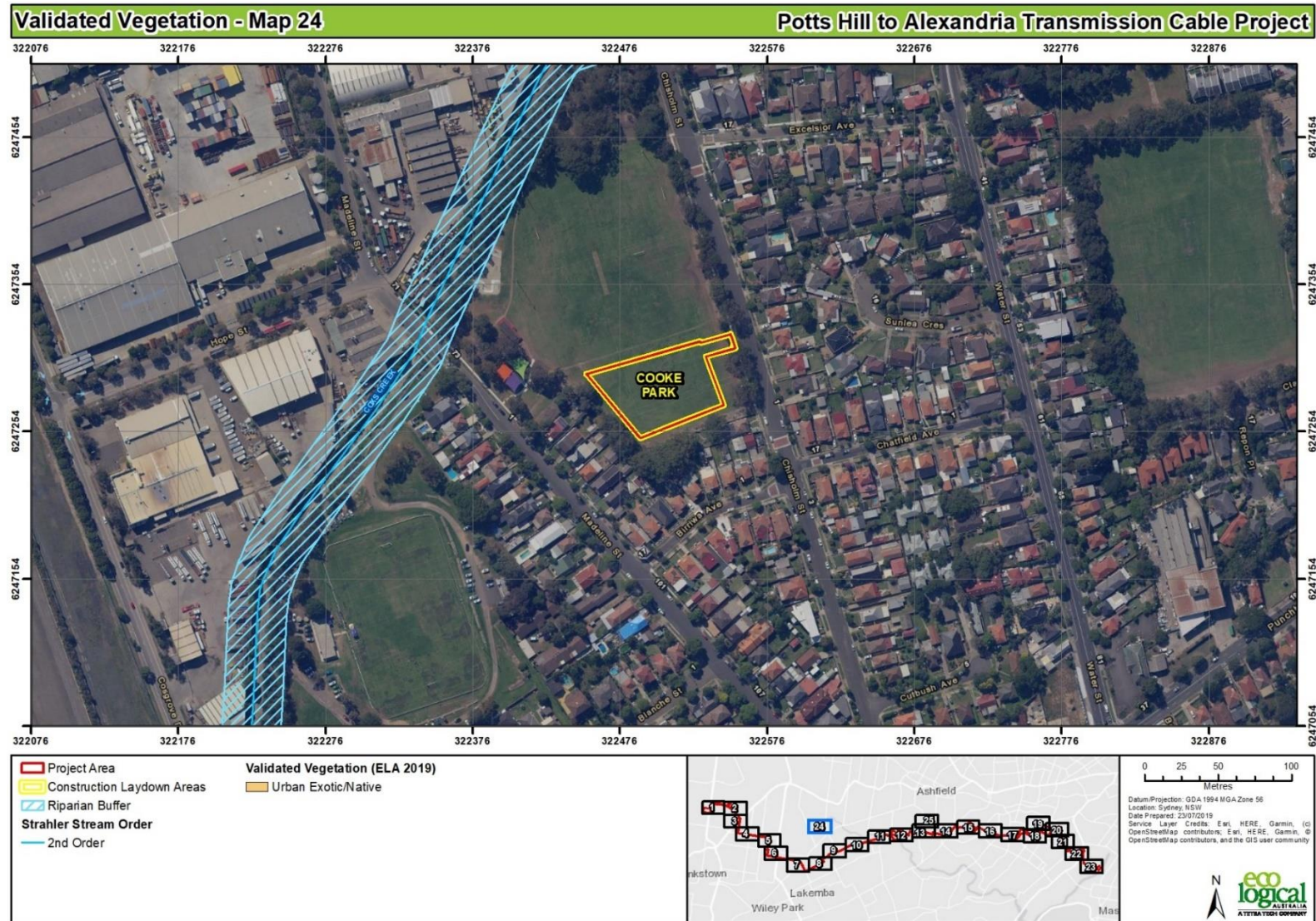


Figure 35: Validated vegetation map 24



Figure 36: Validated vegetation map 25

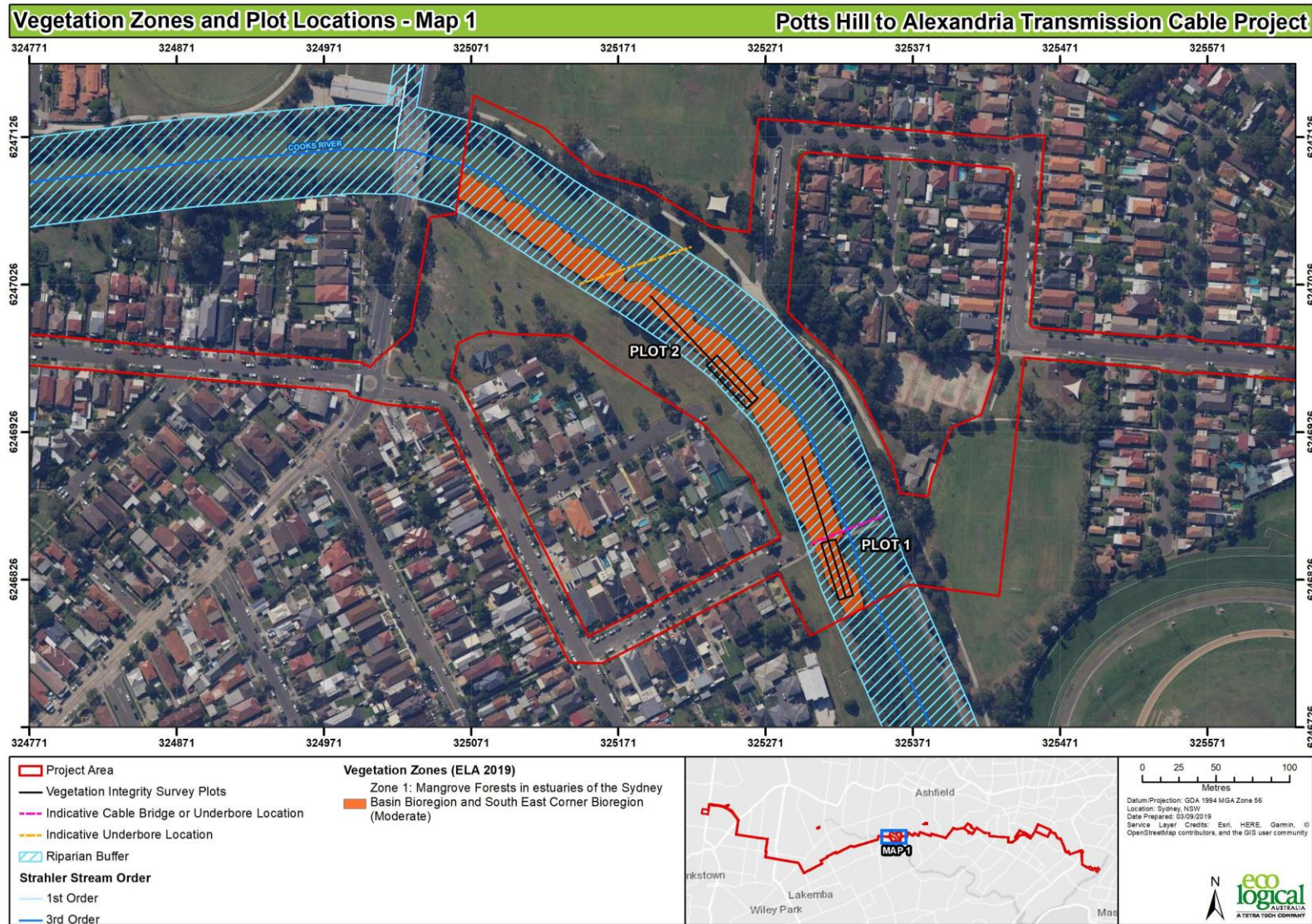


Figure 37: Vegetation zones and plot locations

1.5 Threatened species

The BAM outlines the process for identifying potential threatened flora and fauna species within the project area. Threatened species reliably predicted by PCTs are called 'ecosystem credit species'.

Those species which cannot be accurately predicted by PCTs must undergo additional consideration and are called 'species credit species'.

Offset requirements for ecosystem credit species are calculated within the area of impacted PCT. Species credit species have more specific offset calculations and may require a targeted survey to confirm the presence or absence of habitat.

1.5.1 Ecosystem credit species

Ecosystem credit species are predicted based on the PCT, the IBRA subregion of the project area and the condition and patch size of vegetation. As planted native vegetation, including street trees are not considered as a PCT, ecosystem credit species are only considered for PCT 920 -Mangrove Forest.

Ecosystem credit species predicted to occur in the project area based on their association with PCT 920, their associated habitat constraints, geographic limitations and sensitivity to gain class (related to the ability of a species to respond to improvements in habitat condition at an offset site) is included in Table 12.

Table 12: Predicted ecosystem credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status
<i>Miniopterus australis</i> (foraging)	Little Bentwing-bat	None	None	High	Vulnerable	Not listed
<i>Miniopterus schreibersii oceanensis</i> (foraging)	Eastern Bentwing-bat	None	None	High	Vulnerable	Not listed
<i>Mormopterus norfolkensis</i> (foraging)	Eastern Freetail-bat	None	None	High	Vulnerable	Not listed
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	None	None	High	Vulnerable	Not Listed
<i>Pteropus poliocephalus</i> (foraging)	Grey-headed Flying-fox	None	None	High	Vulnerable	Vulnerable

Ecosystem credit species which have been excluded from the assessment and relevant justification is included in Table 13.

Table 13: Justification for exclusion of predicted ecosystem credit species

Species	Common Name	NSW listing status	EPBC Listing status	Justification for exclusion of species
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Vulnerable	Not Listed	Absence of habitat: Woodlands, dry open sclerophyll forest, usually

Species	Common Name	NSW listing status	EPBC Listing status	Justification for exclusion of species
				eucalypts and mallee associations. Shrub, heathlands and various modified habitats, including regenerating forests
<i>Botaurus poiciloptilus</i>	Australian Bittern	Endangered	Endangered	Absence of habitat: Permanent freshwater wetlands with tall, dense vegetation, particularly <i>Typha</i> spp. (bullrushes) and <i>Eleocharis</i> spp. (spikerushes).
<i>Calidris ferruginea</i>	Curlew Sandpiper	Endangered	Critically Endangered	Absence of habitat: shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Vulnerable	Endangered	Absence of habitat: Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	Endangered	Not Listed	Absence of habitat: floodplain wetlands of the major coastal rivers are key habitat. Also, minor floodplains, coastal sandplain wetlands and estuaries.
<i>Epthianura albifrons</i>	White-fronted Chat	Vulnerable	Not Listed	Absence of habitat: Saltmarsh vegetation, open grasslands and sometimes low shrubs bordering wetland areas.
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	Vulnerable	Not Listed	Absence of habitat: sheltered parts of the coast such as estuarine sandflats and mudflats, lagoons, saltmarshes and reefs.
<i>Limosa limosa</i>	Black-tailed Gotwit	Vulnerable	Not Listed	Absence of habitat: Usually sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found around muddy lakes and swamps
<i>Pandion cristatus</i>	Eastern Osprey	Vulnerable	Not Listed	Absence of habitat: Rocky shorelines, islands, reefs, mouths of large rivers, lagoons and lakes.

1.6 Species credit species

The list of species credit species is based on a Likelihood of Occurrence assessment (Annexure C) informed from database searches (including BioNet database records), previous studies, and specific habitat features present within the project area. BioNet database records within the assessment area are shown in Figure 39 to Figure 47.

Species credit species predicted to occur in the project area (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 14.

The Southern Myotis is included as a species credit species in this assessment due to location of PCT 920 within 200 metres of the Cooks River, and the presence of a bridge directly overhead of PCT 920 within the project area, which provides potential habitat for this species.

Table 14: Candidate species credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status
<i>Myotis</i> <i>Macropus</i>	Southern Myotis	Within 200 m of riparian zone. Bridges, caves or artificial structures within 200 m of riparian zone. Hollow bearing trees.	None	High	Vulnerable	Not listed

Candidate species credit species which have been excluded from the assessment and relevant justification is included in Table 15.

Table 15: Justification for exclusion of candidate species credit species

Species	Common Name	NSW listing status	EPBC Listing status	Justification for exclusion of species
<i>Calidris ferruginea</i> (Breeding)	Curlew Sandpiper	Endangered	Critically Endangered, Migratory	Absence of breeding habitat: Littoral and estuarine habitats, with roosts on shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores.
<i>Haliaeetus leucogaster</i> (Breeding)	White-bellied Sea-eagle	Vulnerable	Not Listed	Absence of breeding habitat: mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts.
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Square Raspwort	Vulnerable	Vulnerable	Absence of habitat: protected and shaded damp situations in riparian habitats.
<i>Limicola falcinellus</i> (Breeding)	Broad-billed Sandpiper	Vulnerable	Migratory	Absence of breeding habitat: banks on sheltered sand, shell or shingle beaches.
<i>Limosa limosa</i> (Breeding)	Black-tailed Godwit	Vulnerable	Migratory	Absence of breeding habitat: low banks of mud, sand and shell bars.
<i>Litoria aurea</i>	Green and Golden Bell Frog	Endangered	Vulnerable	Absence of key habitat: marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.).
<i>Miniopterus australis</i> (Breeding)	Little Bentwing-bat	Vulnerable	Not listed	Absence of nursery sites- only five nursery sites /maternity colonies are known in Australia.
<i>Miniopterus schreibersii oceanensis</i> (Breeding)	Eastern Bentwing-bat	Vulnerable	Not listed	Absence of maternity caves.
<i>Pandion cristatus</i> (Breeding)	Eastern Osprey	Vulnerable	Not Listed	Absence of breeding habitat: high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.

Species	Common Name	NSW listing status	EPBC Listing status	Justification for exclusion of species
Pteropus poliocephalus (Breeding)	Grey-headed Flying-fox	Vulnerable	Vulnerable	Absence of breeding habitat. Roosts in conspicuous often large camps in lowland rainforest, swamp forest and gullies often in remnants or on islands in rivers.
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	Vulnerable	Not Listed	Margins of salt marshes and lakes.

1.6.1 Targeted surveys

The Southern Myotis is included as a species credit species in this assessment. The survey period for this species is November to March. No targeted surveys for this species credit species was undertaken; instead this species was assumed present within the project area and included in the assessment (Table 16). The potential habitat for this species within the project area is shown in Figure 38.

Table 16: Species credit species included in the assessment

Species	Common Name	Species presence	Geographic limitations	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
Myotis Macropus	Southern Myotis	Assumed present	None	0.76 ha	2

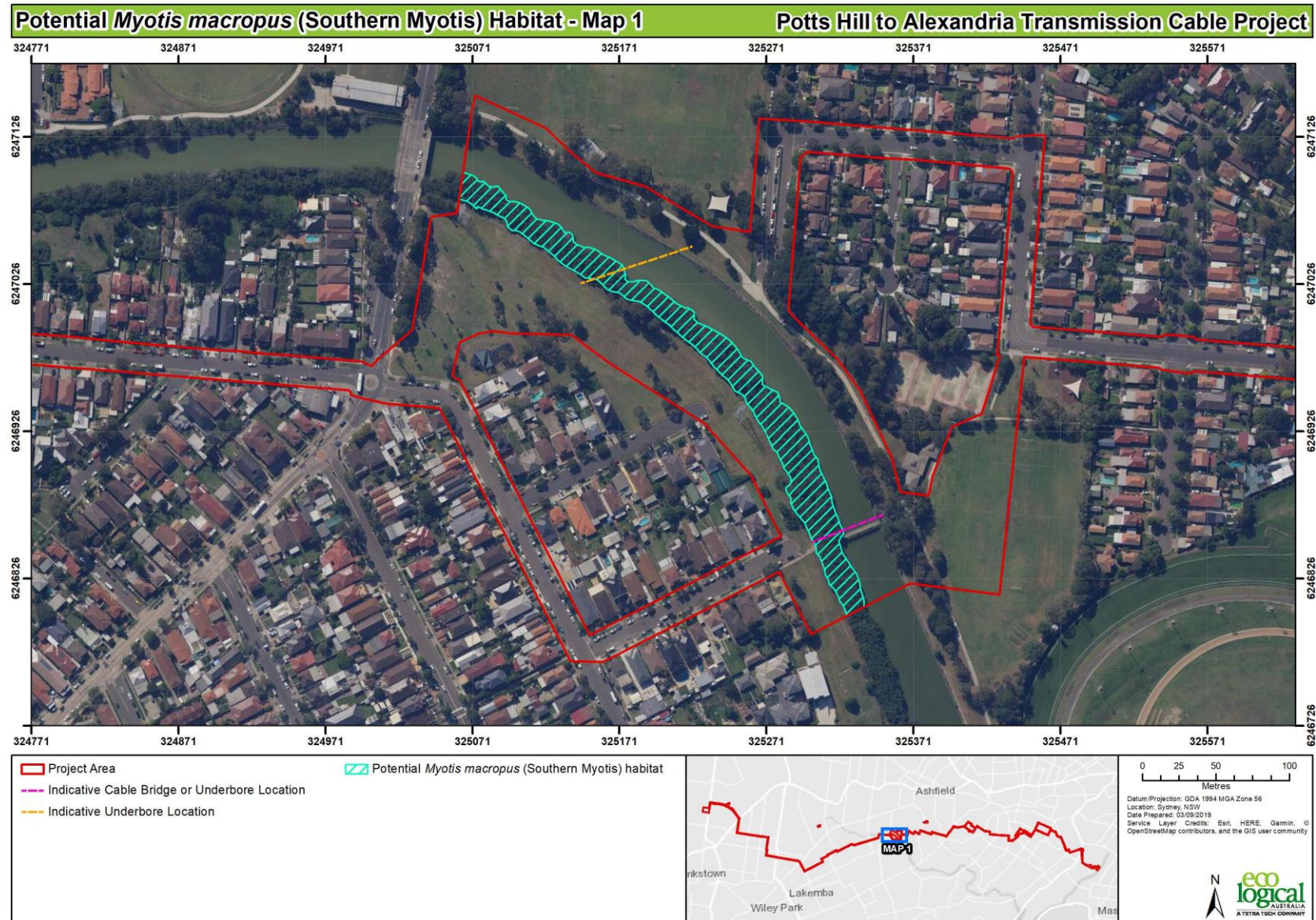


Figure 38: Potential Southern Myotis habitat

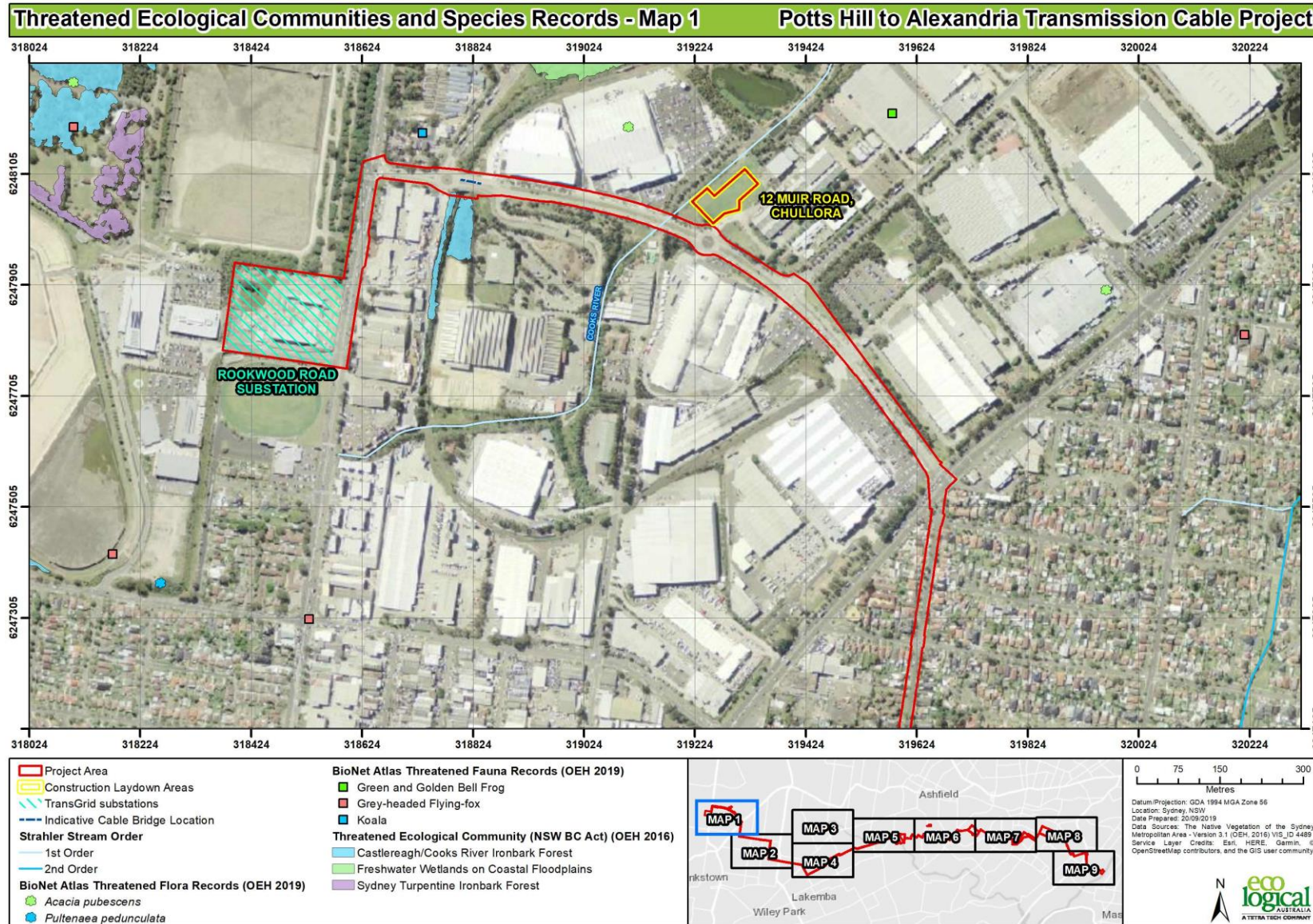


Figure 39: Threatened Ecological Communities Map 1

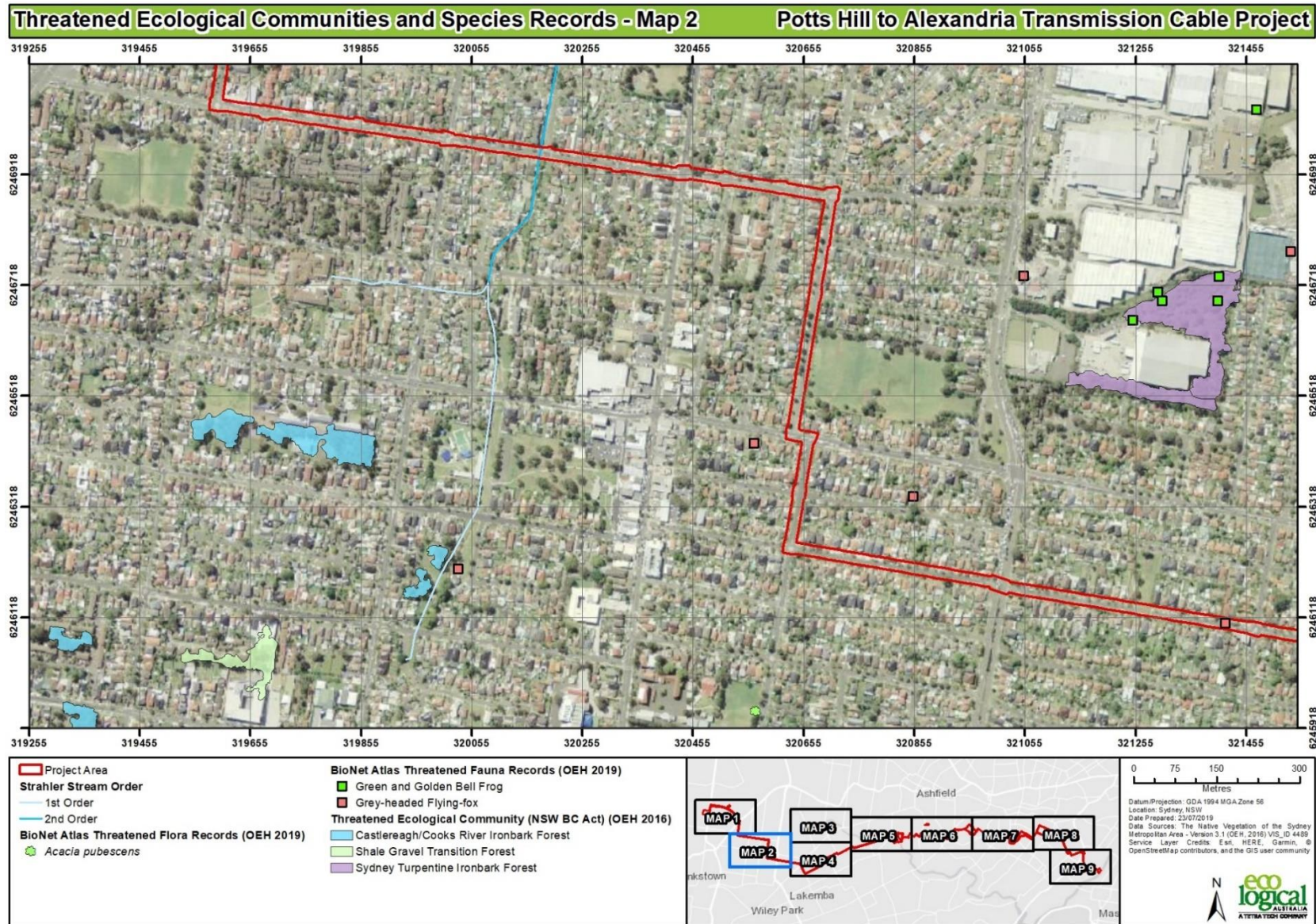


Figure 40: Threatened Ecological Communities Map 2

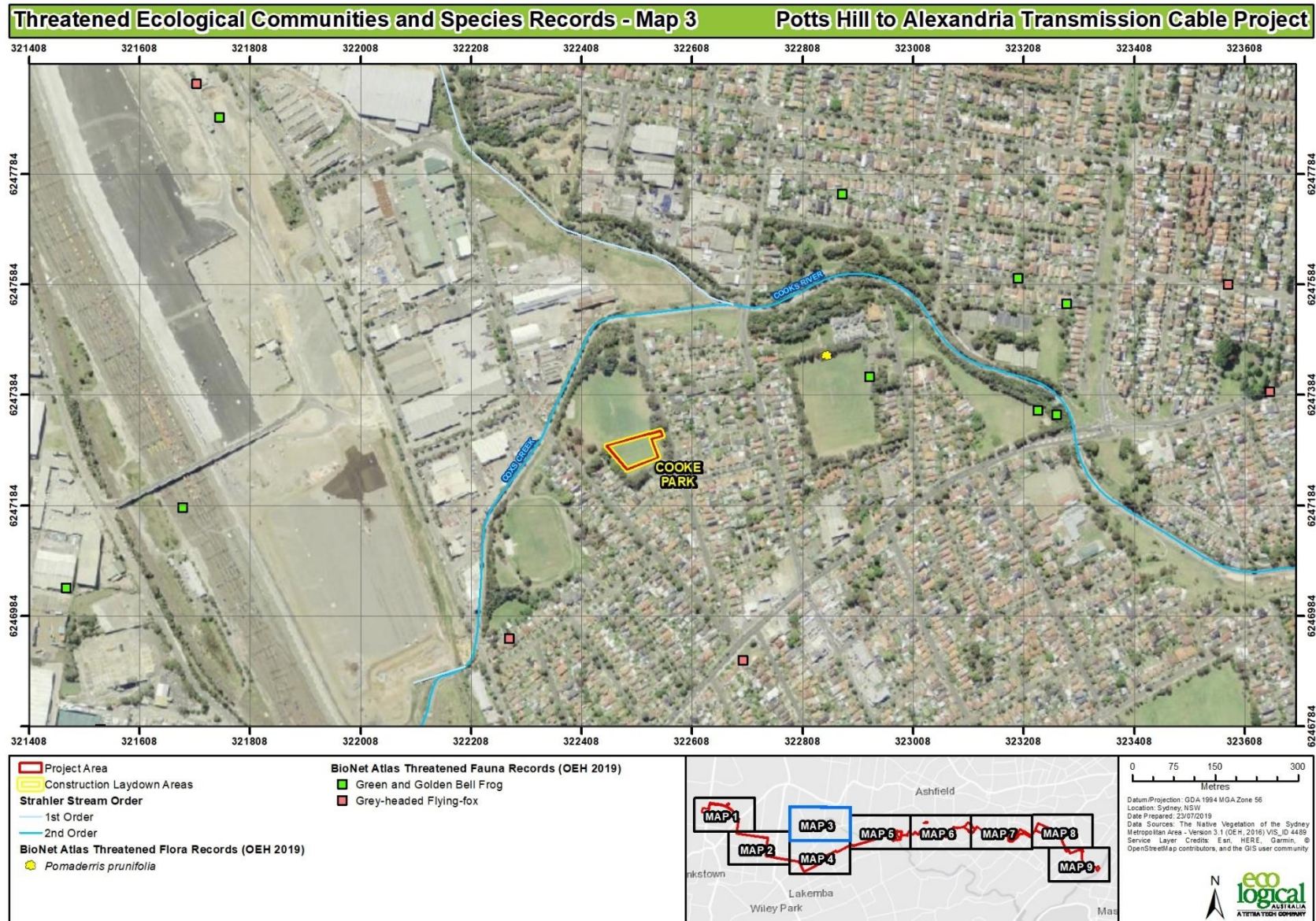


Figure 41: Threatened Ecological Communities Map 3

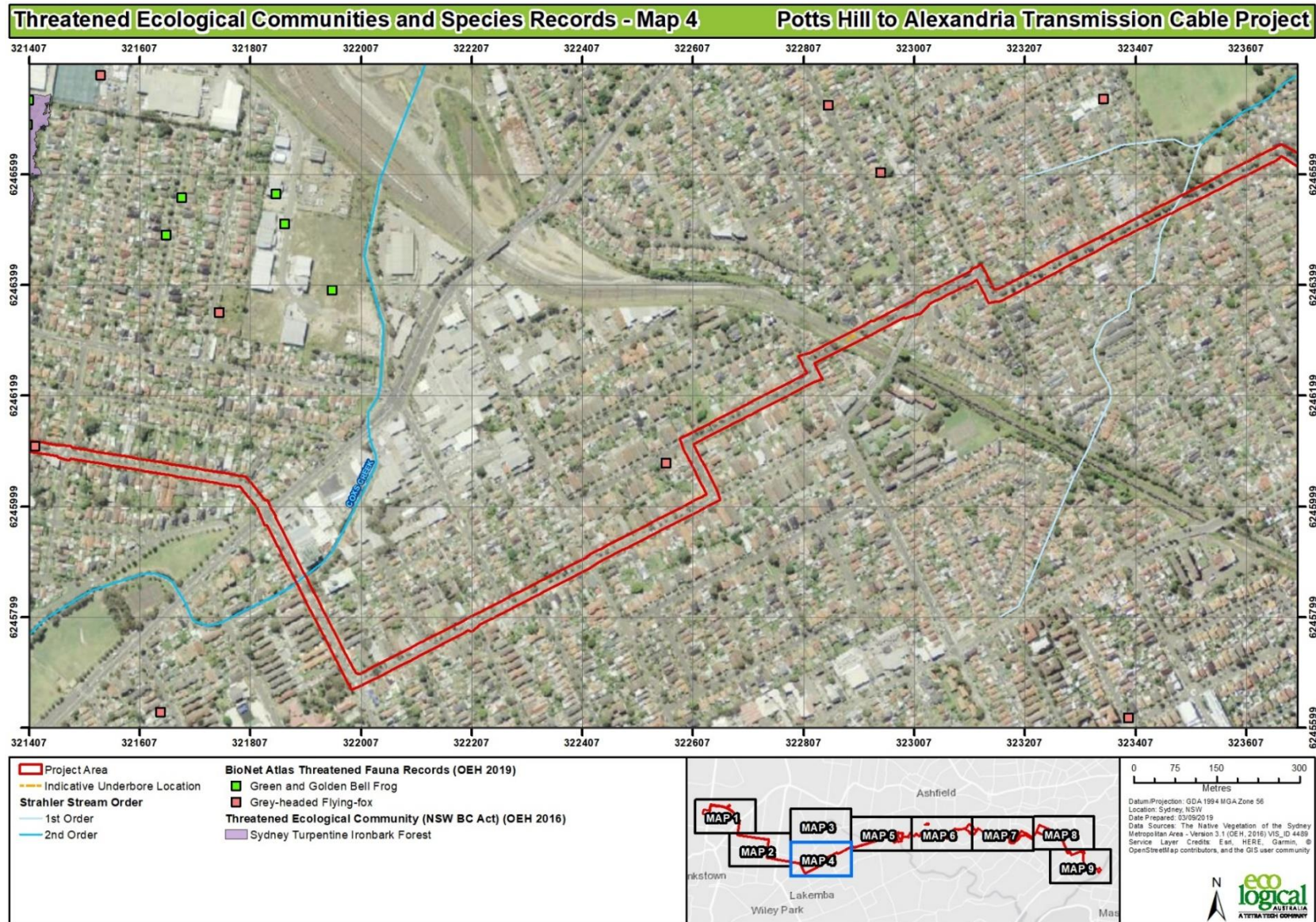


Figure 42: Threatened Ecological Communities Map 4

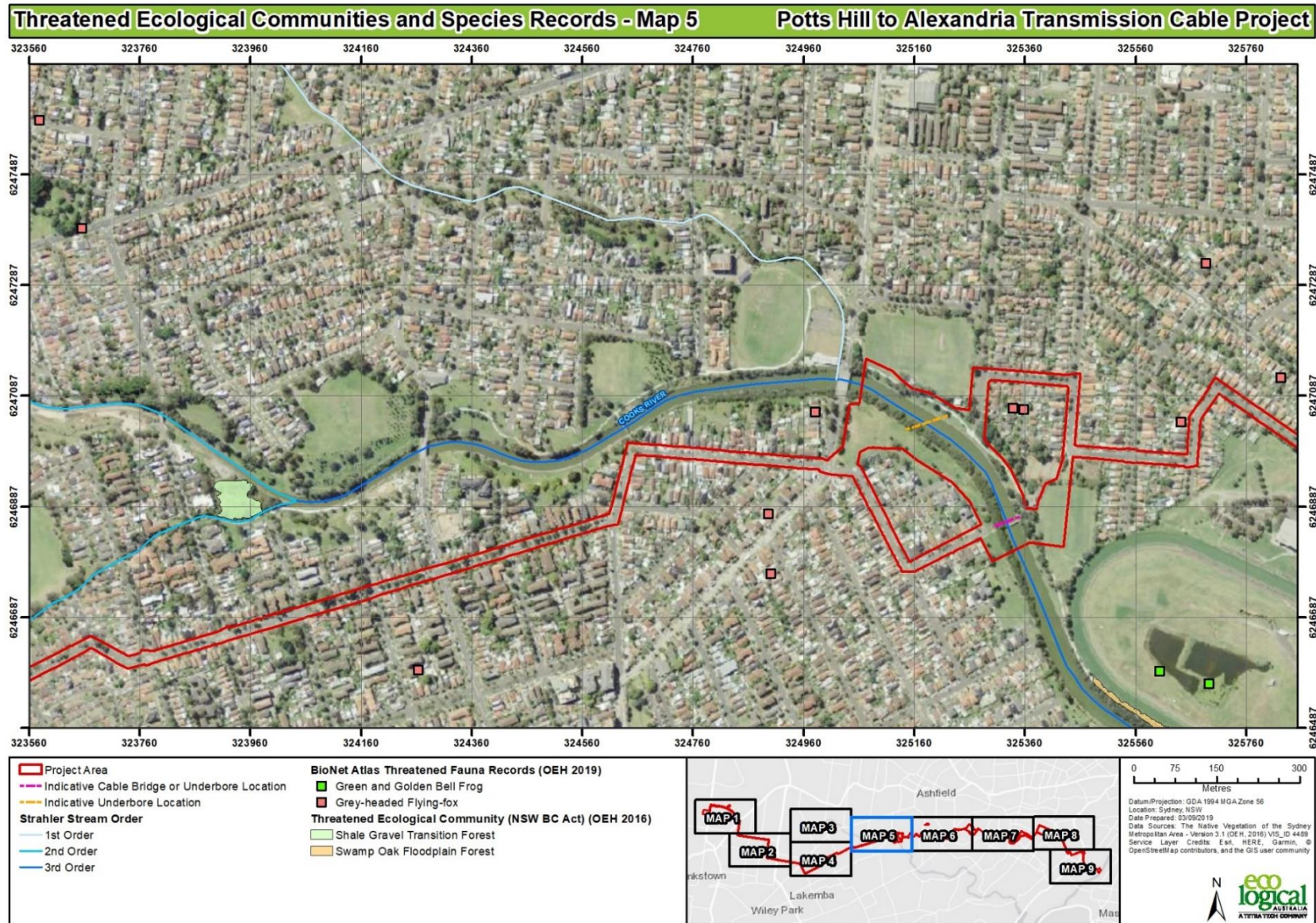


Figure 43: Threatened Ecological Communities Map 5

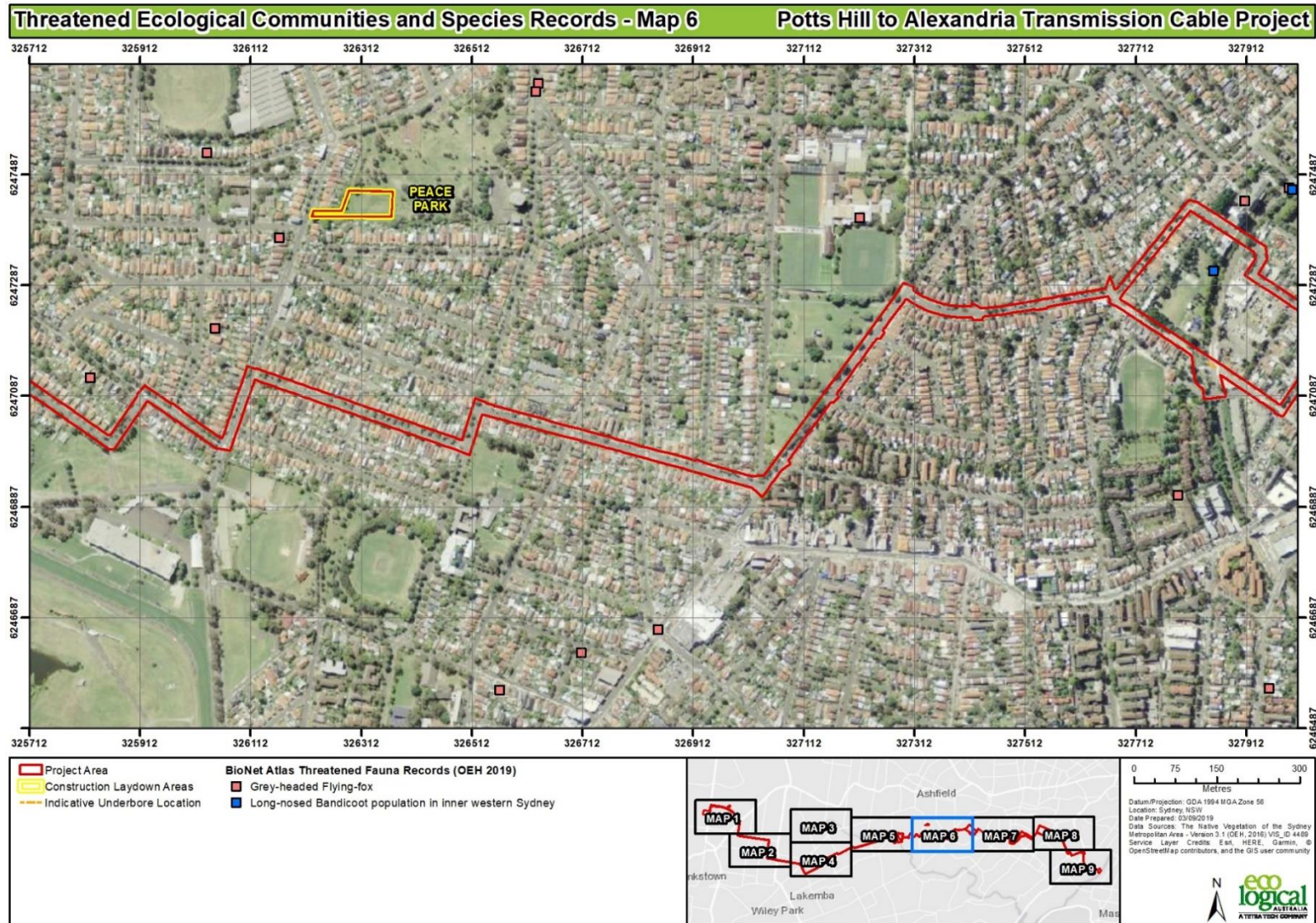


Figure 44: Threatened Ecological Communities Map 6

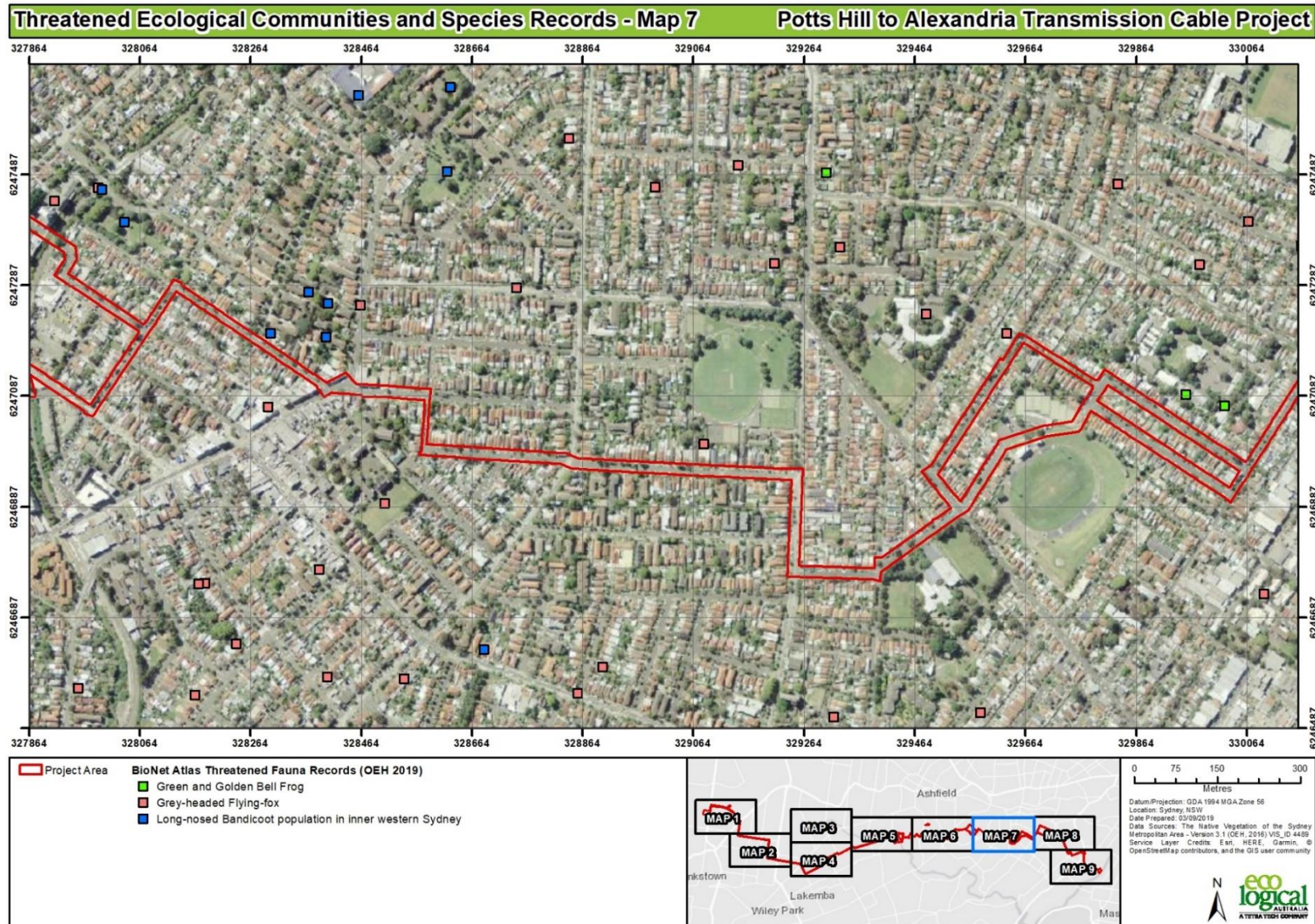


Figure 45: Threatened Ecological Communities Map 7



Figure 46: Threatened Ecological Communities map 8

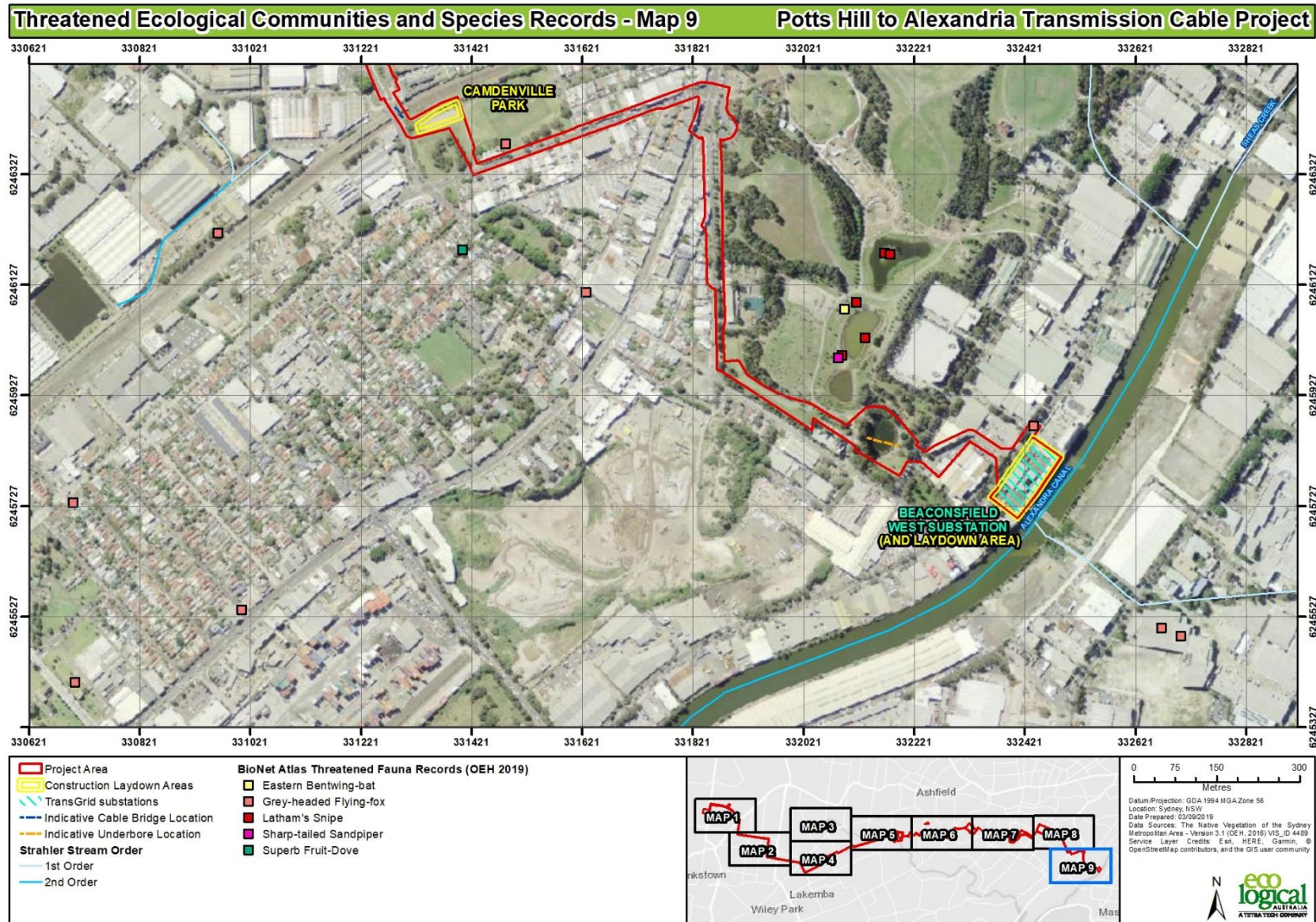


Figure 47: Threatened Ecological Communities Map 9

2. Stage 2: Impact assessment

Section 2 details the impact assessment of the development in accordance with the BAM. This includes: providing evidence for avoiding and minimising impacts on biodiversity; determining direct and indirect impacts of the development; assessment of residual risks following implementation of mitigation measures; and calculating the final offsetting requirements.

2.1 Avoiding impacts

2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat

The development has been located in a way which avoids and minimises impacts as outlined in Table 17.

Table 17: Locating a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
Locating the project in areas where there are no biodiversity values	Areas of cleared land with negligible biodiversity values would be used for the project where possible.	The project area has been located primarily in areas of low biodiversity value within road reserves, as well as within mown grasslands.
Locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	The project area is primarily located within the road reserve, thereby avoiding impacts to remnant vegetation and threatened species habitat.	<p>The project area is primarily located in road reserves, where vegetation consists of a mix of exotic and native planted street trees, which are subject to disturbance from edge effect and tree maintenance. 9.9 hectares (93%) of vegetation within the project area does not meet the definition of a PCT and is classified as 'urban exotics/natives'.</p> <p>A small area (0.76 ha) of PCT 920 - Mangrove Forest, located within the project area at the Cooks River crossing is of moderate condition.</p> <p>A small area (0.2 hectares) of unvalidated PCT 1281- Sydney Turpentine-Grey Ironbark Open Forest on shale in the lower Blue Mountains and Sydney Basin Bioregion, consists of planted native groundcover and shrub vegetation only. It is understood that the project will avoid clearing PCT 1281 through underboring.</p> <p>No TECs have been confirmed within the project area.</p>
Locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species	No threatened ecological community will be impacted.	Six species listed as Vulnerable have habitat within the project area (listed in Table 12 and Table 14) however, no species listed as Endangered or Critically Endangered has habitat occurring within the project area.

Approach	How addressed	Justification
Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	There is minimal ecological connectivity within the project area and removal of native vegetation has been minimised such that movement of species and genetic material would not be affected.	The project area contains minimal areas of ecological connectivity.

2.1.2 Designing a project to avoid and minimise impacts on vegetation and habitat

The development has been designed in a way which avoids and minimises impacts as outlined in Table 18.

Table 18: Designing a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
Reducing the clearing footprint of the project	<p>The project has been designed to reduce the clearing footprint of the project.</p> <p>At the detailed design stage further refinements to the location of project infrastructure will be undertaken which will further reduce the clearing footprint.</p>	<p>The project has been designed to utilise existing utility and services corridors, which are mostly situated within existing road reserves and public open space consisting of mown lawn areas.</p> <p>The project assesses a worst case of all vegetation within the project area being cleared, which represents a conservative approach.</p> <p>The final amount of vegetation removal will be determined during detailed design and is likely further reduce the clearing footprint.</p> <p>At the Cooks River, the area for clearing will depend on the special crossing methodology selected (i.e. underbore or cable bridge), which would be determined during detailed design.</p> <p>The project will avoid clearing at the Johnson Park Bushcare site (which has been planted with native vegetation) by underboring under the light rail corridor in Dulwich Hill.</p> <p>At the detailed design stage further refinements to the location of project infrastructure will be undertaken which will further reduce the clearing footprint.</p>
Locating ancillary facilities in areas where there are no biodiversity values	Proposed construction laydown areas would be primarily located in areas of negligible biodiversity values.	Proposed construction laydown areas would be located within cleared areas of existing substation sites and maintained exotic lawn in mainly public open space.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that	Proposed construction laydown areas would be primarily located in areas of negligible biodiversity values in poorest condition.	Proposed construction laydown areas would be located within cleared areas of existing substation sites and maintained exotic lawn in mainly public open space. The proposed construction laydown areas

Approach	How addressed	Justification
have a lower vegetation integrity score)		are short-term, and the impacted area of lawn in the open spaces will be reinstated post-project construction.
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	Proposed construction laydown areas do not have habitat for threatened ecological communities.	No species listed as Endangered or Critically Endangered or Vulnerable has habitat occurring within the project area.
Providing structures to enable species and genetic material to move across barriers or hostile gaps	There is minimal ecological connectivity within the project area, such that the provision of structures to enable species and genetic material across barriers is not required.	Not Applicable
Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat in the project area	Vegetation demarcation and requirements for restoration or rehabilitation of any impacted areas of vegetation will be addressed in the Construction Environment Management Plan.	The proposed construction laydown areas would be fenced, and impacted areas of lawn in the open spaces will be reinstated post-project construction phase.

2.1.3 Prescribed biodiversity impacts

Section 8.2 of the BAM describes prescribed impacts as impacts on biodiversity values in addition to or instead of clearing native vegetation. Prescribed impacts include impacts to non-native vegetation within the project area classified as '*urban exotics and natives*' and resulting impacts to threatened species and TECs for which non-native vegetation provides habitat.

Records of *Perameles nasuta* (Long-nosed Bandicoot) have been found in proximity (<100 metres) to the project area near the Johnson Park Bushcare site and potential foraging and movement habitat is provided by vegetation within the DHLR corridor. However, no impact is expected on the vegetation of the Johnson Park Bushcare site as this area will be underbored, with the entry and/or exit pit located fully within the adjacent road reserve. Hence this has not been included as a prescribed biodiversity impact.

The project has the prescribed biodiversity impacts as outlined in Table 19.

Table 19: Prescribed biodiversity impacts

Prescribed biodiversity impact	Description in relation to the project area	Threatened species or ecological communities affected
Impacts of development on the habitat of threatened species or ecological communities associated with:	No karst, caves, crevices and cliffs occur in the project area. Scattered rocks may occur within the project area.	Grey-headed Flying Fox: non-native vegetation within the 'urban exotics and natives' category within the project area may provide potential foraging habitat.
karst, caves, crevices, cliffs and other geological features of significance, or	Non-native vegetation occurring as planted street trees; landscaped vegetation and exotic lawn in urban parks may be impacted by removal or trimming.	Little Bentwing-bat and Eastern Bentwing-bat: potential roosting habitat in culverts and stormwater pipes within the project area.
rocks, or		
human made structures, or	The project area contains human made structures such as bridges,	

Prescribed biodiversity impact	Description in relation to the project area	Threatened species or ecological communities affected
non-native vegetation	culverts, stormwater pits and pipes and substation infrastructure. At a number of locations, the stormwater network would be temporarily disturbed by trenching and excavation. Small sections of culvert may require removal/reinstatement.	
Impacts of development on movement of threatened species that maintains their lifecycle	Non-native vegetation occurring as planted street trees and landscaped vegetation in urban parks may be impacted by removal or trimming.	Grey-headed Flying Fox: non-native vegetation within the 'urban exotics and natives' category within the project area may provide potential foraging habitat.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.	Potential for sedimentation of, or runoff into Cooks River, Campsie.	No threatened fish species listed under the Fisheries Management Act or EPBC Act are likely to occur within the project area (ELA, 2019).

2.1.3.1 Locating a project to avoid and minimise prescribed biodiversity impacts

The development has been located to avoid and minimise prescribed biodiversity impacts as outlined in Table 20.

Table 20: Locating a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
Locating the envelope of surface works to avoid direct impacts on the habitat features	The project has been primarily located within existing road reserves. Proposed laydown areas would be located within cleared areas of existing substation sites and maintained exotic lawn in public open space.	The project is located to use existing substations, road reserves and urban parks with limited habitat features.
Locating the project to avoid severing or interfering with corridors connecting different areas of habitat, or local pathways.	The project area has limited existing ecological connectivity. Where a local pathway may exist, the project will underbore this potential local pathway.	A local pathway may exist along the DHLR corridor and through Johnson Park Bushcare site for the Long-nosed Bandicoot. This area will be avoided by locating the entry and/or exit pit fully in the street reserve adjacent to the bushcare site.

2.1.3.2 Designing a project to avoid and minimise prescribed biodiversity impacts

The development has been designed in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 21.

Table 21: Designing a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
Design of the project to maintain environmental processes critical to the formation and persistence of habitat	Street trees including non-native species would be retained where possible. Construction laydown areas in urban	While the boundaries of the project area represent the physical extent of where project infrastructure may be located or construction works

Approach	How addressed	Justification
features not associated with native vegetation	<p>parks are designed to be as small as possible.</p> <p>The detailed design would aim to avoid impacts to street trees.</p>	undertaken, detailed design would aim to refine the location of project infrastructure and work sites within the boundaries of the project area and reduce impact on habitat features not associated with native vegetation where possible.

2.2 Assessment of Impacts

2.2.1 Direct impacts

The direct impacts of the development on:

- native (PCT) vegetation are outlined in Table 22;
- threatened species and threatened species habitat are outlined in Table 23; and
- prescribed biodiversity impacts are outlined in Section 2.2.4.

Table 22: Direct impacts to native (PCT) vegetation

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
920	Mangrove Forest	Saline Wetlands	Mangrove Swamps	0.76

Table 23: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Direct impact Number of individuals/habitat (ha)	NSW listing status	EPBC Listing status
<i>Myotis Macropus</i>	Southern Myotis	0.76	Vulnerable	Not listed

2.2.2 Change in vegetation integrity

The change in vegetation integrity of native (PCT) vegetation as a result of the development is outlined Table 24.

Table 24: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	920	Moderate	0.76	37.3	0	-37.3

2.2.3 Indirect impacts

The indirect impacts of the development are outlined in Table 25.

Table 25: Indirect impacts of the development

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Sedimentation and contaminated and/or nutrient rich runoff	Construction	Runoff disturbance impacting threatened fauna habitat and watercourses	Along the transmission cable route within and adjacent to the project area	Daily, during rainfall and storm events	Throughout construction period, including rehabilitation period post-construction	Throughout construction period
Noise, vibration, dust or light spill	Construction	Disturbance of threatened and non-threatened fauna	Multiple work sites within the project area	Potential to occur at any time during construction	Throughout construction period	During working hours for construction
Inadvertent impacts on adjacent habitat or vegetation	Construction	Damage to fauna habitat and vegetation	In the vicinity of the transmission cable route and laydown areas	Potential to occur at any time during construction	Throughout construction period	Throughout construction period
Transport of weeds and pathogens from the site to adjacent vegetation	Construction	Spread of weed seed or pathogens	Potential for spread into habitat adjacent to the project area	Potential to occur at any time during construction	Throughout construction period	Throughout construction period
Vehicle strike	Construction	Potential for native fauna to be struck by working machinery and moving vehicles	In the vicinity of work sites	Potential to occur at any time during construction	Throughout construction period	During working hours for construction
Rubbish dumping	Construction	Poor waste management by construction crews	Potential for rubbish to spread via wind into vegetation adjacent to the project area	Potential to occur at any time during construction	Throughout construction period	During working hours for construction
Increased risk of fire	Construction	Potential for fire to spark during construction works especially any electrical or machinery works	Throughout vegetation adjacent to the project area	Potential to occur at any time during construction	Throughout construction period	During working hours for construction

2.2.4 Prescribed biodiversity impacts

The prescribed biodiversity impacts are outlined in Table 26.

Table 26: Prescribed biodiversity impacts

Species or ecological community affected	Prescribed biodiversity impact	Nature, extent and duration of long and short-term impacts	Importance within the bioregion of the habitat of these species	Consequence of the impacts for the local and bioregional persistence
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	Habitat of threatened species associated with non-native vegetation.	As a worst case scenario, around 9.9 hectares of urban exotic/native vegetation would be removed.	<p>The National Recovery Plan for this species states that important habitat includes any foraging habitat within 50 kilometres of a camp that has sustained more than 30,000 individuals.</p> <p>The project area is about 4 kilometres south-west of a long-term camp at Centennial Park. This camp has supported between 16,000 and 49,000 individuals since November 2016. There is about 95.2 hectares of foraging habitat within the BDAR assessment area (project area plus 1,500 m buffer).</p> <p>The worst-case scenario removal of non-native vegetation is still negligible compared to the large areas of higher quality foraging habitat, including native vegetation, within the Sydney Basin Bioregion within the range of this species.</p>	<p>The species exists as a dynamic single population which utilises a range of habitats along the Australian east coast.</p> <p>The impacts of removal of non-native vegetation are small relative to the available habitat for this species.</p> <p>Vegetation removal is not likely to result in the long term decrease of the species in the local area or within the bioregion.</p>
Little Bentwing-bat and Eastern Bentwing-bat	Human made structures with potential to be habitat for threatened	Trenching for the transmission cable circuit would cut through or temporarily relocate several	Given the highly urbanised nature of the project area, a vast amount of equivalent roosting habitat is	The consequence of the potential impacts for the local and bioregional

Species or ecological community affected	Prescribed biodiversity impact	Nature, extent and duration of long and short-term impacts	Importance within the bioregion of the habitat of these species	Consequence of the impacts for the local and bioregional persistence
	species or ecological communities.	culverts throughout the project area. As the culverts/stormwater pipes would be reinstated, the impact would be short-term.	likely to be present for this species in the surrounding locality. Additionally, as the affected culvert sections are short and exposed to light it is considered unlikely that these structures would provide suitable roosting habitat.	persistence of the Little Bentwing-bat and Eastern Bentwing-bat is considered low as a vast amount of equivalent roosting habitat is likely to be present for this species.

2.2.5 Mitigating and managing impacts

Measures proposed to mitigate and manage impacts at the project area before, during and after construction are outlined in Table 27.

Table 27: Measures proposed to mitigate and manage impacts on biodiversity

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing of actions
Relocation of resident fauna	Moderate	Minor	<p>Pre-clearance survey of trees to be removed will be undertaken by a suitably qualified ecologist to identify/locate active nests. Removal of nest trees will be supervised by a qualified ecologist/licensed wildlife handler during removal of habitat trees in accordance with best practice methods.</p> <p>Any fauna that will not disperse independently will be captured and relocated to a suitable location nearby.</p> <p>Pre-construction survey of culverts and stormwater pipes for bats will be undertaken. Any roosting bats that will not disperse independently will be captured and relocated to a suitable location nearby.</p>	<p>Relocation of fauna in an ethical and sensitive manner.</p> <p>Any injured fauna will be taken to the local veterinary clinic for assessment.</p>	Prior to and during clearing works for site establishment and during the construction planning for the removal/relocation of stormwater infrastructure.
Timing works to avoid critical life-cycle events such as breeding or nursing	Moderate	Minor	If active bird nests are identified during the pre-clearance survey, avoidance of vegetation clearing works during late winter/early spring breeding/nesting period will be considered, where reasonable and feasible within required timeframes of the project.	Impacts to fauna during nesting/nursing avoided.	During construction planning.
Instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife	Major	Minor	<p>Supervision by a qualified ecologist/licensed wildlife handler during removal of nest trees will be undertaken in accordance with best practice methods.</p> <p>Any tree removal will be undertaken by a suitably qualified arborist.</p>	Any fauna utilising habitat within the project area will be identified and managed to ensure clearing works reduce the likelihood of injuring resident fauna.	Prior to and during clearing works for site establishment.

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing of actions
handler during clearing events					
Installing artificial habitats for fauna in adjacent retained vegetation and habitat or human made structures to replace the habitat resources lost and encourage animals to move from the impacted site, e.g. nest boxes	Minor	N/A	No actions considered as vegetation and other habitat to be removed considered to have minimal biodiversity value.	N/A.	N/A.
Replanting of Grey-headed Flying-fox habitat vegetation in	Moderate	Low	Replanting with potential Grey-headed Flying-fox habitat vegetation would be undertaken within the project area where feasible, and in consultation with local councils.	Recreates potential habitat for the Grey-headed Flying-fox.	During or post construction works

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing of actions
alternative locations within the project area					
Implement clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance	Moderate	Minor	No temporary facilities i.e. site offices/toilets/equipment storage will be placed outside of the designated laydown areas or work sites.	Vegetation outside of the project area will not be disturbed/impacted.	For the duration of construction works.
Sediment barriers or sedimentation ponds to control the quality of water released from work sites into the receiving environment	Minor	Negligible	<p>Appropriate controls will be utilised to manage exposed soil surfaces to reduce sediment discharge into waterways.</p> <p>All works within proximity to drainage lines will have adequate sediment and erosion controls.</p> <p>Revegetation of disturbed areas will commence as soon as practicable to reduce the risk of erosion.</p>	Erosion and sedimentation will be controlled as far as practical.	For the duration of construction works.
Adaptive dust monitoring programs to control air quality	Minor	Negligible	<p>Dust suppression measures will be implemented during construction works to limit dust at work sites.</p> <p>Revegetation of disturbed areas will commence as soon as practicable to reduce areas likely to create dust.</p>	Mitigate dust created during construction activities.	For the duration of construction works.

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing of actions
Temporary fencing to protect significant environmental features	Moderate	Minor	Temporary fencing will be installed at the perimeter at relevant worksites.	Prevent the removal of vegetation outside of designated areas.	Prior to and during clearing works at relevant work sites. During site establishment.
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Moderate	Minor	Vehicles, machinery and construction waste will not enter areas of retained vegetation. Any weeds within the project area listed under the NSW <i>Biosecurity Act 2015</i> to be managed in accordance with the regional priority objectives of the Greater Sydney Regional Strategic Management Plan 2017 – 2022. Weed species identified within the project area include African Olive (<i>Olea europaea</i>) and Cestrum (<i>Cestrum parqui</i>).	Prevent spread of weeds or pathogens.	For the duration of construction works.
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Minor	Negligible	All construction personnel will undertake an environmental induction that will include items such as: <ul style="list-style-type: none"> potential or actual presence of threatened species or habitats; site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and the prevention of the spread of weeds); response to environmental emergencies (chemical spills, fire, and injured fauna); and key environmental project personnel. 	All construction staff entering the project area are fully aware of ecological values present and environmental aspects relating to the project and know what to do in case of any environmental emergencies.	Prior to construction personnel commencing work. Site briefings will be updated based on phase of the work and when environmental issues become apparent.

2.2.6 Serious and Irreversible Impacts (SAII)

Serious and Irreversible Impacts (SAIIs) are impacts of a development which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community (known as entities). A list of candidate entities for SAII is provided in "Guidance to assist a decision-maker to determine a serious and irreversible impact" (OEH 2017d).

No SAII candidate entities have been identified within the project area.

2.3 Risk assessment

A risk assessment has been undertaken for any residual impacts likely to remain after the mitigation measures have been applied. Likelihood criteria, consequence criteria and the risk matrix are provided in Table 28, Table 29 and Table 30 respectively.

Table 28: Likelihood criteria

Likelihood criteria	Description
Almost certain (Common)	Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to ten times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.
Likely (Has occurred in recent history)	There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.
Possible (Could happen, has occurred in the past, but not common)	The event could occur. There is likely to be an event on average every five to twenty years.
Unlikely (Not likely or uncommon)	The event could occur but is not expected. A rare occurrence (once per one hundred years).
Remote (Rare or practically impossible)	The event may occur only in exceptional circumstances. Very rare occurrence (once per one thousand years). Unlikely that it has occurred elsewhere; and, if it has occurred, it is regarded as unique.

Table 29: Consequence criteria

Consequence category	Description
Critical (Severe, widespread long-term effect)	Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely.
Major (Wider spread, moderate to long term effect)	Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible.
Moderate (Localised, short-term to moderate effect)	Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern.

Consequence category	Description
Minor (Localised short-term effect)	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification.
Negligible (Minimal impact or no lasting effect)	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols.

Table 30: Risk matrix

Consequence	Likelihood				
	Almost certain	Likely	Possible	Unlikely	Remote
Critical	Very High	Very High	High	High	Medium
Major	Very High	High	High	Medium	Medium
Moderate	High	Medium	Medium	Medium	Low
Minor	Medium	Medium	Low	Low	Very Low
Negligible	Medium	Low	Low	Very Low	Very Low

Table 31: Risk assessment of residual impacts

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post-mitigation)
Vegetation clearing	Construction / operation	Medium	Low
Sedimentation and contaminated and/or nutrient rich runoff	Construction	Low	Very Low
Noise, dust or light spill	Construction	Medium	Low
Inadvertent impacts on adjacent habitat or vegetation	Construction	Medium	Low
Transport of weeds and pathogens from the site to adjacent vegetation	Construction	Medium	Very Low
Vehicle strike	Construction / operation	Low	Very Low
Rubbish dumping	Construction / operation	Medium	Low
Wood collection	Construction / operation	Low	Very Low
Increased risk of fire	Construction / operation	Medium	Low

2.4 Impact summary

Following implementation of the BAM and the BAM Credit Calculator, the following impacts have been determined.

2.4.1 Serious and Irreversible Impacts (SAII)

The development does not have any SAIIs.

2.4.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 32 and shown on Figure 48. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 33 and on Figure 48.

Table 32: Impacts to native vegetation that require offsets

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
920	Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangrove Swamps	Saline Wetlands	0.76

Table 33: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact Number of individuals/habitat (ha)	NSW listing status	EPBC Listing status
<i>Myotis Macropus</i>	Southern Myotis	0.76	Vulnerable	Not Listed

2.4.3 Impacts not requiring offsets

As outlined in Section 10.3.1 and 10.3.2 of the BAM, impacts not requiring offset are impacts to PCTs where the vegetation integrity score for the PCT is lower than the threshold required for offsetting. The project area does not contain any PCTs where the vegetation integrity score for the PCT is lower than the threshold required for offsetting. Hence, this section is not applicable.

2.4.4 Areas not requiring assessment

A BAM assessor is not required to assess areas of land on the project area, or land proposed for biodiversity certification for ecosystem credits, without native vegetation. Areas not requiring assessment are shown in Figure 49 to Figure 57.

Note that areas of land that do not contain native vegetation must still be assessed for threatened species in accordance with the BAM. This assessment is included in section 2.2.4 of this report.

2.4.5 Credit summary

The number of ecosystem credits required for the development are outlined in Table 34. The number of species credits required for the development are outlined in Table 35. A biodiversity credit report is included in Annexure E.

Table 34: Ecosystem credits required

PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
920	Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangrove Swamps	0.76	14

Table 35: Species credit summary

Species	Common Name	Direct impact Number of individuals/ habitat (ha)	Credits required
<i>Myotis Macropus</i>	Southern Myotis	0.76	14

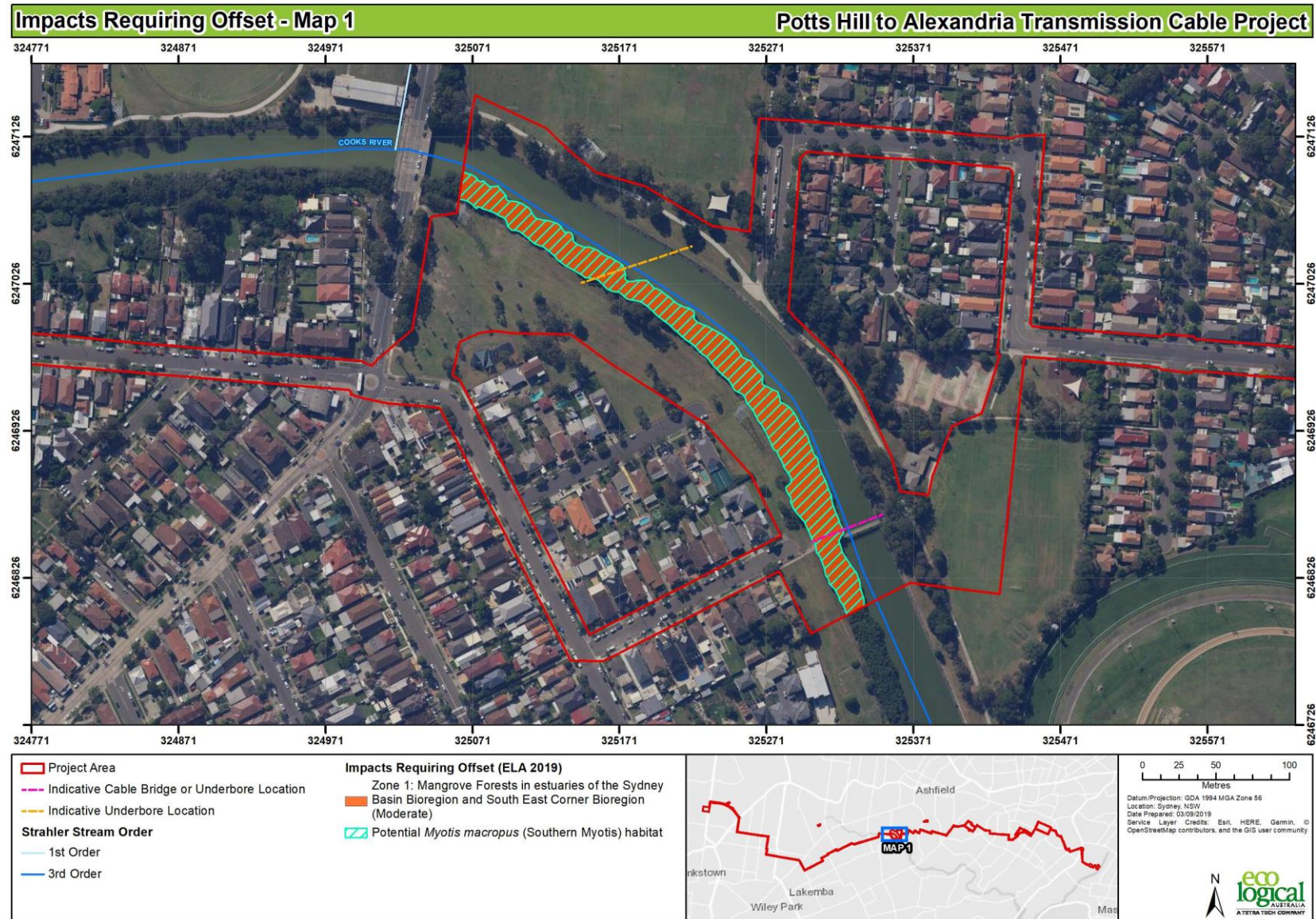


Figure 48: Impacts requiring offset

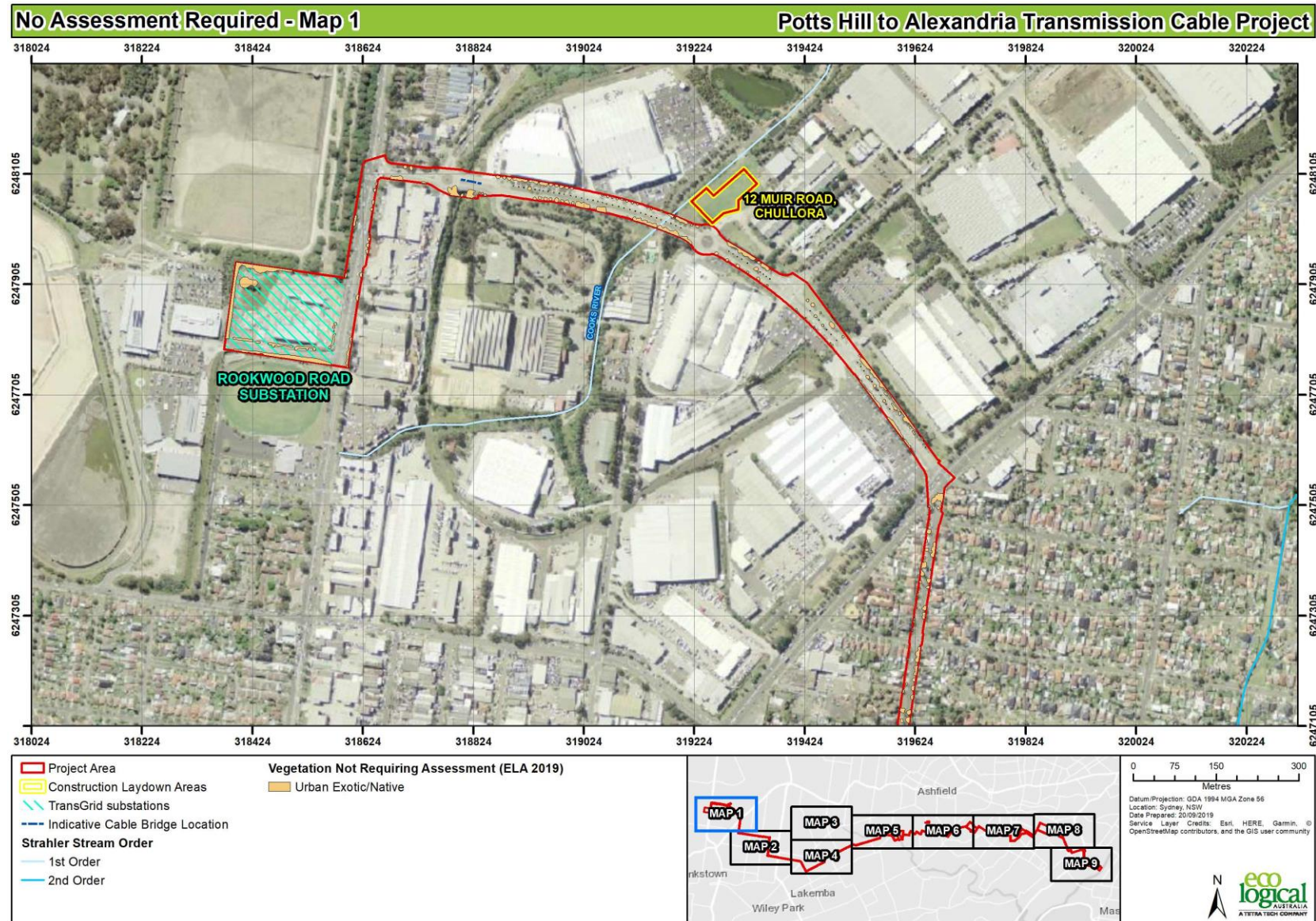


Figure 49: No assessment required map 1

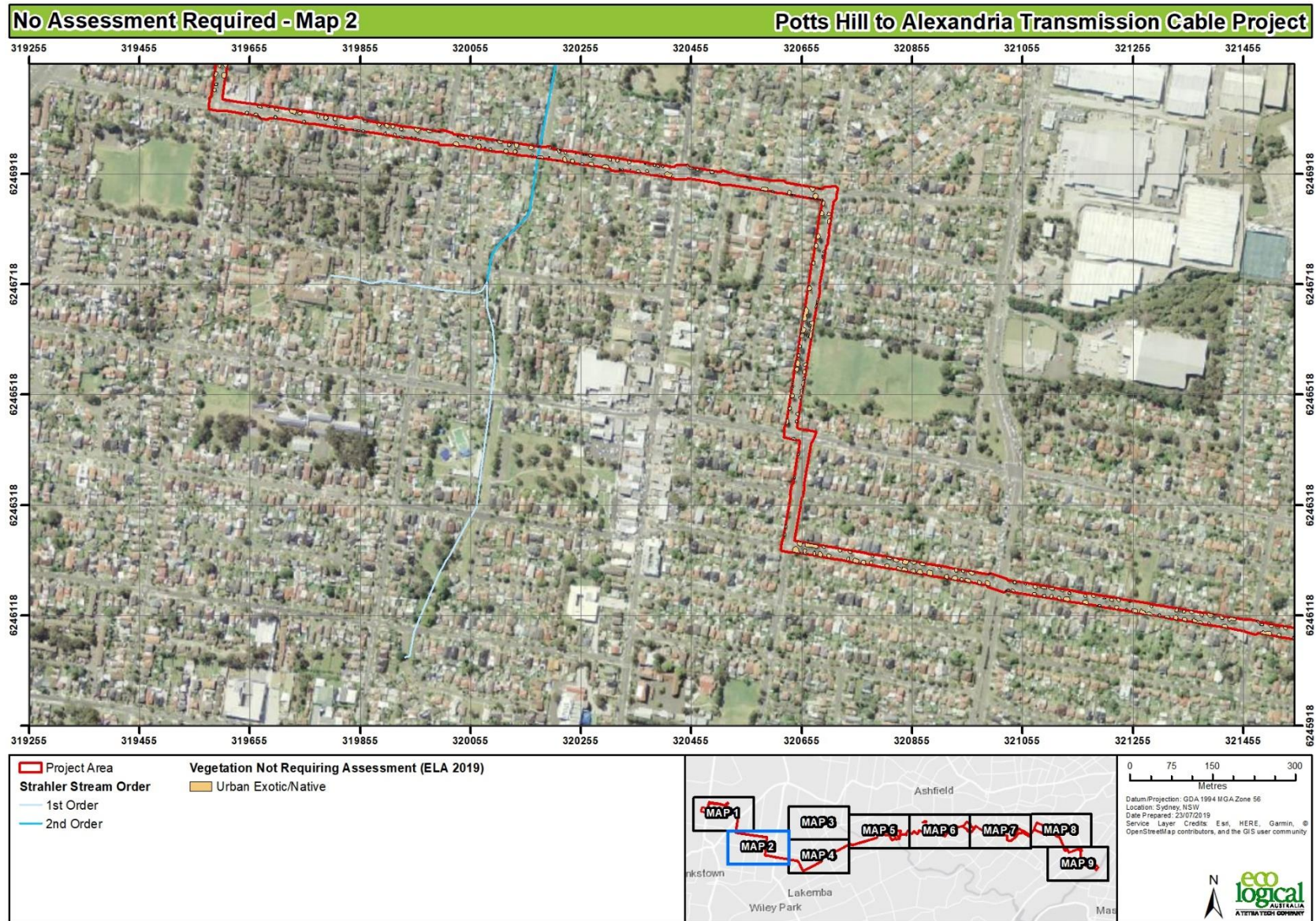


Figure 50: No assessment required map 2

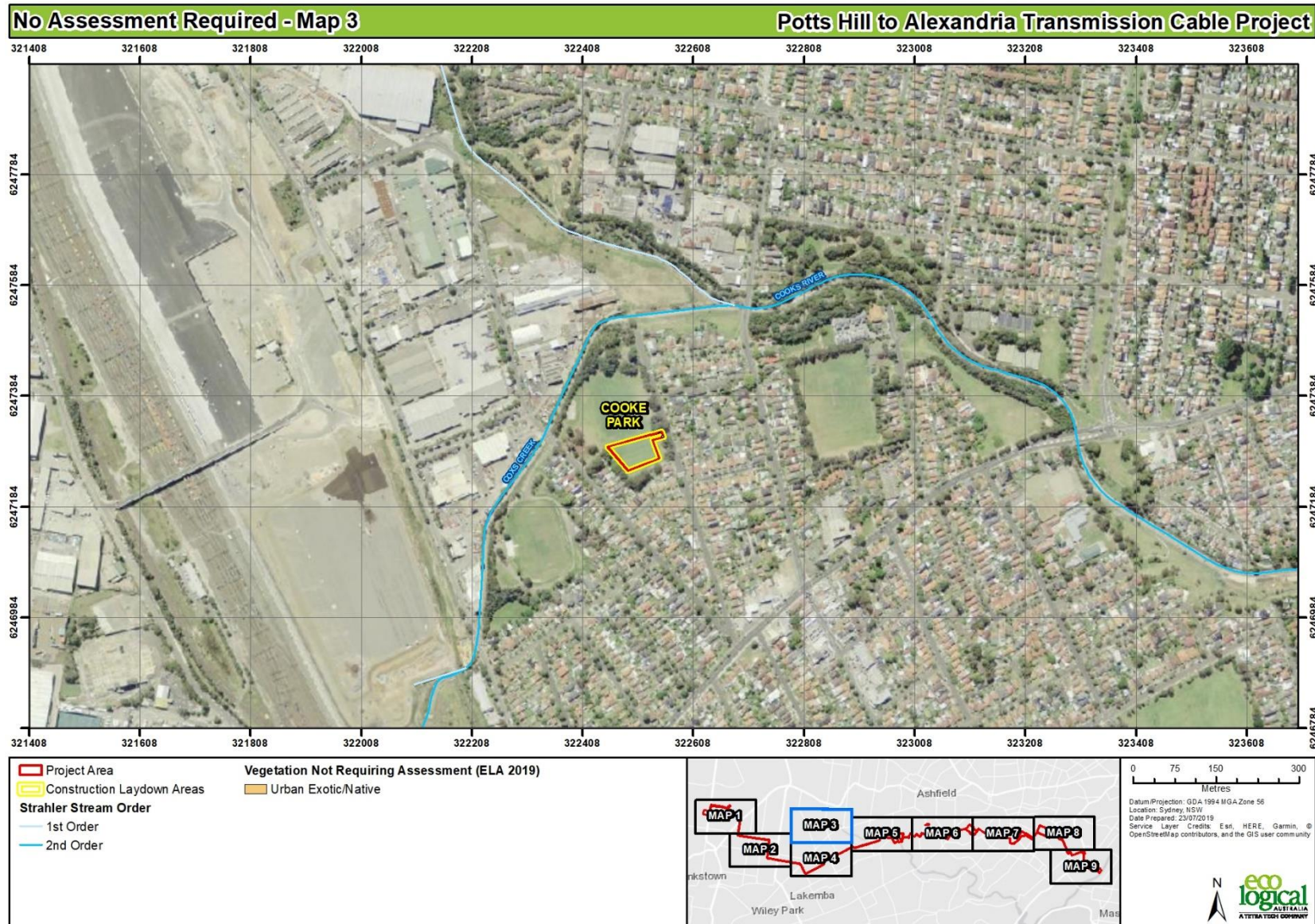


Figure 51: No assessment required map 3

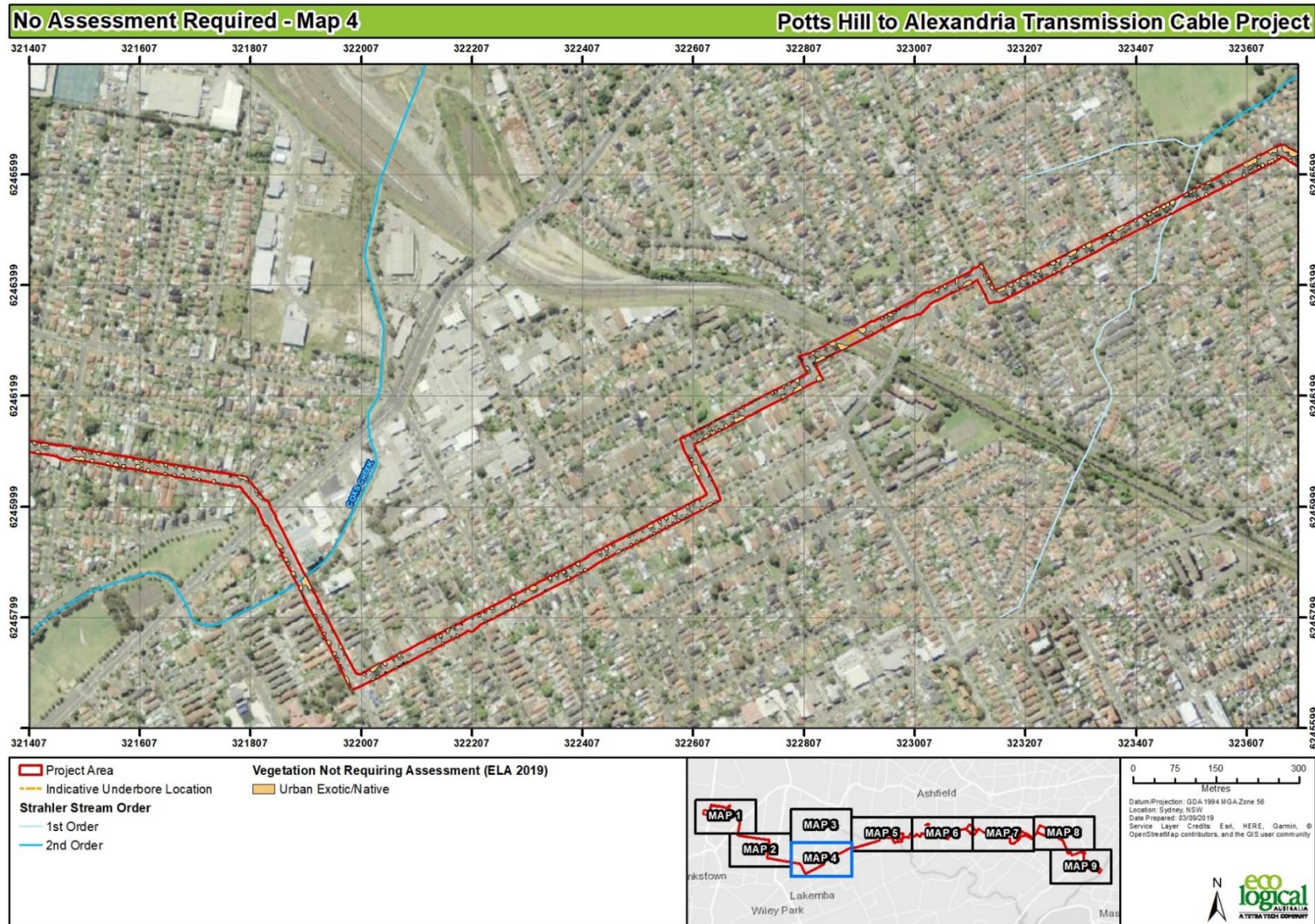


Figure 52: No assessment required map 4

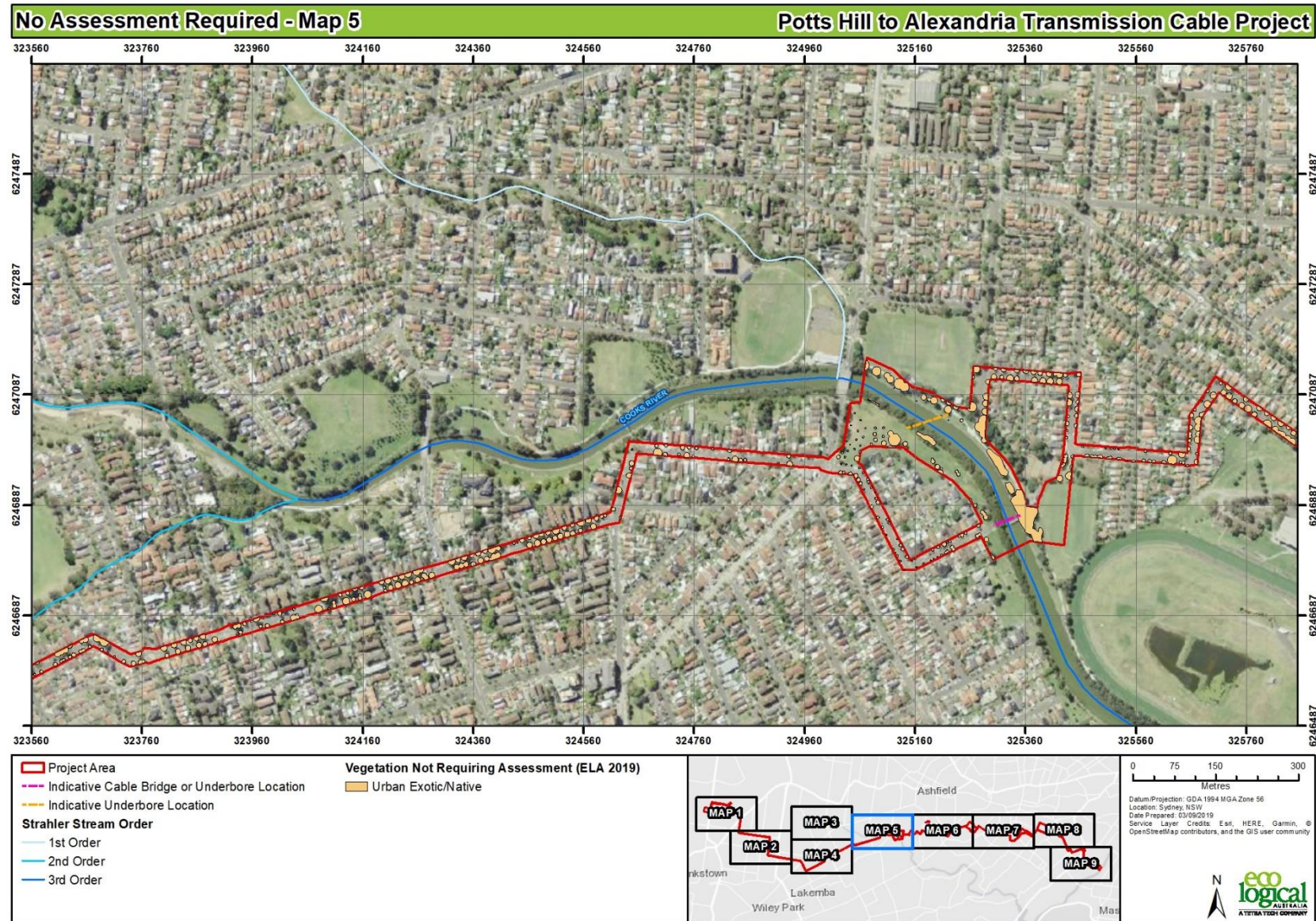


Figure 53: No assessment required map 5

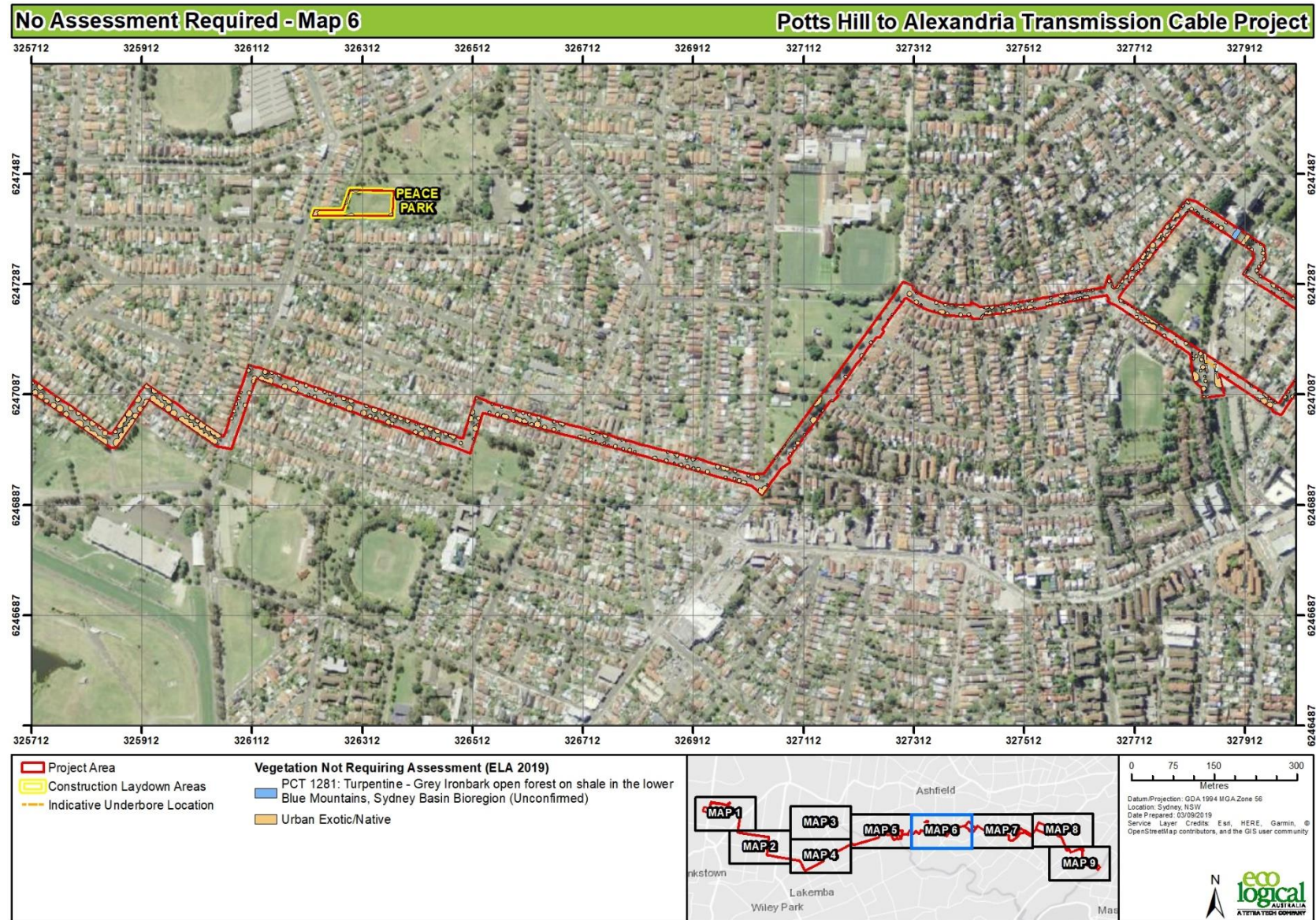


Figure 54: No assessment required map 6



Figure 55: No assessment required map 7

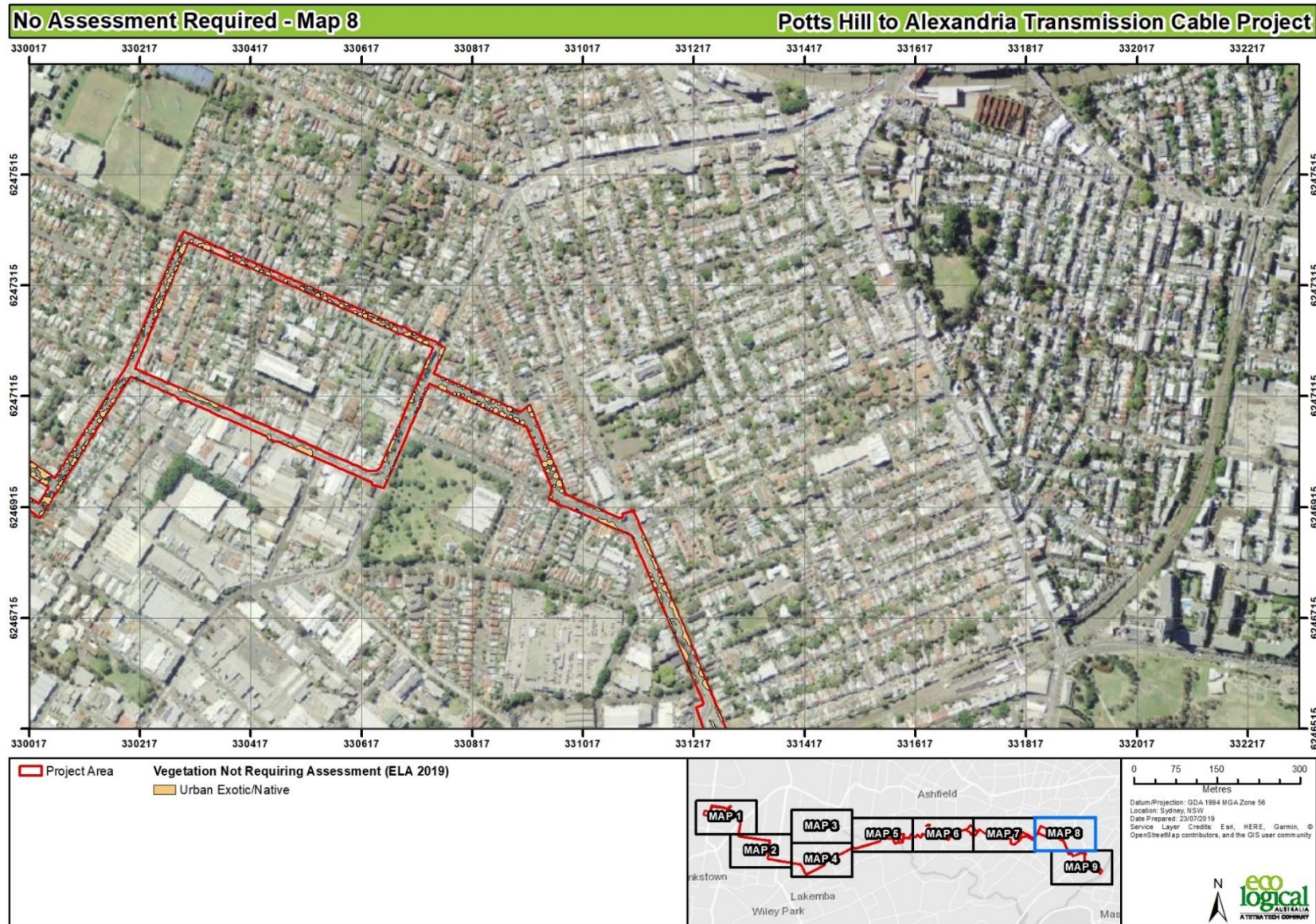


Figure 56: No assessment required map 8

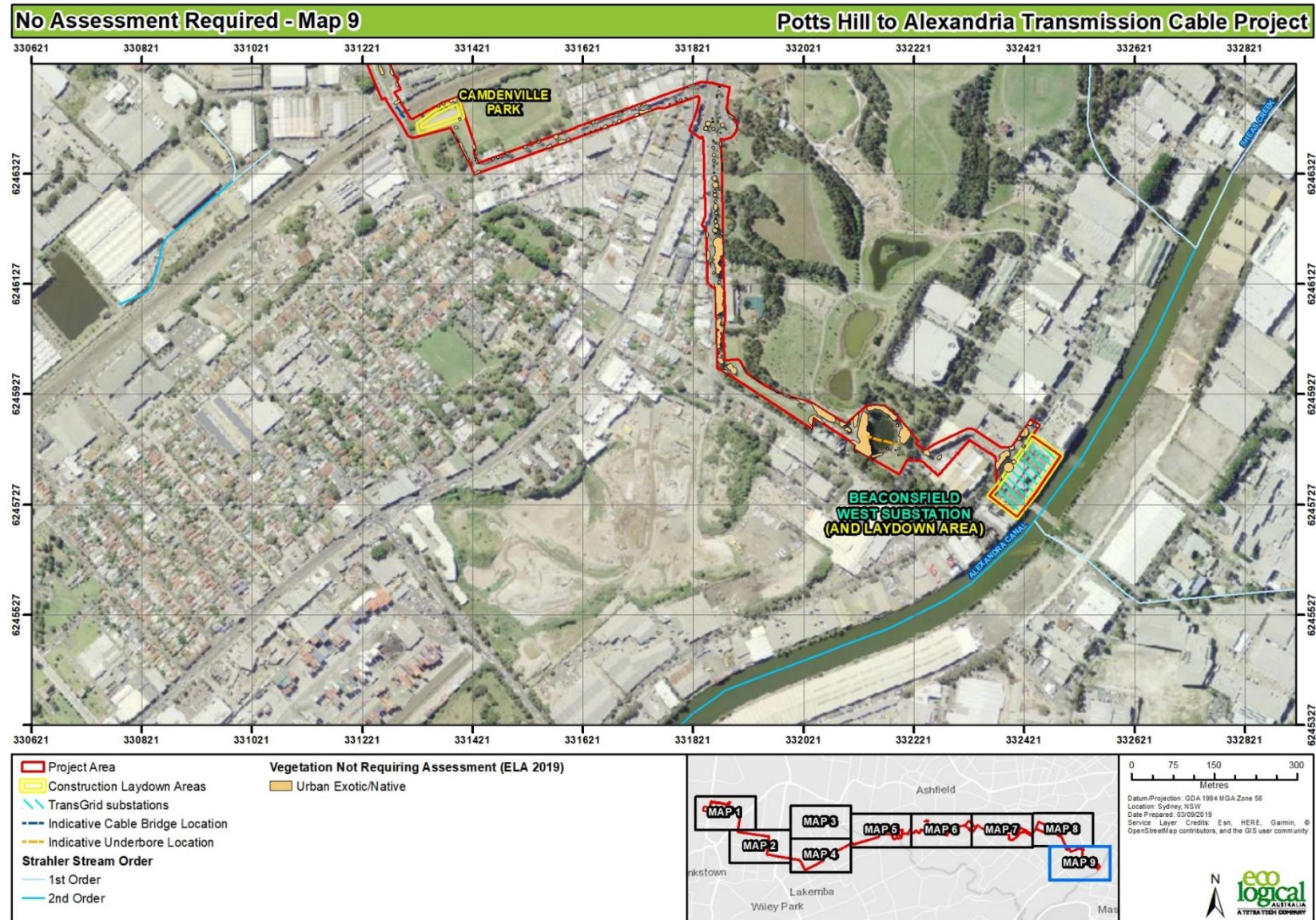


Figure 57: No assessment required map 9

2.5 Consistency with legislation and policy

The BAM applies only to terrestrial impacts. However, an assessment of impact on key fish habitat, marine vegetation and threatened fish, and a description of measures to minimise and rehabilitate impacts, as required by the SEARS and in accordance with the *Fisheries Management Act 1994*, is provided as an annex to this BDAR (Annexure E).

This assessment identified that no species of threatened fish are likely to be impacted by the development, however approximately 7,651 m² of Grey Mangroves may be subject to direct and indirect impacts associated with proposed cable installation at the Cooks River (Figure 6). Grey Mangrove is protected under the *Fisheries Management Act 1994*. As per Department of Primary Industries-(DPI) Fisheries guidelines, impact to Grey Mangrove is required to be offset at a 2:1 ratio to ensure that no net loss of key fish habitat occurs. The assessment includes mitigation measures to minimise impact on the environment and recommends that TransGrid liaise with DPI Fisheries to determine the preferred method of habitat offset.

3. References

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Appendix A: Vegetation plot data

Table 36: Vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Area (ha)	Plots required	Plots surveyed
1	920	Mangrove Forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	0.76	1	2

Table 37: Vegetation integrity data

Plot location data						
Plot no.	PCT	Vegetation Zone	Condition	Eastings	Northings	Bearing
1	920	1	Moderate	325325	6246813	108
2	920	1	Moderate	325262	6246945	95

Composition (number of species)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1	1	0	0	0	0	0
2	1	0	1	0	0	0

Structure (Total cover)						
	Tree	Shrub	Grass	Forb	Fern	Other
1	70	0	0	0	0	0
2	65	0	5	0	0	0

Function											
Plot no.	Large Trees	Hollow trees	Litter Cover	Length Fallen Logs	Tree Stem 5- 9 cm	Tree Stem 10-19 cm	Tree Stem 20-29 cm	Tree Stem 30-49 cm	Tree Stem 50-79 cm	Tree Regen	High Threat Weed Cover
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1

Form	Species name	Common name	Exotic (*)	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2
Tree	<i>Avicennia marina</i>	Grey mangrove			70	65
Tree	<i>Cestrum parqui</i>	Green Cestrum	*	*	65	1
Grass/ Grass-like	<i>Phragmites australis</i>	Common Reed	*	*		5

Appendix B: Likelihood of Occurrence

Table 38: Likelihood of occurrence and requirement for impact assessment of threatened fauna

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
Amphibians						
<i>Crinia tinnula</i>	Wallum Froglet	V	-	Acidic swamps on coastal sand plains (typically in sedgelands and wet heathlands), drainage lines, and swamp sclerophyll forests.	No. No suitable habitat on or near the Project Area.	No
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	No. No suitable habitat on or near the Project Area.	No
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	Marshes, dams and stream-sides, particularly those containing Typha spp. (bullrushes) or Eleocharis spp. (spikerushes). Some populations occur in highly disturbed areas.	No suitable habitat on or near the Project Area. No records of this species have been found within the project area.	No
<i>Litoria raniformis</i>	Growling Grass Frog	-	V	Permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				swamps or billabongs along floodplains and river valleys. Also found in irrigated rice crops.		
<i>Mixophyes balbus</i>	Stuttering Frog	E1	V	Rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	No. No suitable habitat on or near the Project Area.	No
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		Open forests, mostly on Hawkesbury and Narrabeen Sandstones.	No. No suitable habitat on or near the Project Area.	No
Birds						
<i>Actitis hypoleucos</i>	Common Sandpiper	-	M	Coastal wetlands and some inland wetlands, especially muddy margins or rocky shores. Also, estuaries and deltas, lakes, pools, billabongs, reservoirs, dams and claypans, mangroves.	No. No suitable habitat on or near the Project Area.	No
<i>Anous stolidus</i>	Common Noddy	-	M	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Anseranas semipalmata</i>	Magpie Goose	V	-	Shallow wetlands, floodplains, grasslands, pastures, dams and crops.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Anthochaera phrygia</i>	Regent Honeyeater	E4A	CE	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of <i>Casuarina cunninghamiana</i> (River Oak).	No. No suitable habitat on or near the Project Area.	No
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	Riparian woodland, swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	No. No suitable habitat on or near the Project Area.	No
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V	M	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Arenaria interpres</i>	Ruddy Turnstone	-	M	Tidal reefs and pools; pebbly, shelly and sandy shores; mudflats; inland shallow waters; sewage ponds, saltfields; ploughed ground.	No. No suitable habitat on or near the Project Area.	No
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V	-	Woodlands and dry open sclerophyll forest, usually eucalypts and mallee associations. Also have recordings in shrub and heathlands and various modified habitats, including regenerating forests. In	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				western NSW, this species is primarily associated with River Red Gum/Black Box/Coolabah open forest/woodland and associated with larger river/creek systems.		
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E1	E	Permanent freshwater wetlands with tall, dense vegetation, particularly Typha spp. (bullrushes) and Eleocharis spp. (spikerushes).	No. No suitable habitat on or near the Project Area.	No
<i>Burhinus grallarius</i>	Bush Stone-curlew	E1	-	In NSW, it occurs in lowland grassy woodland and open forest.	No. No suitable habitat on or near the Project Area.	No
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	M	Shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	No. No suitable habitat on or near the Project Area.	No
<i>Calidris alba</i>	Sanderling	V	M	Coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and lagoons; rarely recorded in near-coastal wetlands.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Calidris canutus</i>	Red Knot	-	E, M	Intertidal mudflats, sandflats sheltered sandy beaches, estuaries, bays, inlets, lagoons, harbours, sandy ocean beaches, rock platforms, coral reefs, terrestrial saline wetlands near the coast, sewage ponds and saltworks. Rarely inland lakes or swamps.	No. No suitable habitat on or near the Project Area.	No
<i>Calidris ferruginea</i>	Curlew Sandpiper	E1	CE, M	Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland."	No. No suitable habitat on or near the Project Area.	No
<i>Calidris melanotos</i>	Pectoral Sandpiper	-	M	Shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	No. No suitable habitat on or near the Project Area.	No
<i>Calidris ruficollis</i>	Red-necked Stint	-	M	Tidal mudflats, saltmarshes, sandy and shelly beaches, saline and freshwater wetlands, saltfields, sewage ponds.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Calidris subminuta</i>	Long-toed Stint	-	M	Coastal and inland shallow wetlands, sewage ponds, tidelines, tidal mudflats.	No. No suitable habitat on or near the Project Area.	No
<i>Calidris tenuirostris</i>	Great Knot	V	CE, M	Intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.	No. No suitable habitat on or near the Project Area.	No
<i>Calonectris leucomelas</i>	Streaked Shearwater	-	M	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	Forest and woodland, urban fringes.	Potential Marginal suitable habitat on or near the Project Area.	No. Habitat within the Project Area marginal in comparison to more suitable habitat in the locality.
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	-	Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.	No. No suitable habitat on or near the Project Area.	No
<i>Charadrius bicinctus</i>	Double-banded Plover	-	M	Beaches, bays and inlets, exposed reefs and rock platforms, harbours, margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps; shallow estuaries, rivers, saltmarsh, grasslands, pasture. Sometimes associated with coastal lagoons, inland saltlakes,	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				saltworks, seagrass beds, kelp beds.		
<i>Charadrius leschenaultii</i>	Greater Sand-plover	V	V, M	Almost entirely restricted to coastal areas in NSW, mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks.	No. No suitable habitat on or near the Project Area.	No
<i>Charadrius mongolus</i>	Lesser Sand-plover	V	E, M	Almost entirely coastal in NSW, using sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats, sandy beaches, coral reefs and rock platforms.	No. No suitable habitat on or near the Project Area.	No
<i>Charadrius veredus</i>	Oriental Plover	-	M	Open plains, ploughed land, inland swamps, tidal mudflats, claypans, coastal marshes, grassy airfields, playing fields, lawns.	No. No suitable habitat on or near the Project Area.	No
<i>Circus assimilis</i>	Spotted Harrier	V	-	Grassy open woodland, inland riparian woodland, grassland, shrub steppe, agricultural land and edges of inland wetlands.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Cuculus saturatus</i>	Oriental Cuckoo	-	M	Occupies rainforests, monsoon forests and vine thickets with dense vegetation and closed canopies	No. No suitable habitat on or near the Project Area.	No
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Inhabits eucalypt forests and woodlands, mallee and Acacia woodland.	No. No suitable habitat on or near the Project Area.	No
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E1	E	Central and southern populations inhabit heath and open woodland with a heathy understorey. In northern NSW, habitat comprises open forest with dense tussocky grass understorey.	No. No suitable habitat on or near the Project Area.	No
<i>Diomedea antipodensis</i>	Antipodean Albatross	V	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Diomedea antipodensis gibsoni</i>	Antipodean Albatross	V	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Diomedea epomophora</i>	Southern Royal Albatross	-	M	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Diomedea exulans</i>	Wandering Albatross	E1	M	Marine	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Diomedea gibsoni</i>	Gibson's Albatross	V	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Diomedea sanfordi</i>	Northern Royal Albatross	-	M	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	In NSW, floodplain wetlands of the major coastal rivers are key habitat. Also, minor floodplains, coastal sandplain wetlands and estuaries.	No. No suitable habitat on or near the Project Area.	No
<i>Esacus magnirostris</i>	Beach Stone-curlew	E4A	-	Exclusively along the coast, on beaches, islands, reefs and in estuaries, and edges of or near mangroves.	No. No suitable habitat on or near the Project Area.	No
<i>Epthianura albifrons</i>	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	E2	-	"Saltmarsh of Newington Nature Reserve and in grassland on the northern bank of the Parramatta River. Saltmarsh and on the sandy shoreline of a small island of Towra Point Nature Reserve."	No. No suitable habitat on or near the Project Area.	No
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	Saltmarsh vegetation, open grasslands and sometimes low shrubs bordering wetland areas.	No. No suitable habitat on or near the Project Area	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Erythrotriorchis radiatus</i>	Red Goshawk	E4A	V	Open woodland and forest, often along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and coastal riparian Eucalyptus forest.	No. No suitable habitat on or near the Project Area.	No
<i>Falco hypoleucos</i>	Grey Falcon	E	-	Shrubland, grassland and wooded watercourses, occasionally in open woodlands near the coast, and near wetlands.	No. No suitable habitat on or near the Project Area.	No
<i>Falco subniger</i>	Black Falcon	V	-	Woodland, shrubland and grassland, especially riparian woodland and agricultural land. Often associated with streams or wetlands.	No. No suitable habitat on or near the Project Area.	No
<i>Fregata ariel</i>	Lesser Frigatebird	-	M	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Fregata minor</i>	Great Frigatebird	-	M	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Fregetta grallaria grallaria</i>	White-bellied Storm-Petrel	V	V	Marine.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	No. No suitable habitat on or near the Project Area.	No
<i>Gallinago megala</i>	Swinhoe's Snipe	-	M	Breeds in Siberia and Mongolia. In Australia found around edges of fresh and brackish wetlands. This includes swamps, billabongs, river pools, small streams and sewage ponds. They are also found in drying claypans and inundated plains.	No. No suitable habitat on or near the Project Area.	No
<i>Gallinago stenura</i>	Pin-tailed Snipe	-	M	Breeds in Siberia. Habitat specific to Australia includes dense clumps of grass and rushes round the edges of fresh and brackish wetlands. This includes swamps, billabongs, river pools, small streams and sewage ponds. During non-breeding period occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				emergent, sparse to dense cover of grass/sedge or other vegetation. Also found in drier, more open wetlands such as claypans, inundated with plains pitted with crab holes and commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands.		
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	No. No suitable habitat on or near the Project Area.	No
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	No. No suitable habitat on or near the Project Area.	No
<i>Gygis alba</i>	White Tern	V	-	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	-	Rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries.	No. No suitable habitat on or near the Project Area.	No
<i>Haematopus longirostris</i>	Pied Oystercatcher	E1	-	Intertidal flats of inlets and bays, open beaches and sandbanks.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	-	Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	Unlikely. Marginal suitable habitat on or near the Project Area.	No
<i>Halobaena caerulea</i>	Blue Petrel	-	V	Colonies nest in rock crevices or burrows dug among rocks or tussock grasses.	No. No suitable habitat on or near the Project Area.	No
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Open eucalypt forest, woodland or open woodland, including sheoak or Acacia woodlands and riparian woodlands of interior NSW.	No. No suitable habitat on or near the Project Area.	No
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Occur most often over open forest and rainforest, as well as heathland, and remnant vegetation in farmland.	No. No suitable habitat on or near the Project Area.	No
<i>Ixobrychus flavicollis</i>	Black Bittern	V	-	Terrestrial and estuarine wetlands. Also flooded grassland, forest, woodland, rainforest and mangroves where permanent water is present.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Lathamus discolor</i>	Swift Parrot	E1	CE	Box-ironbark forests and woodlands.	No. No suitable habitat on or near the Project Area.	No
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	M	Sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs.	No. No suitable habitat on or near the Project Area.	No
<i>Limosa lapponica baueri</i>	Bar-tailed Godwit (baueri)	-	M	Intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons, bays, seagrass beds, saltmarsh, sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. Rarely inland wetlands, paddocks and airstrips.	No. No suitable habitat on or near the Project Area.	No
<i>Limosa lapponica menzbieri</i>	Northern Siberian Bar-tailed Godwit	-	CE	Occurs mainly in coastal habitats such as intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays as well as coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				ocean beaches, rock platforms and coral reef flats.		
<i>Limosa limosa</i>	Black-tailed Godwit	V	M	Usually sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found around muddy lakes and swamps."	No. No suitable habitat on or near the Project Area.	No
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	V	-	Wide range of treed and treeless inland habitats, always within easy reach of water.	No. No suitable habitat on or near the Project Area.	No
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Timbered habitats including dry woodlands and open forests, particularly timbered watercourses.	No. No suitable habitat on or near the Project Area.	No
<i>Macronectes giganteus</i>	Southern Giant Petrel	E1	E, M	Marine.	No. No suitable habitat on or near the Project Area	No
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-	Open forests or woodlands dominated by box and ironbark eucalypts, or by smooth-barked gums, stringybarks, river sheoaks and tea-trees.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Macronectes halli</i>	Northern Giant-Petrel	V	V, M	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Rainforest, open eucalypt forests, dry sclerophyll forests and woodlands, gullies in mountain areas or coastal foothills, Brigalow scrub, coastal scrub, mangroves, parks and gardens.	No. No suitable habitat on or near the Project Area.	No
<i>Motacilla flava</i>	Yellow Wagtail	-	M	Swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land, lawns.	No. No suitable habitat on or near the Project Area.	No
<i>Monarcha trivirgatus</i>	Spectacled Monarch	-	M	Mountain/lowland rainforest, wooded gullies, riparian vegetation including mangroves.	No. No suitable habitat on or near the Project Area.	No
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Eucalypt-dominated forests, especially near wetlands, watercourses, and heavily-vegetated gullies.	No. No suitable habitat on or near the Project Area.	No
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	E4A	CE	Winter habitat is mostly within 3 kilometres of the coast in sheltered bays, lagoons, estuaries, coastal dunes and saltmarshes. Also, small islands and peninsulas,	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				saltworks, golf courses, low samphire herbland and taller coastal shrubland.		
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Eucalypt and cypress pine open forests and woodlands, ecotones between woodland and grassland, or coastal forest and heath.	No. No suitable habitat on or near the Project Area.	No
<i>Nettapus coromandelianus</i>	Cotton Pygmy-Goose	E1	-	Freshwater lakes, lagoons, swamps and dams.	No. No suitable habitat on or near the Project Area.	No
<i>Ninox connivens</i>	Barking Owl	V	-	Woodland and open forest, including fragmented remnants and partly cleared farmland, wetland and riverine forest.	No. No suitable habitat on or near the Project Area.	No
<i>Ninox strenua</i>	Powerful Owl	V	-	Woodland, open sclerophyll forest, tall open wet forest and rainforest.	No. No suitable habitat on or near the Project Area.	No
<i>Numenius madagascariensis</i>	Eastern Curlew	-	CE, M	Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats or sandflats, ocean beaches, coral reefs, rock platforms, saltmarsh, mangroves, freshwater/brackish	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				lakes, saltworks and sewage farms.		
<i>Numenius minutus</i>	Little Curlew	-	M	Dry grasslands, open woodlands, floodplains, margins of drying swamps, tidal mudflats, airfields, playing fields, crops, saltfields, sewage ponds.	No. No suitable habitat on or near the Project Area.	No
<i>Numenius phaeopus</i>	Whimbrel	-	M	Estuaries, mangroves, tidal flats, coral cays, exposed reefs, flooded paddocks, sewage ponds, grasslands, sports fields, lawns.	No. No suitable habitat on or near the Project Area.	No
<i>Onychoprion fuscatus</i>	Sooty Tern	V	-	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Pandion cristatus</i>	Eastern Osprey	V	-	Rocky shorelines, islands, reefs, mouths of large rivers, lagoons and lakes.	No. No suitable habitat on or near the Project Area.	No
<i>Pandion haliaetus</i>	Osprey	-	M	Coastal areas near shallow waters.	No. No suitable habitat on or near the Project Area.	No
<i>Pachyptila turtur subantarctica</i>	Fairy Prion	-	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Petroica boodang</i>	Scarlet Robin	V	-	Dry eucalypt forests and woodlands, and occasionally in mallee,	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				wet forest, wetlands and tea-tree swamps.		
<i>Petroica phoenicea</i>	Flame Robin	V	-	Breeds in upland tall moist eucalypt forests and woodlands. In winter uses dry forests, open woodlands, heathlands, pastures and native grasslands. Occasionally occurs in temperate rainforest, herbfields, heathlands, shrublands and sedgeland at high altitudes.	No. No suitable habitat on or near the Project Area.	No
<i>Petroica rodinogaster</i>	Pink Robin	V	-	Rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	No. No suitable habitat on or near the Project Area.	No
<i>Pezoporus wallicus</i>	Eastern Ground Parrot	V	-	Coastal or subcoastal low heathland and sedgeland.	No. No suitable habitat on or near the Project Area.	No
<i>Philomachus pugnax</i>	Ruff	-	M	Terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. Occasionally harbours, estuaries, seashores, sewage farms and saltworks.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Phoebastria fusca</i>	Sooty Albatross	V	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Box-gum woodland, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	No. No suitable habitat on or near the Project Area.	No
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-	Open woodland habitats; favours Box-gum woodlands on the slopes and Box-cypress and open Box woodlands on alluvial plains.	No. No suitable habitat on or near the Project Area.	No
<i>Pterodroma solandri</i>	Providence Petrel	V	M	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	-	Rainforest, low-elevation moist eucalypt forest and brush box forests.	No. No suitable habitat on or near the Project Area.	No
<i>Pluvialis fulva</i>	Pacific Golden Plover	-	M	Estuaries, mudflats, saltmarshes, mangroves, rocky reefs, inland swamps, ocean shores, paddocks, sewage ponds, ploughed land, airfields, playing fields.	No. No suitable habitat on or near the Project Area.	No
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	-	Sub-tropical and dry rainforest, moist eucalypt forest and	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				swamp forest, where fruit is plentiful.		
<i>Puffinus assimilis</i>	Little Shearwater	V	-	Marine.	No. No suitable habitat on or near the Project Area.	No
<i>Pluvialis squatarola</i>	Grey Plover	-	M	Mudflats, saltmarsh, tidal reefs and estuaries.	No. No suitable habitat on or near the Project Area.	No
<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	V	E	Marine. Nesting habitat is located within steeply sloping rock scree gullies with a canopy of Cabbage Tree Palms."	No. No suitable habitat on or near the Project Area.	No
<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel (west Pacific subspecies)	V	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Ptilinopus superbis</i>	Superb Fruit-Dove	V	-	Rainforest and closed forests. May also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	No. No suitable habitat on or near the Project Area.	No
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Wet sclerophyll forests, subtropical and temperate rainforests. Sometimes drier sclerophyll forests and woodlands.	No. No suitable habitat on or near the Project Area.	No
<i>Rostratula australis</i>	Australian Painted Snipe	E1	E	Swamps, dams and nearby marshy areas.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, secondary derived grassland, riparian areas and lightly wooded farmland.	No. No suitable habitat on or near the Project Area.	No
<i>Sterna albifrons</i>	Little Tern	-	M, Mar	The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas	No. No suitable habitat on or near the Project Area.	No
<i>Sterna hirundo</i>	Common Tern	-	M	Offshore waters, ocean beaches, estuaries, large lakes. Less commonly freshwater swamps, floodwaters, sewage farms and brackish and saline lakes.	No. No suitable habitat on or near the Project Area.	No
<i>Sternula albifrons</i>	Little Tern	E1	M	Sheltered coastal environments, harbours, inlets and rivers.	No. No suitable habitat on or near the Project Area.	No
<i>Sternula nereis nereis</i>	Australian Fairy Tern	-	V	Embayments of a variety of habitats including offshore, estuarine or lake islands, wetlands and mainland coastline. Nests on sheltered sandy beaches, spits and banks above the high	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				tide line and below vegetation.		
<i>Stictonetta naevosa</i>	Freckled Duck	V		Freshwater swamps and creeks, lakes, reservoirs, farm dams and sewage ponds.	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche bulleri</i>	Buller's Albatross	-	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche bulleri platei</i>	Northern Buller's Albatross	-	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche cauta cauta</i>	Shy Albatross	V	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche chrysostoma</i>	Grey-headed Albatross	-	E	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche eremita</i>	Chatham Albatross	-	E	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche impavida</i>	Campbell Albatross	-	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche cauta</i>	Tasmanian Shy Albatross	-	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche melanophris</i>	Black-browed Albatross	V	V; M	Marine	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Thalassarche salvini</i>	Salvin's Albatross	V		Marine	No. No suitable habitat on or near the Project Area.	No
<i>Thalassarche steadi</i>	White-capped Albatross	-	V	Marine	No. No suitable habitat on or near the Project Area.	No
<i>Tringa brevipes</i> (also listed as <i>Heteroscelus brevipes</i>)	Grey-tailed Tattler	-	M	Sheltered coasts with reefs and rock platforms or intertidal mudflats; intertidal rocky, coral or stony reefs; shores of rock, shingle, gravel or shells; embayments, estuaries and coastal lagoons; lagoons and lakes; and ponds in sewage farms and saltworks.	No. No suitable habitat on or near the Project Area.	No
<i>Tringa incana</i> (also listed as <i>Heteroscelus incanus</i>)	Wandering Tattler	-	M	Rocky coasts with reefs and platforms, offshore islands, shingle beaches or beds; occasionally coral reefs or beaches.	No. No suitable habitat on or near the Project Area.	No
<i>Tringa nebularia</i>	Common Greenshank	-	M	Terrestrial wetlands (swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans, saltflats, sewage farms and saltworks dams, inundated rice crops and bores) and sheltered	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				coastal habitats (mudflats, saltmarsh, mangroves, embayments, harbours, river estuaries, deltas, lagoons, tidal pools, rock-flats and rock platforms).		
<i>Tringa stagnatilis</i>	Marsh Sandpiper	-	M	Swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, intertidal mudflats, sewage farms and saltworks, reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes.	No. No suitable habitat on or near the Project Area.	No
<i>Tyto longimembris</i>	Eastern Grass Owl	V	-	Areas of tall grass, including grass tussocks, swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	No. No suitable habitat on or near the Project Area.	No
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Dry eucalypt forests and woodlands from sea level to 1100 metres.	No. No suitable habitat on or near the Project Area.	No
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	Dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Xenus cinereus</i>	Terek Sandpiper	V	M	Mudbanks and sandbanks near mangroves, rocky pools and reefs, and occasionally up to 10 kilometres inland around brackish pools.	No. No suitable habitat on or near the Project Area.	No
Mammals (excluding bats)						
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V		From tall wet sclerophyll forests on the coast to the dry forests and open woodlands west of the Great Dividing Range.	No. No suitable habitat on or near the Project Area.	No
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Rainforest, sclerophyll forest (including Box-Ironbark), woodland and heath.	No. No suitable habitat on or near the Project Area.	No
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	No. No suitable habitat on or near the Project Area.	No
<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spotted-tailed Quoll	V	E	Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	No. No suitable habitat on or near the Project Area.	No
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E1	E	Heath or open forest with a heathy	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				understorey on sandy or friable soils.		
<i>Perameles nasuta</i>	Long-nosed Bandicoot population in inner western Sydney	E2	-	Backyards, parkland.	Likely. Suitable foraging and movement habitat occurs within Project Area	Potential habitat
<i>Petaurus australis</i>	Yellow-bellied Glider	-	V	The habitat on the Bago Plateau consists of tall wet sclerophyll forest dominated by <i>Eucalyptus delegatensis</i> (Alpine Ash), <i>E. dalrympleana</i> (Mountain Gum), <i>E. radiata</i> (Narrow-leaved Peppermint), and <i>E. rubida</i> (Candlebark).	No. No suitable habitat on or near the Project Area.	No
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Open forest, woodland and riverine forest habitats.	No. No suitable habitat on or near the Project Area.	No
<i>Petauroides volans</i>	Greater Glider population in the Eurobodalla local government area	E2	V	Eucalypt forests and woodlands.	No. No suitable habitat on or near the Project Area.	No
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E1	V	Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	No. No suitable habitat on or near the Project Area.	No
<i>Phascolarctos cinereus</i>	Koala	V	V	Eucalypt woodlands and forests.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	V	-	Optimal habitat appears to be in regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again.	No. No suitable habitat on or near the Project Area.	No
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.	No. No suitable habitat on or near the Project Area.	No
Microbats and Mega Bats						
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	Unlikely	No. Suitable habitat not within Project Area
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Tall (greater than 20 metres) moist habitats.	Unlikely	No. Suitable habitat not within Project Area
<i>Kerivoula papuensis</i>	Golden-tipped Bat	V	-	Rainforest and adjacent wet and dry sclerophyll forest up to 1000 metres. Also recorded in tall open forest, Casuarina-dominated riparian forest and	Unlikely	No. Suitable habitat not within Project Area

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				coastal Melaleuca forests.		
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	Unlikely	No. Suitable habitat not within Project Area
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Unlikely	Potential foraging and potential flyway at Old Canterbury Road bridge. Roosting unlikely as no roosting crevices or signs of presence detected. Potentially impacted sections of drainage network small in size and short in length and unlikely roosting habitat
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Unlikely	No. Suitable habitat not within Project Area
<i>Myotis macropus</i>	Southern Myotis	V	-	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20 metres.	Unlikely	No. Suitable habitat not within Project Area

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Likely. Suitable foraging habitat occurs within the Project Area.	Yes. See Annexure D
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V		Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies.	Unlikely	No
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Woodland, moist and dry eucalypt forest and rainforest.	Unlikely	No
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	Dry open forest and woodland, near cliffs or rocky overhangs, cliff-lines in wet eucalypt forest and rainforest.	Unlikely	No
Reptiles						
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E1	V	Dry and wet sclerophyll forests, riverine forests, coastal heath swamps, rocky outcrops, heaths, grassy woodlands.	No. No suitable habitat on or near the Project Area.	No
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V	-	Heath, open forest and woodland.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
Invertebrates						
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-	Primarily inhabits Cumberland Plain Woodland. Also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest.	No. No suitable habitat on or near the Project Area.	No
<i>Pommerhelix duralensis</i>	Dural Land Snail		E	The Dural Land Snail is endemic to NSW and is confined to the northwest fringes of the Cumberland Plain. The snail has a strong preference for dry shale-influenced transitional landscapes. Associated with open eucalypt forests, particularly Shale-Sandstone Transition Forest and Sydney Turpentine – Ironbark Forest. Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees (particularly <i>Eucalyptus punctata</i>) or burrowing in loose soil around clumps of grass.	No. No suitable habitat on or near the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
Insects						
<i>Petalura gigantea</i>	Giant Dragonfly	E	-	Permanent swamps and bogs with some free water and open vegetation.	Potential	No. Habitat for this species will not be removed as part of the project.
Fish						
<i>Epinephelus daemeli</i>	Black Rockcod,	V (FM Act)	V	Caves, gutters and beneath bomboras on rocky reefs. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries.	No. No suitable habitat on or near the Project Area.	No
<i>Macquaria australasica</i>	Macquarie Perch	E (FM Act)	E	River and lake habitats, especially the upper reaches of rivers and their tributaries.	No. No suitable habitat on or near the Project Area.	No
<i>Prototroctes maraena</i>	Australian Grayling	-	V	Streams and rivers on the eastern and southern flanks of the Great Dividing Range; in NSW, it occurs south from the Shoalhaven River.	No. No suitable habitat on or near the Project Area.	No

^BC Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable; EPBC Act: M = Migratory, E = Endangered, CE – Critically Endangered, Mar = Marine; *species of local conservation significance under the UESAP

Table 39: Likelihood of occurrence and requirement of impact assessment for threatened flora

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Acacia bynoeana</i>	Bynoe's Wattle	E1	V	Heath or dry sclerophyll forest on sandy soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Acacia prominens</i>	Gosford Wattle, Hurstville and Kogarah Local Government Areas	E2	-	Open situations on clayey or sandy soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Acacia pubescens</i>	Downy Wattle	V	V	Open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Acacia terminalis subsp. terminalis</i>	Sunshine Wattle	E1	E	Coastal scrub and dry sclerophyll woodland on sandy soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Allocasuarina diminuta subsp. mimica</i>	Allocasuarina diminuta subsp. mimica L.A.S.Johnson population in the Sutherland and Liverpool local government area	E2	-	Heathy woodland, heathlands and low open woodlands.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Allocasuarina glareicola</i>	-	E1	E	Castlereagh woodland on lateritic soil. Found in open woodland with Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				bakeri, Eucalyptus sclerophylla and Melaleuca decora.		
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	E1	E	The original habitat is tall closed woodland, above a sandstone shelf approximately 20 metres above the harbour. Soils are shallow and sandy; plantings have occurred on similar soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Amperea xiphoclada</i> var. <i>pedicellata</i>	-	E4	-	Heath, woodland and forest in low-fertility, sandy soils. Known only from the type specimen collected in 1892 from Sydney. Has not been observed since and is presumed extinct.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Asterolasia buxifolia</i>	-	E1	-	Restricted to dense riparian scrub along rocky watercourses with a granitic substrate.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Asterolasia elegans</i>	-	E1	E	Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	V	V	Dry sclerophyll woodland on sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Boronia umbellata</i>	Orara Boronia	V	V	In and around gullies in wet open forest.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Caesia parviflora var. minor</i>	Small Pale Grass-lily	E1	-	Damp places in open forest on sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E1	V	Grassy sclerophyll woodland on clay loam or sandy soils, or low woodland with stony soil.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	Dry sclerophyll forest.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Coastal heathlands, margins of coastal swamps and sedgeland, coastal forest, dry woodland, and lowland forest."	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Chamaesyce psammogeton</i>	Sand Spurge	E1	-	Fore-dunes, pebbly strandlines and exposed headlands, often with <i>Spinifex sericeus</i> (Spinifex) and <i>Zoysia macrantha</i> (Prickly Couch).	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Coastal heathlands, margins of coastal swamps and sedgeland, coastal forest, dry woodland, and lowland forest.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Darwinia biflora</i>	-	V	V	Woodland, open forest or scrub-heath on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Darwinia glaucophylla</i>	-	V	-	Occurs in sandy heath, scrub and woodlands, often associated with sandstone rock platforms or near hanging swamps.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Darwinia peduncularis</i>	-	V	-	Rocky outcrops on sandy, well drained, low nutrient soil over sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Deyeuxia appressa</i>	-	E1	E	Moist conditions.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Dichanthium setosum</i>	Bluegrass	V	V	Cleared woodland, grassy roadside remnants and highly disturbed pasture, on heavy basaltic black soils and red-brown loams with clay subsoil.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Dillwynia tenuifolia</i>	-	V	-	Scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest, transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland, and disturbed escarpment woodland on Narrabeen sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Diuris arenaria</i>	Sand Doubletail	E1	-	Coastal heath and dry grassy eucalypt forest.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Diuris bracteata</i>	-	E1	-	Sclerophyll woodland and forest with a predominantly grassy understorey.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Doryanthes palmeri</i>	Giant Spear Lily	V		Exposed rocky outcrops, cliff-tops and on steep cliff-faces in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest."	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	-	V	-	Sclerophyll forest, scrubs and swamps. Most habitats have a strong shale soil influence.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	Coastal heath on shallow sandy soils overlying Hawkesbury sandstone, mostly on exposed sandy ridges."	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Eucalyptus fracta</i>	Broken Back Ironbark	V	-	Dry eucalypt woodland in shallow soils along the upper escarpment of a steep sandstone range.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	Dry grassy woodland, on shallow soils of slopes and ridges.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Eucalyptus pulverulenta</i>	Silver-leafed Gum	V	V	Open forest typically dominated by <i>Eucalyptus mannifera</i> (Brittle Gum), <i>E. macrorhynca</i> (Red Stringybark), <i>E. dives</i> (Broad-leaved Peppermint), <i>E. sieberi</i>	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				(Silvertop Ash) and <i>E. bridgesiana</i> (Apple Box), on shallow soils.		
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E1	V	Open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Galium australe</i>	Tangled Bedstraw	E1	-	Turpentine forest and coastal Acacia shrubland in NSW. Elsewhere sand dunes, sand spits, shrubland and woodland.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E1	E	Dry sclerophyll forest and moss gardens over sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Genoplesium plumosum</i>	Tallong Midge Orchid	E4A	E	Heathland, generally dominated by <i>Kunzea parvifolia</i> (Violet Kunzea), <i>Calytrix tetragona</i> (Common Fringe-myrtle) and <i>Dillwynia</i> spp. (parrot-peas), on very shallow soils, often on sandstone conglomerate rock shelves.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	E1	-	Rainforest and moist eucalypt forest, usually near streams, on rocks or in trees.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Grevillea beadleana</i>	Beadle's Grevillea	E1	E	Open eucalypt forest with a shrubby understorey, mainly on	Unlikely. Suitable habitat for the species	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				steep granite slopes at high altitudes.	not present within the Project Area.	
<i>Grevillea caleyi</i>	Caley's Grevillea	E4A	E	Open forest, generally dominated by <i>Eucalyptus sieberi</i> and <i>E. gummifera</i> on a ridgetop, in association with laterite soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Grevillea juniperina subsp. juniperina</i>	Juniper-leaved Grevillea	V	-	Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest, on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Grevillea parviflora subsp. parviflora</i>	Small-flower Grevillea	V	V	Heath and shrubby woodland to open forest on sandy or light clay soils usually over thin shales.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Grevillea parviflora subsp. supplicans</i>	-	E1	-	Heathy woodland associations on skeletal sandy soils over sandstones.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Grevillea shiressii</i>	-	V	V	Creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Haloragis exalata subsp. exalata</i>	Square Raspwort	V	V	Protected and shaded damp situations in riparian habitats.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Haloragodendron lucasii</i>	-	E1	E	Dry sclerophyll forest and low open woodland on sheltered slopes near creeks, in moist sandy loam soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Hibbertia sp. Bankstown</i>	-	E4A	CE	Heavily modified low grass/shrub association (ex Cooks River/Castlereagh Ironbark Forest) on sandy alluvium with a high silt content.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Hibbertia fumana</i>	-	E4A		Generally found in areas of woodland with a more open understorey, in a long intergrade between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest at the Moorebank Site.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Hibbertia puberula</i>	-	E1	-	Low heath, dry sclerophyll woodland, upland swamps, on sandy soils or clay.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Hibbertia puberula subsp. glabrescens</i>	-	E4A	CE	Heavily modified low grass/shrub association (ex Cooks River/Castlereagh Ironbark Forest) on sandy alluvium with a high silt content.		No
<i>Hibbertia spanantha</i>	Julian's Hibbertia	E4A	-	Endemic to the Sydney Basin bioregion. Grows in forest with canopy species including Eucalyptus pilularis, E. resinifera, Corymbia gummifera and Angophora costata. The	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				understorey is open with species of Poaceae, Orchidaceae, Fabaceae and Liliaceae. Soil identifies as light clay occurring on shale sandstone soil transition.		
<i>Hibbertia stricta subsp. furcatula</i>	-	E1	-	Dry eucalypt forest and woodland	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Hibbertia superans</i>	-	E1	-	Open woodland and heathland, and appears to prefer open disturbed areas.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Isotoma fluviatilis subsp. fluviatilis</i>	-	E1	X	Damp places on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland, and alluvial woodland/shale plains woodland.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Kunzea rupestris</i>	-	V	V	Shrubland or heathland, in shallow depressions on large flat sandstone rock outcrops.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Lasiopetalum joyceae</i>	-	V	V	Heath on lateritic to shaley ridgetops over sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Leptospermum deanei</i>	-	V	V	Woodland, riparian scrub and open forest on lower hill slopes or near creeks, on sand or sandy alluvial soil.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	Woodland on sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Leucopogon fletcheri subsp. fletcheri</i>	-	E1	-	Dry eucalypt woodland or in shrubland on clayey lateritic soils, generally along ridges and spurs.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Marsdenia viridiflora subsp. viridiflora</i>	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2	-	Vine thickets and open shale woodland.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Maundia triglochinoides</i>	-	V	-	Swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Damp places, often near streams or low-lying areas on alluvial soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Heath on sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Micromyrtus blakelyi</i>	-	V	V	Heathlands in shallow sandy soil, on sandstone rock platforms.	Unlikely. Suitable habitat for the species	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
					not present within the Project Area.	
<i>Microtis angusii</i>	Angus's Onion Orchid	E1	E	Ingleside location is highly disturbed and dominated by the introduced weeds Coolatai grass (<i>Hyparrhenia hirta</i>) and <i>Acacia saligna</i> . The area is likely to have originally supported the Duffys Forest Vegetation Community, which ranges from open forest to low open forest and woodland.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pelargonium sp. Striatellum</i>	Omeo Storksbill	E1	E	Irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and wetland or aquatic communities.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Persoonia hirsuta</i>	Hairy Geebung	E1	E	Sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Persoonia mollis subsp. maxima</i>	-	E1	E	Dry to wet sclerophyll forest, in deep sheltered gullies or steep upper hillsides on Hawkesbury Sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Persoonia nutans</i>	Nodding Geebung	E1	E	Northern populations: sclerophyll forest and woodland (Agnes Banks Woodland, Castlereagh Scribbly Gum Woodland and Cooks River / Castlereagh Ironbark Forest) on aeolian and alluvial sediments. Southern	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
				populations: tertiary alluvium, shale sandstone transition communities and Cooks River / Castlereagh Ironbark Forest.		
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	V	V	Woodland, mostly on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pimelea spicata</i>	Spiked Rice-flower	E1	E	Well-structured clay soils. Eucalyptus moluccana (Grey Box) communities and in areas of ironbark on the Cumberland Plain. Coast Banksia open woodland or coastal grassland in the Illawarra."	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pomaderris brunnea</i>	E1	V		Moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pomaderris prunifolia</i>	P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	E2	-	At Rydalmere it occurs among grass species on sandstone near a creek. At Rookwood Cemetery it occurs in a small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Prasophyllum fuscum</i>	Slaty Leek Orchid	E4A	V	Moist heath, often along seepage lines	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Prostanthera askania</i>	Tranquility Mintbush	E1	E	Moist sclerophyll forest and warm temperate rainforest on Narrabeen sandstone and derived alluvial soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Prostanthera densa</i>	Villous Mint-bush	V	V	Sclerophyll forest and shrubland on coastal headlands and near-coastal ranges, chiefly on sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Prostanthera junonis</i>	Somersby Mintbush	E1	E	Open forest, low woodland and open scrub on gently undulating country over weathered Hawkesbury sandstone.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Prostanthera marifolia</i>	Seaforth Mintbush	E4A		In or in close proximity to the endangered Duffys Forest ecological community, on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pterostylis nigricans</i>	Dark Greenhood	V	-		Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E1	E	Small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines, adjacent to sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pultenaea aristata</i>	Prickly Bush-pea	V	V	Dry sclerophyll woodland or wet heath on sandstone.	Unlikely. Suitable habitat for the species	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
					not present within the Project Area.	
<i>Pultenaea parviflora</i>		E1	V	Dry sclerophyll forest, especially Castlereagh Ironbark Forest, Shale Gravel Transition Forest and transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E1	-	Woodland, sclerophyll forest, road batters and coastal cliffs.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Sarcophilus hartmannii</i>	Hartman's Sarcophilus	V	-	On volcanic rocks, in sclerophyll forest or exposed sites, from 500 to 1000 m. Rarely on bases of trees.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Senecio spathulatus</i>	Coast Groundsel	E1	-	Frontal dunes in coastal areas.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V	Subtropical and littoral rainforest on gravels, sands, silts and clays.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Tetratheca glandulosa</i>		V	-	"Heath, scrub, woodlands and open forest on upper-slopes and mid-slope sandstone benches. Soils generally shallow, consisting of a yellow, clayey/sandy loam.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	Low open forest/woodland, heathland and moist forest, mainly on low nutrient soils associated with the Awaba Soil Landscape.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Thelymitra kangaloonica</i>	Kangaloon Sun Orchid	-	CE	Swamps in sedgeland over grey silty grey loam soils.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Thesium australe</i>	Austral Toadflax	V	V	Grassland on coastal headlands or grassland and grassy woodland away from the coast.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Triplarina imbricata</i>	Creek Triplarina	E1	E	Along watercourses in low open forest with <i>Tristaniaopsis laurina</i> (Water Gum).	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E2	-	In Hornsby LGA it occurs in or adjacent to sandstone gully forest. In Western Sydney it is found in remnants of Cooks River/ Castlereagh Ironbark Forest. Typically occurs in damp, disturbed sites.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	V	-	Margins of salt marshes and lakes.	Unlikely. Suitable habitat for the species not present within the Project Area.	No
<i>Zannichellia palustris</i>	-	E1	-	Fresh or slightly saline stationary or slowly flowing water.	Unlikely. Suitable habitat for the species	No

Scientific Name	Common Name	TSC Status	EPBC Status	Habitat	Likelihood of Occurrence	Impact Assessment Required
					not present within the Project Area.	
<i>Zieria involucrata</i>	-	E1	V	Wet sclerophyll forest on mid- to lower slopes and valleys; some populations extend upslope into drier vegetation.	Unlikely. Suitable habitat for the species not present within the Project Area.	No

Appendix C: Assessment of Significance

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where “Matters of National Environmental Significance” (MNES) may be affected. Under the Act, any action which “has, will have, or is likely to have a significant impact on a matter of MNES” is defined as a “controlled action”, and requires approval from the Commonwealth Department of the Environment and Energy (DoEE), which is responsible for administering the EPBC Act (DoEE 2013). The process includes conducting a Significance Assessment for listed threatened species and ecological communities that represent a MNES that would be impacted as a result of the proposed action. Significant impact guidelines (DoEE 2013) that outline criteria have been developed by the Commonwealth to provide assistance in conducting the Significance Assessment and to help decide whether or not a referral to the Commonwealth is required.

Two planted tree species, *Eucalyptus scoparia* (Wallangarra White Gum) and *Eucalyptus nicholii* (Narrow-leaved Black Peppermint) listed as Vulnerable under the EPBC Act were identified as potentially impacted by the project, however the project area is well outside the natural range for these species which is limited to northern NSW and Queensland. Accordingly, they are not considered in a significant impact assessment under the Act.

The threatened entity subject to this assessment is *Pteropus poliocephalus* (Grey-headed Flying Fox) (GHFF), listed as Vulnerable under the EPBC Act.

This species utilises a wide variety of habitats (including disturbed areas) for foraging and have been recorded travelling long distances on feeding forays. Fruits and flowering plants of a wide variety of species are the main food source. The species roosts in large ‘camps’ of up to 200 000 individuals. Camps are usually formed close to water and along gullies, however, the species has been known to form camps in urban areas (DoE 2016b). According to the National Flying-fox Monitoring Program, no GHFF camps currently occur or have previously been recorded within the project area (DoEE 2018). The nearest historic camp occurs approximately 3 kilometres to the south of the transmission cable route and temporary laydown areas at Wolli Creek. An additional active GHFF camp occurs approximately 5 kilometres to the east of the transmission cable route and temporary laydown areas, within Centennial Park (DoEE 2018).

GHFF has not been recorded within the project area but is known from the locality within close proximity to the project area. The vegetation within the project area provides potential foraging habitat in the form of 9.9 hectares of planted native and exotic species, specifically *Lophostemon confertus* (Brush Box), *Melaleuca quinquenervia* (Broad-leaved Paperbark), and *Ficus* spp, and 0.76 hectares of mangrove forest. It is considered likely that this species would utilise these trees within the project area and adjacent areas on occasion for foraging purposes.

Table 40: EPBC Act Assessment of Significance- Grey-headed Flying-fox

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species	<p>A historic GHFF camp is approximately 3 kilometres to the south of the project area, and an active camp approximately 5 kilometres to the east, within Centennial Park. These colonies of GHFF are nationally important camps for the population. Individuals move between camps within the Sydney region to utilise foraging resources.</p> <p>Foraging occurs within a 50 kilometre radius around these camps. Available foraging resources include street trees, urban bushland and conservation reserves.</p> <p>Only a relatively small area of potential foraging habitat would be removed under the proposed action given the extensive amount of similar, and more suitable habitat available in the local area. No individuals or camps of GHFF were recorded within the project area. The proposed action would not impact on any part of any known camps for this species.</p> <p>Given that abundant foraging habitat exists in the surrounding landscape, and that the high mobility of this species (traveling up to 50 kilometres in one night), the proposal is unlikely to affect any important populations of this species that would lead to a long-term decrease in the size of an important population of the GHFF.</p>
2)	reduce the area of occupancy of an important population	<p>The NSW east coast population of GHFF is an important population. The area of occupancy for this population is dynamic, and individuals move between bat camps throughout the Australian east coast. This species is highly mobile and camp sizes may change during seasonal fluctuations.</p> <p>The proposal is unlikely to reduce the area of occupancy for this population given the availability of foraging and roosting habitat present in adjacent areas and the highly mobile nature of this species.</p>
3)	fragment an existing important population into two or more populations	<p>The GHFF population across Sydney is highly dynamic and individuals move between permanent camps to utilise foraging resources. They return to permanent camps to rear offspring. Individuals are highly mobile and populations are not static.</p> <p>It is unlikely that any known camp or an important population would be fragmented under the proposed action. The proposed action would result in an impact to up to 9.9 hectares of urban exotic/ native vegetation and 0.76 hectares of mangrove forest vegetation (as a worst-case scenario, based on the current project area). This vegetation is potential foraging habitat for the GHFF. Large amounts of similar habitat are available in the wider locality. Therefore, the proposed action is unlikely to fragment the existing important population into two or more populations.</p>
4)	adversely affect habitat critical to the survival of a species	<p>As the proposal would not involve the removal of any camp, it would be unlikely to create a barrier to movement or remove breeding habitat. The proposal would remove up to 10.66 hectares of potential foraging habitat (urban exotic/native vegetation and mangrove forest) as a worst case scenario. However, potential foraging habitat would remain in the wider locality. Therefore, it is unlikely that habitat critical to the survival of this species would be adversely affected.</p> <p>Foraging habitat within a 50 kilometre radius of a roost site with greater than 30,000 individuals is foraging habitat critical to the survival of this species. The project area is approximately 3 kilometres north of the nearest camp at Wolli Creek. The camp at Wolli Creek has previously recorded numbers between 16,000 and 49,000 for every survey period (i.e. May and November) since 2016. There is also a camp located approximately 5 kilometres to the east of the project area at Centennial Park. The camp at Centennial Park has previously recorded numbers between 16,000 and 49,000 in 2015 and again in 2016. The most recent survey recorded was up to 16,000</p>

Criterion	Question	Response
		<p>(May 2018). This decline in numbers during the most recent count may be due to the high temperatures experienced over summer months in recent years. It is expected that population numbers have the potential to fluctuate due to various factors.</p> <p>Since these populations have both recorded high numbers previously, as a precaution the foraging habitat within the project area is consistent with habitat that would be critical to the survival of this species.</p> <p>While the habitat would be critical to the survival of the species, the removal of 10.66 hectares is unlikely to significantly impact on the population. There is higher quality and more contiguous habitat available in the surrounding landscape, therefore the species is considered likely to use the project area on an occasional basis only and would not be dependent on the foraging resources within the project area.</p>
5)	disrupt the breeding cycle of an important population	No roosting habitat would be removed or disturbed, therefore it is unlikely that the project would disrupt the breeding cycle of an important population.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No campsites would be removed or disturbed, and foraging habitat exists outside of the project area, therefore the proposal would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Considering the currently disturbed nature and urban context of the site, the proposal would not result in the establishment of invasive species, such as weeds, that would be harmful to GHFF.
8)	introduce disease that may cause the species to decline, or	GHFF are reservoirs for the Australian bat lyssavirus (ABL) and can cause clinical disease and mortality in the species (DECCW, 2009). The proposal is unlikely to present significant ecological stress on known individuals or camps utilizing the project area and is therefore unlikely to affect this species. The proposal would be unlikely to introduce a disease that may cause this species to decline.
9)	interfere substantially with the recovery of the species.	A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2009. As no maternity camps would be removed and the project would only remove some potential resting habitat consisting of planted native and exotic trees, it is unlikely that the proposal works would interfere with the recovery of this species.
Conclusion	Is there likely to be a significant impact?	In consideration of the above, the project is considered unlikely to have a significant impact on the GHFF, and therefore, an EPBC Act referral is not required.

Appendix D: Biodiversity credit report



BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00016347/BAAS18077/19/00016348	Potts Hill to Alexandria	12/06/2019
Assessor Name	Report Created	BAM Data version *
	24/06/2019	11
Assessor Number	* 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.	
Revision No		
0		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAIL	Ecosystem credits
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BAM Credit Summary Report

Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion							
1	920_Low-Mod	37.3	0.8	0.25	High Sensitivity to Potential Gain	2.00	14
						Subtotal	14
						Total	14

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<i>Myotis macropus</i> / <i>Southern Myotis</i> (Fauna)						
920_Low-Mod	37.3	0.76	0.25	2	False	14
					Subtotal	14

Appendix E: Key Fish Habitat, Marine Vegetation and Threatened Fish Impact Assessment

A stylized topographic map graphic with concentric contour lines, rendered in a light grey color, positioned on the left side of the page.

Potts Hill to Alexandria Transmission Cable Project Key Fish Habitat, Marine Vegetation and Threatened Fish Impact Assessment

Prepared for AECOM on behalf of TransGrid

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1. Introduction

TransGrid is manager and operator of the major high-voltage electricity transmission network in New South Wales (NSW) and the Australian Capital Territory (ACT). TransGrid is seeking approval under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of a new 330 kilovolt (kV) underground transmission cable circuit between the existing Rookwood Road substation in Potts Hill and the Beaconsfield West substation in Alexandria (the project).

The project has been identified as a solution to address existing issues in the electricity supply network for inner Sydney, which is characterised by ageing and deteriorating electricity infrastructure and forecast increases in consumer demand.

Key components of the project include:

- cable works connecting Rookwood Road substation with the Beaconsfield West substation comprising:
 - a 330 kV underground transmission cable circuit comprising three cables installed in three conduits
 - another set of three conduits for a possible future 330 kV transmission cable circuit if it is required
 - four smaller conduits for carrying optical fibres
 - around 26-30 joint bays, per circuit, where sections of cable would be joined together, located approximately every 600-800 metres along the transmission cable route
 - link boxes and sensor boxes associated with each joint bay to allow cable testing and maintenance
 - optical fibre cable pits for optical fibre cable maintenance
- seven special crossings of infrastructure or watercourses including two rail lines (at Chullora and St Peters), one freight rail line (Enfield Intermodal, Belfield), one light rail line (at Dulwich Hill), the Cooks River and its associated cycleway (at Campsie/Croydon Park), a playground (at Marrickville) and the southern wetland at Sydney Park (at St Peters)
- upgrade works at the Rookwood Road and Beaconsfield West substations to facilitate the new 330 kV transmission cable circuit
- conversion works at the Beaconsfield West and Sydney South substations to transition the existing Cable 41 from a 330 kV connection to a 132 kV connection
- five temporary construction laydown areas to facilitate construction of the project.

As the project is State Significant Infrastructure (SSI) under section 5.12 of the EP&A Act, an Environmental Impact Statement (EIS) has been prepared to assess the impacts of the project. Secretary's Environmental Assessment Requirements (SEARs) were issued for the project on 20 August 2019 by the Planning Secretary of the NSW Department of Planning, Industry and Environment (DPIE) for Application Number SSI 17_8583. The SEARs require '*an assessment of the likely impacts on key fish habitat, marine vegetation and threatened species of fish, in accordance with the Fisheries Management Act 1994, and a description of the measures to minimise and rehabilitate impacts.*'

This report serves as an annexure to the Potts Hill to Alexandria Transmission Cable Project Biodiversity Development Assessment Report and assesses the impacts on key fish habitat, marine vegetation and threatened fish associated with the proposed transmission cable special crossing options (cable bridge or underboring) of the Cooks River at Campsie/Croydon Park (the study area, as shown in Figure 1). The study area is the only part of the project which was identified to potentially contain marine vegetation and key fish habitat.

A summary of the proposed options for the special crossing at the Cooks River as described in Chapter 4 Project description of the EIS is provided below:

- Option 1a or Option 3a: construct a cable bridge parallel to and to the north of the existing Lindsay Street pedestrian bridge; or
- Option 1b or Option 3b: install the conduits under the Cooks River via underboring in the vicinity of the Lindsay Street pedestrian bridge (preferred); or
- Option 2: From the parkland at Mildura Reserve, the conduits would be underbored beneath the Cooks River, surfacing in Croydon Park near the cul-de-sac of Croydon Avenue.



Figure 1: Study area

2. Legislative context

2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a process for identifying Ramsar wetlands and encourages best practice management through nationally consistent management principles. A 'declared Ramsar wetland' is an area that has been designated under Article 2 of the Ramsar Convention or declared by the Minister to be a declared Ramsar wetland under the EPBC Act, where they are recognised as a Matter of National Significance.

The Towra Point Nature Reserve is a Ramsar wetland covering an area of approximately 600 hectares on the southern shore of Botany Bay. It supports seagrass meadows, areas of saltmarsh and provides habitat for migratory birds listed in the migratory bird agreements that Australia has with Japan, China and the Republic of Korea. Towra Point Nature Reserve is located around nine kilometres from the project, adjacent to the receiving waters of the Cooks River and therefore could be impacted by any degradation of water quality that occurs as a result of the project. However due to the distance between the proposed works area and the Nature Reserve and with the implementation of appropriate safeguards, impacts resulting from the project are considered unlikely.

2.2 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) governs the management of fish and their habitat in NSW. The objectives of the FM Act are to conserve fish stocks and key fish habitats, conserve threatened species, populations and ecological communities of fish and marine vegetation (such as mangroves) and to promote ecologically sustainable development. The FM Act also regulates activities involving dredging and/or reclamation of aquatic habitats, obstruction of fish passage, harming marine vegetation and use of explosives within a waterway.

Mangroves are protected from harm under Section 204 of the FM Act. 'Harm' under Part 7 of the FM Act means activities that gather, cut, pull up, destroy, poison, dig up, remove, injure, prevent light from reaching or otherwise cause harm to marine vegetation or any part of it. As per the Department of Primary Industries (DPI) Fisheries guidelines, impacts on marine vegetation such as mangroves require offsetting at a 2:1 habitat offset ratio.

In accordance with Part 4, Division 1.7, Section 4.41 (b) of the EP&A Act, applications for separate permits under Sections 201, 205 or 219 of the FM Act are not required for SSI, as impacts on species and habitat covered under those sections of the FM Act are assessed when responding to the SEARs. However, the offset policy still applies under the FM Act. In order to inform a comparative and acceptable assessment of impacts on aquatic habitat, the regulatory framework of the FM Act and associated guidelines have been adopted for this assessment.

2.3 Threatened species search

In order to determine whether the Project would impact on any Matters of National Environmental Significance (MNES), a search of the Commonwealth Protected Matters Search tool, OEH BioNet database and Fisheries Threatened Species distribution maps (Riches et al, 2016) was undertaken. The searches identified two threatened species of fish with potential to be found within the study area

(Table 1). A review of the listed records of threatened species however found no records within five kilometres of the study area and a lack of suitable habitat. It is therefore unlikely that these species would be found within the study area.

Table 1: Likelihood of Occurrence table for threatened aquatic species

Scientific Name	Common Name	FM Act	EPBC Act	Habitat Associations	Records within 5 km	Likelihood of occurrence
<i>Epinephelus daemeli</i>	Black Rockcod	V	V	Black Rockcod generally inhabit near-shore rocky and offshore coral reefs at depths down to 50 m but are occasionally recorded from deeper waters. In coastal waters adult Black Rockcod are found in rock caves, rock gutters and on rock reefs. Slightly older juvenile cod are often found in estuary systems.	0	No, no suitable habitat and no records within 5 km of site.
<i>Macquaria australasica</i>	Macquarie Perch	E	E	Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie Perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	0	No, no suitable habitat and no records within 5 km of site.

2.4 Policy and guidelines for fish habitat conservation and management

The *Policy and guidelines for fish habitat conservation and management* (DPI, 2013) (herein referred to as the ‘Policy’) is a supplementary document that outlines the requirements and obligations under the FM Act and the *Fisheries Management (General) Regulation 2010* and was developed to maintain and enhance fish habitat and assist in the protection of threatened species. The Policy provides a definition of key fish habitat and provides guidance for assigning a rating for the type of key fish habitat and fish habitat sensitivity (Table 2) as well as waterway classes for fish passage (Table 3).

For the purposes of the Policy, sections of stream that have been concrete-lined are not considered key fish habitat. However, the presence of mangroves within the study area indicates that this is an area of moderately sensitive key fish habitat, as per Table 2.

Table 2: Key fish habitat and associated sensitivity classification scheme (from Table 1 in Fairfull 2013)

TYPE 1 - Highly sensitive key fish habitat: <ul style="list-style-type: none"> ▪ <i>Posidonia australis</i> (strapweed) ▪ <i>Zostera</i>, <i>Heterozostera</i>, <i>Halophila</i> and <i>Ruppia</i> species of seagrass beds >5m² in area ▪ Coastal saltmarsh >5m² in area ▪ Coral communities ▪ Coastal lakes and lagoons that have a natural opening and closing regime (i.e. are not permanently open or artificially opened or are subject to one off unauthorised openings) ▪ Marine park, an aquatic reserve or intertidal protected area ▪ SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia² ▪ Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants ▪ Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act ▪ Mound springs 	TYPE 2 – Moderately sensitive key fish habitat: <ul style="list-style-type: none"> ▪ <i>Zostera</i>, <i>Heterozostera</i>, <i>Halophila</i> and <i>Ruppia</i> species of seagrass beds <5m² in area ▪ Mangroves ▪ Coastal saltmarsh <5m² in area ▪ Marine macroalgae such as <i>Ecklonia</i> and <i>Sargassum</i> species ▪ Estuarine and marine rocky reefs ▪ Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g. managed in line with an entrance management plan) ▪ Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area ▪ Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna ▪ Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1 ▪ Weir pools and dams up to full supply level where the weir or dam is across a natural waterway
	TYPE 3 – Minimally sensitive key fish habitat may include: <ul style="list-style-type: none"> ▪ Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna ▪ Coastal and freshwater habitats not included in TYPES 1 or 2 ▪ Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

Table 3: Classification of waterways for fish passage (from Table 2 in Fairfull 2013)

Classification	Characteristics of waterway class
CLASS 1 Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.
CLASS 2 Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.
CLASS 3 Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats.
CLASS 4 Unlikely key fish habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).

3. Methods

The site was visited by ELA Aquatic Ecologist Claire Wheeler on 29 May 2019. During this visit, the length of the Cooks River within the study area (Figure 1) was walked to determine the existing condition and extent of riparian and aquatic habitat. The following assessments were undertaken:

- 1. Riparian habitat assessment** - An assessment of riparian condition and recovery potential was conducted. This assessment considered the extent and condition of native vegetation cover, connectivity, quality, bed and bank stability and habitat diversity.
- 2. Aquatic habitat assessment** - An assessment of the aquatic habitat examined the quality of aquatic habitats, including aquatic vegetation structure, extent of regeneration, weed infestation, woody debris, fish habitat, patch size and connectivity potential.

4. Existing environmental conditions

The Cooks River within the study area is a 3rd order watercourse that is approximately 40 metres wide. As per the Natural Resources Access Regulator guidelines (DPI, 2018), 3rd order watercourses have a recommended riparian corridor width of 30 metres. For the purposes of this assessment, the riparian zone is the area within 30 metres from the top of the bank of the Cooks River.

The river is subject to tidal influences from Botany Bay and is located in a highly urbanised catchment. During the site inspection, the water within the river was turbid with visibility of less than 0.5 metres, despite there being no rain in the 24 hours prior to the day of the survey. The field-validated extent of aquatic vegetation is shown in Figure 2. For ease of description, the aquatic and riparian environments within the study area have been split into two sections: the northern and southern banks of the Cooks River.



Figure 2: ELA validated vegetation community

4.1 Southern bank

The riparian zone on the southern bank was predominantly mown grass (Figure 3), with the odd scattering of exotic vegetation and occasional planted trees. The riparian zone was in most places bounded by residential properties. Sewer access structures could be seen along the riparian zone, parallel with the river. The banks of the river have been channelised with concrete slabs (Figure 4), restricting the movement of the river across the floodplains. The riverbanks appear to be relatively stable as a result of the concrete revetment, however erosion behind some of the concrete panels was observed in areas along the reach of the river (Figure 5).

The dominant aquatic vegetation within the study area was *Avicennia marina* (Grey Mangrove, Figure 6). There was a continuous band of Grey Mangroves on the southern bank of the river, up to 15 metres wide at its thickest point. The mangroves were of varying ages, from mature trees up to 8 metres tall, to seedlings and juvenile plants. The range of sizes indicates that this vegetation community is actively recruiting new individuals. At the east end of the study area the mangrove community was intact with very little other vegetation growing in amongst the mangroves. Within the central part of the study area a band of *Phragmites australis* (Common Reed) was growing against the concrete revetment within the river (Figure 7). Towards the west extent of the study area, there was an area where exotic species dominated the landward edge of the riparian zone (Figure 8). Species within this area included *Parietaria judaica* (Asthma Weed), *Phoenix canariensis* (Phoenix Palm), *Conyza bonariensis* (Fleabane) and exotic grasses. The riparian zone appeared to have recently been mown and grass clippings were evident along the top of the concrete revetment (Figure 9).

Multiple stormwater outlets were observed along the southern bank, where stormwater was discharged directly into the river through the concrete revetment. In one location where a stormwater pipe approximately one metre in diameter discharged directly into the river, erosion of the bed sediment was observed and there was a break in the otherwise continuous strip of Grey Mangroves and pneumatophores (Figure 10)



Figure 3: Mown grass riparian zone on the southern bank, looking north west



Figure 4: Concrete revetment on the southern bank of Cooks River, looking north west



Figure 5: Erosion behind concrete slabs, looking north west



Figure 6: Mangrove vegetation on the southern bank, looking south east



Figure 7: Common Reed growing adjacent to concrete revetment, looking east



Figure 8: Area of exotic species at edge of riparian zone, looking south east



Figure 9: Grass clippings on edge of river, looking south east



Figure 10: Erosion of river bed sediment downstream of stormwater outlet, looking east

4.2 Northern bank

The riparian zone on the northern bank was similar to that on the southern bank, in that it was predominantly mown grass. A multi-use pathway extended along the length of the river within the study area (Figure 11) and adjacent land uses included sports fields, a tennis centre and residential properties.

A concrete revetment wall was in place to stabilise the bank; however, this was taller than that observed on the southern bank.

Unlike the southern bank, the northern bank did not have a continuous band of Grey Mangroves on the edge of the river. Instead, isolated mangrove plants (most commonly seedlings, with a few juvenile plants up to 1.5 metres tall) were observed growing out of the concrete revetment on this side of the river (Figure 12).

Aquatic habitat on the northern bank of the river was much poorer than the southern bank and, in most places, non-existent (Figure 13). The concrete revetment wall was clearly visible from the pathway and there was no vegetative buffer between the water within the river and the adjacent land uses. Signs observed during the site survey indicated the presence of an oil pipeline beneath the riparian zone on the northern bank (Figure 14).



Figure 11: Pathway alongside the northern bank, looking north west



Figure 12: Isolated mangrove on the northern bank, looking south east



Figure 13: Relatively bare northern bank compared to dense mangroves on the southern bank, looking south east



Figure 14: Warning sign for presence of oil pipeline beneath riparian zone on the northern bank, looking north west

5. Impact Assessment

While the study area for this assessment includes all the options under consideration at the Cooks River crossing, the potential impacts on the aquatic and riparian environments are associated with the proposed special crossings. Each special crossing option would have a slightly different footprint for establishment of a work site and cable installation. While the underboring options require a larger work site during construction (up to 800 square metres at the launch site and up to 800 square metres at the receive pit) than the cable bridge option, the work sites can be offset from the banks whereas construction of the cable bridge embankments would impact both river banks.

The primary impact on key fish habitat as a result of the proposed works would therefore be the impact on the intact stand of mangroves on the southern bank of the river.

5.1 Encroachment into key fish habitat

The study area currently encompasses mangroves, considered to be Type 2 key fish habitat, as shown in Figure 15. The study area includes approximately 7,642 m² of mangroves on the southern bank and approximately 9.5 m² on the northern bank where the isolated mangrove plants are located.

Removal of a section of mangroves to facilitate the construction of a cable bridge has the potential to impact on connectivity and condition of riparian vegetation and mangroves upstream and downstream of the impact area. Construction of this permanent infrastructure can also introduce impervious surfaces to a previously vegetated or permeable areas (with associated effects on the hydrology of the area) and impact on water quality. Impacts to hydrology and water quality are discussed below.

5.2 Surface erosion and sedimentation

Any clearing of vegetation within the riparian zone or on the edge of the river (in the case of the mangroves) can result in reduction of soil stability.. Impacts to soil stability if the underboring option is undertaken would be due to underboring operations not being suitably planned and undertaken in the local hydrogeological conditions. However, these impacts have a low risk of occurring under normal underboring operations and can be managed by choosing appropriate construction methods, following good industry practice and using a reputable and experienced underboring contractor. Impacts to soil stability if the cable bridge option is undertaken would be as a result of earthworks for embankments and support piers required for the cable bridge structure. The construction of the bridge piers would potentially impact the stability of the river bed depending on the suitability of local geotechnical conditions and how the construction is managed.

Reduction in soil stability may cause surface erosion (sheet and gully erosion) and transportation of sediment overland into the river. Impacts may include increased water turbidity, which would disrupt light penetration through the water column and impact on primary (plant) production, with flow-on effects through the food web. Increased sediment loads may settle in downstream environments, smothering sessile invertebrates and causing a loss of deep habitat and changes to hydrologic connectivity. Sediment could also smother naturally rocky areas, resulting in a loss of habitat where macroinvertebrates shelter in the spaces between rocks.



Figure 15: Key fish habitat within the study area

5.3 Cable installation

The installation of transmission cables across the river can potentially impact on bed stability, water quality and aquatic habitat depending on the construction method used and how the construction is managed.

Earthworks and support piers required for a cable bridge structure over the river would create disturbance to the aquatic environment, water quality, stability of the bed of the river and the mangroves. Installing the cables via underboring could impact on the stability of the river bed there is the chance that drilling fluids can escape from the bore hole and impact on water quality and the health of the aquatic environment.

5.4 Loss of riparian habitat

The study area includes the vegetated edge of the river where there are mangroves. Removal of these mangroves would result in the loss habitat for native fauna species. As the work sites would be offset from the river's edge (either in the road reserve or in parkland) for the underboring options, no mangrove removal would be required for this method. However, the cable bridge option would involve the clearing and disturbance of mangroves on the southern side of the river and vegetation on the northern bank. This may result in loss of habitat and riparian vegetation connectivity and increased fragmentation of riparian habitat areas, introduction of exotic species, increased sedimentation and water quality issues. Mangrove removal would require offsetting for the loss of key fish habitat under the FM Act. While replanting mangroves in the same location following construction would not be possible due to the introduction of permanent operational infrastructure, other offsetting mechanisms would be determined in consultation with Department of Primary Industries – Fisheries (DPI Fisheries).

5.5 Weed invasion

Where disturbance from construction associated with the project results in bare ground or increased sunlight penetration into riparian or key fish habitat areas, there is the potential for invasion of exotic plant species. The movement of construction vehicles in and around the riparian area can also act as a vector for weed propagules. Impacts include introduction of new weeds to the area and extended penetration of weeds into native plant communities. This may result in a loss of biodiversity and habitat value, smothering of native juvenile plants, harbouring of feral animals and alteration of vegetation structure and riparian function.

5.6 Polluted surface water runoff

The construction of a cable bridge over the river would involve the construction of permanently impervious surfaces within the riparian zone. As a result, there is an increased risk of motor vehicle oils, litter and warmer surface water entering the river, as these substances would likely have previously been absorbed or stopped by permeable areas such as mown grass. Subsequent impacts of an increase in surface water runoff due to the construction of impervious surfaces may include water quality issues (heavy metals, oil and grease pollution from vehicles), inorganic clogging of aquatic habitats (litter/rubbish) and destruction of macroinvertebrate communities (warm water inflows). In the case of underboring, the area of impervious surface that would be created for the work sites would be up to

800 square metres at the launch pit and up to 100 square metres at the receive pit. However, these areas of impervious surfaces would be temporary, and the areas revegetated or rehabilitated once the works were completed.

5.7 Increased velocity of surface water runoff

The project could also impact on the velocity of water entering the river where impermeable surfaces are constructed over existing vegetation or mown grass for cable bridge infrastructure or temporary clearing of areas for work sites for underboring. Impacts may include changes to instream flow velocity, which can change the aquatic habitat for invertebrates and other small aquatic fauna, increased bank erosion from fast discharge resulting in bed and bank erosion, loss of riparian vegetation, loss of edge habitat and sedimentation of downstream environments. Due to the size of the Cooks River within the study area, the likelihood of a significant impact to the aquatic habitat as a result of an increase in the velocity of the surface water runoff entering the river is low.

5.8 Shading of mangroves

The cable bridge would be a permanent structure, which may be up to six metres wide. It would have a shading impact on mangrove vegetation immediately adjacent to the bridge on both the northern and southern banks of the river. Shading of vegetation can lead to thinning out, or in worst cases loss of vegetation, where permanent shade is created. However, shading impact from the cable bridge is unlikely to be significant, with shading impacting an area of mangroves of less than 200 square metres. Furthermore, the areas to be shaded would vary throughout the day with limited areas of permanent shading.

6. Mitigation measures

6.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) should be prepared prior to commencement of any construction works to address measures required prior to, during and after works to minimise impacts on the environment. This CEMP should include a Erosion and Sediment Control Plan (ESCP), prepared in accordance with *The Blue Book – Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) and implemented prior to works, with the aim of achieving an outcome of ‘no visible turbid plumes migrating through the waterway’. The ESCP must include, as a minimum, the locations and type of erosion and sediment controls to be erected within and adjacent to the waterway.

6.2 Protection of water quality and habitat condition

Water quality protection measures are recommended for use where the proposed activities require:

- Clearing of groundcover (grasses, herbs and shrubs, including exotic species) to bare earth
- Clearing of any native vegetation or mechanical weed removal within the riparian buffer zone
- Construction of any permanent impervious surfaces
- Temporary staging areas, construction laydown areas and storage areas of oils and chemicals
- Wastewater discharge points, including pumping of groundwater from any below-ground excavation and vehicle wash down bays.

Key protection measures suitable to mitigate the above activities include:

- Sediment fences to slow overland flow and trap sediments created from surface erosion.
- Identify opportunities for reuse of water from any on-site dewatering activities on-site, such as reuse of water for dust suppression during construction.
- Water collected during construction (e.g. during dewatering or surface water inflows to the trench or pits) to be discharged or disposed of in accordance with the *Protection of the Environment Operations Act 1997 and the ANZECC Water Quality Guidelines (2000) for 95% protection level for marine ecosystems.*, The water discharge point should be at a stable point on the bank or across riparian vegetation to allow slowing of water before travelling further downstream. Where feasible, the velocity of downstream flows should not exceed natural seasonal flow velocities. Water released in dynamic pulses will give reprieve for fauna travelling upstream.
- Contaminated water captured during construction to be disposed of at an appropriately licensed facility

6.3 Habitat restoration and weed control

To maintain the connectivity of riparian corridors, rehabilitation and revegetation will be required along the river. Weed control would also be needed prior to and after revegetation within the project area to maintain restored areas as weed free.

6.4 Methods for cable installation

DPI Water's *Controlled activities on waterfront land – Guidelines for laying pipes and cables in watercourses on waterfront land* (DPI, 2012) should be used to inform the cable installation. These guidelines outline factors to consider during the design and construction of these structures, recommending that proposals for directional boring should seek to:

- Minimise or avoid disturbance to river bed and banks
- Minimise or avoid rehabilitation, maintenance and on-going costs after construction to minimise risks associated with cave-ins, bed collapse or frac-outs during boring
- Ensure depth does not result in exposure of assets if river experiences bed or bank degradation
- Locate bore entry and exit points outside designated riparian corridors and existing vegetation
- Address the recovery and removal of construction plant and materials, including drilling mud.

6.5 Offset of lost key fish habitat

The *Policy and guidelines for fish habitat conservation and management* (Fairfull, 2013) includes a description of DPI Fisheries' 'no net loss of key fish habitat' policy, where environmental impacts on aquatic habitat (direct and indirect) are to be offset. NSW DPI calculates habitat compensation on a minimum 2:1 basis for all key fish habitat (TYPE 1-3 in Table 2).

Where 'no net loss' of key fish habitat cannot be achieved, offset fees apply. Consultation with DPI Fisheries would be required to determine the offset requirements for the proposed works.

It is noted that this report assesses impacts on mangroves and aquatic habitat within the entire study area; however, the impacts on mangroves and aquatic habitat are expected to be reduced as the design of the project progresses and the project area is refined.

7. Conclusion

The study area assessed for the proposed transmission cable installation at the Cooks River in Campsie/Croydon Park/Ashbury includes approximately 7,651 m² of Grey Mangroves, some of which may be subject to direct and indirect impacts depending on the final design of permanent infrastructure, construction method selected and construction footprint (i.e. size and location of work sites). This species of marine vegetation is protected under the FM Act. As per DPI Fisheries guidelines, the impact is required to be offset at a 2:1 ratio to ensure that no net loss of key fish habitat occurs.

8. References

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