Flora and Fauna Assessment

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 3A Concept Plan Application

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SIMTA

SIMTA MOOREBANK INTERMODAL TERMINAL FACILITY

FLORA AND FAUNA ASSESSMENT

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EXECUTIVE SUMMARY

The Sydney Intermodal Terminal Alliance (SIMTA), a joint venture between Stockland, Qube Logistics and QR National, is proposing to develop the SIMTA Moorebank Intermodal Terminal Facility (SIMTA proposal). The SIMTA proposal 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 65 hectares respectively, and together comprise the study area for this assessment.

This Flora and Fauna Assessment has been prepared to inform the Concept Plan Environmental Assessment being prepared under Part 3A of the *Environmental Planning and Assessment Act 1979* and addresses the biodiversity issues identified in the Director-General's Requirements for the SIMTA proposal.

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 endangered ecological 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. Detailed flora surveys including six quadrats, random meanders, tree assessment and targeted threatened species searches recorded a total of 269 vascular plant species in the study area, comprising 193 local native species, eight non-local native species (mainly planted trees) and 68 exotic species.

Two threatened plant species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Threatened Species Conservation Act 1995* (TSC Act), the endangered species *Persoonia nutans* and the vulnerable species *Grevillea parviflora* subsp. *parviflora,* were recorded in the rail corridor lands to the south of the SIMTA site. The populations in these areas are relatively large and are considered to be of significant conservation value. Another threatened plant species, the vulnerable *Acacia pubescens,* was recorded to the east of the SIMTA site.

Five threatened ecological communities listed under the TSC Act were identified in the study area, 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
- Cumberland Plain Woodland in the Sydney Basin Bioregion

All threatened ecological communities in the study area are located within the rail corridor lands.

Detailed terrestrial fauna surveys across the study area identified the presence of five exotic and 54 native fauna species. Three threatened fauna species listed under the TSC Act and EPBC Act; Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), Southern Myotis

(*Myotis macropus*) and Grey-headed Flying Fox (*Pteropus poliocephalus*), were recorded within the study area. The probability of other threatened species recorded within 10 kilometres of the study area to occur within the study area was assessed. It was considered possible that 16 species may occur in the study area on a temporary or transient basis, predominantly highly mobile species such as bird and micochiropteran bats.

Three broad terrestrial habitat types were identified within the study area; remnant vegetation, riparian habitats and cleared and disturbed areas. Notable habitat features across the study area that offer potential shelter and foraging resources to fauna include flowering trees and shrubs, Georges River, Anzac Creek and damp areas, well-developed leaf litter in places and several hollow-bearing trees. There is, however, an absence of other important features such as large hollow-bearing trees, rocky features and hollow logs across the site.

The study area contains, and is bound by, significant barriers to fauna movement, including Moorebank Ave, the East Hills Railway Line and chain-mesh fencing surrounding the SIMTA site, rail corridor and Royal Engineers Golf Course. This chain-mesh fencing and 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.

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 are considered to be poor quality.

The SIMTA site is considered to be of limited conservation significance and ecological impacts within the site are likely to be low.The majority of likely impacts on threatened species and communities will occur as a result of construction of the rail link. The extent of scale and impacts within the rail corridor cannot be quantified until the alignment of the rail link has been finalised. The requirement for a 30 metre wide zone of clearing and/or disturbance will result in the removal and fragmentation of threatened communities and threatened plant populations. As the exact area to be cleared and/or disturbed is not yet known, the impacts cannot be assessed with any certainty, a conclusion on the significance of impacts and the potential requirement for additional assessment cannot be made at this stage.

1 INTRODUCTION

The Sydney Intermodal Terminal Alliance (SIMTA) is a joint venture between Stockland, 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.

The SIMTA site is located in the Liverpool Local Government Area. It is 27 kilometres west of the Sydney CBD, 16 kilometres south of the Parramatta CBD, 5 kilometres east of the M5/M7 Interchange, 2 kilometres from the main north-south rail link 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 corridor are referred to as the rail corridor. The proposed rail corridor covers approximately 65 hectares and adjoins the Main Southern Railway to the north. Existing land use includes vacant land, golf course, extractive industries, and a waste disposal depot. Native vegetation includes woodland, forest and wetland communities in varying condition. Georges River and Anzac Creek intersect the proposed rail corridor. The supplementary lands area to the south of the SIMTA site, to the north of the existing East Hills Rail link, are part of Lot 3001 DP1125930 and Lot 1 DP1125930. To the west of the Georges River, the Glenfield Waste Disposal site comprises several lots that are currently all used for the purposes of the waste facility.

The SIMTA proposal seeks approval for a Conept Plan approval under Part 3A of the *Environmental Planning and Assessment Act 1979*.

In addition to lodging an application for Concept Plan approval, it is proposed to progress the design and development to apply for project approval for construction of an approximately 8 hectare area known as Stage 1.

Following project approval, construction documentation is to be completed and modification to existing buildings and services will commence as soon as practical to allow for the demolition and construction of Stage 1.

1.1 Director-General‘s Requirements

The following general and key biodiversity issues were identified in the Director-General‘s Requirements for the SIMTA proposal:

Director-General‘s Requirements	Where addressed
Describe the existing environment;	Sections 3 and 4
Assessment of threatened terrestrial and aquatic (including groundwater dependent) species, populations and endangered ecological communities and/or critical habitat, including the Cumberland Plain Woodland;	Sections 3 and 4
Ecological surveys commensurate with the biology/ecology of species and extent of habitat within and adjacent to the project site;	Sections 3 and 4

Director-General's Requirements	Where addressed
Vegetation clearing (including riparian areas and resultant foraging, nesting, roosting and habitat loss and fragmentation, and edge effects) and operational impacts; and	Section 5
Take into account the *Draft Guidelines for Threatened Species Assessment (DEC & DPI), Threatened Biodiversity and Assessment: Guidelines for Developments and Activities (DEC)* and *Principles for the Use of Biodiversity Offsets in NSW (DECCW).*	Section 3, Section 5, Appendix 5
Assess the potential impacts of the proposal, in accordance with relevant policies and guidelines. Direct, indirect and cumulative impacts must be considered (including regard to other existing and proposed development and activities in the locality);	Section 5, Appendix 5
Describe measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the project and any residual impacts.	Section 6

1.2 Purpose and Scope

This Flora and Fauna Assessment has been prepared to inform the Concept Plan Environmental Assessment being prepared under Part 3A of the *Environmental Planning and Assessment Act 1979* and addresses the biodiversity issues identified in the Director-General's Requirements for the SIMTA proposal. The Assessmrnt has been prepared in accordance with *Draft Guidelines for Threatened Species Assessment (DEC & DPI), Threatened Biodiversity and Assessment: Guidelines for Developments and Activities (DEC)* and *Principles for the Use of Biodiversity Offsets in NSW (DECCW).*

The key objectives of this biodiversity assessment are to:

- describe the existing environment;
- 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* DECC 2004), ;
- identify any threatened terrestrial and aquatic (including groundwater dependent) species, populations or their habitats, Endangered Ecological Communities and/or critical habitat,
- assess the potential impacts of the SIMTA proposal, including direct, indirect and cumulative impacts;
- 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 147 hectares.

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 rail corridor is identified as Lot 3001 DP 1125930, zoned SP2 (Defence) Infrastructure and Lot 1 DP825352, zoned RE1 Public Recreation. It comprises vacant land, the Royal Australian Engineers Golf Course and Glenfield Waste Disposal site. Anzac Creek and the Georges River intersect the rail corridor.

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). The minister will decide whether assessment and approval is required under the EPBC Act.

1.4.2 NSW *Environmental Planning and Assessment Act 1979*

The SIMTA proposal has been declared a state significant development under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which provides the framework for assessing developments in NSW. Part 3A of the Act provides a single assessment and approval regime for all major infrastructure and other projects previously undertaken under Part 4 and/or Division 4 of Part 5 of the EP&A Act.

The Draft Guidelines for Threatened Species Assessment (DEC & DPI 2005) identify important factors and/or heads of consideration that must be considered when assessing impacts on threatened species, populations or ecological communities, or their habitats, arising from development applications under Part 3A of the EP&A Act.

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 the 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, and
- 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.

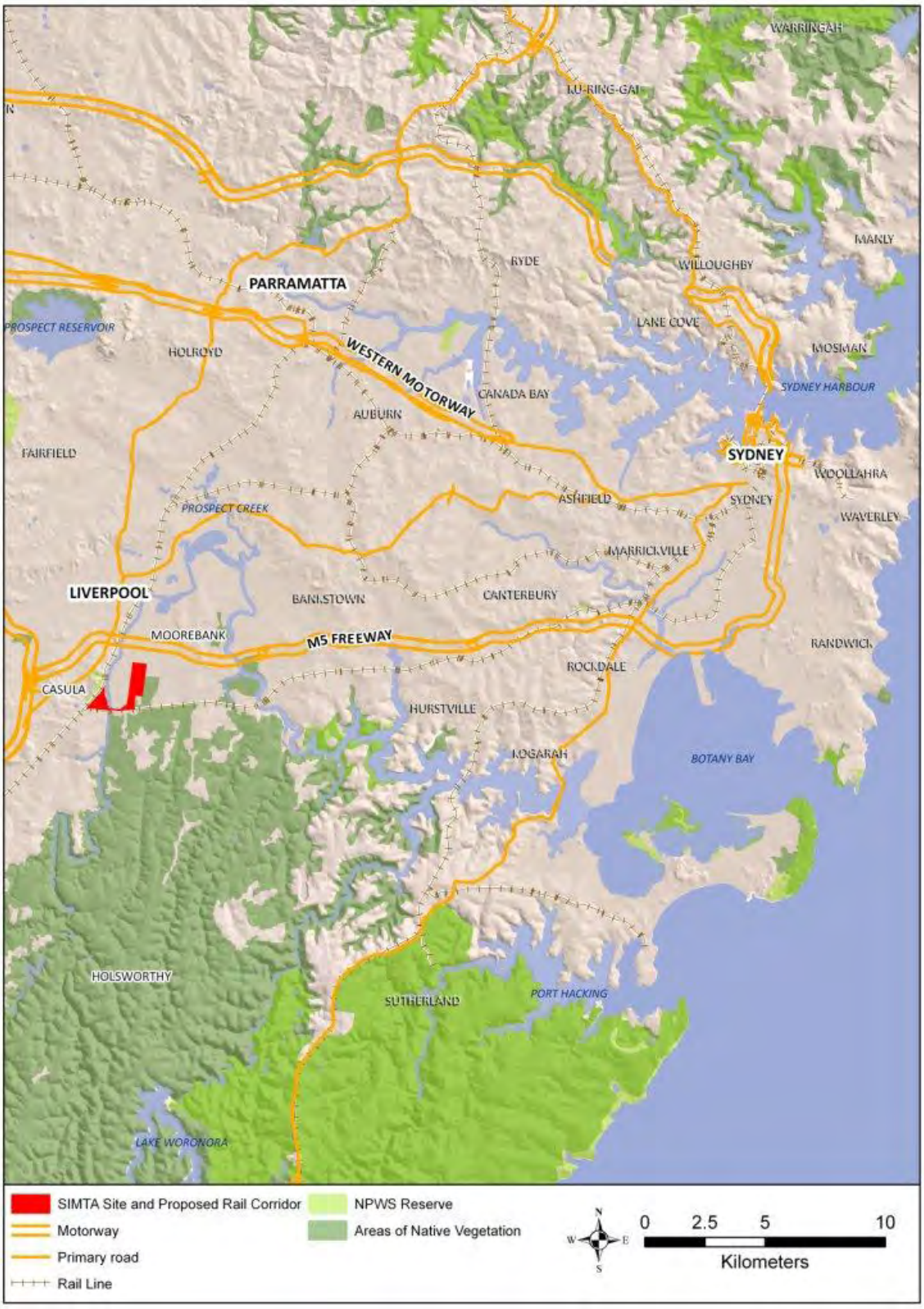

Figure 1: Location of the study area

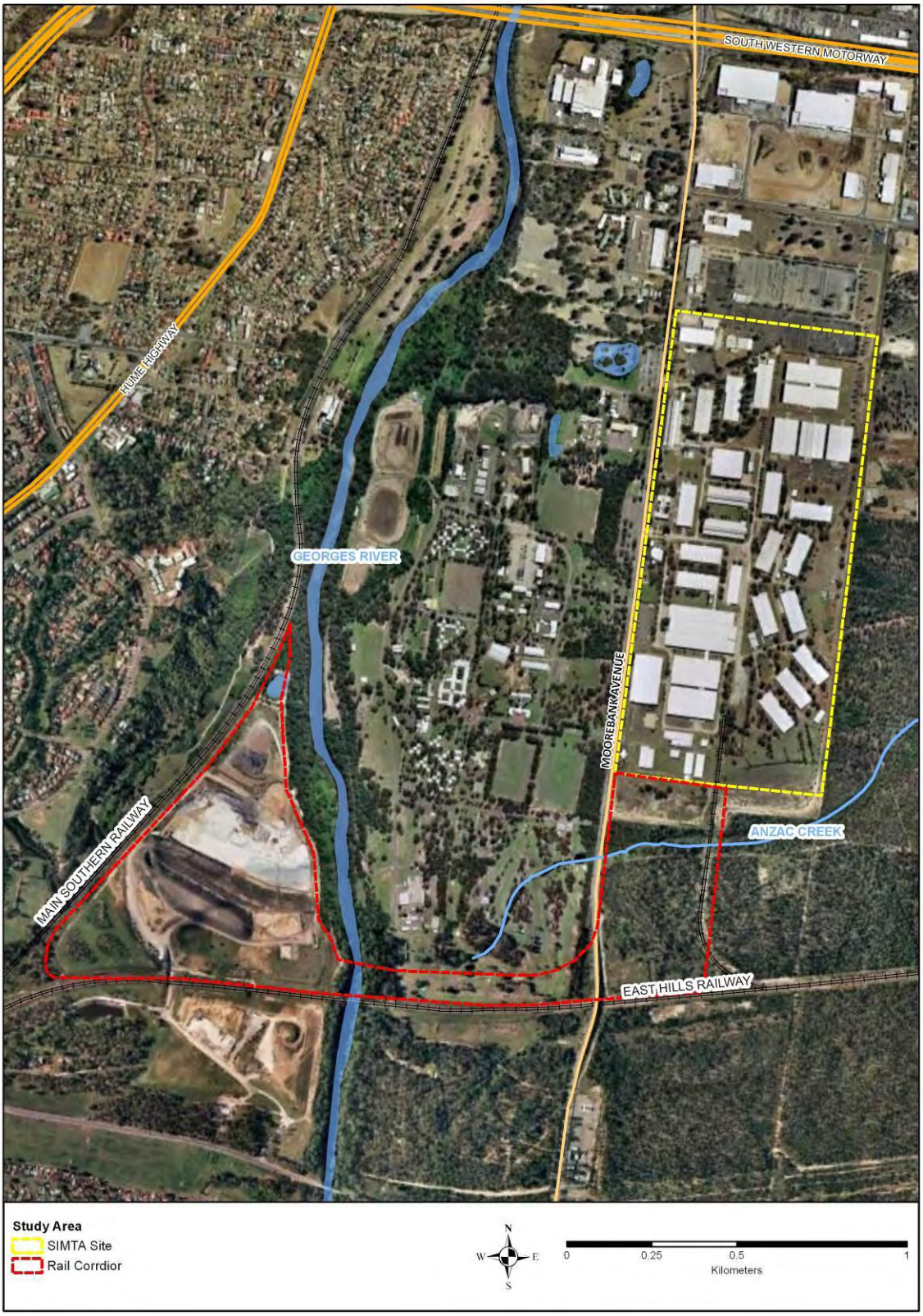

Figure 2: The study area

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 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; and
- The Protected Matters Search Tool which is managed by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (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.

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 2002).
- *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* (DECC 2007a).
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009).
- *Native vegetation of south-east NSW: a revised classification and map for the coast and eastern tablelands* (Tozer *et al.* 2010).

2.2 Field Survey

A terrestrial flora and fauna survey of the study area 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.

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):

Table 1: Weather records from Holsworthy Control Range weather station for the survey dates

Date	Temperature		Rain	Maximum wind gust	
	Min	Max		Dir	Spd
	°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

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.

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 six 400m^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 2008c).

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.

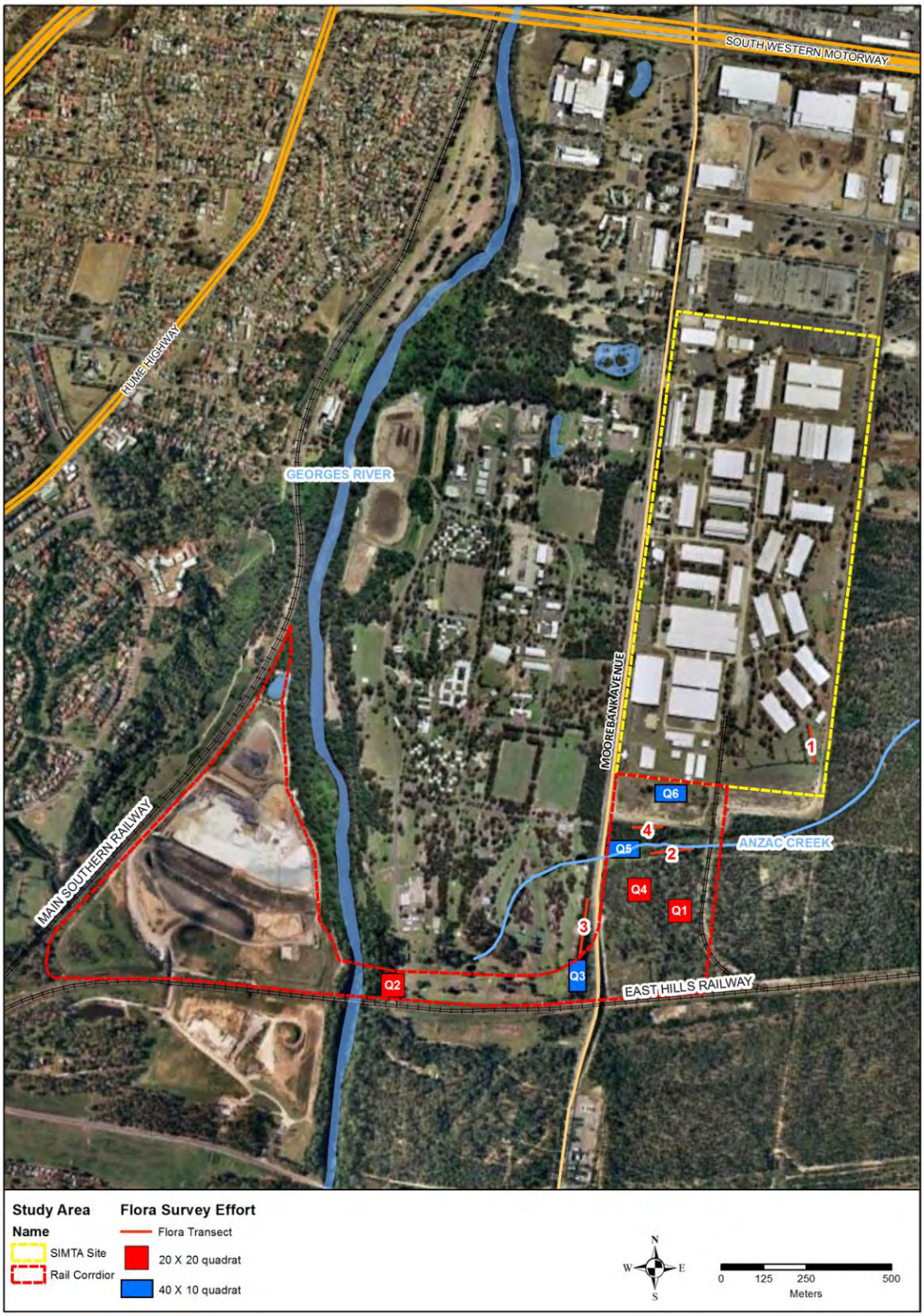

Figure 3: Locations of flora quadrats and transects

2.2.2 Fauna

Fauna surveys, involving diurnal and nocturnal techniques, were conducted across the study area over five days and four nights between Monday 2 May 2011 and Thursday 12 May 2011. 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); and
- 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.
    - Foragaing 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 playered 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 four nights (a total of eight locations within the study area) during the survey period.

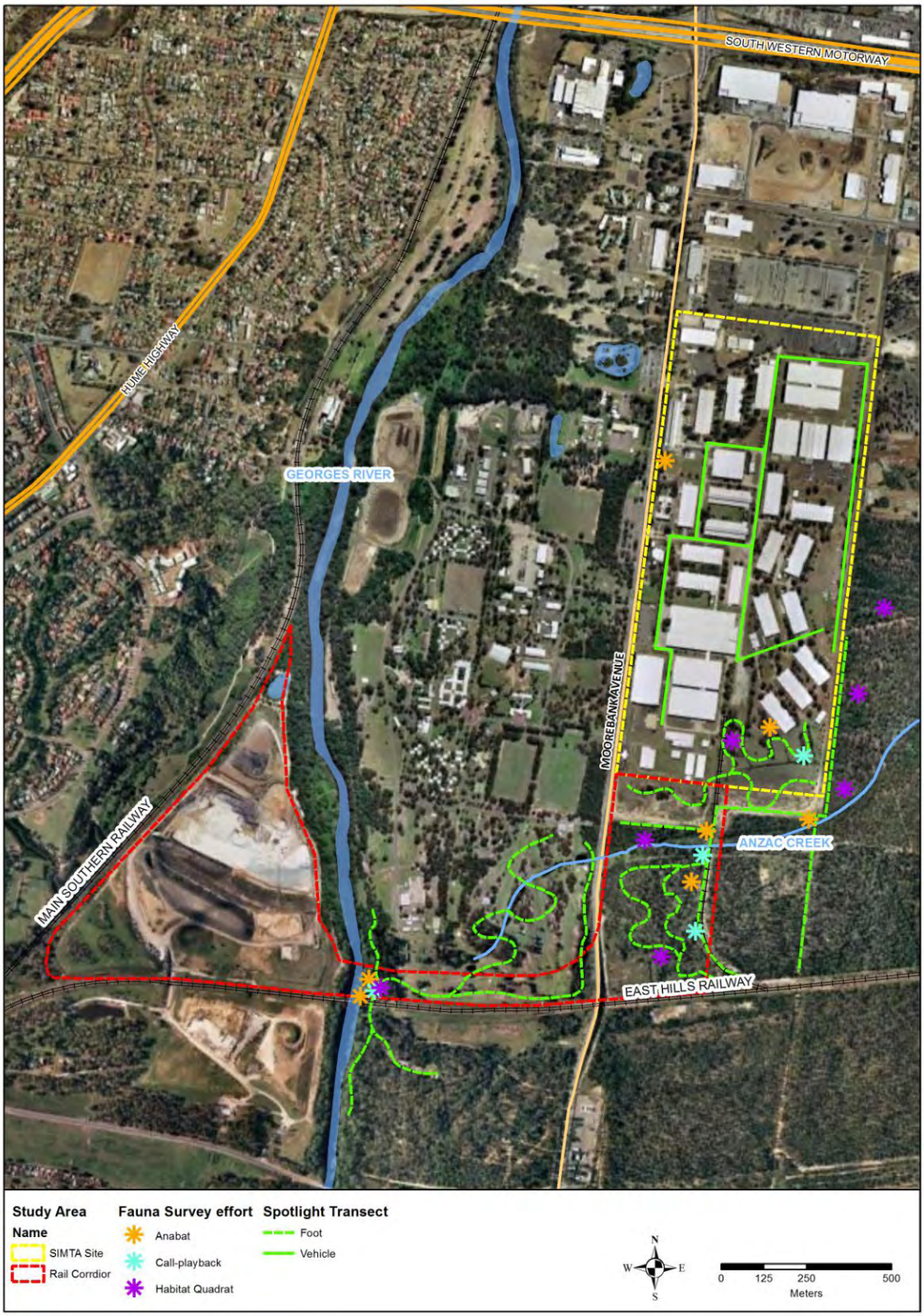

Figure 4: Fauna survey effort

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.

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 2.

Table 2: 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 (ie 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 seven days and four nights in late autumn 2011. 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.

Access to the study area west of the Georges River on the Glenfield Waste Disposal site was restricted and no field assessment of this area was undertaken. As a result, flora and fauna species and potential habitat resources that may occur in this portion of the study area are unconfirmed. This area has been assessed based on desktop information only.

The brevity of the investigation and its timing mean that the full spectrum of flora and fauna species likely to occur on the study area cannot 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. Simialrly, 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 behavious 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 plant species occurring in the study area were not detected during the current survey due to the above factors.

These limitations have been partly addressed by identifying potential habitats for flora and fauna species and assessing 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, and the landscape context. The precautionary principle was applied where marginal habitat is identified or predicted to occur or species are migratory or nomadic and are 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 five different soil landscapes mapped within the study area: the fluvial soil landscapes Berkshire Park, Richmond and Freemans Reach, the erosional soil landscape Luddenham and the residual soil landscape Blacktown.

The features and location in the study area of the mapped soil landscapes are detailed in Table 3.

Table 3: Soil landscapes mapped in the study area by Bannerman and Hazelton *et al.* (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.
Blacktown (Residual)	Shallow to moderately deep hardsetting mottled texture contrast soils; red and brown podzolic soils on crests, draining to yellow podzolic soils on lower slopes and drainage lines. On gently undulating rises on Wianamatta Group Shales.	Small area in south of waste disposal site, 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 metres, 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 1m in depth, but reaches a depth of up to 2.5 metres 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. 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 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) with additional photographs obtained from the NSW Land and Property Management Authority.

SIMTA site

On the 1930 aerial photograph, 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.

By 1951, 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.

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 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.

Rail corridor

In 1930 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; the waste disposal site is mainly cleared and supports paddocks and orchards.

On the 1951 aerial photograph 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.

In 1961, 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.

By 1979 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.

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.

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.

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 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 (IMT site), comprising the Moorebank and Steele Barracks, which lies immediately to the west of the SIMTA site across Moorebank Avenue. Part of the IMT 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 PB (2011) assessment is to provide preliminary assessment of the potential impacts of the proposed IMT project on flora, fauna and ecological values of the MIFT 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 IMT 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 MIFT site, and included some of the vegetation within the rail corridor lands.

The size of the population of each species on the IMT site is not given in the results section, however in the impact significance assessments in Appendix A of 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 IMT site.

An additional eight threatened flora species were considered to have a moderate likelihood of occurrence on the IMT 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 IMT 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 ~~-m~~ap 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.

Six different plant communities were mapped in the study area (Figure 5):

- Cooks River Castlereagh Ironbark Forest
- Castlereagh Swamp Woodland
- Castlereagh Scribbly Gum Woodland
- Shale Plains Woodland
- Alluvial Woodland
- Riparian Forest
- Shale/Gravel Transition Forest

Most of the vegetation within the study area was mapped as being in low condition, with 14.63 of the total 25.2 hectares of mapped vegetation defined as having tree cover only with less than 10 per cent canopy cover.

The conservation significance assessment by NPWS (2002) 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.

Four different native vegetation communities were mapped within the study area (Figure 7):

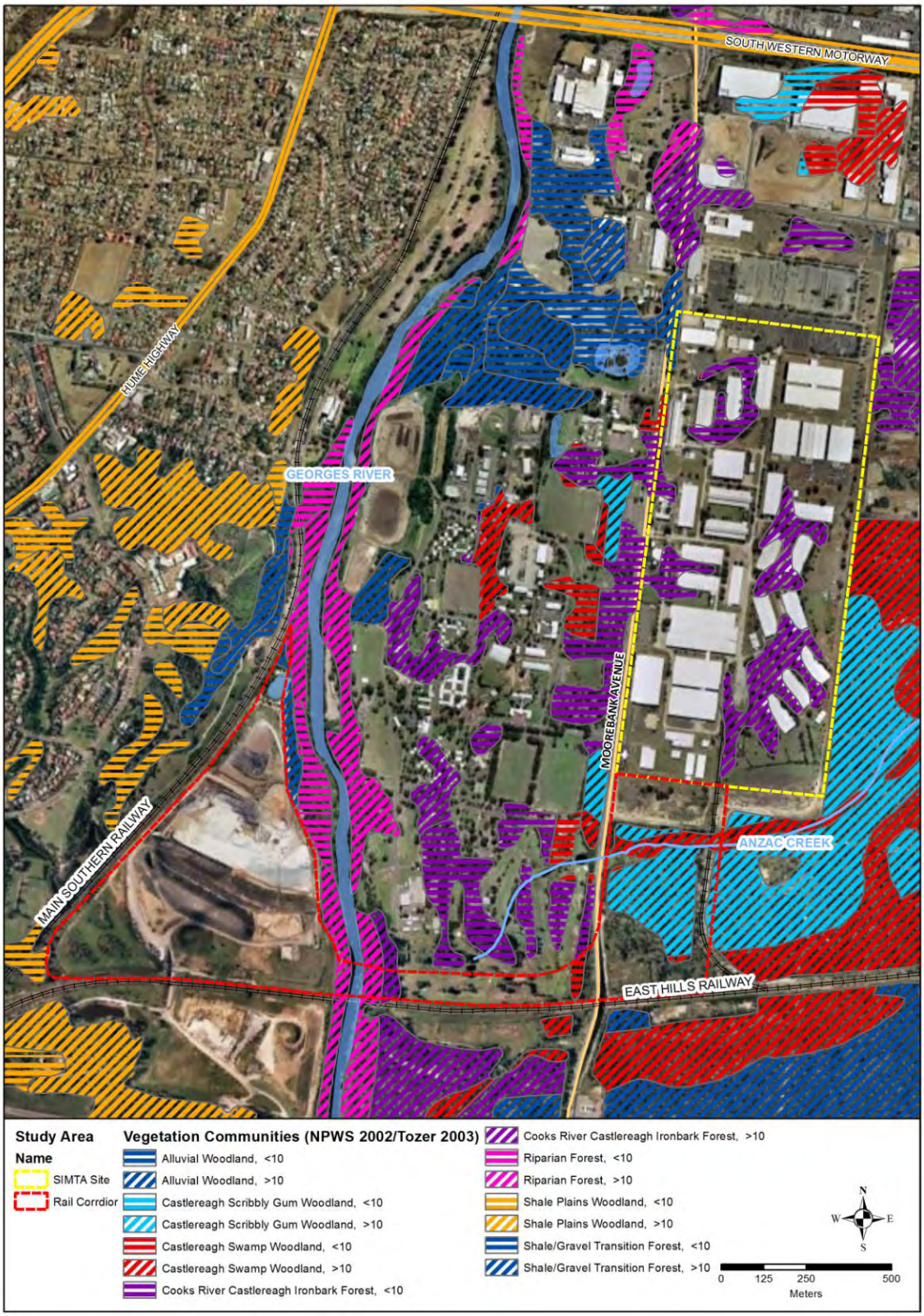

Figure 5: NPWS (2002)/Tozer (2003) vegetation mapping of the study area

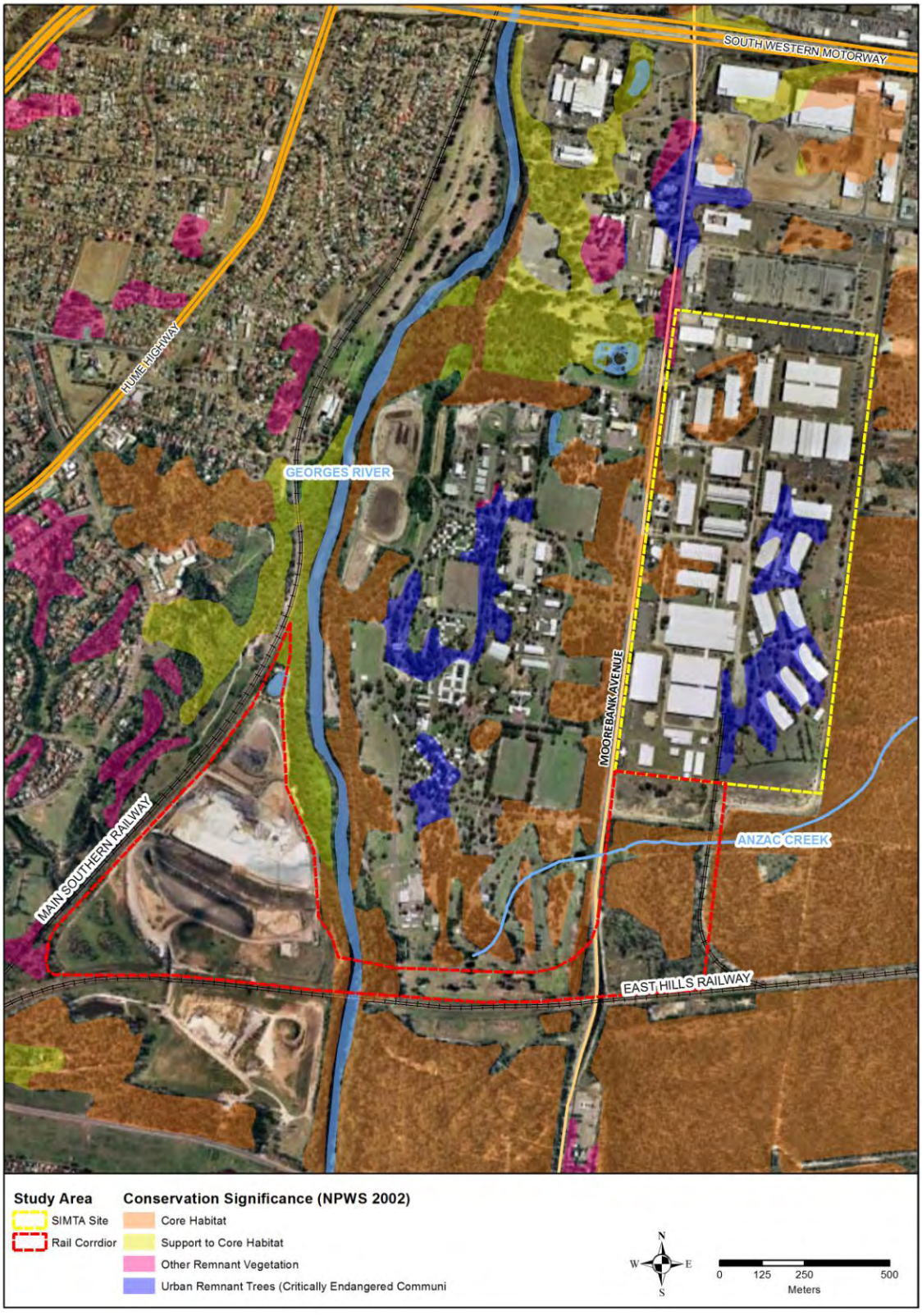

Figure 6: NPWS (2002) conservation significance mapping of the study area

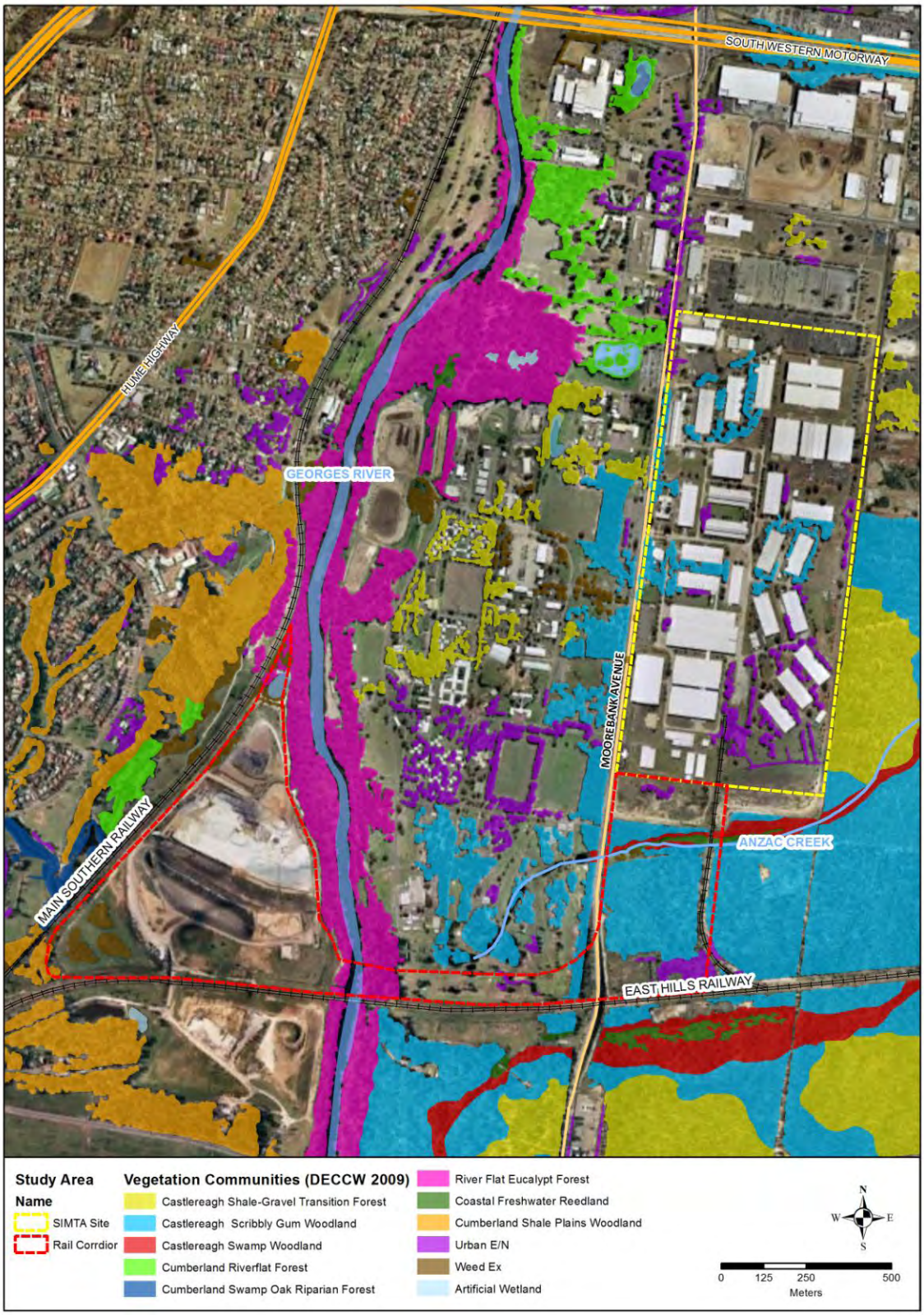

Figure 7: DECCW (2009) vegetation mapping of the study area

- Castlereagh Scribbly Gum Forest
- Castlereagh Swamp Woodland
- Coastal Freshwater Reedland
- Hinterland Flats Eucalypt Forest

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.

Tozer *et al.* (2010) mapped the native vegetation of south-east NSW, comprising an area bounded by the coast from northern Sydney to the Victorian border and the escarpment and tablelands from the Blue Mountains to Delegate. The vegetation was classified into 191 plant communities based on numerical analysis of 10,832 field sample quadrats, and the distribution of communities was mapped at 1:100 000 scale using relationships between plant assemblages and climate, terrain, substrate and vegetation structure as well as aerial photograph interpretation.

Four different plant communities were mapped in the study area (Figure 8):

- Castlereagh Ironbark Forest
- Castlereagh Swamp Woodland
- Castlereagh Scribbly Gum Woodland
- Cumberland River Flat Forest

The vegetation mapping of Tozer (2003), DECCW (2009) and Tozer *et al.* (2010) in the study area was compared (Table 4).

Table 4: 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)		Tozer *et al.* (2010)
	>10% Canopy cover	<10% Canopy cover	Low to moderate disturbance	High to very high disturbance/ not assessed	
Alluvial Woodland	1.31				
Castlereagh Ironbark Forest	0.35	13.43			0.93
Castlereagh Swamp Woodland	1.77	0.54	0.01	0.6	1.67
Castlereagh Scribbly Gum Woodland	6.69		8.04	7.32	6.84
Riparian Woodland/River Flat Forest	1.04	0.02		6.56	2.77
Shale Plains Woodland		0.02	0.14		
Shale/Gravel Transition Forest		0.24			

Vegetation community	Area of vegetation community mapped within study area (hectares)				
	NPWS 2002/ Tozer (2003)		DECCW (2009)		Tozer *et al.* (2010)
	>10% Canopy cover	<10% Canopy cover	Low to moderate disturbance	High to very high disturbance/ not assessed	
Coastal Freshwater Reedland			0.44		
Urban/Exotic vegetation				8.46	
Total vegetation mapped	11.16	14.25	8.63	22.94	12.21

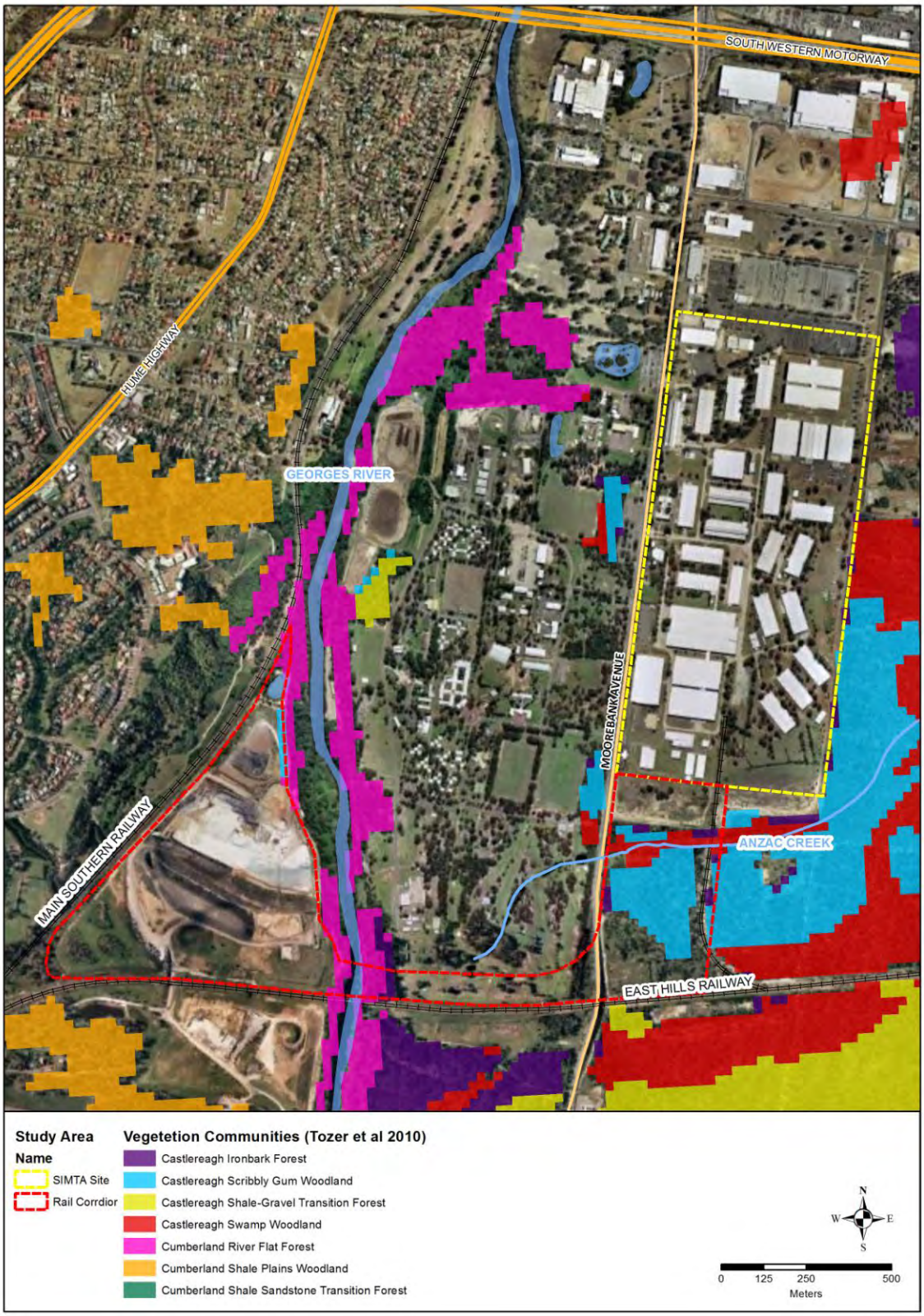

Figure 8: Tozer *et al.* (2010) vegetation mapping of the study area

Tozer *et al.* (2010) is mapped at 1:100 000 scale and appears to exclude vegetation with less than 10 percent canopy cover. 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, 23 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 5). TSC Act records occurring within 10 kilometres of the study area are shown in Figure 9.

Table 5: 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
Caladenia tessellata	Thick Lip Spider Orchid	Vulnerable	Endangered
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered
Deyeuxia appressa	-	Endangered	Endangered
Dillwynia tenuifolia	-	Vulnerable	Vulnerable
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Vulnerable
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	Vulnerable	Vulnerable
Hibbertia sp. ―Bankstown"		Critically Endangered	Critically Endangered
Leucopogon exolasius	Woronora Beard-heath	Vulnerable	Vulnerable
Marsdenia viridiflora subsp. *viridiflora*	-	-	Endangered population
Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Vulnerable
Melaleuca deanei	Deane's Melaleuca	Vulnerable	Vulnerable
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
Pterostylis gibbosa	Illawarra Greenhood	Endangered	Endangered
Pterostylis saxicola	Sydney Plains Greenhood	Endangered	Endangered
Pultenaea parviflora	Sydney Bush-pea	Vulnerable	Endangered

Scientific name	Common name	EPBC Act status	TSC Act status
Pultenaea pedunculata	Matted Bush-pea	-	Endangered
Thelymitra sp. Kangaloon (D.L.Jones 18108)	Kangaloon Sun-orchid	Critically Endangered	-

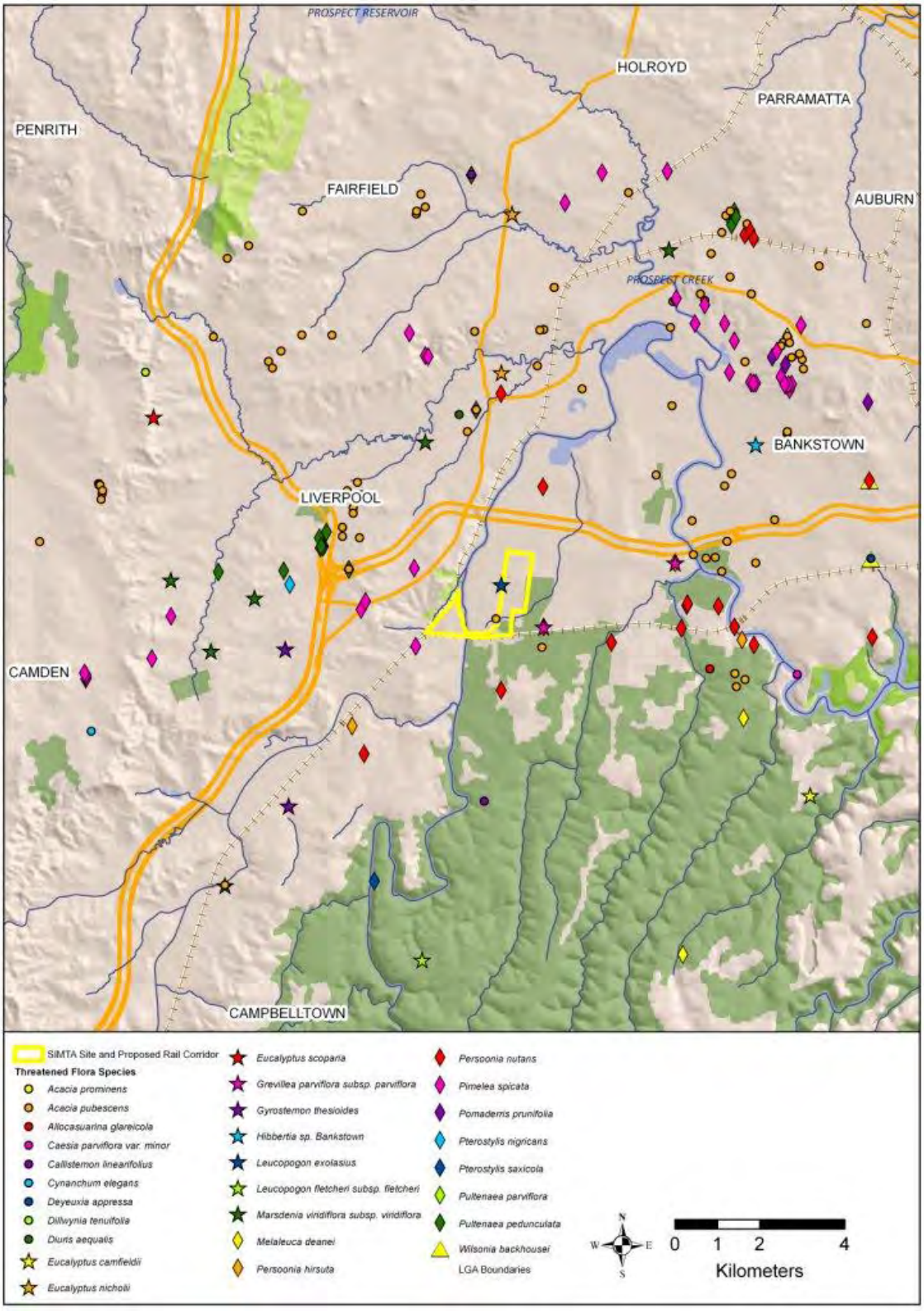

Figure 9: Threatened flora species records within 10 kilometres of the study area

3.2.4 Field Survey

A total of 269 vascular plant species were recorded in the study area, comprising 193 local native species, eight non-local native species (mainly planted trees) and 68 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: 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. 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; 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 16m in height as well as some *E. parramattensis* in this area, most with native shrubs and groundcover species growing around the bases. These trees are visible on the 1955 aerial photograph where they appear to be much smaller; the surrounding area in the south was cleared and filled between 1930 and 1955 and appears as mostly bare soil on aerial photographs from 1955 to 1994. 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 1m 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. 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. Exposed soil beneath a fallen tree showed soil mixed with broken concrete tiles. *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. 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 dense shrubs and a sparse shrub and grass understorey to relatively open in the mid-layer with dense grass and low shrubs. 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. 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 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 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.

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 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 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 botryoides* x *saligna* (Bangalay/Blue Gum 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). The vegetation was less disturbed upslope and included a mixed native and exotic understorey with mature trees of *E. botryoides* x *saligna*. 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

Plate 20. Degraded riparian vegetation

Glenfield Waste Disposal Site

This area was not surveyed due to restricted access. Based on analysis of current and historical aerial photographs and published vegetation maps, this area is likely to support regrowth Cumberland Plain Woodland in and adjoining the south-western corner and degraded riparian forest adjoining the Georges River. The area has been used for farming, sand mining and waste disposal over the last 150 years and is likely to be highly modified.

3.2.4.2 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 6). 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 6: 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

Botanical name	Common name	Count
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
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

Botanical name	Common name	Count
Triadica sebifera	Chinese Tallow Tree	4
Total		590

3.2.5 Noxious weeds

The NSW 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 7.

Table 7: 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.
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.

Nine of the 61 exotic species recorded in the study area are listed as noxious weeds in the Liverpool City Council local government area (Table 8).

Table 8: Noxious weeds recorded in the study area

Scientific name	Common name	Control class	Location in study area
Asparagus asparagoides	Bridal Creeper	4	Banks of Georges River
Chrysanthemoides monilifera subsp. *rotundata*	Bitou Bush	3	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
Lantana camara	Lantana	4	Banks of Georges River
Ligustrum sinense	Small-leaved Privet	4	Banks of Georges River

Scientific name	Common name	Control class	Location in study area
Olea europaea subsp. *cuspidate*	African Olive	4	Banks of Georges River
Opuntia sp.	Prickly Pear	4	Banks of Georges River
Rubus fruticosus agg. spp. (includes *R. discolor*)	Blackberry	4	Banks of Georges River, in disturbed bushland south of Anzac Creek
Salvinia molesta	Salvinia	2	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).

3.2.6 Significant flora

3.2.6.1 Threatened ecological communities

The EPBC Act Protected Matters Search (Appendix 4) identified three Threatened Ecological Communities (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. Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest may occur in the far south-western corner of the study area, on the Glenfield Waste Disposal site. This community is largely equivalent to Cumebrland Plain Woodland as listed under the TSC Act, and the potential occurrence of this community in the study area is discussed in further detail below.

Five threatened ecological communities listed under the TSC Act were identified on the railway corridor lands:

- 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
- Cumberland Plain Woodland in the Sydney Basin Bioregion

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 Scribby Gum Woodland.

Assessments of Significance have been undertaken for Endangered Ecological Communities listed under the TSC Act (Appendix 5).

Castlereagh Scribbly Gum Woodland

Castlereagh Scribbly Gum Woodland is listed as Vulnerable under the TSC Act. 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.

On balance, 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.

Cumberland Plain Woodland

The vegetation in and adjoining the far south-western corner of the study area, on the Glenfield Waste Disposal site, has been mapped as Cumberland Plain Woodland in two vegetation mapping studies (NPWS 2002/Tozer 2003 and DECCW 2009). This approximately 0.5 hectare area of vegetation, most of which lies just outside of the current study area, was not accessible for the current survey and therefore a detailed assessment of its consistency with the legal definition of this critically endangered ecological community could not be undertaken.

In order to qualify as the listed critically endangered community Cumberland Plain Woodland under the EPBC Act, a patch must meet the following minimum criteria as defined in EPBC Act Policy Statement 3.3.1 (Commonwealth of Australia 2010):

- Native tree species present with a minimum projected foliage cover of 10%
- Patch 0.5 hectares or greater in size
- Either:
    - Over 50% of perennial understorey vegetative cover is made up of native species;
    - Patch greater than 5 hectares in size and has over 30% native perennial understorey vegetative cover;
    - Patch contiguous with a native vegetation patch greater than 5 hectares in size and has over 30% native perennial understorey vegetative cover;
    - Patch contains at least one tree per hectare that is large (>80 cm dbh) or has a hollow, and has over 30% native perennial understorey vegetative cover.

Based on these criteria, it is considered unlikely that the 0.5 hectare area of vegetation in and adjoining the south-west of the study area fall within the definition of Cumberland Plain Woodland under the EPBC Act, given that the patch has been mapped as less than 10 percent canopy cover, has a history of disturbance and appears on the recent aerial photograph to have a degraded understorey.

It is possible that this vegetation meets the criteria for the critically endangered ecological community Cumberland Plain Woodland in the Sydney Basin Bioregion under the TSC Act, as there is a broader definition of this community under the Final Determination of the NSW Scientific Committee. In the absence of field assessment of this patch, application of the precautionary principle requires an assumption that this vegetation is consistent with Cumberland Plain Woodland as defined under the TSC Act.

The communities identified in the study area are equivalent to the following Vegetation Types as defined in the NSW Vegetation Type Database (Table 9):

Table 9: Vegetation Types in the study area

Identified vegetation community	Equivalent Vegetation Type
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 on Coastal Floodplains	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin

Identified vegetation community	Equivalent Vegetation Type
Freshwater Wetlands on Coastal Floodplains	Coastal freshwater lagoons of the Sydney Basin and South-east Corner
Cumberland Plain Woodland	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin

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 condition for the equivalent vegetation types (Table 10).

Table 10: 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	BM	Q5	BM
Native plant species richness	47	53	47	25	40	16	24	32	36
Native overstorey cover	15	15	15	30	10-20%	15	28-33%	4	7-42%
Native midstorey cover	2	60	40	30	23-33%	12	21-31%	50	5-25%
Native ground cover (grasses)	40	10	40	10	12-24%	25	24-30%	40	12-38%
Native ground cover (shrubs)	30	10	5	2	0-10%	5	0-10%	5	0-10%
Native ground cover (other)	5	0	0	0	12-24%	15	24-30%	40	12-38%
Number of trees with hollows	0	0	0	0	1	0	1	0	1
Total length of fallen logs (m)	0	0	2	0	30	20	50	3	30

BM = benchmark

3.2.6.2 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.

Assessments of Significance have been undertaken for threatened species listed under the TSC Act (Appendix 5), while Significant Impact Assessments have been undertaken for those species listed under the EPBC Act (Appendix 6).

The locations of threatened 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 0.5–1.5m high, with linear leaves and hairy young branches.

Persoonia nutans is endemic to the Cumberland Plain where it is confined to aeolian and alluvial sediments. The species has a disjunct distribution, with the majority of the population occurring in the north of the range around Agnes Banks, Londonderry, Castlereagh and Windsor Downs, and isolated and relatively small populations found at Kemps Creek, Moorebank, Holsworthy and Voyager Point and Villawood (DEC 2005).

Robertson *et al.* (1996) estimated the total population size at approximately 6278 plants based on counts from nine different populations. DEC (2005) identify 25 populations (populations being distinguished on the basis of a geographic discontinuity of more than one kilometre) and state that the total number of mature individuals is likely to be greater than 5500.

As *P. nutans* is a fire sensitive obligate seeder, the species will exhibit considerable fluctuations in the number of mature individuals over time, depending upon time since fire. Recorded population sizes vary from only a few individuals to thousands of plants, although the majority of populations support a low number of plants; 64% of populations consist of less than ten mature individuals. Less than 1% of individuals occur within the southern part of the species range.

P. nutans is often found at the disturbed edge of bushland and Robertson *et al.* (1996) suggested that the species requires disturbance to persist and is capable of surviving extreme disturbance; fire was probably the primary agent of disturbance in the past.

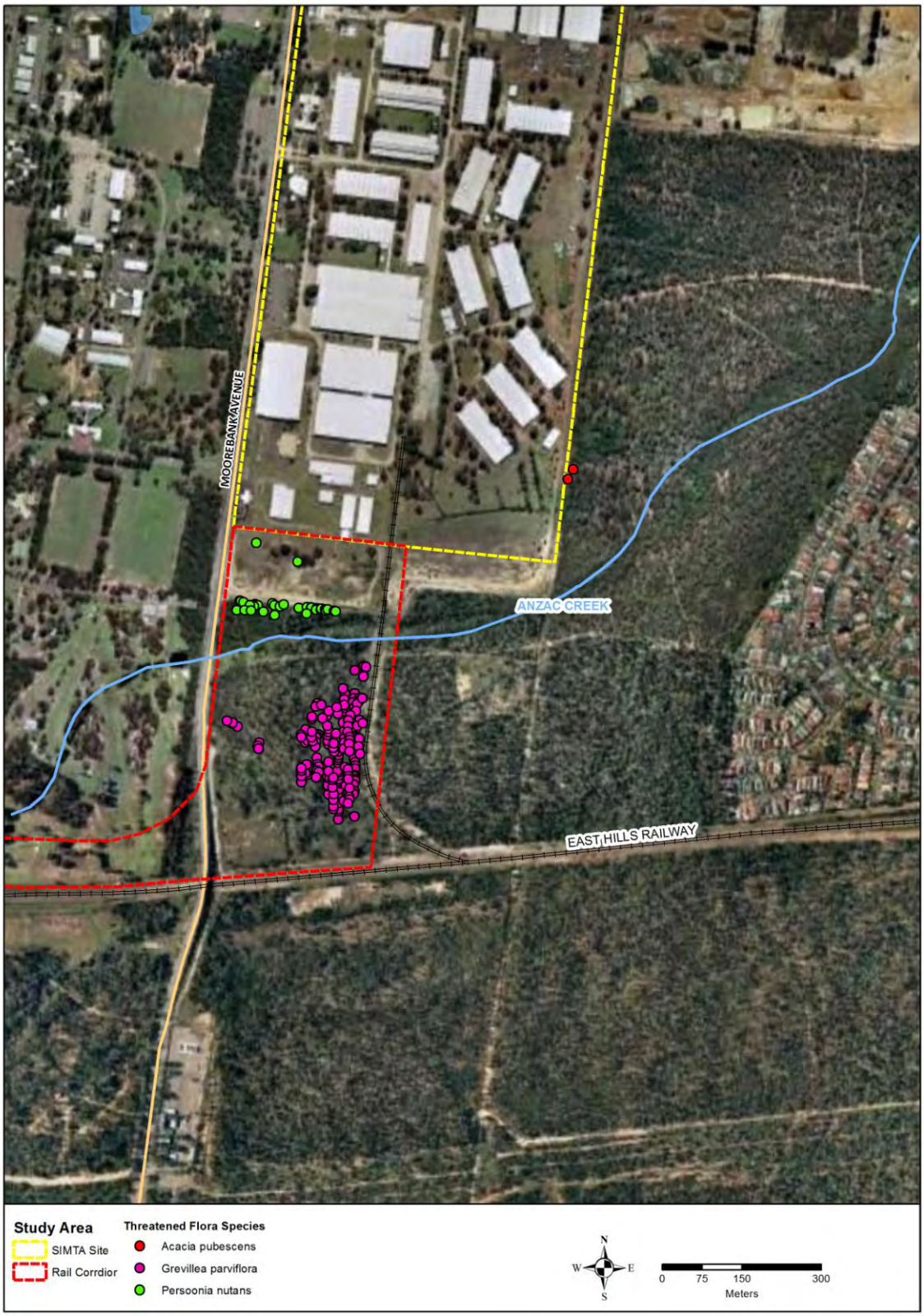

Figure 10: Locations of threatened plant species recorded in the study area

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 44 individual plants Plants ranged from 30cm to about 1.8m in height, and many individuals were observed to be flowering and/or fruiting. Although the bushland east of the disused railway line was not searched as it was not within the current study area, *P. nutans* was observed at the edge of bushland in 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 2m. The species suckers readily from rhizomes, although individuals sometimes have single stems (DSEWPC 2011).

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% 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 on 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. The species is restricted to the Sydney region; populations of the species have been recorded in the Bankstown, Fairfield and Rookwood area, however, the species is also known to occur within the Baulkham Hills, Hawkesbury and Liverpool LGA's.

A. pubescens typically occurs on alluviums, shales and the intergrade between shale and sandstone soil, in association with open woodland and forest communities including Cooks River Castlereagh Ironbark Forest, Shale/Sandstone Transition Forest and Cumberland Plain Woodland Endangered Ecological Communities.

The species is clonal and more commonly recruits from suckers of a parent plant rather than seed, resulting in dense patches of the species formed from one individual. Acacia species generally have high seed dormancy, however, Downy Wattle may require a fire-free period of up to seven years in order to allow an adequate soil seedbank to develop.

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.

3.2.6.3 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 11). Species were assessed as being either Unlikely, Possible, Likely or Known to occur in the study area, based on the criteria in Table 2. 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.

Table 11: 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.
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.
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 No suitable habitat exists 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.
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

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
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
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.
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.
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