

Appendix

S

Technical working paper: Biodiversity



WestConnex M4-M5 Link

Biodiversity Assessment Report

12 August 2017

Prepared for

Roads and Maritime Services

Prepared by

Eco Logical Australia Pty Ltd with support from AECOM and Roads and Maritime Services of NSW

© Roads and Maritime Services

The concepts and information contained in this document are the property of Roads and Maritime Services. You must not reproduce any part of this document without the prior written approval of Roads and Maritime Services.

Disclaimer

This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and AECOM. The scope of services was defined in consultation with AECOM, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.

Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.

BLANK PAGE

Executive summary

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of the Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). A request has been made for the NSW Minister for Planning to specifically declare the project to be State significant infrastructure and also critical State significant infrastructure. An environmental impact statement (EIS) is therefore required.

This technical report forms the Biodiversity Assessment Report (BAR) to support the EIS. In preparing this report, the Secretary's Environmental Assessment Requirements (SEARs) issued for the project have been addressed as well as comments received by the NSW Department of Planning and Environment (DP&E) from government agencies during the preparation of the SEARs. No additional matters for further consideration were identified by the NSW Office of Environment and Heritage (OEH) in its submission to the SEARs. Where appropriate, considerations identified by the NSW Department of Primary Industries (DPI) have been addressed in this BAR. Accordingly, biodiversity impacts have been assessed under the Framework for Biodiversity Assessment (FBA) (OEH 2014a), as required by the SEARs.

The project would be generally located within the City of Sydney and Inner West local government areas (LGAs). The project is located about two to seven kilometres south, southwest and west of the Sydney central business district (CBD) and would cross the suburbs of Ashfield, Haberfield, Leichhardt, Lilyfield, Rozelle, Annandale, Stanmore, Camperdown, Newtown and St Peters. The assessment included both desktop analysis and field assessments, using the FBA methodology to assess the presence of native vegetation, habitat for threatened species and condition of any ecological communities.

A separate project for the Rozelle Rail Yards site management works was assessed through a review of environmental factors (REF) under Part 5 of the EP&A Act and approved by Roads and Maritime in April 2017. The works will remove rail and rail related infrastructure within the Rozelle Rail Yards site, as well as vegetation, buildings and stockpiles. The REF assessed impacts of these works on threatened species and ecological communities listed under State and Commonwealth legislation, in accordance with the EP&A Act. The Rozelle Rail Yards site management works are not part of the M4-M5 Link project and have therefore been excluded from the EIS and this BAR. However, the cumulative impacts of the site management works and the M4-M5 Link project have been considered in this assessment (see section 9.6).

The study area for the assessment comprises the project footprint and includes all areas likely to be impacted by the project and is shown in Figure 2.3. The project footprint defined in this report is the same as the development footprint defined in the FBA. Sufficient flexibility has been provided to allow for refinement of the project footprint during detailed design or in response to submissions received during the exhibition of the EIS.

No Plant Community Types (PCTs), defined as native vegetation by the FBA were recorded within the project footprint, and thus no remnant native vegetation is considered to be present. Vegetation observed is consistent with urban native and exotic vegetation.

The project is located in a highly urbanised environment and much of the area is entirely modified and disturbed and contains exotic species, weeds and planted native or non-indigenous species. It

is characterised by urban parks, landscaped road verges, disused rail infrastructure, compacted soils, introduced fill, existing residential, commercial and light industrial development and other infrastructure. Vegetation in the project footprint is generally considered to be in a poor ecological condition, with little ecological value and unlikely to have any native resilience or recovery potential. As such, there would be no direct impacts to native vegetation from the project. In this regard, potential threatened fauna are limited to those species that utilise urban environments and man-made structures.

Targeted threatened microbat surveys have been completed for those species initially considered as having a potential to occur within the project footprint. Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), both listed as vulnerable under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act) were recorded within the Rozelle Rail Yards. The high number of Eastern Bentwing-bat calls recorded during the targeted surveys suggests that this species may be roosting in the cavities under the Victoria Road bridge, or using the archway under the bridge as a flyway. The Yellow-bellied Sheathtail Bat is a predominantly tree-dwelling bat, and thus, its presence in the project footprint is limited to foraging habitat. The Eastern Bentwing-bat and Yellow-bellied Sheathtail-bat are considered an ecosystem credit species under the FBA in relation to foraging and roosting habitat.

In addition, the Grey-headed Flying Fox (*Pteropus poliocephalus*), listed as vulnerable under the TSC Act and *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) is assumed to be present. It was considered that this species is likely to use some of the vegetation in the project footprint for foraging and has been recorded foraging adjacent to the project footprint. The Grey-headed Flying-fox is considered an ecosystem credit species under the FBA in relation to foraging habitat. No roosting sites or camps occur in proximity to the project footprint, and thus would not be impacted by the works. The closest Grey-headed Flying-fox camps are the Centennial Park and Turrella, approximately five kilometres east and five kilometres southwest respectively.

This BAR assessed the type and number of credits using the FBA methodology. However, no PCTs or threatened species credit species were recorded within the project footprint, and therefore, no offsets are required. The FBA methodology states '*that an assessor is not required to assess areas of land on the development site without native vegetation under Chapter 4 or Chapter 5 (of the methodology), unless the SEARs issued for the project require an assessment of the land in accordance with those chapters*'. It is noted that the Grey-headed Flying-fox, Eastern Bentwing-bat and Yellow-bellied Sheathtail-bat are ecosystem credit species (for foraging and non-breeding habitat) and therefore due to the absence of PCTs within the project footprint, these species do not require an offset.

The project has substantially avoided biodiversity impacts by utilising, as much as possible, already disturbed sites and due to most of the infrastructure being underground. Opportunities to further avoid impacts in the design have been explored, and as a result of investigations for this assessment, the following ecological values have been avoided:

- Native vegetation communities, as defined by the FBA as native PCTs
- Endangered ecological communities such as Coastal Saltmarsh, which is listed under both the TSC Act and EPBC Act.

A number of potential indirect impacts that have been considered in the assessment include:

- Hydrological changes
- Dust, noise, vibration and light impacts (including overshadowing)
- Injury and mortality to flora and fauna
- Spread of weeds.

A number of mitigation measures to minimise direct and indirect ecological impacts would be implemented as part of the project in line with *Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority 2011). These measures would be

detailed in the Construction Flora and Fauna Management Plan for the project which includes: site-specific environmental induction; identification of clearing limits and protective fencing; vegetation clearance procedures; pre-clearance surveys; erosion and sediment controls; weed management and monitoring.

The following matters, while not assessed under the FBA, are also covered in this report:

- Aquatic biodiversity listed under the *Fisheries Management Act 1994* (NSW) (FM Act)
- Groundwater dependent ecosystems (GDEs)
- Matters of national environmental significance (MNES) listed under the EPBC Act, as required by the Bilateral Agreement, made under section 45 of the EPBC Act.

An assessment of the potential impacts on GDEs and aquatic habitats potentially affected by the project concluded there would be no significant impact as a result of the project. No mapped GDEs occur in the study area (see section 4.4). There is likely to be no significant impact to aquatic flora and fauna listed under the FM Act. No protected marine vegetation would be harmed.

Following the desktop assessment and field surveys, one MNES was identified as potentially occurring within the study area and could be adversely affected by the project. The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as vulnerable under the EPBC Act, and is known to camp at Centennial Park and Turrella. It is considered that this species is likely to use some of the study area for foraging, such as fig trees and winter flowering street trees.

An assessment of the Commonwealth Significant Impact Criteria (Commonwealth of Australia 2013) was undertaken for the Grey-headed Flying-fox. The assessment concluded that the project would not have a significant impact on this species, and as such, a referral to the Commonwealth was not required. Furthermore, offsets for this species are not required (according to FBA methodology), as impacts are associated with an ecosystem credit species.

Contents

Executive summary	i
Contents	iv
1 Introduction	1
1.1 Project background.....	1
1.2 Legislative context	4
1.3 SEARs – Biodiversity.....	5
1.4 Context of Biodiversity Assessment Report	7
2 The project	11
2.1 Project location	11
2.2 Overview of the project.....	11
2.3 Construction activities.....	16
3 Landscape features	23
3.1 Identified features	23
3.2 Landscape values.....	24
4 Native vegetation	33
4.1 Method	33
4.2 PCT descriptions	43
4.3 Threatened ecological communities.....	45
4.4 Groundwater dependent ecosystems.....	46
5 Threatened species	49
5.1 Candidate species	49
5.2 Threatened species survey	50
5.3 Threatened species results.....	52
5.4 Aquatic habitat and threatened species	55
6 Matters of national environmental significance	65
6.1 Threatened species	65
6.2 Migratory species.....	65
7 Summary of biodiversity values	66
7.1 Biodiversity values assessed under the FBA	66
7.2 Biodiversity values outside the FBA.....	66
8 Avoid and minimise impacts	67
8.1 Avoidance and minimisation	67
9 Impact assessment	68
9.1 Areas requiring assessment.....	68
9.2 Matters for further consideration	70
9.3 Matters of national environmental significance.....	71
9.4 Other impacts not covered by the FBA	73

9.5	Impact summary	80
9.6	Cumulative impacts	83
10	Mitigation	88
11	Offsetting required	91
11.1	Areas not requiring assessment offsets	91
11.2	Ecosystems requiring offsets	91
11.3	Species requiring offsets.....	91
11.4	Aquatic biodiversity offsets	91
11.5	Compensatory planting recommendations	91
12	References.....	92
Annexure A – Habitat assessment table		96
Annexure B – Species recorded		119
Annexure C – Secretary’s Environmental Assessment Requirements for Biodiversity and Department of Primary Industries requirements.....		122
Annexure D – Anabat survey results		125
Annexure E – EPBC Act Significant Impact Criteria.....		132
Annexure F – FBA Methodology and where addressed in document.....		134
Annexure G – Arboricultural Impact Assessment.....		138

Glossary of terms

Definitions	
Assessment circles	Two circles (the inner and outer assessment circle) in which the percent native vegetation cover in the landscape is assessed, taking into account both cover and condition of vegetation (OEH 2014a)
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and type of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or sets out the number and type of biodiversity credits that are created at an offset site (OEH 2014a)
Campbell Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at St Peters
Concept design	Initial functional layout of a road/road system or other infrastructure. Used to facilitate understanding of a project, establish feasibility and provide basis for estimating and to determine further investigations needed for detailed design
Construction	Includes all physical work required to construct the project
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to construction sites (civil and tunnel), sediment basins, temporary water treatment plants, pre-cast yards and material stockpiles, laydown areas, workforce parking, maintenance workshops and offices
Critically endangered ecological community (CEEC)	A threatened ecological community with a 'critically endangered' listing status under environmental legislation
Cumulative impact	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own
Cut-and-cover	A method of tunnel construction whereby the structure is built in an open excavation and subsequently covered
Darley Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Leichhardt
Detailed design	The stage of design where project elements are design in detail, suitable for construction
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat
Ecosystem credit	A measurement of the value of endangered ecological communities (EECs), critically endangered ecological communities (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 development site and the gain in biodiversity values at an offset site (OEH 2014a)

Definitions	
Endangered ecological community	A threatened ecological community with an 'endangered' listing status under environmental legislation
Groundwater dependent ecosystem	Refers to communities of plants, animals and other organisms whose extent and life process are dependent on groundwater, such as wetlands and vegetation on coastal sand dunes
Haberfield civil and tunnel site / Haberfield civil site	Construction ancillary facilities for the M4-M5 Link project located at Haberfield
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2014a)
Indirect impact	Where an event or circumstance is a direct consequence of the action (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf)
Iron Cove Link	Around one kilometre of twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge
Iron Cove Link civil site	A construction ancillary facility for the M4-M5 Link project south of Victoria Road at Rozelle, near the eastern abutment of Iron Cove Bridge
Matters for further consideration	Impacts that are considered to be complicated or severe that will require further consideration by the consent authority (OEH 2014a). The assessment is based on thresholds detailed in section 9 of the FBA. These can also be included as part of the project SEARs
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014a)
Mitigation	Action to reduce the severity of an impact (OEH 2014a)
Mitigation measure	Specific measure or management action to mitigate the severity of an impact
Northcote Street civil site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
Parramatta Road East civil site	A construction ancillary facility for the M4-M5 Link project Haberfield
Parramatta Road West civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at Ashfield
Population	All the individuals that interbreed within a given area

Definitions	
Project	A new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange
Project footprint	The land required to construct and operate the project. This includes permanent operational infrastructure (including the tunnels), and land required temporarily for construction. For the purposes of this assessment, this term is used instead of 'development footprint' defined in the FBA methodology (OEH 2014a) to describe the area of direct impact: the area of land that is directly impacted on by a proposed Major Project that is under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014a)
Pymont Bridge Road tunnel site	A construction ancillary facility for the M4-M5 Link project located at Annandale
Rozelle civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Lilyfield and Rozelle
Rozelle interchange	A new interchange at Lilyfield and Rozelle that would connect the M4-M5 Link mainline tunnels with City West Link, Anzac Bridge, the Iron Cove Link and the proposed future Western Harbour Tunnel and Beaches Link
Rozelle Rail Yards	The Rozelle Rail Yards is bound by City West Link to the south, Lilyfield Road to the north, Balmain Road to the west, and White Bay to the east. Note that the project only occupies part of the Rozelle Rail Yards site
Secretary's Environmental Assessment Requirements	Requirements and specifications for an environmental assessment prepared by the Secretary of the Department of Planning and Environment under section 115Y of the <i>Environmental Planning and Assessment Act 1979</i> (NSW)
Species credit species	Threatened species and populations that are assessed according to section 6.4 of the FBA (OEH 2014a)
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 Species Profile Database
St Peters interchange	A component of the New M5 project, located at the former Alexandria Landfill site at St Peters. Approved and under construction as part of the New M5 project. Additional construction works proposed as part of the M4-M5 Link project
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2014a)
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure
The Crescent civil site	A construction ancillary facility for the M4-M5 Link project located at Annandale

Definitions	
Victoria Road civil site	A construction ancillary facility for the M4-M5 Link project located on the eastern side of Victoria Road at Rozelle, between Lilyfield Road and Quirk Street
Wattle Street civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
WestConnex program of works	A program of works that includes the following projects: M4 Widening, King Georges Road Interchange Upgrade, M4 East, New M5 and M4-M5 Link projects

Abbreviations	
BAR	Biodiversity Assessment Report
BBCC	BioBanking Credit Calculator
BOPMP	NSW Biodiversity Offsets Policy for Major Projects
BVT	Biometric Vegetation Type
CE	Critically Endangered
CEMP	Construction Environmental Management Plan
CEEC	Critically endangered ecological community
CSSI	Critical State Significant infrastructure
DECC	NSW Department of Environment and Climate Change (former)
DEHWA	Australian Government Department of the Environment, Water, Heritage and the Arts (former)
DotEE	Department of the Environment and Energy
DP	Deposited Plan
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
E	Endangered
EEC	Endangered ecological community
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EP	Endangered Population
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
ESCPs	Erosion Sediment Control Plans
FBA	Framework for Biodiversity Assessment
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GDE	Groundwater dependent ecosystems

Abbreviations	
GIS	Geographic Information Systems
IBRA	Interim Biogeographically Regionalisation of Australia
KFH	Key Fish Habitat
KTP	Key Threatening Process
LGA	Local Government Area
MI	Migratory
MNES	Matters of national environmental significance
NV Act	<i>Native Vegetation Act 2003 (NSW)</i>
OEH	NSW Office of Environment and Heritage
OZCAM	Online Zoological Collections of Australian Museums
P	Protected
PCT	Plant Community Type
REF	Review of environmental factors
Roads and Maritime	NSW Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SMC	Sydney Motorway Corporation
SSD	State Significant Development
SSI	State Significant Infrastructure
TECs	Threatened Ecological Communities
TSPD	Threatened Species Profile Database
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>
V	Vulnerable
VIS	Vegetation information system

1 Introduction

1.1 Project background

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

Together with the other components of the WestConnex program of works and the proposed future Sydney Gateway, the project would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-western Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and local communities.

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) for the project. A request has been made for the NSW Minister for Planning to specifically declare the project to be State significant infrastructure and also critical State significant infrastructure. An environmental impact statement (EIS) is therefore required.

1.1.1 Overview of WestConnex and related projects

The M4-M5 Link is part of the WestConnex program of works. Separate planning applications and assessments have been completed for each of the approved WestConnex projects. Roads and Maritime has commissioned Sydney Motorway Corporation (SMC) to deliver WestConnex, on behalf of the NSW Government. However, Roads and Maritime is the proponent for the project.

In addition to linking to other WestConnex projects, the M4-M5 Link would provide connections to the proposed future Western Harbour Tunnel and Beaches Link, the Sydney Gateway (via the St Peters interchange) and the F6 Extension (via the New M5).

The WestConnex program of works, as well as related projects, are shown in Figure 1.1 and described in Table 1.1.

Table 1.1 WestConnex and related projects

Project	Description	Status
WestConnex program of works		
M4 Widening	Widening of the existing M4 Motorway from Parramatta to Homebush.	Planning approval under the EP&A Act granted on 21 December 2014. Open to traffic.
M4 East	Extension of the M4 Motorway in tunnels between Homebush and Haberfield via Concord. Includes provision for a future connection to the M4-M5 Link at the Wattle Street interchange.	Planning approval under the EP&A Act granted on 11 February 2016. Under construction.
King Georges Road Interchange Upgrade	Upgrade of the King Georges Road interchange between the M5 West and the M5 East at Beverly Hills, in preparation for the New M5 project.	Planning approval under the EP&A Act granted on 3 March 2015. Open to traffic.

Project	Description	Status
New M5	Duplication of the M5 East from King Georges Road in Beverly Hills with tunnels from Kingsgrove to a new interchange at St Peters. The St Peters interchange allows for connections to the proposed future Sydney Gateway project and an underground connection to the M4-M5 Link. The New M5 tunnels also include provision for a future connection to the proposed future F6 Extension.	Planning approval under the EP&A Act granted on 20 April 2016. Commonwealth approval under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth) granted on 11 July 2016. Under construction.
M4-M5 Link (the project)	Tunnels connecting to the M4 East at Haberfield (via the Wattle Street interchange) and the New M5 at St Peters (via the St Peters interchange), a new interchange at Rozelle and a link to Victoria Road (the Iron Cove Link). The Rozelle interchange also includes ramps and tunnels for connections to the proposed future Western Harbour Tunnel and Beaches Link project.	The subject of this EIS.
Related projects		
Sydney Gateway	A high-capacity connection between the St Peters interchange (under construction as part of the New M5 project) and the Sydney Airport and Port Botany precinct.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.
Western Harbour Tunnel and Beaches Link	The Western Harbour Tunnel component would connect to the M4-M5 Link at the Rozelle interchange, cross underneath Sydney Harbour between the Birchgrove and Waverton areas, and connect with the Warringah Freeway at North Sydney. The Beaches Link component would comprise a tunnel that would connect to the Warringah Freeway, cross underneath Middle Harbour and connect with the Burnt Bridge Creek Deviation at Balgowlah and Wakehurst Parkway at Seaforth. It would also involve the duplication of the Wakehurst Parkway between Seaforth and Frenchs Forest.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.
F6 Extension	A proposed motorway link between the New M5 at Arncliffe and the existing M1 Princes Highway at Loftus, generally along the alignment known as the F6 corridor.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.

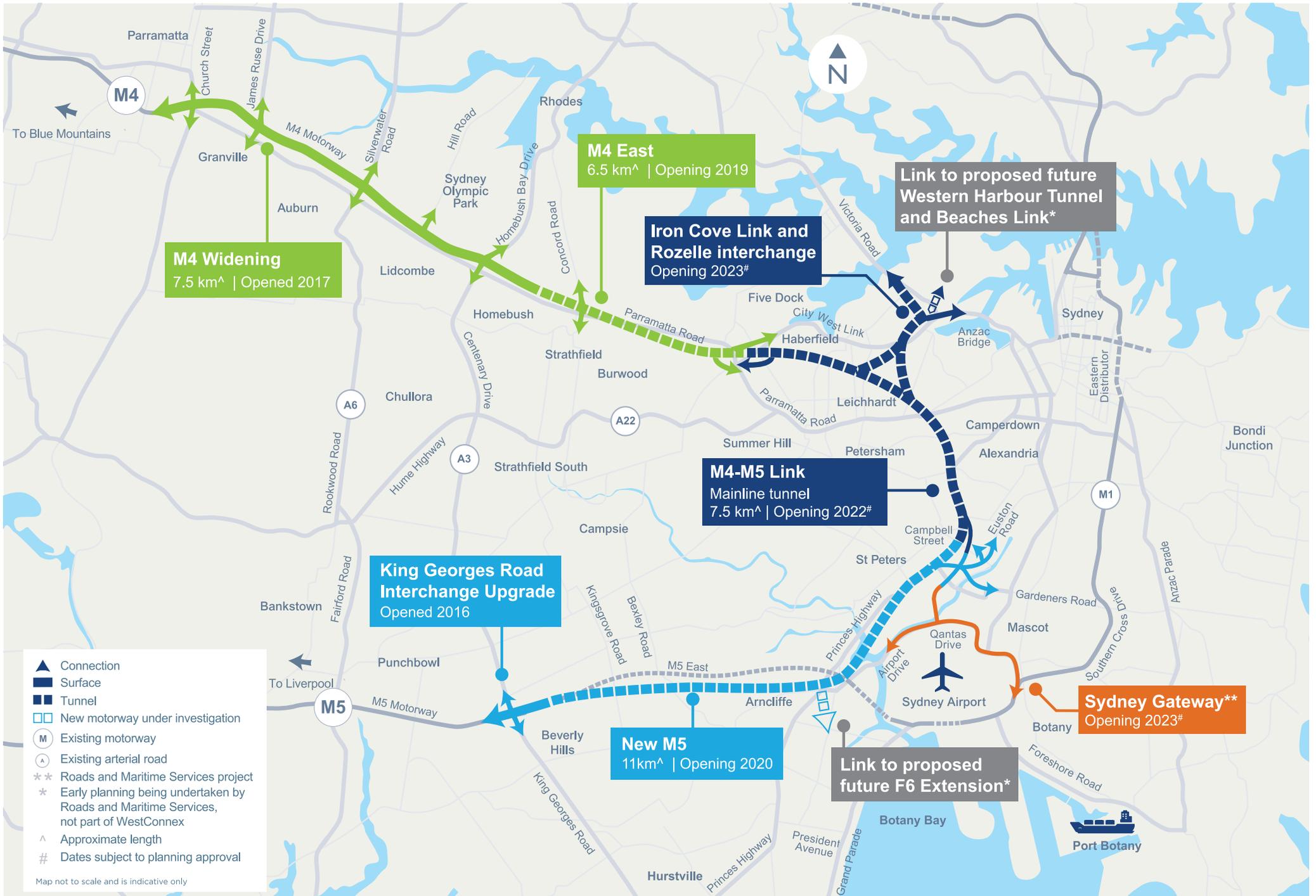


Figure 1-1 Overview of WestConnex and related projects

1.2 Legislative context

EISs are prepared to assess the impacts of major projects, including State significant infrastructure projects, under Part 5.1 of the EP&A Act. This BAR forms part of the EIS being prepared for the M4-M5 Link and assesses the biodiversity impacts of the project.

EISs are subject to a range of legislative and policy requirements as set out in the Secretary's Environmental Assessment Requirements (SEARs). Revised SEARs for the project were issued by the NSW Department of Planning and Environment (DP&E) on 3 May 2017.

The SEARS (outlined in section 1.3 and Annexure C) require that biodiversity impacts are assessed with the current guidelines including the Framework for Biodiversity Assessment (FBA). Any impacts on biodiversity values not covered by the FBA are also required to be addressed. Table 1.2 sets how the biodiversity requirements should be addressed in this BAR.

Table 1.2: Commonwealth and NSW Assessment requirements

Biodiversity assessment	Required by	Section addressed
Inventory		
Identification of the terrestrial biodiversity values, including NSW listed threatened species and endangered ecological communities, in the area proposed for development	Framework for Biodiversity Assessment	Chapter 3 (Landscape features) Chapter 4 (Native vegetation) Chapter 5 (Threatened species)
Identification of aquatic biodiversity values in the area proposed for development	Policy and guidelines for fish habitat conservation and management	Section 5.4
Identification of nationally listed threatened species, endangered ecological communities and migratory species in the area proposed for development	Framework for Biodiversity Assessment	Chapter 6 (Matters of national environmental significance)
Impact assessment		
Description of the direct (related to vegetation clearance) impacts of the project on biodiversity	Framework for Biodiversity Assessment	Chapter 9 (Impact assessment)
Description of the full range of impacts of the project on biodiversity	Secretary's Environmental Assessment Requirements	Chapter 9 (Impact assessment)
Description on the likely significance of impacts of the project on each nationally listed species, EECs and migratory species	Secretary's Environmental Assessment Requirements and Framework for Biodiversity Assessment	Section 9.3
Mitigation measures		
Description of the mitigation measures to be applied	Framework for Biodiversity Assessment	Chapter 8 (Avoid and minimise impacts)
Description of the specific mitigation measures to be applied on each nationally listed species, EEC and migratory species	Framework for Biodiversity Assessment	Chapter 10 (Mitigation)

Biodiversity assessment	Required by	Section addressed
Offset requirements		
Quantification and description of biodiversity offsets required for the unavoidable direct impacts of the project on threatened species and EECs	Framework for Biodiversity Assessment	Chapter 11 (Offsetting required)
Quantification and description of biodiversity offsets required for all direct and indirect significant residual impacts on nationally listed species, EEC and migratory species	EPBC Act Bilateral Agreement	Chapter 11 (Offsetting required)

1.3 SEARs – Biodiversity

The SEARs for biodiversity and where these are addressed in the report are outlined in the table below. This has been extracted from the SEARs for the project (State significant infrastructure (SSI) 16_7485), which are detailed in the EIS. In addition, relevant considerations provided by the NSW Department of Primary Industries (DPI) from the Water and Fisheries sections have been included.

Table 1.3: Secretary’s Environmental Assessment Requirements for biodiversity

Key Issue and desired performance outcome	Requirement (specific assessment requirements in addition to the general requirements)	Section addressed
<p>6. Biodiversity</p> <p>The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity. Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.</p>	<p>1. The Proponent must assess biodiversity impacts in accordance with the current guidelines including the Framework for Biodiversity Assessment (FBA) and be carried out by a person accredited in accordance with section 142B(1)(c) of the <i>Threatened Species Conservation Act</i> (1995).</p> <p>2. The Proponent must assess any impacts on biodiversity values not covered by the FBA. Impacts on species, populations and ecological communities that will require further consideration and provision of information specified in section 9.2 of the FBA include any identified through consultation with the OEH. Species specific surveys shall be undertaken for those species and in accordance with the survey requirements specified by the OEH. The Proponent must identify whether the project as a whole, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the <i>Threatened Species Conservation Act 1995</i> (TSC Act), <i>Fisheries Management Act 1994</i> (FM Act) and <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act).</p>	<p>FBA is addressed in the form of this BAR</p> <p>No species for further consideration were provided by the NSW Office of Environment and Heritage (OEH)</p>
<p>DPI Water (requirements relating to the BAR).</p> <p>NB: Other requirements from DPI Water, not outlined here are provided elsewhere</p>	<p>Groundwater Dependent Ecosystems</p> <p>The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:</p> <ul style="list-style-type: none"> · Identify any potential impacts on GDEs as a result of the proposal including: <ul style="list-style-type: none"> ○ the effect of the proposal on the recharge to groundwater systems; ○ the potential to adversely affect the water 	<p>Section 4.4</p> <p>Section 9.4.2</p> <p>Section 10</p>

<p>in the EIS</p>	<p>quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and</p> <ul style="list-style-type: none"> ○ the effect on the function of GDEs (habitat, groundwater levels, connectivity). <ul style="list-style-type: none"> · Provide safeguard measures for any GDEs. <p>Watercourses, Wetlands and Riparian Land</p> <p>The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:</p> <ul style="list-style-type: none"> · Scaled plans showing the location of: <ul style="list-style-type: none"> ○ wetlands/swamps, watercourses and top of bank; ○ riparian corridor widths to be established along the creeks; ○ existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed); ○ the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and ○ proposed location of any asset protection zones. · Photographs of the watercourses / wetlands and a map showing the point from which the photos were taken. · A detailed description of all potential impacts on the watercourses/riparian land. · A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands. · A description of the design features and measures to be incorporated to mitigate potential impacts. · Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains. 	<p>Section 3.1.3 Section 3.1.4 Section 5.4 Section 9.4.1 Section 9.4.3 Section 10</p> <p>NB: Scaled plans, geomorphic and hydrological assessments and photographs of watercourses, wetlands and riparian land are detailed in Appendix Q (Technical working paper: Surface water and flooding) and Appendix T (Technical working paper: Groundwater) of the EIS.</p>
-------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<p>DPI Fisheries (requirements relating to the BAR).</p> <p>NB: Other requirements from DPI Fisheries, not outlined here are provided elsewhere in the EIS</p>	<p>General Requirements</p> <ul style="list-style-type: none"> • site address and contact details. • property description (eg Lot and DP numbers). • a clear description of the proposal including details of construction methods and materials. • map(s) of the development area and adjacent areas - this should include nearby waterways, adjacent infrastructure (such as jetties) and land use. • clear photographs of the site (at low and high tide in estuaries), including photographs of any riparian and aquatic vegetation present (including pest species such as <i>Caulerpa taxifolia</i>). • a clear description of the physical and hydrological features of the development area (which may extend upstream and downstream of the development site in the case of flowing rivers or tidal waterways). • a clear description of aquatic environments including: <ul style="list-style-type: none"> ○ an aquatic and riparian vegetation survey map (where relevant) of the area which shows the location and/or coverage of saltmarsh, mangrove, seagrass, macroalgae, macrophytes, riparian vegetation and snags, • details of the nature, timing, magnitude and duration of the proposed disturbance to the aquatic environment. • assessments of predicted impacts upon any threatened species (fish and marine vegetation) (i.e. completion of a 7-part test and/or species impact statement(s)) and other aquatic flora and fauna. • details of any mitigation measures to limit environmental impacts. • details of the general regional context, any protected areas, other developments in the area, and/or cumulative impacts. • a copy of the land owner's consent where relevant. • notification of any other matters relevant to the particular proposal and of interest to NSW DPI. 	<p>Section 3.1.3 Section 3.1.4 Section 5.4 Section 9.4.1 Section 9.4.3 Section 10 Section 11.4</p>
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------

1.4 Context of Biodiversity Assessment Report

The NSW Government has developed a *NSW Biodiversity Offsets Policy for Major Projects* (BOPMP) (OEH 2014), including State significant development (SSD) and SSI. As part of an application for a Major Project under the EP&A Act, a proponent must prepare an EIS that addresses the SEARs provided by the DP&E.

The NSW Biodiversity Offsets Policy for Major Projects and the SEARs require the FBA to be applied to assess impacts on biodiversity. The FBA outlines the assessment methodology to quantify and describe the biodiversity values in the project footprint, and the biodiversity offsets required for any unavoidable impacts. Dr Matthew Dowle is an accredited assessor (Table 1.4) and conducted the assessment in accordance with the requirements of the legislation and the FBA.

The FBA applies only to terrestrial impacts. However, assessment of impacts to aquatic biodiversity and requirements for avoiding, minimising and offsetting these impacts is guided by the *Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)* (Fisheries NSW policy and guidelines) and is provided in this BAR. The BAR is also required to consider impacts to matters of national environmental significance (MNES) under the EPBC Act.

1.4.1 Rozelle Rail Yards site management works

The Rozelle Rail Yards site management works was assessed through a Review of Environmental Factors (REF) under Part 5 of the EP&A Act and EPBC Act. The works would remove all rail and rail related infrastructure, as well as vegetation, buildings and stockpiles, and allow existing issues, such as waste and noxious weeds to be appropriately managed.

The REF included an assessment of potential impacts of these works on threatened species and ecological communities listed under State and Commonwealth legislation, in accordance with the EP&A Act. The biodiversity impact assessment for the REF included a database review, vegetation surveys and targeted threatened fauna surveys for the Green and Golden Bell Frog (*Litoria aurea*), Long-nosed Bandicoot (*Perameles nasuta* – *endangered population*) and threatened microbats, including the Eastern Bentwing-bat and Yellow-bellied Sheath-tail-bat. Assessments of Significance under the TSC and EPBC Act were completed for these species, as well as the Grey-headed Flying-fox. These assessments concluded that a significant impact is not likely to occur as a result of the proposed works.

The Rozelle Rail Yards site management works are not part of the M4-M5 Link project and have been excluded from the EIS and the BAR. No additional impacts are expected following the completion of the Rozelle Rail Yards site management works. However, the cumulative impacts of the site management works and the M4-M5 Link project have been considered in this assessment (see section 9.6).

1.4.2 Assessment guidelines

The assessment presented in this BAR was undertaken in accordance with the survey guidelines specified by the SEARs. Updated versions of the guidelines were used if available and were confirmed with DP&E. These include:

- *NSW Framework for Biodiversity Assessment* (OEH 2014a)
- *NSW offset policy for major projects (State Significant Development and State Significant Infrastructure)* (OEH 2014b)
- *Policy and guidelines for fish habitat conservation and management* (update 2013). This guideline supersedes the *Guidelines for Aquatic Habitat Management and Fish Conservation* (DPI 1999)
- *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (DPI 2012)
- *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft November 2004* (NSW Department of Environment and Conservation (DEC) 2004)
- *NSW Threatened species survey and assessment guidelines: field survey methods for fauna (Amphibians)* (NSW Department of Environment and Climate Change (DECC) 2009)
- *Aquatic Ecology in Environmental Impact Assessment – EIA Guideline* (Marcus Lincoln Smith 2003)
- *NSW Sustainable Design Guidelines Version 3.0* (Transport for NSW, 2013)
- *Commonwealth Survey Guidelines for Australia's Threatened Frog* (Australian Government Department of the Environment, Water, Heritage and the Arts (DEHWA) 2010a)
- *Commonwealth Survey Guidelines for Australia's Threatened Bats* (DEHWA 2010b)
- *Matter of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2013)
- *Referral guideline for management actions in Grey-headed and Spectacled Flying-fox camps* (Commonwealth of Australia 2015).

1.4.3 Report structure

This BAR follows the structure as outlined in FBA (OEH 2014a). The report is divided into several chapters, which reflect the requirements of the FBA (refer to Annexure F):

- Executive summary
- Chapter 1 – Project background
- Chapter 2 – The project
- Chapter 3 – Landscape features
- Chapter 4 – Native vegetation
- Chapter 5 – Threatened species
- Chapter 6 – Matters of national environmental significance
- Chapter 7 – Avoidance, mitigation and impacts
- Chapter 7 – Summary of biodiversity issues
- Chapter 8 – Avoid and minimise impacts
- Chapter 9 – Impact assessment
- Chapter 10 – Mitigation
- Chapter 11 – Offsetting required
- Chapter 12 – References
- Annexure A – Habitat assessment table
- Annexure B – Species recorded
- Annexure C – Secretary’s Environmental Assessment Requirements for Biodiversity and Department of Primary Industries requirements
- Annexure D – Anabat survey results
- Annexure E – EPBC Act Significant Impact Criteria
- Annexure F – FBA Methodology and where addressed in document
- Annexure G – Arboricultural impact statement.

1.4.4 Personnel

This BAR was carried out by appropriately qualified and experienced environmental professionals, ecologists and accredited Biobanking assessors as demonstrated in Table 1.4.

Table 1.4: Personnel, role and qualifications

Name	Role	Qualifications
Dr Steven Ward	Project Director	Accredited Biodiversity Banking Assessor Doctor of Philosophy, University of Western Sydney, 2002 Bachelor of Science Honours, Wollongong University, 1994 Bachelor of Science, Major in Botany/Zoology, University of Western Australia, 1992
Dr Mathew Dowle	Biodiversity Assessment	Doctor of Philosophy, Macquarie University, Sydney 2012 Bachelor of Advanced Science (Honours), University of NSW 2004 Accredited Biobanking Assessor (#0203)
Dr Meredith Henderson	Quality Assurance	Doctor of Philosophy, Victoria University, Melbourne 2003 Bachelor of Science (Honours), University of Wollongong 1991 Accredited Biobanking Assessor (#0155)
Ian Dixon	Aquatic Assessment	AUSRIVAS Accreditation (Australian River Assessment System), 2011 Master of Tropical Environmental Management, Charles Darwin University, 2006 Graduate Diploma of Tropical Environmental Management, Charles Darwin University, 2001 Bachelor of Landscape Architecture, 1999
Dr Peter Hancock	Groundwater Assessment	Doctor of Philosophy, University of New England, 2004 Bachelor of Natural Resources. University of New England, 1996

Name	Role	Qualifications
Stacey Wilson	Ecology Assessment	Master of Environment, Macquarie University, 2015 Bachelor of Biodiversity and Conservation, Macquarie University, 2013
Vivian Hamilton	GIS Analysis and Mapping	Completion of the BioBanking and Biocertification Assessor Accreditation Training Course (AHCLPW503A), OEH Bachelor of Environmental Management, Macquarie University, 2007
Byron Heffernan	GIS Analysis and Mapping	Bachelor of Science (Biological Sciences), University of Wollongong, 2006

2 The project

2.1 Project location

The project would be generally located within the City of Sydney and Inner West local government areas (LGAs). The project is located about two to seven kilometres south, southwest and west of the Sydney central business district (CBD) and would cross the suburbs of Ashfield, Haberfield, Leichhardt, Lilyfield, Rozelle, Annandale, Stanmore, Camperdown, Newtown and St Peters. The local context of the project is shown in Figure 2.1.

2.2 Overview of the project

Key components of the project are shown in Figure 2.1 and would include:

- Twin mainline motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 7.5 kilometres long and would generally accommodate up to four lanes of traffic in each direction
- Connections of the mainline tunnels to the M4 East project, comprising:
 - A tunnel-to-tunnel connection to the M4 East mainline stub tunnels east of Parramatta Road near Alt Street at Haberfield
 - Entry and exit ramp connections between the mainline tunnels and the Wattle Street interchange at Haberfield (which is currently being constructed as part of the M4 East project)
 - Minor physical integration works with the surface road network at the Wattle Street interchange including road pavement and line marking
- Connections of the mainline tunnels to the New M5 project, comprising:
 - A tunnel-to-tunnel connection to the New M5 mainline stub tunnels north of the Princes Highway near the intersection of Mary Street and Bakers Lane at St Peters
 - Entry and exit ramp connections between the mainline tunnels and the St Peters interchange at St Peters (which is currently being constructed as part of the New M5 project)
 - Minor physical integration works with the surface road network at the St Peters interchange including road pavement and line marking
- An underground interchange at Leichhardt and Annandale (the Inner West subsurface interchange) that would link the mainline tunnels with the Rozelle interchange and the Iron Cove Link (see below)
- A new interchange at Lilyfield and Rozelle (the Rozelle interchange) that would connect the M4-M5 Link mainline tunnels with:
 - City West Link
 - Anzac Bridge
 - The Iron Cove Link (see below)
 - The proposed future Western Harbour Tunnel and Beaches Link
- Construction of connections to the proposed future Western Harbour Tunnel and Beaches Link project as part of the Rozelle interchange, including:
 - Tunnels that would allow for underground mainline connections between the M4 East and New M5 motorways and the proposed future Western Harbour Tunnel and Beaches Link (via the M4-M5 Link mainline tunnels)

- A dive structure and tunnel portals within the Rozelle Rail Yards, north of the City West Link / The Crescent intersection
- Entry and exit ramps that would extend north underground from the tunnel portals in the Rozelle Rail Yards to join the mainline connections to the proposed future Western Harbour Tunnel and Beaches Link
- A ventilation outlet and ancillary facilities as part of the Rozelle ventilation facility (see below)
- Twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge (the Iron Cove Link). Underground entry and exit ramps would also provide a tunnel connection between the Iron Cove Link and the New M5 / St Peters interchange (via the M4-M5 Link mainline tunnels)
- The Rozelle surface works, including:
 - Realigning The Crescent at Annandale, including a new bridge over Whites Creek and modifications to the intersection with City West Link
 - A new intersection on City West Link around 300 metres west of the realigned position of The Crescent, which would provide a connection to and from the New M5/St Peters interchange (via the M4-M5 Link mainline tunnels)
 - Widening and improvement works to the channel and bank of Whites Creek between the light rail bridge and Rozelle Bay at Annandale, to manage flooding and drainage for the surface road network
 - Reconstructing the intersection of The Crescent and Victoria Road at Rozelle, including construction of a new bridge at Victoria Road
 - New and upgraded pedestrian and cyclist infrastructure
 - Landscaping, including the provision of new open space within the Rozelle Rail Yards
- The Iron Cove Link surface works, including:
 - Dive structures and tunnel portals between the westbound and eastbound Victoria Road carriageways, to connect Victoria Road east of Iron Cove Bridge with the Iron Cove Link
 - Realignment of the westbound (southern) carriageway of Victoria Road between Springside Street and the eastern abutment of Iron Cove Bridge
 - Modifications to the existing intersections between Victoria Road and Terry, Clubb, Toelle and Callan streets
 - Landscaping and the establishment of pedestrian and cycle infrastructure
- Five motorway operations complexes; one at Leichhardt (MOC1), three at Rozelle (Rozelle West (MOC2), Rozelle East (MOC3) and Iron Cove Link (MOC4)), and one at St Peters (MOC5). The types of facilities that would be contained within the motorway operations complexes would include substations, water treatment plants, ventilation facilities and outlets, offices, on-site storage and parking for employees
- Tunnel ventilation systems, including ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels
- Three new ventilation facilities, including:
 - The Rozelle ventilation facility at Rozelle
 - The Iron Cove Link ventilation facility at Rozelle
 - The Campbell Road ventilation facility at St Peters

- Fitout (mechanical and electrical) of part of the Parramatta Road ventilation facility at Haberfield (which is currently being constructed as part of M4 East project) for use by the M4-M5 Link project
- Drainage infrastructure to collect surface and groundwater for treatment at dedicated facilities. Water treatment would occur at
 - Two operational water treatment facilities (at Leichhardt and Rozelle)
 - The constructed wetland within the Rozelle Rail Yards
 - A bioretention facility for stormwater runoff within the informal car park at King George Park at Rozelle (adjacent to Manning Street). A section of the existing informal car park would also be upgraded, including sealing the car park surface and landscaping
- Treated water would flow back to existing watercourses via new, upgraded and existing infrastructure
- Ancillary infrastructure and operational facilities for electronic tolling and traffic control and signage (including electronic signage)
- Emergency access and evacuation facilities, including pedestrian and vehicular cross and long passages and fire and life safety systems
- Utility works, including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities. A Utilities Management Strategy has been prepared for the project that identifies management options for utilities, including relocation or adjustment. Refer to **Appendix F** (Utilities Management Strategy) of the EIS.

The project does not include:

- Site management works at the Rozelle Rail Yards. These works were separately assessed and determined by Roads and Maritime through a Review of Environmental Factors under Part 5 of the EP&A Act (refer to **Chapter 2** (Assessment process) of the EIS)
- Ongoing motorway maintenance activities during operation
- Operation of the components of the Rozelle interchange which are the tunnels, ramps and associated infrastructure being constructed to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project.

Temporary construction ancillary facilities and temporary works to facilitate the construction of the project would also be required.

2.2.1 Staged construction and opening of the project

It is anticipated the project would be constructed and opened to traffic in two stages (as shown in Figure 2.1).

Stage 1 would include:

- Construction of the mainline tunnels between the M4 East at Haberfield and the New M5 at St Peters, stub tunnels to the Rozelle interchange (at the Inner West subsurface interchange) and ancillary infrastructure at the Darley Road motorway operations complex (MOC1) and Campbell Road motorway operations complex (MOC5)
- These works are anticipated to commence in 2018 with the mainline tunnels open to traffic in 2022. At the completion of Stage 1, the mainline tunnels would operate with two traffic lanes in each direction. This would increase to generally four lanes at the completion of Stage 2, when the full project is operational.

Stage 2 would include:

- Construction of the Rozelle interchange and Iron Cove Link including:
 - Connections to the stub tunnels at the Inner West subsurface interchange (built during Stage 1)
 - Ancillary infrastructure at the Rozelle West motorway operations complex (MOC2), Rozelle East motorway operations complex (MOC3) and Iron Cove Link motorway operations complex (MOC4)
 - Connections to the surface road network at Lilyfield and Rozelle
 - Construction of tunnels, ramps and associated infrastructure as part of the Rozelle interchange to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project
- Stage 2 works are expected to commence in 2019 with these components of the project open to traffic in 2023.

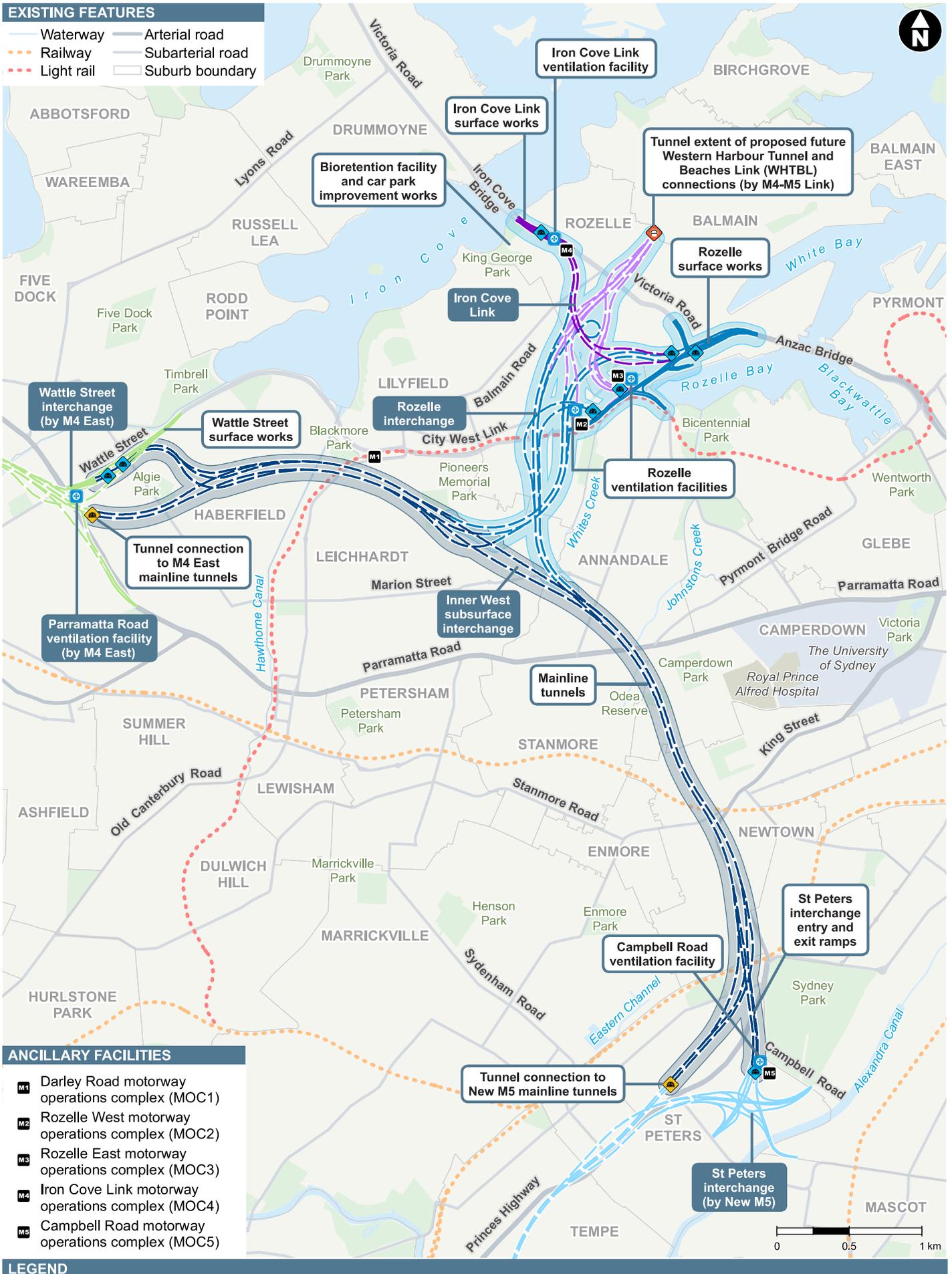


Figure 2-1 Overview of the project

2.3 Construction activities

2.3.1 Overview

An overview of the key construction features of the project is shown in Figure 2.2 and would generally include:

- Enabling and temporary works, including provision of construction power and water supply, ancillary site establishment including establishment of acoustic sheds and construction hoarding, demolition works, property adjustments and public and active transport modifications (if required)
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure
- Haulage of spoil generated during tunnelling and excavation activities
- Fitout of the road tunnels and support infrastructure, including ventilation and emergency response systems
- Construction and fitout of the motorway operations complexes and other ancillary operations buildings
- Realignment, modification or replacement of surface roads, bridges and underpasses
- Implementation of environmental management and pollution control facilities for the project.

A more detailed overview of construction activities is provided in Table 2.1.

Table 2.1: Overview of construction activities

Component	Typical activities
Site establishment and enabling works	<ul style="list-style-type: none"> • Vegetation clearing and removal • Utility works • Traffic management measures • Install safety and environmental controls • Install site fencing and hoarding • Establish temporary noise attenuation measures • Demolish buildings and structures • Carry out site clearing • Heritage salvage or conservation works (if required) • Establish construction ancillary facilities and access • Establish acoustic sheds • Supply utilities (including construction power) to construction facilities • Establish temporary pedestrian and cyclist diversions
Tunnelling	<ul style="list-style-type: none"> • Construct temporary access tunnels • Excavation of mainline tunnels, entry and exit ramps and associated tunnelled infrastructure and install ground support • Spoil management and haulage • Finishing works in tunnel and provision of permanent tunnel services • Test plant and equipment
Surface earthworks and structures	<ul style="list-style-type: none"> • Vegetation clearing and removal • Topsoil stripping • Excavate new cut and fill areas • Construct dive and cut-and-cover tunnel structures • Install stabilisation and excavation support (retention systems) such as sheet pile walls, diaphragm walls and secant pile walls (where required) • Construct required retaining structures • Excavate new road levels

Bridge works	<ul style="list-style-type: none"> Construct piers and abutments Construct headstock Construct bridge deck, slab and girders Demolish and remove redundant bridges
Drainage	<ul style="list-style-type: none"> Construct new pits and pipes Construct new groundwater drainage system Connect drainage to existing network Construct sumps in tunnels as required Construct water quality basins, constructed wetland and bioretention facility and basin Construct drainage channels Construct spill containment basin Construct onsite detention tanks Adjustments to existing drainage infrastructure where impacted Carry out widening and naturalisation of a section of Whites Creek Demolish and remove redundant drainage
Pavement	<ul style="list-style-type: none"> Lay select layers and base Lay road pavement surfacing Construct pavement drainage
Operational ancillary facilities	<ul style="list-style-type: none"> Install ventilation systems and facilities Construct water treatment facilities Construct fire pump rooms and install water tanks Test and commission plant and equipment Construct electrical substation to supply permanent power to the project
Finishing works	<ul style="list-style-type: none"> Line mark to new road surfaces Erect directional and other signage and other roadside furniture such as street lighting Erect toll gantries and other control systems Construct pedestrian and cycle paths Carry out earthworks at disturbed areas to establish the finished landform Carry out landscaping Closure and backfill of temporary access tunnels (except where these are to be used for inspection and/or maintenance purposes) Site demobilisation and preparation of the site for a future use

Twelve construction ancillary facilities are described in this EIS (as listed below). To assist in informing the development of a construction methodology that would manage constructability constraints and the need for construction to occur in a safe and efficient manner, while minimising impacts on local communities, the environment, and users of the surrounding road and other transport networks, two possible combinations of construction ancillary facilities at Haberfield and Ashfield have been assessed in this EIS. The construction ancillary facilities that comprise these options have been grouped together in this EIS and are denoted by the suffix a (for Option A) or b (for Option B).

The construction ancillary facilities required to support construction of the project include:

- Construction ancillary facilities at Haberfield (Option A), comprising:
 - Wattle Street civil and tunnel site (C1a)
 - Haberfield civil and tunnel site (C2a)
 - Northcote Street civil site (C3a)
- Construction ancillary facilities at Ashfield and Haberfield (Option B), comprising:
 - Parramatta Road West civil and tunnel site (C1b)
 - Haberfield civil site (C2b)
 - Parramatta Road East civil site (C3b)
- Darley Road civil and tunnel site (C4)

- Rozelle civil and tunnel site (C5)
- The Crescent civil site (C6)
- Victoria Road civil site (C7)
- Iron Cove Link civil site (C8)
- Pymont Bridge Road tunnel site (C9)
- Campbell Road civil and tunnel site (C10).

The number, location and layout of construction ancillary facilities would be finalised as part of detailed construction planning during detailed design and would meet the environmental performance outcomes stated in the EIS and the Submissions and Preferred Infrastructure Report and satisfy criteria identified in any relevant conditions of approval.

The construction ancillary facilities would be used for a mix of civil surface works, tunnelling support, construction workforce parking and administrative purposes. Wherever possible, construction sites would be co-located with the operational footprint to minimise property acquisition and temporary disruption. The layout and access arrangements for the construction ancillary facilities are based on the concept design only and would be confirmed and refined in response to submissions received during the exhibition of this EIS and during detailed design.

2.3.2 Construction program

The total period of construction works for the project is expected to be around five years, with commissioning occurring concurrently with the final stages of construction. An indicative construction program is shown in Table 2.2.

Table 2.2: Construction program overview

Construction activity	Indicative construction timeframe																							
	2018				2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mainline tunnels																								
Site establishment and establishment of construction ancillary facilities																								
Utility works and connections																								
Tunnel construction																								
Portal construction																								
Construction of permanent operational facilities																								
Mechanical and electrical fitout works																								
Establishment of tolling facilities																								
Site rehabilitation and landscaping																								
Surface road works																								
Demobilisation and rehabilitation																								
Testing and commissioning																								

Construction activity	Indicative construction timeframe																											
	2018				2019				2020				2021				2022				2023							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Rozelle interchange and Iron Cove Link																												
Site establishment and establishment of construction ancillary facilities																												
Utility works and connections and site remediation																												
Tunnel construction																												
Portal construction																												
Construction of surface road works																												
Construction of permanent operational facilities																												
Mechanical and electrical fitout works																												
Establishment of tolling facilities																												
Site rehabilitation and landscaping																												
Demobilisation and rehabilitation																												
Testing and commissioning																												

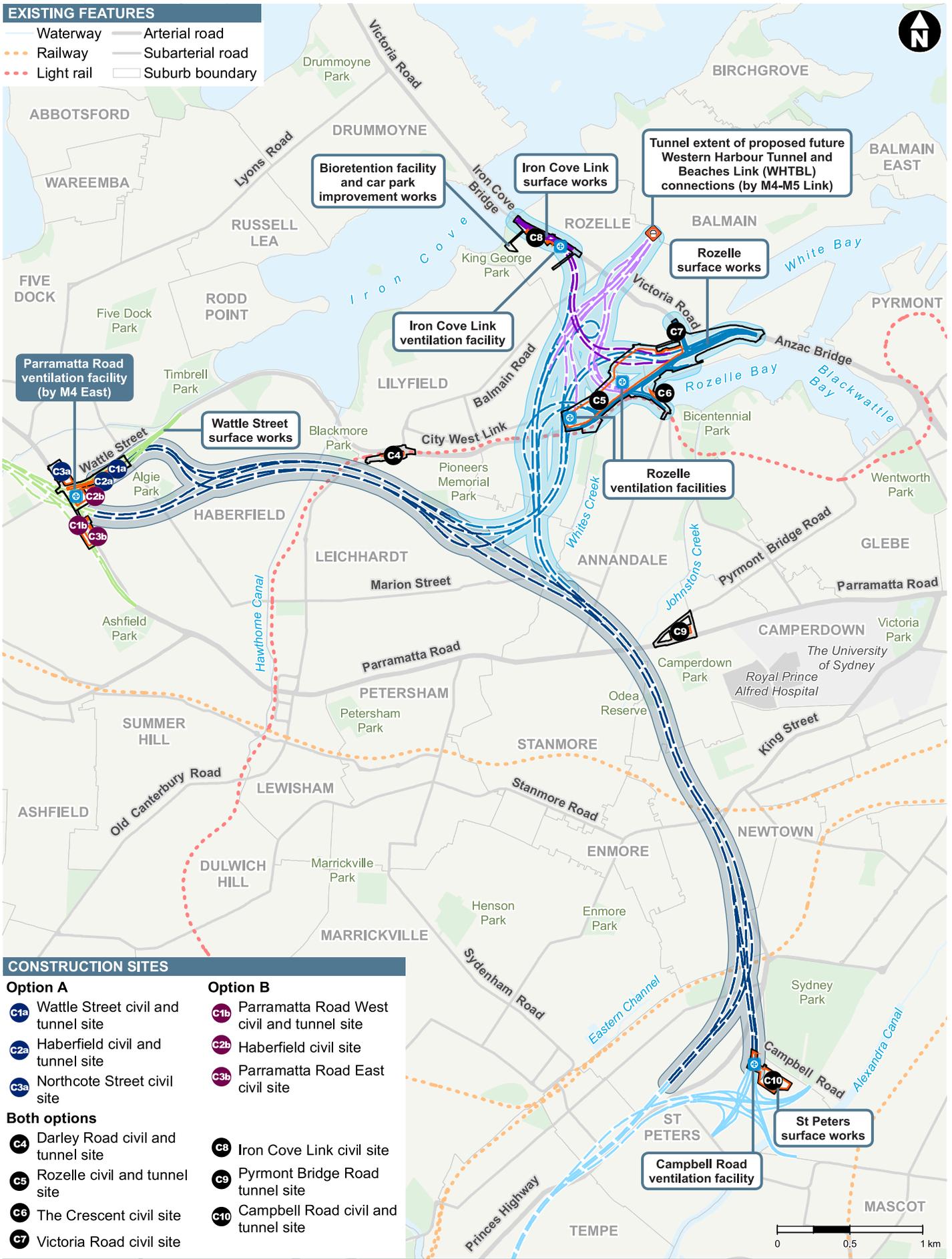


Figure 2-2 Overview of project footprint and ancillary facilities

2.3.3 Study area

The project is located within the Cumberland and Pittwater sub-regions of the Sydney Basin Bioregion. The study area comprises the project footprint and a surrounding 550 metre buffer, as required by the FBA. The project footprint defined in this report is the same as the development footprint defined in the FBA.

The study area includes existing roads, motorways, residential areas, industrial areas, urban landscaped areas, and exotic vegetation and is shown in Figure 2.3. Figure 2.3 also shows the corridor assessed for MNES, groundwater dependant ecosystems (GDEs) and riparian ecosystems.

Project Location

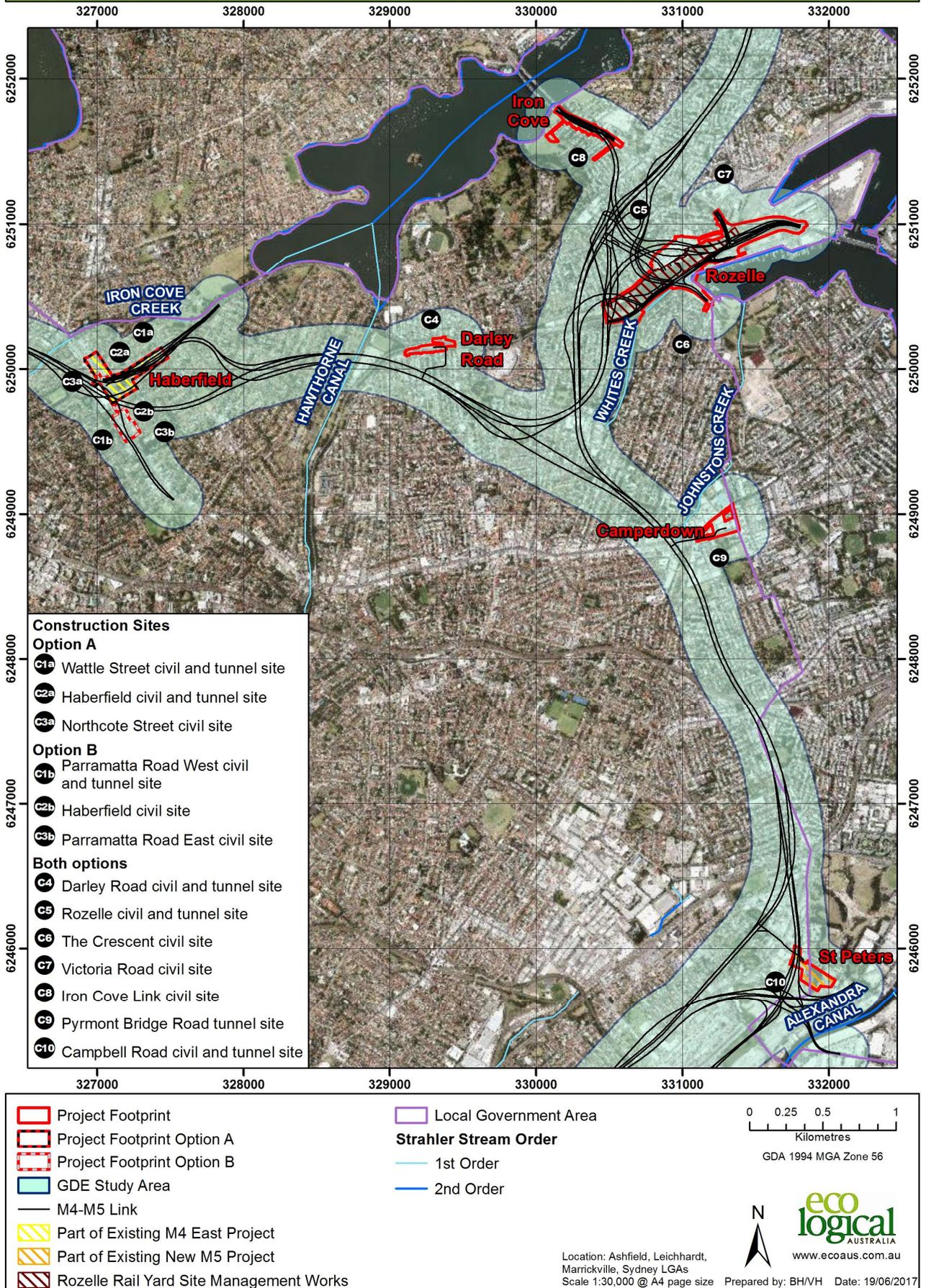


Figure 2.3: Project location and study area (project footprint assessed under the FBA is in red outline)

3 Landscape features

3.1 Identified features

In accordance with Chapter 4 of the FBA, the BAR is required to identify a number of landscape features such as the Interim Biogeographic Regionalisation for Australia (IBRA) region, IBRA sub-region, Mitchell landscape, rivers and streams, extent of native vegetation in the area assessed for the project footprint. The landscape features of the project footprint are shown in this chapter (Chapter 3).

3.1.1 IBRA Bioregions and subregions

The project footprint is located within the Sydney Basin Bioregion which extends north to the Hunter Valley, west to Mudgee and south to Batemans Bay. The project footprint occurs within a highly urbanised setting surrounded by extensive areas of established urban development to the east, north and south.

The project footprint is located entirely within the Sydney Basin Bioregion and crosses two IBRA subregions, the Cumberland subregion and the Pittwater subregion. They were used for the 550 metre buffer (see section 3.2.1 and Figure 3.1).

3.1.2 NSW landscape regions (Mitchell landscapes)

The project footprint occurs across two Mitchell Landscapes with the majority occurring within Sydney – Port Jackson and Ashfield Plains landscapes (Mitchell 2002) (Figure 3.1). A further Mitchell Landscape; Sydney - Newcastle Barriers and Beaches occurs within the study area.

3.1.3 Rivers and streams

Riparian buffers of three waterways occur within the project footprint: The riparian buffers of Whites Creek (1st Order Stream) and Rozelle Bay (Estuarine Area) are located near the surface works at Rozelle (Figure 3.4); and a small portion of the riparian buffer of Iron Cove (2nd Order Stream) is located near construction at Iron Cove. No other construction compounds or operational areas are within riparian corridors.

Whites Creek has not been mapped as Key Fish Habitat (KFH), as defined in the *Fisheries Policy and Guidelines for Fish Habitat Conservation and Management – update 2013* (Fairfull 2013). Rozelle Bay is mapped as KFH and is located within the project footprint.

Iron Cove has been mapped as KFH and would not be directly impacted by the project. However, it will require protection from indirect impacts associated with drainage flows from works associated with the Iron Cove Link. Waterways in or adjacent to the project footprint are not suitable habitat for threatened fish species.

3.1.4 Wetlands

There are no wetlands identified in State Environmental Planning Policy No 14 – Coastal Wetlands (SEPP 14) in the study area. Artificial waterbodies are scattered across the study area and surrounds as detention basins and ponds.

3.1.5 State or Regionally significant biodiversity links

No formal regional or State biodiversity links recognised by the FBA methodology occur within the study area. Given there were no links crossed, in accordance with the FBA the connectivity value class entered into the calculator was zero.

3.2 Landscape values

The FBA requires the landscape value (landscape attributes defined in Section 4.2 of the FBA) of the study area to be determined. This value contributes to the overall biodiversity value of the project footprint and it is used to inform the required offsets. It is combined with the credits calculated from the ecosystem and species credits which are detailed in Chapters 4 and 5.

3.2.1 Current and future native vegetation cover score

The linear assessment method was selected for this project, as defined in the FBA. An assessment buffer of 550 metres was applied to the project footprint in accordance with Appendix 5 of the FBA. This was used to assess the impact of the project on the surrounding vegetation cover (Figure 3.2 to Figure 3.7).

The amount of existing native vegetation within the study area was calculated using ArcGIS, and the vegetation mapping from the Native Vegetation of the Sydney Metropolitan Area (OEH 2013) (excluding the non-native categories). Where this layer did not cover the whole buffer, the gaps were filled in manually based on interpretation of recent aerial imagery.

To determine the native vegetation cover after the project in the study area, the total amount of clearing was subtracted from the pre-project cover. The project footprint was then used to calculate the amount of vegetation loss. Table 3.1 outlines the vegetation before and after the project, and the average and associated Native Vegetation Cover Class (per cent) to be entered into the online calculator for the assessment.

The assessment for the study area recorded approximately 0.62 hectares of native vegetation cover before the project (Table 3.1). This represents 0.05 per cent native vegetation cover. After the project, the area of native vegetation was 0.62 hectares. This represents 0.05 per cent native vegetation cover.

The area of native vegetation after the project was in the same cover category as before the project (≤ 5 per cent). The native vegetation cover class did not change between before and after the project. Therefore in accordance with Table 16 of the FBA, the score for the per cent native vegetation cover entered into the calculator was 1.25.

Table 3.1: Area of native vegetation in buffer area

Area in 550 metre buffer	Native Vegetation Cover (Before The project)	Native Vegetation Cover (After The project)
1133.38 ha	0.62 ha	0.62 ha

3.2.2 Connectivity value score

A connectivity assessment was conducted using the FBA technique for linear based projects (OEH 2014a). No formal State or regional biodiversity links recognised by the methodology are present within the study area. There is also no native vegetation in moderate to good condition within the study area that meets the definition of a very large, large, or local area biodiversity link.

Given there were no links present, in accordance with the FBA the connectivity value score is zero.

3.2.3 Patch size

The vegetation within the project footprint is limited to patches of urban native and exotic vegetation (as described by the Native Vegetation of the Sydney Metropolitan Area (OEH 2013)), and is surrounded by extensive urbanised areas. These patches of vegetation do not conform to the FBA definition of moderate to good condition native vegetation (refer to the definition of 'vegetation in low condition' on page 60 of the FBA), and as such, do not meet the criteria for assessing patch size. In accordance with Table 18 of the FBA, the patch size score is zero.

3.2.4 Change in area to perimeter ratio

For a linear shaped or multiple fragmented major project such as this project, the FBA requires the change in area to perimeter ratio of impacted patch size areas to be calculated. This represents the area of native vegetation before and after the project. As there are no patch sizes of native vegetation associated with the project, the proportional change in area to perimeter ratio cannot be assessed. In accordance with Table 19 of the FBA, the proportional change in area to perimeter ratio score is zero.

Site Value and Landscape Value

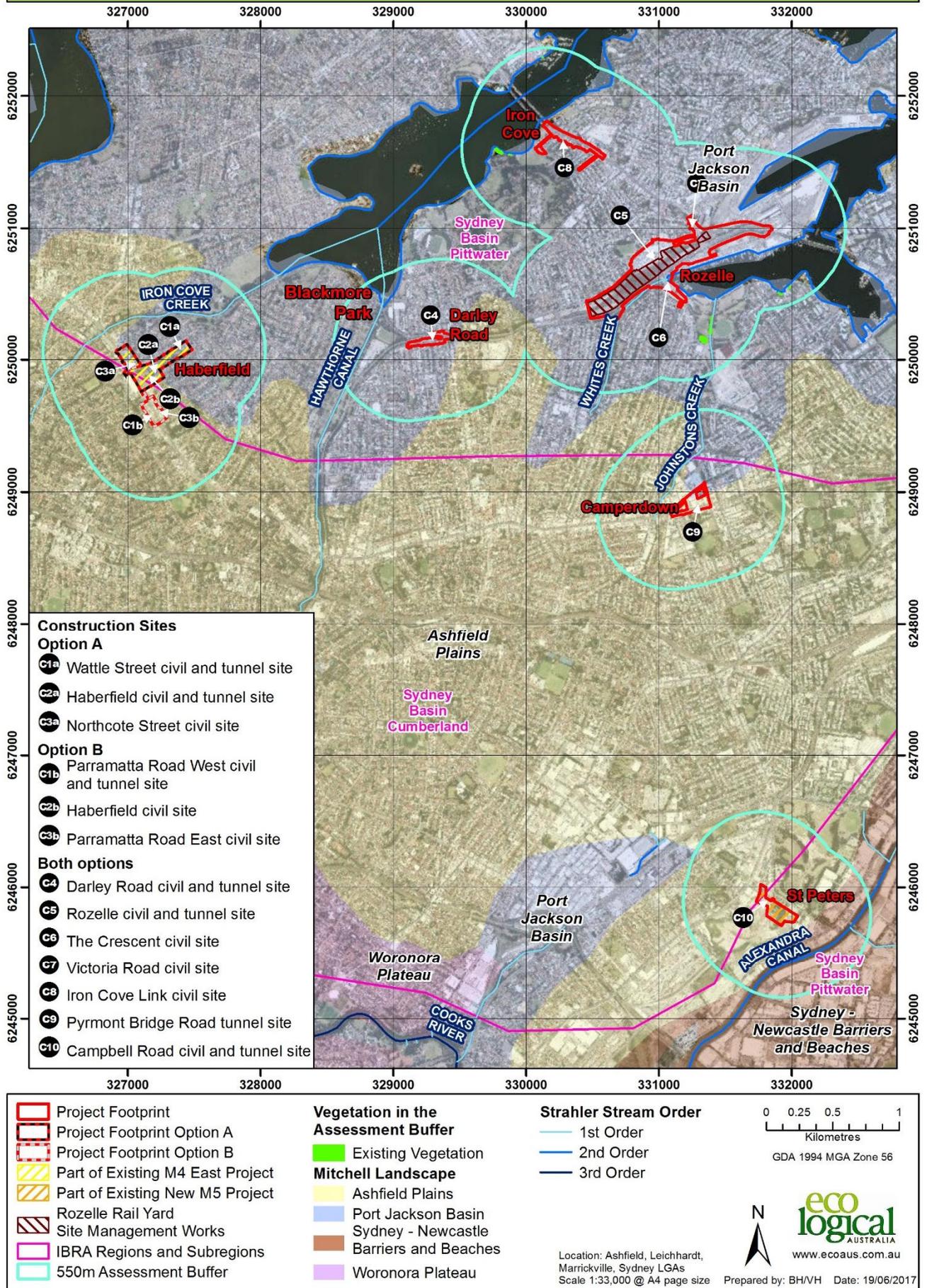


Figure 3.1: Landscape values overview

Site Value and Landscape Value - Haberfield

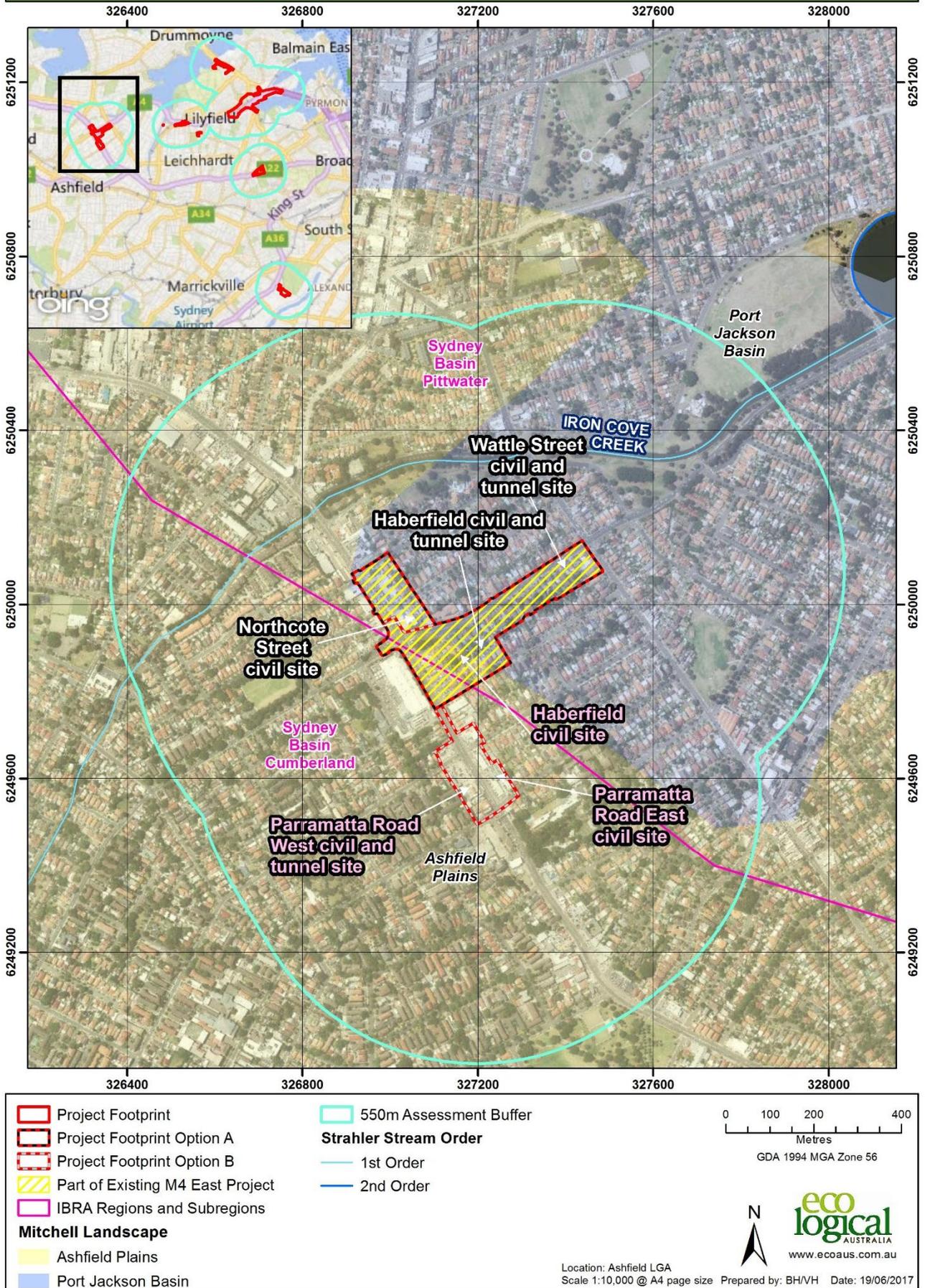


Figure 3.2: Landscape values at Haberfield and Ashfield

Site Value and Landscape Value - Darley Road

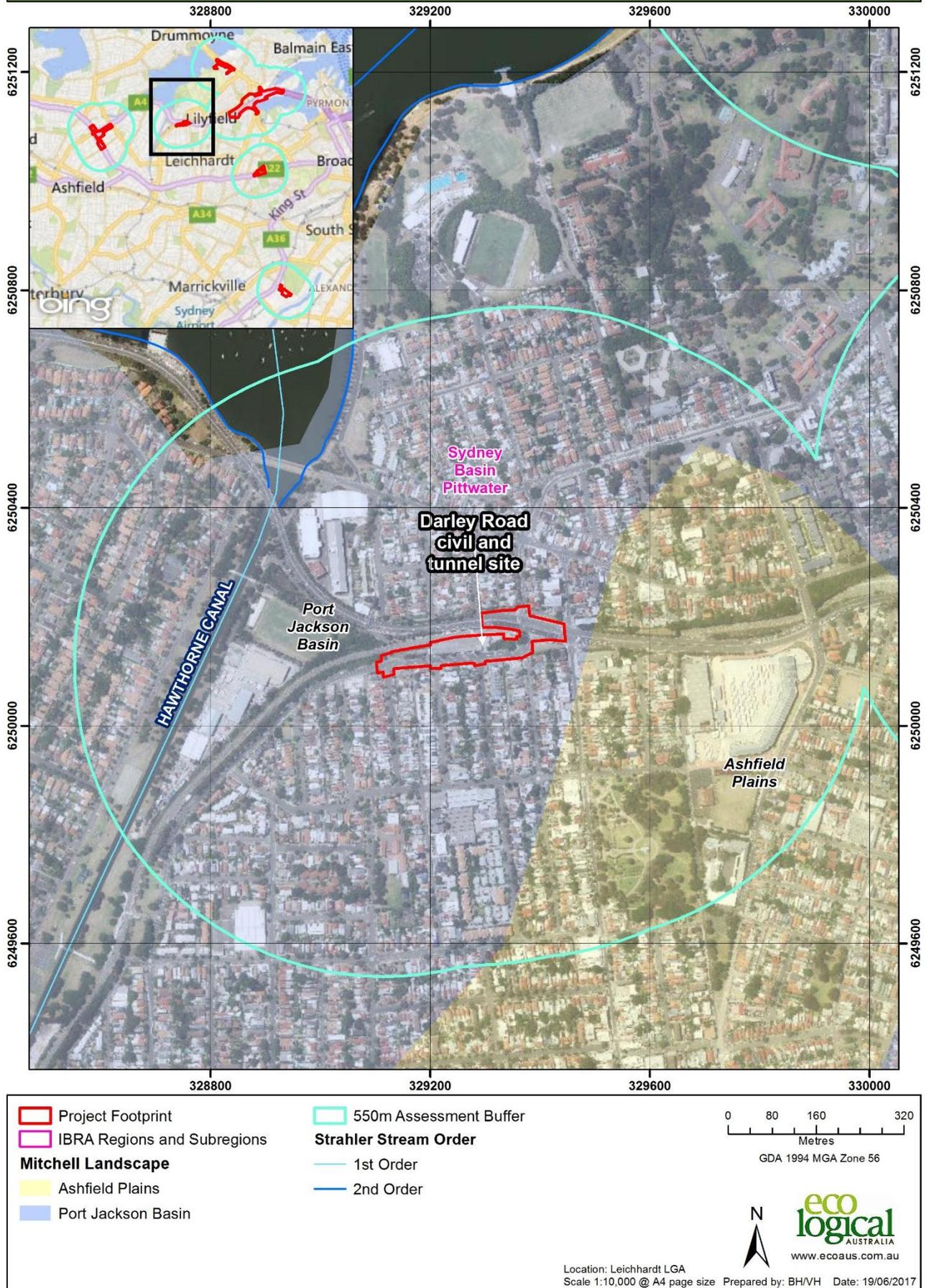


Figure 3.3: Landscape values at the Darley Road civil and tunnel site (C4)

Site Value and Landscape Value - Rozelle

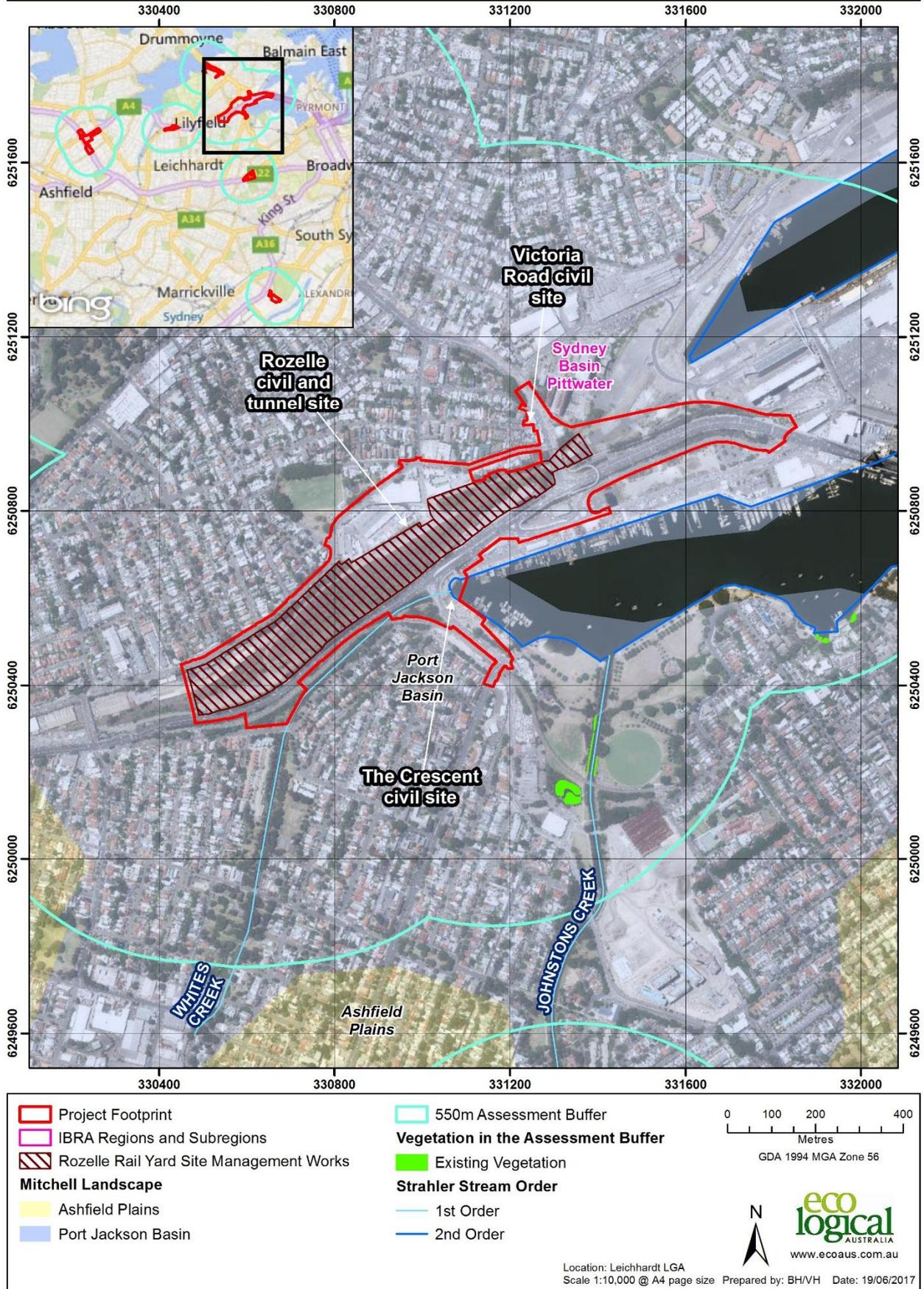


Figure 3.4: Landscape values at the Rozelle civil and tunnel site (C5), The Crescent civil site (C6) and Victoria Road civil site (C7)

Site Value and Landscape Value - Iron Cove

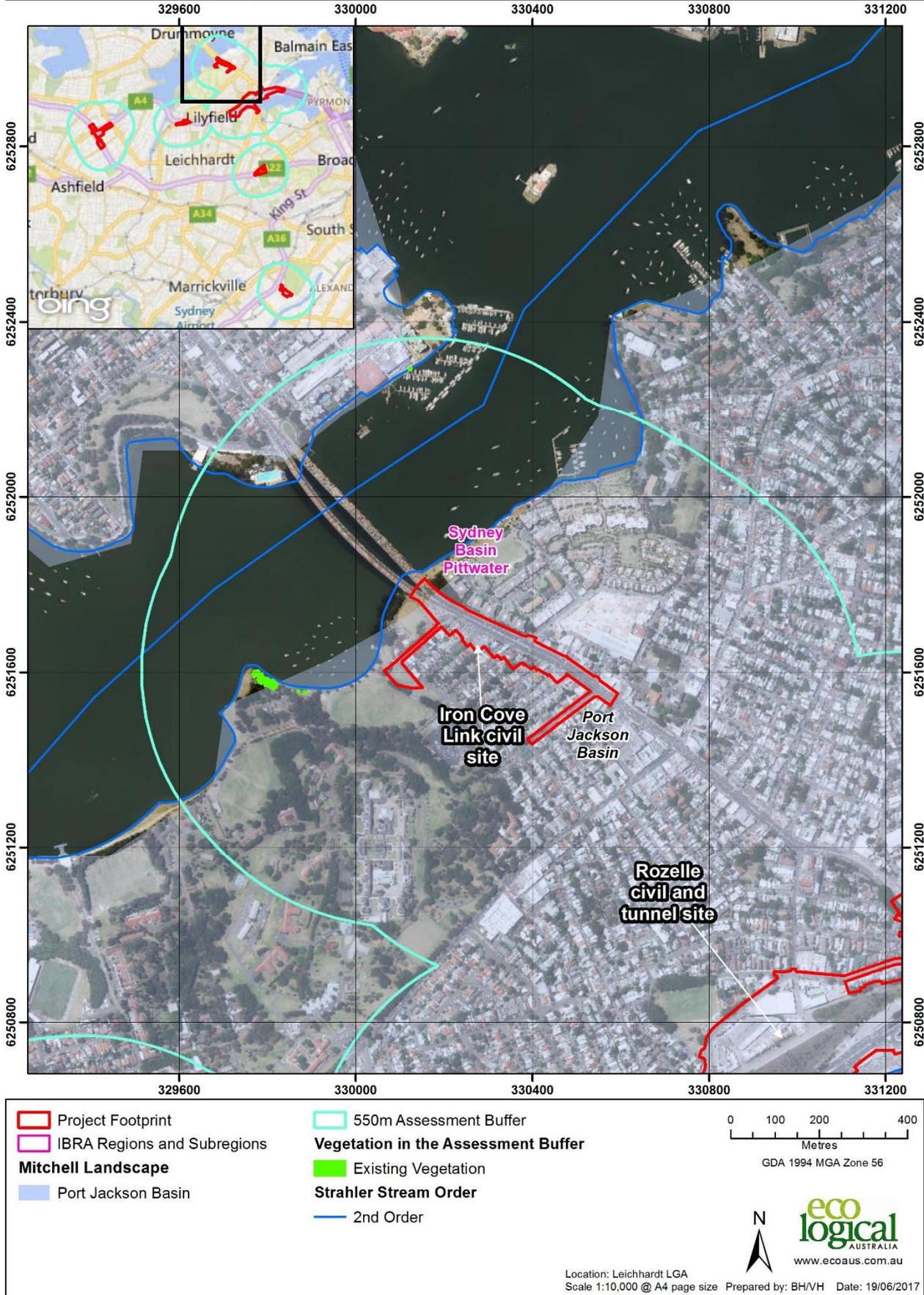


Figure 3.5: Landscape values at Iron Cove Link civil site (C8)

Site Value and Landscape Value - Camperdown

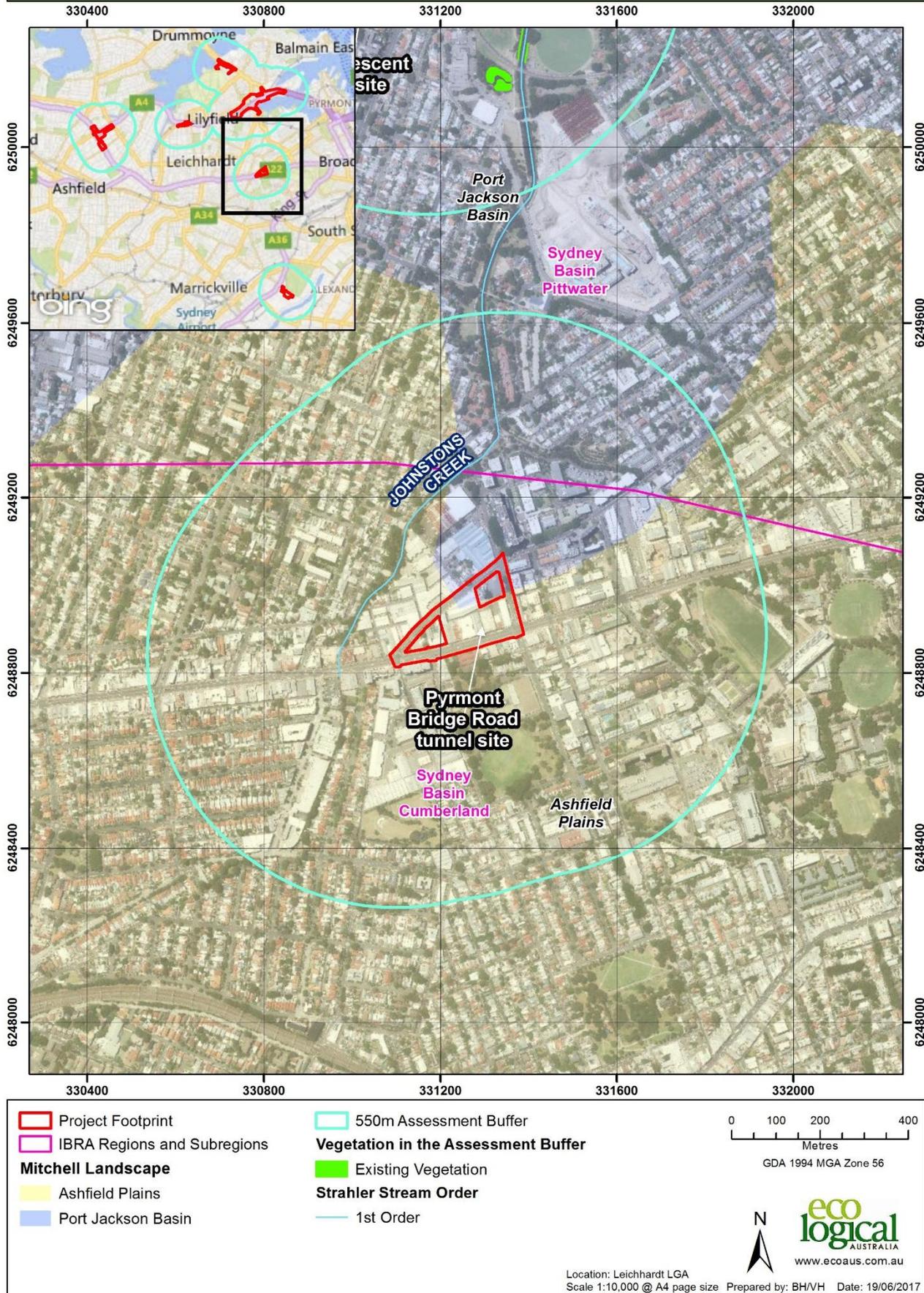
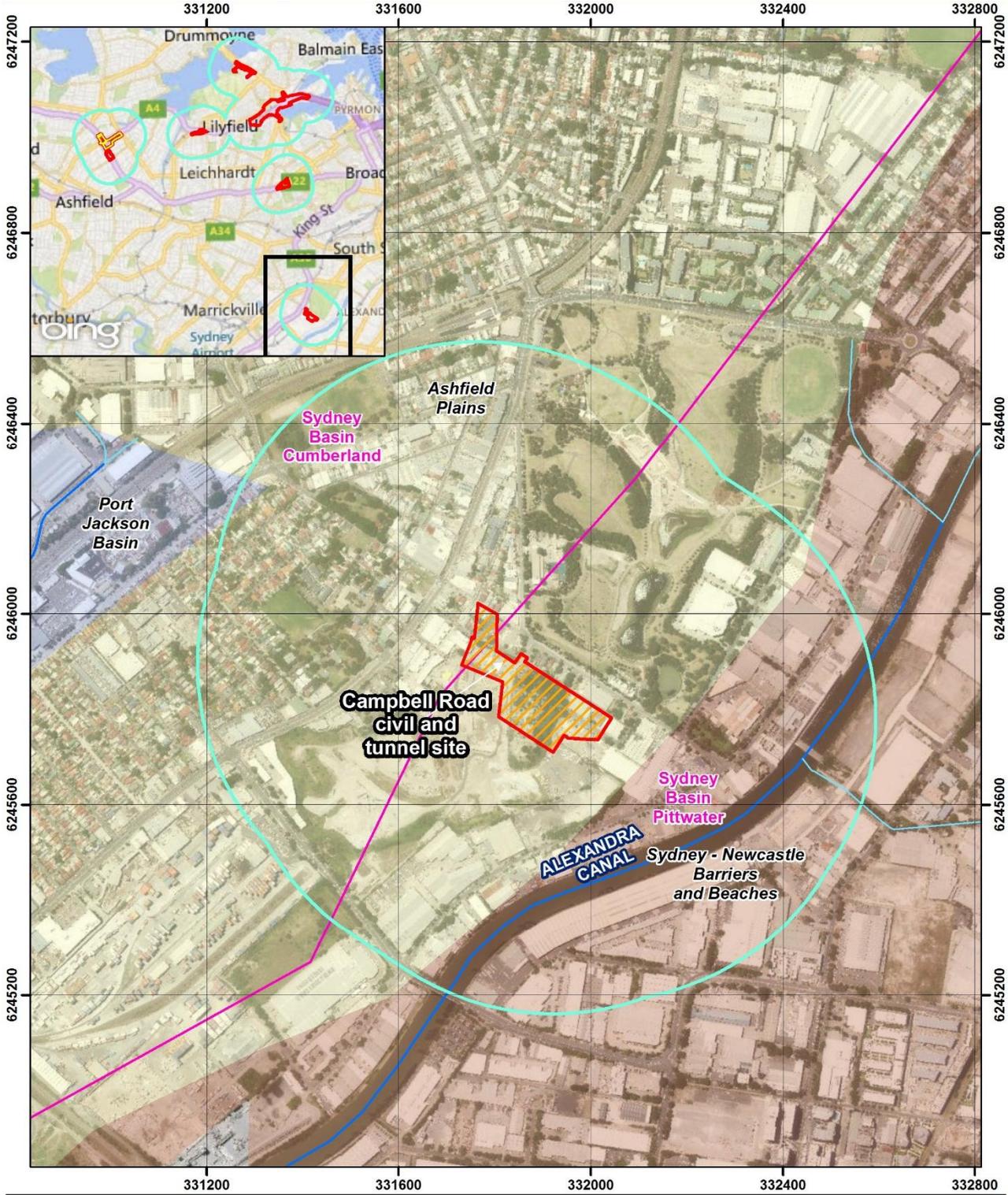


Figure 3.6: Landscape values at Pyrmont Bridge Road tunnel site (C9)

Site Value and Landscape Value - St Peters



Project Footprint	550m Assessment Buffer	 GDA 1994 MGA Zone 56
Part of Existing New M5 Project	Strahler Stream Order	
IBRA Regions and Subregions	1st Order	 eco logical AUSTRALIA www.ecoaus.com.au
Mitchell Landscape	2nd Order	
Ashfield Plains		
Port Jackson Basin		Location: Marrickville & Sydney LGAs Scale 1:10,000 @ A4 page size Prepared by: BH/VH Date: 19/06/2017
Sydney - Newcastle Barriers and Beaches		

Figure 3.7: Landscape values at Campbell Road civil and tunnel site (C10)

4 Native vegetation

Eco Logical Australia (ELA) employed a series of survey methods to undertake the field assessment of the biodiversity values within the study area. The surveys conducted were consistent with the SEARs, FBA, survey guidelines and relevant impact assessment guidelines. The methods used and rationale behind their selection are described in section 4.1.

4.1 Method

4.1.1 Background research

Data searches

ELA reviewed aerial photography as well as the following vegetation and soil datasets which overlap within the study area:

- Vegetation Information System (VIS) online vegetation classification database (OEH 2016c)
- The Native Vegetation of the Sydney Metropolitan Area (OEH 2013)
- Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy 1989).

The following threatened species and predicted species databases were reviewed for the locality:

- OEH Atlas of NSW Wildlife (NSW BioNet) (10 kilometre radius, searched 17 August 2016)
- NSW Threatened Species Profile Database (OEH 2016b)
- EPBC Act Protected Matters Search Tool (10 kilometre radius search) (DotEE 2016b)
- FM Act Listed protected and threatened species and populations, including species profiles, 'Primefact' publications and expected distribution maps (Riches et al 2016)
- Online Zoological Collections of Australian Museums (OZCAM)
- Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (searched 27 September 2016).

Previous Reports

To understand the context of the study area in relation to previous biodiversity studies, reviews of reports were conducted. ELA reviewed a number of previous reports or documents that may be relevant to the study area, including:

- M4 East EIS - Biodiversity Impact Assessment (GHD Pty Ltd 2015)
- The New M5 EIS – Biodiversity Assessment Report (ELA 2015)
- Rozelle Rail Yards REF – Brief Biodiversity Assessment (ELA 2016)
- WestConnex M4-M5 Link Geotechnical Investigations Flora and Fauna Assessment (Niche 2016)
- CBD Metro Environmental Assessment (SKM 2010)
- Local Council Action Plans or Strategies:
 - The City of Sydney Urban Ecology Strategic Action Plan (2014)
 - City of Sydney Environmental Action 2016-2021 Strategy and Action Plan (2016)
 - Marrickville Council Biodiversity Action Plan 2011-2015 (2011)
 - Marrickville Council Biodiversity Strategy 2011-2021 (2011)
 - Inner West Council Greenway Strategy:
 - Greenway Biodiversity Strategy (2012)
 - Greenway Revegetation and Bushcare Plan (2011)
 - Greenway Flora and Fauna Literature Review (2010)
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 (Appendix 2).

A cumulative impact assessment has been undertaken that assesses impacts from M4-M5 Link project, Rozelle Rail Yards site management works, New M5 project and the M4 East

project (see section 9.6).

M4 East EIS – Biodiversity Impact Assessment

The M4 East project was declared as SSI and will result in the clearing of 15.7 hectares of vegetation, including planted trees along road reserves and urban parklands. This vegetation did not represent threatened ecological communities listed under the TSC or EPBC Acts. In addition, no threatened flora (or its potential habitat) listed under the TSC or EPBC Acts was observed within the project footprint. It is noted that part of the M4 East construction footprint overlaps with the M4-M5 Link project footprint at Haberfield.

The Grey-headed Flying-fox, which is listed as vulnerable under the TSC and EPBC Acts, was recorded foraging within the project footprint. Following the relevant Significant Impact Criteria, the report determined that impacts to this species were not significant. This was due to the large expanses of available habitat in the locality and due to the project not impacting on any roosting sites or camps.

The report also determined that several threatened microbat species, such as the Eastern Bentwing-bat and the Large-footed Myotis (*Myotis macropus*), may also occur within the project footprint on occasion. However, similarly, Assessments of Significance concluded that the project would not have a significant impact as a result of the proposed works.

The report determined that a formal biodiversity offset was not necessary to compensate for the minor and localised residual impacts from the project. However, the planting of Grey-headed Flying-fox food trees in landscaped areas following construction would compensate for the removal of planted vegetation and assist in maintaining foraging habitat for this species in the study area.

It is noted this report did not use the FBA methodology to assess impacts on biodiversity. The impact assessment methodology used was consistent with the original Director General's Requirements (DGRs) for the project issued on 7 January 2014 and also subsequently by the Secretary's Environmental Assessment Requirements (SEARs) issued on 16 June 2015.

The New M5 EIS – Biodiversity Assessment Report

The New M5 project was declared as SSI, and unlike the M4 East, was assessed using the FBA methodology, as outlined in the project's SEARs. Part of the New M5 overlaps with the M4-M5 Link project footprint at St Peters.

The assessment determined that the New M5 would result in 3.31 hectares of direct impacts on native vegetation (ecosystem credits), comprising the following plant community types:

- Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion
- Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion
- Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion.

The project would also impact on the Green and Golden Bell Frog, a species credit species, through the removal of potential breeding and known foraging, dispersal and sheltering habitat.

Accordingly, the project BAR assessed the type and number of credits using the FBA methodology. These calculations identified the following offset requirements for the project:

- A total of 58 ecosystem credits consisting of 31 Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 725) credits and 27 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (PCT 1046) credits
- A total of 203 credits for Green and Golden Bell Frog.

Rozelle Rail Yards REF –Biodiversity Assessment

ELA prepared the biodiversity assessment to support a REF for site management works to be undertaken at a part of the former Rozelle Rail Yards. The report assessed the potential impacts of the proposed works on threatened species and ecological communities listed under State and Commonwealth legislation.

The works would remove rail and rail related infrastructure and allow existing issues, such as waste and noxious weeds to be appropriately managed. This would allow Roads and Maritime to manage existing environmental and safety issues and would also improve access to surface conditions which would allow further investigation into the location of utilities and the presence of contamination and waste. The works would benefit future uses of the Rozelle Rail Yards.

A database review and field surveys were conducted to determine the extent of vegetation present (particularly threatened ecological communities) and to inform an impact assessment for threatened species, their habitat and ecological communities. Targeted threatened fauna surveys were completed for those species initially considered as having a potential to occur, including the Green and Golden Bell Frog, Long-nosed Bandicoot and threatened microbats.

The Rozelle Rail Yards is entirely modified and disturbed, and represented primarily by exotic species and weeds. No remnant native vegetation was recorded. It is considered to be in a very poor ecological condition, consisting of compacted soils and introduced fill, and unlikely to have any native resilience or recovery potential. No threatened flora species or listed ecological communities were identified, or are considered as having the potential to occur within the site.

The Eastern Bentwing-bat was recorded within the Rozelle Rail Yards and may be roosting in the cavities under the Victoria Road bridge, or using it as a flyway. Yellow-bellied Sheath-tail-bat was also recorded as a possible call from and may be using the site to forage. Several Grey-headed Flying-fox were observed feeding on fig trees immediately adjacent to the site during targeted fauna surveys. The habitat assessment also identified limited foraging habitat for this species. The Grey-headed Flying-fox may therefore be present within the site on occasion. No other threatened fauna species were observed, or have previously been observed within the site. Targeted fauna survey for the Green and Golden Bell Frog and the Long-nosed Bandicoot (endangered population) were conducted as part of the project and confirmed that no habitat for these species was present within the Rozelle Rail Yards.

Assessments of Significance under the TSC and EPBC Act were completed for those threatened fauna species recorded (threatened microbats), as well as the Green and Golden Frog and the Long-nosed bandicoot. These assessments concluded that a significant impact is not likely to occur as a result of the proposed works. This conclusion was due primarily to the disturbed and degraded nature of the habitat present, lack of records of previous sightings (for those species not recorded during the targeted surveys), and lack of known breeding habitat within the study area. In addition, the targeted surveys did not confirm the presence of Green and Golden Frogs or Long-nosed bandicoots. Thus, a Species Impact Statement (SIS) or EPBC Act referral was not considered to be required.

A range of biodiversity safeguards designed to avoid or mitigate potential impacts on ecological values, namely potential threatened fauna and their habitat were provided. The safeguards and mitigation measures are to be incorporated into an Environmental Management Plan. The measures are to include site boundary fencing for protection of off-site trees, a weed management plan, a soil and water management plan and an unexpected finds procedure that outlines the process if a threatened species is observed during the works.

WestConnex M4-M5 Link Geotechnical Investigations Flora and Fauna Assessment

Niche (2016) was commissioned by WestConnex to prepare a flora and fauna assessment for geotechnical investigations at The Crescent and Rozelle Rail Yards. The NSW listed Coastal Saltmarsh endangered ecological community was recorded along the banks of Johnstons

Creek at Bicentennial Park. However, the report determined a significant impact was unlikely given the implementation of avoidance and mitigation measures.

The report determined potential habitat for several threatened fauna may be impacted by the works, including the Grey-headed Flying-fox, Green and Golden Bell Frog, Long-nosed Bandicoot (endangered population) and some migratory bird species. However, assessments of significance concluded that a significant impact on these species was unlikely to occur. It is noted that no suitable potential habitat for microbats was determined to be present.

CBD Metro Environmental Assessment

SKM prepared an environmental assessment for sites associated with the CBD Metro, including part of the Rozelle Rail Yards. No threatened ecological communities or threatened flora were recorded or considered as having a potential to be impacted by the works. The report assessed potential impacts to the Grey-headed Flying-fox and some microbats, due to the presence of potential habitat. The assessment concluded that the project was unlikely to result in a significant impact on local populations of these threatened species.

Local Council Action Plans

The local council action plans from the City of Sydney and Marrickville (now part of Inner West Council) provides a framework for the protection and enhancement of Biodiversity in the LGA's. The plans identify significant ecological values present (flora and fauna, the majority of which represent non-threatened species) within the respective LGAs, and their potential treats. The action plans also identify areas of connectivity and/or priority biodiversity sites that contain relatively high biodiversity values.

It is noted that the project footprint occurs outside of the 'priority sites' identified within the City of Sydney LGA and outside of the 'priority biodiversity sites' identified within the Marrickville LGA.

A number of threatened priority fauna species identified in both plans were considered to have suitable habitat (or were recorded) within the project footprint, including; Grey-headed Flying-fox and Eastern Bentwing-bat (and other microbats). The Green and Golden Bell Frog and Long-nosed Bandicoot are also threatened species identified in the plans, however, suitable habitat for these species is not considered to be present within the project footprint. It is noted that targeted fauna surveys for these species were conducted as part of the Rozelle Rail Yards REF; Biodiversity Assessment. Other species considered to be uncommon in urban areas, but are not listed as threatened under State or Commonwealth legislation may have potential within the project footprint.

4.1.2 Vegetation surveys

Assessment of vegetation mapping

The existing vegetation community mapping (OEH 2013) within the study area was verified to confirm the presence or absence of native vegetation communities, including presence of any threatened ecological communities (TECs). Vegetation communities were identified from a combination of floristic surveys and transect traverses, and checked to see if a PCT could be assigned or as non-native vegetation, by comparing the dominant canopy species, the general description of location, soil type and other attributes as described in the OEH online VIS classification database (OEH 2016c).

Vegetation within the project footprint is shown in Figure 4.1 to Figure 4.6. Where vegetation was present but it could not be classified as any particular PCT, it was combined into the vegetation type 'Urban Exotic and Native Cover' (see section 4.2).

Biometric plots using the methodology described in the FBA

No biometric plots were completed as part of this FBA, as no PCTs are present within the project footprint.



Figure 4.1: Existing vegetation at the Haberfield and Ashfield sites

Vegetation - Darley Road



Figure 4.2: Existing vegetation at Darley Road civil and tunnel site (C4)

Vegetation - Rozelle



Figure 4.3: Existing vegetation at Rozelle civil and tunnel site (C5), The Crescent civil site (C6) and Victoria Road civil site (C7)

Vegetation - Iron Cove



Figure 4.4: Existing vegetation at Iron Cove Link civil site (C8)

Vegetation - St Peters

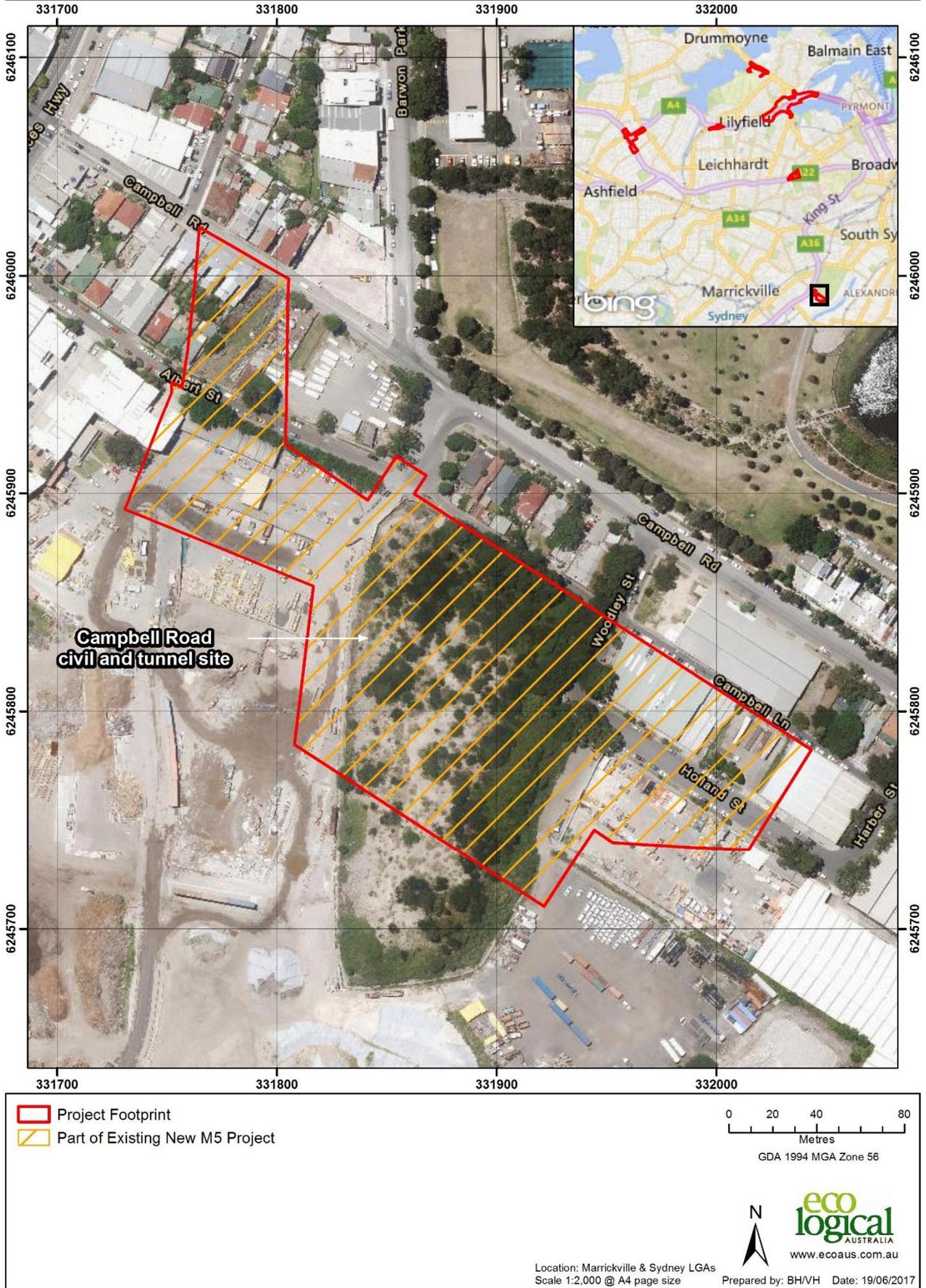


Figure 4.6: Cleared site at Campbell Road civil and tunnel site (C10)

4.2 PCT descriptions

The FBA requires that the extent of native vegetation within the project footprint be mapped. This native vegetation is to be classified using PCTs defined in the VIS Classification database (OEH 2016c).

The FBA provides the following definitions:

- *PCT* – a NSW plant community type identified using the PCT classification system, which is the system of classifying native vegetation approved by the NSW Plant Community Type Control Panel and described in the VIS Classification Database
- *Native vegetation* - as the same meaning as in section 6 of the *Native Vegetation Act 2003* (NV Act).

However, no PCTs were recorded within the project footprint, and thus no native vegetation is considered to be present. The project footprint is entirely modified and disturbed, and contains exotic species, weeds and planted native or non-indigenous species. The project footprint is characterised by urban parks, landscaped road verges, disused rail infrastructure, compacted soils, introduced fill, existing dwellings and other infrastructure and considered to be in a poor ecological condition, with little ecological value and unlikely to have any native resilience or recovery potential.

All vegetation present within the project footprint was classified as 'Urban Exotic and Native Cover', as shown by the non-native vegetation mapped by OEH (2013; *Sydney Metropolitan Catchment Management Authority Vegetation Mapping project*) and was considered to be in a low condition, as described by the FBA (Table 4.1). This vegetation type is not required to be further assessed using the FBA methodology, and was thus excluded from any credit or offset calculations.

Table 4.1 Vegetation zones

Veg zone	Veg zone code	Vegetation Type	PCT	TEC?	Site value score	Area (ha)
1	Low	Urban Exotic and Native Cover	No	No	N/A	4.49*

* This number excludes any areas that have been assessed as part of the M4 East and New M5 projects and Rozelle Rail Yards site management works.

The FBA describes vegetation in low condition where:

- woody native vegetation with native over-storey percent foliage cover less than 25 per cent of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and where either:*
 - less than 50 per cent of ground cover vegetation is indigenous species, or
 - greater than 90 per cent of ground cover vegetation is cleared OR
- native grassland, wetland or herffield where either:*
 - less than 50 per cent of ground cover vegetation is indigenous species, or
 - more than 90 per cent of ground cover vegetation is cleared.

Under the OEH (2013) mapping project, “*non-native vegetation cover comprised two classes: ‘weeds and exotics’ and ‘urban exotics and natives’.* The label ‘weeds and exotics’ was applied to vegetation patches greater than 0.1 hectare in size with a complete cover of exotic species in the upper strata (ie where no visible native species could be discerned). The label ‘urban exotics and natives’ was applied to polygons greater than 0.1 hectares in size for which urban land use covered more than 70 per cent of the polygon and there was evidence of both exotic and native species in the upper or lower strata. Typically these areas include backyard trees, street trees, gardens, median strips and other small-scale features that are small isolated stands”.

4.2.1 Urban Exotic and Native Cover

Urban exotic and native cover within the project footprint consisted of planted indigenous, non-indigenous native and exotic species within local parklands, urban backyards, riparian vegetation (eg Figure 4.7) and the Rozelle Rail Yards (see description below). These areas often contained large expanses of exotic grasses and other weeds and generally occurred where the soil profile had been extensively modified. Some areas such as parklands only contain large established trees (native and exotic) over exotic grasses, with no shrub layer or evidence of regenerating overstorey species.

A typical area within and adjacent to the Rozelle Rail Yards was dominated by exotic vegetation or non-indigenous and disturbance tolerant species across all vegetation layers, including, *Casuarina glauca* (Swamp Oak), *Phoenix canariensis* (Canary Island Date palm), *Acacia longifolia* subsp. *sophorae* (Coastal Wattle), *Acacia saligna* (Golden Wreath Wattle), *Lantana camara* (Lantana), *Rubus fruticosus* (Blackberry), and *Phyllostachys aurea* (Bamboo) in the mid to upper stratum. The ground layer was dominated by exotic grasses including *Andropogon virginicus* (Whiskey Grass), *Melinis repens* (Red Natal Grass), *Eragrostis curvula* (African Love Grass), *Cortaderia selloana* (Pampas Grass), *Pennisetum* spp. (Swamp Foxtail and Kikuyu) and *Chloris gayana* (Rhodes Grass).

Other key information relating to this vegetation category is summarised in Table 4.2.

Table 4.2: Key information regarding the Urban Exotic and Native Cover vegetation category within the study area Threatened ecological communities within the study area locality

Vegetation formation and class	Not applicable
PCT / BVT	Non-Native Vegetation. Mapped as Urban Exotic and Native Cover
Other mapping sources	Native Vegetation of the Sydney Metropolitan Area (OEH 2013).
Conservation status	Not listed
Condition	Low
Extent in the study area	Around 4.49 hectares



Figure 4.7: Urban exotic and native cover within and adjacent to the Rozelle Rail Yards

4.3 Threatened ecological communities

No threatened ecological communities were recorded within the project footprint.

It is noted that three threatened ecological communities listed under the TSC and/or EPBC Act have been mapped close to the site. However, impacts to these communities will not occur as a result of the works, and therefore have not been assessed further in the report.

Table 4.3: Threatened ecological communities within the study area locality

Common name	TSC Act listing	EPBC Act listing	Nearest occurrence
Coastal Saltmarsh	Endangered: <i>Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions</i>	Vulnerable: <i>Subtropical and Temperate Coastal Saltmarsh</i>	Mapped approximately 300 metres south-east of the works associated with the widening of The Crescent and 600 metres south-east of the Rozelle Rail Yards. It occurs along the banks of Johnstons Creek at Bicentennial Reserve, and in small patches along the northern shores of Iron Cove.
Sydney Turpentine Ironbark Forest	Endangered: <i>Sydney Turpentine Ironbark Forest</i>	Critically endangered <i>Turpentine Ironbark Forest in the Sydney Basin Bioregion</i>	Mapped at Five Dock Park and Russell Lea Infants School, 900 metres and 1,800 metres north of the Wattle Street tunnel and civil site.

Swamp Oak Floodplain Forest	Endangered: <i>Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions</i>	Not listed	Mapped along the banks of Iron Cove approximately 400 metres west of the Victoria Road and Iron Cove civil site.
-----------------------------------	-----------------------------------------------------------------------------------------------------------------------------	------------	------------------------------------------------------------------------------------------------------------------

4.4 Groundwater dependent ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function. Groundwater use by an ecological community or individual species does not necessarily imply groundwater dependence.

The assessment process followed the steps outlined in the risk assessment guidelines for groundwater dependent ecosystems (NSW DPI 2012). A search of the National GDE Atlas was conducted for the study area (inclusive of the mainline tunnel alignment and its adjacent areas), and the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* was reviewed for high priority GDEs. Potential GDEs were assessed by a GDE expert for their type and level of groundwater dependence, as well as their ecological value (where this was known).

The GDE assessment does not estimate the impacts of the project on groundwater, rather it attempts to estimate and assess the impacts of groundwater extraction on the biodiversity values of GDEs.

No field assessments were conducted for the assessment of GDEs. The GDE assessment was based on a desktop assessment only. A map of the GDEs in relation to the project footprint is provided in Figure 4.8. ELA relied on information available at the time to determine the type and intensity of potential impacts. This information was limited to the spatial extent of the proposed road corridor and did not consist of modelled groundwater data or detailed information on the volume and extent of groundwater extraction. To account for any impact that may extend beyond the proposed road corridor, a buffer of approximately 200 metres was included in the assessment.

In Australia, many ecosystems have a dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. Most wetland communities and many river systems have some degree of dependence on groundwater resources.

GDEs are generally classified into six categories:

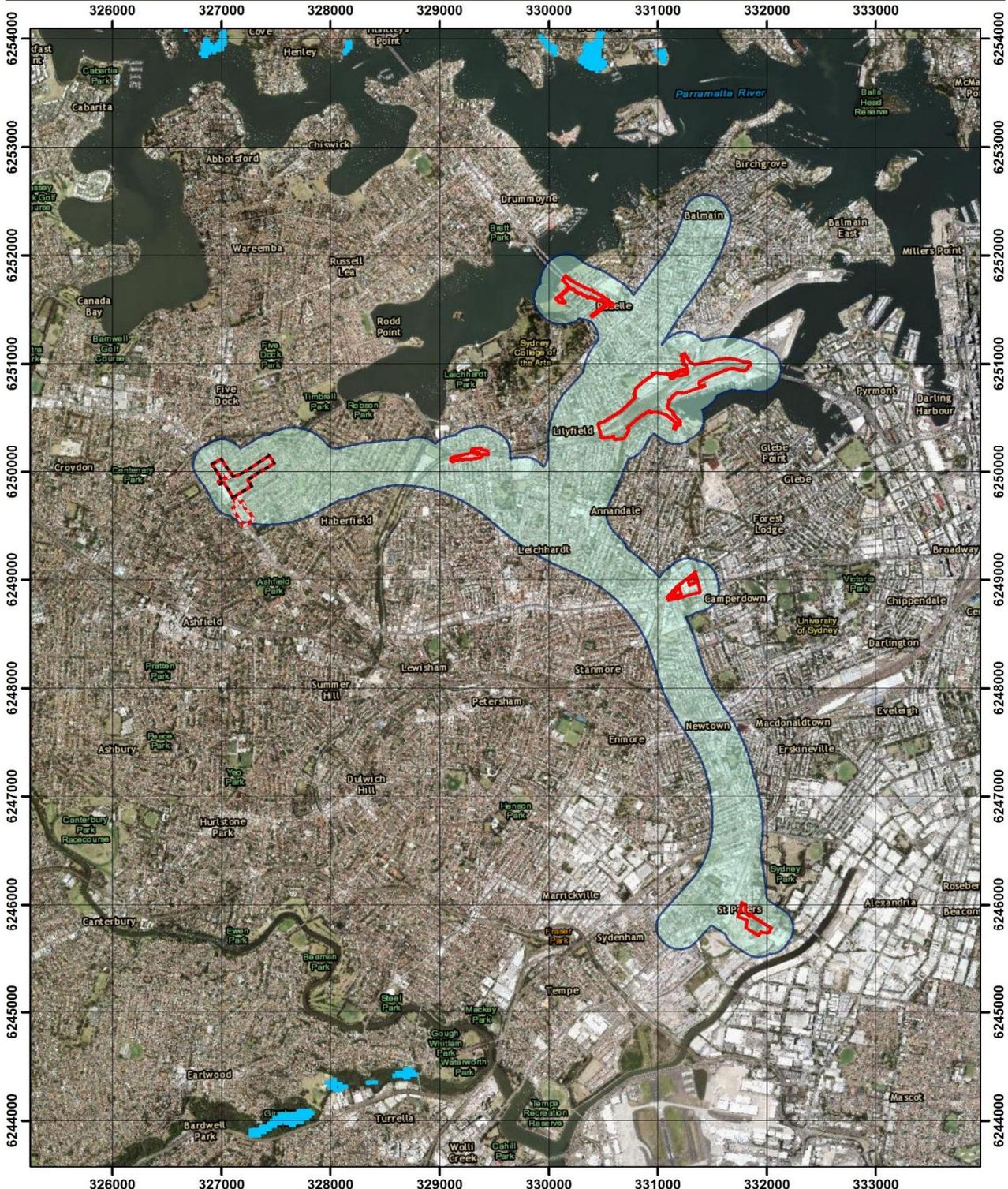
- *Terrestrial vegetation* – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table
- *Base flow in streams* – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow
- *Aquifer and cave systems* – aquatic ecosystems that occupy caves or aquifers
- *Wetlands* – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands
- *Estuarine and near shore marine ecosystems* – various ecosystems including mangroves, saltmarsh and seagrass, whose ecological function has some dependence on groundwater discharge
- *Terrestrial fauna* – fauna species assemblages reliant on groundwater for drinking water.

A final category is also recognised 'not apparently dependant'. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependent entirely on surface flows and or rainfall.

The most likely GDE types in the Sydney region are terrestrial vegetation communities with deep roots that use groundwater, wetlands, and river baseflow systems. The project footprint is highly developed. A search of the GDE Atlas (Bureau of Meteorology, accessed 27 September 2016) indicates that there are no ecosystems within the study area that are likely to be dependent on groundwater.

Although not mapped as being groundwater dependent, Johnstons Creek and Whites Creek are associated with palaeochannels and it is possible that fracturing of basement rock may result in draining of the alluvium associated with these channels. Tunnels passing beneath these creeks should be constructed in a way that ensures no draining of the alluvium.

Groundwater Dependent Ecosystems



- Project Footprint
- Project Footprint Option A
- Project Footprint Option B
- GDE Study Area
- Ecosystems That Rely on Subsurface
- Presence of Groundwater

No Groundwater Dependent Ecosystems (Reliant on Surface/Subsurface) or Inflow Dependent Ecosystems River/Springs/Wetlands/Vegetation) Occur in the Construction Footprint

0 0.5 1 2

Kilometres

GDA 1994 MGA Zone 56

Data Sources:
 Australian Atlas of Groundwater
 Dependent Ecosystems(GDE) V 1.0
 © Commonwealth of Australia
 (Bureau of Meteorology) 2012.

Location: Ashfield, Leichhardt,
 Marrickville, Sydney LGAs
 Scale 1:44,000 @ A4 page size

N

eco
logical

AUSTRALIA

www.ecoaus.com.au

Prepared by: BH/VH Date: 19/06/2017

Figure 4.8: GDE assessment area