Flora and Fauna Assessment

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Impact Assessment Report

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SIMTA

SIMTA MOOREBANK INTERMODAL TERMINAL FACILITY

FLORA AND FAUNA ASSESSMENT

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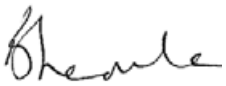
Checker	Brad Searle	
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CONTENTS

Glossary and acronyms ii
Executive Summary 1
1 Introduction 4
1.1 Purpose and Scope 4
1.2 Objectives 5
1.3 Study Area 5
1.4 Legislation and Policy 9
2 Methodology 12
2.1 Desktop Research 12
2.2 Field Survey 13
2.3 Likelihood of Occurrence of Threatened Species Criteria 20
2.4 Limitations 20
3 Results 22
3.1 Environmental Context 22
3.2 Flora 27
3.3 Fauna 61
3.4 Matters of National Environmental Significance 92
4 Impact Assessment 93
4.1 Construction Phase 93
4.2 Operational Phase 105
4.3 Summary of Impacts 106
4.4 Cumulative Impacts 108
4.5 Key Threatening Processes 112
4.6 Commonwealth EIS Requirements 113
4.7 Assessment of Impacts 115
5 Mitigation Measures 117
5.1 Avoid Impacts 117
5.2 Mitigate Impacts 117
5.3 Offset impacts 126
6 Conclusion 128
7 References 132

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Appendix 1 Aquatic Ecology Assessment

Appendix 2 Flora species inventory

Appendix 3 Fauna species inventory

Appendix 4 EPBC Protected Matters Search Results

Appendix 5 Commonwealth Species and Species of Concern

Appendix 6 Assessments of Significance

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GLOSSARY AND ACRONYMS

DECCW	Department of Environment, Climate Change and Water (NSW) – now OEH
DNSDC	Defence National Storage and Distribution Centre
DPI	Department of Primary Industries (NSW)
DSEWPC	Department of Sustainability, Environment, Population, Water and Communities (DSEWPC)
EIS	Environmental Impact Statement
Endangered population	A population listed as endangered under the TSC Act.
EP&A Act	*Environmental Planning and Assessment Act* 1979 (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth)
FM Act	*Fisheries Management Act* 1994 (NSW)
Key Threatening Process (KTP)	A threatening process listed under the EPBC Act, TSC Act or FM Act
Migratory species	Species protected as Migratory under the EPBC Act
MNES	Matter of National Environmental Significance (as defined by the EPBC Act)
OEH	Office of Environment and Heritage (NSW)
SIMTA	Sydney Intermodal Terminal Alliance
SSFL	Southern Sydney Freight Line
Threatened ecological community (TEC)	An ecological community listed under the EPBC Act or TSC Act (includes Critically Endangered, Endangered and Vulnerable ecological communities)
Threatened species	A species listed under the EPBC Act, TSC Act or FM Act (includes Critically Endangered, Endangered and Vulnerable species)
TSC Act	*Threatened Species Conservation Act* 1995 (NSW)

EXECUTIVE SUMMARY

The Sydney Intermodal Terminal Alliance (SIMTA), a consortium of Qube Logistics and QR National, is proposing to develop the SIMTA Moorebank Intermodal Terminal Facility (**SIMTA proposal**). The SIMTA proposal includes an intermodal terminal, rail link and approximately 300,000 m^2 of warehousing. The **SIMTA site** (including intermodal terminal) is to be located on the land parcel currently occupied by the Defence National Storage and Distribution Centre (**DNSDC**)). The parcels of land to the south and south-west would be utilised for the proposed rail corridor that would service the SIMTA proposal. The SIMTA site is located on Moorebank Avenue, Moorebank, in the Liverpool Local Government Area, approximately 27 kilometres west of the Sydney CBD. The SIMTA site and rail corridor cover 83 hectares and approximately 75 hectares respectively, and together comprise the study area for this assessment.

This technical document has been prepared to address both the Commonwealth EIS guidelines as issued under the *Environment Protection and Biodiversity Conservation Act 1999* dated (June 2012) and the Environmental Assessment Requirements (**EARs**) issued under the *Environmental Planning and Assessment Act* 1979 to support the Concept Plan environment impact statement (**EIS**) for the SIMTA proposal.

The assessment considers both construction and operational impacts of the SIMTA proposal. The SIMTA site, approximately 83 hectares in area, is proposed to be developed into an intermodal terminal facility and warehouse/distribution facility, which would offer container storage and warehousing solutions with direct rail access to Port Botany. The proposed rail corridor covers approximately 75 hectares and adjoins the Main Southern Railway to the north. The rail line is approximately 3.5 kilometres in length, 20 metres in width (variable width) and includes two connections to the SSFL, one south and one north. This would include a small box culvert-style railway bridge over Anzac Creek, widening of the Moorebank Avenue underpass within the East Hills Railway corridor and a single-track railway bridge over the Georges River (bridge designs will be confirmed during detailed design).

The purpose of this assessment is to describe terrestrial and aquatic flora and fauna species and their habitats which occur within the study area; determine the likely occurrence of threatened entities and their habitats; assess potential impacts of the SIMTA proposal on ecological values and provide recommendations with regard to the minimisation of impacts on such values.

Database searches were undertaken to identify existing records of threatened species, populations and communities occurring within the study area and the surrounding locality. Flora and fauna surveys were undertaken across the study area from Monday 2 May 2011 to Wednesday 25 May 2011 and from Wednesday 30 May 2012 and Thursday 31 May 2012. Additional targeted threatened species surveys were undertaken from Tuesday 10 to Wednesday 18 July 2012.

Detailed flora surveys including quadrats, random meanders, tree assessment and targeted threatened species searches recorded a total of 310 vascular plant species in the study area, comprising 213 local native species, eight non-local native species (mainly planted trees) and 89 exotic species.

Two threatened species listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (**EPBC Act**) and the *Threatened Species Conservation Act* 1995 (**TSC Act**) were recorded within the study area, namely *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea). Another threatened species, *Acacia pubescens* (Downy Wattle), was recorded at the edge of bushland to the east of the SIMTA site. *Persoonia nutans* is listed as Endangered under the EPBC Act and on Schedule 1 of the TSC Act. G*revillea parviflora subsp. parviflora* is listed as Vulnerable under the EPBC Act and on

Schedule 2 of the TSC Act. *Acacia pubescens* is listed as Vulnerable under the EPBC Act and on Schedule 2 of the TSC Act.

Five vegetation types were identified within the study area, of which four correspond with threatened ecological communities (**TECs**) listed under the TSC Act, based on analysis of existing vegetation maps and ground truthing:

- Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion.
- Castlereagh Swamp Woodland.
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.

No threatened ecological communities listed under the EPBC Act were identified within the study area.

Detailed terrestrial fauna surveys, including call-playback, spotlighting, placement of Anabats, targeted habitats searches across the study area identified the presence of five exotic and 54 native fauna species. Four threatened fauna species listed under the TSC Act and/or EPBC Act; Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), Southern Myotis (*Myotis macropus*), Eastern Free-tail Bat (*Mormopterus norfolkensis*) and Grey-headed Flying Fox (*Pteropus poliocephalus*), were recorded within the study area. Other species of concern that have been specifically addressed by this assessment include Green and Golden Bell Frog (*Litorea aurea*), Spotted-tail Quoll (*Dasyurus maculatus*) and Macquarie Perch (*Macquaria australasica*).

Five broad fauna habitat types were identified from the study area; remnant vegetation, riparian habitats, landscaped areas and cleared and disturbed areas. Notable habitat features across the study area that would offer potential sheltering, nesting, roosting or foraging resources to fauna included flowering trees and shrubs, hollow-bearing trees, rough-barked eucalypts with exfoliating bark, ground timber and well-developed leaf litter in places. Georges River, Anzac Creek and damp areas were considered to offer habitat to a variety of fish and amphibian species. There was, however, an absence of other important features such as large hollow-bearing trees, stags, rocky features and hollow logs across the site. Aquatic fauna surveys identified a low diversity of macroinvertebrates and one native and one exotic fish species from sampling sites in the Georges River and Anzac Creek. Aquatic habitats in both the Georges River and Anzac Creek were considered to be of poor quality.

The study area as assessed contains, and is bound by, significant barriers to fauna movement, including Moorebank Avenue, the East Hills Railway line and chain-mesh fencing surrounding the SIMTA site, Royal Australian Engineers Golf Course and Glenfield Waste Disposal Facility. This chain-mesh fencing and the large areas cleared of vegetation fragments habitat connectivity and would limit movement into and through the study area to small terrestrial mammals, reptiles, amphibians, bats and birds. Larger terrestrial mammals that may occur in the locality would be excluded from much of the study area.

The following biodiversity values are likely to be impacted as a result of the SIMTA proposal:

- Two threatened flora species listed under the EPBC Act and TSC Act.
- Four TECs listed under the TSC Act.
- Four threatened fauna species, of which one is listed under the EPBC Act and TSC Act and three are listed under the TSC Act..
- Habitat for threatened flora species.

- Habitat for locally occurring fauna species.
- Potential habitat for threatened terrestrial and aquatic fauna species.

In accordance with the EIS guidelines, assessment of seven particular threatened species and communities listed under the EPBC Act that are known or likely to be present in the vicinity of the proposed action area was undertaken:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.
- Green and Gold Bell Frog (*Litoria aurea*).
- Downy Wattle (*Acacia pubescens*).
- Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*).
- Nodding Geebung (*Persoonia nutans*).
- Macquarie Perch (*Macquaria australasica*).
- Spot-tailed Quoll (*Dasyurus maculatus*).

The assessment included specific information on the ecology, local and regional distribution and habitat, threats and assessment of the above species and communities of concern.

Assessments of significance, using New South Wales (**NSW**) assessment guidelines, have been prepared for the threatened flora and fauna species and ecological communities known or likely to be impacted by the SIMTA proposal. These assessments concluded that the four threatened ecological communities, four threatened terrestrial fauna species and one aquatic fauna species would not be significantly impacted by the SIMTA proposal. Impacts on these threatened species and communities can be adequately managed through the mitigation measures proposed in this report. The threatened plant species *Grevillea parviflora* subsp. *parviflora* was also considered unlikely to be significantly impacted by the SIMTA proposal.

The Assessment of Significance for *Persoonia nutans* concluded that this endangered species would be significantly impacted as a result of the SIMTA proposal. The population of this species in the study area is considered highly significant due to its size and location in the southern part of the species' distribution. The proposed rail link would require the clearing of a predominantly 20 metre wide alignment that will bisect the area of occupied habitat of *P. nutans* and require the removal of 14 per cent of recorded individuals in the population. The remaining plants would be fragmented by a 20 metre wide, fenced gap and subject to associated edge impacts.

Impacts on the identified ecological values should be avoided as far as practicable. Where impacts cannot be avoided, a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during and following construction. Specific management measures are identified for conservation of threatened plant species in retained habitat adjoining the rail link.

1 INTRODUCTION

The Sydney Intermodal Terminal Alliance (SIMTA) is a consortium of Qube Logistics and QR National. The SIMTA Moorebank Intermodal Terminal Facility (SIMTA proposal) is proposed to be located on the land parcel currently occupied by the Defence National Storage and Distribution Centre (DNSDC) on Moorebank Avenue, Moorebank, south west of Sydney. SIMTA proposes to develop the DNSDC occupied site into an intermodal terminal facility and warehouse/distribution facility, which will offer container storage and warehousing solutions with direct rail access to Port Botany. Construction of the rail connection from the SIMTA site to the Southern Sydney Freight Line (**SSFL**) will be undertaken as part of the first stage of works for the SIMTA proposal.

The SIMTA site is located in the Liverpool Local Government Area. It is 27 kilometres west of the Sydney CBD, 17 kilometres south of the Parramatta CBD, 5 kilometres east of the M5/M7 Interchange, 2 kilometres from the main north-south rail line and future Southern Sydney Freight Line, and 0.6 kilometres from the M5 motorway.

The **SIMTA site**, approximately 83 hectares in area, is currently operating as a Defence storage and distribution centre. The SIMTA site is legally identified as Lot 1 in DP1048263 and zoned as General Industrial under Liverpool City Council LEP 2008. The parcels of land to the south and south west that would be utilised for the proposed rail link are referred to as the **rail corridor**. The proposed rail corridor covers approximately 75 hectares and adjoins the Main Southern Railway to the north. The rail line is approximately 3.5 kilometres in length, 20 metres in width (variable width) and includes two connections to the SSFL, one south and one north.

The proposed rail corridor is owned by third parties, including the Commonwealth of Australia, RailCorp, private owners and Crown Land held by the Department of Primary Industries, and would link the SIMTA site with the Southern Sydney Freight Line. Existing uses include vacant land, existing rail corridors (East Hills Railway and Main Southern Railway), extractive industries, and a waste disposal facility. The rail corridor is intersected by Moorebank Ave, Georges River and Anzac Creek. Native vegetation cover includes woodland, forest and wetland communities in varying condition. The proposed rail corridor is zoned partly 'SP2 Infrastructure (Defence and Railway)' and partly 'RE1 - Public Recreation'. The surrounding Commonwealth lands are zoned 'SP2 Infrastructure (Defence)'.

1.1 Purpose and Scope

This technical document has been prepared to address the Commonwealth EIS guidelines as issued under the *Environment Protection and Biodiversity Conservation Act 1999* dated (June 2012).

The Assessment has been prepared in accordance with the following policy and guidelines:

- *Threatened Species Assessment Guidelines* (DECC 2007a).
- *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).
- *Policy and Guidelines for Fish Friendly Waterway Crossings* (DPI 2003).
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (*DEC 2004a).
- *Principles for the Use of Biodiversity Offsets in NSW* (DECCW 2011).
- *EPBC Act Environmental Offsets Policy* (Commonwealth of Australia 2012).

1.2 Objectives

The key objectives of this biodiversity assessment were to:

- Undertake targeted flora and fauna survey within and adjacent to the study area (in accordance with *Threatened Biodiversity and Assessment: Guidelines for Developments and Activities* (DEC 2004a).
- Describe the biodiversity values of the site and surrounding areas, including remnant vegetation, fauna corridors and foraging, nesting or roosting habitat for species.
- Identify any threatened terrestrial and aquatic (including groundwater dependent) species, populations or their habitats, Threatened Ecological Communities (**TEC**) and/or critical habitat.
- Assess the potential construction and operational impacts of the SIMTA proposal, (including direct, indirect and cumulative impacts) on any threatened species or communities (and their habitats) identified from the study area.
- Describe measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the SIMTA proposal and any residual impacts.

1.3 Study Area

The study area for the current assessment comprises the SIMTA site and the adjoining rail corridor (Figure 1, Figure 2), covering a total of approximately 175 hectares. The rail corridor contains the proposed rail link. The study area includes a portion of Defence land to the east of the rail corridor.

The portion of the study area currently occupied by the DNSDC (the SIMTA site) is identified as Lot 1 in DP1048263 and zoned as IN1 General Industrial under Liverpool City Council LEP 2008. It comprises low rise buildings including warehouses, administrative offices, hardstand areas, car parks and associated infrastructure.

The proposed rail corridor is zoned partly 'SP2 Infrastructure (Defence and Railway)' and partly 'RE1 - Public Recreation'. The surrounding Commonwealth lands are zoned SP2 Infrastructure (Defence). It comprises vacant land, the Royal Australian Engineers Golf Course, East Hills Railway line corridor, Main Southern Railway line corridor and the Glenfield Waste Disposal facility. Anzac Creek and the Georges River intersect the rail corridor and the corridor passes beneath Moorebank Avenue at the East Hills Railway corridor crossing. Areas of the rail corridor comprise several lots that are held by the Commonwealth of Australia, RailCorp or privately used for the purposes of the waste disposal facility (See Table 1).

Table 1: Lot descriptions of the SIMTA site and rail corridor

Lot	Deposited Plan	Property Address/Description	Owner
1	1048263	Moorebank Avenue, Moorebank (SIMTA Site)	SIMTA
3001	1125930	Moorebank Avenue, Moorebank (land immediately south and south-west of SIMTA Site, including School of Military Engineering)	The Commonwealth of Australia
1	825352	Railway land and to the north of East Hills	RailCorp NSW

Lot	Deposited Plan	Property Address/Description	Owner
2	825348	Railway Line	
1	1061150		
2	1061150		
1	712701		
7	833516		RailCorp NSW
5	833516	Privately owned land north of East Hills Railway Line, east of Cumberland & South Passenger Line and Southern Sydney Freight line and west of Georges River	Helen Louise Kennett, Figela Pty Ltd and JC and FW Kennett Pty Ltd
51	515696		JC and FW Kennett Pty Ltd
52	517310		
104	1143827		
103	1143827		Figela Pty Ltd
91	1155962		JC and FW Kennett Pty Ltd
4	1130937	Land west of the Georges River, north of the above privately owned land	The Commonwealth of Australia
5	833516	Railway land along shared railway line – Cumberland & South Passenger Line and Southern Sydney Freight Line	RailCorp NSW
101	1143827		
102	1143827		
Conveyance Book 76	Number 361	Main Southern Railway corridor	RailCorp NSW

The existing land uses within the parcels of land to be utilised for operation and construction of the proposed rail link include vacant land, extractive industries and the Glenfield Waste Disposal facility. Native vegetation includes woodland, forest and wetland communities in varying condition. Moorebank Avenue, the Georges River and Anzac Creek intersect the proposed rail corridor area.

The study area also includes a portion of Defence land to the east of the rail corridor and the riparian vegetation adjoining the study area ion the western bank of the Georges River.

The study area for the current assessment covers a total area of approximately 175 hectares and is shown on Figures 1 and 2.

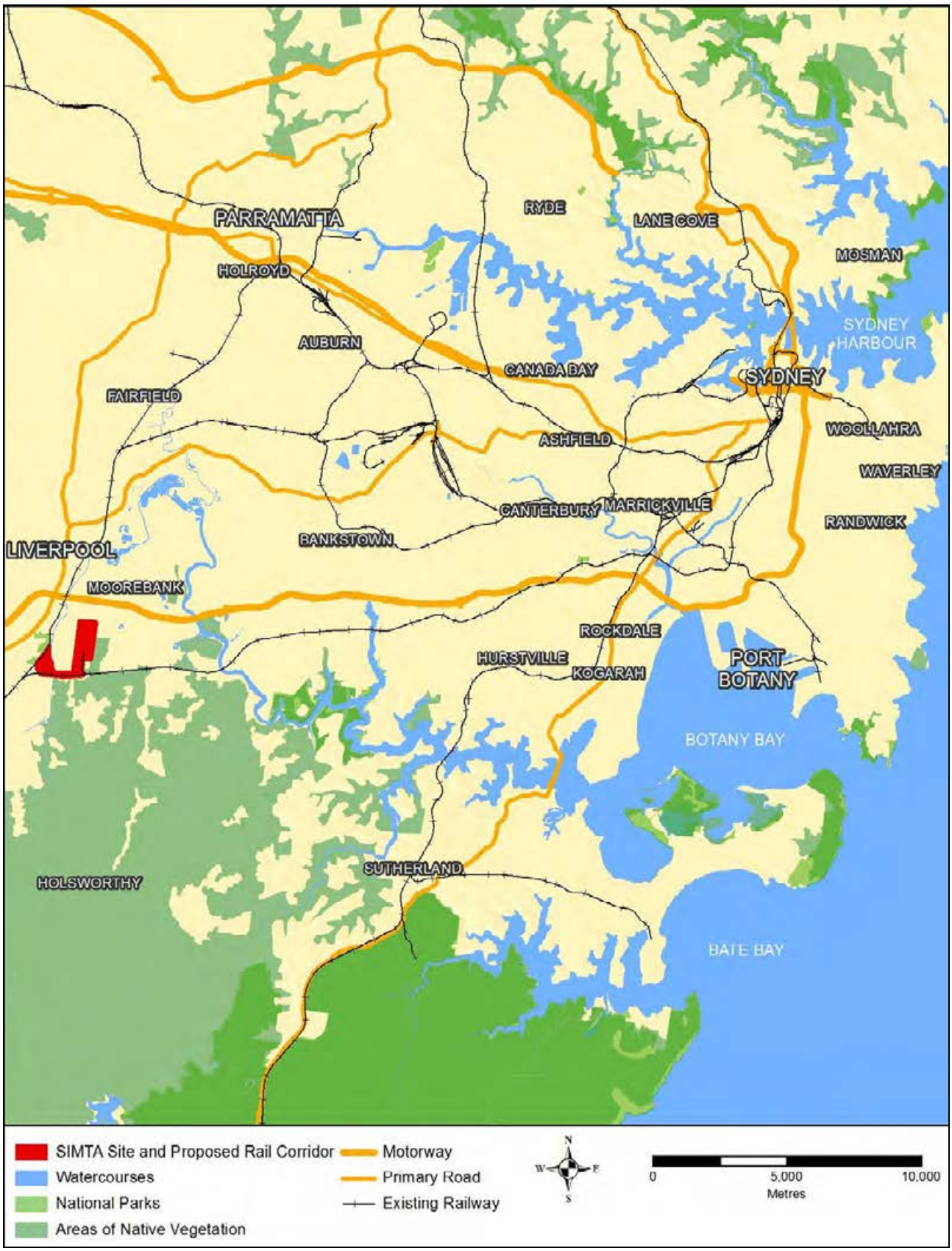

Figure 1: Location of the study area

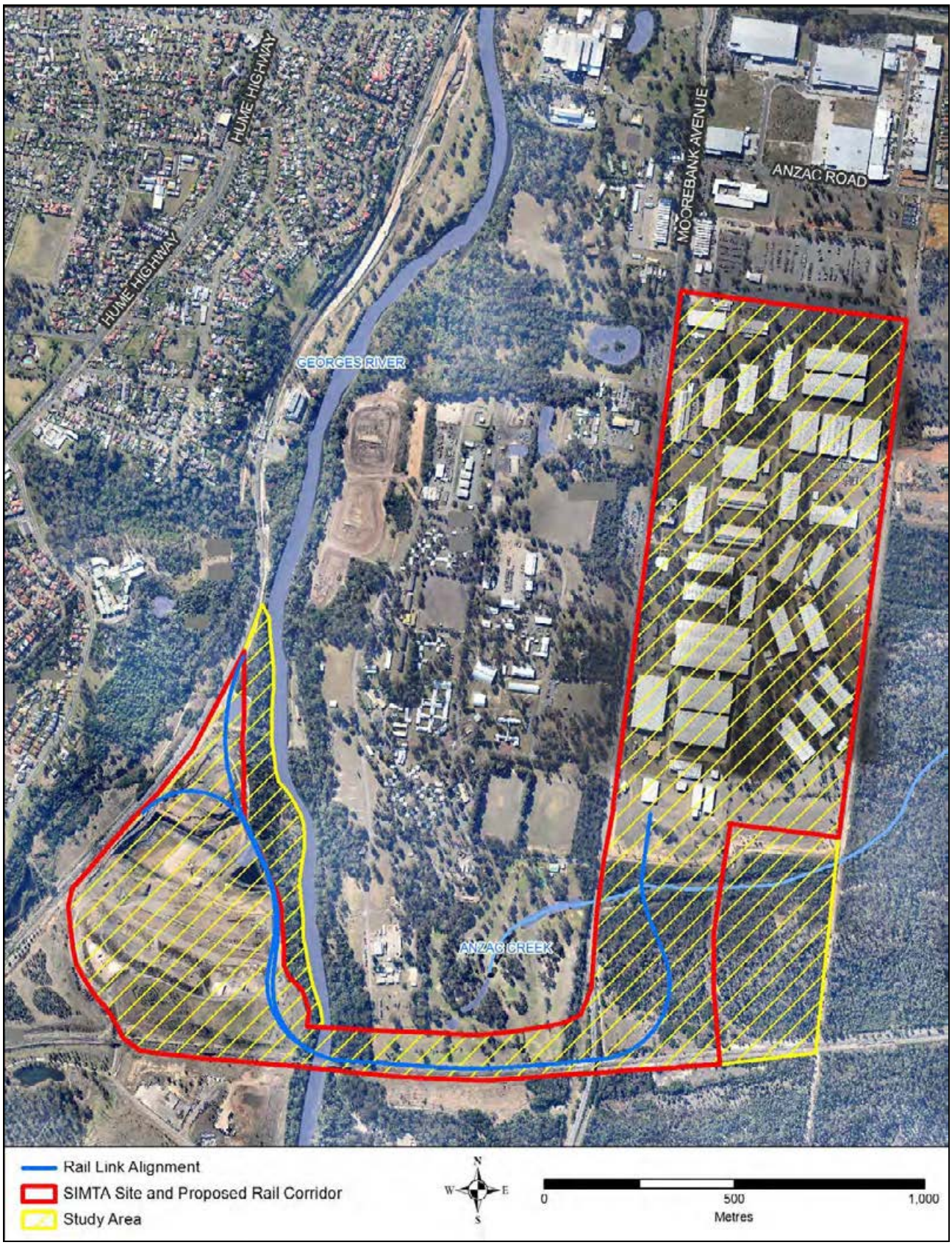

Figure 2: The study area

1.4 Legislation and Policy

1.4.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as matters of National Environmental Significance. Matters of NES identified in the Act include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Threatened species and communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of NES require approval from the Australian Government Minister for Sustainability, Environment, Water, Population and Communities (the Minister).

A referral was made to the Department of Sustainability, Environment, Water, Population and Communities of the proposed action of the SIMTA proposal. The referral of the proposed action under the EPBC Act was accepted by the DSEWPC on 21 December 2011. On 23 January 2012, a delegate for the Minister determined that assessment and approval was required under the EPBC Act and the proposed action would be assessed by Environmental Impact Statement (EIS). EIS guidelines for the SIMTA proposal were issued in June 2012.

The EIS guidelines state that the SIMTA proposal has the potential to have a significant impact upon the following matters of national environmental significance (MNES) that are protected under Part 3 of the EPBC Act:

- Listed threatened species and communities (sections 18 & 18A).
- Commonwealth land (sections 26 & 27A).

The EIS guidelines have issued specific requirements for assessment of impacts to listed threatened species and communities that are known or likely to be present in the vicinity of the proposed action area.

1.4.2 NSW *Environmental Planning and Assessment Act 1979*

On 9 November 2010, the New South Wales Minister for Planning declared the SIMTA Moorebank Intermodal Terminal Facility to be a 'Major Project' under Part 3A of the *Environmental Planning and Assessment Act* 1979 (**EP&A Act**). Director-General's environmental assessment requirements for the preparation of an environmental assessment to accompany a concept plan application (MP 10_0193) were issued on 24 December 2010. An environmental assessment (**EA**) to support an application for approval of a Concept Plan for the SIMTA proposal has been prepared in accordance with the environmental assessment

requirements and is undergoing assessment with by the NSW Department of Planning and Infrastructure (DoPI).

The SIMTA proposal is classified as a transitional Part 3A project under Schedule 6A of the EP&A Act and the Concept Plan for the SIMTA proposal will be assessed in accordance with the provisions of the now-repealed Part 3A of the EP&A Act. Subsequent stages of the SIMTA proposal will be assessed under Part 4 of the EP&A Act, with the first stage of development, which includes construction of the rail link, classified as State Significant Development.

In accordance with Section 5A (s.5A) of the EP&A Act seven factors "must be taken into account" by a consent or determining authority in the administration of Sections 78A, 79C and 112 of the Act when considering an activity or development proposal. These seven factors comprises the Assessment of Significance, the aim of which is to determine "whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats", as listed under Schedules 1, 1A and 2 of the *Threatened Species Conservation Act 1995* and Schedules 4, 4A and 5 of the *Fisheries Management Act 1994.* If it is concluded that the proposal is likely to significantly impact any threatened species, populations or ecological communities, a Species Impact Statement (SIS) must be prepared.

Under Section 5D of the EP&A Act, a reference to threatened species, populations and ecological communities does not include a reference to any vulnerable ecological community. Vulnerable ecological communities are generally excluded from the provisions of this Act relating to threatened species, populations and ecological communities and an Assessment of Significance is not required for these communities.

Under Section 79B of the EP&A Act, the Minister cannot grant approval to development on land that is, or is part of, critical habitat, or development that is likely to significantly affect a threatened species, population or ecological community, or its habitat, without the concurrence of the Director General of DECCW (now OEH). Section 79B of the EP&A Act does not apply to trasntional Part 3A project or State Significant Development.

1.4.3 NSW *Threatened Species Conservation Act 1995*

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides for the protection and management of threatened species, populations and ecological communities listed under schedules 1, 1A and 2 of the Act. The purpose of the TSC Act is to:

- Conserve biological diversity and promote ecologically sustainable development.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- Protect the critical habitat of those species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities through co-operative management.

1.4.4 *NSW Fisheries Management Act 1994*

The *Fisheries Management Act 1994* (FM Act) provides for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. The Act also covers the identification and management of key threatening processes which affect threatened species or could cause other species to become threatened.

If a planned development or activity is likely to have any impact on a threatened species listed under the FM Act, an Assessment of Significance must be undertaken. If the impacts are likely to be significant, or if critical habitat is affected, a species impact statement must be prepared.

2 METHODOLOGY

2.1 Desktop Research

2.1.1 Database Interrogation

Two database searches were undertaken to identify State and Commonwealth records of threatened entities and Commonwealth matters of national environmental significance (NES). Databases interrogated for this purpose were:

- The NSW Bionet Wildlife Atlas which is managed by the NSW Office of Environment and Heritage (OEH). A coordinate search using the centre point of the study area (33.95444,150.9263) was undertaken to determine threatened species records listed under the *Threatened Species Conservation Act 1995* (TSC Act) to within 10 kilometres of the study area.
- The Protected Matters Search Tool which is managed by DSEWPC. A coordinate search using the centre point of the study area (33.95444,150.9263) was undertaken to determine threatened species records listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to within 10 kilometres of the study area.
- The Department of Primary Industries Records Viewer which is managed by the NSW Department of Industry and Investment. A search of the Sydney Metropolitan Catchment Management Authority (CMA) was undertaken to determine threatened fish species records listed under the *Threatened Species Conservation Act 1995* (TSC Act) to within 10 kilometres of the study area.

2.1.2 Literature Review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the study area and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- *Soil Landscapes of the Penrith 1:100 000 Sheet* (Bannerman & Hazelton 1990).
- *Taken for Granted: The Bushland of Sydney and its Suburbs* (Benson and Howell 1990).
- *Vegetation of the Holsworthy Military Area* (French *et al.* 2000).
- *Interpretation Guidelines for the Native Vegetation of the Cumberland Plain* (NPWS 2002a).
- *Conservation significance guidelines for the Native Vegetation of the Cumberland Plain* (NPWS 2002b).
- *Biodiversity of the Georges River Catchment: Terrestrial biodiversity* (Steller and Bryant 2004).

2.1.3 Vegetation mapping

A number of large-scale vegetation mapping projects have been undertaken in the Sydney region. Those reviewed for this study are as follows:

- *The natural vegetation of the Penrith 1:100 000 map sheet* (Benson 1992).

- *Native vegetation maps of the Cumberland Plain, western Sydney* (NPWS 2002c).
- *The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities* (Tozer 2003).
- *Changes in the distribution of Cumberland Plain Woodland* (NSW Scientific Committee and Simpson 2008).
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009).

2.2 Field Survey

A terrestrial flora and fauna survey of the SIMTA site and rail corridor (study area east of the Georges River) was conducted by ecologists Jane Rodd and Laura Worthington over seven days and four nights from Monday 2 May 2011 to Wednesday 25 May 2011. The edge of the bushland immediately east of the SIMTA site was also inspected, but no detailed surveys were undertaken in this area.

A terrestrial flora and fauna survey of the riparian corridor and disturbed lands on and adjoining the Glenfield Waste Disposal site (study area west of the Georges River) was conducted by ecologists Jane Rodd and Jennifer Charlton over two days and two nights on Wednesday 30 May 2012 and Thursday 31 May 2012.

Additional targeted threatened species surveys were conducted in the rail corridor and the area to the east in the south-east of the study area by ecologists Jane Rodd and Laura Worthington on Tuesday 10, Wednesday 11 and Wednesday 18 July 2012.

Weather conditions at the time of survey ranged from mild and sunny to cold, cloudy and rainy. The weather records from the Holsworthy Range Control weather station (station 067117) for the surveyed dates are as follows (BOM 2011, 2012):

Table 2: Weather records from Holsworthy Control Range weather station for the survey dates

Date	Temperature		Rain	Maximum wind gust	
	Min	Max		Direction	Speed
	°C	°C	Mm		km/h
2 May 2011	10.1	18.9	0	W	19
3 May 2011	10.2	18.8	0.4	SSW	24
4 May 2011	10.7	21.2	0	S	30
9 May 2011	6.2	18.4	0	SSE	44
10 May 2011	7.7	17.8	0	SSW	30
11 May 2011	-0.1	15.3	0	W	50
12 May 2011	3.8	16.0	0	WSW	39
25 May 2011	10.7	15.7	0.2	S	46
30 May 2012	8.0	18.6	0.2	SE	20
31 May 2012	8.9	18.1	0	SE	19
10 July 2012	3.2	15.3	0.2	WNW	15

Date	Temperature		Rain	Maximum wind gust	
11 July 2012	6.8	20	7	NNW	31
18 July 2012	3.0	18.2	0	SW	24

2.2.1 Flora

The plant taxonomy used in this report follows the system and nomenclature presented in the most recent edition of *Flora of New South Wales* (Harden 1990-1993, 2002) and was supplemented by subsequent advice from The Royal Botanic Gardens and Domain Trust (May 2011). In this report plant species are referred to by both their scientific and common names (if applicable) when first mentioned. Subsequent references to these species cite the scientific name only.

Plant species and their habitat were surveyed by undertaking general habitat assessments, plot surveys and targeted searches. An inventory of plant species observed in the study area was compiled.

Random meander and targeted searches

The entire study area was traversed on foot and all species observed were recorded. Notes were made on the structure and condition of the vegetation in, and adjoining, the study area. Targeted searches for threatened plant species with potential habitat within the study area were undertaken during the random meanders.

Additional targeted searches for threatened plant species were conducted in the rail corridor lands and the area to the east of the rail corridor, following detection of two listed threatened species, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.* The searches were undertaken using different methodologies for each species:

- *Persoonia nutans:* the main areas of habitat, north of Anzac Creek, were intensively searched by two ecologists walking in east-west aligned transects spaced no more than two metres apart. GPS waypoints were recorded at points where the species occurred.
- *Grevillea parviflora* subsp. *parviflora:* the areas of habitat, south of Anzac Creek, were surveyed using north-south transects four metres wide, spaced 10 metres apart. GPS waypoints were recorded at points where the species occurred and the number of stems within each four metre x four metre quadrat was recorded.

Plot based survey (quadrats)

In order to comprehensively describe the structure and floristics of each sampled plant community, plot-based surveys were used. Plot-based surveys also provided a concentrated search area for the detection of inconspicuous plant species that may be present at a particular site. The structure and floristics of each plant community present in the study area were sampled using eight 400 m^2 quadrats. The quadrats were in the form of a 20 metre x 20 metre square within larger patches or 40 metre x 10 metre rectangle for linear strips of vegetation. The locations of the quadrats were determined using a stratified random sampling approach, with stratification units determined by referring to the published vegetation maps (see section 3.2.2). The quadrat locations are shown on Figure 3.

The approximate projective foliage cover of every species identified in each quadrat was estimated and recorded as a percentage. Structural data including the height and projective foliage cover of each strata were recorded, as were the total length of fallen logs and number of trees with hollows within the quadrat.

Vegetation condition assessment

During the terrestrial flora survey the vegetation condition was assessed and rated according to the degree to which it resembled relatively natural, undisturbed vegetation. The condition assessment was based on visual assessment of the current habitat condition for each of the vegetation communities within the study area. Features examined to determine condition included: native species richness, native cover in each stratum, exotic cover, litter and bare ground cover, number of trees with hollows, woody debris, regeneration, diameter at breast height, canopy recruitment and tree health. These values were recorded quantitatively in transects/plots as well as qualitatively in general traverses across the study area.

The vegetation condition data obtained for each vegetation community in quadrats was compared with the Vegetation Type Benchmarks for the identified vegetation types (DECC 2008a).

Tree survey

An assessment of trees on the SIMTA site was undertaken. Individual trees or groups of trees on the site were documented, with the species, approximate height, diameter at breast height and apparent health noted. Health was assessed by inspection of the tree canopy for dead limbs or diseased/dying leaves, signs of stress including epicormic reshooting, and evidence of bark disease or fungal infection. Tree health was assessed using the following measures:

- Good: Almost all branches living, no evidence of disease or stress.
- Moderate: Some dead branches in canopy, minor bark disease or fungal infestation.
- Poor: Numerous dead branches or limbs, significant bark disease or fungal infestation, signs of stress and/or senescence.

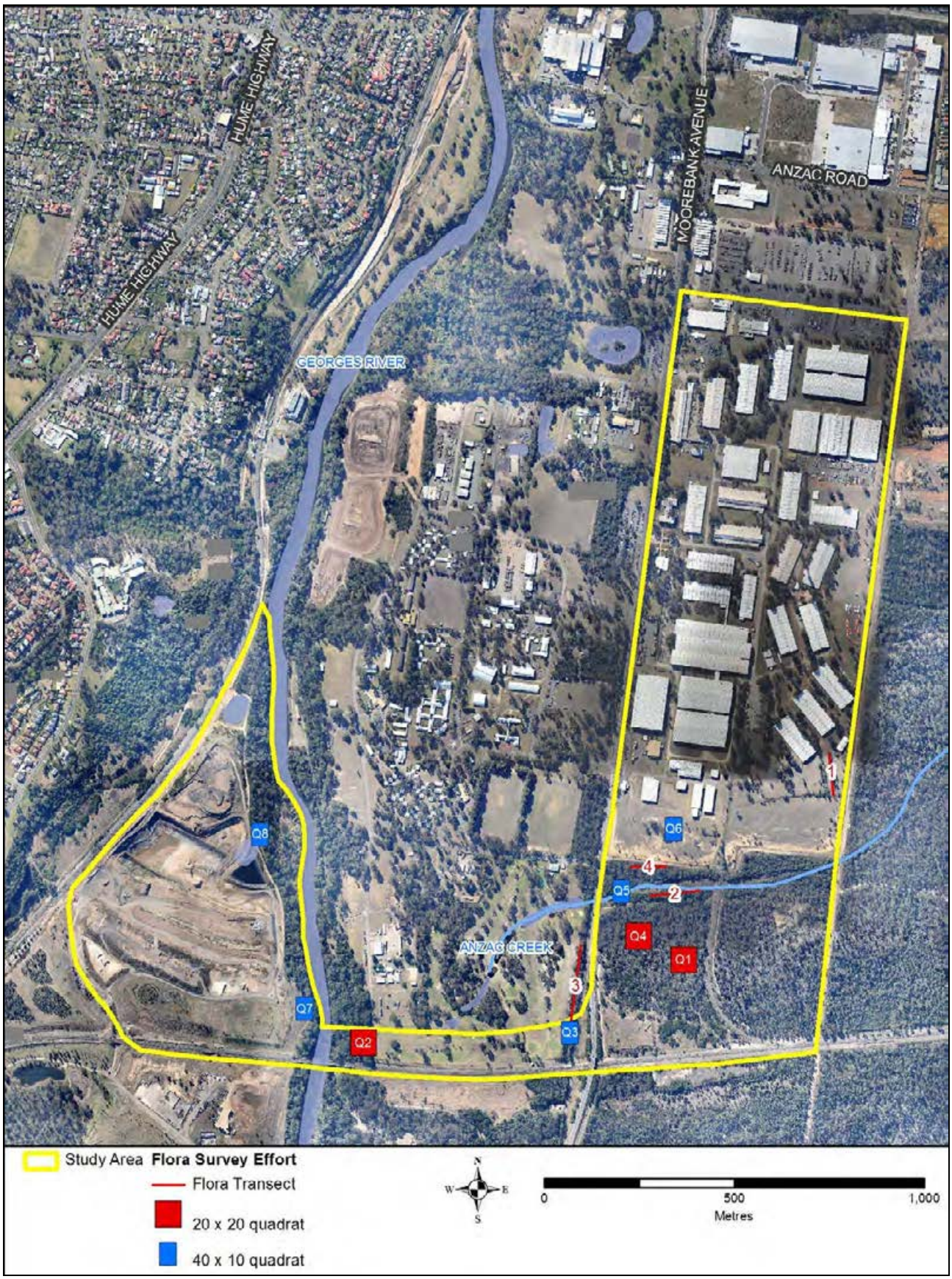

Figure 3: Locations of flora quadrats and transects

2.2.2 Terrestrial Fauna

Fauna surveys, involving diurnal and nocturnal techniques, were conducted across the study area at the following times:

- The SIMTA site and rail corridor were surveyed over five days and four nights between Monday 2 May 2011 and Thursday 12 May 2011.
- The riparian corridor and disturbed lands on and adjoining the Glenfield Waste Disposal site were surveyed over two days and two nights on Wednesday 30 May 2012 and Thursday 31 May 2012.

The entire study area was traversed on foot and all species and evidence of fauna presence observed was recorded. An inventory of fauna species recorded in the study area was compiled. Fauna survey locations are identified on Figure 4.

Diurnal Surveys

Diurnal field surveys involved:

- Direct visual observations of animal activity.
- Aural recognition of bird and frog calls.
- Raking leaf litter and turning logs, rocks and other debris.
- Inspecting tree hollows, logs and built structures, including under bridges and culverts were access was possible.
- Searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- Plot-based fauna habitat assessment. Components of fauna habitat were assessed using 20 x 20m quadrats, randomly located across the study area. Data collected included:
    - Structure and floristics of vegetation.
    - Surface drainage features.
    - Rocky features.
    - Abundance and type of tree and log hollows.
    - Foraging resources.
    - Microhabitats.

Nocturnal Surveys

Nocturnal surveys involved:

- Spotlighting from a vehicle and along foot traverses for direct visual observations of animal activity. Spotlight effort comprised of 16 person hours across four nights during the survey period.
- Call-playback for aural recognition of threatened owls and frogs at one site within the study area, on each of four nights during the survey period. Upon arrival, listening for vocalisations for 10 minutes was undertaken. Calls were played intermittently for 15 minutes, followed by another listening period of 10 minutes.
- Searching microhabitats, including turning logs and rocks and searching fringing vegetation of waterbodies.

- Stationary placement of ultrasonic bat call detection equipment (Anabats) in potential flyways. Two Anabats were placed for six nights (a total of 12 locations within the study area) during the survey periods.

2.2.3 Aquatic Fauna

Australian Laboratory Services (ALS) undertook aquatic ecological surveys on Thursday 12 May 2011 at the Georges River and Anzac Creek within the study area boundaries. Methodology for surveys is described in detail in *Assessment of the Sydney Intermodal Terminal Facility, Moorebank: Aquatic Ecology* (ALS 2011 in Appendix 1). Briefly, surveys included:

- Measurement of in-situ water quality, including temperature, pH, electrical conductivity, dissolved oxygen, turbidity and alkalinity and comparison against ANZECC (2000) guidelines.
- Collection of macroinvertebrates in accordance with the Rapid Bio-Assessment (RBA) protocols as outlined in the NSW AUSRIVAS Sampling and Processing Manual (Turak *et al.* 2004).
- Fish trapping using three millimetre mesh traps. Upon retrieval, fish were identified to species using Allen *et al.* (2002).
- Assessment of aquatic habitats adapted from First National Assessment of River Health (FNARH) methodology. Attributes collected included streambed composition, riparian vegetation cover, amount of in-stream organic material, bank height, stream width and depth.

No groundwater monitoring bores were located in the study area so no groundwater quality or invertebrates could be sampled. A visual assessment of any potential groundwater dependent ecosystems was made at both sites

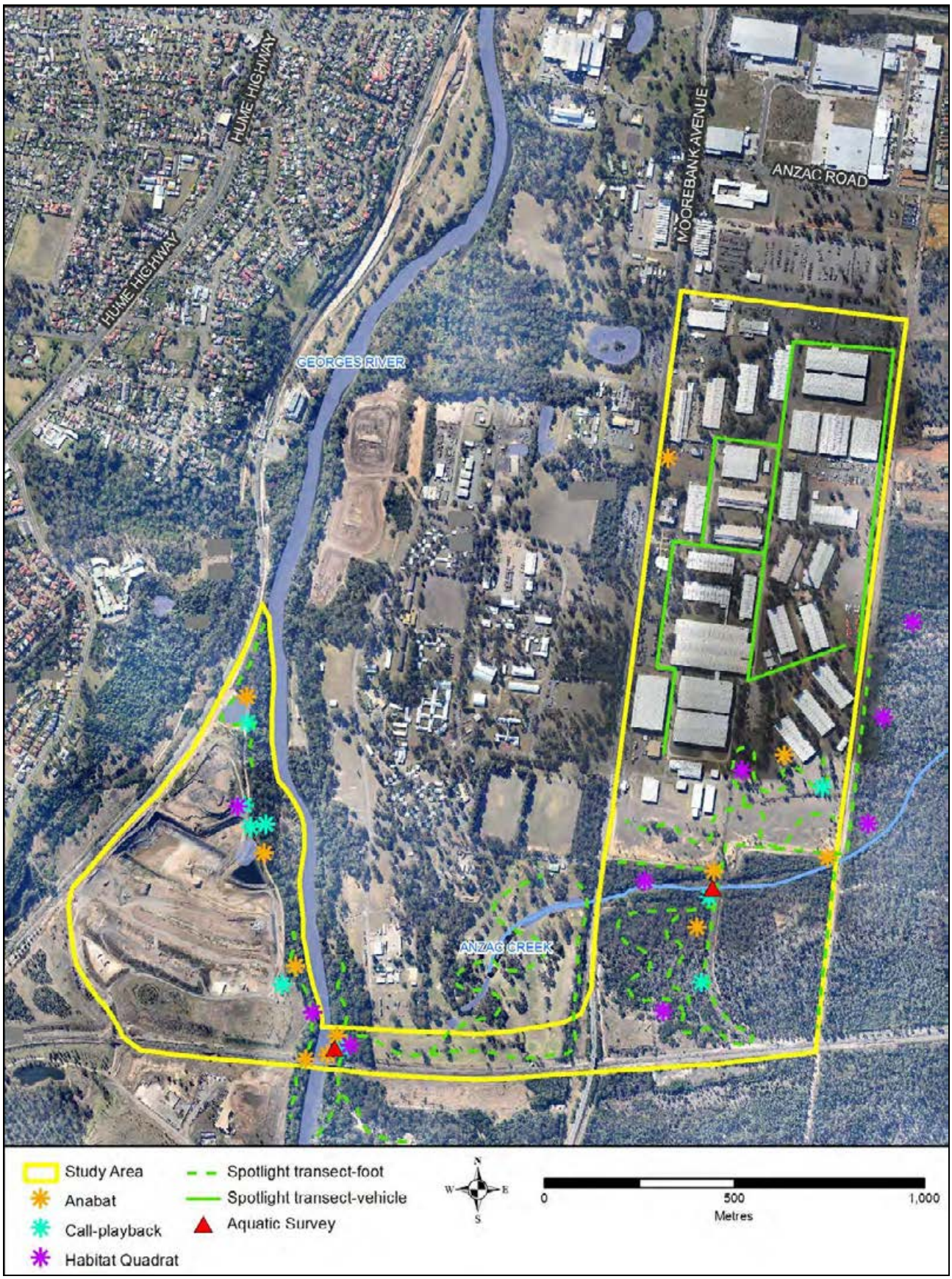

Figure 4: Fauna survey effort

2.3 Likelihood of Occurrence of Threatened Species Criteria

The database searches identified threatened flora and fauna species that have been recorded or that are likely to occur within 10 kilometres of the study area. The probability that each threatened species occurs within the study area was determined as being either Unlikely, Possible, Likely or Known, based on the criteria in Table 3.

Table 3: Likelihood of occurrence criteria for threatened species

Likelihood of occurrence	Criteria - one or more of the following conditions applies
Unlikely	The species has not been recorded previously in the study area or nearby, and is beyond the current known geographic range. The species has specific habitat requirements that are not present in the study area. The species is considered extinct.
Possible	The species has historically been recorded in the study area (>20 years ago) The species has specific habitat requirements that are present in the study area, but in a poor or modified condition. The species is unlikely to maintain a resident population in the study area, however may occasionally utilise resources within the study area.
Likely	The species has recently been recorded in the study area (i.e. within last 20 years). The species has specific habitat requirements that are present in the study area and are in good condition. The species is known or likely to maintain resident populations in proximity to the study area. The species is known or likely to regularly utilise resources in the study area.
Known	The species was recorded in the study area during the current survey.

2.4 Limitations

The flora and fauna surveys for this assessment were carried out over nine days and six nights in late autumn 2011 and 2012. This assessment is based on the condition of the study area at the time of field investigation and the information provided by SIMTA on the nature of the SIMTA proposal at the date of publication of this document.

The seasonal timing of the field investigation means that the full spectrum of flora and fauna species likely to occur on the study area may not be fully quantified or described in this report. Some plant species that occur in the local area, such as cryptic species, are annuals and are present only in the seed bank for much of the year. Other plant species are perennial but are inconspicuous or difficult to identify unless flowering.

Similarly, some fauna species that have been recorded in the local area occur on a seasonal or migratory basis, and may be absent from the locality for much for the year. Fauna behaviours may have also affected detectability; species that are easily disturbed or cryptic may not have been detected during surveys. It is possible that a number of flora and fauna species occurring in the study area were not detected during the current survey due to the above factors.

The planned survey methods for aquatic ecology included electrofishing using a backpack electrofisher, seine nets, and bait traps. However, both the Georges River and Anzac Creek presented logistical difficulties that prevented the use of the electrofisher and the seine net. Georges River was too deep for effective electrofishing, and contained too many submerged logs for effective seine netting. The lack of open water at Anzac Creek made electrofishing and seine netting impossible. To compensate for this, additional bait traps were deployed at each site.

These potential limitations have been addressed by a thorough literature research and review and through identification of potential habitats for flora and fauna species and assessment of the potential for targeted species to occur on the site based on:

- Previous records.
- The type and condition of habitats present
- The land use throughout the study area and surrounds.
- The landscape context.

The precautionary principle was applied where marginal habitat was identified or predicted to occur or where species are migratory or nomadic and were therefore likely to utilise habitat components at some stage during their life cycle.

3 RESULTS

3.1 Environmental Context

3.1.1 Geology and Soils

The geology of the Penrith 1:100 000 sheet was mapped by Clark and Jones (1991). The study area east of the Georges River was mapped as Tertiary alluvium (map unit Ta), described as clayey quartzose sand and clay. The study area to the west of the Georges River was mapped as mainly Quaternary deposits of medium-grained sand, clay and silt (map unit Qpn), with some Tertiary alluvium in the centre.

The soil landscapes of the Penrith 1:100 000 sheet were mapped by Bannerman and Hazelton (1990). There are four different soil landscapes mapped within the study area: the fluvial soil landscapes Berkshire Park, Richmond and Freemans Reach, and the erosional soil landscape Luddenham.

The features and location in the study area of the mapped soil landscapes are detailed in Table 4.

Table 4: Soil landscapes mapped in the study area by Bannerman and Hazelton (1990)

Soil Landscape	Features (Bannerman and Hazelton 1990)	Location in study area
Berkshire Park (Fluvial)	Orange heavy clays and clayey sands, often mottled; ironstone nodules common. On dissected, gently undulating rises on the Tertiary terraces of the Hawkesbury/Nepean river system.	SIMTA site and rail corridor lands east of Georges River.
Richmond (Fluvial)	Poorly structured orange to red clay loams, clays and sands; ironstone nodules may be present. Landscape is Quaternary terraces of the Nepean and Georges Rivers, mainly flat.	100m wide strip adjoining western bank of Georges River.
Freemans Reach (Fluvial)	Deep brown sands and loams, apedal to moderately structured, usually friable. Landscape: present active floodplain of the Nepean River; level with minor relief to meander scrolls, levees and back swamps.	Small area in south-eastern corner of the study area west of the Georges River.
Luddenham (Erosional)	Shallow dark podzolic soils or massive earthy clays on crests; moderately deep red podzolic soils on upper slopes; moderately deep yellow podzolic soils and prairie soils on lower slopes and drainage lines. Landscape is undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury Sandstone.	Across most of study area west of Georges River.

The soils of the SIMTA site consist of a mixture of residual soils and filled materials, with undisturbed areas retaining some residual topsoil. The residual soil material generally consists of stiff to very stiff clayey soils to rock, with areas of dense silty and clayey sands to depths of approximately 3 m, possibly associated with an old stream bed, also encountered through the central area. Much of the SIMTA site has already been subject to filling operations. Where filling

is already present, it is generally up to 1 m in depth, but reaches a depth of up to 2.5 m in some locations (Hyder Consulting 2011).

3.1.2 Hydrology

The study area is located within the Georges River catchment, covering approximately 960 square kilometres and managed by the Sydney Metropolitan Catchment Management Authority. Georges River flows north where it transects the study area. The river is freshwater here, until it flows over the Liverpool Weir approximately 3.5 kilometres to the north. The weir, constructed in 1836, defines the upper reach of the Georges River estuary; below the weir the Georges River is influenced by tidal flows. The Georges River meanders south-east from Chipping Norton before draining into Botany Bay.

Anzac Creek originates from the Royal Engineers Golf Course and extends north-east across the study area just south of the SIMTA site. The creek flows north past the adjoining suburbs of Wattle Grove and Moorebank before draining into Lake Moore in Chipping Norton, which flows into the Georges River.

In addition to these named watercourses, formalised drainage channels are located in the south-east of the SIMTA site. At the time of survey, some of these channels contained water, predominantly where *Typha sp*. was present. Other channels support only ephemeral flow. Other hydrological features of the study area are restricted to constructed artificial wetlands in the Royal Australian Engineers Golf Course.

3.1.3 Land use

The history of land use in the study area, with a focus on changes in vegetation patterns, was assessed through interpretation of historical aerial photographs as presented in Arup (2008) and AHMS (2010) with additional photographs obtained from NSW Land and Property Information (Table 5).

Land use in the locality is currently characterised by industrial development to the north, including Greenhills Industrial Estate, Moorebank Distribution Centre and Moorebank Business Park. Residential areas to the east, south-west and west include the suburbs of Wattle Grove, Macquarie Fields, Glenfield and Casula. Public open space within the locality includes Kelso Park, Chipping Norton Lakes, Leacock Regional Park and numerous smaller parks and reserves bordering the Georges River.

Table 5: Historical aerial photograph review

Photograph	Date and source	SIMTA site	Rail Corridor
	10 February 1930 NSW Land and Property Information	The SIMTA site is relatively undisturbed and appears to support a mosaic of low vegetation types, possibly including woodland and dense heathy shrubland, with some clearing in the east and numerous tracks intersecting the SIMTA site and lands to the east and south. There appears to be a small drainage depression in the south of the SIMTA site, running from west to east parallel to Anzac Creek.	There appears to be standing water in the centre of the Anzac Creek, which is fringed by strips of vegetation that look different from that to the north and south of the creek. In the west of the rail corridor lands there are larger cleared areas with scattered trees and some narrow strips of forest persisting at the edges of the Georges River; Glenfield Waste Disposal site is mainly cleared and supports paddocks and orchards.
	May 1951 NSW Land and Property Information	The SIMTA site has been developed, with most of the existing buildings visible and rows of planted trees identifiable as very small crowns. There appears to be some natural vegetation remaining on the site, to the south of the buildings. A channel is being constructed along the small drainage line in the south of the SIMTA site.	There is a large cleared area with exposed soil adjoining the southern edge of the SIMTA site; there are a few small tree crowns visible in the west of this area. A wide track has been cleared to the south of Anzac Creek and there appears to be some disturbance immediately north of the track.

Photograph	Date and source	SIMTA site	Rail Corridor
	1961 NSW Land and Property Information	Almost all the natural vegetation appears to have been cleared from the SIMTA site by the time of the 1961 aerial photograph; there are some scattered tree crowns visible immediately to the south of the SIMTA site and the rows of planted trees amongst the buildings are becoming more established with larger crowns visible. The channels in the south of the site have been fully constructed and cleared of all vegetation.	The track to the south of Anzac Creek appears more formal and there is a circular clearing at the eastern end of the track. There appears to be some disturbance in the bushland to the north of Anzac Creek, however, there has been no significant canopy removal.
	1979 AHMS (2010)	-	There appears to be less obvious disturbance in the vicinity of Anzac Creek, however, there has been significant clearing for the golf course, with natural vegetation in this area reduced to the current pattern of a thin strip of bushland adjoining the eastern boundary and a wider band of riparian vegetation next to the Georges River. Sand/gravel extraction has commenced on the Waste Disposal site west of the Georges River and there are still orchards in the south of this area.

Photograph	Date and source	SIMTA site	Rail Corridor
	1984 AHMS (2010)	-	There was significant clearing prior to the 1984 aerial photograph for the construction of the East Hills railway line, and there is evidence of extensive clearing of the bushland south of Anzac Creek. By this time the rail spur extending south from the SIMTA site has been cleared and the East Hills rail line is being constructed along the southern boundary of the study area, crossing the Georges River. By 1994 this rail line has been completed.
	1978, 1994 and current Arup (2008)	The vegetation pattern does not change much following 1961, with tree crowns increasing in size as trees mature over the next few decades. Between 1994 and 2007 there appears to be an increase in growth of trees and shrubs in the south of the site, particularly along the constructed drainage channels and adjoining areas to the south and west.	-

3.2 Flora

3.2.1 Literature Review

The natural vegetation of the Sydney region is described in Benson and Howell (1990). The vegetation of the Moorebank area is described as follows (p82):

> *At Moorebank and Holsworthy, reasonably extensive deposits of Tertiary gravels and sands overlie the sandstone. These areas have woodland and low woodland similar to the Castlereagh Woodlands with Scribbly Gum,* Eucalyptus sclerophylla, *and Narrow-leaved Apple,* Angophora bakeri, *and a rich understorey of shrubby species. There are also patches of wet heath with* Banksia oblongifolia *and* Xanthorrhoea minor.

French *et al.* (2000) surveyed and mapped the vegetation of the Holsworthy Military Area, comprising approximately 18 000 hectares of continuous native vegetation, much of which have remained largely undisturbed as a result of restricted access to the Military Area. The Military Area occurs across the boundary between sandstone, shale and Tertiary alluvium geologies. Eight different vegetation communities were identified and described: four on infertile sandstones and four on more fertile shales and alluviums.

It was stated that there were considerable areas of Tertiary alluvium with *Melaleuca decora* and Ironbark forests to the north of the Holsworthy Military Area, which had been interpreted in other studies as Castlereagh Scribbly Gum Woodland with some areas of Grey-box Ironbark Forest. This area is likely to include part of the study area.

The Holsworthy Military Area was considered to be of high conservation significance as it contains relatively undisturbed, continuous vegetation and includes several endangered ecological communities.

The terrestrial biodiversity of the Georges River catchment was assessed by Steller and Bryant (2004). The biodiversity assessment was based on survey works completed in 1999 to 2000.

The study consisted of five major components:

- Mapping of remnant patches of vegetation on the Cumberland Plain using aerial photograph interpretation (API) techniques and selective site-based assessment.
- Predictive modelling of the pre-1750 distribution of vegetation communities.
- An assessment of the fauna and floristics of specified sites.
- Studies of the locations of selected species of flora and fauna.
- Habitat modelling for selected species for which sufficient information was gathered.

A total of 22 vegetation communities were identified as occurring on or adjoining the Cumberland Plain within the Georges River catchment, based on cluster analysis of 523 sample sites. The study area appears, based on the large scale map of extant vegetation that forms Figure 4 of Steller and Bryant (2004), to be mapped as the following communities:

- Castlereagh Scribbly Gum Woodland as patches on the SIMTA site, across most of the rail corridor lands to the south of the SIMTA site and adjoining the eastern bank of the Georges River.
- Castlereagh Swamp Woodland along Anzac Creek.
- Castlereagh Ironbark Forest adjoining western side of Moorebank Avenue.
- Riparian Forest adjoining the Georges River.

Seven species of flora known or likely to occur in the catchment, and either threatened by land use changes or identified as rare, were selected to represent the threatened flora of the Georges River and to provide surrogates for species diversity. The seven species were *Pimelea spicata, Persoonia nutans, Pultenaea parviflora, Pterostylis saxicola, Pterostylis gibbosa, Cynanchum elegans* and *Gyrostemon thesioides.* Predictive habitat models were developed for six of the species with a view to improved habitat identification and management. Predicted habitat for only one of the six threatened species, *Persoonia nutans,* was mapped within the study area (Steller and Bryant 2004).

The Cumberland Plain Recovery Plan has been prepared by DECCW (2011). The recovery plan focuses on threatened ecological communities, populations and species that are endemic to or primarily distributed on the Cumberland Plain, and specifically addresses six threatened flora species, one threatened fauna species, four threatened populations and nine threatened ecological communities.

The approach of the recovery plan is to focus recovery efforts on the lands which represent the best remaining opportunities to secure viable, long-term conservation outcomes for the lowest cost. These Priority Conservation Lands (PCLs) were identified using a methodology based on considerations of size, shape, condition, landscape context and presence of threatened biota, with targets for inclusion of ecological communities applied. The PCLs cover approximately 25,566 hectares.

The native vegetation within the rail corridor lands to the south of the study area, an area of approximately nine hectares, has been mapped as part of the Priority Conservation Lands, as the north-western extent of a 2,314 hectare area extending across the Holsworthy Military Area.

Parsons Brinckerhoff (PB) (2011) prepared a report on the existing ecological values of the proposed Moorebank Intermodal Freight Terminal site, which is proposed to be developed by the Moorebank Intermodal Terminal Company Ltd (MICL site), comprising the Moorebank and Steele Barracks, which lies immediately to the west of the SIMTA site across Moorebank Avenue. Part of the MICL site, within approximately 100 m of the southern boundary and along the southern section of the eastern boundary adjoining Moorebank Avenue, also falls within the rail corridor portion of the current study area.

The purpose of the Parsons Brinckerhoff (2011) assessment is to provide preliminary assessment of the potential impacts of the proposed MICL intermodal terminal project on flora, fauna and ecological values of the MICL site, which will be assessed further during subsequent broader environmental assessment.

Four vegetation communities were verified by field investigations: Riparian Forest, Alluvial Woodland, Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland. All four communities are equivalent to threatened ecological communities listed under the TSC Act.

Two threatened plant species listed under the EPBC and TSC Acts were recorded on the MICL site: the Endangered species *Persoonia nutans* (Nodding Geebung) and the Vulnerable species *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea). The precise locations of the threatened plant species populations on the site are not specified or mapped, but stated to be located in Castlereagh Scribbly Gum patches parallel with Moorebank Avenue in the east of the site. Potential habitat for both species was mapped along the southern half of the eastern boundary of the MICL site, and included some of the vegetation within the rail corridor lands.

The size of the population of each species on the MICL site is not given in the results section, however in the impact significance assessments in the report it is stated that the proposed action would result in the loss of at least 16 individuals of *Grevillea parviflora* subsp. *parviflora* with many suckers; and at least 10 individuals of *Persoonia nutans*. It was estimated that there

was approximately 6.5 hectares of potential habitat for both threatened plant species on the MICL site.

An additional eight threatened flora species were considered to have a moderate likelihood of occurrence on the MICL site, due to the presence of suitable habitat and historical records from the locality. Targeted searches of potential habitat areas did not detect these species.

As the design of the MICL intermodal terminal project was not yet finalised at the time of the report, only preliminary impact assessments could be undertaken for the Endangered species *Persoonia nutans* and the Vulnerable species *Grevillea parviflora* subsp. *parviflora* using the Commonwealth EPBC Significant Impact Criteria (DEWHA 2009). The preliminary significance assessment for both *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans* concluded that potential impact from the project on the species was not considered significant with regard to its context and intensity.

3.2.2 Vegetation Mapping

Benson (1992) mapped the vegetation of the Penrith 1:100 000 map sheet. The SIMTA site was mapped as "Cleared", the associated lands were mapped as "map unit 14a: Castlereagh Scribbly Gum Woodland" and the strip of vegetation adjoining the Georges River was mapped as "map unit 9b: River-flat Forest".

NPWS (2002)/Tozer (2003) mapped the native vegetation of the Cumberland Plain at a 1:16 000 scale, based on aerial photograph interpretation, mapped geological boundaries and field sampling. A total of 22 plant communities were defined using a multi-variate analysis of quantitative field survey data. Each community was described using structural features, habitat characteristics and diagnostic species.

Five different plant communities were mapped in the study area (Figure 5); all correspond with threatened ecological communities (TECs) listed under the TSC Act. The mapped TECs and their threatened status are listed in Table 6.

Table 6: Vegetation communities mapped by NPWS (2002)/Tozer (2003) and corresponding TECs

Vegetation map unit (NPWS 2002/Tozer 2003)	Corresponding TEC	EPBC Act Status	TSC Act Status
Cooks River Castlereagh Ironbark Forest	Cooks River Castlereagh Ironbark Forest in the Sydney Basin bioregion	Not listed	Endangered
Castlereagh Swamp Woodland	Castlereagh Swamp Woodland	Not listed	Endangered
Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Not listed	Vulnerable
Alluvial Woodland	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listedNot listed	Endangered Endangered

Vegetation map unit (NPWS 2002/Tozer 2003)	Corresponding TEC	EPBC Act Status	TSC Act Status
Riparian Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Shale/Gravel Transition Forest	Shale/Gravel Transition Forest in the Sydney Basin bioregion	Endangered	Endangered

The conservation significance assessment by NPWS (2002b) mapped the vegetation in the study area as follows (Figure 6):

- Core habitat: two patches of Cooks River Castlereagh Ironbark Forest in the north-west and west of the SIMTA site, the large patch of Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland to the south of the SIMTA site in rail corridor lands, the strip of Cooks River Castlereagh Ironbark Forest adjoining the eastern edge of the golf course, and the patches of Riparian Forest adjoining the Georges River.
- Support to core habitat: Alluvial Woodland and Riparian Forest adjoining the north-eastern edge of the waste disposal site and extending on to the northern tip of this site.
- Other remnant vegetation: the small patch of Shale Plains Woodland that falls partially within the south-western corner of the study area.
- Urban remnant trees (critically endangered community): two patches of Cooks River Castlereagh Ironbark Forest in the east of the SIMTA site.

DECCW (2009) mapped the vegetation of the Sydney Metropolitan Catchment Management Authority (CMA) Area. The Sydney CMA area encompasses the eastern portions of the Sydney Metropolis, extending from the coastline to the catchments that flow to the Parramatta, Georges and Hacking River.

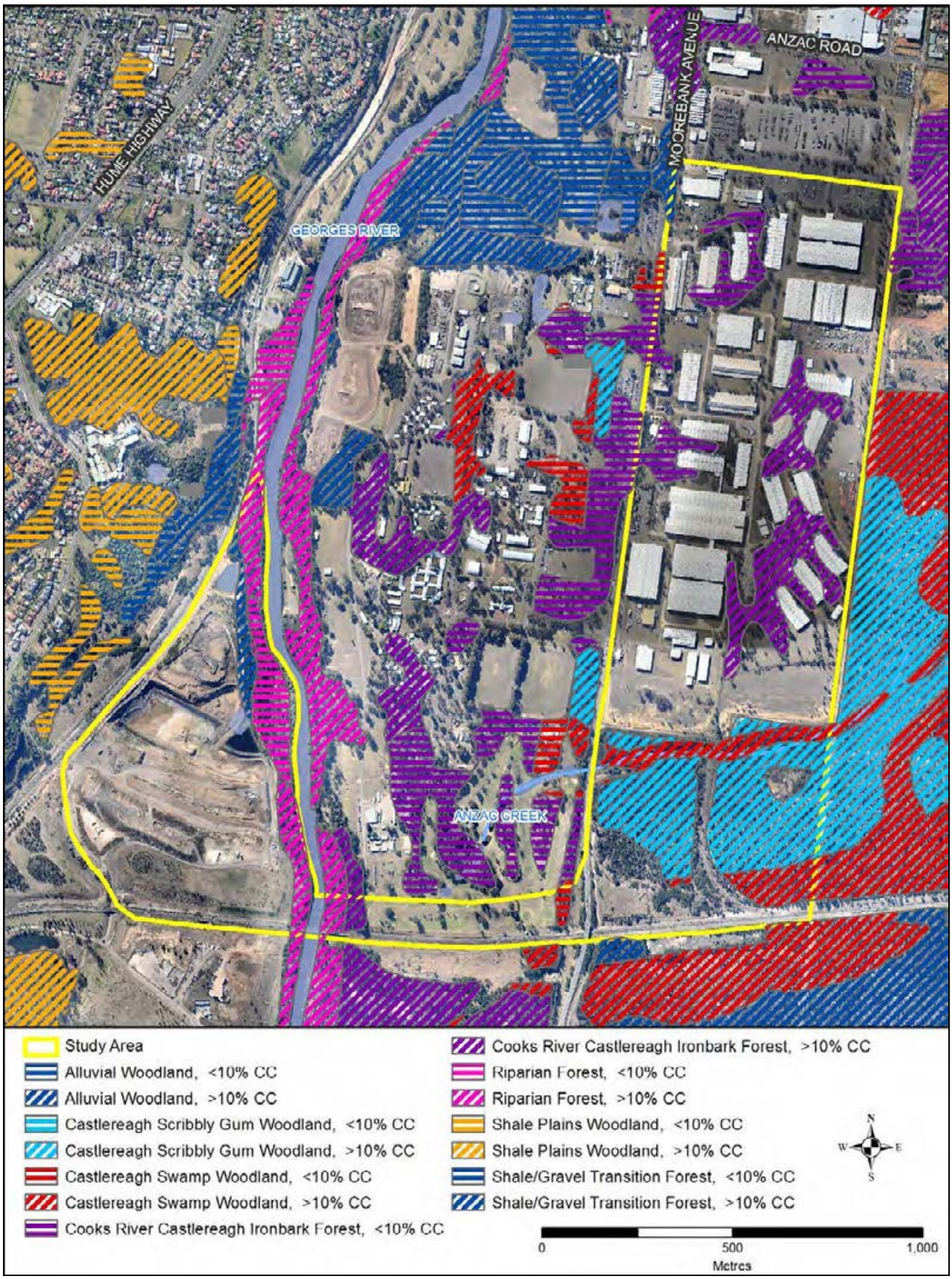

Figure 5: NPWS (2002)/Tozer (2003) vegetation mapping of the study area

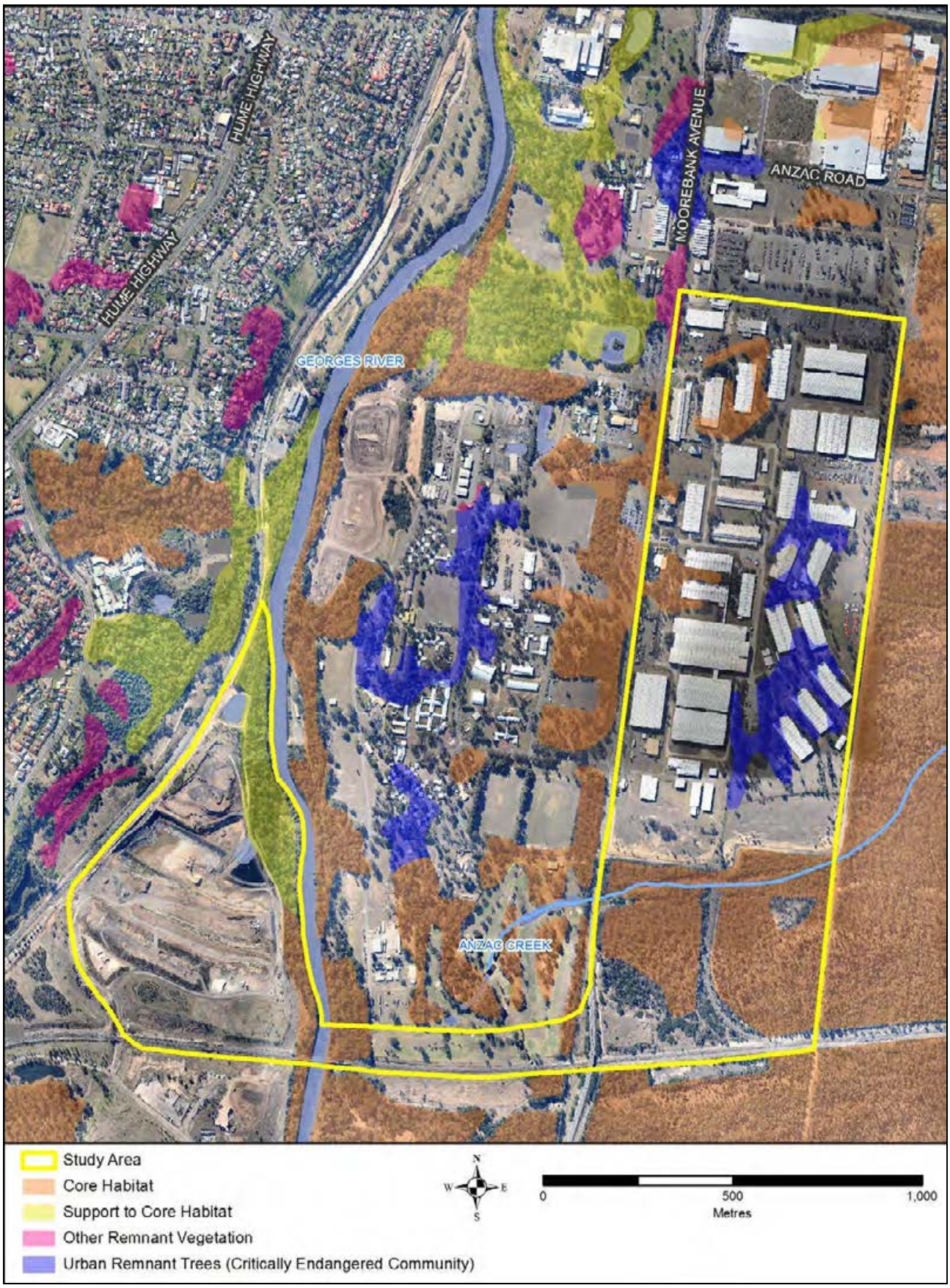

Figure 6: NPWS (2002) conservation significance mapping of the study area

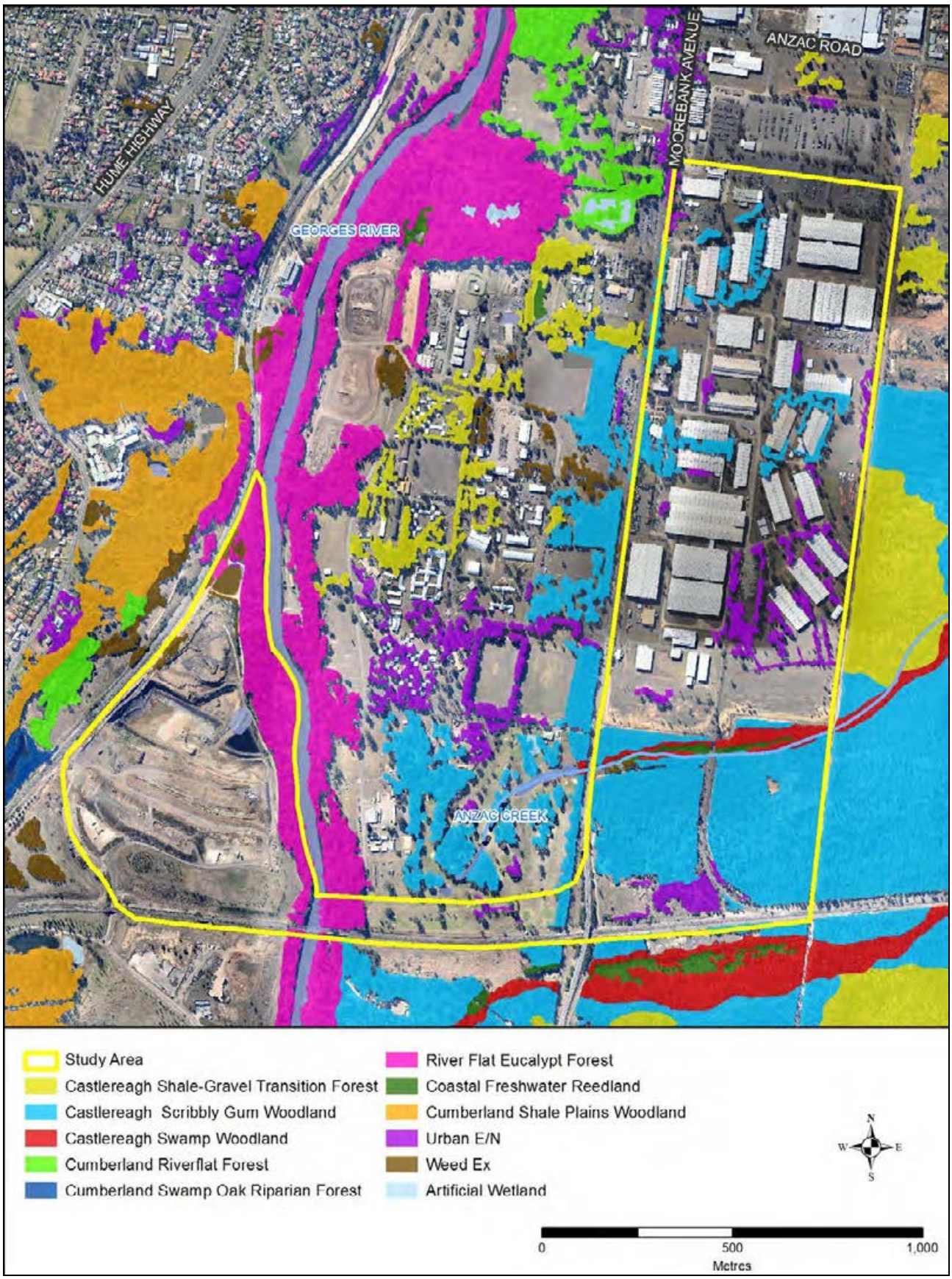

Figure 7: DECCW (2009) vegetation mapping of the study area

Four different native vegetation communities were mapped within the study area (Figure 7); all correspond with threatened ecological communities under the TSC Act (Table 7).

Table 7: Vegetation communities mapped by DECCW (2009) and corresponding TECs

Vegetation map unit (DECCW 2009)	Corresponding TEC	EPBC Act Status	TSC Act Status
Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Not listed	Vulnerable
Castlereagh Swamp Woodland	Castlereagh Swamp Woodland	Not listed	Endangered
Coastal Freshwater Reedland	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Hinterland Flats Eucalypt Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered

In addition to the described vegetation communities were two map units, “Urban_E/N” and “Weed_Ex” that were not described in the report accompanying the map, but are assumed to refer to degraded urban vegetation fragments and vegetation dominated by weeds and exotic species.

The vegetation mapping of NPWS (2002)/Tozer (2003) and DECCW (2009) in the study area was compared (Table 8).

Table 8: Comparison of vegetation mapping in the study area

Vegetation community	Area of vegetation community mapped within study area (hectares)			
	NPWS 2002/ Tozer (2003)		DECCW (2009)	
	>10% Canopy cover	<10% Canopy cover	Low to moderate disturbance	High to very high disturbance/ not assessed
Alluvial Woodland	1.52	0.02		
Castlereagh Ironbark Forest	8.87	4.45		
Castlereagh Swamp Woodland	5.07	0.50	1.32	0.55
Castlereagh Scribbly Gum Woodland	14.98		18.87	7.29
Riparian Woodland/Hinterland Flats Eucalypt Forest	4.18	2.92		8.81
Shale/Gravel Transition Forest	0.25			

Vegetation community	Area of vegetation community mapped within study area (hectares)			
	NPWS 2002/ Tozer (2003)		DECCW (2009)	
	>10% Canopy cover	<10% Canopy cover	Low to moderate disturbance	High to very high disturbance/ not assessed
Coastal Freshwater Reedland				0.66
Urban/Exotic vegetation				7.28
Total vegetation mapped	34.86	7.88	20.19	24.6

The mapping by NPWS (2002)/Tozer (2003) and DECCW (2009) is similar, with the major difference being the classification of patches on the SIMTA site as Cooks River Castlereagh Ironbark Forest by NPWS (2002)/Tozer (2003) whereas DECCW (2009) classifies these areas as “Urban E_N” and Castlereagh Scribbly Gum Woodland.

3.2.3 Database Searches

Based on database and literature review, 38 plant species listed under the EPBC and/or TSC Acts are either known or have the potential to occur within 10 kilometres of the study area (Table 9). TSC Act records occurring within 10 kilometres of the study area are shown in Figure 8.

Table 9: Threatened flora occurring within 10 kilometres of the study area

Scientific name	Common name	EPBC Act status	TSC Act status
Acacia pubescens	Downy Wattle	Vulnerable	Vulnerable
Allocasuarina glareicola	-	Endangered	Endangered
Asterolasia elegans	-	Endangered	Endangered
Caesia parviflora var. *minor*	Small Pale Grass-lily		Endangered
Caladenia tessellata	Thick Lip Spider Orchid	Vulnerable	Endangered
Callistemon linearifolius	Netted Bottle Brush		Vulnerable
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered
Deyeuxia appressa	-	Endangered	Endangered
Dillwynia tenuifolia	-	Vulnerable	Vulnerable
Epacris purpurascens var. *purpurascens*	-		Vulnerable
Eucalyptus camfieldii	Camfield’s Stringybark	Vulnerable	Vulnerable
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Vulnerable
Eucalyptus scoparia	Wallangarra White Gum	Vulnerable	Endangered

Scientific name	Common name	EPBC Act status	TSC Act status
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	Vulnerable	Vulnerable
Gyrostemon thesioides	-		Endangered
Hibbertia sp. “Bankstown”	-	Critically Endangered	Critically Endangered
Hibbertia sp. nov. ‘Menai’	-		Endangered
Leucopogon exolasius	Woronora Beard-heath	Vulnerable	Vulnerable
Leucopogon fletcheri subsp. *fletcheri*	-		Endangered
Marsdenia viridiflora subsp. *viridiflora*	-		Endangered population
Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Vulnerable
Melaleuca deanei	Deane's Melaleuca	Vulnerable	Vulnerable
Pelargonium sp. Striatellum	Omeo Stork’s-bill	Endangered	Endangered
Persoonia hirsuta	Hairy Geebung	Endangered	Endangered
Persoonia nutans	Nodding Geebung	Endangered	Endangered
Pimelea curviflora var. curviflora	-	Vulnerable	Vulnerable
Pimelea spicata	Spiked Rice-flower	Endangered	Endangered
Pomaderris brunnea	Rufous Pomaderris	Vulnerable	Vulnerable
Pomaderris prunifolia	Plum-leaf Pomaderris		Endangered Population
Pterostylis gibbosa	Illawarra Greenhood	Endangered	Endangered
Pterostylis nigricans	Dark Greenhood		Vulnerable
Pterostylis saxicola	Sydney Plains Greenhood	Endangered	Endangered
Pultenaea parviflora	Sydney Bush-pea	Vulnerable	Endangered
Pultenaea pedunculata	Matted Bush-pea		Endangered
Streblus pendulinus	Siah’s Backbone	Endnagered	
Thelymitra sp. Kangaloon (D.L.Jones 18108)	Kangaloon Sun-orchid	Critically Endangered	
Wilsonia backhousei	Narrow-leafed Wilsonia		Vulnerable

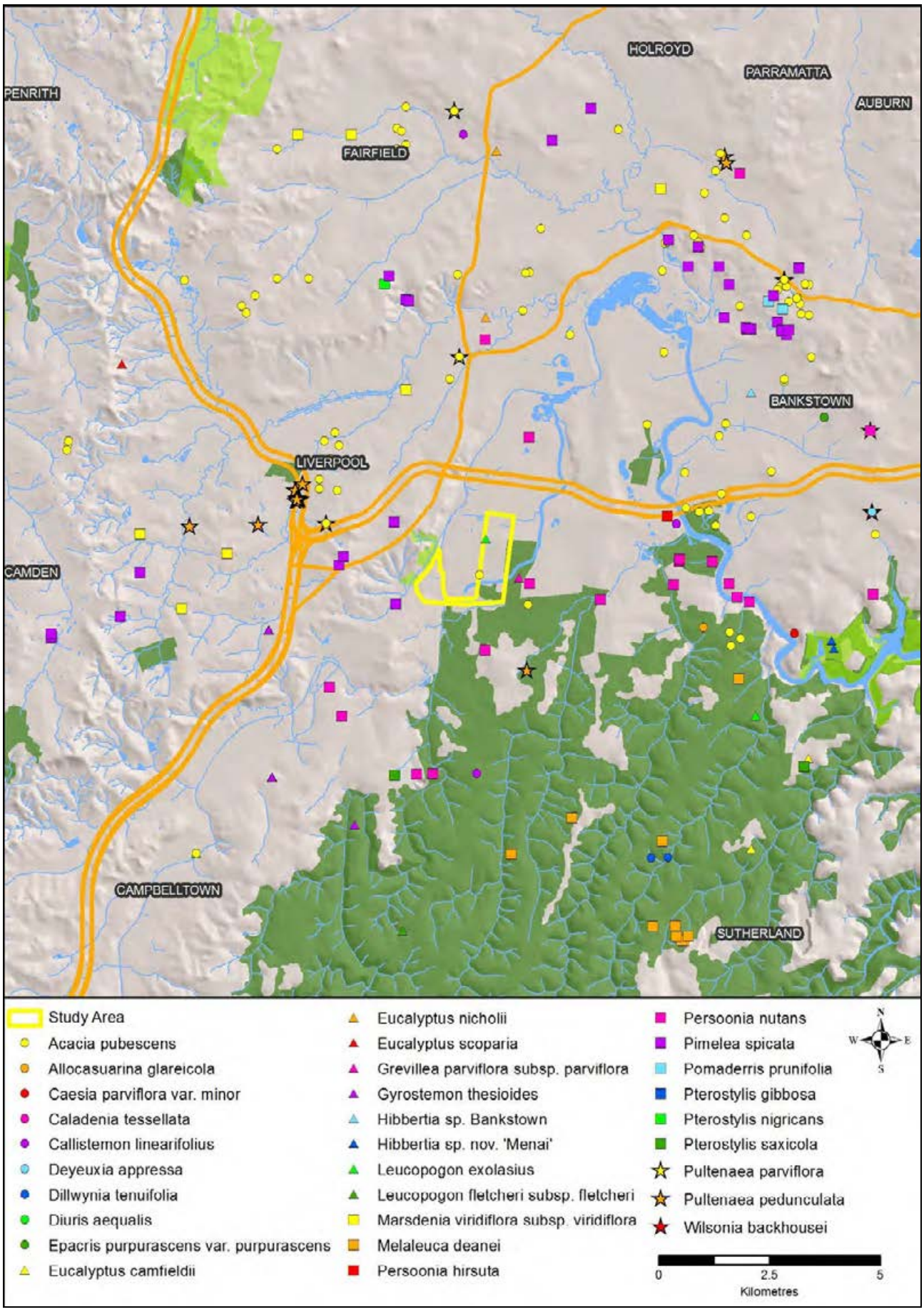

Figure 8: Threatened flora species records within 10 kilometres of the study area

3.2.4 Field Survey

A total of 310 vascular plant species were recorded in the study area, comprising 213 local native species, eight non-local native species (mainly planted trees) and 89 exotic species. A list of plant species recorded in the study area is provided in Appendix 2.

3.2.4.1 Vegetation observations

SIMTA Site

The SIMTA site is currently used for the Defence National Storage and Distribution Centre (DNSDC). The site contains numerous large warehouse buildings and is covered by a network of roads, carparks and other hardstand areas. The site was developed between 1939 and 1945 and trees were probably planted at or shortly after this time, as there are distinct rows of tree crowns visible on the 1955 aerial photograph.

There are currently mature and mainly healthy trees lining the roads and paved areas (Plate 1, Plate 2). Planted tree species are typical of cultivated eucalypts that are commonly found as mature street trees in suburban Sydney, with *Eucalyptus microcorys* (Tallowwood), *E. saligna* (Sydney Blue Gum), *Corymbia maculata* (Spotted Gum) and *C. citriodora* (Lemon-scented Gum) frequently recorded. The results of the tree survey are provided in greater detail in Section 3.2.4.2.

Plate 1. Mature trees of *Eucalyptus saligna* and *Corymbia maculata* on SIMTA site

Plate 2. Mature trees of Eucalyptus microcorys on SIMTA site

The ground layer in the non-paved areas of the SIMTA site consisted of mown grass lawns, dominated by *Cynodon dactylon* (Couch), *Pennisetum clandestinum* (Kikuyu) and other exotic grass species; there was a native grass component persisting in some locations, with native grasses observed including *Paspalidium distans, Austrodanthonia* sp. (Wallaby Grass) and *Eragrostis leptostachya* (Paddock Lovegrass) as well as some small native herbs.

In the south of the SIMTA site is a network of drainage channels with some tree plantings and some apparent tree and shrub regeneration. The channels supported a mixture of native, non-local native and exotic trees and shrubs including *Eucalyptus saligna, E. tereticornis* (Forest Red Gum), *Corymbia maculata, Melaleuca quinquenervia* (Broad-leaved Paperbark), *Casuarina glauca* (Swamp Oak) and *Eucalyptus parramattensis* (Parramatta Red Gum).

There was one area adjoining the disused rail line in the south-east of the SIMTA site that supported native understorey (Plate 3, Plate 4); it is possible that this area has been subject to management as there were mesh tree guards around the bases of two trees. This area supported mature trees of *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) and numerous shrubs of *Acacia* spp., *Allocasuarina littoralis* (Black She-oak), *Hakea salicifolia* (Willow Hakea) and *Melaleuca nodosa* (Ball Honey-myrtle). The ground layer was characterised by native

grasses including *Aristida ramosa* (Wiregrass), *Entolasia stricta* (Wiry Panic), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass) and there were a number of small groundlayer herb and shrub species including *Astroloma humifusum* (Cranberry Heath), *Laxmannia gracilis* (Slender Wire Lily), *Pimelea linifolia* (Slender Rice Flower) and *Lomandra* spp. Exotic cover was low, with *Eragrostis curvula* (African Lovegrass) dominating in patches.

Plate 3. Native regrowth near rail line in SIMTA site

Plate 4. Native regrowth near rail line in SIMTA site

Scattered trees to south of SIMTA site

Immediately to the south of the SIMTA site is a large area of mown grassland with waterlogged soils in patches. There are scattered large trees of *Eucalyptus sclerophylla* to 16 metre in height as well as some *E. parramattensis* in this area, most with native shrubs and groundcover species growing around the bases (Plate 5, Plate 6). These trees are visible on the 1951 aerial photograph where they appear to be much smaller; the surrounding area in the south was cleared and filled between 1930 and 1951 and appears as mostly bare soil on aerial photographs from 1961 to 1994 (Table 5). This area presently supports patchy grassland and boggy, waterlogged soils.

The largest patch of native understorey was sampled in Quadrat 6. It is not clear whether this area has been planted or managed as a landscape area; there were a few cut logs around 1 metre in length placed around the edges of the patch, and it has not been mown or slashed recently, whereas surrounding areas have. The shrub and groundcover species are all local natives that also occur in the bushland to the south, including *Kunzea ambigua* (Tick-bush), *Astroloma humifusum, Aristida ramosa* and *Microlaena stipoides* (Weeping Grass). The endangered species *Persoonia nutans* (Nodding Geebung) was recorded in the shrub layer beneath two trees in the west of this area.

Plate 5. *Eucalyptus sclerophylla* as scattered trees with patches of native understorey south of SIMTA site

Plate 6. Native groundlayer species growing at base of E. sclerophylla to south of SIMTA site

Bushland between disused rail line and Moorebank Avenue

To the south of the SIMTA site is a fenced area of bushland bordered by the unused rail line to the east and Moorebank Avenue to the west. Anzac Creek runs from west to east in the northern portion of this bushland.

The section of Anzac Creek within the study area consists of a shallow muddy waterbody, with limited standing water observed at the time of survey, supporting dense stands of *Typha orientalis* (Broad-leaf Cumbungi) and *Bolboschoenus fluviatilis* (Club-rush) with *Juncus* sp. dominant in patches. Immediately to the west of the railway line there is a dense infestation of *Salvinia molesta* (Salvinia) on the creek surface (Plate 7, Plate 8).

Plate 7. Anzac Creek to west of existing rail spur, showing *Salvinia molesta* infestation in foreground and native sedges and rushes further upstream

Plate 8. Ground layer of wetland in Anzac Creek

Fringing Anzac Creek is a narrow band of swamp woodland dominated by *Melaleuca linariifolia* (Flax-leaved Paperbark); the understorey of this forest varied from sedges, especially *Leptocarpus tenax* which dominated in patches, to ferns, grasses and dense shrubs. To the south of the eastern part of Anzac Creek there were occasional emergent trees of *Angophora subvelutina* (Broad-leaved Apple) and *Eucalyptus sclerophylla.*

Adjoining the southern bank of the western section of Anzac Creek the vegetation is disturbed and dominated by exotic vegetation, with a large stand of *Phyllostachys aurea* (Golden Bamboo), thickets of *Acacia decurrens* (Black Wattle) and *Pennisteum clandestinum* forming a carpet over a raised, uneven ground surface, likely to be fill material deposited in this location

decades ago (Plate 9). Exposed soil beneath a fallen tree showed soil mixed with broken concrete tiles (Plate 10). *Agave americana* (Century Plant) and *Aloe maculata* (Common Soap Aloe) were also growing in this location, suggesting dumped landscape or garden waste.

Plate 9. Disturbed area south of Anzac Creek: *Pennisetum clandestinum, Agave americana* and *Phyllostachys aurea*

Plate 10. Exposed fill material in disturbed area

South of Anzac Creek there is an access track, relatively open in the west but overgrown in the east. Along the track, and in the bushland to the north is a quantity of dumped rubble, mainly building materials including concrete slabs, bricks, and strips of metal (Plate 11, Plate 12). A lot of this material was overgrown by vegetation, suggesting it had been there for some time.

Plate 11. Piled bricks and rubble at edge of bushland south of Anzac Creek

Plate 12. Concrete slabs and bricks next to overgrown fill piles at edge of bushland south of Anzac Creek

To the south of the track adjoining the disturbed area is a large tract of relatively intact woodland. The woodland is dominated by *Eucalyptus sclerophylla* and *E. parramattensis* with a subcanopy of *Angophora bakeri* (Narrow-leaved Apple) and *Melaleuca decora* (White Cloud Tree). The understorey varies in structure from relatively open in the mid-layer with dense grass and low shrubs (Plate 13) to dense shrubs and a sparse shrub and grass understorey (Plate 14). The shrub and ground layers have a high level of species diversity.

Plate 13. Woodland with open, grassy understorey

Plate 14. Woodland with dense shrubby understorey

In the south near the existing rail line the woodland adjoins degraded areas that have previously been subject to clearing and disturbance (Plate 15). In the south-west is a large fenced area that was not accessible during the current survey. Based on observations from outside the fence and analysis of current and historical aerial photographs, this fenced area consists of scattered trees and tall shrubs – mainly *Acacia decurrens* and/or *A. parramattensis* (Parramatta Green Wattle) – and a disturbed groundlayer dominated by exotic grasses and pasture weeds (Plate 16).

Plate 15. Disturbed grassland with thickets of *Acacia* spp. near existing rail line

Plate 16. Fenced area in south of rail corridor lands

Golf Course

The vegetation of the Royal Australian Engineers Golf Course is characterised by regularly mown greens and fairways and managed rough areas with rows of planted trees between fairways. Adjoining the eastern edge of the golf course was a thin strip of bushland approximately 25 metres wide. The canopy was composed of *Eucalyptus sclerophylla, E. parramattensis* and *Angophora bakeri* to a height of approximately 10 metres; there was a dense shrub layer in the understorey, with *Pultenaea villosa* (Hairy Bush-pea), *Kunzea ambigua, Bursaria spinosa* (Blackthorn), *Lambertia formosa* (Mountain Devil) and *Micrantheum ericoides* all common (Plate 17).

Despite its width and the large edge to area ratio, this vegetation was in relatively good condition with a low number of exotic species recorded in the drier parts of the bushland. In the south of the strip of bushland was a large pool of standing water (Plate 18) fringed by *Melaleuca linariifolia* and *M. nodosa* with native rushes and herbs including *Leptocarpus tenax* and *Persicaria decipiens* (Slender Knotweed) at the water's edge. Adjoining the north-eastern

section of the waterbody was a large bank of disturbed, mounded soil supporting a dense cover of *Pennisetum clandestinum* (Kikuyu).

Plate 17. Bushland adjoining eastern boundary of golf course

Plate 18. Standing water in south of bushland adjoining eastern boundary of golf course

Banks of Georges River

To the west of the golf course, the land within approximately 100 metres of the eastern bank of the Georges River supports forest vegetation. On the steep slope adjacent to the riverbank was severely degraded riparian vegetation, currently reduced to mature trees of *Eucalyptus saligna* x *botryoides* (Blue Gum/Bangalay hybrid) and *E. longifolia* (Woollybutt) with an understorey dominated by *Ligustrum sinense* (Small-leaved Privet) and smothered by exotic weeds, mainly *Cardiospermum grandiflorum* (Balloon Vine), *Lantana camara* (Lantana) and *Delairea odorata* (Cape Ivy) (Plate 19, Plate 20).

The vegetation was less disturbed upslope and included a mixed native and exotic understorey with mature trees of *E. saligna* x *botryoides.* Given the relatively low native diversity coupled with low exotic cover in upslope areas, it is likely that there has been weed removal in this area and that the native understorey is regenerating.

Plate 19. Degraded riparian vegetation on eastern bank of Georges River

Plate 20. Degraded riparian vegetation

On the western bank of the Georges River, adjacent to the Glenfield Waste Disposal site, the vegetation was similar in structure and condition to that on the eastern bank. The southern part of the riparian forest on the study area supported a canopy dominated by *Eucalyptus saligna x botryoides* to 20 metres in height, with occasional *E. punctata* (Grey Gum) and *E. baueriana* (Blue Box) (Plate 21).

The understorey on the river flats near the rail bridge consisted of a mixture of local native shrub, herb and grass species and some dense stands of *Olea europaea* subsp. *cuspidata* and *Lantana camara,* with *Tradescantia fluminensis* dominating the ground layer in some areas.

In the northern parts of the riparian corridor, the landform changes, with the very steep slopes above the river flats. The steep slopes support trees of *Eucalyptus saligna* x *botryoides* and *E. baueriana* over a dense shrub layer of *Olea europaea* subsp. *cuspidata, Ligustrum lucidum* and *Lantana camara* (Plate 22). The native small tree species *Backhousia myrtifolia* (Grey Myrtle) and *Melaleuca decora* occurred sporadically.

Plate 21. Edge of riparian vegetation on western bank of Georges River in south of study area

Plate 22. Riparian vegetation on western bank of Georges River with dense weed understorey

At the base of the steep slope on the west side of the Georges River, there were wetlands on the river flats dominated by exotic species including *Ludwigia peruviana* (Peruvian Primrose) and *Alternanthera philoxeroides* (Alligator Weed), with scattered occurrence of the native reed *Typha orientalis*. A stand of *Salix alba* (White Willow) dominated the centre of this area (Plate 23).

Closer to the bank, most areas were covered in a dense carpet of weedy vines, predominantly *Delairea odorata* and *Cardiospermum grandiflorum,* with *Pennisetum clandestinum* dominating the ground layer (Plate 24).

Plate 23. Wetlands at base of slope on west side of Georges River

Plate 24. Weed-infested vegetation on western banks of Georges River

Glenfield Waste Disposal Site

Most of the area of Glenfield Waste Disposal Site within the study area is currently an active quarry and landfill site (Plate 25). The natural landform has been excavated and the vegetation

consists of weedy exotic herbs and grasses and some native shrubs and small trees, some of which may have been planted as part of revegetation of constructed slopes (Plate 26). The native trees and shrubs *Angophora floribunda, Acacia decurrens* and *Acacia binervia* were abundant on the slope adjoining the eastern haul road.

Plate 25. View of Glenfield Waste Disposal Facility from eastern haul road

Plate 26. Native shrubs planted on slopes.

3.2.4.2 Vegetation communities

Based on the results of the field assessment, the vegetation communities in the study area are generally consistent with the vegetation mapping of DECCW (2009), with the exception that the vegetation within the SIMTA site consists almost entirely of planted trees with a mown or managed groundlayer or fragmented regrowth along drainage lines. The vegetation of the study area is mapped in Figure 9 and the mapped areas provided in Table 11. The vegetation communities have been named after the corresponding threatened ecological communities as listed in the TSC Act (see Table 7).

Table 10: Areas of vegetation communities identified in the study area

Vegetation Community	Area in study area (ha)
Castlereagh Scribbly Gum Woodland	18.93
Castlereagh Swamp Woodland	4.37
Freshwater Wetlands	0.66
River Flat Eucalypt Forest	7.23
Urban/exotic	13.64
TOTAL	44.83

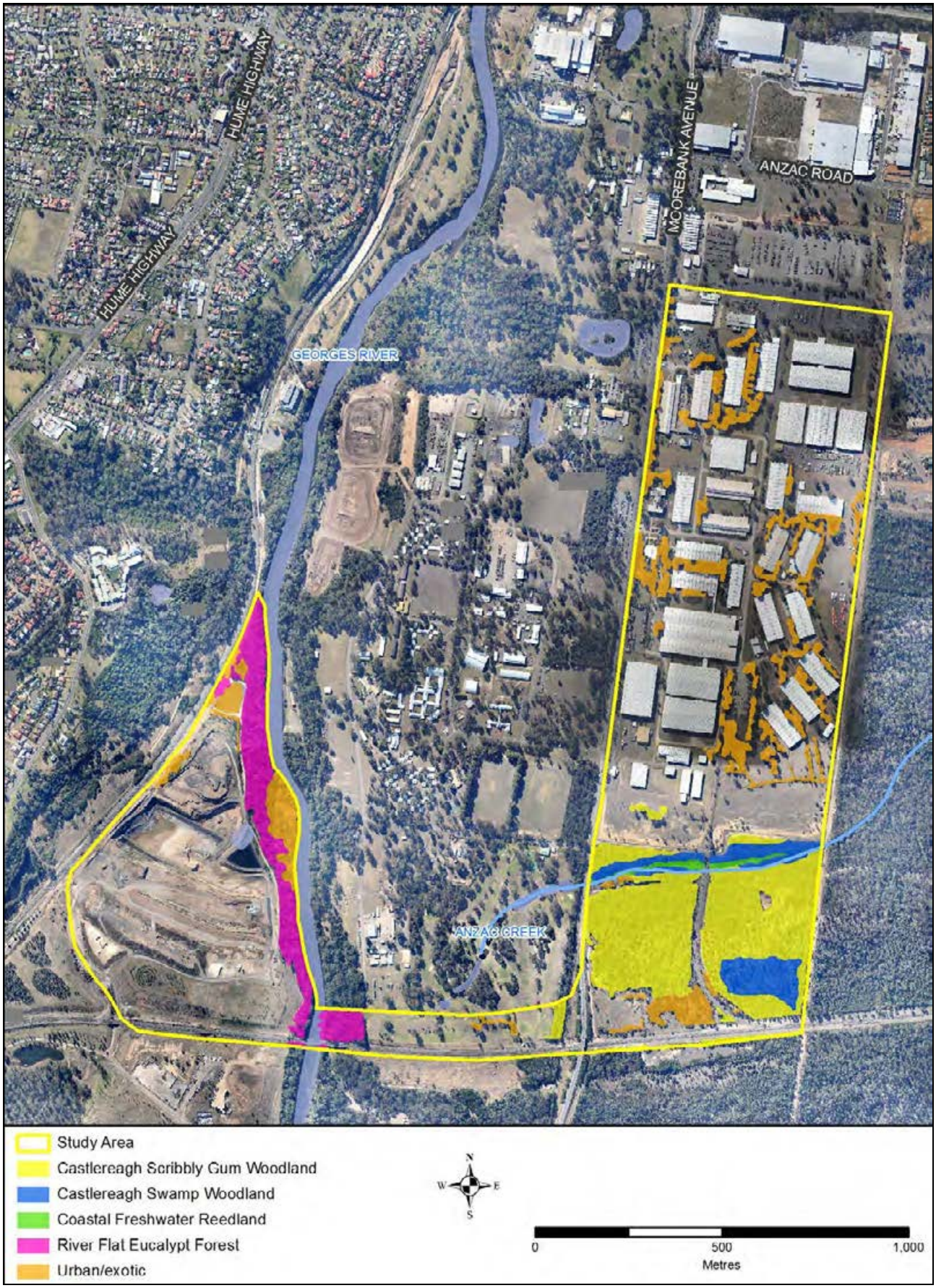

Figure 9: Vegetation communities identified in the study area

The four natural vegetation communities identified on the rail corridor lands fall within the definitions of threatened ecological communities listed under the TSC Act. Threatened ecological communities are discussed further in section 3.2.5.1.

The communities identified in the study area are equivalent to the following Vegetation Types as defined in the NSW Vegetation Type Database (Table 11):

Table 11: Vegetation types in the study area

Identified vegetation community	Equivalent Vegetation Type in Vegetation Type Database
Castlereagh Scribbly Gum Woodland	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin
Castlereagh Swamp Woodland	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin
River-flat Eucalypt Forest	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin
Freshwater Wetlands	Coastal freshwater lagoons of the Sydney Basin and South-east Corner

A comparison of the quadrat data from the current survey with the benchmark values for the identified communities as defined in the OEH Vegetation Benchmarks Database found that the sampled vegetation was generally outside of benchmark (BM) condition for the equivalent vegetation types (Table 12).

Table 12: Quadrat data compared with vegetation benchmarks for the sampled vegetation types

Benchmark Attribute	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland					Forest Red Gum - Rough-barked Apple grassy woodland				Parramatta Red Gum woodland	
	Q1	Q3	Q4	Q6	BM	Q2	Q7	Q8	BM	Q5	BM
Native plant species richness	47	53	47	25	40	16	33	6	24	32	36
Native overstorey cover	15	15	15	30	10-20%	15	10	10	28-33%	4	7-42%
Native midstorey cover	2	60	40	30	23-33%	12	60	10	21-31%	50	5-25%
Native ground cover (grasses)	40	10	40	10	12-24%	25	25	2	24-30%	40	12-38%
Native ground cover (shrubs)	30	10	5	2	0-10%	5	10	1	0-10%	5	0-10%
Native ground cover (other)	5	0	0	0	12-24%	15	5	1	24-30%	40	12-38%
Number of trees with hollows	0	0	0	0	1	0	1	1	1	0	1

Benchmark Attribute	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland					Forest Red Gum - Rough-barked Apple grassy woodland				Parramatta Red Gum woodland	
Total length of fallen logs (m)	0	0	2	0	30	20	10	5	50	3	30

BM = benchmark

3.2.4.3 Tree survey

A total of 590 trees were identified on the SIMTA site based on field interpretation of tree locations on the site survey plan prepared by Hard and Forester dated 3 August 2010. It should be noted that not all of the trees on the plan were identified due to survey limitations; it was also observed that there were numerous trees on site not included on the survey plan.

A total of 43 different tree species were recorded on the SIMTA site (Table 13). The most frequently recorded tree was *Eucalyptus microcorys,* followed by *Eucalyptus tereticornis, Corymbia maculata* and *Corymbia citriodora.* Most of the trees were assessed as being in good health.

Table 13: Tree species recorded on the SIMTA site

Botanical name	Common name	Count
Acacia binervia	Coast Myall	1
Acacia parramattensis	Parramatta Green Wattle	6
Angophora bakeri	Small-leaved Apple	1
Angophora costata	Sydney Red Gum	2
Angophora floribunda	Rough-barked Apple	7
Araucaria heterophylla	Norfolk Island Pine	1
Callistemon linearis	Narrow-leaved Bottlebrush	1
Callistemon salignus	White Bottlebrush	2
Casuarina glauca	Swamp Oak	3
Cinnamomum camphora	Camphor-laurel	3
Corymbia citriodora	Lemon-scented Gum	54
Corymbia eximia	Yellow Bloodwood	1
Corymbia maculata	Spotted Gum	55
Cupressus sempervirens	Pencil Pine	4
Erythrina x sykesii	Coral Tree	1
Eucalyptus amplifolia	Cabbage Gum	3
Eucalyptus botryoides	Bangalay	2
Eucalyptus camaldulensis	River Red Gum	13
Eucalyptus crebra	Narrow-leaved Ironbark	28
Eucalyptus fibrosa	Red Ironbark	9

Botanical name	Common name	Count
Eucalyptus longifolia	Woollybutt	14
Eucalyptus microcorys	Tallowwood	152
Eucalyptus moluccana	Grey Box	14
Eucalyptus parramattensis	Parramatta Red Gum	3
Eucalyptus punctata	Grey Gum	6
Eucalyptus racemosa	Snappy Gum	1
Eucalyptus saligna	Sydney Blue Gum	30
Eucalyptus sclerophylla	Scribbly Gum	30
Eucalyptus sideroxylon	Mugga	14
Eucalyptus sp. (unidentified)		25
Eucalyptus tereticornis	Forest Red Gum	57
Grevillea robusta	Silky Oak	3
Jacaranda mimosifolia	Jacaranda	1
Liquidambar styraciflua	Liquidambar	2
Lophostemon confertus	Brush Box	28
Melaleuca decora	White Cloud Tree	2
Nerium oleander	Oleander	1
Pinus sp.	Pine	1
Quercus palustris	Pin Oak	2
Sorbus sp.	Rowan, Service Tree	2
Syncarpia glomulifera	Turpentine	1
Triadica sebifera	Chinese Tallow Tree	4
Total		590

3.2.4.4 Noxious weeds

The *Noxious Weeds Act* 1993 imposes obligations on occupiers of land to control noxious weeds declared for their area. The control requirements for the classes of noxious weeds recorded in the study area are presented in Table 14.

Table 14: Weed control classes and requirements

Control Class	Weed type	Control requirements
Class 2	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.

Control Class	Weed type	Control requirements
Class 3	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

Fourteen of the 89 exotic species recorded in the study area are listed as noxious weeds in the Liverpool City Council local government area (Table 15). Nine of the noxious weeds are also listed as Weeds of National Significance under the National Weeds Strategy (Thorp and Wilson 2012).

Table 15: Noxious weeds recorded in the study area

Scientific name	Common name	Noxious weed control class	Weed of National Significance	Location in study area
Alternanthera philoxeroides	Alligator Weed	3	Yes	Wetlands on western side of Georges River
Asparagus asparagoides	Bridal Creeper	4	Yes	Banks of Georges River
Chrysanthemoides monilifera subsp. *rotundata*	Bitou Bush	3	Yes	Disturbed edges of bushland south of SIMTA site and east of golf course
Cortaderia selloana	Pampas Grass	3		Disturbed area in south-east of rail corridor lands
Eichhornia crassipes	Water Hyacinth	2	Yes	In channel of wetland on western side of Georges River
Lantana camara	Lantana	4	Yes	Banks of Georges River
Ligustrum lucidum	Broad-leaved Privet	4		Western bank of Georges River
Ligustrum sinense	Small-leaved Privet	4		Banks of Georges River
Ludwigia peruviana	Peruvian Primrose	3		In wetland on western side of Georges River
Olea europaea subsp. *cuspidate*	African Olive	4		Banks of Georges River

Scientific name	Common name	Noxious weed control class	Weed of National Significance	Location in study area
Opuntia sp.	Prickly Pear	4	Yes	Banks of Georges River
Rubus fruticosus agg. spp. (includes *R. anglocandicans*)	Blackberry	4	Yes	Banks of Georges River, in disturbed bushland south of Anzac Creek
Salix alba	Willow	5	Yes	In wetland on western side of Georges River
Salvinia molesta	Salvinia	2	Yes	On Anzac Creek adjacent to existing culvert in east

The occurrence of noxious weeds in the study area was localised; the most severe infestations were on the lower slopes adjoining the banks of the Georges River, where there were large stands of privet *Ligustrum sinense* (Small-leaved Privet) and *Lantana camara* (Lantana).

3.2.5 Significant flora

3.2.5.1 EPBC Act listed threatened ecological communities

The EPBC Act Protected Matters Search (Appendix 4) identified three EPBC Act listed TECs as likely to occur within 10 kilometres of the study area:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.
- Turpentine-Ironbark Forest in the Sydney Basin Bioregion.
- Shale/Sandstone Transition Forest.

Based on the review of soil, geology and vegetation mapping in the study area and the results of the field survey, Turpentine-Ironbark Forest in the Sydney Basin Bioregion and Shale/Sandstone Transition Forest are unlikely to occur in the study area.

Communities that are equivalent to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest have been mapped adjacent to the study area (Figure 5, Figure 7): Shale Plains Woodland has been mapped to the west, south-west and south of the Glenfield Waste Disposal Site, and Shale Gravel Transition Forest has been mapped to the north and south of the study area. No EPBC Act listed TEC or equivalent vegetation communities have been mapped within the study area, except for a small edge area of Shale Gravel Transition forest overlapping the north-western corner of the SIMTA site; this vegetation forms part of a larger area of mapped Shale Gravel Transition Forest to the north-west of the site, and the site inspection did not identify any natural vegetation in this location.

3.2.5.2 TSC Act listed threatened ecological communinities

All four natural vegetation communities identified on the rail corridor lands are threatened ecological communities listed under the TSC Act

Table 16: Threatened ecological communities recorded in the study area

Identified vegetation community	Equivalent TEC	TSC Act Status
Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable
Castlereagh Swamp Woodland	Castlereagh Swamp Woodland	Endangered
River-flat Eucalypt Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered
Freshwater Wetlands	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered

Based on the results of the field assessment, the extent of these communities is generally consistent with the vegetation mapping of DECCW (2009), with the exception that the vegetation within the SIMTA site consists almost entirely of planted trees with a mown or managed groundlayer, and does not meet the criteria for any threatened ecological communities. The extent of Castlereagh Swamp Woodland in the study area is difficult to assess as this community intergrades with Castlereagh Scribbly Gum Woodland.

Assessments of Significance have been undertaken for Endangered Ecological Communities listed under the TSC Act (Appendix 6).

Castlereagh Scribbly Gum Woodland

This community occurred in the rail corridor lands to the south of the SIMTA site, and in a narrow strip adjoining the eastern edge of the golf course. The community was of woodland structure and canopy dominants were *Eucalyptus sclerophylla, E. parramattensis* and *Angophora bakeri.* The understorey ranged from densely shrubby to relatively open with grasses and low shrubs dominant. Castlereagh Scribbly Gum Woodland was sampled in Quadrats 1, 3 and 4.

There were also remnant scattered *E. sclerophylla* over patches of shrub and grass cover in the cleared grassland immediately south of the SIMTA site. Although the trees and groundcover species in these patches are characteristic of Castlereagh Scribbly Gum Woodland, it is difficult to determine whether these fragments meet the criteria for the vulnerable ecological community. It is not known whether the scattered trees of *Eucalyptus sclerophylla* were planted or regenerated following clearing in the 1950s, and if planted, whether the stock was sourced from the local bushland.

It is considered more likely that these trees regenerated from the seedbank, given the species are the same as those in bushland to the south, and the regeneration of the native understorey suggests that the natural soils are intact in these locations. The application of the precautionary principle would require consideration of this area as regrowth, highly fragmented Castlereagh Scribbly Gum Woodland.

Castlereagh Swamp Woodland

The vegetation adjoining Anzac Creek grades from Castlereagh Swamp Woodland to Castlereagh Scribbly Gum Woodland. There is no clear boundary between the communities, and much of the vegetation could be considered transitional.

Based on interpretation of the Final Determination for Castlereagh Swamp Woodland and reference to vegetation community descriptions in Tozer (2003) and DECCW (2009), it was concluded that the thin strips of *Melaleuca*-dominated woodland with occasional *Eucalyptus parramattensis* and *Angophora subvelutina* adjoining the banks of Anzac Creek were most consistent with this community.

River-flat Eucalypt Forest on Coastal Floodplains

The degraded riparian vegetation adjoining the Georges River loosely meets the criteria for River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.

The riparian vegetation in the study area consisted of remnant trees of *Eucalyptus botryoides* x *saligna* and *Eucalyptus longifolia* and scattered small trees of *Acacia implexa* and *Hakea salicifolia* with an understorey was dominated by dense cover of *Ligustrum sinense* and *Cardiospermum grandiflorum,* which was smothering the shrub and ground layer. Further upslope were areas of riparian forest with higher native diversity and lower exotic cover.

Freshwater Wetlands on Coastal Floodplains

Anzac Creek supported a wetland dominated by *Typha orientalis* and *Bolboschoenus fluviatilis.* The wetland was in moderate condition with the aquatic weed *Myriophyllum aquaticum* abundant and an infestation of the noxious weed *Salvinia molesta* near the culvert in the east of the study area. This wetland meets the criteria for Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.

3.2.5.3 Threatened Species

Two threatened species listed under the EPBC Act and TSC Act were recorded within the study area, namely *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea). Another threatened species, *Acacia pubescens* (Downy Wattle), was recorded at the edge of bushland to the east of the SIMTA site.

The locations of threatened plant species recorded in the study area are shown on Figure 10.

Persoonia nutans

Persoonia nutans is listed as Endangered under the EPBC Act and on Schedule 1 of the TSC Act. This species is an erect to spreading shrub 0.5–1.5 metres high, with linear leaves and hairy young branches.

Persoonia nutans was recorded in the Castlereagh Scribbly Gum Woodland north of Anzac Creek, in the rail corridor lands. A targeted search for this species recorded 126 individual plants, of which 110 occurred within the rail corridor. Seventeen of the plants within the rail corridor occurred within the construction footprint of the rail link. There were two distinct sub-populations in the study area, separated by an approximately 170 metre gap. Plants ranged from 20 cm to about 1.8 metres in height, and many individuals were observed to be flowering and/or fruiting. A search of the bushland to the east of the disused railway line recorded a further 16 indivdual plants within this area (Figure 10).

Grevillea parviflora* subsp. *parviflora

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable under the EPBC Act and on Schedule 2 of the TSC Act. *G. parviflora* subsp. *parviflora* is a spindly shrub varying from prostrate to erect, usually 0.3–1m high but growing up to 1.5 to 2 metres. The species suckers readily from rhizomes, although individuals sometimes have single stems (DSEWPC 2012b).

Grevillea parviflora subsp. *parviflora* was recorded in the east of the large patch of Castlereagh Scribbly Gum Woodland south of Anzac Creek in the Rail corridor lands (Figure 10). A total of

1038 stems of *G. parviflora* subsp. *parviflora* were recorded from 4 metre wide transects spaced 10 metres apart; as the survey method sampled 40 per cent of the survey area, the population estimate within the study area is approximately 2,645.

The number of genetically distinct individuals is likely to be lower than this estimate given the suckering habit of this species and the localised high density of plant stems observed. The species was more widespread within the more open, grassy areas of bushland, with few plants recorded from the western parts of this patch where there was a dense shrubby midlayer.

Acacia pubescens

Acacia pubescens is listed as Vulnerable under the EPBC Act and in Schedule 2 of the TSC Act. *A. pubescens* is a spreading shrub growing from 1 to 4 metres high with bright yellow flowers, bipinnate leaves and conspicuously hairy branchlets.

This species was not recorded within the study area, but two individuals were recorded at the edge of bushland immediately to the east of the SIMTA site.

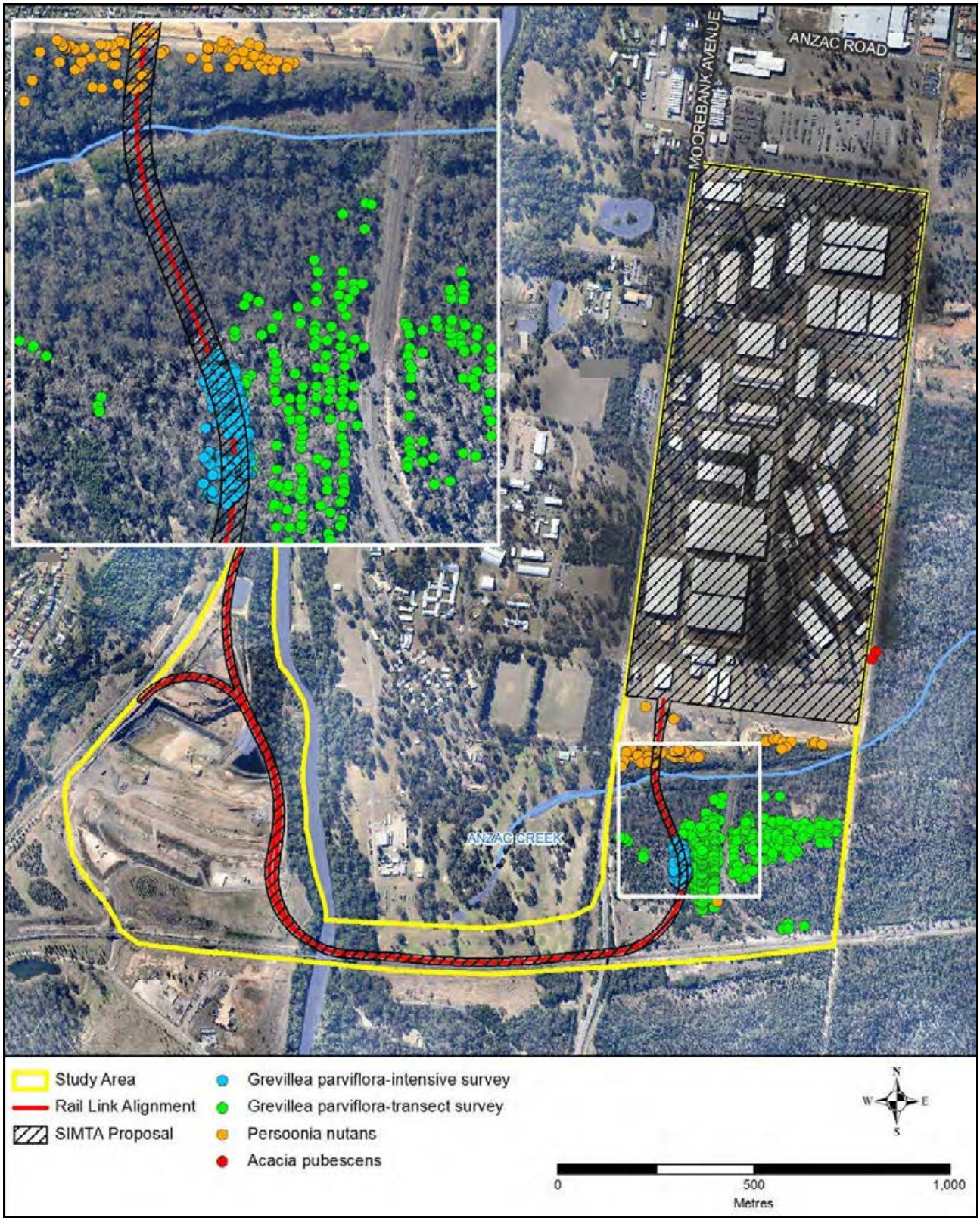

Figure 10: Locations of threatened plant species recorded in the study area

3.2.5.3 Probability of Occurrence of Threatened Species

Threatened flora habitat analysis

A habitat analysis was undertaken for threatened flora occurring within 10 kilometres of the study area to determine the likelihood of occurrence within the study area based on suitability of habitat observed during the field survey (Table 17). Species were assessed as being either Unlikely, Possible, Likely or Known to occur in the study area, based on the criteria in Table 3. The comparative analysis was undertaken using database information for point locality records against habitat preferences identified by OEH (Threatened Species Profiles), Harden (1990-1993, 2002) and DSEWPC (Species Profile and Threats Database).

Table 17: Threatened Flora Habitat Analysis

Scientific name	Habitat preference/ known distribution	Probability of occurrence in the study area
Acacia pubescens	On alluviums, shales and at the intergrade between shales and sandstones.	Possible Recorded east of the study area, but not found in targeted searches within the study area
Allocasuarina glareicola	Primarily restricted to the Richmond district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil.	Possible One outlier record approximately 4.5 km south-east of study area. Suitable habitat present in Castlereagh Scribbly Gum Woodland in study area.
Asterolasia elegans	Found in sheltered forests on mid- to lower slopes and valleys on Hawkesbury Sandstone. Known from only seven populations north of Sydney in the Baulkham Hills. Hawkesbury and Hornsby Local Government Areas.	Unlikely No records within 10 km of study area. No suitable habitat exists within the study area.
Caesia parviflora var. *minor*	Occurs uncommonly in Tasmania, Victoria and South Australia with an outlying population in NSW, between Grafton and Coffs Harbour. Found in damp places in open forest on sandstone.	Unlikely Outside of typical range, although one record occurs 10km east of the study area. No suitable habitat exists within the study area.
Caladenia tessellata	Records in Sydney area are old. Generally found in grassy sclerophyll woodland on clay loam or sandy soils.	Unlikely No records within 10 km of study area. No suitable habitat exists within the study area.

Scientific name	Habitat preference/ known distribution	Probability of occurrence in the study area
Callistemon linearifolius	Grows in dry sclerophyll forest on the coast and adjacent ranges, chiefly from Georges River to the Hawkesbury River.	Unlikely Pre-1960 records within 5 km of the site. Habitat is poorly defined; riverbank habitat on site likely to be too degraded.
Cryptostylis hunteriana	Known from a range of communities including swamp, heath and most typically woodland dominated by *Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera* and *Allocasuarina littoralis.*	Possible No records within 10 km of the study area Although habitat for this species is poorly defined, potential habitat may exist within the study area.
Cynanchum elegans	Occurs on margins of dry rainforest, also littoral rainforest, open forest and woodland, and scrub.	Unlikely No suitable habitat exists within the study area.
Deyeuxia appressa	Known only from two pre-1942 records in the Sydney area. Almost nothing is known of the species' habitat and ecology.	Unlikely, but cannot assess with no information on habitat
Dillwynia tenuifolia	The core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park; in Liverpool LGA has been recorded from Voyager Point and Kemps Creek. May be locally abundant within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest; may also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Possible One record approximately 7.5 km north-west of study area Marginal potential habitat may occur in Castlereagh Scribbly Gum Woodland in study area.
Epacris purpurascens var. *purpurascens*	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts. Found in a range of habitat types, most of which have a strong shale soil influence.	Unlikely. Records from 1990s occur 7.5 km to east of site. No suitable habitat exists within the study area.
Eucalyptus camfieldii	Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges	Unlikely. No suitable habitat exists within the study area.
Eucalyptus nicholii	Natural distribution confined to the New England Tablelands of NSW. Widely planted as an urban street tree and in gardens.	May occur as a planted tree; not of conservation significance in this region
Eucalyptus scoparia	In NSW it is known from only three locations near Tenterfield, including Bald Rock National Park. Widely planted as an urban street tree and in gardens.	May occur as a planted tree; not of conservation significance in this region

Scientific name	Habitat preference/ known distribution	Probability of occurrence in the study area
Grevillea parviflora subsp. *parviflora*	Occurs on sandy clay loam soils, often with lateritic ironstone gravels. Generally found on crests, upper slopes or flats. Distribution generally associated with Nepean and Georges Rivers. Populations are more commonly found in relatively open, disturbed sites along roads and tracks in areas of open-forest or woodland.	Known Recorded in Castlereagh Scribbly Gum Woodland south of Anzac Creek
Gyrostemon thesioides	Grows on hillsides and riverbanks and may be restricted to fine sandy soils. Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers	Unlikely. Records from 1966-1967 approximately 5 km south-west of site. Riverbank habitat on site likely to be too degraded.
Hibbertia sp. "Bankstown"	Currently known from one population of less than 50 mature individuals in Bankstown Airport. This population is found in highly modified Georges River Tertiary Alluvium Floodplain Communities which, due to vegetation clearance and modification are currently maintained as grasslands.	Unlikely – however habitat not well defined
Hibbertia sp. nov. 'Menai'	Known to occur in two metapopulations, one in southern Sydney (Menai-Bangor and Alfords Point), and one near Nowra. The habitat of the Sydney metapopulation is broadly dry sclerophyll forest and woodland. Dominant tree species at various sites include *Corymbia gummifera, Angophora costata, Eucalyptus resinifera, E. piperita* and *Allocasuarina littoralis.*	Unlikely No suitable habitat exists within the study area.
Leucopogon exolasius	Found along the upper Georges River area and in Heathcote National Park. Occurs in woodland on sandstone.	Unlikely There is one record on the western boundary of the SIMTA site. The accuracy of this record is given as "1000" indicating that the location of the record could be anywhere within 1000 m of the point. The location is described as "Lands within Holsworthy Military Reserve, North Holsworthy". No suitable habitat exists within the study area.

Scientific name	Habitat preference/ known distribution	Probability of occurrence in the study area
Leucopogon fletcheri subsp. *fletcheri*	Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils generally on flat to gently sloping terrain along ridges and spurs. Restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains.	Unlikely One record 7.5 km south of study area. No suitable habitat exists within the study area.
Marsdenia viridiflora subsp. *viridiflora*	Typically grows in vine thickets and open shale woodland.	Unlikely No suitable habitat exists within the study area.
Melaleuca biconvexa	Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Unlikely No suitable habitat exists within the study area.
Melaleuca deanei	Known from two areas in the north and south of Sydney (Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas). Typically grows in wet heath on sandstone.	Unlikely No suitable habitat exists within the study area.
Pelargonium sp. Striatellum	Associated with irregularly inundated or ephemeral lakes, in the transition zone between grasslands/pasture and wetland communities. Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst.	Unlikely No records within 10 km of the study area. The study area is far outside of the typical range for this species – it is unclear why this species is in the search results. No suitable habitat exists within the study area.
Persoonia hirsuta	The Hairy Geebung has been recorded in the Sydney coastal area, the Blue Mountains area and the Southern Highlands. The Hairy Geebung grows in sandy to stony soils derived from sandstone, or very rarely on shale, in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations.	Unlikely There are three pre-1970 records of this species within five km of the study area: two along the Georges River and one in the vicinity of Bunbury-Curran Creek. No suitable habitat exists within the study area.
Persoonia nutans	Confined to aeolian and alluvial sediments on the Cumberland Plain and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Known Recorded in Castlereagh Scribbly Gum Woodland north of Anzac Creek

Scientific name	Habitat preference/ known distribution	Probability of occurrence in the study area
Pimelea curviflora var. curviflora	A small shrub confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Distribution associated with shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Unlikely No records within 10 km of the study area. No suitable habitat exists within the study area.
Pimelea spicata	In western Sydney, occurs on undulating topography of substrates derived from Wianamatta Shale in associated with Cumberland Plain Woodland.	Unlikely There are records of this species to the west of the study area. The closest record near the south-west corner of Glenfield Waste Disposal site is dated from 1962. No suitable habitat exists within the study area.
Pomaderris brunnea	Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers. Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Unlikely No records within 10 km of the study area. No suitable habitat exists within the study area.
Pomaderris prunifolia	In Sydney, known from only three sites in the Parramatta, Auburn, Strathfield and Bankstown LGAs. On rocky slopes, often along creeks.	Unlikely Closest records are in the Bankstown LGA. The species is not known to occur in the Liverpool LGA.
Pterostylis gibbosa	Known from a small number of populations in the Hunter, Illawarra and Shoalhaven regions. Apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	Unlikely No records within 10 km of the study area; the study area appears to be outside the current known geographical range of this species.
Pterostylis nigricans	Coastal heathland with heath and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils. Occurs in north-east NSW north from Evans Head, and in Queensland.	Unlikely No suitable habitat exists within the study area.
Pterostylis saxicola	Distribution restricted between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.	Unlikely No records within 10 km of the study area. No suitable habitat exists within the study area.

Scientific name	Habitat preference/ known distribution	Probability of occurrence in the study area
Pultenaea parviflora	Endemic to the Cumberland Plain from Windsor to Penrith and east to Dean Park, with outlier populations in Kemps Creek and Wilberforce. Associated with scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays.	Possible One record approximately 7.5 km north-west of study area Marginal potential habitat may occur in Castlereagh Scribbly Gum Woodland in study area.
Pultenaea pedunculata	In NSW represented by just three disjunct populations, including one on the Cumberland Plain. Generally grows in woodland but plants have also been found on road batters and coastal cliffs.	Possible Marginal potential habitat may occur in Castlereagh Scribbly Gum Woodland in study area.
Streblus pendulinus	Occurs from Cape York Peninsula to Milton, south-east NSW, as well as Norfolk Island. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest.	Unlikely No records within 10 km of the study area. The study area is far outside of the typical range for this species – it is unclear why this species is in the search results. No suitable habitat exists within the study area.
Thelymitra sp. Kangaloon (D.L.Jones 18108)	Endemic to the Fitzroy Falls/Robertson/ Kangaloon area; grows in seasonally swampy sedgeland on grey silty clay loam at 600–700m above sea level.	Unlikely No records within 10 km of the study area. No suitable habitat exists within the study area.
Wilsonia backhousei	Grows in coastal saltmarshes; chiefly in the Sydney district, also common at Jervis Bay.	Unlikely No suitable habitat exists within the study area.

3.3 Fauna

3.3.1 Database Searches

Based on database and literature review, 54 animal species listed under the EPBC and/or TSC Acts are either known or have the potential to occur within 10 kilometres of the study area (Table 18). TSC Act records occurring within 10 kilometres of the study area are shown in Figure 11.

Table 18: Threatened fauna occurring within 10 kilometres of the study area

Scientific name	Common name	Status under EPBC Act	Status under TSC Act
Anthochaera phrygia	Regent Honeyeater	Endangered	Critically endangered

Scientific name	Common name	Status under EPBC Act	Status under TSC Act
Apus pacificus	Fork-tailed Swift	Migratory	
Ardea alba	Great Egret	Migratory	
Ardea ibis	Cattle Egret	Migratory	
Botaurus poiciloptilus	Australasian Bittern	Endangered	
Burhinus grallarius	Bush Stone-curlew		Endangered
Callocephalon fimbriatum	Gang-gang Cockatoo		Vulnerable
Cercartetus nanus	Eastern Pygmy-possum		Vulnerable
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable
Circus assimilis	Spotted Harrier		Vulnerable
Climacteris picumnus victoriae	Brown Treecreeper		Vulnerable
Cthonicola sagittata	Speckled Warbler		Vulnerable
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Vulnerable
Dasyornis brachypterus	Eastern Bristlebird	Endangered	
Dasyurus maculatus maculatus	Spotted-tailed Quoll	Endangered	Endangered
Ephippiorhynchus asiaticus	Black-necked Stork		Endangered
Epinephelus daemelii	Black Rockcod	Vulnerable	
Epthianura albifrons	White-fronted Chat		Vulnerable
Epthianura albifrons	White-fronted Chat Population in the Sydney Metropolitan Catchment Area		Endangered population
Erythrotriorchis radiatus	Red Goshawk	Vulnerable	
Falsistrellus tasmaniensis	Eastern False Pipistrelle		Vulnerable
Glossopsitta pusilla	Little Lorikeet		Vulnerable
Haliaeetus leucogaster	White-bellied Sea Eagle	Migratory	
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Vulnerable
Hieraaetus morphnoides	Little Eagle		Vulnerable
Hirundapus caudacutus	White-throated Needletail	Migratory	
Hoplocephalus bungaroides	Broad-headed Snake	Vulnerable	Endangered
Gallinago hardwickii	Latham's Snipe	Migratory	
Isodon obesulus obesulus	Southern Brown Bandicoot	Endangered	
Lathamus discolor	Swift Parrot	Endangered	Endangered

Scientific name	Common name	Status under EPBC Act	Status under TSC Act
Litoria aurea	Green and Golden Bell Frog	Vulnerable	Endangered
Litoria littlejohni	Littlejohn's Tree Frog	Vulnerable	
Litoria raniformis	Growling Grass Frog	Vulnerable	
Lophoictinia isura	Square-tailed Kite		Vulnerable
Macquaria australasica	Macquarie Perch	Endangered	
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)		Vulnerable
Meridolum corneovirens	Cumberland Plain Land Snail		Endangered
Merops ornatus	Rainbow Bee-eater		
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		Vulnerable
Mixophyes balbus	Stuttering Frog	Vulnerable	Endangered
Monarcha melanopsis	Black-faced Monarch	Migratory	
Mormopterus norfolkensis	Eastern Freetail-bat		Vulnerable
Myiagra cyanoleauca	Satin Flycatcher	Migratory	
Myotis macropus	Southern Myotis		Vulnerable
Neophema chrysogaster	Orange-bellied Parrot	Critically Endangered	
Ninox connivens	Barking Owl		Vulnerable
Ninox strenua	Powerful Owl		Vulnerable
Petaurus australis	Yellow-bellied Glider		Vulnerable
Petaurus norfolcensis	Squirrel Glider		Vulnerable
Petrogale penicillata	Brush-tailed Rock-wallaby	Vulnerable	Endangered
Petroica boodang	Scarlet Robin		Vulnerable
Petroica phoenicea	Flame Robin		Vulnerable
Petroica rodinogaster	Pink Robin		Vulnerable
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	Vulnerable	Vulnerable
Pseudomys novaehollandiae	New Holland Mouse	Vulnerable	
Pseudophryne australis	Red-crowned Toadlet		Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable

Scientific name	Common name	Status under EPBC Act	Status under TSC Act
Rhipidura rufifrons	Rufous Fantail	Migratory	
Rostratula australis	Australian Painted Snipe	Vulnerable	Endangered
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		Vulnerable
Scoteanax rueppellii	Greater Broad-nosed Bat		Vulnerable
Sternula nereis nereis	Fairy Tern	Vulnerable	