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The Northern Road Upgrade Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park

NSW Environmental Impact Statement /
Commonwealth Draft Environmental Impact Statement

Appendix I – Technical working paper: Biodiversity

June 2017



The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park Biodiversity Assessment Report May 2017

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Roads and Maritime Services

**The Northern Road Upgrade –
Mersey Road to Glenmore Parkway
Biodiversity Assessment Report
May 2017**

Prepared for Roads and Maritime Services by Jacobs Australia

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Executive summary

The project involves upgrading the 16 km section of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park.

The NSW Biodiversity Offsets Policy for Major Projects (BOPMP) provides a standard method for assessing impacts of major projects on biodiversity and determines offsetting requirements. In the State Significant Infrastructure (SSI) application process, the Environmental Impact Statement (EIS) must address the Secretary's Environmental Assessment Requirements (SEARs) requested by Department of Planning and Environment (DP&E) and apply the Framework for Biodiversity Assessment (FBA). The FBA adopts the BOPMP and provides an assessment methodology to identify terrestrial biodiversity values, assess impacts and quantify and describe biodiversity offsets required for unavoidable impacts. The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be on the development site.

This Biodiversity Assessment Report (BAR) was completed in accordance with the requirements specified by the SEARs issued on 28 July 2015, the amended SEARs issued on 9 March 2016 and Commonwealth EIS Guidelines issued on 24 August 2016.

Within the study area, five Plant Community Types (PCTs) are present which require assessment under the FBA. Two threatened ecological communities as listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) are present including Cumberland Plain Woodland in the Sydney Basin Bioregion and River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

The field surveys recorded one threatened flora species listed under the TSC Act: *Pultenaea parviflora* (listed as endangered under the TSC Act). No other threatened plant species were recorded during the surveys. One endangered population listed under the TSC Act: the *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas was recorded in the study area during field surveys.

The field surveys identified the presence of threatened fauna species listed under the TSC Act including the Cumberland Plain Land Snail, Eastern Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat and the Grey-headed Flying-fox. The Regent Honeyeater is assumed present based on the presence of suitable foraging habitat.

Cumberland Plain Woodland is listed as a critically endangered ecological community (CEEC). The project may significantly reduce the viability of this CEEC within the locality and therefore it is considered a matter for further consideration under the FBA. While not recorded during the surveys, there is also likely to be impacts to potential habitat for the critically endangered Regent Honeyeater. As such, this species is also considered a matter for further consideration.

Some of the higher quality patches of Cumberland Plain Woodland also meet the description of the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The plant species *Pultenaea parviflora* is also listed as vulnerable under the EPBC Act. Other matters of National Environmental Significance that may be impacted by the project include habitat for the listed Regent Honeyeater, Swift Parrot, Grey-headed Flying-fox and Large-eared Pied Bat.

The project has been identified as a controlled action under the EPBC Act due to predicted significant impacts to listed threatened species and ecological communities and Commonwealth land. The controlled action is considered by the Department of the

Environment, likely to have a significant impact on the following EPBC Act listed threatened species and ecological communities:

- Critically endangered – Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Cumberland Plain Woodlands)
- Critically endangered – *Lathamus discolor* (Swift Parrot)
- Critically endangered – *Anthochaera phrygia* (Regent Honeyeater)
- Vulnerable – *Pultenaea parviflora*
- Vulnerable – *Pteropus poliocephalus* (Grey-headed Flying-fox).

Chapter 4 of the EIS describes the alternatives to the project that were considered as part of the project development process and explains how and why the project was selected as the preferred option. The merits of the project were considered in the context of a range of other potentially available alternatives. A detailed route selection phase was undertaken including a rapid biodiversity assessment in the area of the options under consideration. During the short listing options process, key areas were identified where additional field based investigations would assist in assessing the route options. Early biodiversity field investigations were carried out between July and September 2015 to identify areas of high ecological value to be avoided. Once all practicable steps to avoid or minimise impacts have been implemented at the design phase, mitigation measures will be implemented to further reduce the potential ecological impacts of the project.

The project is likely to result in a range of impacts to biodiversity which are not covered under the FBA including impacts to the aquatic environment, changes to hydrology, habitat fragmentation, edge effects, injury and mortality of fauna (including potential for vehicle strike), invasion and establishment of weeds, invasion and spread of pathogens and disease, noise, vibration, dust, light and contaminant pollution, and a range of cumulative impacts to vegetation and associated species within the Cumberland Plain region. Mitigation measures will be undertaken during the construction and operational phases to reduce such impacts. The Roads and Maritime guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of the project, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate.

Despite avoidance and mitigation, residual impacts from the clearing of native vegetation and fauna habitat features will occur. These impacts have been quantified using the BioBanking Credit Calculator, and will form the basis of offsets for the project. The following credits are required:

- Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion – 178 credits
- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion – 307 credits
- Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion – 409.66 credits
- Derived grasslands on shale hills of the Cumberland Plain (50-300m asl) – 223.39 credits
- *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion – 142 credits
- *Pultenaea parviflora* – 60 credits

- *Marsdenia viridiflora* subsp. *viridiflora* - endangered population – 1,400 credits
- Cumberland Plain Land Snail – 169 credits
- Regent Honeyeater – 2,021 credits.

A Biodiversity Offset Strategy (BOS) has been prepared for the project and is included as Appendix E of this BAR. The project offsets will aim to provide 'like for like' offsets for all biodiversity values, with this being the minimum requirement for those matters listed under the EPBC Act. The BOS includes details of offsets to be implemented to compensate for residual significant impacts associated with the Project in accordance with the BOPMP and FBA, which have been endorsed by the Commonwealth. Investigations for sourcing the required credits to meet the offset obligations are underway, with a range of offset options already identified.

The final offset requirement for the Project will be determined during development of the offset package. During the detailed design phase the project footprint may change from that assessed here which would result in a different offset requirement for the Project than what is presented in this BAR.

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Glossary of terms and abbreviations

Term	Meaning
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 2014).
Cryptic species	When referring to plants and animals this refers to size, shape and/or coloration or markings that serve to camouflage the plant or animal in its natural environment. Some plants may not be present above ground at certain times of the year.
Cumulative impact	The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to the project SEARs for cumulative impact assessment requirements.
Direct impact	Where an event or circumstance is a direct consequence of the action.
Ecosystem credit species	A threatened species that can be predicted by habitat surrogates. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site (OEH 2014).
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 2014).
Indirect impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter.
Matters for further consideration	Impacts that are considered to be complicated or severe that will require further consideration by the consent authority (OEH 2014). 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 2014).
Mitigation	Action to reduce the severity of an impact. (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	All the individuals that interbreed within a given area.
Project area	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 2014).

Term	Meaning
Species credit species	Threatened species and populations that are assessed according to Section 6.4 of the FBA (OEH 2014).
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 2014).

Abbreviations	
BAR	Biodiversity Assessment Report
BBCC	BioBanking credit calculator
BVT	Biometric Vegetation Type
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
CPSWSGTF	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
DoEE	Commonwealth Department of Environment and Energy
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (Commonwealth).
FBA	Framework for Biodiversity Assessment
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy

Abbreviations	
SSI	State Significant Infrastructure
TECs	Threatened Ecological Communities
TSPD	Threatened Species Profile Database
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW).</i>
VIS	Vegetation information system

1 Introduction

1.1 Project background

The Northern Road is about 45 km west of the Sydney central business district and traverses the local government areas of Penrith in the north and Liverpool in the south.

The Northern Road is a key north–south road between Narellan and Richmond, connecting the North West and South West Priority Growth Areas (see Figure 1.1). The corridor intersects with a number of regional motorway, arterial and collector roads such as (south to north) Camden Valley Way, Bringelly Road, Elizabeth Drive M4 Western Motorway, Great Western Highway and Richmond Road.

South of Glenmore Parkway, the project area is surrounded by rural residential zoned land as well as pastures and grasslands. Land to the east of The Northern Road in this section is occupied by the Commonwealth Defence Establishment, Orchard Hills. Further south, The Northern Road passes *through* the village of Luddenham (including a small number of residential and commercial properties), before continuing through agricultural grasslands to its junction with Mersey Road (the northern extent of The Northern Road Upgrade, Mersey Road to Peter Brock Drive). A seven kilometre section of the existing The Northern Road alignment bisects the Western Sydney Airport site south-east of the Luddenham town centre.

The regional context of The Northern Road Upgrade is provided on Figure 1.1.

1.1.1 Key project features

The project involves upgrading the 16 km section of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (the project). The location of the project is shown on Figure 1.2 (sheet 1 and 2).

The project comprises the following key features:

- A six-lane divided road between Mersey Road, Bringelly and Bradley Street, Glenmore Park (two general traffic lanes and a kerbside bus lane in each direction). The wide central median would allow for an additional travel lane in each direction in the future, if required
- An eight-lane divided road between Bradley Street, Glenmore Park and about 100 m south of Glenmore Parkway, Glenmore Park (three general traffic lanes and a kerbside bus lane in each direction separated by a median)
- About eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham, to realign the section of The Northern Road that currently bisects the Western Sydney Airport site and to bypasses Luddenham
- About eight kilometres of upgraded and widened road between the existing Elizabeth Drive, Luddenham and about 100 m south of Glenmore Parkway, Glenmore Park
- Closure of the existing The Northern Road through the Western Sydney Airport site
- Tie-in works with the following projects:
 - The Northern Road Upgrade, between Peter Brock Drive, Oran Park and Mersey Road, Bringelly (to the south)
 - The Northern Road Upgrade, between Glenmore Parkway, Glenmore Park and Jamison Road, South Penrith (to the north)

- New intersections including:
 - A traffic light intersection connecting the existing The Northern Road at the southern boundary of the Western Sydney Airport, incorporating a dedicated u-turn facility on the western side
 - A traffic light intersection for service vehicles accessing the Western Sydney Airport, incorporating 160 m of new road connecting to the planned airport boundary
 - A traffic light intersection connecting the realigned The Northern Road with the existing The Northern Road (west of the new alignment) south of Luddenham
 - A 'give way' controlled intersection (that is, no traffic lights) connecting the realigned The Northern Road with Eaton Road (east of the new alignment, left in, left out only)
 - A four-way traffic light intersection formed from the realigned Elizabeth Drive, the realigned The Northern Road and the existing The Northern Road, north of Luddenham
 - A traffic light intersection at the Defence Establishment Orchard Hills entrance, incorporating a u-turn facility
- New traffic lights at four existing intersections:
 - Littlefields Road, Luddenham
 - Kings Hill Road, Mulgoa
 - Chain-O-Ponds Road, Mulgoa
 - Bradley Street, Glenmore Park incorporating a u-turn facility
- Modified intersection arrangements at:
 - Dwyer Road, Bringelly (left in, left out only)
 - Existing Elizabeth Drive, Luddenham (left out only)
 - Gates Road, Luddenham (left in only)
 - Longview Road, Luddenham (left in, left out only)
 - Grover Crescent south, Mulgoa (left in only)
 - Grover Crescent north, Mulgoa (left out only)
- Dedicated u-turn facilities at:
 - The existing The Northern Road at Luddenham, south-west of Elizabeth Drive
 - The existing Elizabeth Drive, Luddenham around 800 m east of The Northern Road
 - Chain-O-Ponds Road, Mulgoa
- Twin bridges over Adams Road, Luddenham
- Local road changes and upgrades, including:
 - Closure of Vicar Park Lane, east of the realigned The Northern Road, Luddenham
 - Eaton Road cul-de-sac, west of the realigned The Northern Road, Luddenham
 - Eaton Road cul-de-sac, east of the realigned The Northern Road, Luddenham
 - Elizabeth Drive cul-de-sac, about 300 m east of The Northern Road with a connection to the realigned Elizabeth Drive, Luddenham
 - Extension of Littlefields Road, east of The Northern Road, Mulgoa
 - A new roundabout on the Littlefields Road extension, Mulgoa

- A new service road between the Littlefields Road roundabout and Gates Road, including a 'give way' controlled intersection (that is, no traffic lights) at Gates Road, Luddenham
- Extension of Vineyard Road, Mulgoa between Longview Road and Kings Hill Road
- A new roundabout on the Vineyard Road extension at Kings Hill Road, Mulgoa
- A new shared path on the western side of The Northern Road and footpaths on the eastern side of The Northern Road
- A new shared path on the western side of The Northern Road and footpaths on the eastern side of The Northern Road where required
- The upgrading of drainage infrastructure
- Operational ancillary facilities including:
 - Heavy vehicle inspection bays for both northbound and southbound traffic, adjacent to Grover Crescent, Mulgoa and Longview Road, Mulgoa respectively
 - An incident response facility on the south-western corner of the proposed four-way traffic light intersection at Elizabeth Drive, Luddenham
- New traffic management facilities including variable message signs (VMS)
- Roadside furniture and street lighting
- The relocation of utilities and services
- Changes to property access along The Northern Road (generally left in, left out only)
- Establishment and use of temporary ancillary facilities and access tracks during construction
- Property adjustments as required
- Clearance of undetonated explosive ordinance (UXO) within the Defence Establishment Orchard Hills as required.

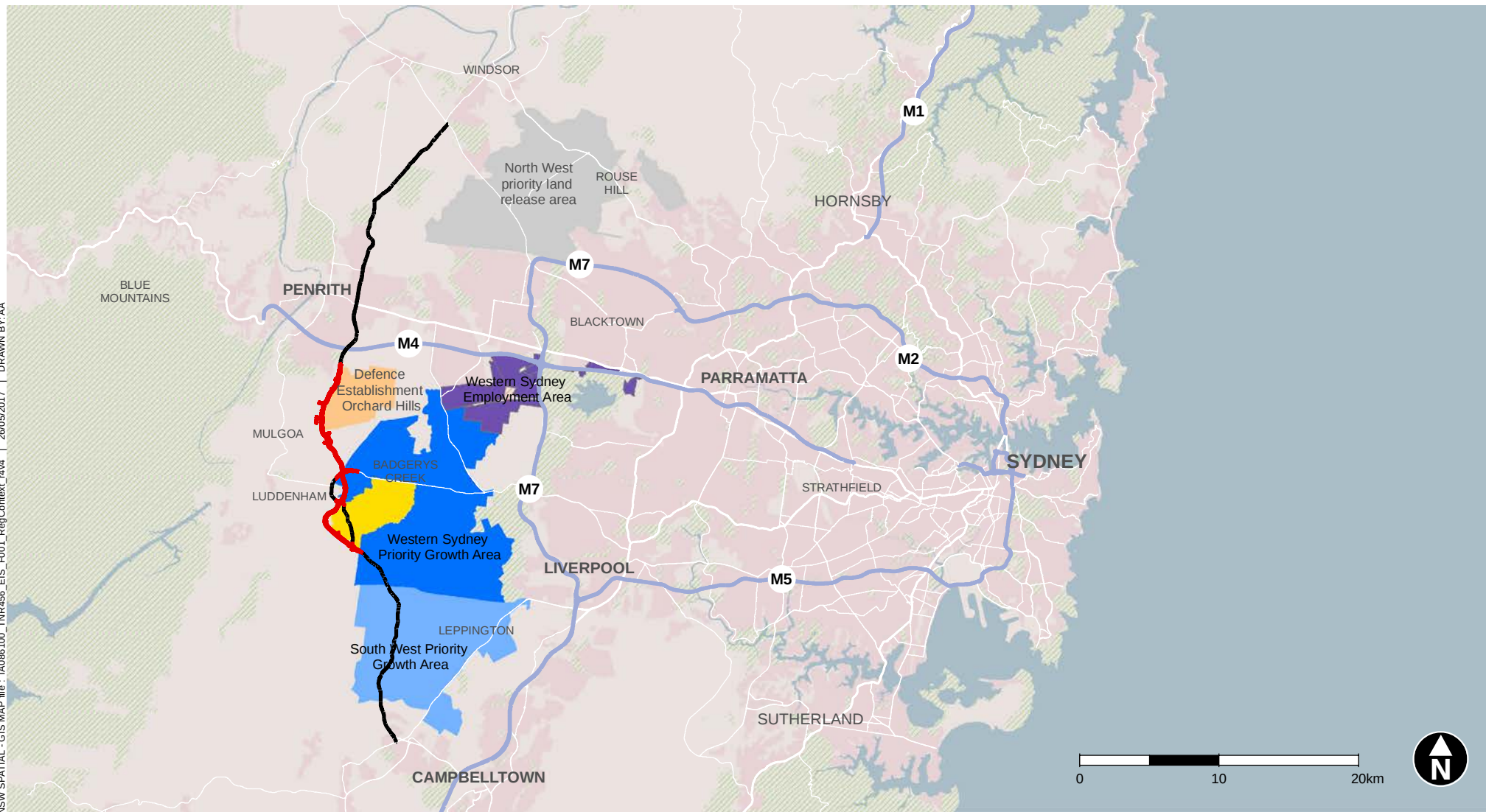
The upgrade of The Northern Road is part of the Western Sydney Infrastructure Plan (WSIP). The WSIP involves major road and transport linkages that will capitalise on the economic gains from developing the Western Sydney Airport site at Badgerys Creek whilst boosting the local economy and liveability of western Sydney.

Jacobs Group (Australia) Pty Ltd (Jacobs) was commissioned by Roads and Maritime Services (Roads and Maritime) to undertake an assessment of the potential environmental impacts of the project, and prepare an Environmental Impact Statement (EIS) in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act) that adequately addresses the *Secretary's Environmental Assessment Requirements (Application number SSI 7127)* (SEARS) and Commonwealth EIS Guidelines issued on 24 August 2016. This document is the Biodiversity Assessment Report (BAR) for the project.

1.1.2 Study area

The project is located within the Penrith and Liverpool local government areas (LGAs) and traverses the suburbs of Bringelly, Luddenham, Orchard Hills, Mulgoa and Glenmore Park. The study area is located within the Cumberland sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995). The study area is located wholly on the Cumberland Plain Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008).

The study area contains the development footprint, which includes the construction footprint and operational footprint. A map of the study area is presented in Figure 1.2. The construction footprint is the area proposed to be impacted, cleared and/or disturbed during construction. For the purposes of this BAR, it is assumed that there would be complete vegetation clearance within the construction footprint. This precautionary approach has been taken to the assessment to ensure all potential impacts are captured and assessed as the design is yet to be finalised. The construction footprint has the same meaning as 'development site' for the purposes of the FBA. The operational footprint for the project is the area that would be physically impacted by the operation of the project, including all operational ancillary infrastructures. The operational footprint is fully contained within the construction footprint.

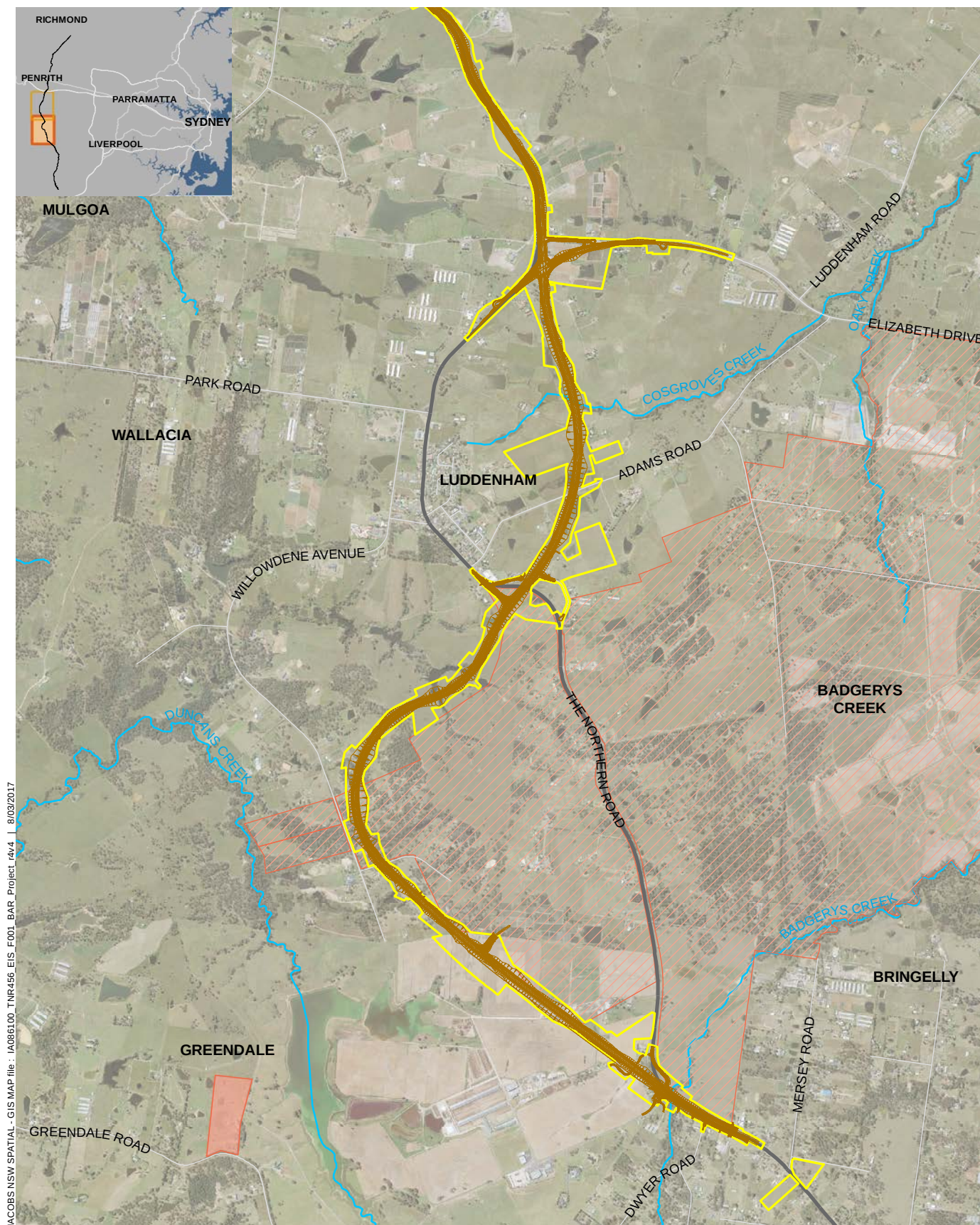


Legend

- | | | | |
|---|---|---|--|
|  The Northern Road upgrade - Mersey Road to Glenmore Parkway |  Western Sydney Airport site (Commonwealth Land) |  Western Sydney Employment Area |  Reserves and parklands |
|  The Northern Road |  Defence Establishment Orchard Hills |  South West Priority Growth Area |  Growth centres |
| | |  Western Sydney Priority Growth Area |  Built areas |

Figure 1-1 | Location of the project

The Northern Road upgrade - Mersey Road to Glenmore Parkway



- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- Development site boundary
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Land

0 0.5 1 km

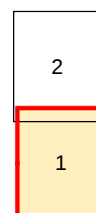
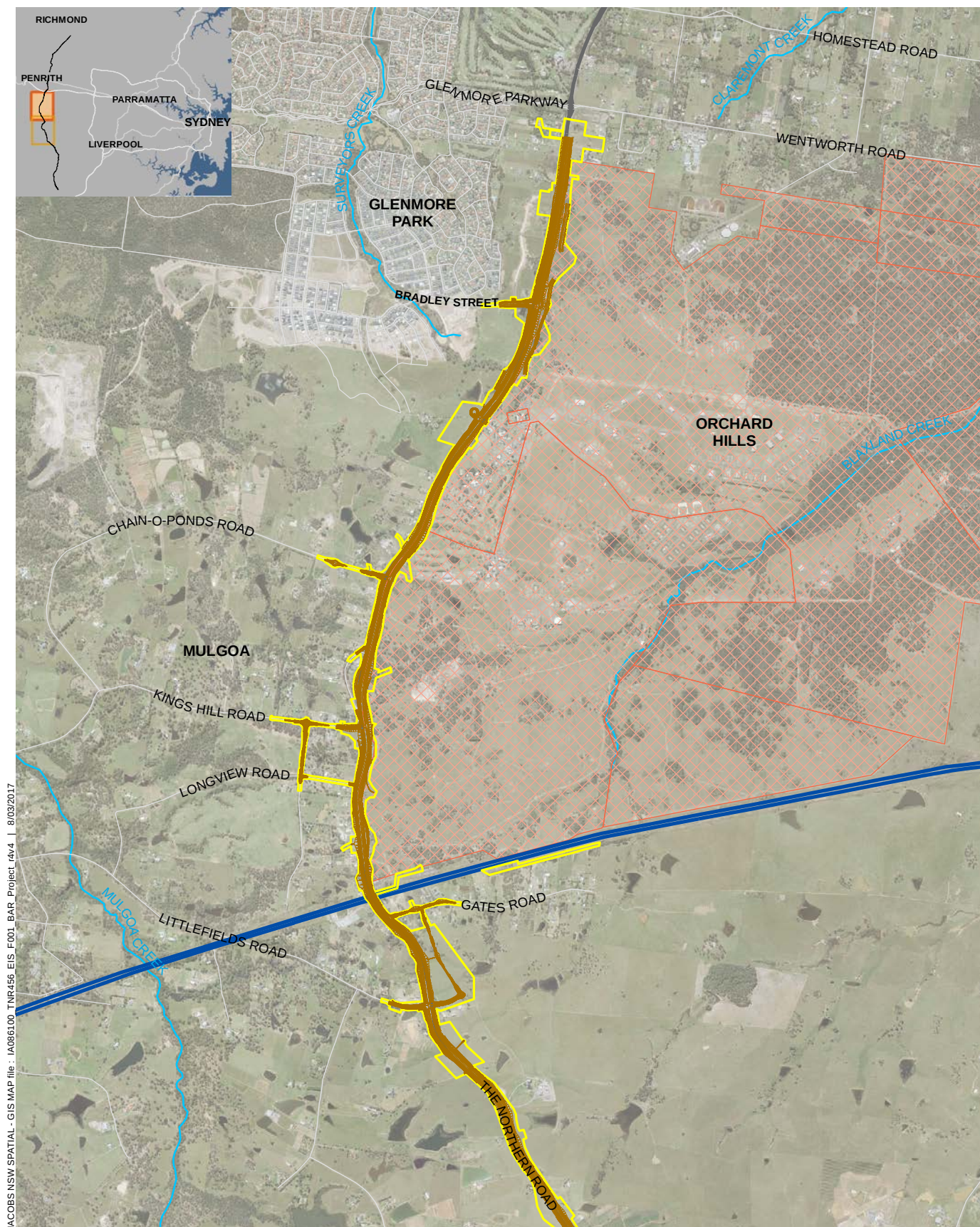


Figure 1-2 | The project



- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- WaterNSW supply pipelines
- Development site boundary
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Land

0 0.5 1 km

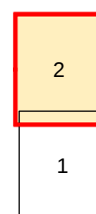


Figure 1-2 | The project

1.2 Legislative context, SEARs and Commonwealth EIS Guidelines

Environmental Impacts Statements (EISs) are prepared to assess the impacts of major projects, including State Significant Infrastructure (SSI) projects, under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and Controlled Actions under Part 9 of the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). This BAR forms part of the EIS being prepared for the Northern Road Upgrade – Mersey Road to Glenmore Parkway and assesses the biodiversity impacts of the project.

EIS's are subject to a range of legislative and policy requirements as set out in the Secretary's Environment Assessment Requirements (SEARs) and Commonwealth EIS Guidelines issued on 24 August 2016. The SEARs specific for this assessment are:

an assessment of impacts on biodiversity, including terrestrial and aquatic ecology, and riparian corridors, in accordance with the Framework for Biodiversity Assessment (unless otherwise agreed by OEH) and the Policy and Guidelines for Fish Habitat Conservation And Management—Update 2013 (NSW Department of Primary Industries 2013). The assessment is to be conducted by a person accredited in accordance with s142B(1)(c) of the Threatened Species Conservation Act 1995.

Note: This includes a requirement for a Biodiversity Assessment Report and a Biodiversity Offset Strategy'.

Table 1.2 outlines the Commonwealth EIS Guidelines for the Project (see Appendix B and Appendix C) for a copy of the SEARs and Commonwealth EIS Guidelines).

Table 1.2: Commonwealth EIS Guidelines

Commonwealth EIS Guidelines	Where addressed in BAR
The EIS must include a description of the environment of the proposal site and the surrounding areas that may be affected by the action. It is recommended that this include the following information: Listed threatened species (and suitable habitat) and ecological communities that are likely to be present in all areas of potential impact. To satisfy this requirement details must be presented on the scope, timing/effort (survey season/s) and methodology for studies and surveys used to provide information on the relevant listed threatened species/ecological community/habitat. This includes details of: - How best practice survey guidelines have been applied - How surveys are consistent with (or a justification for divergence from) published Australian Government guidelines and policy statements.	Section 3 Native vegetation Section 4 Threatened species
A description of the environment in all areas of potential impact, including all components of the environment as defined in Section 528 of the EPBC Act including: - Ecosystems and their constituent parts, including plants and animals, landscapes and soils - Natural and physical resources, including water resources.	Section 2 Landscape features Section 3 Native vegetation Section 4 Threatened species
The EIS should also provide a detailed assessment of any likely impact that this proposed action may facilitate MNES at the local, regional, state, national and international scale.	Section 8.3 Matters of National Environmental Significance

Commonwealth EIS Guidelines	Where addressed in BAR
The controlled action is considered likely to have a significant impact on the following EPBC listed threatened species and ecological communities: - Critically endangered – <i>Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest</i> (Cumberland Plain Woodlands) - Critically endangered – <i>Lathamus discolor</i> (Swift Parrot) - Critically endangered – <i>Anthochaera phrygia</i> (Regent Honeyeater) - Vulnerable – <i>Pultenaea parviflora</i> - Vulnerable – <i>Pteropus poliocephalus</i> (Grey-headed Flying-fox).	Section 5 Matters of National Environmental Significance Section 8.3 Impacts to Matters of National Environmental Significance, Section 11 Offsetting required
Impacts to the environment (as defined in section 528) should include: - Changes to water quality on site and downstream of the site; - Hydrological changes - Native flora and fauna habitat removal and degradation (on site and in surrounding areas that may be affected by the action) - Vehicle strike (fauna) - Lighting impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment).	Section 8.4.1 Aquatic impacts Section 8.1.1 Removal of native vegetation Section 8.4.4 Injury and mortality of fauna Section 8.4.7 Noise, vibration, dust, light and contaminants
The EIS must take into account relevant agreements and plans that cover impacts or known threats to a matter protected by a controlling provision (including but not necessarily limited to): - Any recovery plan and/or conservation advice for the affected species or ecological community - Any threat abatement plan for a process that threatens an affected species or ecological community - Any wildlife conservation plan for the affected species - Any relevant strategic assessment undertaken in accordance with an agreement under Part 10 of the EPBC Act.	Section 8.1 Impact assessment Section 9 Mitigation Appendix F EPBC Act assessment of significance
The EIS must include details of an offset package to be implemented to compensate for residual significant impacts associated with the project as well as an analysis of how the offset meets the requirements of the Department's <i>Environmental Protection and Biodiversity Conservation Act 1999</i> Environmental Offsets Policy October 2012 (EPBC Act Offset Policy) or a state offsetting policy that has been endorsed by the Commonwealth.	Appendix E Biodiversity Offset Strategy
The offset package can comprise a combination of direct offsets and other compensatory measures, as long as it meets the requirements of the EPBC Act Offset Policy. Offsets should align with conservation priorities for the impacted protected matter and be tailored specifically to the attribute of the protected matter that is impacted in order to deliver a conservation gain.	Appendix E Biodiversity Offset Strategy
Offsets should compensate for an impact for the full duration of the impact.	Appendix E Biodiversity Offset Strategy
Offsets must directly contribute to the ongoing viability of the protected matter impacted by the project and deliver an overall conservation outcome that maintains or improves the viability of the protected matter, compared to what is likely to have occurred under the 'status quo' (i.e. if the action and associated offset had not taken place).	Appendix E Biodiversity Offset Strategy

Commonwealth EIS Guidelines	Where addressed in BAR
Note: Offsets do not make an unacceptable impact acceptable and do not reduce the likely impacts of a proposed action. Instead, offsets compensate for any residual significant impact.	Appendix E Biodiversity Offset Strategy
The EIS must provide: - Details of the offset package to compensate for significant residual impacts on a protected matter - An analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy.	Appendix E Biodiversity Offset Strategy
Details in relation to the proposed offsets package, including: - The location and size, in hectares, of any offset site(s) - Maps for each offset site that clearly show: - The relevant ecological features - The landscape context - The cadastre boundary - The current tenure arrangements (including zoning and ownership) of any proposed offset sites - Confirmed records of presence (or otherwise) of relevant protected matter(s) on the offset site(s) - Details of studies and surveys used to confirm the presence of individuals and or likely habitat within offset site(s), including the scope, timing/effort (survey season/s) and methodologies employed - Detailed information regarding the extent (in hectares) and quality of habitat for relevant protected matter(s) on the offset site. The quality of habitat should be assessed in a manner consistent with the approach outlined in the document titled How to use the offset assessment guide available at http://www.environment.gov.au/epbc/publications/environmental-offsets-policy.html	To be confirmed with DoEE

Commonwealth EIS Guidelines	Where addressed in BAR
Provide information and justification regarding how the offsets package will deliver a conservation outcome that will maintain or improve the viability of the protected matter(s) consistent with the EPBC Act environmental offsets policy (October 2012) including: a. Management actions that will be undertaken to improve or maintain the quality of the proposed offset site(s) for the relevant protected matter(s). Management actions must be clearly described, planned and resourced as to justify any proposed improvements in quality for the protected matter(s) over time b. The time over which management actions will deliver any proposed improvement or maintenance of habitat quality for the relevant protected matter(s) c. The risk of damage, degradation or destruction to any proposed offset site(s) in the absence of any formal protection and/or management over a foreseeable time period (20 years). Such risk assessments may be based on: i. Presence of pending development applications, mining leases or other activities on or near the proposed offset site(s) that indicate development intent ii. Average risk of loss for similar sites iii. Presence and strength of formal protection mechanisms currently in place d. The legal mechanism(s) that are proposed to protect offset site(s) into the future and avert any risk of damage, degradation or destruction.	Appendix E Biodiversity Offset Strategy
Provide information regarding how the proposed offsets package is additional to that already required, as determined by law or planning regulations, agreed to under other schemes or programs or required under an existing duty-of-care.	Appendix E Biodiversity Offset Strategy
The overall cost of the proposed offsets package; including costs associated with, but not necessarily limited to: a. Acquisition and transfer of lands/property b. Implementation of all related management actions c. Monitoring, reporting and auditing of offset performance.	Appendix E Biodiversity Offset Strategy

1.2.1 Biodiversity guidelines

The information presented in this BAR assesses the potential biodiversity impacts of the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy.

This BAR was completed in accordance with the requirements specified by the SEARs issued on 28 July 2015, the amended SEARs issued on 9 March 2016 and Commonwealth EIS Guidelines issued on 24 August 2016.

As outlined in Table 1.2 the SEARs require biodiversity impacts related to the proposed development including terrestrial and aquatic ecology, and riparian corridors, be assessed in accordance with the Framework for Biodiversity Assessment (FBA) (unless otherwise agreed by OEH) and the *Policy and Guidelines for Fish Habitat Conservation And Management—Update 2013* (NSW Department of Primary Industries 2013). This includes a requirement for a BAR and a Biodiversity Offset Strategy (BOS).

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

The BAR has been prepared with reference to the SEARs and the Commonwealth EIS Guidelines using relevant policies and guidelines and refers to the following:

- *Framework for Biodiversity Assessment* (Office of Environment and Heritage, 2014a).
- *NSW Biodiversity Offsets Policy for Major Projects* (Office of Environment and Heritage, 2014b).
- *Fisheries NSW Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries (Department of Primary Industries, 2013).
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (Department of Environment and Conservation, 2004).
- *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016)
- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians* (Department of Environment and Climate Change, 2009).
- Commonwealth Policy Statements on survey guidelines for Australia's threatened fauna including bats birds, frogs, fish, mammals and reptiles (Department of the Environment Water Heritage and the Arts, 2010b, Department of Environment Water Heritage and the Arts, 2010, Department of the Environment Water Heritage and the Arts, 2010a, Department of Environment Water Heritage and the Arts, 2011a, Department of Environment Water Heritage and the Arts, 2011b).
- the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment, 2013).
- the *EPBC Act Policy Statement 1.2 Significant Impact Guidelines - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* (Department of the Environment and Heritage, 2006).

Commonwealth EIS Guidelines

The Project was referred under the EPBC Act to the Commonwealth Minister for the Environment and Energy on 2 May 2016. The Minister determined on 21 July 2016 that approval is required as the action has the potential to have a significant impact on listed threatened species and ecological communities and Commonwealth land. Following the provision of preliminary information, the delegate of the Minister determined, on 21 July 2016 that the proposed activity be assessed by an Environment Impact Statement (EIS). The controlled action is considered likely to have a significant impact on the following EPBC Act listed threatened species and ecological communities:

- Critically endangered – Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Cumberland Plain Woodlands)
- Critically endangered – *Lathamus discolor* (Swift Parrot)
- Critically endangered – *Anthochaera phrygia* (Regent Honeyeater)
- Vulnerable – *Pultenaea parviflora*
- Vulnerable – *Pteropus poliocephalus* (Grey-headed Flying-fox).

The Commonwealth EIS Guidelines issued on 24 August 2016 are provided in Appendix D.

1.2.2 Context of the BAR

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

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

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

For aquatic biodiversity impacts, the FBA refers to the requirements of the *Fisheries NSW Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries, 2013). This assessment has been included in the BAR for completeness.

The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and ecological communities. The Commonwealth EIS guidelines outline the specific assessment requirements for matters of national environmental significance, impacts to the environment of Commonwealth land and content of the EIS. The Commonwealth EIS Guidelines issued on 24 August 2016 are provided in Appendix D.

2 Landscape features

2.1 Identified features

In accordance with Chapter 4 of the FBA, the BAR is required to identify a number of landscape features such as the IBRA region, IBRA sub-region, Mitchell landscape, rivers and streams, extent of native vegetation in the area assessed for the development site. The landscape features of the development site are shown in Figure 2.1.

2.1.1 IBRA Bioregions and subregions

The study area is located within the Cumberland sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995). A brief summary of the characteristic geology, landforms, soils and vegetation of the Cumberland subregion (as it applies to the study area) is provided below as described by Morgan (2001).

The landscape is predominantly low rolling hills and wide valleys in a rain shadow area below the Blue Mountains (Morgan, 2001). Geology is dominated by undifferentiated middle Triassic Wianamatta group shales (Bringelly Shale) with Quaternary alluvium present along streams in the north and south of the study area (Clarke and Jones, 1991). Soils overlying the Wianamatta Shale are predominantly of the residual Blacktown soil landscape with some areas of the erosional Luddenham soil landscape (red and brown texture contrast soils on crests and slopes, grading into harsher yellow texture-contrast soils in valleys and sometimes affected by salt in tributary valley floors (Hazelton et al., 1989, Morgan, 2001, Department of Environment and Climate Change, 2008). The modern floodplain alluvium of the South Creek soil landscape is present along streams (Morgan, 2001, Hazelton et al., 1989). The vegetation is characterised by *Eucalyptus moluccana* and *Eucalyptus tereticornis* woodland. Alluvial areas contain *Angophora subvelutina*, *Eucalyptus amplifolia*, and *Casuarina glauca*. Man-made lagoons and swamps (i.e. dams) possess *Eleocharis sphacelata* and a range of aquatic species.

2.1.2 NSW Landscape Regions (Mitchell landscapes)

The study area is located wholly on the Cumberland Plain Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008). The description provided for the Cumberland sub-region of the Sydney Basin Bioregion is also applicable to the Cumberland Plain Mitchell Landscape.

The Cumberland Plain Mitchell Landscape is an over cleared landscape with 89 per cent of native vegetation having been cleared. Only 11 per cent of the original native vegetation remains.

2.1.3 Rivers and Streams

The project lies within the Lower Nepean River Management Zone of the Hawkesbury and Lower Nepean Rivers Water Source. The catchment is relatively flat with gently undulating hills. The project is largely an upgrade of the existing Northern Road between just south of Glenmore Parkway to Littlefields Road, Luddenham and then a new road bypassing Luddenham and the Western Sydney Airport.

The Nepean River is the ultimate downstream receiving environment of the project. It is significant both environmentally and economically and provides for a range of domestic and irrigation uses. However, the project itself is located a long distance from the river and close to the catchment divide, just west of the eastern boundary. The project directly traverses a number of unnamed tributaries and drainage lines (sometime associated with farm dams), as well as the following named creeks:

- Cosgroves Creek, a second order intermittent stream which is a tributary of South Creek
- Badgerys Creek, a second order intermittent stream containing permanent residual pools.

Key hydrological features of the project area are shown on Figure 2.1.

Key fish habitat

No watercourse crossings have been mapped as Key Fish Habitat by DPI Water (2007); however, five waterway crossings in the study area have been identified as Type 1 – Key Fish Habitats (DPI 2013), as they contain a combination of native aquatic plants and/or woody snags. These watercourses are impacted, intermittently flowing waterways which are also identified as Class 2 – Moderate Key Fish Habitat (Fairfull and Witheridge, 2003) due to the presence of limited in stream aquatic vegetation. The waterways are:

1. Badgerys Creek (287912.65E / 6244897.30N)
2. Cosgrove Creek (287247.11E / 6249490.76N)
3. 'Site 29a' (286060.62 E / 6246544.14N), an intermittent stream
4. The large dam at 'Site 39' (286460.594 E, 6247352.348N), fed by several minor 1st and 2nd order streams. These streams are ephemeral with minimal channel definition, only flowing when the upstream dams overflow.
5. Unnamed tributary of Surveyors Creek (286887.04E/6257728.90N)

The Nepean River is the downstream receiving environment to the project area; however, the project itself is located close to the catchment divide, just west of the eastern boundary. The Nepean River is significant both environmentally and economically and provides for a range of domestic and irrigation uses. No threatened or protected fish species are expected to occur within the study area due to the limited water and aquatic habitat present.

2.1.4 Wetlands

Artificial wetlands (i.e. farm dams, detention basins, roadside drains, effluent treatment systems) are scattered throughout the study area (see Figure 2.1). There are no naturally occurring wetlands in the study area.

2.1.5 State or Regionally Significant Biodiversity Links

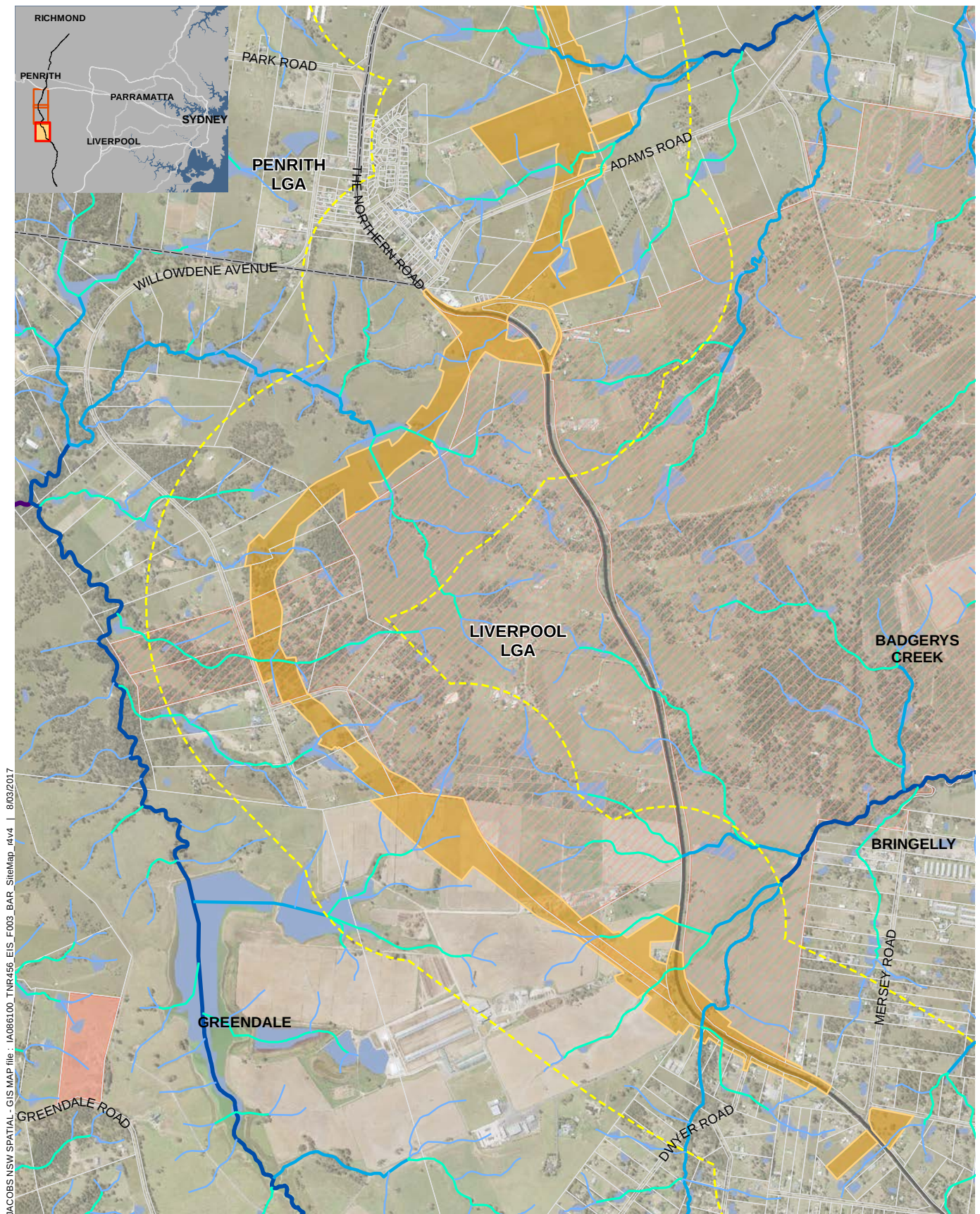
A Biodiversity Investment Opportunities Map (BIO Map) (Office of Environment and Heritage, 2015a) has been developed for the Cumberland sub-region as a key deliverable of the NSW Government's Green Corridors program. The areas identified for biodiversity investment funding within the Cumberland sub-region, termed priority investment areas, include core areas and biodiversity corridors of state and regional significance.

The northern portion of the study area on the Defence Establishment Orchard Hills is mapped as a core area on the BIO Map (Office of Environment and Heritage, 2015a) (see Figure 2.1). This core area is also identified as Priority Conservation Land from the Cumberland Plain Recovery Plan (Department of Environment Climate Change and Water, 2010) and mapped as a Regional Corridor on the BIO Map (see Figure 2.1). Regional Corridor 17, a corridor that connects the Mulgoa Nature Reserve to the vegetation on the Defence Establishment Orchard Hills is also mapped in this area on the BIO Map.

The BIO Map (Office of Environment and Heritage 2015a) has not been approved by the Chief Executive of OEH and therefore these biodiversity links have not been included in the FBA calculations.

There are seven local area biodiversity links as defined under Table 17 of the FBA that the project will impact on (see Figure 2.1). These links are areas of native vegetation in moderate to good condition that are ≥ 250 hectares and < 1000 hectares in total, or areas greater than 1000 hectares in total and the width of the vegetation in moderate to good condition that is connecting the area is > 30 metres and < 100 metres. These seven functional local area connecting links contain woody Plant Community Types (PCTs) assumed to have a percentage foliage cover in over-storey and mid-storey or ground cover condition within benchmark levels.

The minor riparian buffers (1st and 2nd order streams) within the development site are not eligible for classification under state or regional biodiversity links according to Appendix 5 of the FBA.



JACOBS NSW SPATIAL - GIS MAP file : IA086100_TNR456_EIS_F003_BAR_SiteMap_r4v4 | 8/03/2017

- | | | |
|--|---|--|
| <ul style="list-style-type: none"> The Northern Road (Existing) Development site boundary 550m assessment buffer | <ul style="list-style-type: none"> Local Government Area boundaries Hydro areas (dams and waterbodies) Western Sydney Airport site (Commonwealth Land) Defence Establishment Orchard Hills (Commonwealth Land) Commonwealth Lands | <ul style="list-style-type: none"> Rivers and streams (Stahler stream order) 0 1 2 3 4 5 |
|--|---|--|

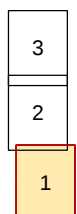
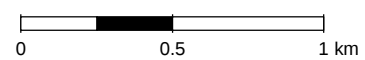
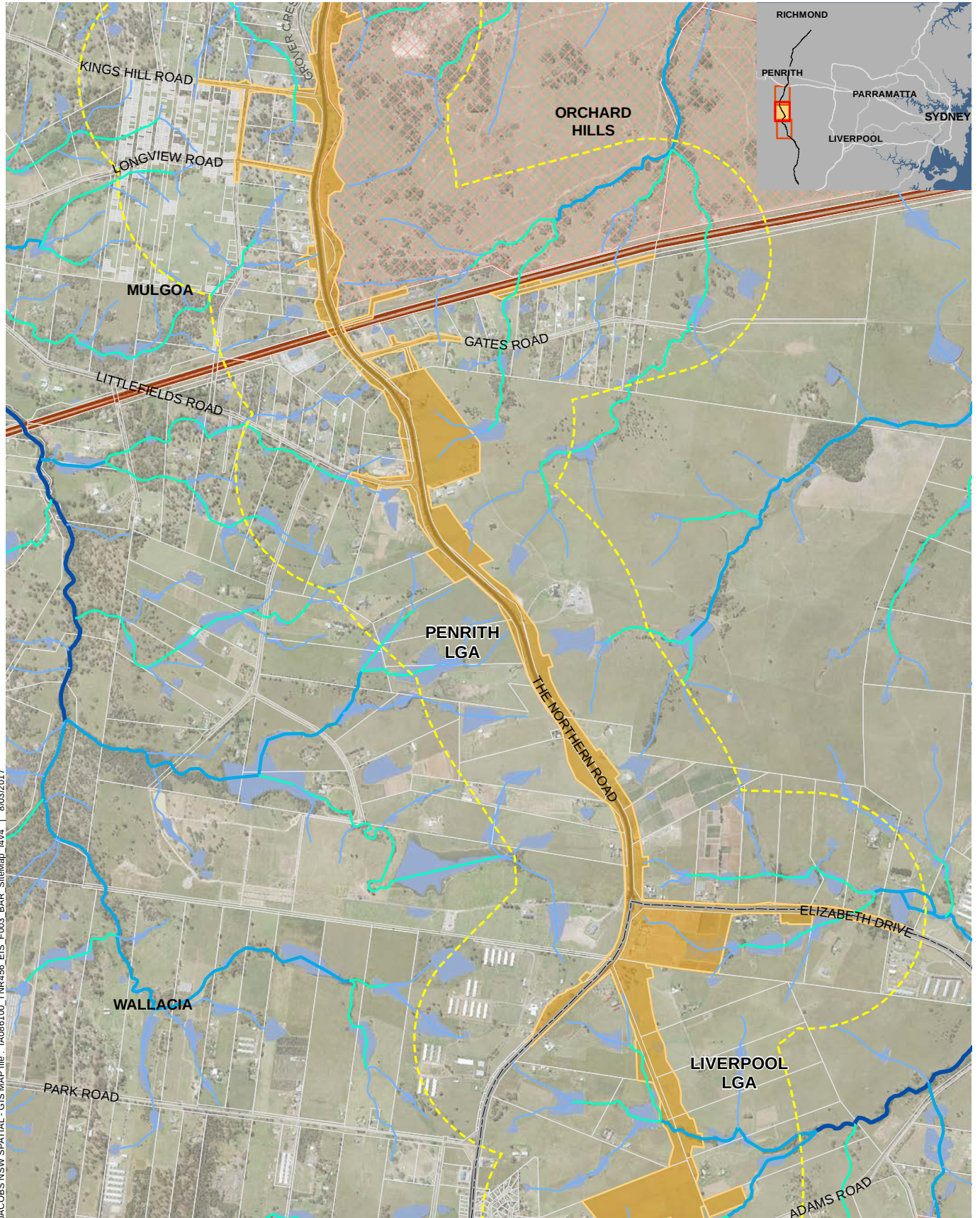


Figure 2-1 | Site map



JACOBS NSW SPATIAL - GIS MAP file : IA086100_TNR456_EIS_F003_BAR_SiteMap_rdv4 | 8/03/2017

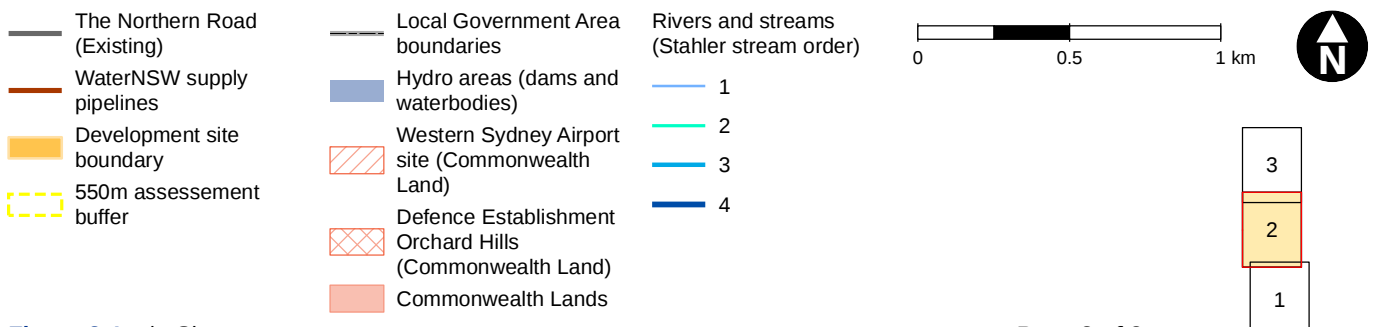
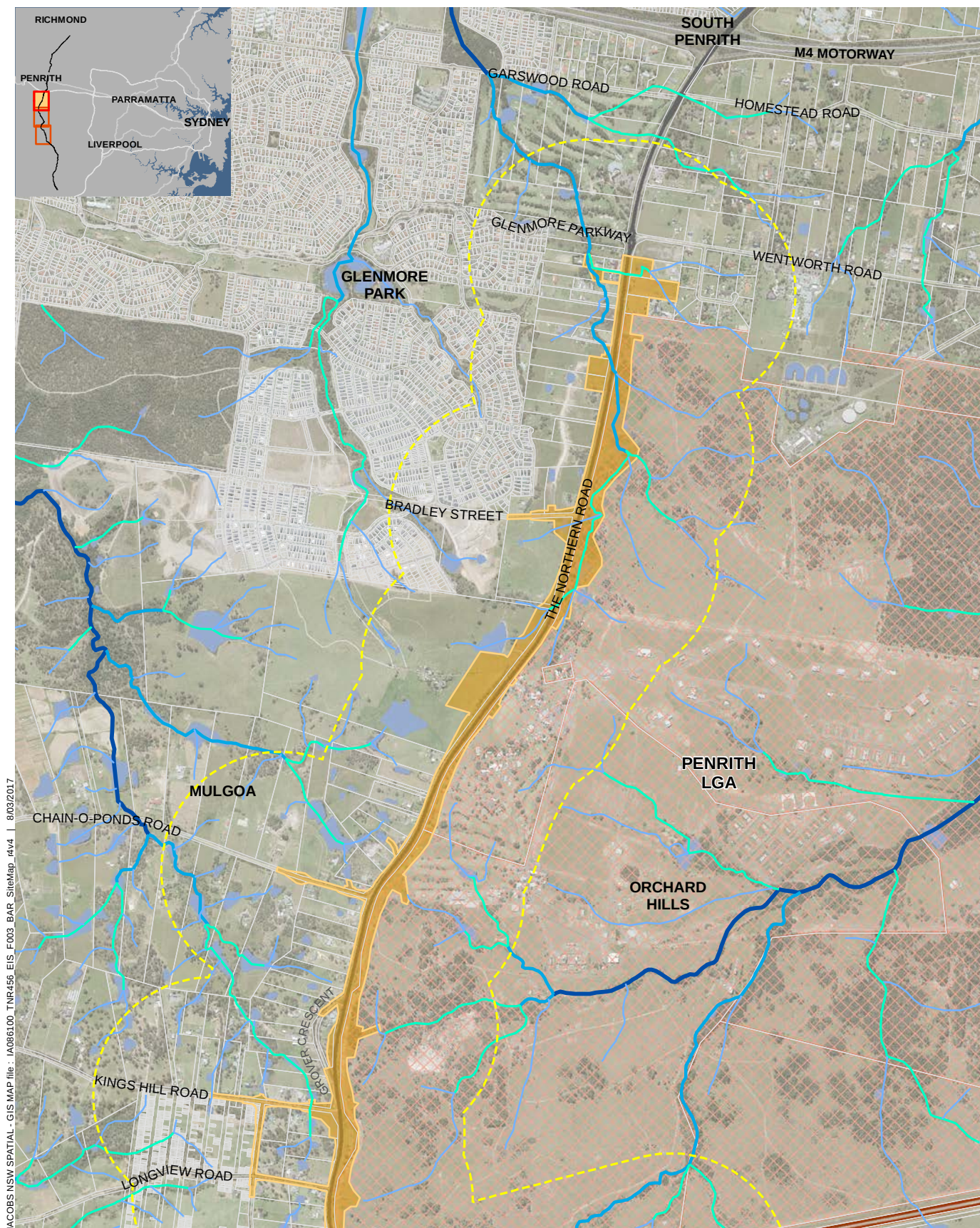


Figure 2-1 | Site map



JACOBS NSW SPATIAL - GIS MAP file : IAO86100_TNR456 EIS F003 BAR SiteMap_r4v4 | 8/03/2017

- | | | | |
|------------------------------|------------------------|---|---|
| The Northern Road (Existing) | 550m assessment buffer | Local Government Area boundaries | Rivers and streams (Stahler stream order) 1 |
| WaterNSW supply pipelines | | Hydro areas (dams and waterbodies) | 2 |
| Development site boundary | | Western Sydney Airport site (Commonwealth Land) | 3 |
| | | Defence Establishment Orchard Hills (Commonwealth Land) | 4 |
| | | Commonwealth Lands | |

0 0.5 1 km

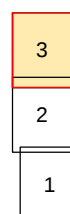


Figure 2-1 | Site map



JACOBS NSW SPATIAL - GIS MAP file : JAC06100_TNR456_EIS_F004_BAR_SiteLandscape_v4v4 | 5/11/2016

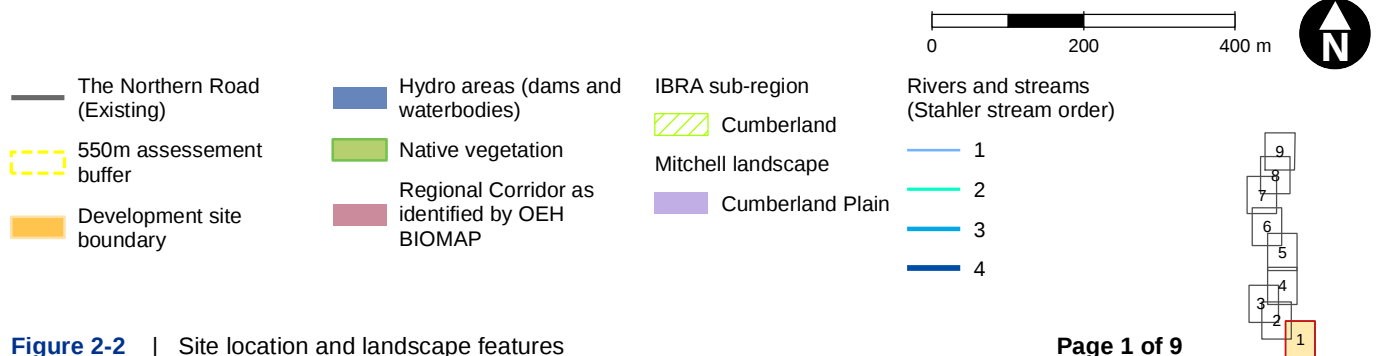
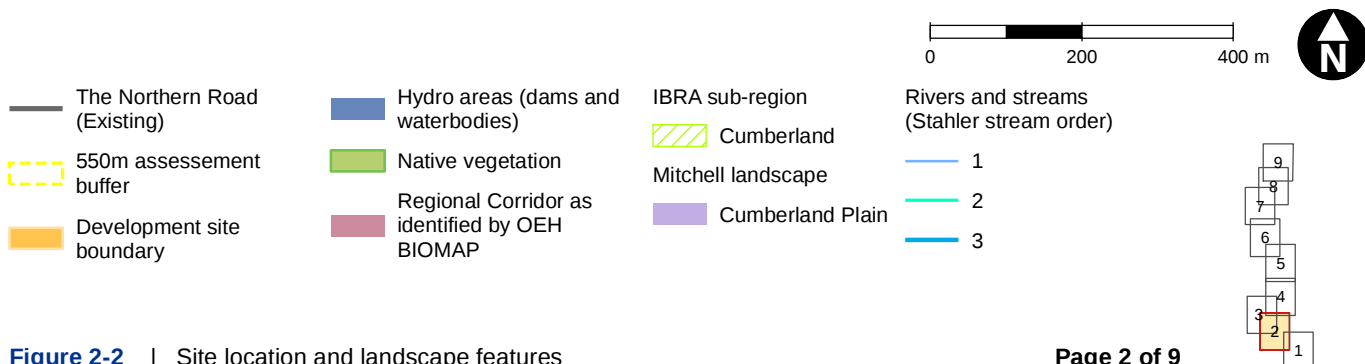
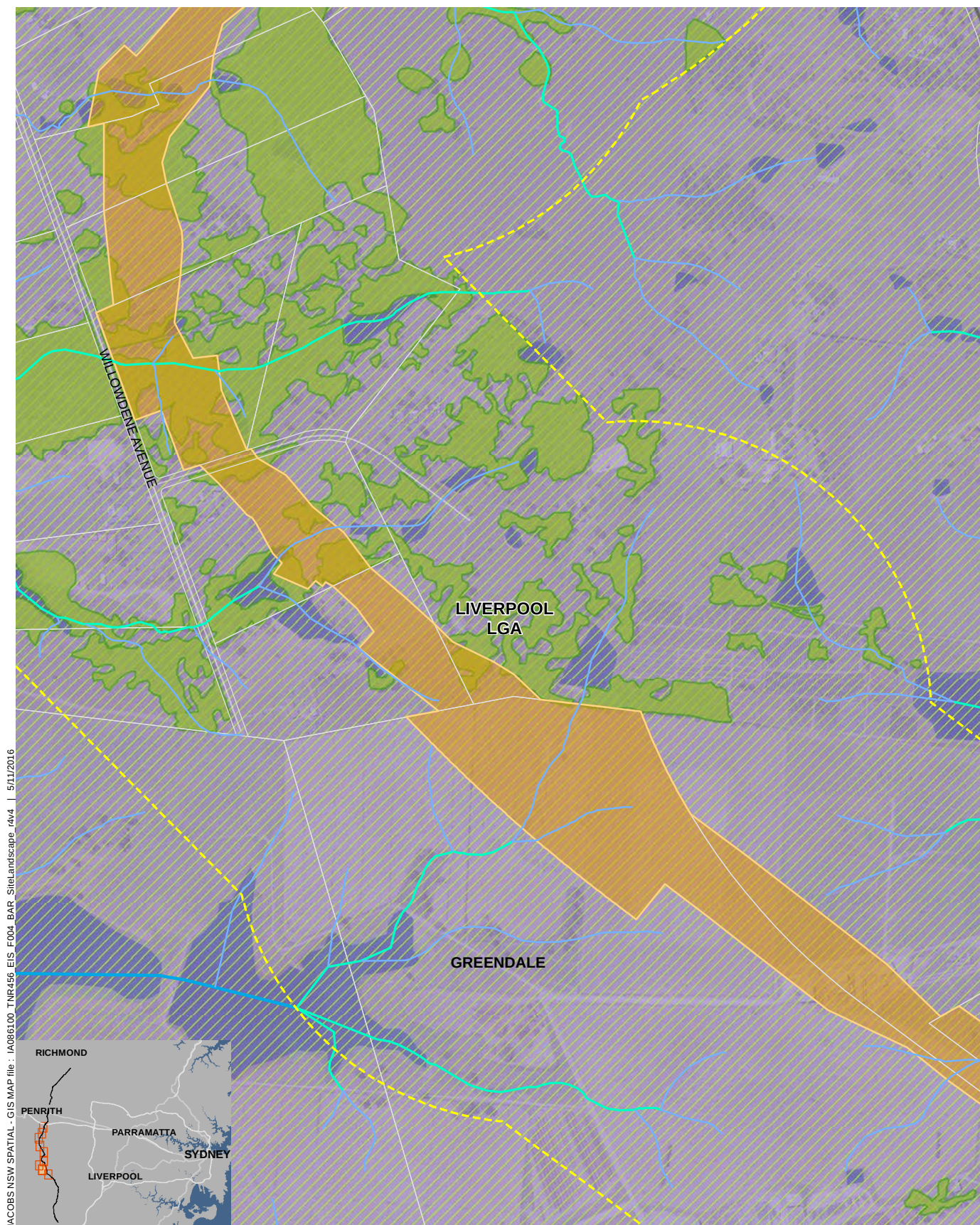


Figure 2-2 | Site location and landscape features



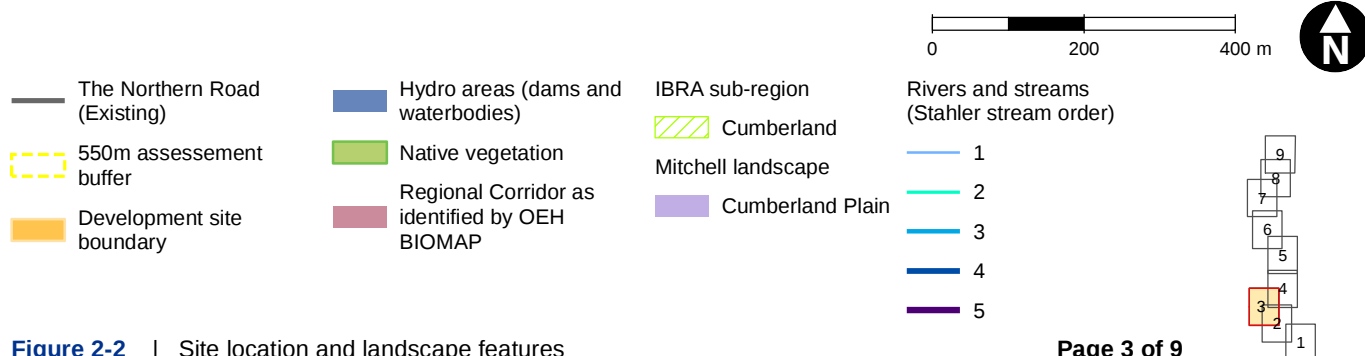
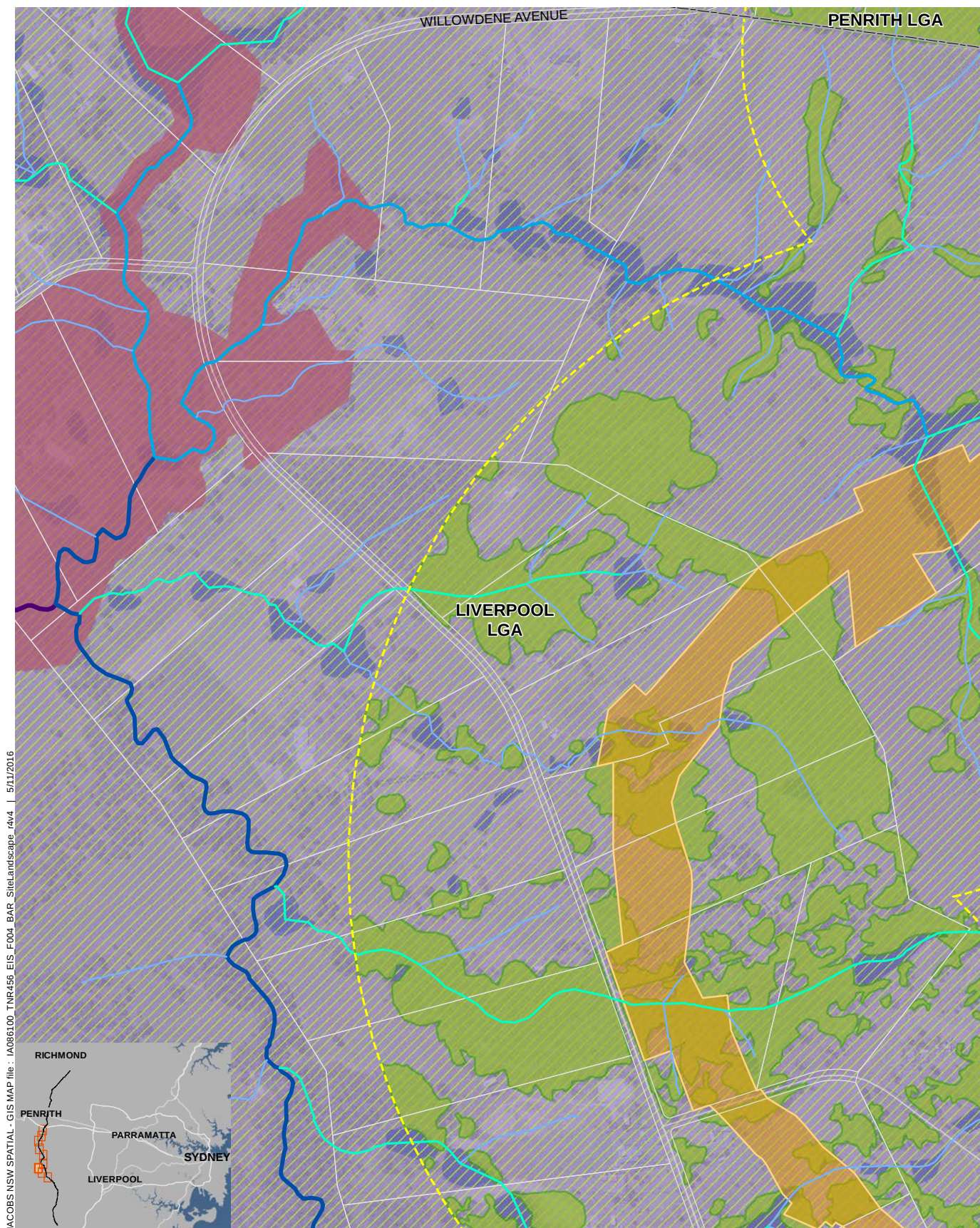
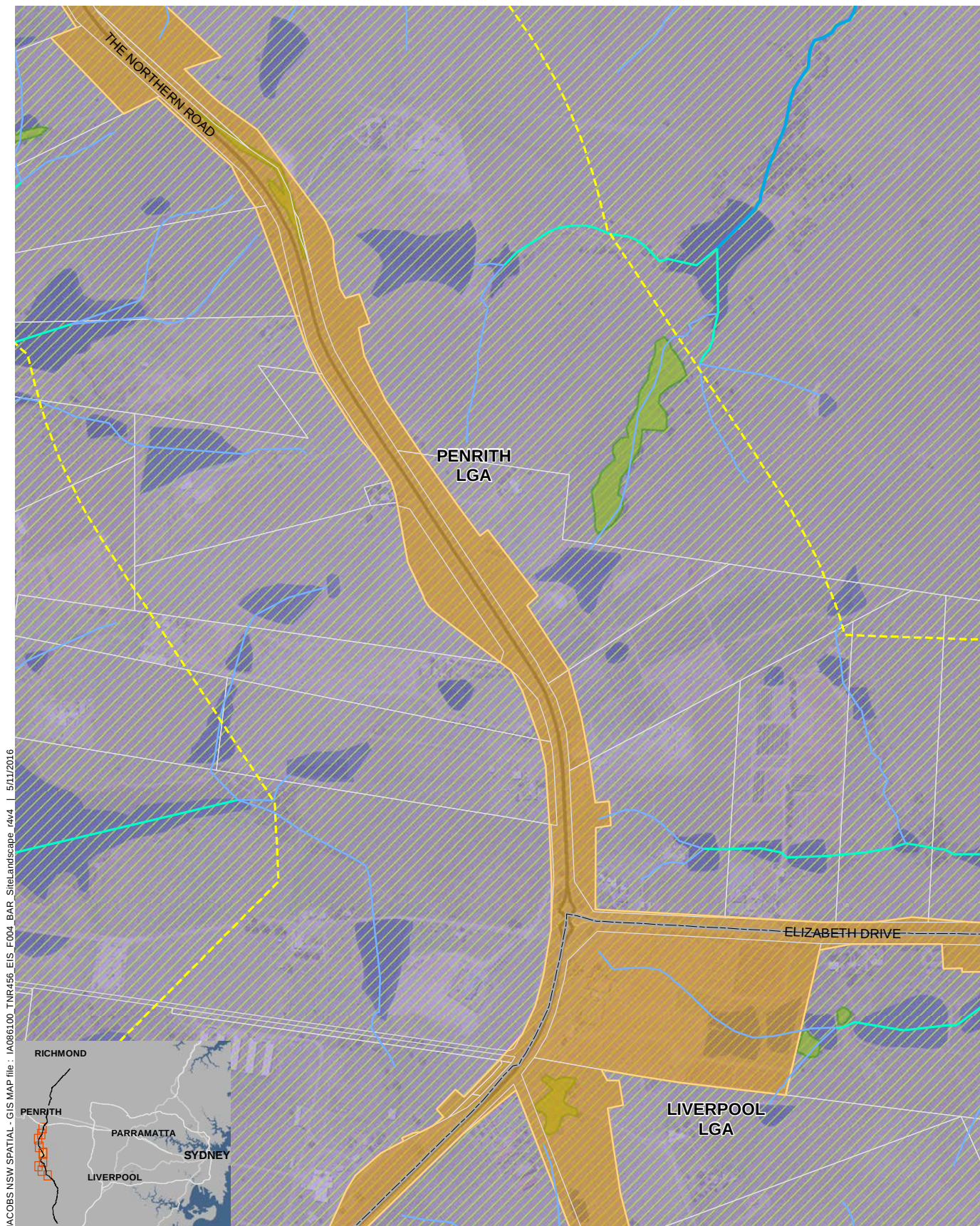


Figure 2-2 | Site location and landscape features



Figure 2-2 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file : JA086100_TNR456_EIS_F004_BAR_SiteLandscape_v4v4 | 5/11/2016

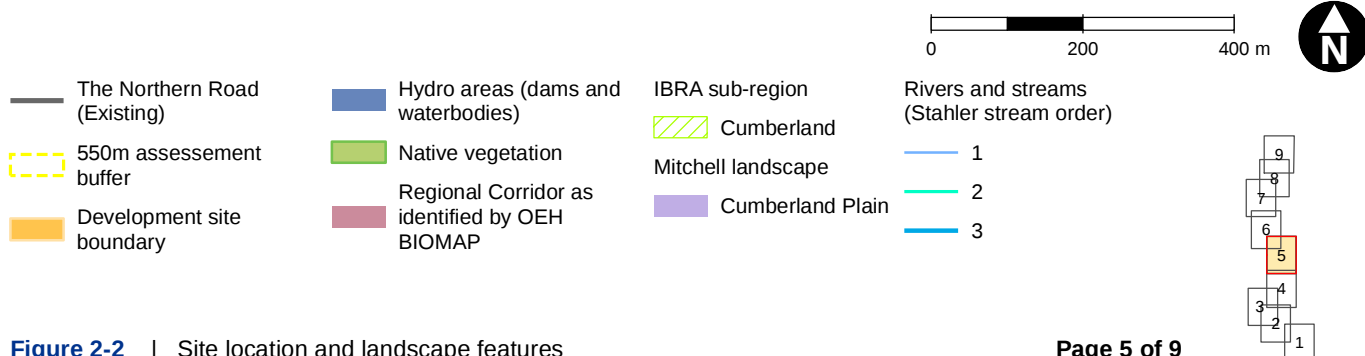


Figure 2-2 | Site location and landscape features



0 200 400 m



- The Northern Road (Existing)
- WaterNSW supply pipelines
- 550m assessment buffer
- Development site boundary

- Hydro areas (dams and waterbodies)
- Native vegetation
- Regional Corridor as identified by OEH BIOMAP

- IBRA sub-region
- Cumberland
- Mitchell landscape
- Cumberland Plain

- Rivers and streams (Stahler stream order)
- 1
- 2
- 3

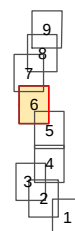
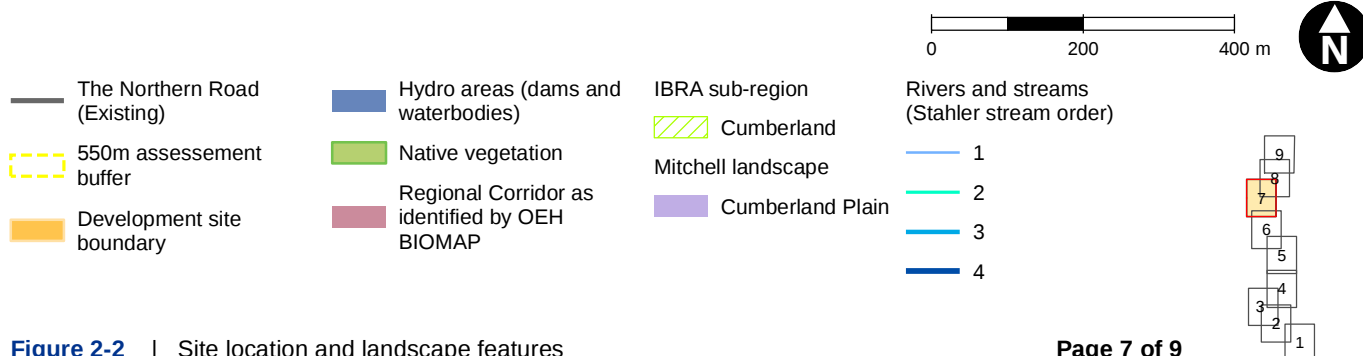
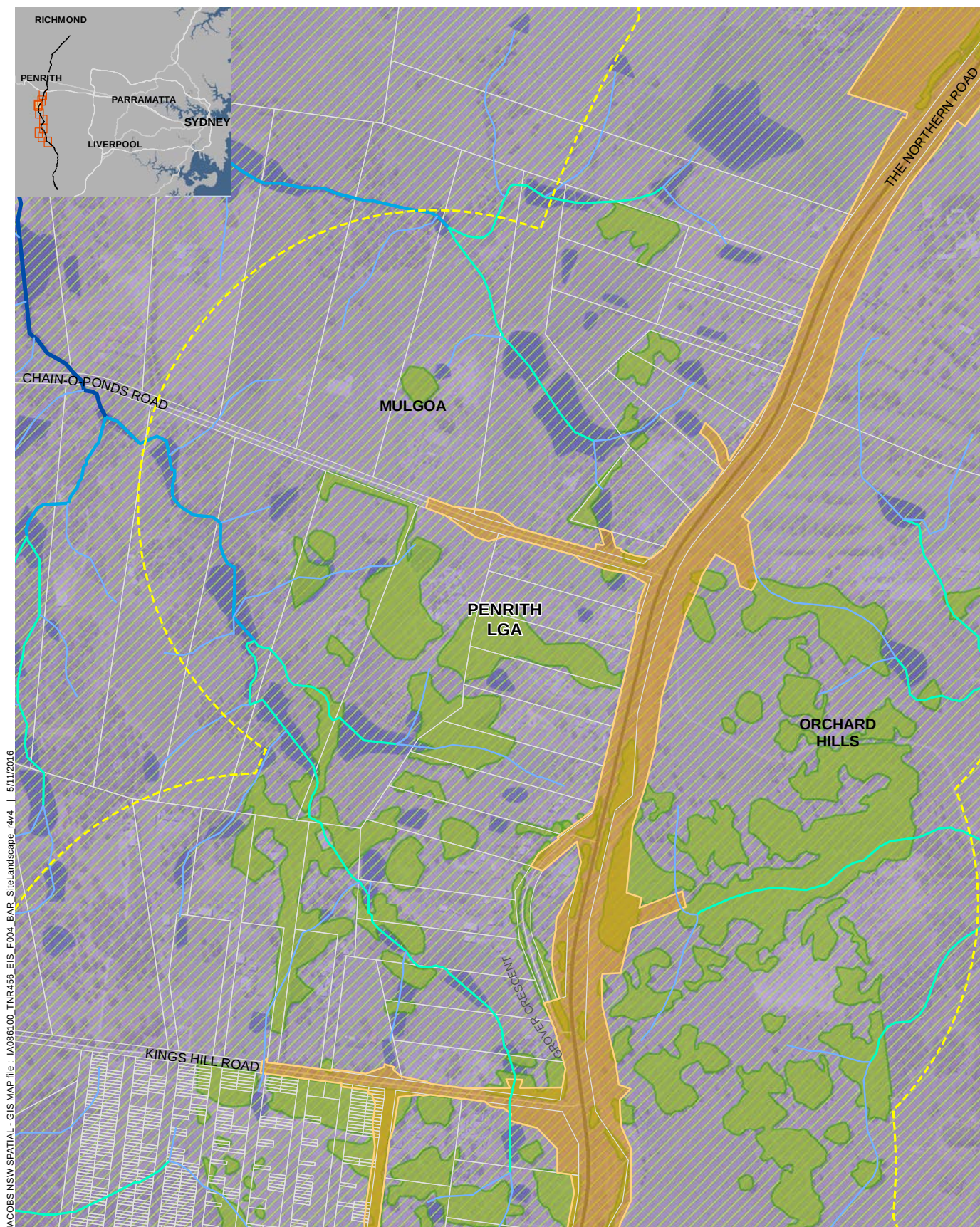
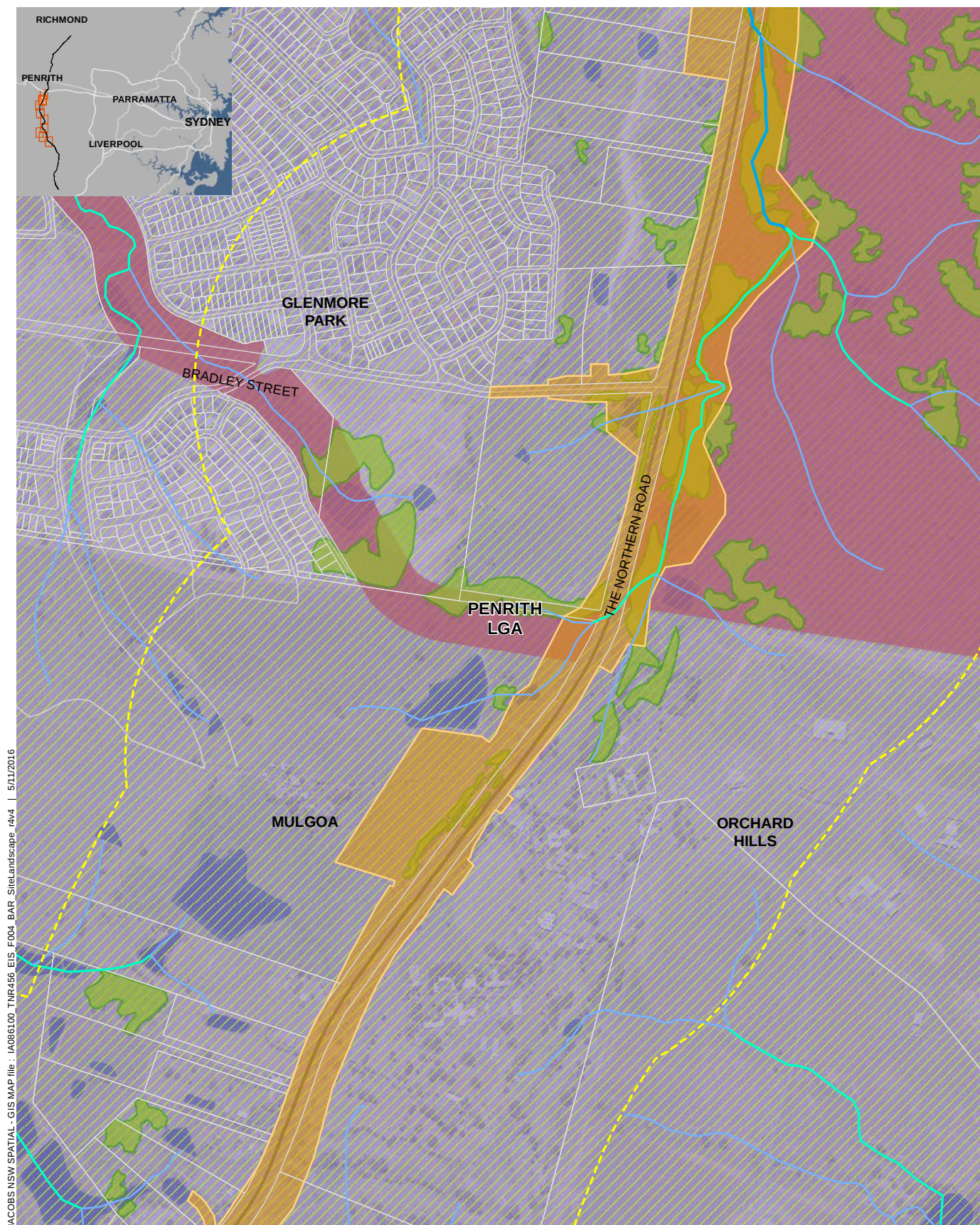


Figure 2-2 | Site location and landscape features





JACOBS NSW SPATIAL - GIS MAP file : JA086100_TNR456_EIS_F004_BAR_SiteLandscape_v4v4 | 5/11/2016

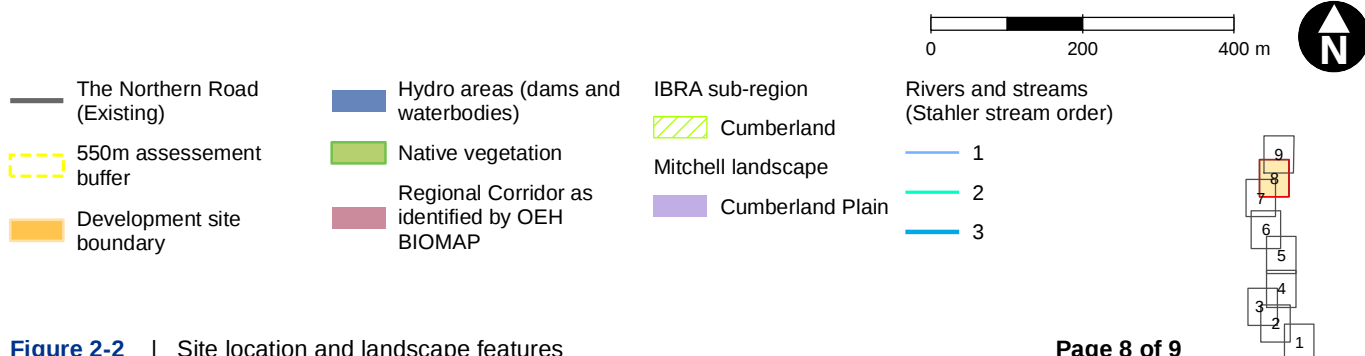


Figure 2-2 | Site location and landscape features

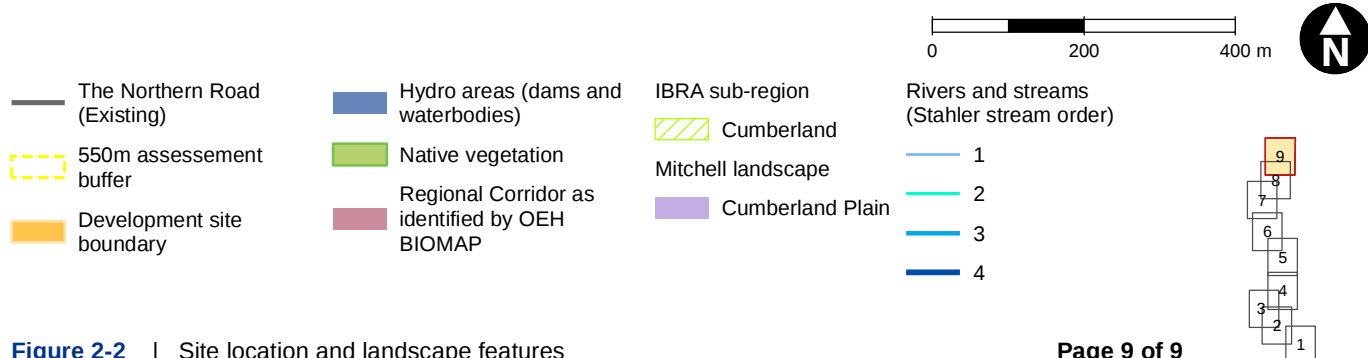
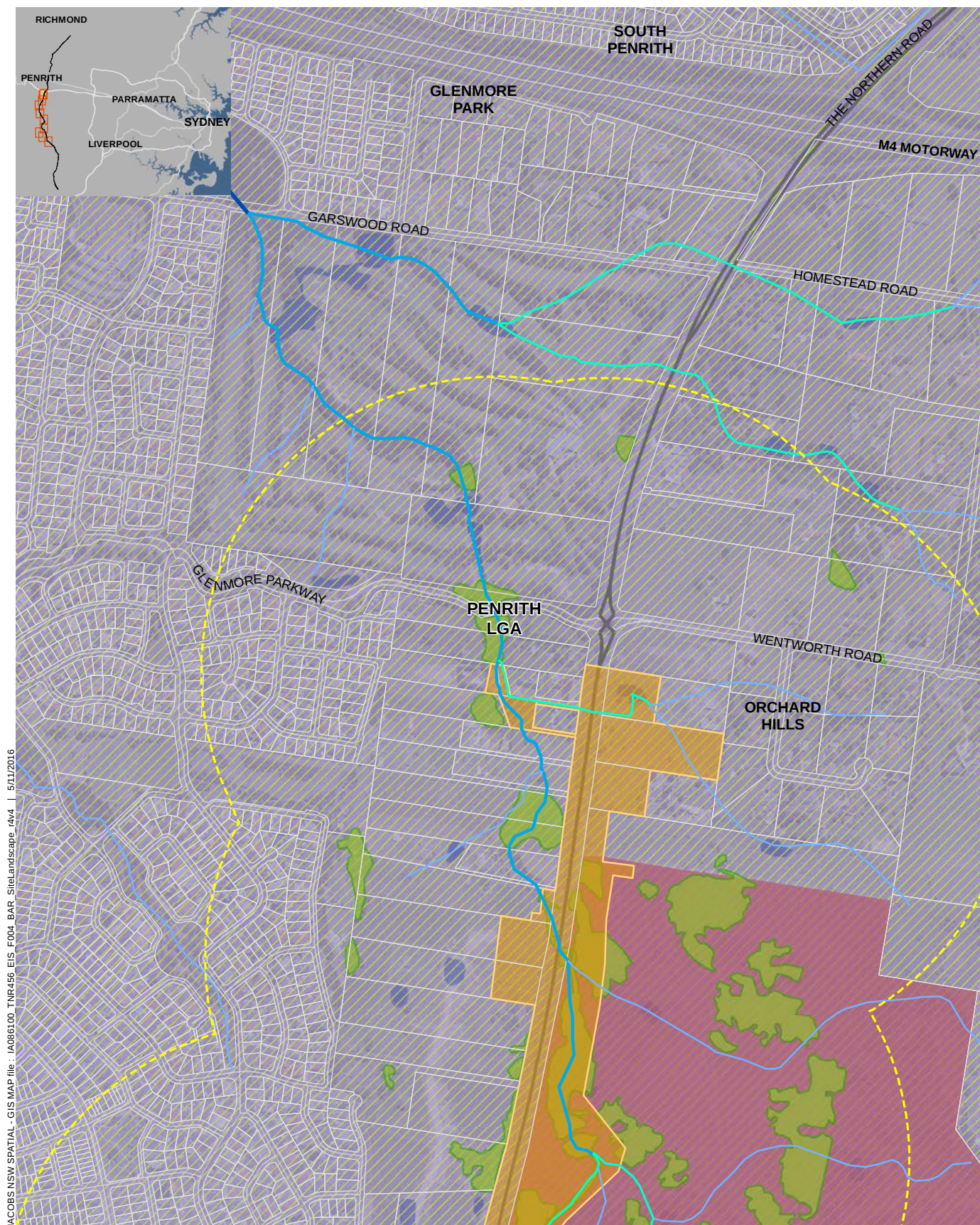


Figure 2-2 | Site location and landscape features

2.2 Landscape values

As the project is a road upgrade, it is a linear shaped development and landscape value must be assessed according to Appendix 5 of the FBA (Assessing landscape value for linear shaped developments, or multiple fragmentation impacts). This section of the BAR includes a discussion on landscape value components applicable to linear shaped developments including:

- Percent extent of native vegetation cover in the landscape
- Connectivity value
- Patch size
- Area to perimeter ratio.

All landscape value calculations were undertaken using ESRI ArcGIS 10.1 software. To undertake the assessment of landscape values, a 550 metre buffer was established either side of the centre line of the development footprint. The final landscape value score is provided and any assumptions made in the calculation of the landscape value score are discussed.

2.2.1 Percent native vegetation cover

Percent native vegetation cover within the 550 metre landscape buffer from the centreline of the development footprint was digitised based off aerial photography. This method was chosen in place of using regional vegetation mapping (e.g. Tozer, 2003, NSW National Parks & Wildlife Service, 2004) to improve the accuracy of the vegetation cover estimates as these mapping projects are not suitable for use at such fine scales. The accuracy difference between regional mapping and digitised aerial photography is illustrated in Figure 2.2.

Once the native vegetation cover had been digitised, the extent of native vegetation in the landscape before and after the development was calculated (see Table 2.1). Current percent native vegetation cover is estimated at 11.8 per cent (score 2.5 as outlined in Table 16 of Appendix 5 of the FBA). After the development, percent native vegetation cover is estimated at 10 per cent (score 1.25 as outlined in Table 16 of Appendix 5 of the FBA). The score for percent native vegetation cover is 1.25.

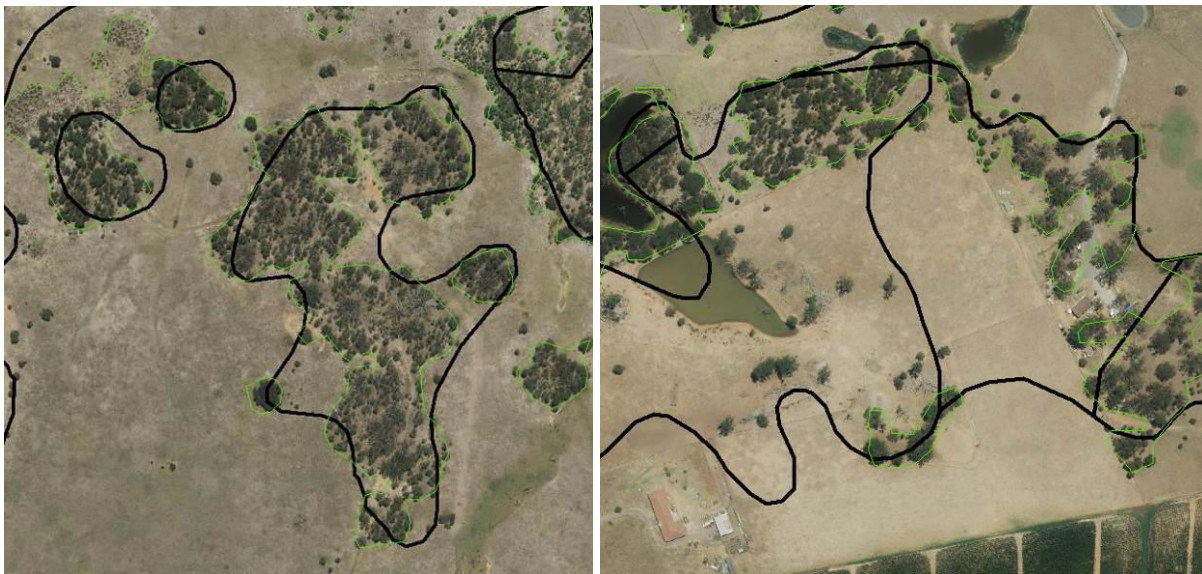


Figure 2.2 Accuracy comparisons between available regional vegetation mapping (Tozer 2003 (black outline) and digitised aerial photography (green outline)

Table 2.1 Percent native vegetation cover in the landscape before and after development

Assessment buffer	Before development		After development		Score for percent native vegetation cover
	Remnant vegetation cover (ha)	Cover (%)	Remnant vegetation cover (ha)	Cover (%)	
550m from centre line (2,464 hectares)	291 hectares	11.8% (score 2.5)	246.7 hectares	10% (score 1.25)	1.25

2.2.2 Connectivity value

According to the FBA, a connecting link is when native vegetation on the site adjoins native vegetation surrounding the site and the native vegetation:

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

Regional Corridor 17 and the core area identified by the OEH in the BIO Map are considered a regionally significant biodiversity link by the OEH but the BIO Map (Office of Environment and Heritage 2015a) has not been approved by the Chief Executive of OEH. Therefore, these biodiversity links have not been included in the FBA calculations.

The Northern Road is currently a two lane road and is not a dual carriageway (i.e. it is not currently a divided highway with central reservation). Therefore, the current northern road is not considered under the FBA to be a barrier of a size that would sever a connecting link. Vegetation either side of the current The Northern Road can be part of the same connecting link where it is in moderate to good condition, has a patch size of more than 1 hectare, and areas of vegetation are within 100 metres of each other. The project will impact on local area biodiversity links and the score for connectivity value class is 2.5. The local links are illustrated in Figure 2.3.

Table 2.2 Connectivity value score

Category of connecting link	Definition of connecting link	Score
Local area biodiversity link	Links areas of native vegetation in moderate to good condition that are ≥250 hectares and <1000 hectares in total, or areas greater than 1000 hectares in total AND Width of vegetation in moderate to good condition that is connecting the area is >30 m and <100 m	2.5

2.2.3 Patch size

For a development that is linear shaped or a multiple fragmentation development, the assessor must assess the patch size for each Mitchell landscape in which the major project

occurs. The project occurs in the Cumberland Plain Mitchell Landscape which is 89 per cent cleared. The development footprint crosses three distinct vegetation patches.

The first vegetation patch (Patch 1) is located in the north of the study area and is composed of the vegetation on the Defence Site Orchard Hills and east of the current Northern Road into Glenmore Park. Patch 1 is not part of the patch that contains the Mulgoa Nature Reserve as recent residential development has severed connectivity along Surveyors Creek. Patch 1 is at least 778 hectares in size (see Table 2.3 and Figure 2.3).

Patch 2 is located in the north of the study area at the south western end of the Defence Site Orchard Hills. This patch continues west across the Northern Road into Mulgoa and to the Nepean River. This patch contains the Mulgoa Nature Reserve. Patch 2 is at least 1,820 hectares in size (see Table 2.3 and Figure 2.3).

Patch 3 is located in the south of the study area and the project crosses the patch at Luddenham and Bringelly. Patch 3 spreads from Badgerys Creek to the east of the study area, west through Luddenham to the Nepean River at Wallacia. The patch extends north to the WaterNSW supply pipelines and south to Bringelly and Cobbity. Patch 3 is at least 2,573 hectares in size (see Table 2.3 and Figure 2.3).

The final patch size score is 12.5 (the average of the three patch scores).

Table 2.3 Patch size score

Patch	Size (ha)	Patch size class	Patch size score
Patch 1	778	Extra-large (>100 hectares)	12.5
Patch 2	1,820	Extra-large (>100 hectares)	12.5
Patch 3	2,573	Extra-large (>100 hectares)	12.5
Average			12.5

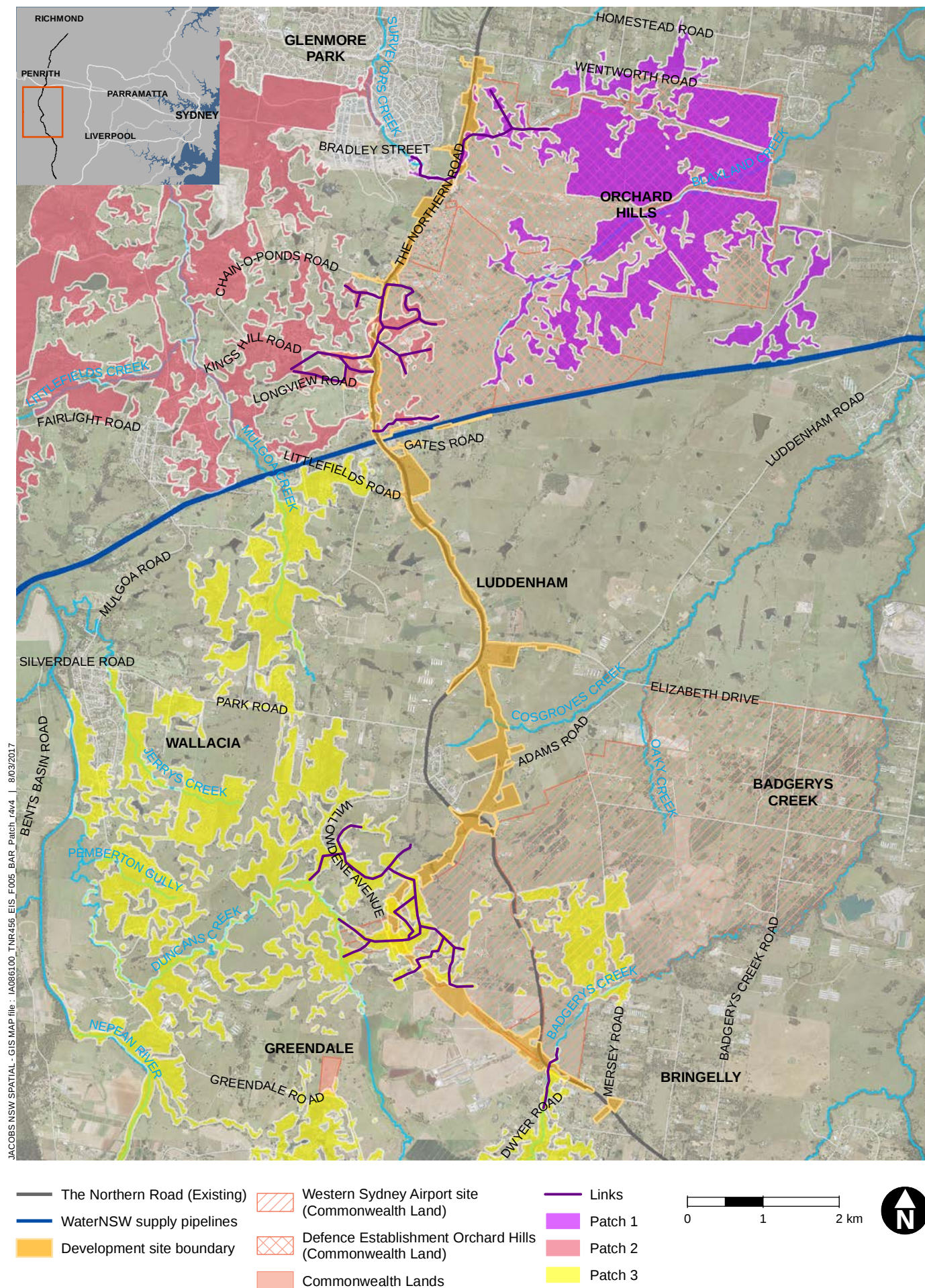


Figure 2-3 | Patch size

2.2.4 Area to perimeter ratio

For a major project that is a linear shaped development or multiple fragmentation development, the change in area to perimeter ratio of patches impacted must be assessed.

The total area (square metres) and perimeter (metres) of vegetation patches impacted by the development within the 550 metre buffer is outlined in Table 2.4. The area to perimeter ratio before the development is 22 and after development is 21. The proportional change in area to perimeter ratio as calculated by the credit calculator is 4.5 and the score for the proportional change in area to perimeter ratio is 1 according to Table 19 in Appendix 5 of the FBA (see Table 2.4). This is a relatively small change in area to perimeter ratio and is expected as the vegetation currently has a high area to perimeter ratio (due to many small fragments of vegetation in the landscape) which will not be increased significantly by the project.

Table 2.4 Area to perimeter ratio

Before development			After development			Proportional change	Score
Vegetation area (m ²)	Vegetation perimeter (m)	Area to perimeter ratio	Vegetation area (m ²)	Vegetation perimeter (m)	Area to perimeter ratio		
638,142	28,780	22	499,454	24,316	21	4.5	1

2.2.5 Landscape value score

A summary of the landscape value assessment is provided here. The landscape component scores are as follows:

- Percent native vegetation cover = 1.25
- Connectivity value class = 2.5
- Area / perimeter ratio score = 1
- Average patch size score = 12.5

The landscape value score as determined by the BioBanking credit calculator is 17.25.