SIMTA Intermodal Terminal Facility- Stage 1

Biodiversity Assessment Report

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

May 2015

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SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)

INTERMODAL TERMINAL FACILITY - STAGE 1

Biodiversity Assessment Report

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Report No	1	
Date	4 May 2015	

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1 INTRODUCTION

1.1 REPORT PURPOSE

This report has been prepared as an Appendix to the Environmental Impact Statement (EIS) for Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility (the Proposal). The Proposal includes the construction and operation of an intermodal terminal facility and Rail link at Moorebank, NSW. The NSW Department of Planning and Environment (DPE) issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal which state that the impacts of the Proposal must be assessed in accordance with OEH's *Framework for Biodiversity Assessment* (FBA) under the *NSW Biodiversity Offsets Policy for Major Projects* published in October 2014. As such, this report has been prepared in accordance with the FBA requirements and follows the recommended report structure in Appendix 7 of the FBA. This report also meets Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (now the Department of the Environment) conditions of approval (No. 2011/6229) for a Referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 BACKGROUND

The SIMTA Project involves the development of an intermodal facility, including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank (the SIMTA site). The SIMTA Project also includes a Rail link, within an identified Rail Corridor (the Rail Corridor), which connects from the southern part of the SIMTA site to the Southern Sydney Freight Line (SSFL). This entire area including the SIMTA site and Rail Corridor are collectively referred to as the Project site. The SIMTA Project is to be developed in three key stages:

- Stage 1- Construction of the Intermodal Terminal Facility (IMT) and Rail link
- Stage 2- Construction of warehouse and Distribution Facilities
- Stage 3- Extension of the IMT and completion of Warehouse and Distribution Facilities.

A summary of the approvals undertaken to date for the SIMTA site, relating to the SIMTA Project, include:

- **EPBC Approval** (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act).
- **Concept Approval** (No. 10_0193) granted by the Planning Assessment Commission (PAC) on the 29 September 2014 for the 'Concept Approval' of the SIMTA Project under Part 3A of the EP&A Act.

Both of these approvals involved the preparation of design and environmental assessment documentation.

1.3 STAGE 1 PROPOSAL

The Proposal involves the construction and operation of the necessary infrastructure to support a container freight volume of 250,000 TEU (twenty-foot equivalent units) throughput per annum. Specifically, Stage 1 includes the following key components, which together comprise the intermodal terminal (IMT) facility:

- Truck processing, holding and loading areas- entrance and exit from Moorebank Avenue.
- Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively.
- Administration facility and associated car parking- light vehicle access from Moorebank Avenue.
- The Rail link – located within the Rail Corridor, including a connection to the IMT facility, traversing of Moorebank Avenue, Anzac Creek and Georges River and connection to the SSFL.
- Ancillary works- vegetation clearing, remediation, earth works, utilities installation/connection, signage and landscaping.

The extent of construction works, namely areas to be disturbed during construction of the Stage 1 site, the Rail link and construction compounds is herein referred to as the 'construction area'. The components of the Project site, including the construction area, are shown in Figure 1.

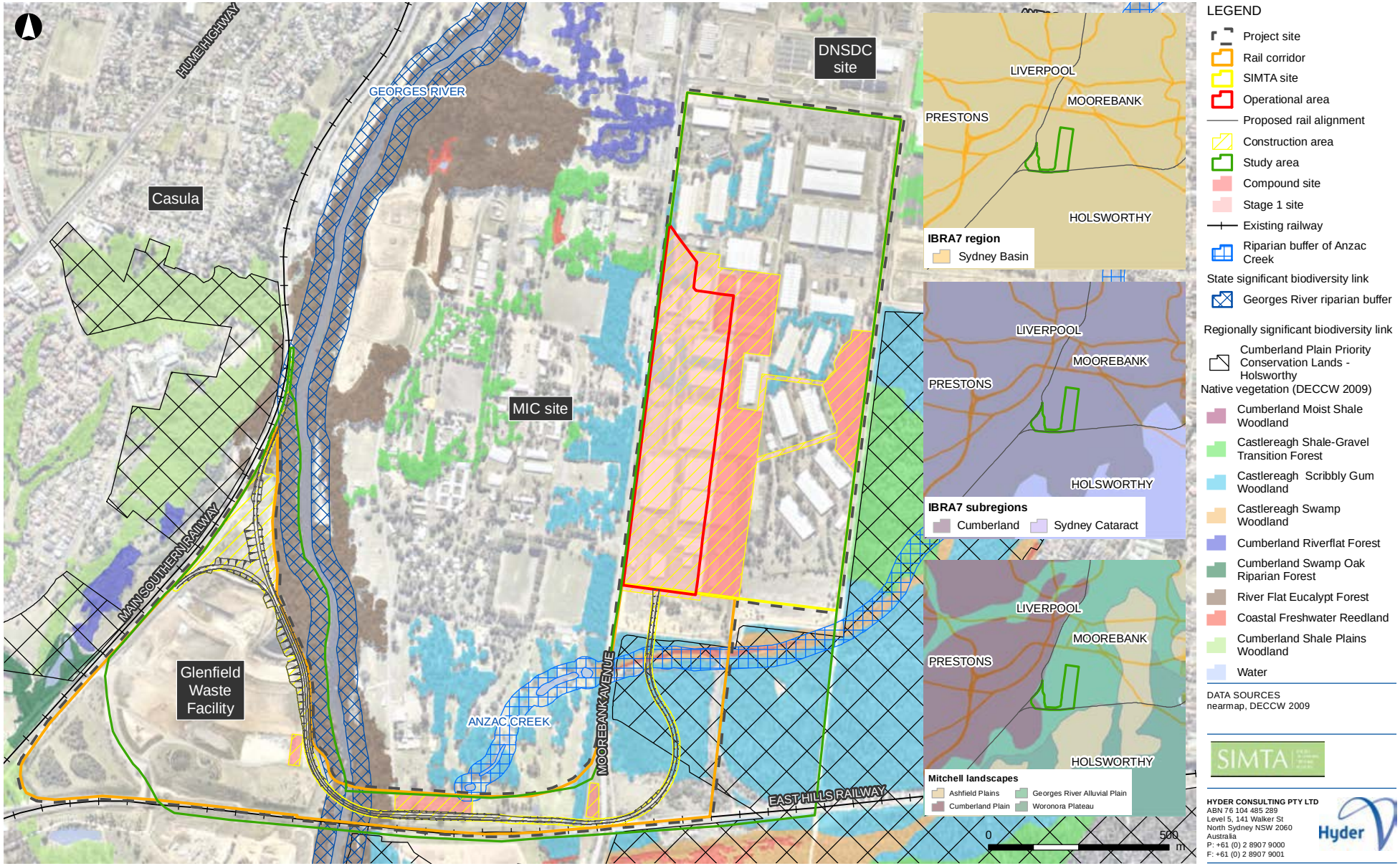

Figure 1: Site map

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QA by : AW

1.4 SITE DESCRIPTION

The SIMTA site, including the Stage 1 site, is located approximately 27 kilometres south-west of the Sydney Central Business District (CBD) and approximately 26 kilometres west of Port Botany. The SIMTA site is situated within the Liverpool Local Government Area (LGA), in Sydney's South West Sub-Region, approximately 2.5 kilometres from the Liverpool City Centre.

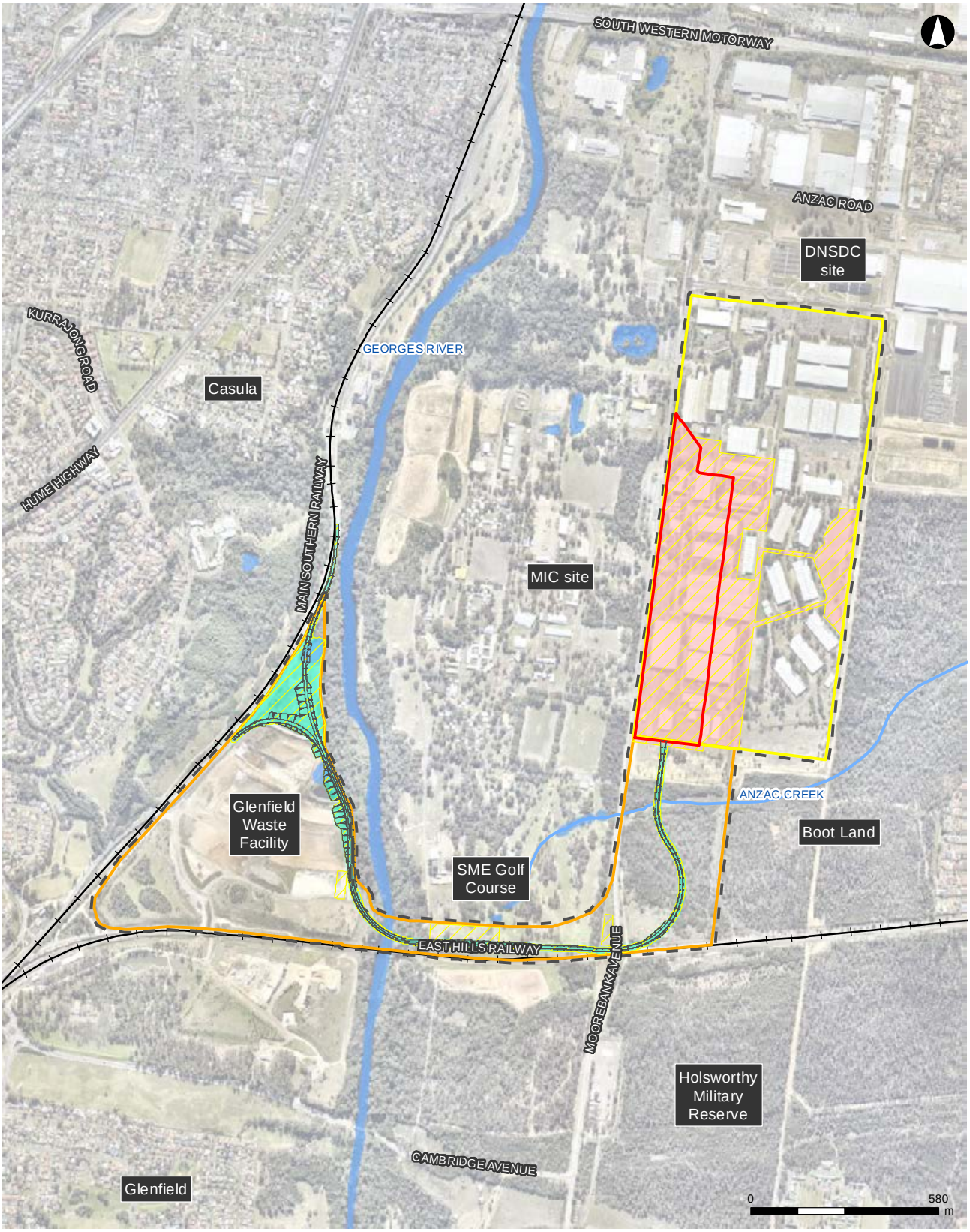
The SIMTA site is located approximately 800 metres south of the intersection of Moorebank Avenue and the M5 Motorway (Figure 3).

The SIMTA site was recently operating as the Defence National Storage and Distribution Centre (DNSDC) however Defence has recently relocated this operation and vacated the SIMTA site. The majority of land immediately surrounding the SIMTA site is owned and operated by the Commonwealth and comprises:

- School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the SIMTA site and includes a Golf Course (herein referred to as the MIC site).
- Holsworthy Military Reserve, to the south of the SIMTA site on the southern side of the East Hills Rail Line.
- Commonwealth Residual Land, to the east between the SIMTA site and the Wattle Grove residential area comprising part of the 'Boot Land'.
- Defence National Storage and Distribution Centre (DNSDC), to the north and north east of the SIMTA site.

The site to immediate west of the SIMTA site which currently includes the SME is the subject of a Development Application (DA) (SSD-5066), under Part 4, Division 4.1 of the EP&A Act, for the development of an intermodal facility known as the Moorebank Intermodal Terminal Project (MIC Proposal). The EIS for the MIC Proposal has recently been prepared and publically exhibited on 8 October 2014 to 8 December 2014. The MIC Proposal has yet to be determined by the Department of Planning and Environment (DP&E).

The Project site and surrounding land uses are shown in Figure 2. The Project site includes the SIMTA site and the Rail Corridor. Landscape features, including the relevant IBRA (Interim Biogeographic Regionalisation for Australia) bioregions/subregions, Mitchell landscapes and native vegetation, mapped in the outer assessment circle for the Proposal, are shown in Figure 3. These landscape features are discussed further in Section 30.



LEGEND

- Project site
- Rail corridor
- SIMTA site
- Operational area
- Proposed rail alignment
- Construction area
- Rail link
- Stage 1 site
- Existing railway
- Watercourse

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Figure 2: Land use map

Date: 21/04/2015 Path: \\hc-aus-ns-fs-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\AA003760_BAR_Stage1_Figure2_Land_use_A4_r2v2.mxd
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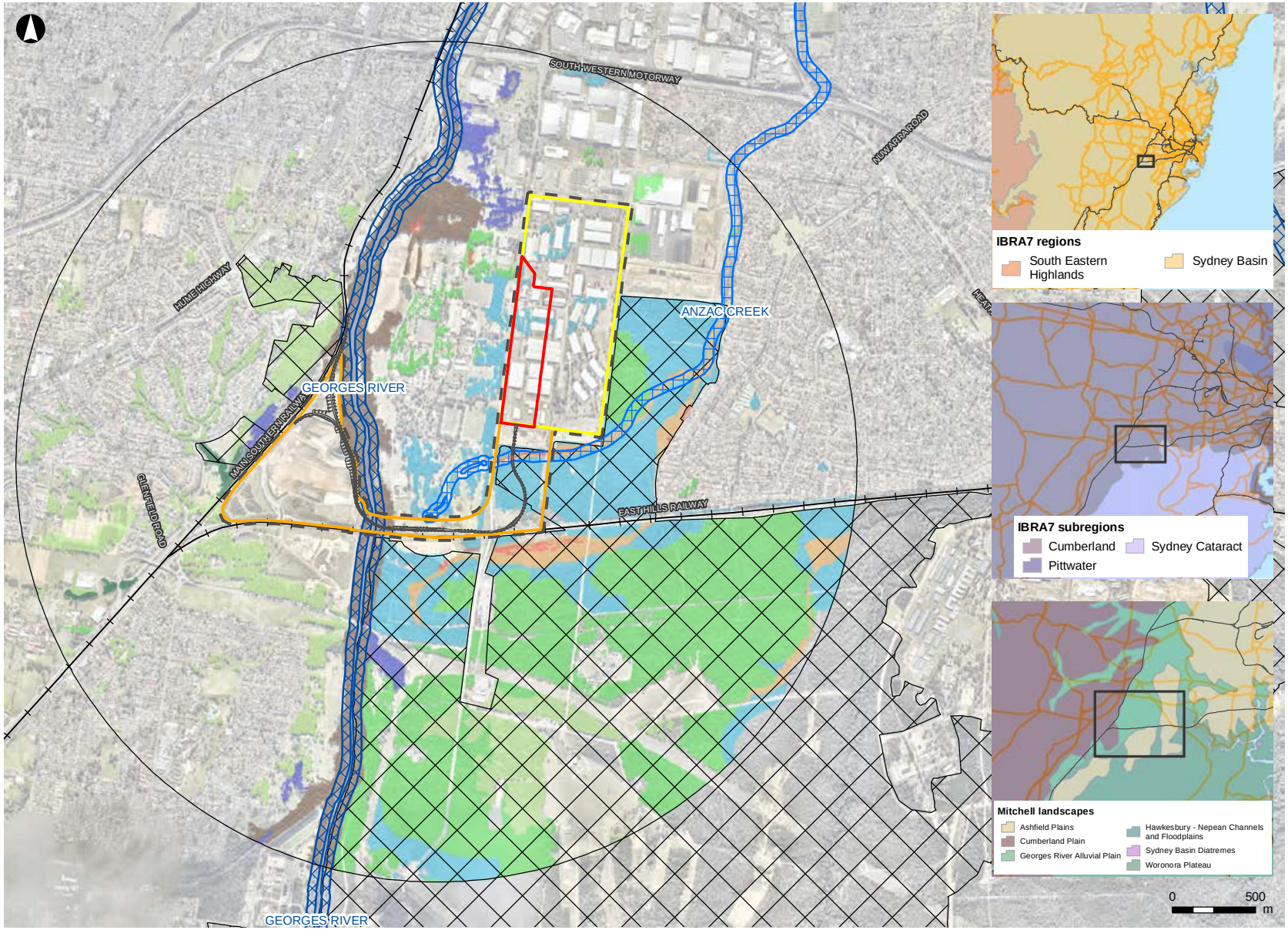

LEGEND

- Project site
- Rail corridor
- SIMTA site
- Operational area
- Proposed rail alignment
- Existing railway
- 2
- Riparian buffer of Anzac Creek

State significant biodiversity link

- Georges River riparian buffer

Regionally significant biodiversity link

- Cumberland Plain Priority Conservation Lands - Holsworthy

Native vegetation (DECCW 2009)

- Cumberland Moist Shale Woodland
- Castlereagh Shale-Gravel Transition Forest
- Castlereagh Scribbly Gum Woodland
- Castlereagh Swamp Woodland
- Cumberland Riverflat Forest
- Cumberland Swamp Oak Riparian Forest
- River Flat Eucalypt Forest
- Coastal Freshwater Reedland
- Cumberland Shale Plains Woodland

DATA SOURCES
nearmap, DECCW 2009

SIMTA

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Figure 3: Location map

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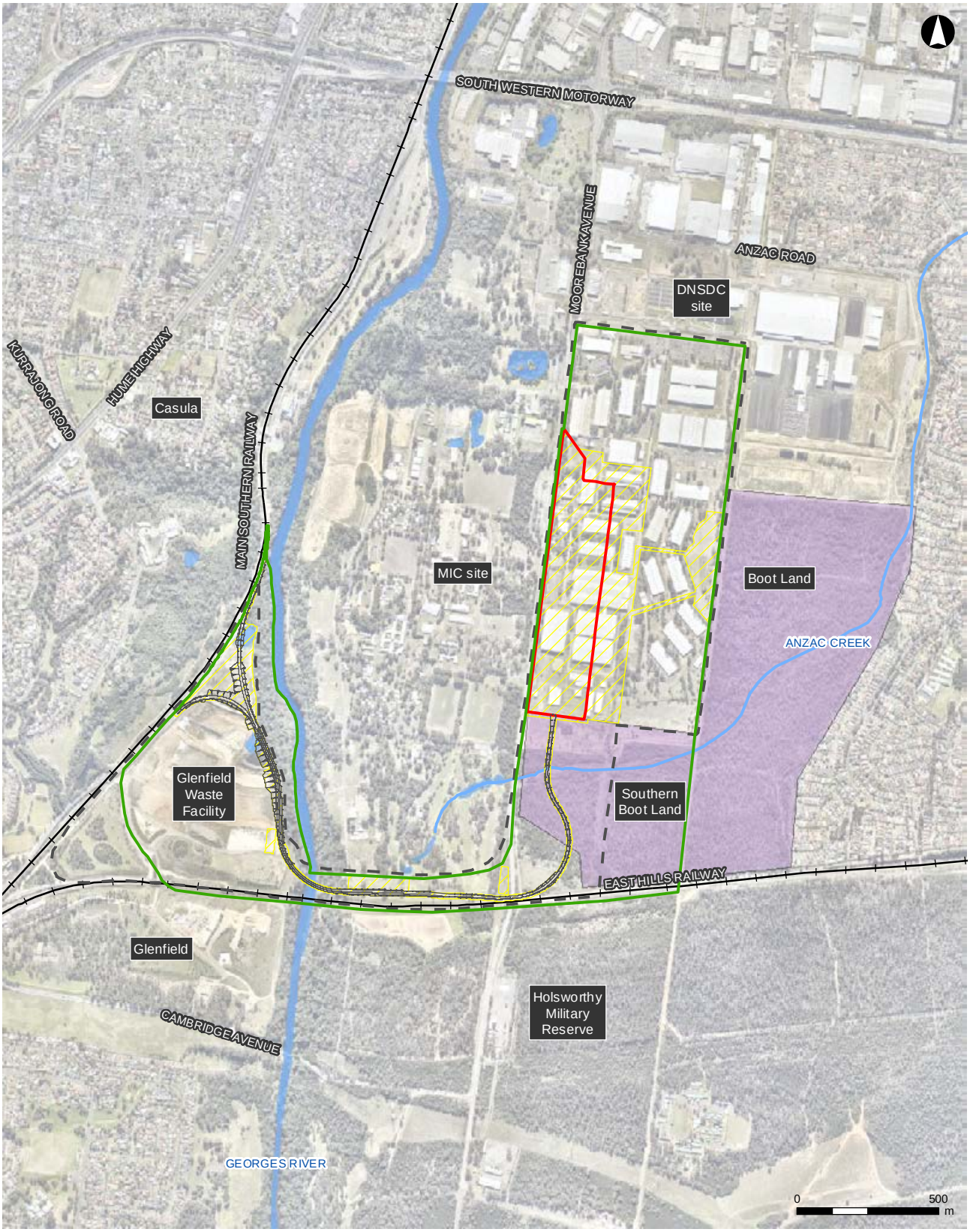
1.4.1 STUDY AREA

The study area for the current assessment comprises the entire Project site (SIMTA site and the adjoining Rail Corridor), including the construction area, a portion of Southern Boot Land to the east of the Rail Corridor and the riparian vegetation adjoining the study area on the western bank of the Georges River (Figure 4). The study area covers a total of approximately 175.59 hectares. The Rail Corridor contains the proposed Rail link and covers the former DNSDC south and Southern Boot Land, RailCorp Land, East Hills Rail Corridor, the MIC site, the Glenfield Waste Facility and Main Southern Rail Line.

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

Under the FBA, the area subject to impact assessment is referred to as the 'development site'. In this assessment, the development site is considered to be the Project site (SIMTA site and the adjoining Rail Corridor). In order to assess impacts on the riparian corridor, the section of riparian vegetation on the western bank of Georges River adjoining the Project site was also included in impact calculations.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Construction area
- Study area
- Boot Land
- Existing railway
- Watercourse

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Figure 4: Study area

1.4.2 OPERATIONAL AREA

The built form of the Stage 1 Proposal includes the IMT (including an administration facility) and the Rail link between the SSFL and the intermodal terminal facility.

Intermodal terminal facility

The layout of the IMT facility which is included in the Stage 1 Proposal is shown on Figure 5 and generally comprises operational areas, an administration area, rail sidings, utilities and drainage infrastructure, landscaping and signage. The operational areas of the intermodal terminal facility consist of the primary and secondary container loading / unloading areas and container storage areas, and the truck holding area. Within these areas containers would be stacked up to five high.

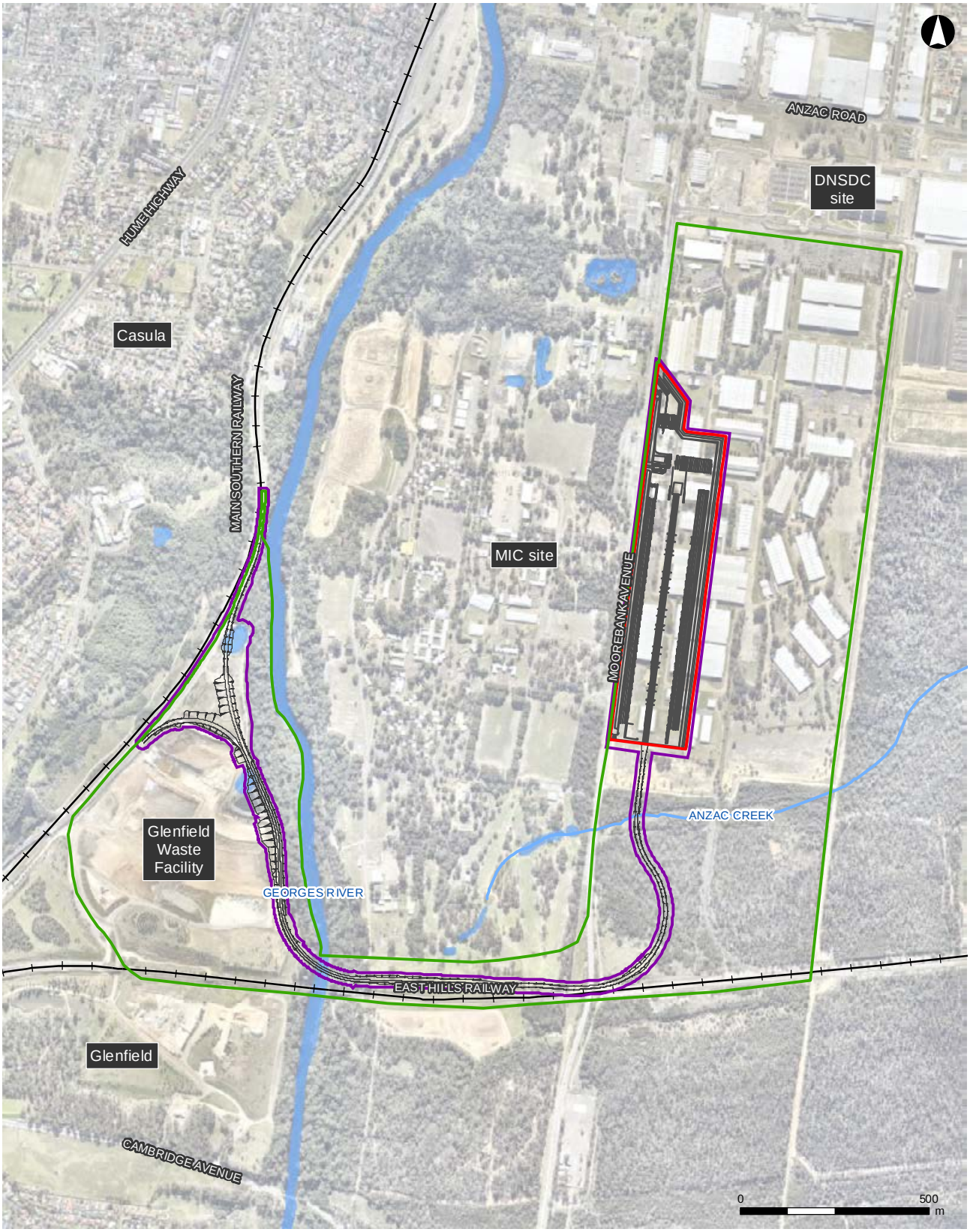
On the western boundary of the site fronting Moorebank Avenue, a landscaping setback would be provided along the length of the site with the exception of the three access and egress points. This landscaped setback would include a bio-retention swale. Landscaping on the western boundary, along Moorebank Avenue, would generally consist of mixed tree and understorey plantings including native shrubs and groundcovers. Differentiating plant species would be used at the access and egress points, to the administration facility, to accentuate this nodal point.

Rail link

The Rail link would connect the intermodal terminal facility site to the SSFL. From the intermodal terminal facility site, the rail line would travel in a southerly direction, crossing Anzac Creek via a proposed culvert structure before turning towards the west near the East Hills Rail Line and heading underneath Moorebank Avenue, via an alteration to the existing Moorebank Ave overbridge. The Rail link would cross the Georges River via a proposed bridge structure in proximity to the existing East Hill Rail Line bridge before turning in a north-westerly direction through the Glenfield Waste Facility (western side of the Georges River). The Rail link would branch to provide both northbound and southbound connections to the SSFL, around 500 m south of the Casula Railway Station at the northern connection.

The Rail link would provide between one and two rail tracks in the various sections. The two single tracks branching off the SSFL would join on the western side of the Georges River to provide two tracks. The two tracks would continue across the Georges River until forming one track prior to passing underneath the Moorebank Avenue overbridge. The operational footprint that would be maintained for the Rail link would generally be 20 m from the centreline of the tracks.

The bridge for the Rail link over the Georges River would be located on a horizontal curve and would support two rail tracks. The bridge would be approximately 184 m in length with a width of 11.3 m and a height of 11 m. The crossing of Anzac Creek would be via approximately 15 m of box culverts that would support one rail track and a maintenance access footway.



LEGEND

- Operational area
- Operational footprint
- Proposed rail alignment
- Existing railway
- Intermodal terminal facility layout
- Watercourse
- Study area

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Figure 5: Operational footprint

1.4.3 CONSTRUCTION AREA

The construction area for the Proposal is shown in Figure 1. It includes the Rail link and operational area in the Stage 1 site. In addition to the footprint that will be used in the operational phase of the Proposal, a number of areas have been identified that will be used for earthworks, construction site compounds, possible batching plants, materials handling and laydown areas.

Further, there are additional works areas outside of the construction area and study area as follows:

- Sewer main in the Moorebank Avenue road reserve. This would connect to an existing main on Moorebank Avenue, north of Anzac Road.
- Culvert upgrades in the East Hills Rail Corridor.

It is understood that no vegetation clearing would be required for these additional works.

IMT compound

To support the construction of the IMT facility, the area to the immediate east of the operational area would be utilised as a compound site. The south-eastern area would be used to store materials with a possible batching plant, located to the north of this and a laydown area to the north of the possible batching plant. Site offices and amenities would be located to the north of the storage and earthworks area.

A high point on the eastern boundary of the SIMTA site would also be used to excavate general fill material.

Rail link compounds

To support the construction of the Rail link three compound sites are proposed:

- Rail East Compound: located on Defence owned land, to the west of Moorebank Avenue, this compound would cover an area of approximately 3,000m^2 and would consist of a materials testing and storage area as well as a small site compound and amenities block. Access to the compound would be via an internal access road, off Moorebank Avenue.
- Georges River compound: located near the eastern bank of the Georges River, within the MIC site. This compound would be used to support the construction of the Georges River bridge and would cover an area of approximately 9,800m^2. The compound would contain an area for materials handling and storage, site offices and amenities and car parking. Access to the compound would be via a haul road that would traverse the MIC site, off an intersection at Moorebank Avenue.
- Rail West Compound: located within the Glenfield Waste Facility, the compound would cover an area of approximately 2,500m^2. The compound would contain an area for materials handling and storage, site offices and amenities and car parking. Access to the compound would be via a haul road that would traverse the Glenfield Waste Facility, with access from the entry to the Glenfield Waste Facility, from Cambridge Avenue.

Compound site locations are shown in Figure 1. Cut and fill works would be required for the compounds.

Compound and stockpile sites would be temporary in nature and removed / decommissioned at the completion of construction.

1.5 INFORMATION SOURCES

1.5.1 DATABASE INTERROGATION

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

- The NSW Bionet Wildlife Atlas which is managed by the NSW Office of Environment and Heritage (OEH). A coordinate search using the centre point of the study area (33.95444,150.9263) was undertaken on 9 March 2015 to determine threatened species records listed under the *Threatened Species Conservation Act 1995* (TSC Act) to within 10 km of the study area.
- The NSW Threatened Species Profile Database (TSPD) which is managed by OEH.
- The Vegetation Information System (VIS) database which is managed by OEH.
- The Protected Matters Search Tool which is managed by the Department of the Environment. A coordinate search using the centre point of the study area (33.95444,150.9263) was undertaken on 7 November 2014 to determine threatened species records listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to within 10 km of the study area.
- The Department of Primary Industries Records Viewer which is managed by the NSW Department of Industry and Investment. A search of the Sydney Metropolitan Catchment Management Authority (CMA) was undertaken to determine threatened fish species records listed under the *Threatened Species Conservation Act 1995* (TSC Act) and/or *Fisheries Management Act 1994* (FM Act) to within 10 km of the study area.
- A search was undertaken of the Australian Government's Atlas of Groundwater Dependent Ecosystems (managed by the Bureau of Meteorology) on 20 March 2015 to find any groundwater dependent ecosystems in the locality.

1.5.2 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).
- *Moorebank Intermodal Terminal – Ecological Impact Assessment* (Parsons Brinckerhoff 2014).

1.5.3 VEGETATION MAPPING

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

- *The natural vegetation of the Penrith 1:100 000 map sheet* (Benson 1992).
- *Native vegetation maps of the Cumberland Plain, western Sydney* (NPWS 2002c).
- *The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities* (Tozer 2003).
- *Changes in the distribution of Cumberland Plain Woodland* (NSW Scientific Committee and Simpson 2008).
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009).

1.6 STAGE 1 PROPOSAL - SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The NSW Department of Planning and Environment (DPE) issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal in December 2014 (SSD 14-6766). Input was also received from Office of Environment and Heritage (OEH) and Department of Primary Industries (Fisheries) (DPI). The following general and key biodiversity issues were identified in the SEARs (Table 1). DPI Fisheries provided prescriptive Environmental Assessment Requirements as part of their submissions included within the SEARs. These are provided in Table 2.

Table 1 Secretary's Environmental Assessment Requirements (SEARs) for the project

Secretary's Environmental Assessment Requirements	Where addressed
12. Biodiversity	
– including but not limited to: *A Flora and Fauna assessment. The assessment shall:* a) *Assess impacts on biodiversity values of the site and adjoining areas, including Endangered Ecological Communities and threatened flora and fauna species and their habitat, groundwater-dependent ecosystems, impacts on wildlife and habitat corridors, riparian land, and habitat fragmentation and details of mitigation measures, having regard to the range of fauna species and opportunities for connectivity (terrestrial, arboreal and aquatic) across the rail link between the site and the East Hills Passenger Line*	Section 6
b) *Consider the OEH's Threatened species Survey and Assessment Guidelines (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm) any relevant draft or recovery plans, Fish Passage Requirements for Waterway Crossings Policy and Guidelines for Fish Friendly Waterway Crossings (DPI) and Commonwealth Significant Impact Guidelines*	Sections 5 and 6
c) *Include a Vegetation Management Plan that has been prepared in consultation with the NSW Office of Water*	Appendix I

Secretary's Environmental Assessment Requirements	Where addressed
d) *Document how impacts to the* Persoonia nutans *and the* Grevillea parviflora *subsp.* parviflora *flora species have been minimised through the detailed design process*	Section 6.1
e) *Assess and document impacts related to the proposed project in accordance with the Framework for Biodiversity Assessment (OEH 2014), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the Threatened Species Conservation Act 1995; and*	This document
f) *Include a comprehensive offset strategy, in accordance with the NSW Biodiversity Offsets Policy for Major Projects including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise or offset' principle.*	Appendix B

Table 2 Environmental Assessment Requirements by Fisheries NSW in response to the request for project SEARs

Comment by Fisheries NSW	Where addressed
Fisheries NSW is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitat upon which they depend. To achieve this, Fisheries NSW ensures that developments comply with the requirements of the *Fisheries Management* (FM) *Act 1994* (namely the aquatic habitat protection and threatened species provisions in Part 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Fish Habitat Conservation and Management* (2013).	Section 2.4, 5.5, **Error! Reference source not found.** and 6.3.3
The Georges River is important key fish habitat within South West Sydney and Fisheries NSW recommends that the project is designed to: o maintain fish passage at all stages during and following construction, o minimise potential erosion and sedimentation impacts to the river during and following construction, o maintain a minimum 50m wide vegetated buffer zone to the river, o minimise harm of the riparian zone, o minimise the number of bridge pilons placed in the Georges River, and preferably that these be placed in alignment with the piles of the existing bridge near by.	Section 6.1
It is important that the key fish habitat values of the Georges River are maintained to ensure continuance of recreational fishing. The site is adjacent to the more pristine parts of the upper Georges River catchment that supports populations of the recreationally fished Australian Bass that migrates through the site to and from saline waters as part of its life cycle. The threatened Macquarie Perch has also been identified in parts of the upper Georges River catchment.	Section 6.2
In light of the above, it is important that the environmental assessment provides: o accurate information on the location of the bridge crossing over the Georges River, approximate dimensions of the bridge and associated number of pilons and where these will be located. o an assessment of the width of the riparian buffer zone and the area of	Section 1.4, 6.2, 6.6, Appendix I

Comment by Fisheries NSW	Where addressed
riparian vegetation that may be removed during the construction the bridge and associated rail approaches. o information on erosion and sedimentation mitigation measures to be used during construction. o measures to rehabilitate disturbed areas in the riparian zone following construction.	
In assessing impacts on the riparian zone, the overall ecological function of the riparian zone in enhancing the water quality, bank stability and aquatic habitat values of the Georges River needs to be considered along with the current biodiversity status of the zone.	Section 6.2
As this stage of the proposal includes the construction of the rail link and bridge over the Georges River, Fisheries NSW recommends that the above assessment requirements are incorporated into the SEARs. It is particularly noted that the draft SEARs currently do not include consideration of erosion and sedimentation impacts to waters during construction.	Section 6.2
Fisheries NSW notes that the draft SEARs include a requirement to describe interactions with the neighbouring intermodal proposal and an assessment of cumulative impacts. Fisheries NSW requests that the assessment includes some justification for having two intermodal facilities at this location. This should include some assessment of whether these two facilities will be feasible over time, considering logistical limitations that may exist at this site, such as the capacity of the Southern Sydney Freight Line delivery to the site. This information will assist Fisheries NSW in providing comment on the combined number and location of bridge crossings across the river.	Section6.1, 6.4 and EIS
The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and: o Identify any potential impacts on GDEs as a result of the proposal including: ▪ the effect of the proposal on the recharge to groundwater systems; ▪ the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and ▪ the effect on the function of GDEs (habitat, groundwater levels, connectivity). o Provide safeguard measures for any GDEs.	Section 6.2 Section 6.6
Fisheries NSW recommends that development proposals comply with the *Policy and Guidelines for Fish Habitat Conservation and Management (2013)* (referred to hereafter as P&GLs). A list of general information requirements for developments and standard precautions and mitigation measures are outlined in Section 3.1 of this document. See http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation.	Section 6.6
A: General Requirements o site address and contact details. o property description (e.g. Lot and DP numbers). o a clear description of the proposal including details of construction	Sections 1.3, 1.4 Section 2.5 in EIS Section 6.2

Comment by Fisheries NSW	Where addressed
methods and materials.	
○ map(s) of the development area and adjacent areas - this should include nearby waterways, and land use.	Figure 2, Figure 10
○ clear photographs of the site, including photographs of any riparian and aquatic vegetation present.	Section 4.8
○ a clear description of the physical and hydrological features of the development area (which may extend upstream and downstream of the development site in the case of flowing rivers).	Section 3.3
○ a clear description of aquatic environments including: ▪ including threatened and protected species, populations, ecological communities, pest species or presence of 'critical habitat' under the FM Act or EPBC Act, ▪ a riparian vegetation survey map of the area which shows the location and/or coverage of riparian vegetation and snags,	Figure 21, Sections 4.8 and 5.5
○ details of the nature, timing, magnitude and duration of the proposed disturbance to the aquatic environment.	Section 6.2
○ assessments of predicted impacts upon any threatened species (fish and marine vegetation) (i.e. completion of a 7 part test and/or species impact statement/s) and other aquatic flora and fauna.	Section 6.2
○ details of any mitigation measures to limit environmental impacts.	Section 6.6
○ details of the general regional context, any protected areas, other developments in the area, and/or cumulative impacts.	Sections 3 and 6.4
Dredging and reclamation activities	Section 4.8.2, 6.2, 6.6, EIS
○ purpose of works.	
○ type(s) and distribution of marine vegetation in the vicinity of the proposed works.	
○ method of dredging to be used.	
○ timing and duration of works.	
○ dimension of area of works including levels and volume of material to be extracted or placed as fill.	
○ nature of sediment to be dredged, including Acid Sulphate Soil, contaminated soils etc.	
○ method of marking area subject to works.	
○ environmental safeguards to be used during and after works.	
○ measures for minimising harm to fish habitat under the proposal.	
○ spoil type and source location for reclamation activities.	
○ method of disposal of dredge material.	
○ location and duration of spoil stockpiling, if planned.	
Activities that block fish passage	Section 6.2, EIS
○ type of activity eg works in a stream that change flow or morphological characteristics.	
○ length of time fish passage is to be restricted.	

Comment by Fisheries NSW	Where addressed
○ timing of proposed restriction. ○ remediation works.	
B. Aquatic habitat assessment The aim of the aquatic assessment should be to define the presence of 'key fish habitat' within the study site, adjacent areas (upstream and downstream), and the broader regional area. There may be a range of potential fish habitats that could be impacted by a particular activity. Some points to consider include: ○ geomorphic characteristics of the waterway (i.e. what characteristics of a CLASS 1-4 waterway does it have (see Table 2 in P&GLs)? Is it a gully, intermittent stream or major river? Does it have deep pools or in-stream gravel beds? Does the watercourse connect with other watercourses upstream or downstream? What is the slope/gradient?), ○ is it mapped as key fish habitat? (see www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats#KFH for maps of key fish habitat per Local Government Area), ○ description of the water quality (e.g. discolouration, sedimentation, turbidity, pH, dissolved oxygen, nutrients), ○ types of surrounding land use (e.g. agricultural, urban, aquaculture), ○ condition of riparian vegetation (i.e. present or absent. Are the species native or exotic? Is the density of vegetation thick or sparse?), ○ substrate type (e.g. rock, sand, gravel, silt), ○ timing of construction in relation to any fish (e.g. Australian Bass) migration seasons, ○ presence of any listed threatened or protected aquatic species or 'critical habitat' under the FM Act and EPBC Act.	Sections 4.8, 5.5, 6.2 and Appendix C
C. Assessment of likely impacts indicate the location, nature and extent of habitat removal or modification (both direct and indirect) which may result from the proposed action; discuss the potential impact of the modification or removal of habitat (potential direct and indirect sources of impact are stated in the letter with this attachment). Note: In defining the proposal area, discussion must be provided in regard to possible indirect effects of the proposal on species/habitats in the area surrounding the subject site: for example, through altered hydrological regimes, soil erosion or pollution.	Section 6.2
D. Ameliorative measures The environmental assessment should consider and provide detail on how the proposal has been or may be modified and managed to minimise impacts and conserve aquatic habitat on the subject site and in the study area.	Section 6.1

1.7 CONCEPT PLAN - CONDITIONS OF APROVAL AND STATEMENT OF COMMITMENTS

The Concept Plan Approval (dated 29 September 2014) included condition of approval and Statement of Commitments relating to 'Biodiversity' for future approvals. The Conditions of Approval provided are consistent with the SEARs provided for the Proposal (refer to Section 1.6, above) and have been addressed in this BAR. Table 3 outlines the Statement of Commitments (SoCs) relevant to biodiversity and where these have been addressed in this BAR.

Table 3 Concept Plan Statement of Commitments

Condition	Where addressed
The Proponent will undertake further detailed assessment to establish the potential biodiversity impacts of the proposed rail link and measures to mitigate its potential impacts. The investigations shall incorporate the mitigation measures listed within Section 5 of the Flora and Fauna Assessment and as summarised below: <u>Avoid Impacts</u> ▪ Site establishment, earthworks and rail construction <u>Mitigate Impacts</u> ▪ Soil disturbance related to site establishment, earthworks and rail construction ▪ Vegetation clearance for rail construction, access and maintenance tracks Construction in riparian areas/in proximity to watercourse ▪ Construction of pavement, slabs and building structures ▪ Hot works (including vegetation clearing requiring heat producing equipment) ▪ Alteration to air quality and noise environments ▪ Operation of the SIMTA proposal	Section 6
<u>Management of Threatened Plant Species</u> The Proponent shall prepare and implement a Threatened Species Management Plan for the *P. nutans* and *G. parviflora* populations within the rail corridor that would be affected by the rail link	Appendix A
<u>Off-Set Impacts</u> The Proponent will update the *Preliminary Biodiversity Offset Strategy* (Hyder Consulting 2013) and continue to consult with the Department of the Environment (DOTE) and the NSW Office of Environment and Heritage (OEH) through the project approval processes.	Appendix B
<u>Aquatic Flora and Fauna</u> The Proponent will implement the following measures to protect the aquatic flora and	Section 6

Condition	Where addressed
fauna as part of the applications for the detailed planning applications (where relevant and applicable): ▪ Implementation of design principles for friendly fish passage. ▪ Implementation of Construction and Operation Management Plans for maintenance of structures in riparian and aquatic zones. ▪ Minimise siltation of the Georges River during construction through implementing the water quality mitigation measures detailed within the Stormwater and Flooding section of the Statement of Commitments. ▪ Thorough assessment of any development within the Anzac Creek CSWL community, including potential impacts on groundwater quality and quantity. ▪ Lantana removal within nominated construction zones to reduce degradation of streamside vegetation and offset any potential impacts to aquatic biodiversity.	
Riparian ▪ The proposed rail link (located within the rail corridor) is exempt from the requirement for an a WM Act controlled activity approval from NOW as a transitional Part 3A project; however the detailed design of the rail link will seek to conform to the objects of the WM Act and its associated guidelines. ▪ The riparian setback for Anzac Creek, as specified by NOW, is 30 metres (20 metre CRZ and 10 metre VB), while for Georges River the riparian setback is likely to be a minimum of 50 metres (40 metre CRZ and 10 metre VB). ▪ Riparian corridors will be appropriately revegetated to restore and/or maintain ecological, functional and habitat values and impede surface flows and drop sediment before it reaches the waterways. ▪ Water quality and quantity issues will be managed during the construction phase through the implementation, inspection and maintenance of best practice soil and water management techniques which will be defined in the CEMP for sedimentation and erosion control during construction. ▪ Water quality and quantity issues will be managed during the operation phase through the implementation, inspection and maintenance of Water Sensitive Urban Design (WSUD) measures such as rainwater tanks, grass filter strips, swales and bio retention.	Section 6, Appendix I

1.8 EPBC ACT REFERRAL APPROVAL CONDITIONS

As discussed in Section 1.2, a referral was made to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (now the Department of the Environment) of the proposed action of the SIMTA proposal. The referral of the proposed action under the EPBC Act was accepted by the Department on 21 December

2011. On 23 January 2012, a delegate for the Minister determined that assessment and approval was required under the EPBC Act and the proposed action would be assessed by Environmental Impact Statement (EIS). EIS guidelines for the SIMTA Project were issued in June 2012.

Approval (No. 2011/6229) was granted under the EPBC Act on March 2014 by the Commonwealth Department of Environment for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank, for its impacts on:

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

Conditions of this approval are provided in Section Table 4 and addressed in this report, where applicable.

Table 4 Conditions of the project approval under the EPBC Act Referral

Condition	Where addressed
Protection of EPBC flora and fauna & the environment on Commonwealth land	
1. For the better protection of the GHFF [Grey-headed Flying-fox], the person taking the action must: a) not clear more than 11 hectares of GHFF foraging habitat;	Section 6.2.3
b) engage a suitably qualified expert to undertake a pre-clearance survey(s) to confirm the absence of GHFF roosting camps within the rail easement, no more than 48 hours prior to the clearance of potential GHFF roosting habitat; and	Section 6.6
c) notify the Department in writing of the results of pre-clearance surveys. If the GHFF is detected roosting on site, all native vegetation clearance activities must halt until the person taking the action has complied with any directions the Minister may wish to issue regarding timing of construction or methods for dispersal of the GHFF.	Section 6.6
2. For the better protection of the Macquarie Perch, the person taking the action must:	
a) engage a suitably qualified expert to design (or provide input on the design of) all crossings which are proposed to be implemented across Macquarie Perch habitat. Any such crossings must be of a suitable design that provides for the passage requirements of Macquarie Perch; and	Section 6.2.1
b) implement all feasible and practicable measures that ensure sedimentation and / or erosion (as a result of the proposed action) do not lead to any further reductions in the water quality, or degradation of, Macquarie Perch habitat.	Section 6.6
3. For the better protection of *Hibbertia* sp. Bankstown, the person taking the action must engage a suitably qualified expert to undertake a targeted search for individuals of *Hibbertia* sp. Bankstown within all areas of potential habitat during the species' flowering period.	Section 5.1.1

Condition	Where addressed
4. For the better protection of Bynoe's Wattle, the person taking the action must engage a suitably qualified expert to undertake a field habitat assessment that targets the ecological requirements of Bynoe's Wattle, in all areas of Castlereagh Scribbly Gum Woodland likely to be cleared as a result of the proposed action. If the assessment determines there is potential for the species to occur on site, then a suitably qualified expert must undertake a targeted search for individuals of Bynoe's Wattle within all areas of potential habitat identified by the habitat assessment during the species' flowering period.	Section 5.1.1
Flora and Fauna Management Plan	
5. For the better protection of EPBC listed flora & the environment on Commonwealth land, the person taking the action must engage a suitably qualified expert to prepare a Flora and Fauna Management Plan (FFMP) for the approval of the Minister. The FFMP must include (but need not be limited to): a) details on the timing of native vegetation clearance works; b) detailed maps of the rail link easement and construction zone showing: i. permanent infrastructure and temporary works; ii. no-go areas; and iii. physical barriers used for the protection of native vegetation on Commonwealth land, and of EPBC Act listed Nodding Geebung and Small-flower Grevillea. c) measures to minimise the extent of native vegetation clearing upon Commonwealth land and the clearing of Nodding Geebung and Small-flower Grevillea; d) provisions to ensure no more than 17 individuals of Nodding Geebung and 634 stems of Small-flower Grevillea are cleared; e) the results of targeted surveys for Hibbertia sp. Bankstown and Bynoe's Wattle (including the number of individuals recorded) and what measures will be implemented to avoid, mitigate and manage impacts to these species, if individuals are found on site; f) measures which allow terrestrial fauna to disperse naturally ahead of clearing activities, and minimise the risk of injury to individuals; g) actions to maintain or enhance the long-term viability of native vegetation adjoining the rail easement in particular, adjoining populations of Nodding Geebung and Small-flower Grevillea; h) measures to safeguard flora and fauna from the threat of weeds, fire, pathogens and unauthorised access, including (but not limited to) the commitments outlined in section 7.4.1 of the EIS (and summarised at Annexure A); i) ongoing monitoring to inform the adaptive management of native vegetation adjoining the rail easement.	Appendix A

Condition	Where addressed
Native vegetation clearance must not occur until the FFMP has been approved. The FFMP must be implemented once approved.	Section 6.6
Threatened Flora Offset Management Plan	
6. For the better protection of Nodding Geebung, Small-flower Grevillea (and potentially, *Hibbertia* sp. Bankstown and Bynoe's Wattle) the person taking the action must engage a suitably qualified expert to prepare a Threatened Flora Offset Management Plan (TFOMP) (or plans) for the approval of the Minister. The TFOMP must include (but need not be limited to): a) details of a direct offset that satisfies the requirements of the Department's offset policy, in accordance with the offset user guide (including timeframes for the delivery or acquisition of the direct offset); b) map(s) and shapefiles that identify the location and boundaries of the direct offset; c) details of the management actions and performance objectives which will maintain and enhance the Nodding Geebung and Small-flower Grevillea habitat and/or population covered by the TFOMP (including the duration, intensity, and timing of management actions); d) an assessment of the baseline population and distribution for Nodding Geebung and Small-flower Grevillea within the direct offset, including: i. the number of plants protected and their location; and ii. plant and habitat condition. e) measures for regular monitoring of the status of individuals of Nodding Geebung and Small-flower Grevillea and their habitat as measured against the baseline population and distribution, including: i. fluctuations in population size and distribution; and ii. response to disturbances and/or management actions. f) provisions to revise the approved TFOMP in response to monitoring associated with condition 6(e); g) provisions to revise the approved TFOMP in response to monitoring associated with condition 6(e);	Appendix A
Native vegetation clearance must not occur until the TFOMP has been approved. The TFOMP must be implemented once approved.	Section 6.6
Should the action result in, or be likely to result in, residual impacts to *Hibbertia* sp. Bankstown or Bynoe's Wattle (as determined by the Minister), the TFOMP must also demonstrate how it meets the standards described in (a) to (f), for these two species.	Not applicable, see Section 6.2

2 LEGISLATION AND POLICY

2.1 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 (MNES). MNES 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 MNES require approval from the Australian Government Minister for the Environment (the Minister).

2.2 *ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979*

On the 29 September 2014 Concept Plan Approval was granted, under Part 3A (Transitional), Section 75O of the EP&A Act for the “use of the site [Project Site] as an intermodal facility, including a Rail link to the Southern Sydney Freight Line within an identified Rail Corridor, warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works”.

Notwithstanding this, as indicated in the Conditions of Approval, this Concept Plan Approval does not permit the construction or operation of any part of the SIMTA Project, which is subject to obtaining subsequent development consent under the EP&A Act. The Concept Plan Approval states that approval to carry out the SIMTA Project is subject to Part 4, Division 4.1 of the EP&A Act and the environmental assessment requirements specified in Schedule 3 of the Conditions of Approval.

In accordance with the Concept Plan Approval, development consent is sought for the Proposal under Part 4, Division 4.1 of the EP&A Act. In accordance with Section 5A (s.5A) of the EP&A Act seven factors “must be taken into account” by a consent or determining authority in the administration of Sections 78A, 79C and 112 of the EP&A Act when considering an activity or development proposal. These seven factors comprises the Assessment of Significance, the aim of which is to determine “whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats”, as listed under Schedules 1, 1A and 2 of the *Threatened Species Conservation Act 1995* and Schedules 4, 4A and 5 of the *Fisheries Management Act 1994.* If it is concluded that the proposal is likely to significantly impact any threatened species, populations or ecological communities, a Species Impact Statement (SIS) must be prepared.

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

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

2.2.1 NSW BIODIVERSITY OFFSETS POLICY FOR MAJOR PROJECTS - FRAMEWORK FOR BIODIVERSITY ASSESSMENT 2014

The *NSW Biodiversity Offsets Policy for Major Projects* was released in October 2014 and is applicable to projects that are SSD or State Significant Infrastructure (SSI) under the EP&A Act. The NSW Biodiversity Offsets Policy for Major Projects requires proponents to apply the *Framework for Biodiversity Assessment* (FBA) to assess impacts on biodiversity. The FBA also guides the identification of reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity associated with a proposal.

As noted above, the SEARs prescribe the development of an offset strategy in accordance with the FBA, consistent with the 'avoid, minimise, or offset' principle.

2.3 NSW *THREATENED SPECIES CONSERVATION ACT 1995*

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

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

The Proposal will impact on threatened species and ecological communities listed under the TSC Act. This report assesses and quantifies the impacts to these threatened entities in accordance with the FBA requirements and outlines the corresponding offsetting requirements.

2.4 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 in accordance with Part 7A of the FM Act.

The FM Act requires permits for the harming of aquatic vegetation, blockage of fish passage and dredging and reclamation. Though the Proposal could result in these impacts Clause 89J of the EP&A Act provides an exemption for these permits for SSD assessed under Part 4, Division 4.1 of the EP&A Act.

3 LANDSCAPE FEATURES

3.1 LANDSCAPE REGIONS

3.1.1 BIOREGIONS AND LANDSCAPES

IBRA Bioregions and Subregions

Bioregions and landscapes associated with the study area and outer assessment circle are mapped in Figure 3. The study area is located within the Sydney Basin Bioregion and the Cumberland Subregion classified under IBRA (Interim Biogeographic Regionalisation for Australia). The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares (http://www.environment.nsw.gov.au/bioregions/SydneyBasinBioregion.htm). The bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. The Sydney Basin Bioregion is one of the most diverse species in Australia. This is a result of the variety of rock types, topography and climates in the bioregion.

The Cumberland Subregion is characterised by low rolling hills and wide valleys in a rain shadow area below the Blue Mountains (http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm). Typical vegetation in the subregion includes Grey Box, Forest Red Gum, Narrow-leaved Ironbark woodland with some Spotted Gum on the shale hills, Hard-leaved Scribbly Gum, Rough-barked Apple and Old Man Banksia on alluvial sands and gravels, Broad-leaved Apple, Cabbage Gum and Forest Red Gum with abundant Swamp Oak on river flats and Tall Spike Rush and Juncus with Parramatta Red Gum in lagoons and swamps.

Mitchell Landscapes

The study area is located within the Cumberland Plain and Georges River Alluvial Plain Mitchell landscapes. The Georges River Alluvial Plain landscape covers the majority of the development site, generally lying east of the Georges River. The Cumberland Plain landscape generally lies west of the Georges River, encompassing part of the Rail Corridor on the Glenfield Waste Facility site. The Georges River Alluvial Plain comprises channel, floodplain and terraces of the Georges River on Quaternary and Tertiary alluvial sediments (DECC 2008c). It has mostly clayey sand and sandy soils with limited gravel on the highest terrace. The general elevation ranges from 0m to 30m. Vegetation found in this landscape includes forest and woodland of Cabbage Gum (*Eucalyptus amplifolia*), Rough-barked Apple (*Angophora floribunda*), Broad-leaved Ironbark (*Eucalyptus fibrosa* ssp. *fibrosa*), Scribbly Gum (*Eucalyptus sclerophylla*) and Narrow-leaved Apple (*Angophora bakeri*). Extensive Swamp Oak (*Casuarina glauca*) is found along riverbanks and, in low-lying areas, often with Prickly-leaved Tea-tree (*Leptospermum stypheliodes*). These extend to brackish estuarine swamps with Grey Mangrove (*Avicennia marina*) and limited saltmarsh.

The Cumberland Plain landscape, largely west of the study area, lies between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline (DECC 2008c). It has a small number of volcanic vents and is partly covered by Tertiary river gravels and sands. The mains streams contain quaternary alluvium. The general elevation ranges from 30 metres to 120 metres. Vegetation found in this landscape includes woodlands and open forest of Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Cabbage Gum (*Eucalyptus amplifolia*) and Broad-leaved Apple (*Angophora subvelutina*). It has grassy to shrubby understoreys often dominated by Australian Boxthorn (*Bursaria spinosa*) on poorly

drained valley floors, often salt affected, with Swamp Oak (*Casuarina glauca*) and Paperbark (*Melaleuca* spp.).

The Georges River Alluvial Plain landscape covers the majority of the development site. This Mitchell Landscape was not listed in the credit calculator, so the Cumberland Plain landscape was used.

3.1.2 SOILS AND GEOLOGY

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) (Figure 6), described as clayey quartzose sand and clay. The study area to the west of the Georges River was mapped as mainly Quaternary deposits of medium-grained sand, clay and silt (map unit Qpn), with some Tertiary alluvium in the centre.

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

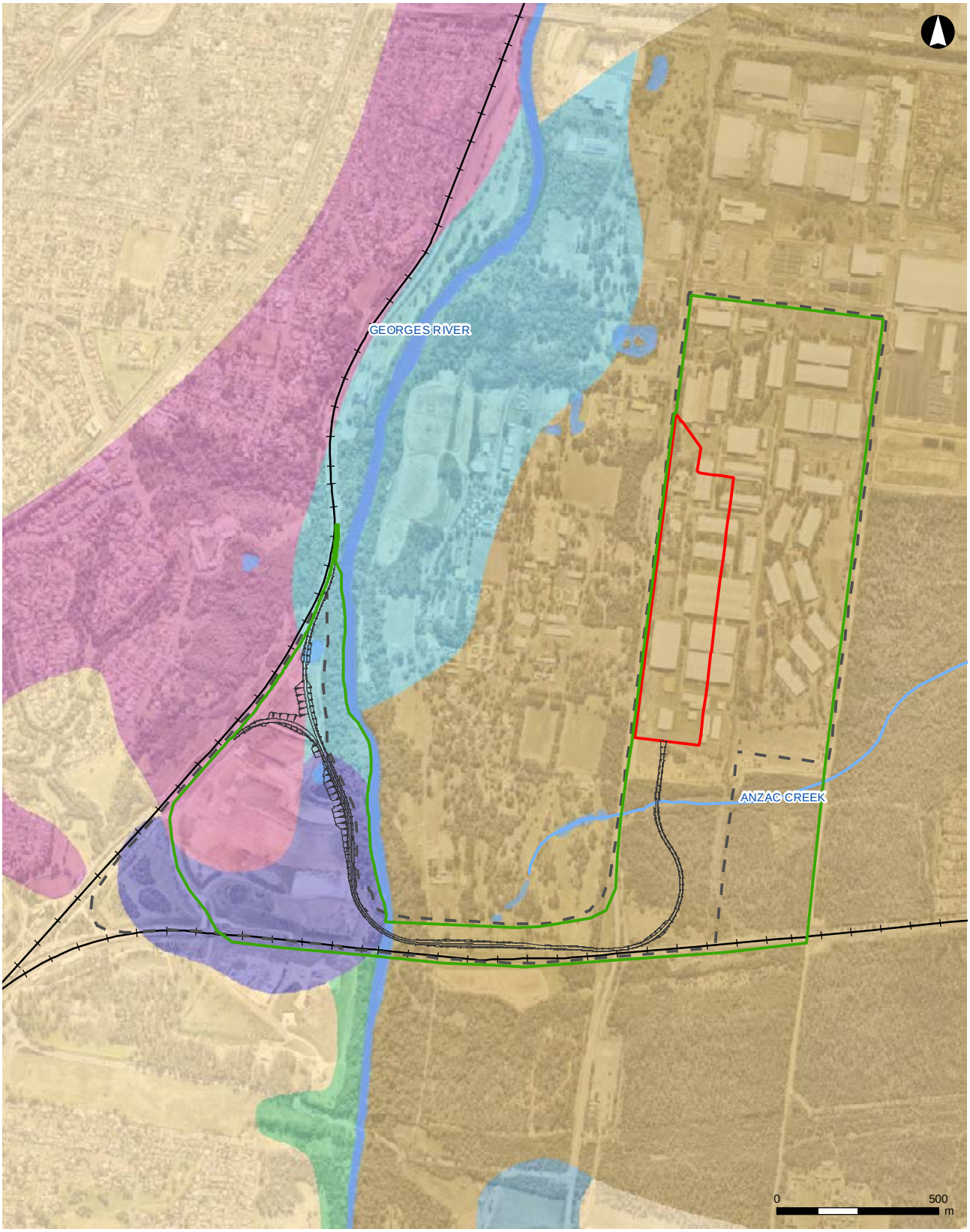
The features and locations in the study area of the mapped soil landscapes are detailed in Table 5.

Table 5 Soil landscapes mapped in the study area by Bannerman and Hazelton (1990)

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

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

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



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Existing railway
- Watercourse

Soil landscapes

- BERKSHIRE PARK
- BLACKTOWN
- FREEMANS REACH
- LUCAS HEIGHTS
- LUDDENHAM
- RICHMOND
- SOUTH CREEK
- WATER

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Figure 6: Soil landscapes of the study area

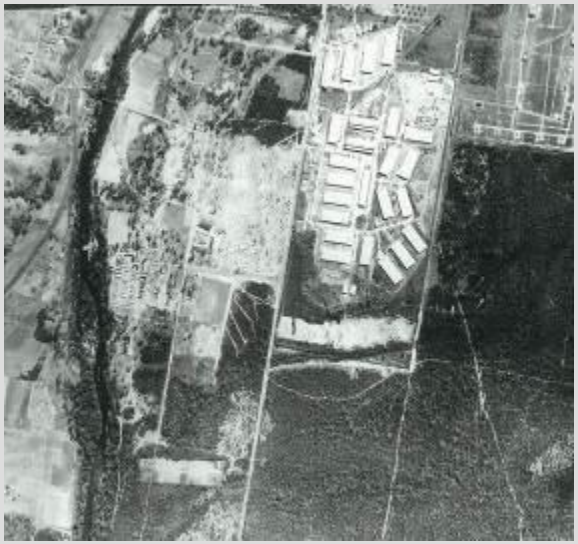
3.2 NATIVE VEGETATION EXTENT

3.2.1 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), AHMS (2010) and Artefact 2015 with additional photographs obtained from NSW Land and Property Information (Table 6).

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

Table 6 Historical aerial photograph review

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

Photograph	Date and source	SIMTA site	Rail Corridor
	1961 NSW Land and Property Information	Almost all the natural vegetation appears to have been cleared from the SIMTA site by the time of the 1961 aerial photograph; there are some scattered tree crowns visible immediately to the south of the SIMTA site and the rows of planted trees amongst the buildings are becoming more established with larger crowns visible. The channels in the south of the site have been fully constructed and cleared of all vegetation.	The track to the south of Anzac Creek appears more formal and there is a circular clearing at the eastern end of the track. There appears to be some disturbance in the bushland to the north of Anzac Creek, however, there has been no significant canopy removal.
	1979 AHMS (2010)	The southern part of the SIMTA site can be seen only. The development and clearing on this part of the site remains generally consistent with the 1961 aerial photographs.	There appears to be less obvious disturbance in the vicinity of Anzac Creek, however, there has been significant clearing for the SME 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 Glenfield Waste Facility west of the Georges River and there are still orchards in the south of this area.

Photograph	Date and source	SIMTA site	Rail Corridor
	1984 AHMS (2010)	The southern part of the SIMTA site can be seen only. The development and clearing on this part of the site remains generally consistent with the 1979 aerial photographs.	There was significant clearing prior to the 1984 aerial photograph for the construction of the East Hills rail line, and there is evidence of extensive clearing of the bushland south of Anzac Creek. By this time the rail spur extending south from the SIMTA site has been cleared and the East Hills rail line is being constructed along the southern boundary of the study area, crossing the Georges River. By 1994 this rail line has been completed.
	1978, 1994 and 2007 (Arup 2008)	The vegetation pattern does not change much following 1961, with tree crowns increasing in size as trees mature over the next few decades. Between 1994 and 2007 there appears to be an increase in growth of trees and shrubs in the south of the site, particularly along the constructed drainage channels and adjoining areas to the south and west.	-

Photograph	Date and source	SIMTA site	Rail Corridor
	2011 (Artefact 2015)	Between 2007 and 2011, vegetation extent remains similar.	-

3.2.2 VEGETATION MAPPING

Native vegetation is mapped in the outer assessment circle in Figure 3 and Figure 7, Figure 8 and Figure 9.

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.

Seven different plant communities were mapped in the outer assessment circle (Figure 7); all correspond with threatened ecological communities (TECs) listed under the TSC Act. The mapped TECs and their threatened status are listed in Table 7.

Table 7 Vegetation communities mapped by NPWS (2002)/Tozer (2003) and corresponding TECs

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

The conservation significance assessment by NPWS (2002b) mapped the vegetation in the outer assessment circle as follows (Figure 8):

- Core habitat: large patches of vegetation in the Boot Land and south of the SSFL, smaller patches of vegetation in the MIC site and Stage 1 site, riparian vegetation along the Georges River (predominantly eastern side).
- Support to core habitat: Riparian vegetation along the western side of the Georges River and in the north of the MIC site.
- Other remnant vegetation: small patches of vegetation in the north of the MIC site, west of the Georges River and south and east of the Boot Land.
- Urban remnant trees (critically endangered community): in the east of the SIMTA site, in the centre of the MIC site and to the north of MIC site (adjacent to Moorebank Ave).

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.

Nine different native vegetation communities were mapped within the outer assessment circle (Figure 9) and are listed in Table 8. All of these communities correspond to TECs as noted in Table 8.

Table 8 Vegetation communities mapped by DECCW (2009) and corresponding TECs

Vegetation map unit (DECCW 2009)	Corresponding TEC	EPBC Act Status	TSC Act Status
Castlereagh Shale-gravel Transition Forest	Shale/Gravel Transition Forest in the Sydney Basin bioregion	Critically Endangered	Endangered
Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Endangered	Vulnerable
Castlereagh Swamp Woodland	Castlereagh Swamp Woodland Community	Not listed	Endangered
Coastal Freshwater Reedland	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Cumberland Riverflat Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Cumberland Swamp Oak Riparian Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin bioregion	Critically Endangered	Critically Endangered
Cumberland Moist Shale Woodland	Moist Shale Woodland in the Sydney Basin bioregion	Critically Endangered	Endangered

Vegetation map unit (DECCW 2009)	Corresponding TEC	EPBC Act Status	TSC Act Status
Riverflat Eucalypt Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered

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

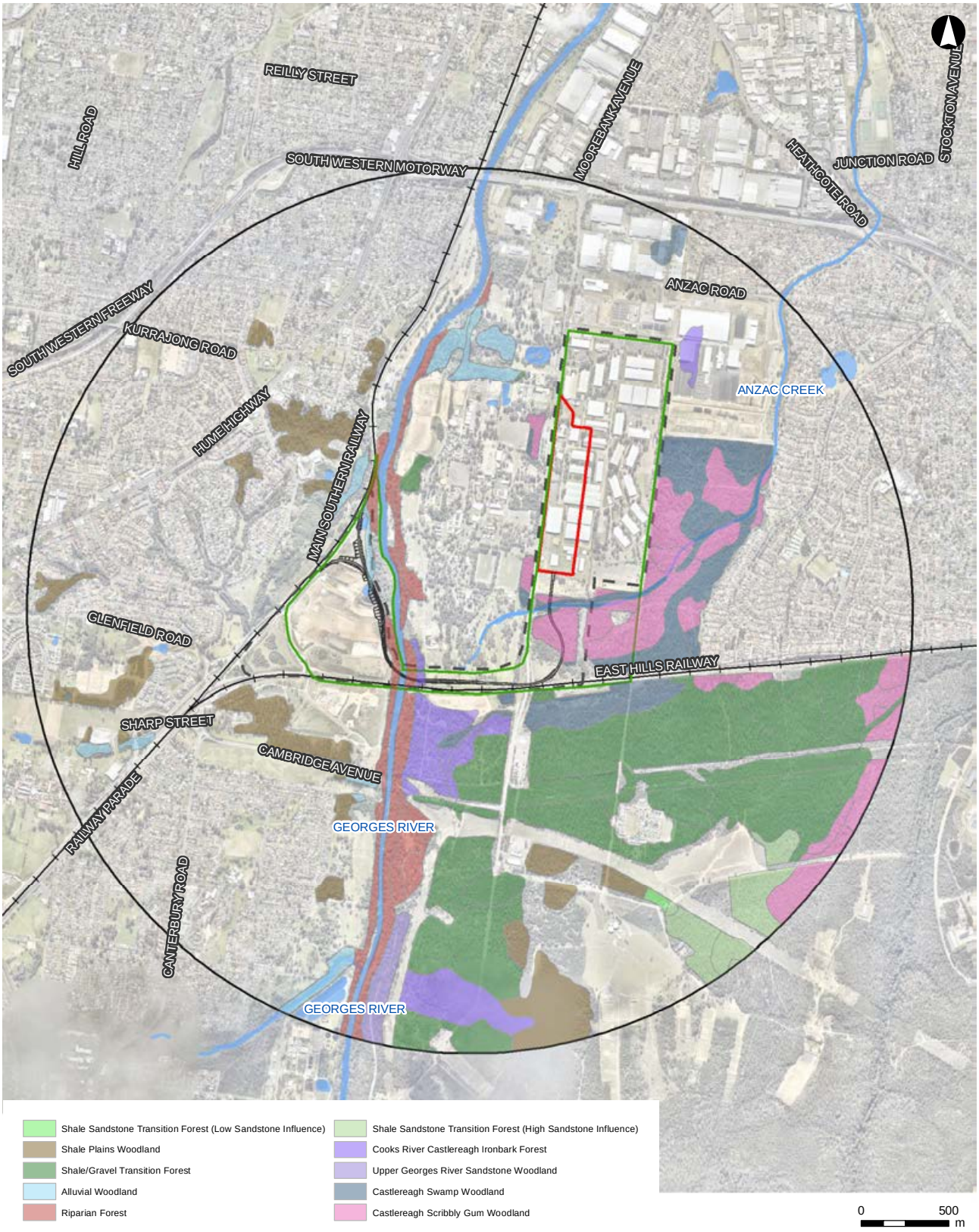
The vegetation mapping of NPWS (2002)/Tozer (2003) and DECCW (2009) in the 2000 hectare outer assessment circle was compared (Table 9).

Table 9 Comparison of vegetation mapping in the outer assessment circle

TEC	Vegetation community	Area of vegetation community mapped within outer assessment circle (hectares)	
		NPWS 2002/ Tozer (2003)	DECCW (2009)
Cooks River Castlereagh Ironbark Forest in the Sydney Basin bioregion	Cooks River Castlereagh Ironbark Forest	89.16	N/A
Castlereagh Swamp Woodland Community	Castlereagh Swamp Woodland	71.08	27.8
Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Castlereagh Scribbly Gum Woodland	76.46	164.6
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Coastal Freshwater Reedland	N/A	3.50
Moist Shale Woodland in the Sydney Basin bioregion	Cumberland Moist Shale Woodland	N/A	0.21
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions/ Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Cumberland Swamp Oak Riparian Forest	N/A	4.68
	Alluvial Woodland	43.77	N/A
River-flat Eucalypt Forest on	Riparian Forest	54.40	N/A

TEC	Vegetation community	Area of vegetation community mapped within outer assessment circle (hectares)	
		NPWS 2002/ Tozer (2003)	DECCW (2009)
Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Riverflat Eucalypt Forest (& Cumberland Riverflat Forest)	N/A	17.95
Shale/Gravel Transition Forest in the Sydney Basin bioregion	Shale/Gravel Transition Forest	234.92	261.44
Cumberland Plain Woodland in the Sydney Basin bioregion	Shale Plains Woodland (Cumberland)	133.46	116.79
Shale Sandstone Transition Forest in the Sydney Basin Bioregion		1.42	
Non-TECs	Woronora Sandstone Exposed Bloodwood Woodland	-	4.98
	Hinterland Sandstone Transition Grey Gum Forest		0.03
	Hinterland Flats Eucalypt Forest		74.56
	Hinterland Sandstone Dwarf Apple Heath-Woodland		0.19
Total native vegetation mapped		**739.49**	**678.33**

NPWS (2002)/Tozer (2003) and DECCW (2009) mapped Cumberland Plain Woodland, Shale/Gravel Transition Forest and Riverflat Eucalypt Forest in similar areas within the outer assessment circle. There were notable differences in mapping of Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland in extent and location. Furthermore there are several communities mapped by DECCW that were not identified in NPWS (2002)/Tozer (2003) mapping such as Coastal Freshwater Reedland and Cumberland Moist Shale Woodland. These communities occur over small areas. NPWS (2002)/Tozer (2003) also identified Cooks River Castlereagh Ironbark Forest over a large portion of the study area; most of this vegetation is mapped by DECCW (2009) as Castlereagh Scribbly Gum Woodland.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Outer assessment circle

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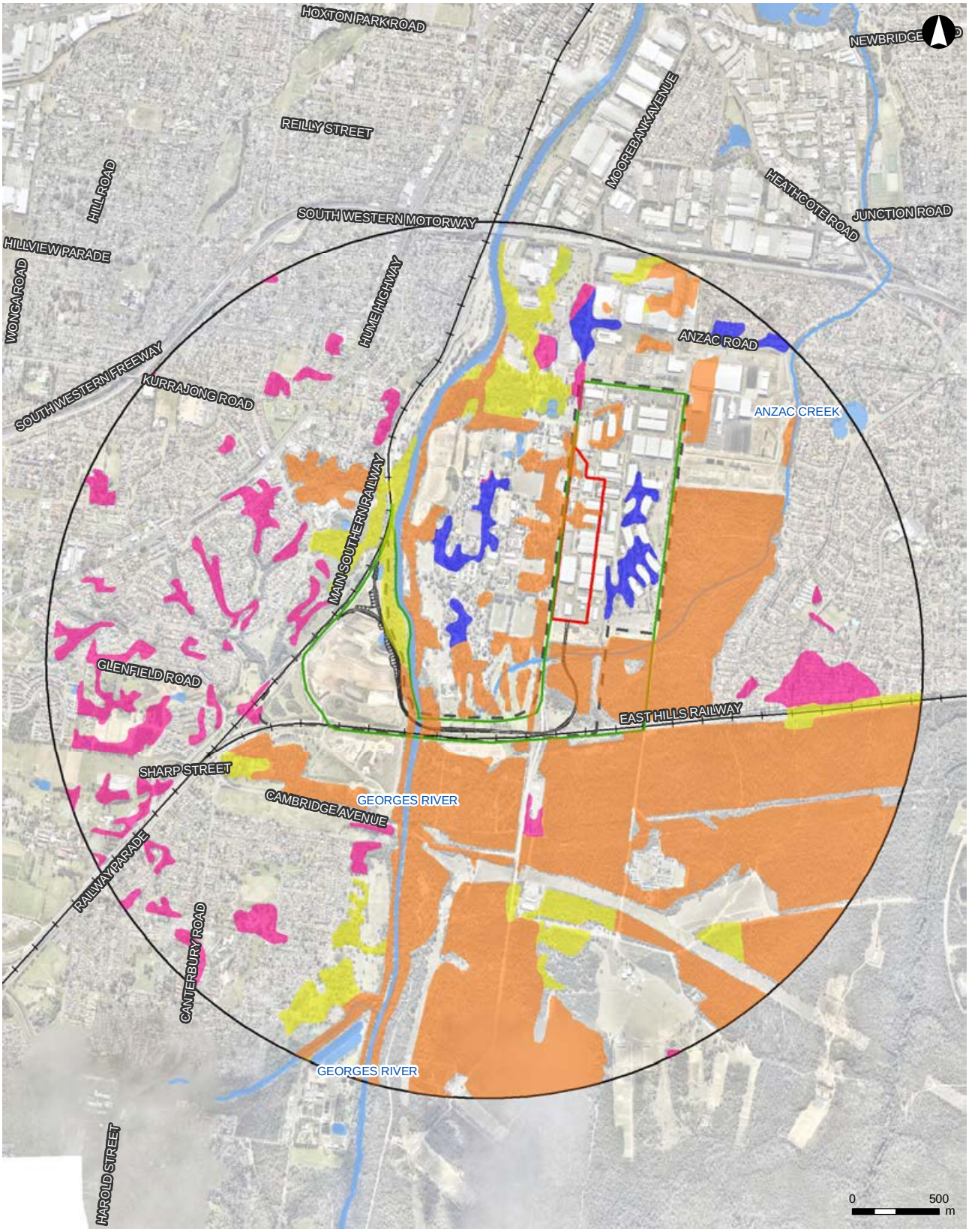
Figure 7: NPWS (2002)/Tozer (2003) vegetation mapping in outer assessment circle



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Outer assessment circle

Conservation significance (NPWS 2002)

- Core Habitat
- Support to Core Habitat

- Other Remnant Vegetation
- Urban Remnant Trees (Critically Endangered Community)

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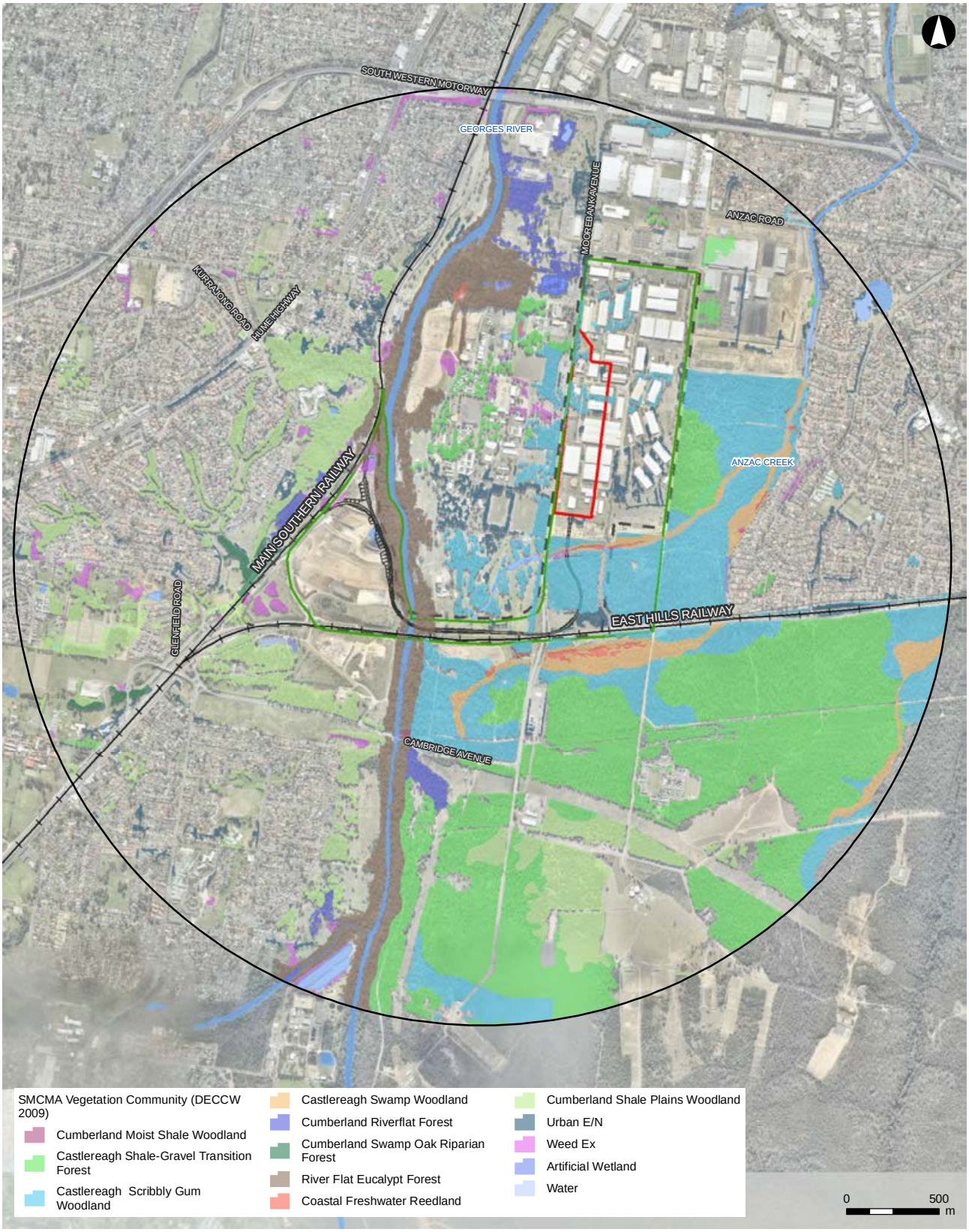
Figure 8: NPWS (2002) Conservation significance mapping in outer assessment circle



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Outer assessment circle

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Figure 9: DECCW (2009) vegetation mapping in outer assessment circle

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Created by : GC
QA by : WO

3.3 RIVERS, STREAMS AND WETLANDS

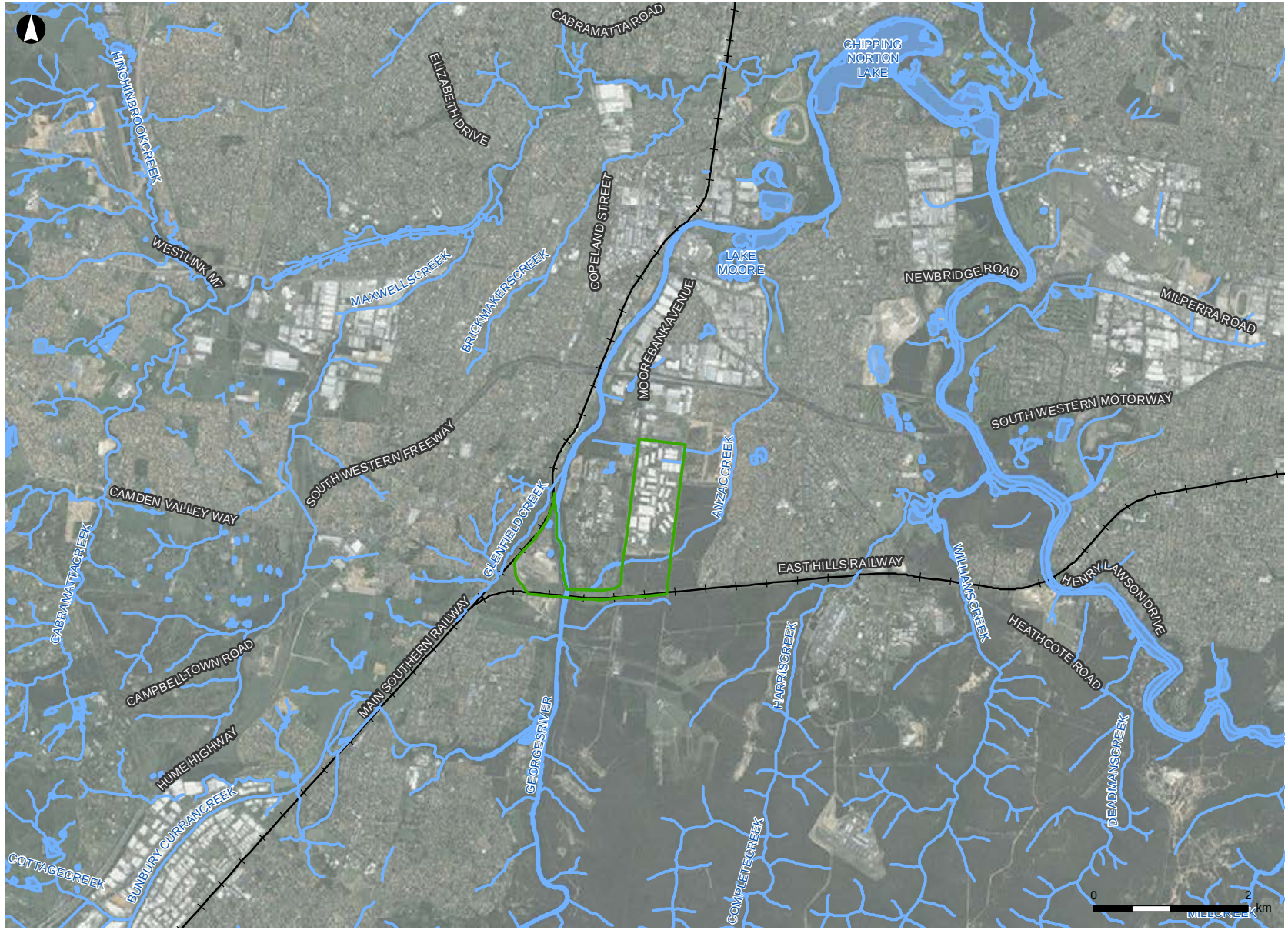
The study area is located within the Georges River catchment, covering approximately 960 square kilometres and managed by the Sydney Metropolitan Catchment Management Authority. Georges River flows north where it transects the Rail Corridor and is considered to be a 6th order stream. The river is freshwater 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 MIC site and extends north-east across the Rail Corridor 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. It is considered to be a 3rd order stream.

In addition to these named watercourses, formalised drainage channels are located in the south-east of the SIMTA site. At the time of 2011/2012 surveys, 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 MIC site.

No local or important wetlands occur in the outer assessment circle. However, several local wetlands lie downstream of the study area on the Georges River. This includes Lake Moore Wetlands approximately 5.3 kilometres downstream of the study area and Chipping Norton Lake a further 2.7 kilometres downstream of the study area.

Watercourses and wetlands in the locality are mapped in Figure 10.



LEGEND

- Study area
- Existing railway
- Waterbody

DATA SOURCES
ESRI basemap

SIMTA

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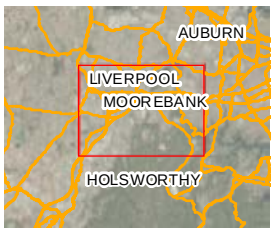


Figure 10: Watercourses and wetlands in the locality

3.4 LANDSCAPE VALUE SCORE

The landscape value has been calculated from the site-based methodology outlined in Appendix 4 of the *Framework for Biodiversity Assessment* (OEH 2014) (FBA) by determining the following:

1. Percent native vegetation cover in the landscape – percentage of all land within the inner and outer assessment circles that contains native vegetation is to be calculated for the current extent of cover and future extent of cover once clearing for the development has occurred.
2. Connectivity value – the value determined by identifying connecting links and state or regional biodiversity links. Where the development will impact on more than one connecting link, a connectivity value must be determined for each link based on the linkage widths and conditions. State significant biodiversity links have a connectivity value of 12 and regionally significant biodiversity links have a connectivity value score of 9.
3. Patch size score – determined from the percentage of native vegetation that has been cleared within the Mitchell landscape in which most of the development occurs and the patch size class. The patch size class considers the largest patch of native vegetation occurring within or connecting to the study area and attributing a size class between nil or small to extra large, dependent on the size of the patch in hectares and the percentage of native vegetation cleared.

A discussion of each of these determining factors in relation to the study area is provided below.

Native vegetation cover in landscape

Two assessment circles were mapped to determine the percent current extent of native vegetation cover within and adjacent to the development site. In accordance with the allowable combinations of inner and outer assessment circles in Table 8 of the FBA, an inner circle of 200 hectares and an outer circle of 2000 hectares were used. Both circles were centred on the area of greatest native vegetation loss in the study area, with the inner assessment circle placed to capture most of the native vegetation in the development site.

The native vegetation cover in the landscape was determined with reference to the regional vegetation mapping by DECCW (2009). All native vegetation types mapped by DECCW (2009) within the inner and outer assessment circles were considered to represent the current native vegetation cover. The future native vegetation cover was determined by subtracting the area of native vegetation to be cleared for the Proposal from the current summed native vegetation cover in each circle. Native vegetation cover percentages were calculated as a proportion of all land within each assessment circle that contains native vegetation. The current and future percentage of native vegetation cover in the inner and outer assessment circles has been provided in Table 10. Scores for each percent cover was then determined using the score criteria in Table 9, Appendix 4 of the FBA.

Table 10 Scores for the assessment of landscape value

Criteria	Assessment circle	% cover	Score
Current native vegetation cover	Inner assessment circle	31-35	8.45
	Outer assessment circle	31-35	8.45
Future native vegetation	Inner assessment circle	31-35	8.45

Criteria	Assessment circle	% cover	Score
cover	Outer assessment circle	31-35	8.45

Connectivity value

Two connecting links have been identified on the Stage 1 site - the link to native vegetation surrounding the Southern Boot Land and the Georges River. The vegetation in in both locations represent native vegetation in moderate to good condition (although the riparian vegetation adjoining the Georges River is degraded), have a patch size greater than 1 hectare and minimal cleared or hostile land features between patches of vegetation.

The Cumberland Plain Priority Conservation Lands are located within and adjacent to the Boot Land, including a portion of the Rail Corridor (Southern Boot Land). These lands are considered to be a regionally significant biodiversity link by OEH and are shown in Figure 1 and Figure 3. The corresponding connectivity value is 9.

The Georges River is a 6th order stream and as such the riparian buffer 50 metres either side is considered to be a state significant biodiversity link in accordance with Appendix 4 of the FBA. This link is also shown in Figure 1 and Figure 3. The corresponding connectivity value is 12.

The higher of the two connectivity scores is considered to be the final connectivity score. This would therefore be a score of 12.

No further assessment of connectivity value is required for the Major Project calculator assessment. Further general discussion on fauna habitat connectivity is provided in Section 4.8.3.

Patch size

The Georges River Alluvial Plain is the Mitchell landscape that covers the largest part of the construction area (Figure 1). Using the DECCW (2009) mapping of the Sydney Metropolitan Catchment Management Area (SMCMA), the percent native vegetation cleared in the Georges River Alluvial Plain Mitchell landscape is calculated to be 86%. The size of the largest patch of native vegetation occurring in the study area is the riparian corridor adjoining the Georges River, which covers approximately 167 hectares within the Georges River Alluvial Plain landscape. The Boot Land also covers an area of 90.5 hectares, including land outside the study area. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be *extra large* with a corresponding patch size score of 12.

4 NATIVE VEGETATION

4.1 BACKGROUND

4.1.1 MAPPING DATASETS

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

Five different plant communities were mapped in the study area in the NPWS (2002)/Tozer (2003) mapping of the Cumberland Plain (Figure 7) as follows:

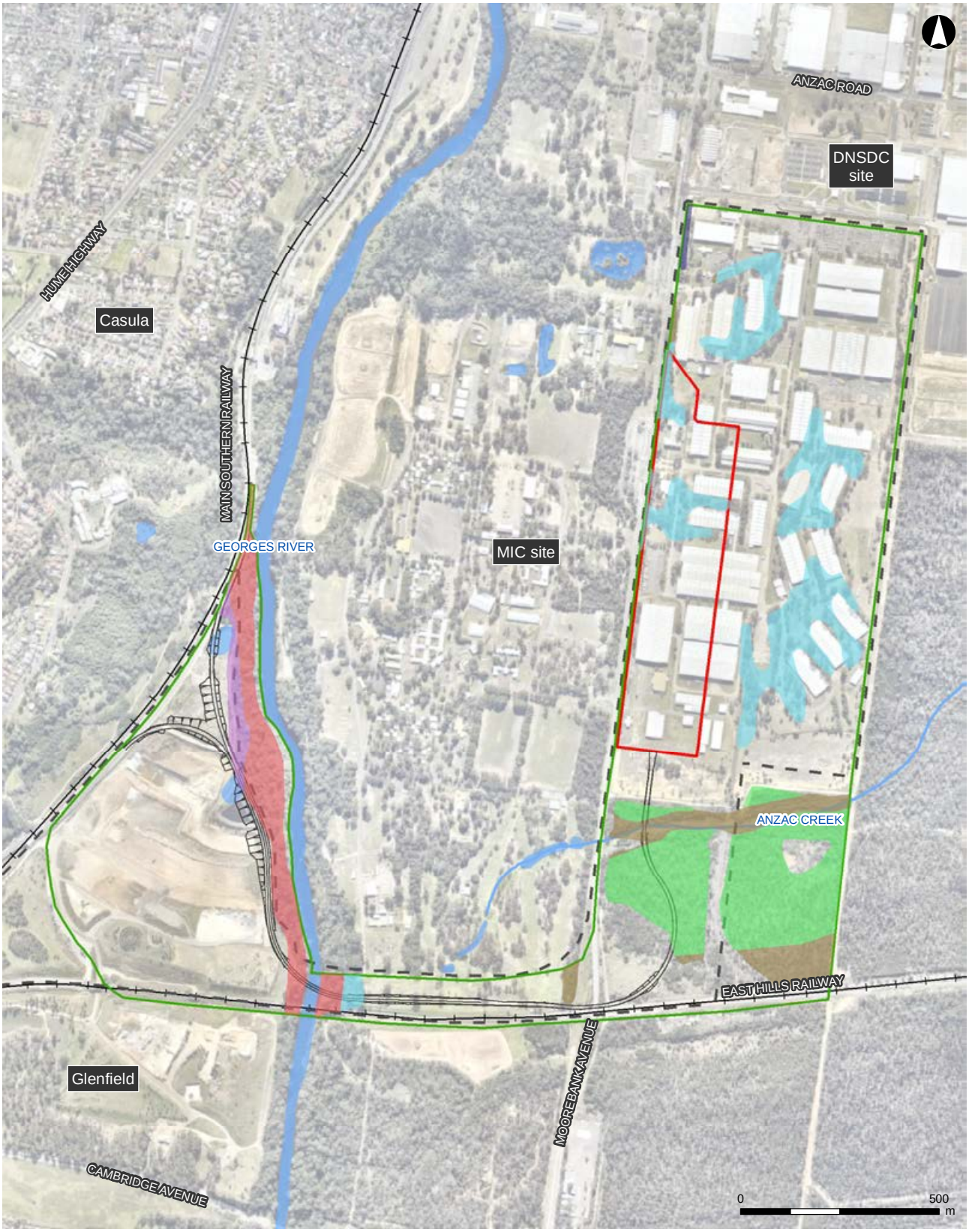
- Alluvial Woodland
- Castlereagh Scribbly Gum Woodland
- Castlereagh Swamp Woodland
- Cooks River Castlereagh Ironbark Forest
- Riparian Forest

All plant communities correspond with threatened ecological communities (TECs) listed under the TSC Act. The mapped TECs and their threatened status are listed in Table 7.

The conservation significance assessment by NPWS (2002b) mapped the vegetation in the study area as follows (Figure 8):

- 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 within the Rail Corridor, the strip of Cooks River Castlereagh Ironbark Forest adjoining the eastern edge of the MIC site, and the patches of Riparian Forest adjoining the Georges River.
- Support to core habitat: Alluvial Woodland and Riparian Forest adjoining the north-eastern boundary of the Glenfield Waste Facility 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.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area

Vegetation communities (NPWS 2002/Tozer 2003)

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

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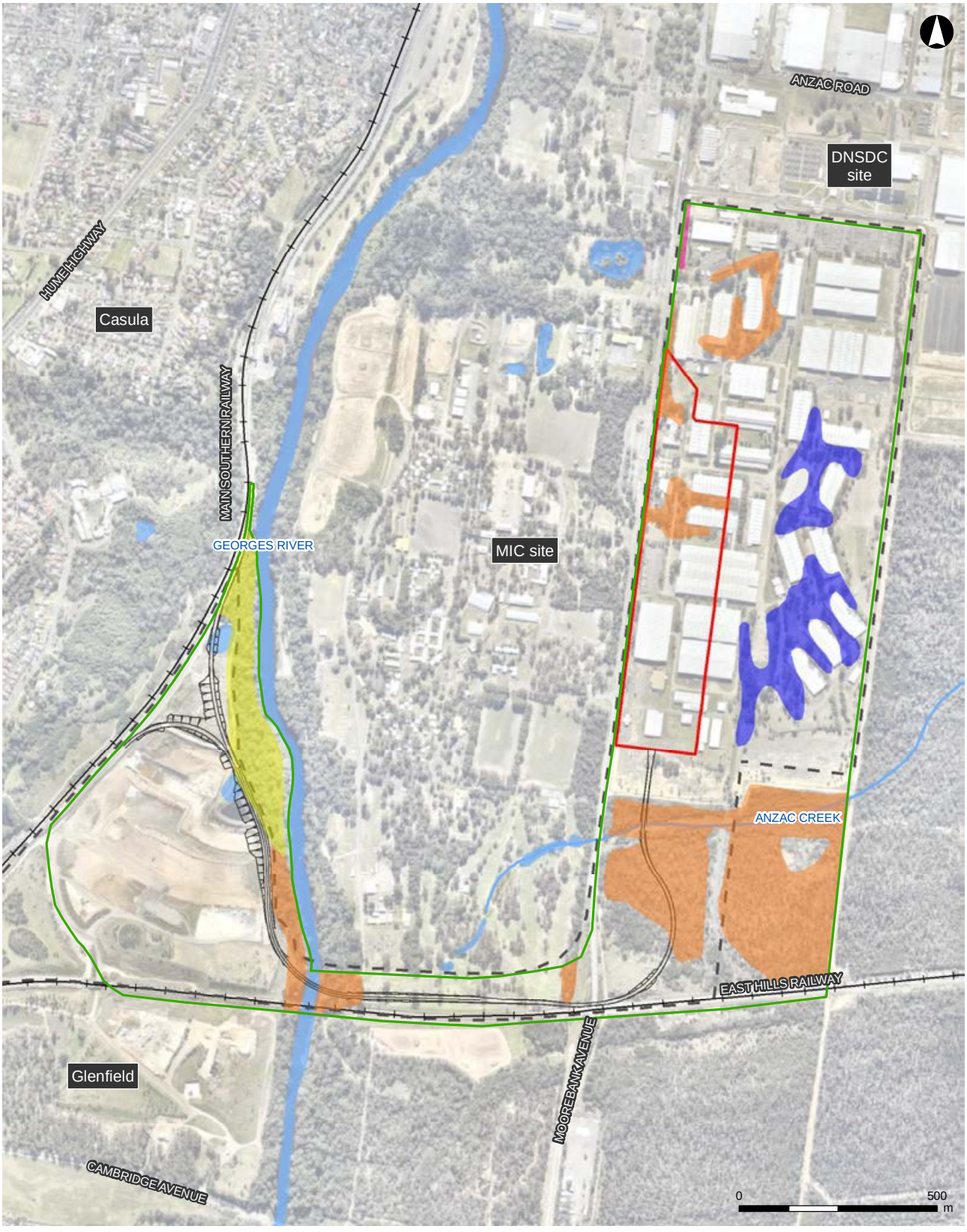
Figure 11: NPWS (2002)/Tozer (2003) vegetation mapping in development site



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area

Conservation Significance (NPWS 2002)

- Core Habitat
- Support to Core Habitat
- Other Remnant Vegetation
- Urban Remnant Trees (Critically Endangered Community)

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Figure 12: NPWS (2002) Conservation significance mapping in development site

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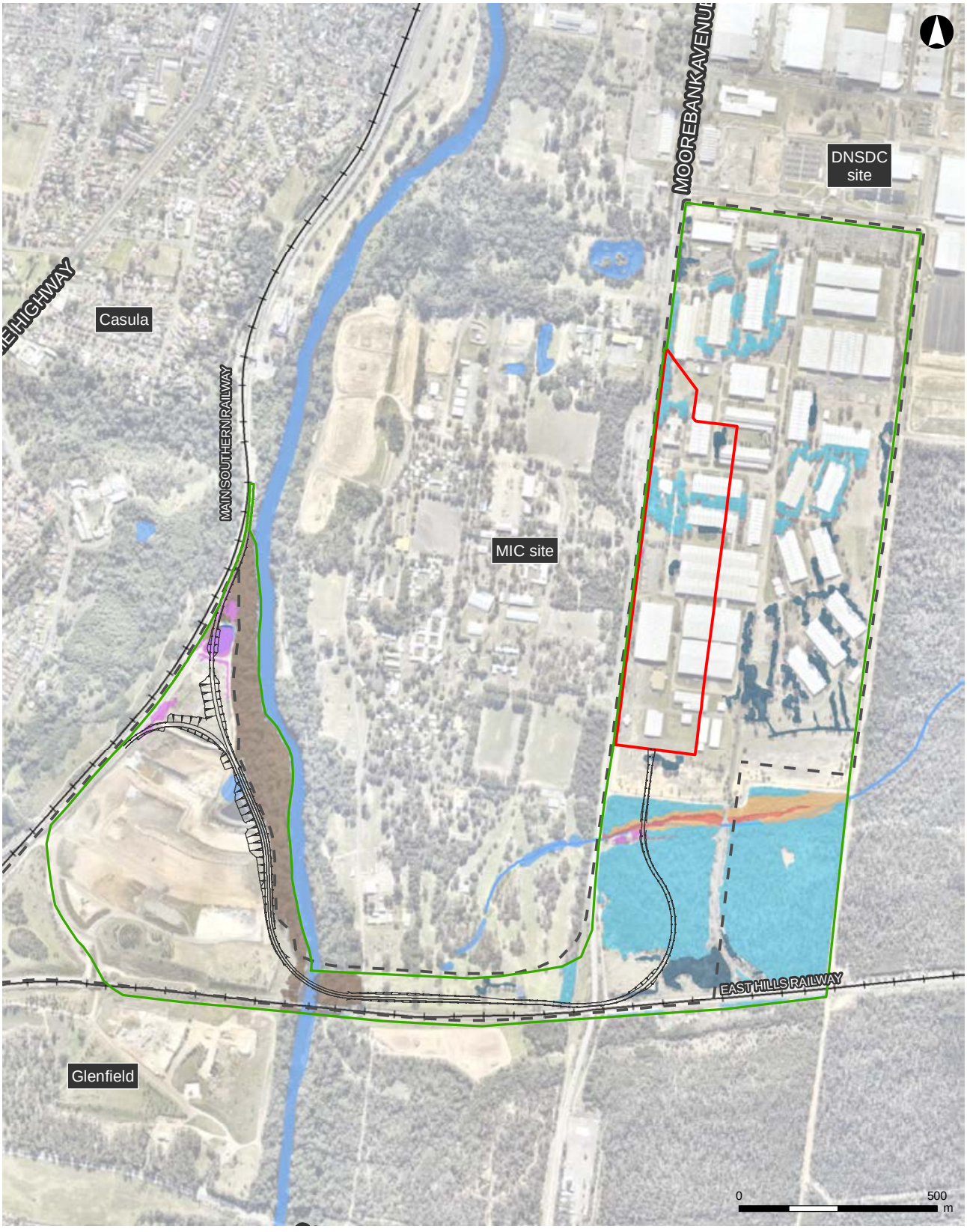

LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Castlereagh Scribbly Gum Woodland
- Castlereagh Swamp Woodland
- River Flat Eucalypt Forest
- Coastal Freshwater Reedland
- Urban E/N
- Weed Ex
- Water

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Figure 13: DECCW (2009) vegetation mapping in development site

Four different native vegetation communities were mapped within the study area (Figure 9); all correspond with threatened ecological communities under the TSC Act (Table 11).

Table 11 Vegetation communities mapped by DECCW (2009) and corresponding TECs

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

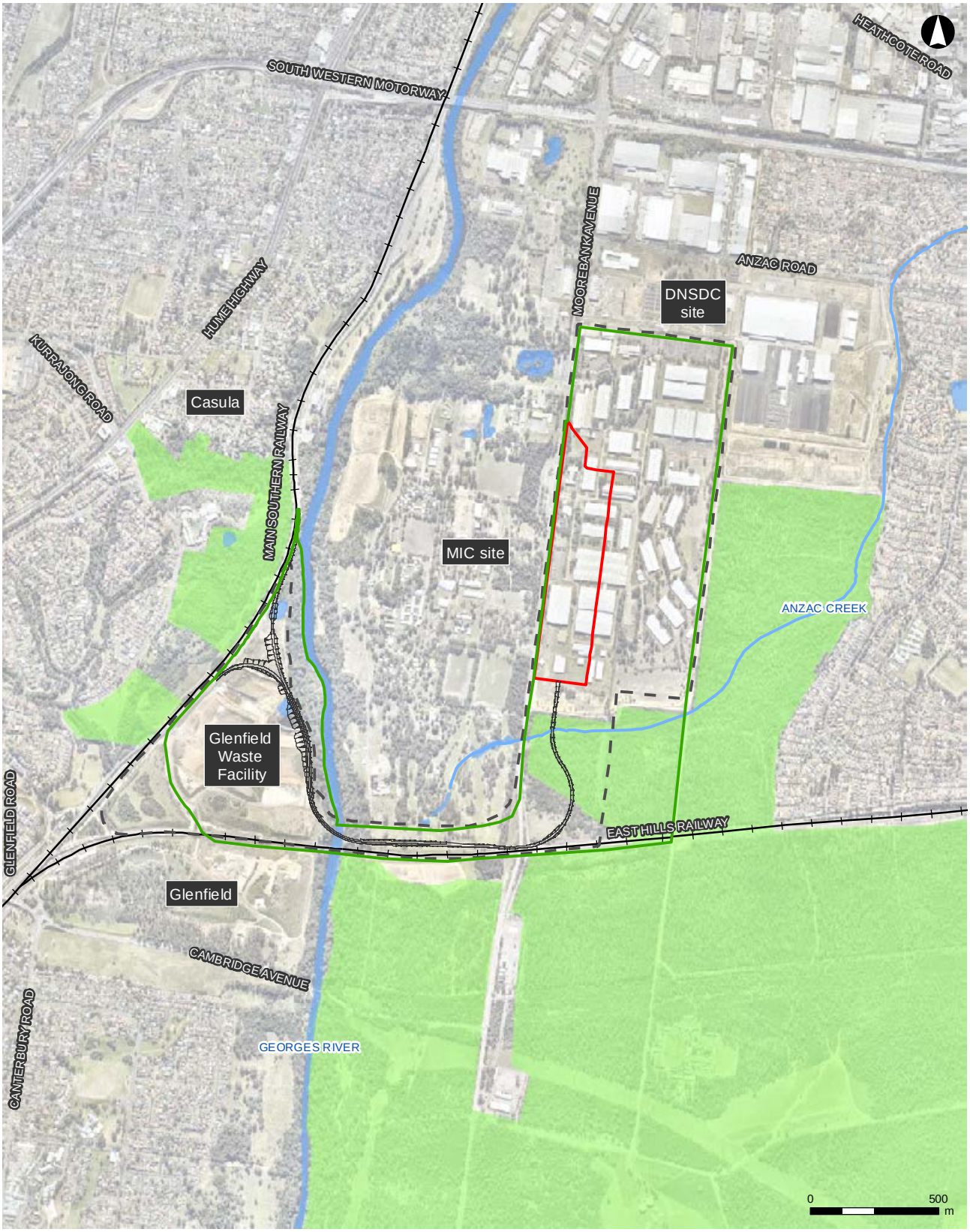
The vegetation mapping of NPWS (2002)/Tozer (2003) and DECCW (2009) in the study area was compared (Table 12).

Table 12 Comparison of vegetation mapping in the study area

Vegetation community	Area of vegetation community mapped within study area (hectares)			
	NPWS 2002/ Tozer (2003)		DECCW (2009)	
	>10% Canopy cover	<10% Canopy cover	Low to moderate disturbance	High to very high disturbance/ not assessed
Alluvial Woodland	1.52	0.02	N/A	N/A
Castlereagh Ironbark Forest	8.87	4.45	N/A	N/A
Castlereagh Swamp Woodland	5.07	0.50	1.32	0.55
Castlereagh Scribbly Gum Woodland	14.98	N/A	18.87	7.29
Riparian Woodland/Hinterland Flats Eucalypt Forest	4.18	2.92	N/A	8.81
Shale/Gravel Transition Forest	0.25	N/A	N/A	N/A
Coastal Freshwater Reedland	N/A	N/A	N/A	0.66
Urban/Exotic vegetation	N/A	N/A	N/A	7.28

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

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



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Existing railway
- Watercourse
- Cumberland Plain Priority Conservation Lands

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Figure 14: Priority Conservation Lands of the Cumberland Plain

4.2 FIELD SURVEY EFFORT

Terrestrial flora surveys of the study area have been conducted over a total of eighteen days between May 2011 and March 2015. Quadrat sampling of vegetation communities was initially undertaken in May 2011 and May 2012, with quadrats resampled in November 2014, January 2015 and March 2015 to assess any changes in vegetation condition and maintain consistency with the methodology required by the FBA.

In order to comprehensively describe the structure and floristics of each sampled plant community, plot-based surveys were used. Plot-based surveys also provide a concentrated search area for the detection of inconspicuous plant species that may be present at a particular site. The surveys were conducted in accordance with the guidelines in Section 5 of the FBA. The structure and floristics of each plant community present in the study area were sampled using twelve 0.1 hectare quadrats. The quadrats were in the form of a 20 metre x 50 metre plot with a nested 20 metre x 20 metre plot (Figure 15).

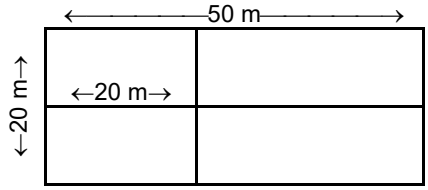


Figure 15 Flora quadrat layout

The extent of vegetation sampling required was established through review of regional vegetation mapping and site reconnaissance to determine the vegetation type and condition. Once preliminary vegetation zones were identified and mapped, the minimum number of quadrats for each zone was identified with reference to Table 3 of the FBA. Plots were established randomly within each vegetation zone, with some plots placed deliberately to sample any observed variation in vegetation structure within a vegetation zone. The quadrat locations are shown on Figure 16.

Floristic data were collected from each plot in accordance with the Table 1 of the FBA (Table 13).

Table 13 Data collected from vegetation plots

Variable	Data collected
Stratum (and layer)	Stratum and layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name (where applicable)
Cover	A measure or estimate of the appropriate cover measure for each species recorded within the 20 m x 20 m plot. Recorded from 1–5% and then to the nearest 5%. If the cover of a species is less than 1% and the species is considered important, then the estimated cover is entered (e.g. 0.4)

Variable	Data collected
Abundance rating	A relative measure of the number of individuals or shoots of a species within the 20 m x 20 m plot using the following intervals (numbers above about 20 are estimates only): 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or specify a number greater than 1000 if required

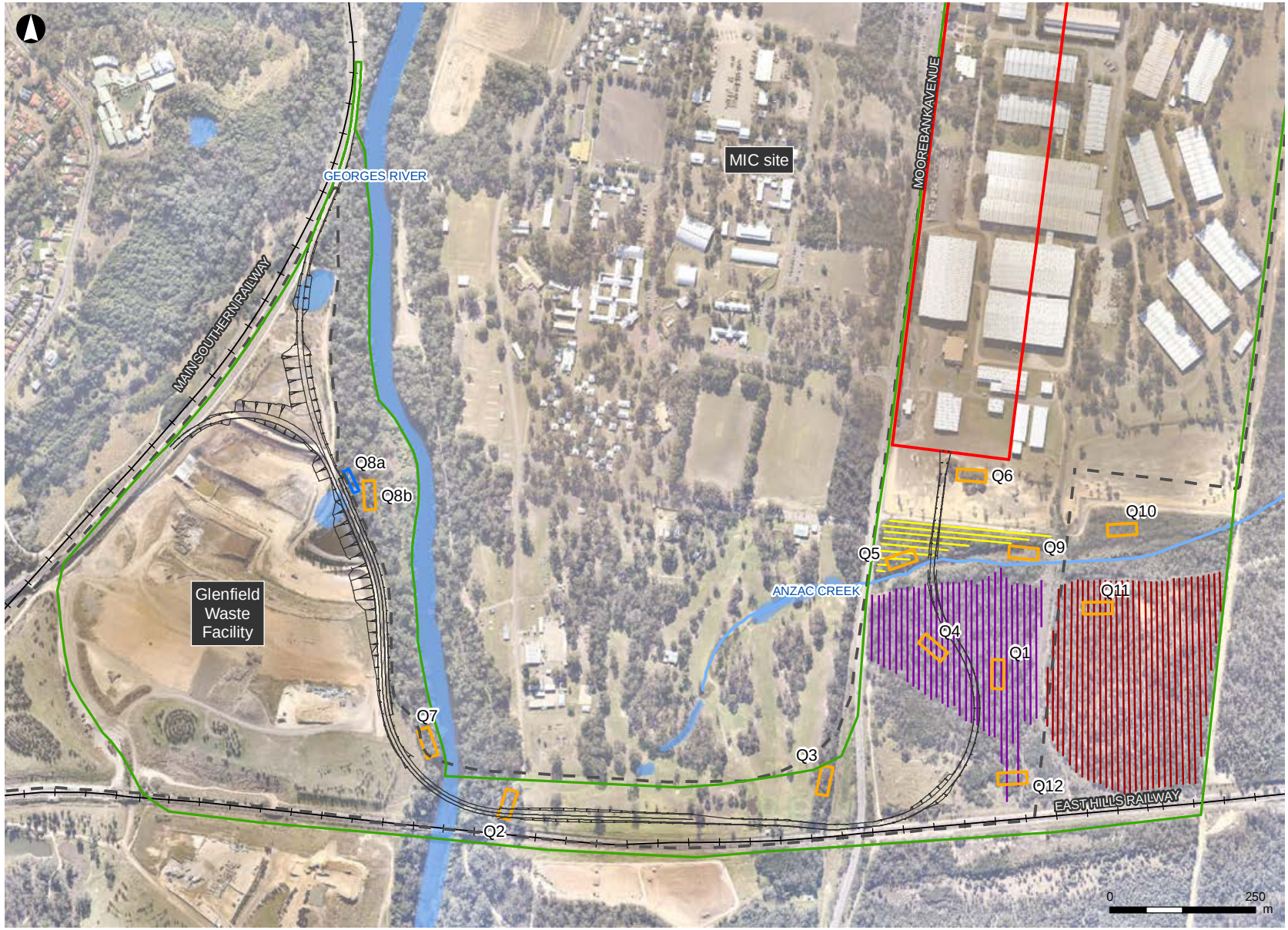
During the terrestrial flora survey the vegetation condition was assessed and rated according to the degree to which it resembled relatively natural, undisturbed vegetation. The initial condition assessment was based on visual assessment of the current habitat condition for each of the PCTs identified in the study area.

Site attribute data were collected from each plot in accordance with Table 2 of the FBA (Table 14).

Table 14 Site attribute data collected from vegetation plots

Site attribute	Data collected
Indigenous plant species richness	Number of indigenous plant species within 20 m x 20 m plot
Native over-storey cover	Estimate of percent foliage cover at 10 points (every 5 m) along the 50 m transect
Native mid-storey cover	Estimate of percent foliage cover at 10 points (every 5 m) along the 50 m transect
Native ground cover (grasses)	At 50 points along the 50 m transect (every 1 m), recorded whether native grass intersects that point.
Native ground cover (shrubs)	At 50 points along the 50 m transect (every 1 m), recorded whether native ground cover (shrub) intersects that point.
Native ground cover (other)	At 50 points along the 50 m transect (every 1 m), recorded whether native ground cover (other) intersects that point.
Exotic plant cover	Measured as total percent foliage cover of all exotics in all strata; exotic cover measured using the same method as for native over-storey, mid-storey and ground cover.
Number of trees with hollows	Count of the number of living and dead trees within the 50 m x 20 m plot that have at least one hollow.
Regeneration	Measured as the proportion of over-storey species present in the zone that are regenerating (i.e. with diameter at breast height < 5 cm).
Total length of fallen logs	Total length of logs at least 10 cm in diameter and at least 0.5 m long.

The vegetation condition data obtained for each vegetation community in quadrats was used to obtain site attribute scores and given a weighting as per Table 2 in the FBA. The scores were assessed against the Vegetation Type Benchmarks for the identified vegetation types in the VIS classification database.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Persoonia nutans transects
- Grevillea parviflora subsp. parviflora transects 2012
- Grevillea parviflora subsp. parviflora transects 2014
- Flora quadrat 2012
- Flora quadrats 2014
- Existing railway
- Watercourse

DATA SOURCES
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SIMTA

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Hyder

Figure 16: Flora survey effort

4.3 VEGETATION OBSERVATIONS

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

SIMTA site

The SIMTA site was formerly used for the Defence National Storage and Distribution Centre (DNSDC). The site contains numerous large warehouse buildings and is covered by a network of roads, carparks and other hardstand areas. The site was largely 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. Further development occurred in the early 1990s (Artefact 2015), whereupon additional plantings or landscaping would have occurred.

There are currently mature and mainly healthy trees lining the roads and paved areas (Plate 1, Plate 2). Planted tree species are typical of cultivated eucalypts that are commonly found as mature street trees in suburban Sydney, with *Eucalyptus microcorys* (Tallowwood), *E. saligna* (Sydney Blue Gum), *Corymbia maculata* (Spotted Gum) and *C. citriodora* (Lemon-scented Gum) frequently recorded. The results of the tree survey are provided in greater detail in Section 4.3.1.

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

Plate 2. Mature trees of *Eucalyptus microcorys* on SIMTA site

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

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

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

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

Plate 3. Native regrowth near existing rail line in SIMTA site

Plate 4. Native regrowth near rail spur in southern part of the SIMTA site

East of SIMTA site (Boot Land)

The area to the east of the SIMTA site, although outside of the current study area, was inspected during the current survey. An approximately 20 to 25 metre wide cleared powerline easement adjoins the eastern boundary of the SIMTA site. The vegetation beneath the powerline consists largely of slashed grassland dominated by the exotic perennial grass *Eragrostis curvula,* with scattered eucalypt and shrub regrowth (Plate 5). A dirt track runs north-south beneath the powerline.

The bushland to the east of the powerline easement consists of an open forest of *Eucalyptus crebra* (Narrow-leaved Ironbark)*, E. fibrosa* (Red Ironbark)*, Corymbia maculata* and *E. tereticornis* with a midlayer of *Acacia decurrens* (Black Wattle), *Allocasuarina littoralis* and *Melaleuca decora* (White Cloud Tree)*.* Common species observed in the shrub layer included *Bursaria spinosa* (Boxthorn)*, Daviesia ulicifolia* (Gorse Bitter-pea) and *Exocarpos cupressiformis* (Cherry Ballart)*,* and the ground layer was grassy and herbaceous with *Themeda australis, Austrostipa pubescens* (Speargrass)*,* and *Aristida vagans* (Threeawn Speargrass) frequently observed. The edge of the forest adjoining the cleared easement was disturbed, with incursions of *Eragrostis curvula* observed in some areas (Plate 6).

Plate 5. Looking south along powerline easement to east of SIMTA site

Plate 6. Bushland to east of SIMTA site

Former DNSDC South

Immediately to the south of the SIMTA site in the Former DNSDC South is a large area of mown grassland with waterlogged soils in patches. There are scattered large trees of *Eucalyptus sclerophylla* to 16 metres in height as well as some *E. parramattensis* in this area, most with native shrubs and groundcover species growing around the bases (Plate 7, Plate 8). These trees are visible on the 1951 aerial photograph where they appear to be much smaller; the surrounding area in the south was cleared and filled between 1930 and 1951 and appears as mostly bare soil on aerial photographs from 1961 to 1994 (Table 6). This area presently supports patchy grassland and boggy, waterlogged soils.

The largest patch of native understorey was sampled in Quadrat 6. It is not clear whether this area has been planted or managed as a landscape area; there were a few cut logs around 1 metre in length placed around the edges of the patch, and it has not been mown or slashed recently, whereas surrounding areas have been. 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 7. *Eucalyptus sclerophylla* as scattered trees with patches of native understorey south of SIMTA site

Plate 8. Native groundlayer species growing at base of E. sclerophylla to south of SIMTA site

Southern Boot Land

To the south of the SIMTA site is a fenced area of bushland bordered by the existing rail spur 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 *Alternanthera philoxeroides* (Alligator Weed) abundant in the lower stratum. In 2011 and 2012, a dense infestation of *Salvinia molesta* (Salvinia) was observed on the creek surface immediately to the west of the railway line (Plate 9, Plate 10). This was not observed during vegetation surveys in 2014.

Plate 9. Anzac Creek to west of existing rail spur, showing *Salvinia molesta* infestation in foreground and native sedges and rushes further upstream

Plate 10. Ground layer of wetland in Anzac Creek

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

Adjoining the southern bank of the western section of Anzac Creek the vegetation is disturbed and dominated by exotic vegetation, with a large stand of *Phyllostachys aurea* (Golden Bamboo), thickets of *Acacia decurrens* (Black Wattle) and *Pennisteum clandestinum* forming a carpet over a raised, uneven ground surface, likely to be fill material deposited in this location decades ago (Plate 11). Exposed soil beneath a fallen tree showed soil mixed with broken concrete tiles (Plate 12). *Agave americana* (Century Plant) and *Aloe maculata* (Common Soap Aloe) were also growing in this location, suggesting dumped landscape or garden waste.

Plate 11. Disturbed area south of Anzac Creek: *Pennisetum clandestinum, Agave americana* and *Phyllostachys aurea*

Plate 12. Exposed fill material in disturbed area

South of Anzac Creek there is an access track, relatively open in the west but overgrown in the east. Along the track, and in the bushland to the north is a quantity of dumped rubble, mainly building materials including concrete slabs, bricks, and strips of metal (Plate 13, Plate 14). A lot of this material was overgrown by vegetation, suggesting it had been there for some time.

Plate 13. Piled bricks and rubble at edge of bushland south of Anzac Creek

Plate 14. Concrete slabs and bricks next to overgrown fill piles at edge of bushland south of Anzac Creek

To the south of the track adjoining the disturbed area is a large tract of relatively intact woodland. The woodland is dominated by *Eucalyptus sclerophylla* and *E. parramattensis* with a subcanopy of *Angophora bakeri* (Narrow-leaved Apple) and *Melaleuca decora* (White Cloud Tree). The understorey varies in structure from relatively open in the mid-layer with dense grass and low shrubs (Plate 15) to dense shrubs and a sparse shrub and grass understorey (Plate 16). The shrub and ground layers have a high level of species diversity.

Plate 15. Woodland with open, grassy understorey

Plate 16. Woodland with dense shrubby understorey

In the south near the existing rail line the woodland adjoins degraded areas that have previously been subject to clearing and disturbance (Plate 17). In the south-west is a large fenced area that was not accessible during the any of the surveys. 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 18).

Plate 17. Disturbed grassland with thickets of *Acacia* spp. near existing rail line

Plate 18. Fenced area in south of Rail Corridor lands

MIC site

The vegetation of the MIC site, including the SME 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 SME Golf Course within the Rail Corridor 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 m; there was a dense shrub layer in the understorey, with *Pultenaea villosa* (Hairy Bush-pea), *Kunzea ambigua, Bursaria spinosa* (Blackthorn), *Lambertia formosa* (Mountain Devil) and *Micrantheum ericoides* all common (Plate 19).

Despite its width and the large edge to area ratio, this vegetation was in relatively good condition with a low number of exotic species recorded in the drier parts of the bushland. In the south of the strip of bushland was a large pool of standing water (Plate 20) 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 19. Bushland adjoining eastern boundary of SME Golf Course

Plate 20. Standing water in south of bushland adjoining eastern boundary of SME Golf Course

Banks of Georges River

To the west of the MIC site, the land within approximately 100 metres of the eastern bank of the Georges River supports forest vegetation. On the steep slope adjacent to the riverbank was severely degraded riparian vegetation, currently reduced to mature trees of *Eucalyptus saligna* x *botryoides* (Blue Gum/Bangalay hybrid) and *E. longifolia* (Woollybutt) with an understorey dominated by *Ligustrum sinense* (Small-leaved Privet) and smothered by exotic weeds, mainly

Cardiospermum grandiflorum (Balloon Vine), *Lantana camara* (Lantana) and *Delairea odorata* (Cape Ivy) (Plate 21, Plate 22).

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

Plate 21. Degraded riparian vegetation on eastern bank of Georges River

Plate 22. Degraded riparian vegetation

On the western bank of the Georges River, adjacent to the Glenfield Waste Facility, the vegetation was similar in structure and condition to that on the eastern bank. The southern part of the riparian forest on the study area supported a canopy dominated by *Eucalyptus saligna x botryoides* to 20 metres in height (Plate 23).

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

In the northern parts of the riparian corridor, the landform changes, with the very steep slopes above the river flats. The steep slopes support trees of *Eucalyptus saligna* x *botryoides* and *E. baueriana* over a dense shrub layer of *Olea europaea* subsp. *cuspidata, Ligustrum lucidum* and *Lantana camara* (Plate 24). The native small tree species *Backhousia myrtifolia* (Grey Myrtle) and *Melaleuca decora* occurred sporadically.

Plate 23. Edge of riparian vegetation on western bank of Georges River in south of study area

Plate 24. Riparian vegetation on western bank of Georges River with dense weed understorey

At the base of the steep slope on the west side of the Georges River, there were wetlands on the river flats dominated by exotic species including *Ludwigia peruviana* (Peruvian Primrose) and *Alternanthera philoxeroides* (Alligator Weed), with scattered occurrence of the native reed *Typha orientalis*. A stand of *Salix alba* (White Willow) dominated the centre of this area (Plate 25).

Closer to the bank, most areas were covered in a dense carpet of weedy vines, predominantly *Delairea odorata* and *Cardiospermum grandiflorum,* with *Pennisetum clandestinum* dominating the ground layer (Plate 26).

Plate 25. Wetlands at base of slope on west side of Georges River

Plate 26. Weed-infested vegetation on western banks of Georges River

Glenfield Waste Facility

Most of the area of Glenfield Waste Facility within the study area is currently an active quarry and landfill site (Plate 27). The natural landform has been excavated and the vegetation consists of weedy exotic herbs and grasses and some native shrubs and small trees, some of which may have been planted as part of revegetation of constructed slopes (Plate 28). The native trees and shrubs *Angophora floribunda, Acacia decurrens* and *Acacia binervia* were abundant on the slope adjoining the eastern haul road.

Plate 27. View of Glenfield Waste Facility from eastern haul road

Plate 28. Native shrubs planted on slopes.

4.3.1 TREE SURVEY

A total of 590 trees were identified on the SIMTA site in 2011 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 15). 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 15 Tree species recorded on the SIMTA site

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

Botanical name	Common name	Count
Eucalyptus sideroxylon	Mugga	14
Eucalyptus sp. (unidentified)	N/A	25
Eucalyptus tereticornis	Forest Red Gum	57
Grevillea robusta	Silky Oak	3
Jacaranda mimosifolia	Jacaranda	1
Liquidambar styraciflua	Liquidambar	2
Lophostemon confertus	Brush Box	28
Melaleuca decora	White Cloud Tree	2
Nerium oleander	Oleander	1
Pinus sp.	Pine	1
Quercus palustris	Pin Oak	2
Sorbus sp.	Rowan, Service Tree	2
Syncarpia glomulifera	Turpentine	1
Triadica sebifera	Chinese Tallow Tree	4
Total		590

4.4 PLANT COMMUNITY TYPES OF THE STUDY AREA

Based on the results of the field assessment, the vegetation communities in the study area are generally consistent with the vegetation mapping of DECCW (2009), with the exception that the vegetation within the SIMTA site consists almost entirely of planted trees with a mown or managed groundlayer dominated by exotic grasses, or fragmented regrowth and plantings along drainage lines.

The vegetation communities identified in the study area were assigned to the equivalent or best fit Plant Community Type (PCT) according to the NSW PCT classification as described in the Vegetation Information System (VIS) database. The estimated percent cleared value of each PCT in the Sydney Metro CMA was sourced from the VIS database (9 March 2015). The PCTs in the study area are listed in Table 16 and shown on Figure 17.

Table 16 Plant community types (PCTs) identified in the study area

Vegetation class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) in study area	Area (ha) in development site
Sydney Sand Flats Dry Sclerophyll Forest	ME003	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	50%	20.27	10.42

Vegetation class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) in study area	Area (ha) in development site
Cumberland Dry Sclerophyll Forests	ME005	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	45%	4.08`	0.94
Coastal Valley Grassy Woodlands	ME018	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	95%	7.13	7.08
Coastal Freshwater Lagoons	ME007	Coastal freshwater lagoons of the Sydney Basin and South-east Corner	70%	0.67	0.42

PCTs were identified following review of existing regional mapping (NPWS 2002/Tozer 2003, DECCW 2009), soil and geology attributes, landscape position and structural and floristic attributes recorded during site assessments. The justification for assigning PCTs in the study area is provided in Table 17.

Table 17 Justification for identification of PCTs in the study area

PCT	Species relied upon for ID of PCT	Justification of evidence used to identify a PCT
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	*Eucalyptus sclerophylla* *Eucalyptus parramattensis*	Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references.
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	*Eucalyptus parramattensis* *Melaleuca linariifolia* *Melaleuca decora*	Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references.
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	*Eucalyptus saligna x botryoides* *Eucalyptus longifolia*	Previous regional mapping as an equivalent vegetation type Landscape position Absence of any other appropriate equivalent PCT in the VIS database

PCT	Species relied upon for ID of PCT	Justification of evidence used to identify a PCT
Coastal freshwater lagoons of the Sydney Basin and South-east Corner	*Typha orientalis* *Bolboschoenus fluviatilis*	Previous regional mapping as an equivalent vegetation type Landscape position Structure and species composition is consistent with descriptions in VIS database and/or published references.

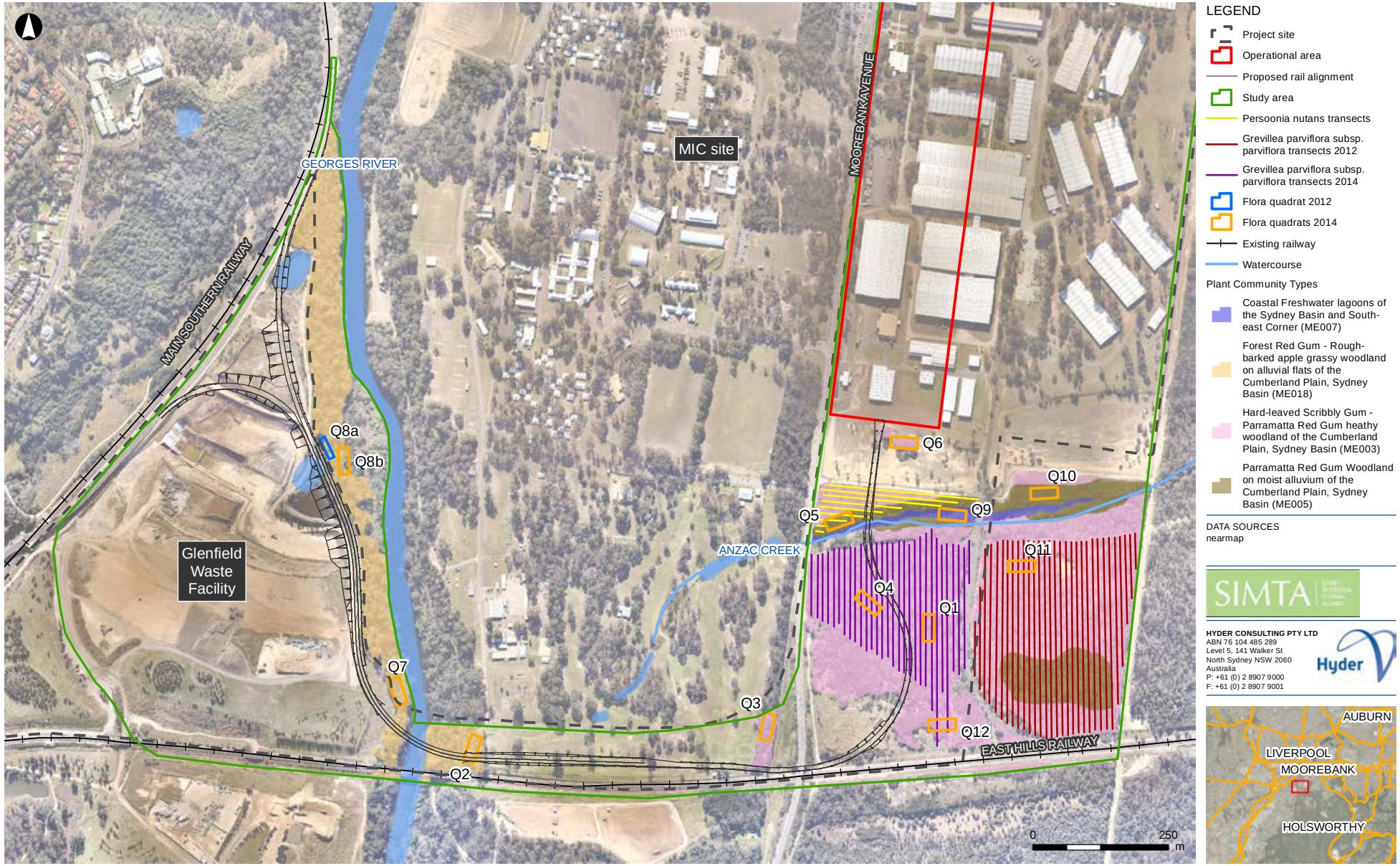

Figure 17: Plant Community Types identified in the study area

4.4.1 ENDANGERED ECOLOGICAL COMMUNITIES

The four PCTS identified in the study area fall within the definitions of threatened ecological communities listed under the TSC Act as per Table 18 and are mapped in Figure 18.

Table 18 Threatened ecological communities recorded in the study area

Plant Community Type	Equivalent TEC	TSC Act Status
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered
Coastal freshwater lagoons of the Sydney Basin and South-east Corner	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered

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

Castlereagh Scribbly Gum Woodland

This community occurrs in the Rail Corridor lands to the south of the SIMTA site, and in a narrow strip adjoining the eastern edge of the MIC site. 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.

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

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

Castlereagh Swamp Woodland

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

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

River-flat Eucalypt Forest on Coastal Floodplains

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

The riparian vegetation in the study area consists of remnant trees of *Eucalyptus botryoides* x *saligna* and *Eucalyptus longifolia* and scattered small trees of *Acacia implexa* (Hickory Wattle) 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 poor to moderate condition with a dense infestation of the noxious weed *Alternanthera philoxeroides* in the lower stratum and the aquatic weed *Myriophyllum aquaticum* (Parrots Feather) also abundant. This wetland meets the criteria for Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.

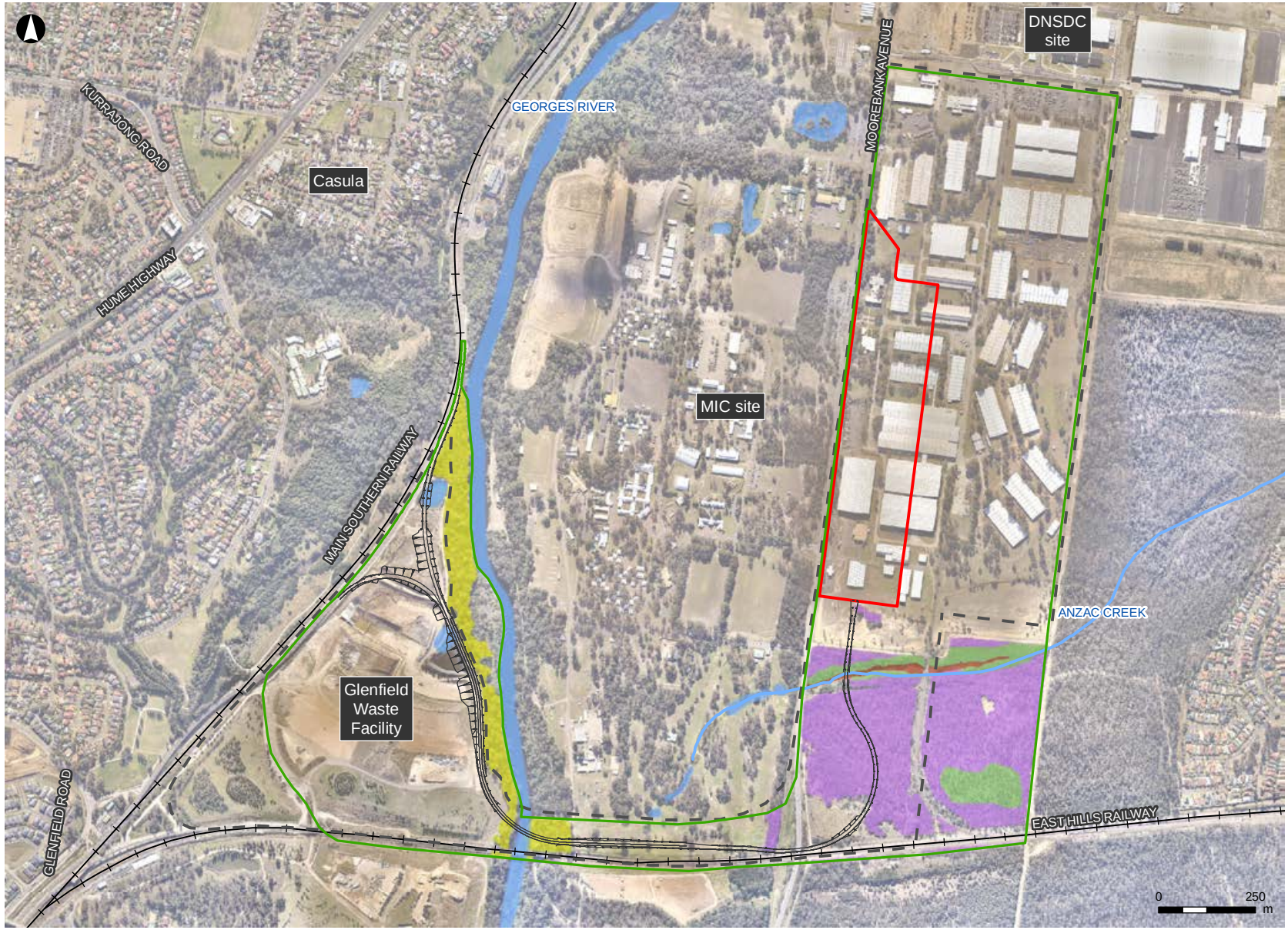

Figure 18: Threatened Ecological Communities of the study area

EPBC Act listed threatened ecological communities

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

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

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

Communities that are equivalent to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest have been mapped adjacent to the study area (Figure 7, Figure 9). Shale Plains Woodland has been mapped to the west, south-west and south of the Glenfield Waste Facility, and Shale Gravel Transition Forest has been mapped to the north and south of the study area. No EPBC Act listed TEC or equivalent vegetation communities have been mapped within the study area, except for a small edge area of Shale Gravel Transition forest overlapping the north-western corner of the SIMTA site; this vegetation forms part of a larger area of mapped Shale Gravel Transition Forest to the north-west of the site, and the site inspection did not identify any natural vegetation in this location.

The bushland to the east of the SIMTA site was mapped as Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland by NPWS (2002)/Tozer (2003) and as Shale-Gravel Transition Forest by DECCW (2009). No detailed surveys were undertaken in this area, but site inspections found that it appeared to be most consistent with Shale Gravel Transition Forest.

Castlereagh Scribbly Gum and Agnes Banks Woodland of the Sydney Basin Bioregion was listed as an Endangered Ecological Community (EEC) under the EPBC Act on 17 March 2015 and occurs within the Holsworthy area. This community occurs in the Southern Boot Land and is equivalent to the PCT *Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin* (ME003).

4.5 VEGETATION ZONES

The PCTs recorded in the study area were found to be in broadly consistent condition with all in Moderate/Good condition as defined in the FBA. The PCTs were divided into five vegetation zones, and the number of sampling plots required in each vegetation zone was determined with reference to Table 3 of the FBA. Additional plots were sampled in the Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good – Good vegetation zone, as there was some variation in the vegetation structure across the zone (Table 19). Vegetation zones are shown on Figure 19.

Table 19 Vegetation zones mapped in the study area

Vegetation Zone	Area mapped in study area	Area mapped in development site*	Minimum number of transects/plots required	Number of quadrats sampled
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	18.88 ha	9.59 ha	3	5
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	1.39 ha	0.83 ha	1	1
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	4.08 ha	0.94 ha	1	2
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	7.13 ha	7.08 ha	3	3
Coastal freshwater lagoons of the Sydney Basin and South-east Corner: Moderate/Good - Poor	0.67 ha	0.42 ha	1	1

*includes Project site and adjoining riparian vegetation on the western bank of Georges River

4.5.1 SITE VALUE SCORES OF VEGETATION ZONES

The site value score for each vegetation zone identified in the study area was determined through assessment of site attribute data collected in vegetation quadrats. The site attribute data was entered into the credit calculator to generate site value scores. The site attribute data entered into the credit calculator is presented in Table 20.

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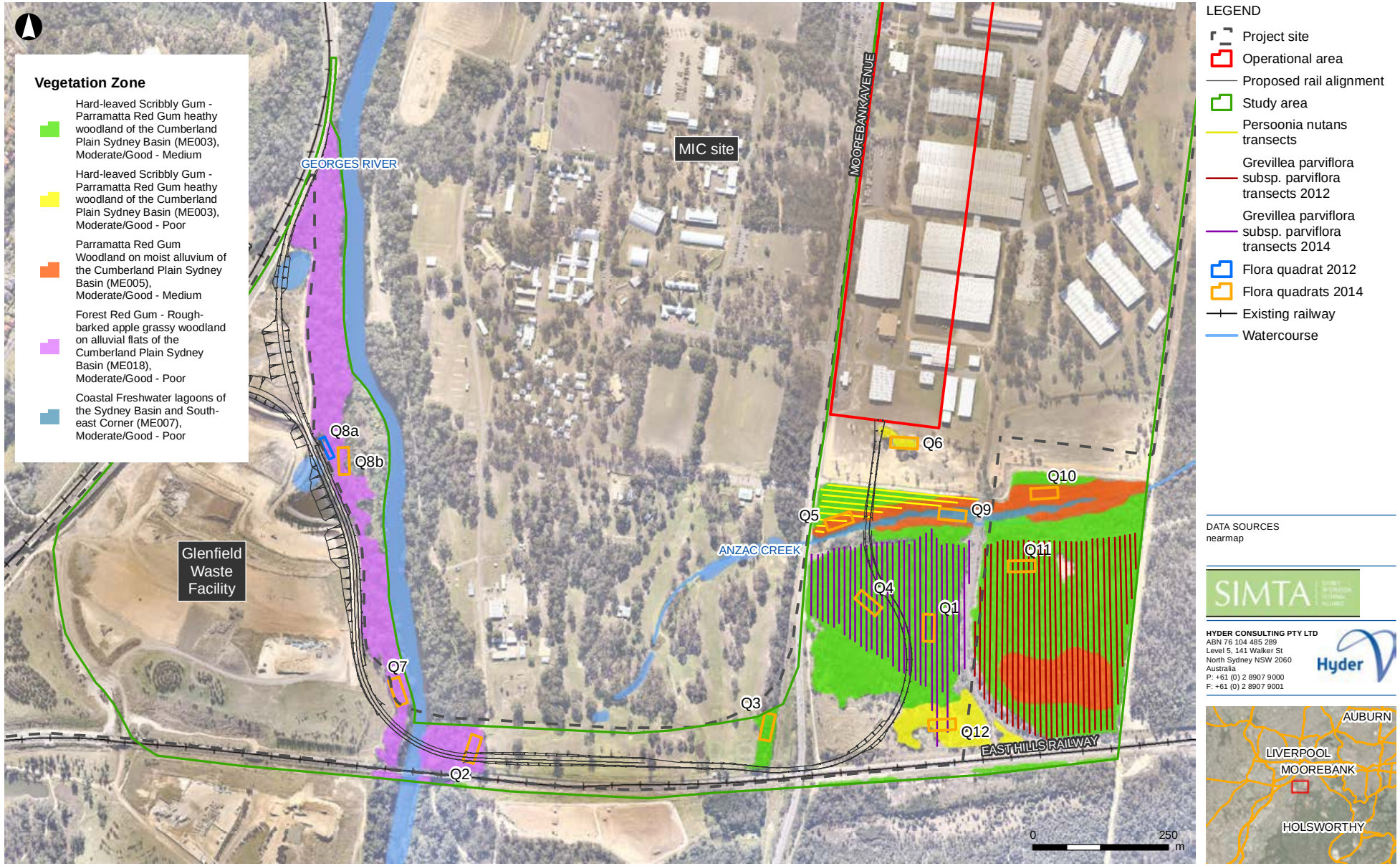


Figure 19: Vegetation zones in the study area

Table 20 Site attribute data and benchmarks for the sampled PCTs

Plot Name	Site attributes									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
ME_003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Medium										
Benchmark	40	10 to 20	23 to 33	12 to 24	0 to 10	12 to 24	-	>1	1	>30
Q1	38	27.5	21	36	12	26	0	0	1	6
Q3	42	35.5	2.5	44	6	10	2	3	1	19
Q4	39	19	24	20	16	40	0	0	1	7
Q6	20	41	0	16	38	4	2	1	0	11
Q11	34	19.5	5	24	8	14	0	1	1	4
ME_003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Poor										
Q12	32	7	20.5	32	2	2	38	0	0	4
ME_005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Medium										
Benchmark	36	7 to 42	5 to 25	12 to 38	0 to 10	12 to 38		1	1	>30
Q5	36	42.5	30	14	2	46	4	0	1	5
Q10	40	18	41	22	4	74	0	1	1	11
ME_007 Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion: Moderate/Good - Poor										
Benchmark	4	0 to 5	0 to 0	0 to 72	21 to 58	0 to 72		0	1	0
Q9	8	0	0	0	2	100	24	0	0	0
ME_018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Poor										
Benchmark	24	28 to 33	21 to 31	24 to 30	0 to 10	24 to 30		>1	1	>50
Q2	23	49.5	4.5	20	2	4	6	1	0	166

Plot Name	Site attributes									
Q7	20	30	7	2	0	4	28	1	0	62
Q8	11	22	17.5	6	0	4	14	0	0	39

The site value scores for each vegetation zone are provided in Table 21.

Table 21 Area and site value score for each vegetation zone

Vegetation Zone	Area mapped in study area	Area mapped in development site*	Current site value score
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	18.88 ha	9.59 ha	63.02
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	1.39 ha	0.83 ha	35.94
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	4.08 ha[1]	0.94 ha	76.74
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	7.13 ha	7.08 ha	44.97
Coastal freshwater lagoons of the Sydney Basin and South-east Corner: Moderate/Good - Poor	0.67 ha	0.42 ha	58.33

*includes Project site and adjoining riparian vegetation on the western bank of Georges River

4.6 NOXIOUS WEEDS

The *Noxious Weeds Act* 1993 imposes obligations on occupiers of land to control noxious weeds declared for their area. The control requirements for the classes of noxious weeds recorded in the study area are presented in Table 22.

Table 22 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.

Thirteen of the 89 exotic species recorded in the study area are listed as noxious weeds in the Liverpool City Council Local Government Area (Table 23). Nine of the noxious weeds are also listed as Weeds of National Significance under the National Weeds Strategy (Thorp and Wilson 2012).

Table 23 Noxious weeds recorded in the study area

Scientific name	Common name	Noxious weed control class	Weed of National Significance	Location in study area
Alternanthera philoxeroides	Alligator Weed	3	Yes	Anzac Creek, wetlands on western side of Georges River
Asparagus asparagoides	Bridal Creeper	4	Yes	Banks of Georges River
Chrysanthemoides monilifera subsp. *rotundata*	Bitou Bush	3	Yes	Disturbed edges of bushland south of SIMTA site and east of SME Golf Course on MIC site
Cortaderia selloana	Pampas Grass	3	No	Disturbed area in the southern disturbed part of the Boot Land

Scientific name	Common name	Noxious weed control class	Weed of National Significance	Location in study area
Lantana camara	Lantana	4	Yes	Banks of Georges River
Ligustrum lucidum	Broad-leaved Privet	4	No	Western bank of Georges River
Ligustrum sinense	Small-leaved Privet	4	No	Banks of Georges River
Ludwigia peruviana	Peruvian Primrose	3	No	Anzac Creek, in wetland on western side of Georges River
Olea europaea subsp. *cuspidate*	African Olive	4	No	Banks of Georges River
Opuntia sp.	Prickly Pear	4	Yes	Banks of Georges River
Rubus fruticosus agg. spp. (includes *R. anglocandicans*)	Blackberry	4	Yes	Banks of Georges River, in disturbed bushland south of Anzac Creek
Salix alba	Willow	5	Yes	In wetland on western side of Georges River
Salvinia molesta	Salvinia	2	Yes	On Anzac Creek adjacent to existing culvert

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).

4.7 GROUNDWATER DEPENDENT ECOSYSTEMS

Geotechnical and Phase 2 investigations at the SIMTA site and along the Rail link have identified that groundwater within vicinity of the Proposal site is present between 5 metres below ground level (mbgl) and 11 mbgl (Golder Associates, 2013). Groundwater flow is generally radial from the topographic high with the location of the Georges River, indicating that groundwater flow underlying the area would be predominantly westerly (URS, 2002). Groundwater was observed flowing into geotechnical boreholes adjacent to the proposed Georges River bridge at approximately 3 mAHD at a time when the water level in the Georges River was at 5.26 mAHD. This indicates that there is some loss of water from the river to the groundwater table, with granular alluvium acting as a drainage layer.

Groundwater flows within the Glenfield Waste Facility site are likely to have been influenced by the extraction and filling activities undertaken on the site, however, groundwater flows are understood to be generally in an easterly direction towards the Georges River (JBS&G, 2015).

Groundwater monitoring is regularly undertaken at the Glenfield Waste Facility. JBS&G reviewed the data from 2013 to 2014 and noted that groundwater within the site ranges between 3.48 and 11.98 m below the top of casing.

It is probable, due to local hydrogeology, that groundwater across the study area and the wider region is interconnected. As such, if stygofauna were present they are unlikely to be isolated to the vicinity of the study area.

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was undertaken on 20 March 2015. No data on subterranean groundwater-dependent ecosystems (GDEs) is available for the locality. Notwithstanding this, several GDEs with potential reliance on subsurface groundwater were identified in the locality including the study area (Bureau of Meteorology 2015). Results are mapped in Figure 20. Riparian woodland vegetation of Anzac Creek and the Georges River was identified as having a high potential for groundwater interaction. Other woodland vegetation in the Southern Boot Land was identified as having a moderate potential for groundwater interaction.

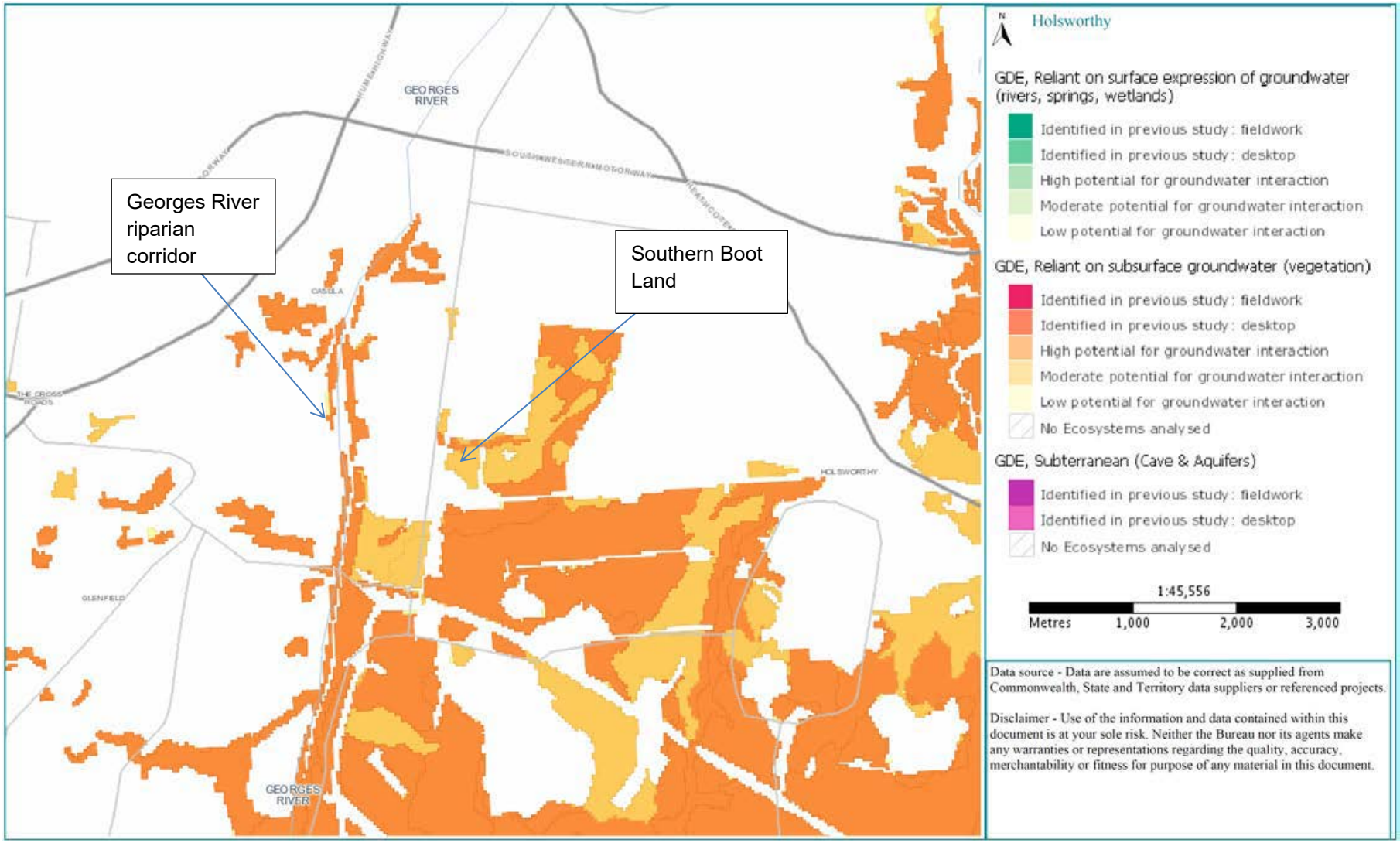


Figure 20 Groundwater-dependent ecosystems in the vicinity of the study area (BOM 2015)

4.8 FAUNA HABITATS

4.8.1 TERRESTRIAL FAUNA HABITATS

Five broad terrestrial fauna habitat types were identified from the study area (Figure 21):

- Remnant vegetation
- Riparian habitats
- Landscaped areas
- Buildings
- Cleared and disturbed areas

Within these broad habitat types, remnant vegetation was found to contain both remnant woodland and remnant forest and riparian habitats differed between the two waterbodies found on site – Anzac Creek and Georges River. The total area of each habitat type found within the study area, including broad and specific habitat types is shown in Table 24. A total of 174.20 hectares of terrestrial fauna habitats were found in the study area. The remaining 1.39 hectares of the 175.59 hectare study area comprised the waterbodies Georges River and Anzac Creek.

Table 24 Fauna habitats found in the study area

Broad fauna habitat type	Area within the study area (ha)	Specific fauna habitat type	Area within the study area (ha)
Remnant vegetation	22.86	Remnant Woodland	22.30
		Remnant Forest	0.56
Riparian habitats	10.42	Riparian Habitat-Anzac Creek	2.26
		Riparian Habitat-Georges River	8.16
Landscaped areas	63.20	Landscaped areas	63.20
Buildings	24.38	Buildings	24.38
Cleared and disturbed	53.34	Cleared and disturbed	53.34
Total terrestrial habitat (ha)	**174.20**		
Aquatic habitats			
Waterbody	1.39	Georges River	0.73
		Anzac Creek	0.66
Total area (terrestrial and aquatic habitats)	**175.59**		

Remnant Vegetation

Remnant Woodland

Remnant woodland communities occur across the proposed Rail Corridor/Southern Boot Land south of the SIMTA site over an area of 22.3 hectares (Plate 29, Plate 30). The low canopy is dominated by eucalypts and melaleucas, providing potential nesting, roosting and sheltering habitat for birds such as Black-faced Cuckoo-shrike (*Coracina novaehollandiae*) and Spotted Pardalote (*Pardalotus punctatus*). Hollow-bearing trees were recorded in low densities and would provide valuable roosting and nesting habitat for a range of arboreal fauna in the locality.

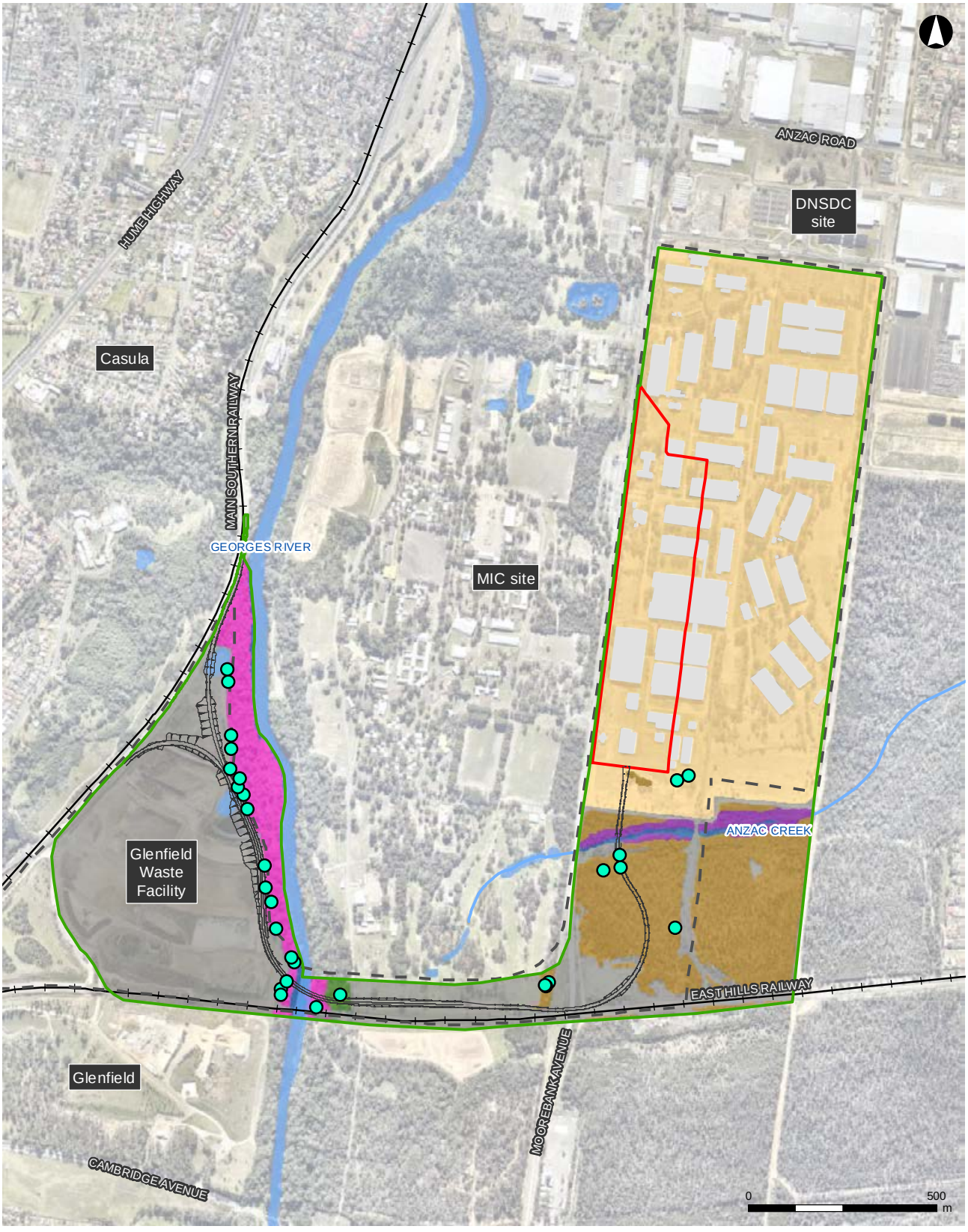
The dense shrub layer offers sheltering and foraging habitat for birds such as Red-browed Finch (*Neochmia temporalis*). Well-developed leaf litter and groundlayer vegetation offers sheltering and foraging habitat for reptiles such as Red-bellied Black Snake (*Pseudechis porphyriacus*) and Eastern brown Snake (*Pseudonaja textilis*). Micro-chiropteran bat species including Gould's Wattled Bat (*Chalinolobus gouldii)* and the threatened Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis)* were recorded by Anabats placed in remnant woodland, suggesting these species may forage for invertebrates above, within and along the margins of woodland vegetation.

Plate 29. Remnant woodland of the Rail Corridor/Boot Land

Plate 30. Remnant woodland of the Rail Corridor

Remnant Forest

Remnant forest upslope of the Georges River riparian zone (Plate 31, Plate 32) supports large canopy trees, predominantly eucalypts, that offer nesting and sheltering habitat to woodland birds including Golden Whistler (*Pachycephala pectoralis*), Eastern Rosella (*Platycercus eximius*) and Eastern Yellow Robin (*Eopsaltria australis*). Remnant forest was found to occupy an area of 0.56 hectares of the study area and is shown in Figure 21.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Hollow-bearing tree
- Existing railway
- Watercourse

Fauna Habitat

- Remnant forest
- Remnant woodland
- Riparian habitat - Anzac Creek
- Riparian habitat - Georges River
- Landscaped areas
- Cleared and disturbed
- Waterbody
- Buildings

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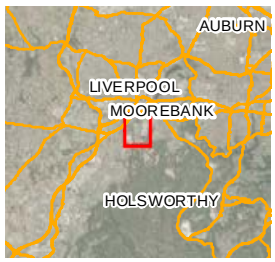

Figure 21: Fauna habitats in the study area

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Created by : GC
QA by : WO

Plate 31. Remnant forest upslope of Georges River riparian zone of the Rail Corridor

Plate 32. Remnant forest upslope of Georges River riparian zone of the Rail Corridor

The mid-storey of small trees and shrubs of the understorey offer sheltering and foraging habitat for arboreal mammals such as Ringtail Possum (*Pseudocheirus peregrines*). Groundlayer features including well-developed leaf litter and fallen timber offers foraging and sheltering habitat to reptiles and small terrestrial mammals. Possible recordings of microchiropteran bat species including the threatened Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) the Southern Myotis (*Myotis macropus*) and an unidentified Long-eared Bat (*Nyctophilus sp*.), were made by Anabats (bat detectors) placed in remnant forest. Such species may forage amongst forest vegetation or along Georges River.

Riparian Habitats

Anzac Creek

Anzac Creek is heavily vegetated and contains pools of open water. Aquatic vegetation included *Typha, Salvinia molesta* and the dense covering of ferns, sedges and rushes fringing the creek provides habitat for amphibians such as the Common Eastern Froglet (*Crinia signifera*) (Plate 33, Plate 34). Riparian vegetation is dominated by a canopy of melaleucas and eucalypts with a dense understorey of flowering shrubs such as *Hakea sp., Banksia sp.* and *Acacia,* providing sheltering, nesting and foraging habitat for a variety of birds including Brown Gerygone (*Gerygone mouki*), Grey Butcherbird (*Cracticus torquatus*) and Fan-tailed Cuckoo (*Cacomantis flabelliformis*). Well-developed leaf litter and small ground timber offers shelter and foraging habitat to small terrestrial mammals and reptiles, although there is an absence of rocky features and hollow logs which can also provide habitat for these groups of species. The riparian vegetation of Anzac Creek covers 2.26 hectares of the study area.

Plate 33. Anzac Creek within Rail Corridor

Plate 34. Anzac Creek within Rail Corridor

Georges River

Georges River is approximately 50m wide and slow-flowing through the study area, providing habitat for water birds such as Pacific Black Duck (*Anas superciliosa*), Dusky Moorhen (*Gallinula tenebrosa*) and Purple Swamphen (*Poryphyrio poryphyri*).

Riparian vegetation associated with Georges River is highly disturbed on both the western and eastern banks (Plate 35 to Plate 38). The riparian vegetation of Georges River covers 8.16 hectares of the study area. Canopy trees on the eastern bank do not appear to support hollows of any size. An abundance of trees supporting small to medium-sized branch hollows are located on the western bank of the Georges River. These hollows offer potential nesting and roosting habitat to hollow-dependent fauna. Decorticating bark of eucalypts offer potential roosting habitat to microchiropteran bat species.

Plate 35. Dense infestation of Balloon Vine within Georges River riparian vegetation (eastern bank)

Plate 36. Georges River (looking towards western bank from eastern bank)

Plate 37. Dense infestation of Lantana within Georges River riparian vegetation (western bank)

Plate 38. Georges River (looking towards eastern bank from western bank)

The understorey and groundlayer strata are dominated by woody weeds such as Small-leaved Privet (*Ligustrum sinense*), African Olive (*Olea europaea ssp. Cuspidata*) and Lantana (*Lantana camara)* and exotic climbers such as Balloon Vine (*Cardiospermum grandiflorum)*. Dense infestations of these weeds offer potential sheltering and foraging habitat to birds such as Superb Fairy Wren (*Malurus cyaneus*) and Eastern Whipbird (*Psophodes olivaceus*). Leaf litter and small ground timber offers shelter and foraging habitat to small terrestrial mammals and reptiles. Rocky features and large hollow logs are absent.

A diversity of microchiropteran bat species were recorded in Georges River riparian vegetation, including Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio),* and the threatened Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and East Coast Freetail Bat (*Mormopterus norfolkensis*).

Small gaps between the concrete spans of the existing rail bridge spanning Georges River may offer potential roosting habitat to microchiropteran bat species. Rock gabions of the western bridge abutment offer potential habitat to small reptiles.

Landscaped Areas

Landscaped areas occur across the entire SIMTA site and the southern portion of the Rail Corridor (the MIC site) that adjoins the East Hills Rail Corridor, covering an area of 63.20 hectares within the study area. Native vegetation has been predominantly cleared from these areas and persists as isolated trees amongst expanses of mown exotic and native grasses (Plate 39).

Isolated trees (Plate 40) offer potential nesting, sheltering and roosting habitat to birds such as Pied Currawong (*Strepera graculina*) and Noisy Miner (*Manorina melanocephala*). Flowering eucalypts also provide foraging habitat for Grey-headed Flying Fox (*Pteropus poliocephalus)*. A small number of scribbly gums (*Eucalyptus sclerophylla)* located in the south of the SIMTA site support small and medium-sized hollows, offering nesting habitat to hollow-dependent species such as Rainbow Lorikeet (*Trichoglossus haematodus*) and Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*).

A diversity of microchiropteran bat species were recorded in cleared and disturbed areas, including White-striped Mastiff Bat (*Tadarida australis*), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Little Forest Bat (*Vespadelus vulturnus*) and the threatened Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

Open grassy areas provide foraging habitat for ground-feeding birds such as White-winged Chough (*Corcorax melanorhamphos*), Red-rumped parrot (*Psephotus haematonotus*) and small terrestrial mammals such as the Brown Hare (*Lupus capensis*).

Scattered native and exotic shrubs and trees associated with the formalised drainage channels in the south of the SIMTA site, such as Black She-oak (*Allocasuarina littoralis*), eucalypts, Camphor Laurel (*Cinnamomum camphora*) and *Cotoneaster* sp., offer foraging, sheltering and roosting habitat to birds such as Noisy Miner (*Manorina melanocephala*), Raven (*Corvus coronoides*) and Magpie Lark (*Grallina cyanoleuca*). Other small trees and shrubs throughout the SIMTA site that may offer sheltering and nesting habitat to smaller birds are restricted to small areas of horticultural plantings.

Plate 39. Cleared areas of Rail Corridor in the SIMTA site

Plate 40. Isolated trees of SIMTA site in the south

Other fauna habitat features such as rocky features, well-developed leaf litter, ground timber and hollow logs are absent from cleared and disturbed areas. As a result, the availability of sheltering and foraging habitat for reptiles and cover-dependent terrestrial mammals is reduced. Depressions in open areas that contain temporary water following rain events offer habitat to colonising amphibians such as Common Eastern Froglet (*Crinia signifera*).

Buildings

The buildings currently on the Stage 1 site and (within the SIMTA site) offer limited habitat features to native fauna, although they may support potential roosting habitat for microchiropteran bats. Given that inspection of these buildings was not possible during site surveys, it is assumed that some of the buildings offer potential fauna habitat. Buildings occupy an area of 24.38 hectares.

Cleared and Disturbed

The type and abundance of habitat features within cleared and disturbed areas are limited, as native vegetation has been almost entirely cleared. Cleared and disturbed habitats occupy 53.34 hectares of the study area which includes the Glenfield Waste Facility, the MIC site and edges of remnant woodland in the Southern Boot Land. Weedy exotic herbs and grasses may offer sheltering and foraging habitat to small mammals and reptiles, while native shrubs and small trees may offer roosting, nesting, sheltering and foraging habitat to small birds. Potential foraging resources for nectivorous fauna species such as *Angophora floribunda, Acacia decurrens* and *Acacia binervia* were abundant on the planted slope adjoining the eastern haul road of the Glenfield Waste Facility.

Plate 41. Glenfield Waste Facility eastern end near Georges River riparian corridor view north

Plate 42. Glenfield Waste Facility eastern end near Georges River riparian corridor view south

Terrestrial Fauna Species

A total of 64 terrestrial vertebrate fauna species, comprising 59 native and 5 exotic species, were recorded during the current field investigation (Appendix F). Forty-three species of birds, 15 species of mammals, four species of reptiles and two species of amphibians were aurally and visually identified from the study area. Examples are shown in Plate 58 to Plate 46.

Four threatened mammal species: East Coast Freetail Bat (Mormopterus norfolkensis); Southern Myotis (*Myotis macropus*); Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and Grey-headed Flying Fox (*Pteropus poliocephalus*) were recorded in the study area. These species are discussed in further detail in Section 5.3.

Plate 43. White-winged Choughs on SIMTA site

Plate 44. Rainbow Lorikeets in tree hollow on SIMTA site

Plate 45. Red-bellied Black Snake in Rail Corridor

Plate 46. Red-rumped Parrots on SIMTA site

4.8.2 AQUATIC FAUNA HABITATS

Anzac Creek

Anzac Creek comprises a named waterway with intermittent flow supporting semi-permanent to permanent water in pools and as such, is classified as Class 3 (Minimal Fish Habitat) in accordance with Fairfull and Witheridge (2003).

Aquatic habitat types of Anzac Creek within the study area included soft substrate pools and extensive macrophyte cover. Water in Anzac Creek was mostly static and shallow; small pools were heavily vegetated with floating and emergent macrophytes such as *Typha sp*. and *Salvinia molesta* (Plate 47, Plate 48).

Plate 47. Anzac Creek – upstream of the existing rail spur

Plate 48. Anzac Creek – downstream of existing rail spur

The introduced Gambusia (*Gambusia holbrooki*) was recorded at Anzac Creek. One Long-fin Eel (*Anguilla reinhardtii*) was identified in the upper reaches of Anzac Creek within the MIC site (outside of the study area).

A total of 23 macroinvertebrate families were recorded in Anzac Creek (ALS 2011). Family diversity was generally low and many sensitive taxa were not recorded. Anzac Creek falls into Band B, indicating that the macroinvertebrate community was 'significantly impaired'; fewer families than expected were observed. This result may be attributed to a current/existing 'potential' impact on water quality or habitat quality or both (ALS 2011).

Georges River

Georges River (Plate 49, Plate 50) comprises a major permanently flowing river and as such, is classified as Class 1 (Major Fish Habitat) in accordance with Fairfull and Witheridge (2003). It is also mapped as 'Key Fish Habitat' on DPI's Key Fish Habitat map for the Sydney Metropolitan. Aquatic habitats of Georges River within the study area included soft substrate pool habitat, large woody debris and extensive macrophyte cover. Overhanging vegetation, fallen logs, mats of sticks, submerged (*Elodea canadiensis*) and floating aquatic plants (*Azolla sp., Salvinia molesta*) were present along the bank. This extensive macrophyte cover of submerged and floating aquatic plants has reduced the heterogeneity of aquatic habitat and most likely affects the composition of the macroinvertebrate community present.

Plate 49. Georges River in the study area

Plate 50. Georges River beneath existing rail bridge

Georges River within the study area may be considered poor quality habitat, attributed to the lack of diversity of micro-habitats required to support a diverse and healthy macroinvertebrate community (ALS 2011).

Flathead Gudgeon (*Philypnodon grandiceps*) and the introduced Gambusia (*Gambusia holbrooki*) were recorded in the Georges River. Gambusia was more abundant in Georges River than in Anzac Creek.

Australian Bass (*Macquaria novemaculeata*) migrates through the study area within the Georges River, to and from saline waters, as part of its life cycle. A fish ladder was installed at the Liverpool weir to enable this migration (GRCCC 2012). The species is commonly caught by recreational fishers.

The threatened Macquarie Perch has also been identified in parts of the upper Georges River catchment in the (Atlas of Living Australia 2015). Potential habitat for this species is present in the study area within the Georges River, as discussed in Section 5.5.

The Georges River at Cambridge Avenue was sampled for the *Biodiversity of the Georges River Catchment* study (Steller and Bryant 2004) and was classified as an "Urban" site. Five fish species were recorded: Long-finned Eel (*Anguilla reinhardtii*), Goldfish (*Carassius auratus*) Striped gudgeon (*Gobiomorphus australis*), Empire gudgeon (*Hypseleotris compressa*) and Australian bass (*Macquaria novemaculeata*). These species, with the exception of Australian bass, have been classified as relatively tolerant of general disturbance. The study concluded that urbanised parts of the Georges River contain fewer species of native fish, higher abundances of introduced species of fish, lower numbers of species known to be intolerant of environmental disturbance, and have higher incidence of fish with visible signs of disease (Steller and Bryant 2004).

A total of 18 macroinvertebrate families were recorded in Georges River (ALS 2011). Family diversity was generally low and many sensitive taxa were not recorded. The Georges River site

falls into Band B and C in accordance with the AUSRIVAS model, indicating that it is 'severely impaired'; fewer macroinvertebrate families were observed than expected. This result may be attributed to current/existing 'substantial' impacts on water quality, habitat quality, or both.

Other aquatic habitats

In addition to Georges River and Anzac Creek, formalised drainage channels are located in the south-east of the SIMTA site (Plate 51, Plate 52). These channels do not all support permanent water; some flow only ephemerally following rain. Channels that support aquatic and fringing vegetation, such as *Typha* sp, offer habitat for reptiles and amphibians such as Common Eastern Froglet (*Crinia signifera*).

Constructed artificial wetlands within the MIC site offer potential habitat to amphibians, fish and aquatic birds. Those wetlands supporting aquatic and fringing vegetation offer sheltering and potential nesting habitat to such species. Several dams are located within Glenfield Waste Facility which offer potential habitat to those species of amphibians, fish and aquatic birds that are tolerant of highly degraded aquatic habitats (Plate 53, Plate 54).

Plate 51. Formalised channels of SIMTA site

Plate 52. Formalised channels of SIMTA site

Plate 53. Dam in Glenfield Waste Facility

Plate 54. Leachate dam in Glenfield Waste Facility

4.8.3 HABITAT CONNECTIVITY

The study area is located within a relatively industrialised and urbanised landscape. Vegetation of landscaped and cleared and disturbed areas, largely in the MIC site, Glenfield Waste Facility and SIMTA site is generally limited to single, isolated trees amongst expanses of mown exotic

and native grasses; habitat features of these areas do not maintain connectivity with habitat features elsewhere within the study area.

Larger expanses of habitat within the study area are isolated from habitat adjacent to the study area, due to the presence of significant barriers to fauna movement. These barriers include Moorebank Ave, chain-mesh fencing surrounding the SIMTA site (Plate 55), East Hills Rail Corridor (Plate 56), Glenfield Waste Facility (Plate 57, Plate 58), Southern Boot Land and MIC site. The chain-mesh fencing would limit movement into and through the study area to small terrestrial mammals, reptiles, amphibians and birds and bats. Larger terrestrial mammals that may occur in the locality would be excluded from much of the study area as a result.

A lack of habitat connectivity within the study area, and between the study area and adjacent areas, reduces potential movement of arboreal mammals and cover-dependent fauna into and through the study area.

Plate 55. SIMTA site bound by chain mesh fencing and adjoining Moorebank Avenue

Plate 56. Rail Corridor bound by chain mesh fencing adjoining East Hills Rail Line

Plate 57. Glenfield Waste Facility is bound by chain-mesh fencing

Plate 58. Glenfield Waste Facility is bound by chain-mesh fencing

Riparian vegetation associated with Georges River maintains connectivity with riparian vegetation to the north and south, including Holsworthy Military Area. The riparian vegetation below the East Hills Rail Line bridge impacts this connectivity over a narrow width. There are other narrow sections of the riparian corridor in further up/downstream of the study area including the Cambridge Avenue and M5 bridges. This riparian corridor may facilitate the movement of less mobile species, including cover-dependent species, larger terrestrial mammals and arboreal mammals.

Substantial areas of intact native vegetation are contained with the Holsworthy Military Area (to the south of the SIMTA site, on the southern side of the East Hills Rail Corridor). Holsworthy

Military Area, located to the south of the study area, comprises approximately 18,000 hectares of continuous native vegetation, much of which has remained largely undisturbed as a result of restricted access to the Military Area (French *et al.* 2000). The diversity of vegetation communities within the Military Area includes forests, woodlands, heath and swamp communities, which in turn provide important habitat for locally and regionally occurring, and threatened flora and fauna species.

Highly mobile fauna species such as birds and some mammals may predominantly reside within the Holsworthy Military Area and utilise the resources offered by the study area on a temporary or transient basis.

5 THREATENED SPECIES

5.1 METHODS

5.1.1 TARGETED SURVEYS

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

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

Additional targeted threatened species surveys were conducted in the Rail Corridor and the area to the east in the Southern Boot Land by ecologists Jane Rodd and Laura Worthington on Tuesday 10, Wednesday 11 and Wednesday 18 July 2012.

Surveys were repeated in the Rail Corridor, SIMTA site, Southern Boot Land and the riparian corridor adjoining the Glenfield Waste Facility by ecologists Jane Rodd and Kate Carroll on Thursday 13, Tuesday 18, Monday 26 and Tuesday 27 November 2014, Tuesday 20 January and Wednesday 11 March 2015. Surveys included targeted threatened flora surveys, resampling quadrats using the FBA methodology, and an assessment of any change to fauna habitat.

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) or Holsworthy Aerodrome (station 06616) for the surveyed dates are as shown in Table 25 (BOM 2011, 2012, 2014, 2015).

Table 25 Weather records from Holsworthy Control Range or Holsworthy Aerodrome weather stations for the survey dates

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

Date	Temperature		Rain	Maximum wind gust	
31 May 2012	8.9	18.1	0	SE	19
10 July 2012	3.2	15.3	0.2	WNW	15
11 July 2012	6.8	20	7	NNW	31
18 July 2012	3.0	18.2	0	SW	24
13 Nov 2014	16.2	25.1	0	ENE	33
18 Nov 2014	13.7	26.0	0	ESE	50
26 Nov 2014	17.6	25.0	0	E	35
27 Nov 2014	16.5	20.8	3.2	Not recorded	Not recorded
20 Jan 2015	17.0	25.8	2.2	E	44
11 Mar 2015	18.7	30.2	0	WNW	35

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 (2011-2014). In this report, plant species are referred to by both their scientific and common names (if applicable) when first mentioned. Subsequent references to these species cite the scientific name only.

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

Random meander and targeted searches

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

Additional targeted searches for threatened plant species were conducted in the Rail Corridor and the area to the east of the Rail Corridor, following detection of two listed threatened species, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.* The searches were initially undertaken in July 2012, and repeated in November 2014 and January 2015, with slightly different methodologies used for surveys of each species:

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

Intensive surveys in July 2012 for *Grevillea parviflora* subsp. *parviflora* focused on quantifying the population of the species in the vicinity of the proposed Rail link; these surveys involved

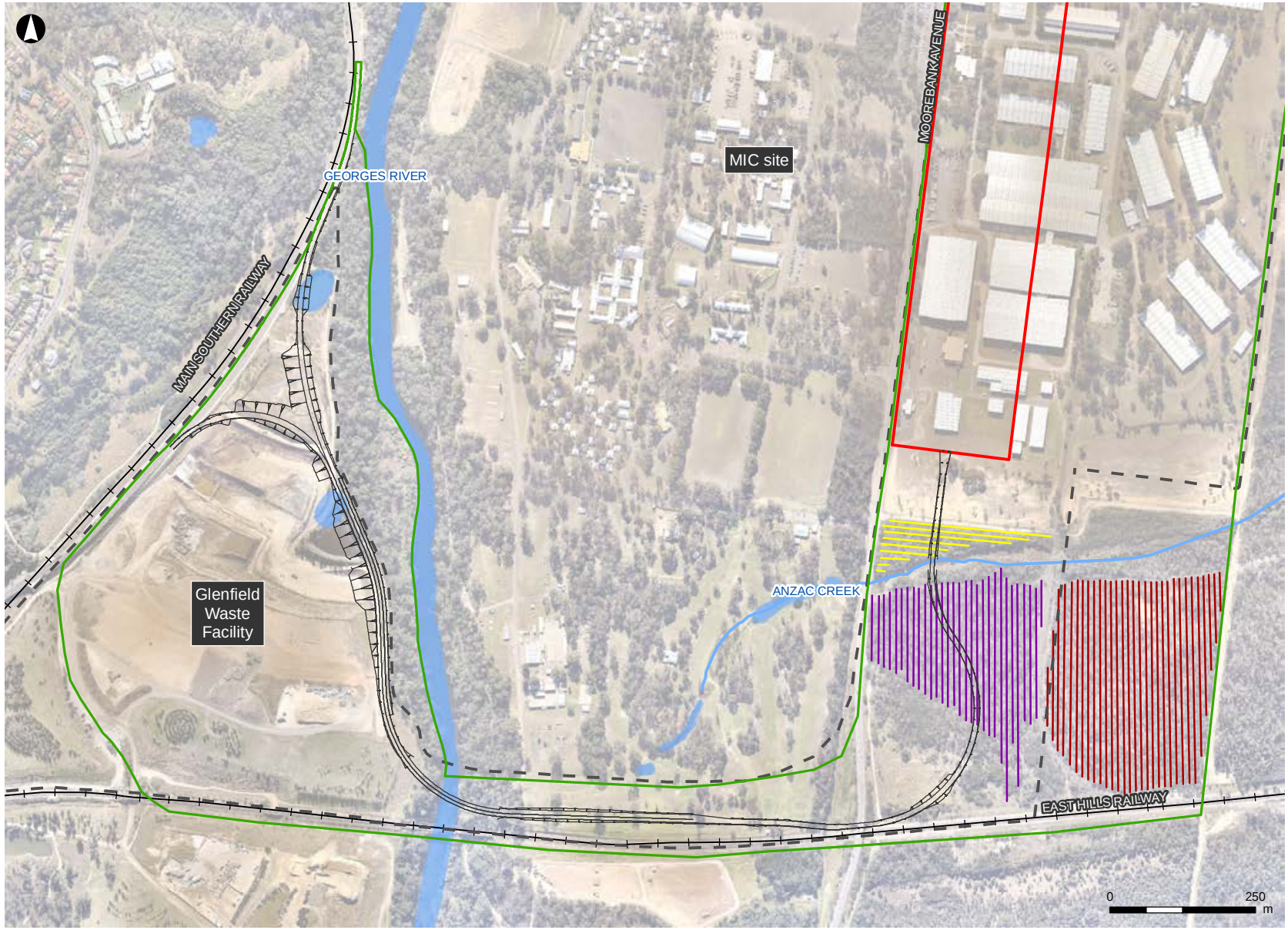
counting all stems within approximately 25 metres either side of the centre line of the proposed Rail link, and were undertaken over an area of approximately 0.37 hectares.

In response to EPBC Act conditions of approval, the threatened plant species *Acacia bynoeana* (Bynoe's Wattle) and *Hibbertia sp.* 'Bankstown' (syn. *Hibbertia puberula* subsp. *glabrescens*) were also targeted in threatened species searches.

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.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Threatened flora transects (5m interval)
- Threatened flora transects (10m interval) 2012
- Threatened flora transects (10m interval) 2014
- Existing railway
- Watercourse

DATA SOURCES
nearmap

SIMTA

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Hyder

Figure 22: Targeted flora survey effort

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Terrestrial Fauna

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

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

The entire study area was traversed on foot and all species and evidence of fauna presence observed was recorded. An inventory of fauna species recorded in the study area was compiled. Fauna survey locations are identified on Figure 23. The survey areas were visited again in November 2014 and January 2015 to assess any change to habitat condition.

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 where access was possible
- Searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings)
- Plot-based fauna habitat assessment. Components of fauna habitat were assessed using 20 x 20m quadrats, randomly located across the study area. Data collected included:
    - Structure and floristics of vegetation
    - Surface drainage features
    - Rocky features
    - Abundance and type of tree and log hollows
    - Foraging resources
    - Microhabitats.

Nocturnal Surveys

Nocturnal surveys involved:

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

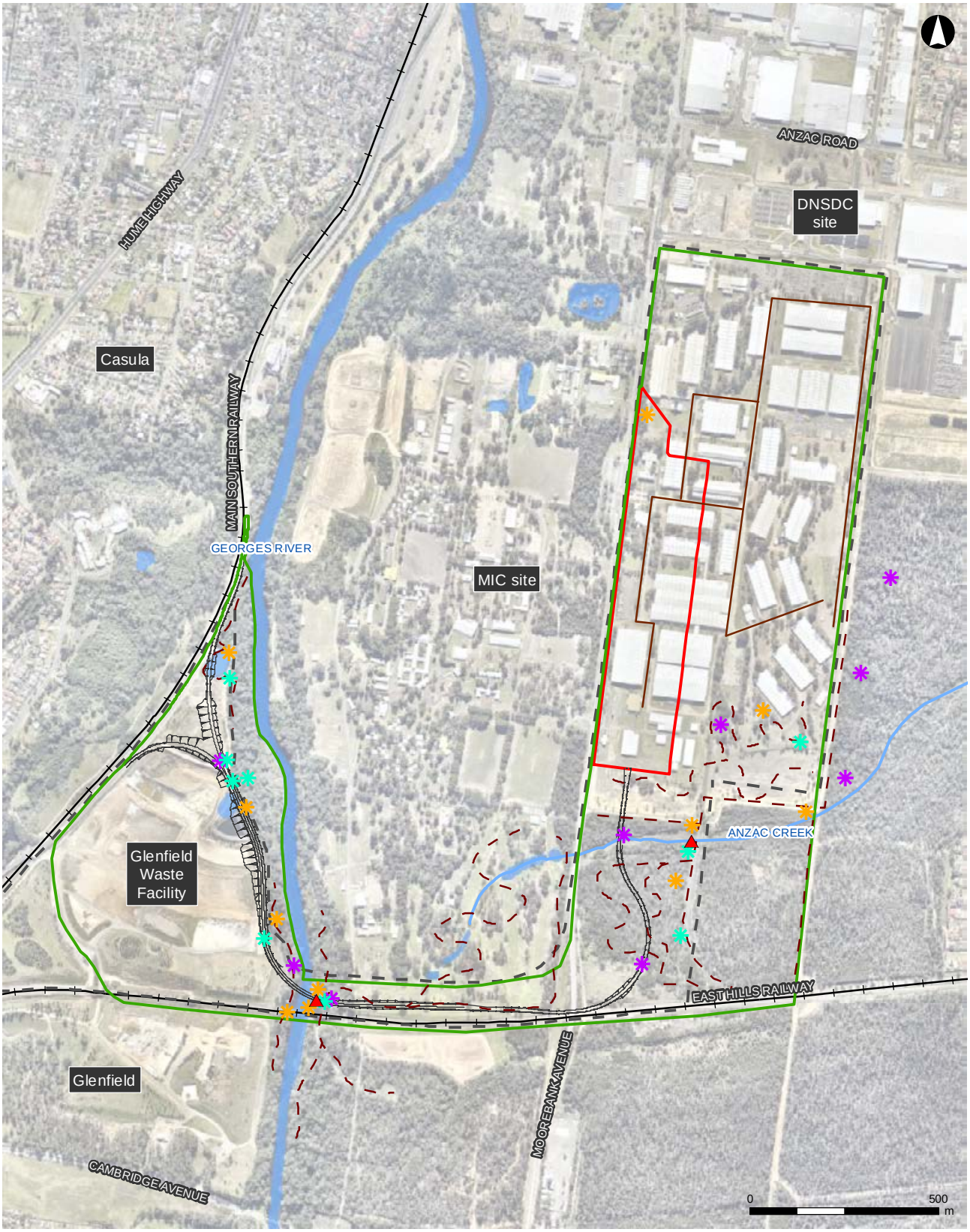
- Stationary placement of ultrasonic bat call detection equipment (Anabats) in potential flyways. Two Anabats were placed for six nights (a total of 12 locations within the study area) during the survey periods.

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 C). 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.

A visual assessment of any potential groundwater dependent ecosystems was made at both sites. Groundwater data was also obtained from boreholes drilled for contaminated land investigations (JBS+G, 2015).



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Aquatic survey

Fauna survey effort

- Anabat
- Call-playback
- Habitat quadrat
- Spotlight transect-foot
- Spotlight transect-vehicle

- Existing railway
- Watercourse

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Figure 23: Fauna survey effort

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5.1.2 LIMITATIONS

The flora and fauna surveys for this assessment were carried out over fourteen days and six nights in late autumn 2011 and 2012 and spring/summer of 2014 and 2015. This assessment is based on the condition of the study area at the time of field investigations and the information provided by SIMTA on the nature of the SIMTA Project at the date of publication of this document.

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

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

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

Some areas and features of the study area could not be assessed in detail due to access restrictions. Access was restricted to the areas of the Glenfield Waste Facility (to the southwest) where sand and gravel extraction is currently occurring, as well as the disturbed Railcorp land in the south-west of the Southern Boot Land. These areas were assessed based on site observations from outside the areas as well as current and historical aerial photograph interpretation, regional vegetation mapping and database records. It was also not possible to inspect or photograph the existing buildings on the SIMTA site, which could include roosting habitat for some microchiropteran bat species. In the absence of inspection of these buildings, it is assumed that some may support marginal roosting habitat.

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

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

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

5.2 PREDICTED ECOSYSTEM CREDIT SPECIES

The following species were derived from the four PCTs found on the development site as predicted ecosystem credit species:

- Australian Painted Snipe (*Rostratula australis*)
- Barking Owl (*Ninox connivens*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis* subsp. *gularis*)
- Black-tailed Godwit (*Limosa limosa*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus subsp. victoriae*)
- Bush-stone Curlew (*Burhinus grallarius*)
- Diamond Firetail (*Stagonopleura guttata*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Flame Robin (*Petroica phoenicea*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Hooded Robin (south-eastern form) (*Melanodryas cucullata* subsp. *cucullata*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Lorikeet (*Glossopsitta pusilla*)
- New Holland Mouse (*Pseudomys novaehollandiae*)
- Painted Honeyeater (*Grantiella picta*)
- Scarlet Robin (*Phoenica boodang*)
- Speckled Warbler (*Chthonicola sagittata*)
- Spot-tailed Quoll (*Dasyurus maculatus maculatus*)
- Spotted Harrier (*Circus assimilis*)
- Swift Parrot (*Lathamus discolor*)
- Varied Sitella (*Daphoenositta chrysoptera)*
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

Each species has been assessed for potential presence in each of the vegetation zones in the development site in Table 26 using information obtained from the Threatened Species Profiles Database (TSPD). It was found that 20 species have potential habitat in one or more vegetation zones and as such would be considered ecosystem credit species.

Of these species, one was recorded on site; the Eastern Freetail-bat. As it was recorded on the development site, it is considered a species credit species in accordance with Section 6.5.1.2 of the FBA and has therefore been assessed in Section 5.3.2.

Table 26 Predicted ecosystem credit species presence assessment

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
Australian Painted Snipe ***Rostratula australis*** **E-TSC Act** **E, M-EPBC Act**	**ME007**	<5 ha	0.75	Areas of tussock grass, lignum, reeds, sedges or rushes within 500 m of, and including, shallow wetlands or ephemeral or permanent waterbodies, or inundated grasslands/paddocks.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME005.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME018.
Barking Owl ***Ninox connivens*** **V-TSC Act**	**ME003** **ME005** **ME018**	25-100 ha	0.325	Foraging habitat includes associated vegetation types and up to 250 m from these into adjoining grassland. Larger trees and hollow trees facilitate a more diverse and abundant prey base, thus improving breeding	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
				success. Living or dead trees with hollows >20 cm diameter that are > 4 m above the ground are required for breeding.					
Black-chinned Honeyeater (eastern subspecies) ***Melithreptus gularis*** **subsp.** ***Gularis*** **V-TSC Act**	**ME003** **ME005** **ME018**	5-25 ha	0.75	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
				in the landscape as birds forage over large home ranges of at least 5 hectares.					
Black-tailed Godwit ***Limosa limosa*** **V-TSC Act** **M-EPBC Act**	**ME007**	<5 ha	0.375	The species breeds in the northern hemisphere. Foraging and refuge habitat comprise sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME005.	**No.** Veg zone does not contain large intertidal mudflats or sandflats.	**No.** Species not associated with PCT ME018.
Brown Treecreeper (eastern subspecies) ***Climacteris picumnus*** **subsp.**	**ME018**	5-25 ha	0.5	Associated vegetation types provide foraging and refuge habitat for the species. Hollows >6cm in live trees or in dead standing or fallen timber provide breeding habitat.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME005.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
victoriae **V-TSC Act**									
Bush Stone-curlew ***Burhinus grallarius*** **E-TSC Act**	**ME003** **ME005** **ME018**	25-100 ha	0.375	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Associated vegetation types provide foraging and refuge habitat for the species. Open grassy woodland with fallen dead timber provides breeding habitat.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Vegetation zone does not contain suitable habitat. Species occurs in forest and woodland vegetation.	**Yes.** Potential habitat is present in this vegetation zone.
Diamond Firetail ***Stagonopleura guttata*** **V-TSC Act**	**ME003** **ME005** **ME018**	<5 ha	0.75	Foraging habitat includes associated vegetation types with native grassy understorey or adjoining native grassland. Does not occur within	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
				grasslands which are further than 1.5 km from trees or woodland. Breeding occurs in vegetation with small patches of shrubs.					
Eastern False Pipistrelle ***Falsistrellus tasmaniensis*** **V-TSC Act**	**ME018**	5-25 ha	0.45	Prefers moist habitats, with trees taller than 20 m. Associated vegetation types provide foraging habitat for the species. Species roosts in live or dead hollow-bearing trees, under bark, caves buildings.	**No.** Trees generally less than 20m tall.	**No.** Trees generally less than 20m tall.	**No.** Trees generally less than 20m tall.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.
Eastern Freetail-bat ***Mormopterus***	**ME003** **ME005** **ME007**	5-25 ha	0.45	Associated vegetation types provide foraging habitat for the species. Species roosts in tree	**Yes.** Potential habitat is present in this vegetation zone. Species was	**Yes.** Potential habitat is present in this vegetation zone. Species was	**Yes.** Potential habitat is present in this vegetation zone. Species was	**Yes.** Potential habitat is present in this vegetation zone. Species	**Yes.** Potential habitat is present in this vegetation zone. Species

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
norfolkensis **V-TSC Act**	**ME018**			hollows, loose bark or man-made structures. Breed in hollows in dead or alive trees.	recorded on site.	recorded on site.	recorded on site.	was recorded on site.	was recorded on site.
Flame Robin ***Petroica phoenicea*** **V-TSC Act**	**ME003** **ME005** **ME018**	25-100ha	0.75	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense.	**No.** Species prefers tall forest with clearings or open understorey. This veg zone is not tall or moist.	**No.** Species prefers tall forest with clearings or open understorey. This veg zone is not tall or moist.	**No.** Species prefers tall forest with clearings or open understorey. This veg zone is not tall and has a dense understorey.	**No.** Species not associated with PCT ME007.	**No.** Species prefers tall forest with clearings or open understorey. This veg zone is tall but has a densely vegetated understorey overgrown with weeds.
Gang-gang Cockatoo ***Callocephalo***	**ME003** **ME005**	<5ha	0.5	In summer, generally found in tall mountain forests and woodlands,	**Yes.** Potential habitat is present in this vegetation	**Yes.** Potential habitat is present in this vegetation	**Yes.** Potential habitat is present in this vegetation	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
n fimbriatum **V-TSC Act**	**ME018**			particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Favours old growth attributes required for nesting and roosting purposes. Uses hollows for breeding >10cm diameter and >9m above the ground.	zone.	zone.	zone.		zone.
Greater Broad-nosed Bat ***Scoteanax***	**ME003** **ME005** **ME018**	<5ha	0.45	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
rueppellii **V-TSC Act**				most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.					
Hooded Robin (south-eastern form) ***Melanodryas cucullata*** **subsp.** ***cucullata*** **V-TSC Act**	**ME003** **ME005** **ME018**	5-25ha	0.6	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes. T**his veg zone does not contain structurally diverse habitat with few mature eucalypts.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**No. T**his veg zone does not contain structurally diverse habitat or native grassy understorey with open areas/near clearings.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
Little Eagle ***Hieraaetus morphnoides*** **V-TSC Act**	**ME003 ME005 ME007 ME018**	<5ha	0.725	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Vegetation zone does not contain suitable habitat. Species occurs in forest and woodland vegetation.	**Yes.** Potential habitat is present in this vegetation zone.
Little Lorikeet ***Glossopsitta pusilla*** **V-TSC Act**	**ME003 ME005 ME007 ME018**	Not provided in TSPD	0.575	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Vegetation zone does not contain suitable habitat. Species occurs in forest and woodland vegetation.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
				productivity.					
New Holland Mouse ***Pseudomys novaehollandiae*** **V-EPBC Act**	**ME003** **ME005**	<5ha	0.375	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes	**Yes.** Potential habitat is present in this vegetation zone.	**No.** This veg zone does not contain a heathy understorey.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**No.** Species not associated with PCT ME018.
Painted Honeyeater ***Grantiella picta*** **V-TSC Act**	**ME018**	<5ha	0.75	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME005.	**No.** Species not associated with PCT ME007.	**No** Eucalypt/acacia mistletoes not present which species requires for feeding.
Scarlet Robin	**ME003** **ME005**	25-100ha	0.75	The Scarlet Robin lives in dry eucalypt forests and woodlands. The	**Yes.** Potential habitat is present in this vegetation	**No.** This veg zone has low volumes of	**Yes.** Potential habitat is present in this vegetation	**No.** Species not associated with	**No.** This veg zone does not have a grassy open

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
Petroica boodang **V-TSC Act**	**ME018**			understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Abundant logs and fallen timber are important habitat components.	zone.	fallen timber.	zone.	PCT ME007.	understorey, but a dense, overgrown weedy understorey.
Speckled Warbler ***Chthonicola sagittata*** **V-TSC Act**	**ME003** **ME005** **ME018**	5-25ha	0.375	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat	**Yes.** Potential habitat is present in this vegetation zone.	**No.** This veg zone has low volumes of native grasses.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**No.** This veg zone does not have a grassy understorey with a sparse shrub layer, but a dense, overgrown weedy

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
				would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.					understorey.
Spotted Harrier ***Circus assimilis*** **V-TSC Act**	**ME007**	<5ha	0.725	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME003.	**No.** Species not associated with PCT ME005.	**No.** Veg zone is not grassy open woodland.	**No.** Species not associated with PCT ME018.
Spot-tailed Quoll	**ME003**	25-100ha	0.375	Recorded across a range of habitat types, including	**Yes.** Potential habitat is present in	**Yes.** Potential habitat is present in	**Yes.** Potential habitat is present in	**No.** Vegetation zone does not	**Yes.** Potential habitat is present

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
Dasyurus maculatus **V-TSC Act** **E-EPBC Act**	**ME005** **ME007** **ME018**			rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.	this vegetation zone.	this vegetation zone.	this vegetation zone.	contain suitable habitat. Species occurs in forest and woodland vegetation.	in this vegetation zone.
Swift Parrot ***Lathamus discolor*** **E-TSC Act** **E-EPBC Act**	**ME003** **ME005** **ME018**	<5ha	0.75	Occurs in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia*	**Yes.** Potential habitat is present in this vegetation zone.	**No.** This veg zone has low volumes of eucalypts and other potential feed trees.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
				maculata, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*.					
Varied Sittella ***Daphoenositta chrysoptera*** **V-TSC Act**	**ME003** **ME005** **ME018**	5-25ha	0.75	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**No.** Species not associated with PCT ME007.	**Yes.** Potential habitat is present in this vegetation zone.
Yellow-bellied Sheathtail-bat ***Saccolaimus***	**ME003** **ME005** **ME007** **ME018**	<5ha	0.45	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.	**Yes.** Potential foraging habitat is present in this vegetation zone.	**Yes.** Potential habitat is present in this vegetation zone.

Predicted ecosystem credit species	Associated PCTs found on site from TSPD	Patch size	TG Value	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence in vegetation zone?				
					Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)
flaviventris **V-TSC Act**				Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.					

CE – Critically Endangered
E – Endangered
V – Vulnerable

5.2.1 DISCUSSION

Tg values for predicted ecosystem credit species are provided in Table 26. The lowest Tg value of all ecosystem credit species is 0.325 for the Barking Owl. Following a review of ecosystems credit species habitat requirements and PCT associations in Table 26, some species were excluded from vegetation zones found in the study area. This included the Barking Owl in the vegetation zone *Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007).* In this vegetation zone, the lowest Tg value is 0.375 for the Australian Painted Snipe. The Barking Owl otherwise has the lowest Tg value of 0.325 in each vegetation zone. The lowest Tg value for each vegetation zone is provided in Table 27.

Table 27 Lowest Tg value associated with each vegetation zone identified in the study area

Vegetation Zone	Lowest Tg value	Associated species
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME003)	0.325	Barking Owl
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME003)	0.325	Barking Owl
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Medium (ME005)	0.325	Barking Owl
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor (ME007)	0.375	Australian Painted Snipe
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Moderate/Good_Poor (ME018)	0.325	Barking Owl

5.3 SPECIES CREDIT SPECIES

5.3.1 FLORA

The following threatened flora species listed under the TSC Act were identified in the credit calculator as predicted flora species credit species:

- *Acacia bynoeana* (Bynoe's Wattle)
- *Dillwynia tenuifolia*
- *Hibbertia puberula*
- *Hibbertia sp. Bankstown*
- *Hypsela sessiliflora*
- *Callistemon linearifolius* (Netted Bottle Brush)
- *Persoonia nutans* (Nodding Geebung)
- *Pimelea curviflora subsp. curviflora*
- *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea)
- *Caladenia tessellata* (Thick Lip Spider Orchid)
- *Cynanchum elegans* (White-flowered Wax Plant)
- *Leucopogon exolasius* (Woronora Beard-heath)

Table 28 assesses the potential for these flora species credit species to be present on the development site using information obtained from the TSPD. It also identifies species that cannot withstand further loss and, where applicable, whether a species polygon is required to be prepared or other further action is required.

Two threatened flora species credit species were recorded within the study area, namely *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea). The locations of these species recorded in the study area are shown on Figure 26.

Table 28 Flora species credit species and their presence status

Species	Associated PCTs found on study area	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Acacia bynoeana Bynoe's Wattle E-TSC Act V-EPBC Act	ME003	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	Yes. Potential habitat present in ME003.	Targeted searches using random meanders and transects	January, May, July, November	Not found during targeted surveys	No	No
Dillwynia tenuifolia V-TSC Act	ME003 ME005	In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. At Yengo, is reported to occur in disturbed escarpment woodland on Narrabeen sandstone.	Marginal potential habitat may occur in Castlereagh Scribbly Gum Woodland in study area.	Targeted searches using random meanders and transects	January, May, July, November	Not found during targeted surveys	No	No

Species	Associated PCTs found on study area	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Hibbertia puberula E-TSC Act	ME005	Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. One of the recently (2012) described subspecies also favours upland swamps.	Habitat in the study area was considered unlikely to be suitable, however targeted surveys for this species were undertaken according to Commonwealth Conditions of Approval	Targeted searches for *Hibbertia puberula* subsp. *glabrescens* would have identified this species.	November and January	Not found during targeted surveys	Yes	No
Hibbertia sp. *Bankstown* (syn. *Hibbertia puberula* subsp. *glabrescens*) CE-TSC Act CE-EPBC Act	ME005	The species is currently known to occur in only one population at Bankstown Airport. The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.	Habitat in the study area was considered unlikely to be suitable, however targeted surveys for this species were undertaken according to Commonwealth Conditions of Approval	Targeted searches using random meanders and transects	November and January	Unlikely. Habitat is marginal. Not found during targeted surveys	No	No

Species	Associated PCTs found on study area	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Hypsela sessiliflora (syn. *Isotoma sessiliflora*) E-TSC Act Ex-EPBC Act	ME005 ME018	Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone.	No.	Species not targeted.	Species not targeted.	Unlikely to occur: no nearby records and typical habitat is not present.	No	No
Callistemon linearifolius Netted Bottle Brush V-TSC Act	ME018	The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges. Open-forest e.g. with *Corymbia eximia, Eucalyptus punctata, E. umbra, Allocasuarina littoralis, Angophora costata;* sandy to clayey soils on sandstone.	No typical habitat in study area.	Species not targeted.	N/A	Unlikely to occur: no nearby records and typical habitat is not present.	No	No

Species	Associated PCTs found on study area	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Persoonia nutans Nodding Geebung E-TSC Act E-EPBC Act	ME003 ME005	This species occupies tertiary alluvium, extending onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest.	Yes. Occupied habitat for this species in Castlereagh Scribbly Gum Woodland.	Targeted searches using random meanders and transects	May 2012, July 2012, November 2014, January 2015	Present	No	Yes. Species could be impacted and offsets would be required. Species polygon prepared in Figure 24
Pimelea curviflora subsp. *curviflora* V-TSC Act V-EPBC Act	ME003	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Distribution associated with shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.	No. The study area is outside of the known distribution of the species in the Sydney region. Typical habitat does not occur in the study area,	Species not targeted.	N/A	Unlikely to occur: no nearby records and typical habitat is not present.	No	No

Species	Associated PCTs found on study area	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea V-TSC Act V-EPBC Act	ME003	Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park.	Yes. Occupied habitat for this species in Castlereagh Scribbly Gum Woodland.	Targeted searches using random meanders and transects	May 2012, July 2012, November 2014, January 2015	Present	No	Yes. Species could be impacted and offset may be required. Species polygon prepared in Figure 27
Caladenia tessellata Thick Lip Spider Orchid	ME003 ME005	Records in Sydney area are old; the species is now known with certainty from only two populations on the NSW Southern Tablelands. Generally found in grassy sclerophyll woodland on clay loam or sandy soils.	Habitat for this species is poorly defined; potential habitat may exist within the study area. There are no records in the Sydney region after 1948.	Species not targeted.	N/A	Unlikely to occur: no nearby records, and no records in the larger Sydney region for over 60 years.	No	No

Species	Associated PCTs found on study area	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
White-flowered Wax Plant *Cynanchum elegans* E-TSC Act V-EPBC Act	ME018	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*) – Coastal Banksia (*Banksia integrifolia* subsp. *integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum (*Corymbia maculata*) aligned open forest and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub.	No suitable habitat exists within the study area.	Species not targeted.	N/A	Unlikely to occur: no nearby records, and no suitable habitat in study area.	No	No
Woronora Beard-heath *Leucopogon exolasius* V-TSC Act V-EPBC Act	ME003 ME005	Grows in woodland on sandstone, restricted to the Woronora and Grose Rivers and Stokes Creek, Royal National Park. Substrate is sandy alluvium and rocky sandstone hillsides near creeks, low nutrient soils.	No	Species not targeted.	N/A	Unlikely to occur: no suitable habitat in study area.	No	No

Ex – Extinct
CE – Critically Endangered
E – Endangered
V – Vulnerable

Persoonia nutans

Persoonia nutans is listed as Endangered under the EPBC Act and in Schedule 1 of the TSC Act. This species is an erect to spreading shrub 0.5–1.5 metres high, with linear leaves and hairy young branches (DotE 2015e).

Persoonia nutans was recorded in the Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland north of Anzac Creek, within the Rail Corridor. A targeted search for this species recorded 126 individual plants. A single individual was found south of Anzac Creek and another individual was found further north, in the land known as the former DNSDC south. The plant was otherwise found within the Southern Boot Land, north of Anzac Creek. A total of 89 plants were recorded west of the rail spur with an additional 35 plants recorded east of the rail spur. Eleven of the plants within the Rail Corridor occurred within the footprint of the Rail link. There were two distinct sub-populations in the Southern Boot Land, separated by an approximately 170 metre gap. Plants ranged from 20 cm to about 1.8 m in height, and many individuals were observed to be flowering and/or fruiting. Plant locations are shown in Figure 26.

Grevillea parviflora subsp. *parviflora*

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable under the EPBC Act and in Schedule 2 of the TSC Act. *G. parviflora* subsp. *parviflora* is a spindly shrub varying from prostrate to erect, usually 0.3–1m high but growing up to 1.5 to 2 metres. The species suckers readily from rhizomes, although individuals sometimes have single stems (DotE 2015b).

Grevillea parviflora subsp. *parviflora* was recorded in the large patch of Castlereagh Scribbly Gum Woodland south of Anzac Creek in the Rail Corridor, within the Southern Boot Land (Figure 26). A total of 1644 stems of *G. parviflora* subsp. *parviflora* were recorded on both sides of the existing rail spur in 2011-2012 from 4 metre wide transects spaced 10 metres apart. As the survey method sampled 40 per cent of the survey area, the population within the study area was estimated to be approximately 4110 stems. Repeated transect surveys in 2014 in the development site to the west of the existing rail spur found a total of 2825 stems with a population estimate of approximately 7063 stems.

Intensive surveys in July 2012 focused on the population of *G. parviflora* subsp. *parviflora* in the vicinity of the proposed Rail link; these surveys involved counting all stems within approximately 25 metres either side of the centre line of the proposed Rail link, and were undertaken over an area of approximately 0.37 hectares. A total of 842 stems were recorded in this area, resulting in a much higher density of plants than the transect surveys, It was also noted during this survey that the species was recorded in areas where it had not been recorded in May 2011.The number of genetically distinct individuals is likely to be lower than this estimate given the suckering habit of this species and the localised high density of plant stems observed. The species was more widespread within the more open, grassy areas of bushland, with few plants recorded from the western parts of this patch where there was a dense shrubby midlayer.

Acacia pubescens

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

This species was not recorded within the study area, but two individuals were recorded at the edge of bushland immediately to the east of the SIMTA site. As it was not recorded on the development site, it would not be considered a candidate species credit species.

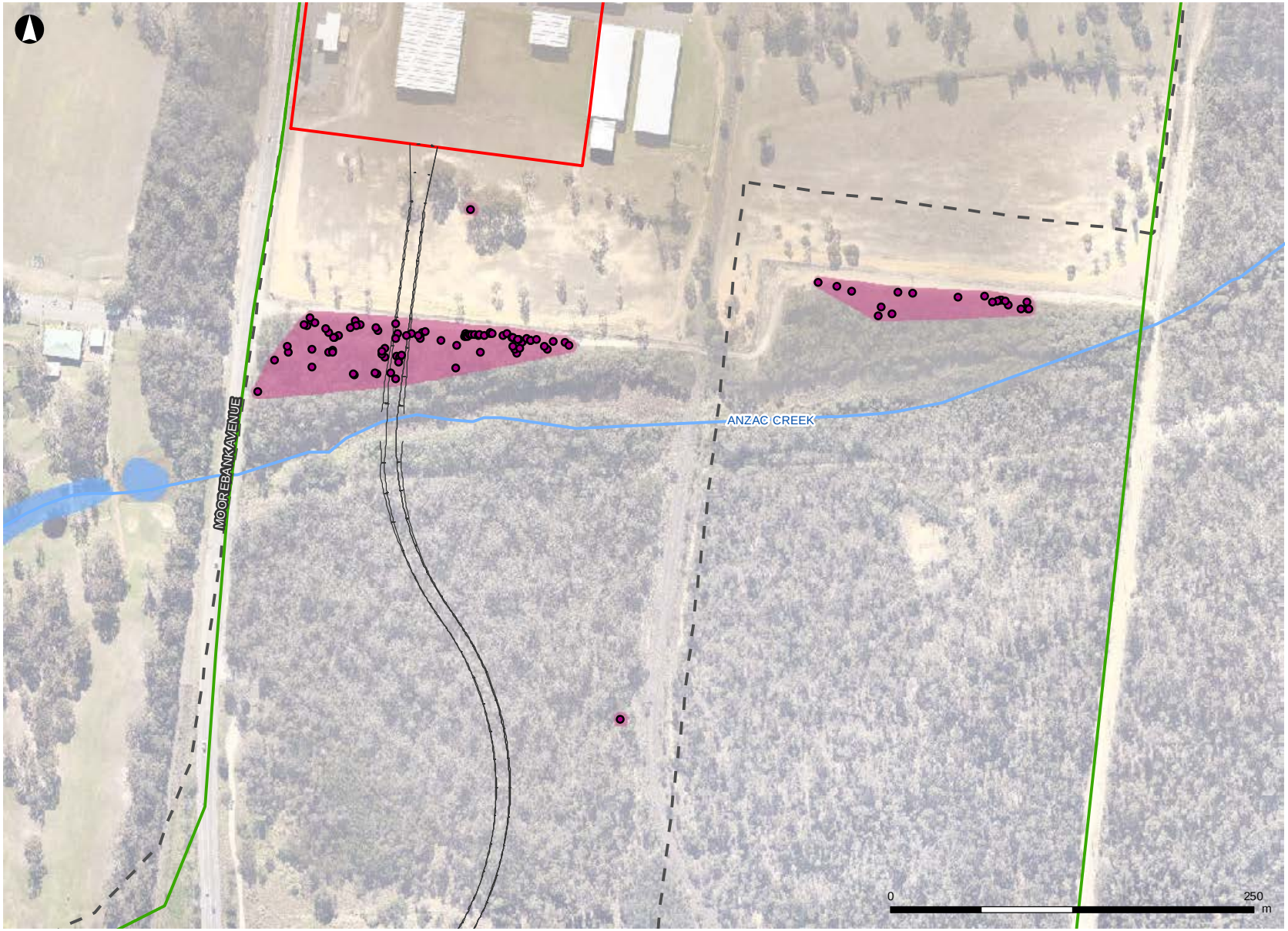

Figure 24: Species credit species polygon *Persoonia nutans*

Date: 21/04/2015 Path: \\hc-aus-ns-fs-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\AA003760_BAR_Stage1_Figure24_Persoonia_polygon_credit_A4_r2v3.mxd
Created by : DD
QA by : AW

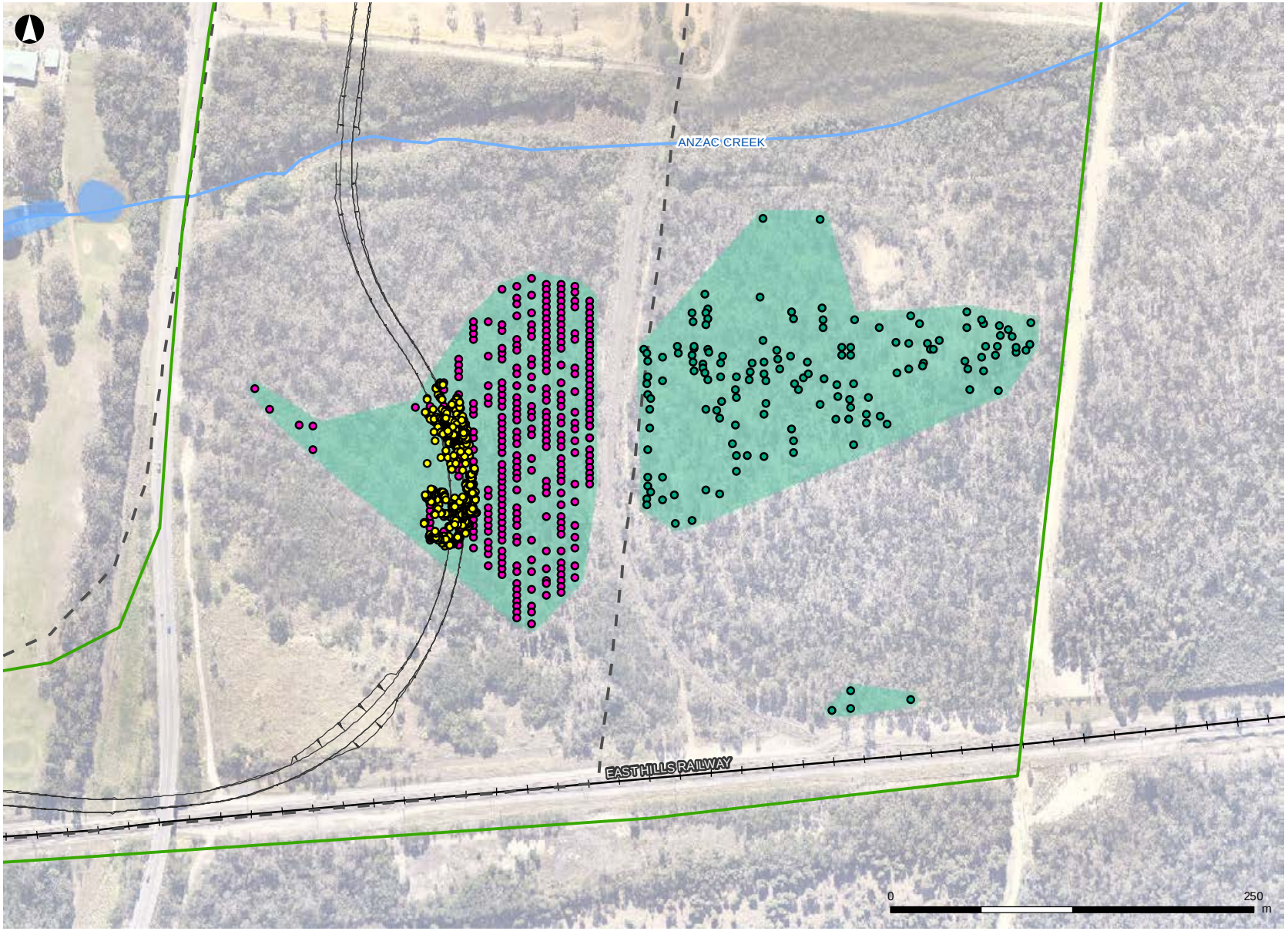

Figure 25: Species credit species polygon *Grevillea parviflora subsp. parviflora*

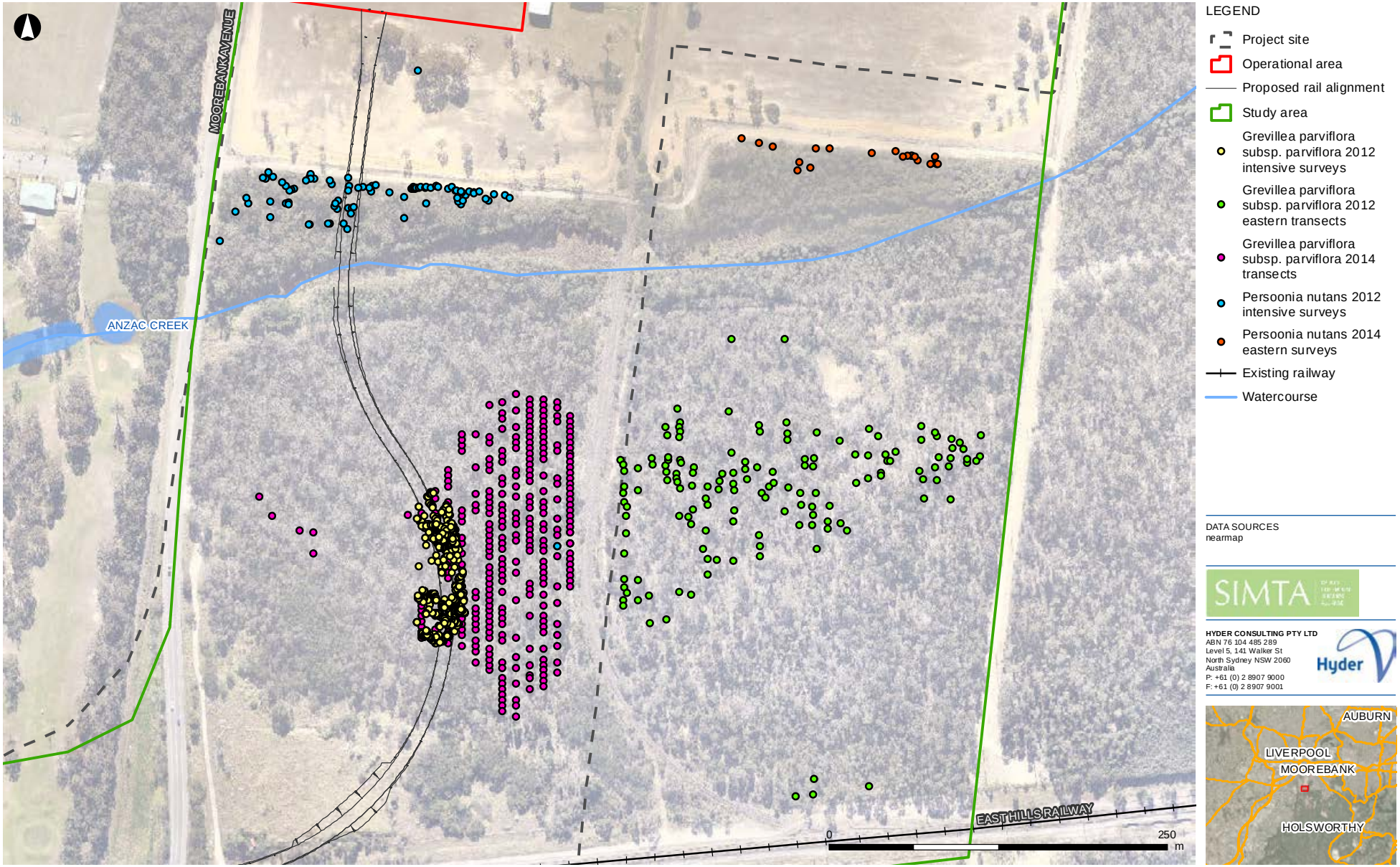

Figure 26: Locations of threatened plant species recorded in the study area

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QA by : AW

5.3.2 FAUNA

The following were identified in the credit calculator as predicted fauna species credit species:

- Cumberland Plain Land Snail (*Meridolum corneovirens*)
- Eastern Osprey (*Pandion cristatus*)
- Eastern Pygmy-possum (*Cercartatus nanus*)
- Green and Golden Bell Frog (*Litoria aurea*)
- Koala (*Phascolarctos cinereus*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Rosenberg's Goanna (*Varanus rosenbergi*)
- Squirrel Glider (*Petaurus norfolkensis*)

Table 29 assesses the potential for fauna species credit species to be present on the development site using information obtained from the TSPD. Habitat requirements for each species were assessed against the habitat values on the development site. Habitat information was obtained from OEH's Threatened Species Profiles Database. Targeted survey methods and timing for each identified species is noted and an assessment of the presence status of each species was determined based on targeted survey results and habitat presence. Table 29 also identifies species that cannot withstand further loss and where applicable, whether a species polygon is required to be prepared.

Of the eight species, seven are unlikely to occur in the study area based on the assessment provided in Table 29. One species, Eastern Pygmy Possum (Vulnerable under the TSC Act), was assumed to be present. This species was not found during field surveys undertaken by Hyder or for the MIC Proposal. However, there are anecdotal records of this species in bushland further south of the site on Defence land in the Holsworthy Military Reserve. Suitable habitat for this species is present in Parramatta Red Gum Woodland and Hard-leaved Scribbly Gum – Parramatta Red Gum heathy Woodland PCTs. Though there are barriers to connectivity between habitats south of the study area, including the East Hills rail line and perimeter fencing around the entire Boot Land, it is conceivable that the species could persist in a patch of this size. A species polygon for this species has been prepared in Figure 27 based on an assumption that the species is present.

Furthermore, four threatened fauna species were recorded or potentially recorded on site which will subsequently be considered as candidate species credit species. These species included three microchiropteran bats (microbats) listed as Vulnerable under the TSC Act: Southern Myotis (*Myotis macropus*), Eastern Freetail-bat (*Mormopterus norfolkensis*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*); and one megachiropteran bat listed as Vulnerable under the TSC Act and EPBC Act: Grey-headed Flying-fox (*Pteropus poliocephalus*).

Discussions on the occurrence of each species and their potential habitat on the development site are provided below. Locations of where they were recorded (or potentially recorded) are shown in Figure 28.

Table 29 Fauna species credit species and their presence status

Species	Associated PCTs found on site	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Cumberland Plain Land Snail *Meridolum corneovirens* E-TSC Act	ME003 ME005 ME018	Occurs in bark or leaf litter accumulation in associated vegetation types (ME003, ME005, ME018). Primarily inhabits Cumberland Plain Woodland. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Yes. Study area supports small isolated areas of marginal habitat.	Diurnal hand searches of leaf litter and bark in native vegetation during the 10 days of survey.	May 2012 in cool weather, 7 dry days and 3 days with light rain.	Unlikely. The species was not found during targeted surveys.	Yes	Not required
Eastern Osprey *Pandion cristatus* V-TSC Act	ME003 ME018	Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of	Yes.	Diurnal searches for nests and feeding signs in native vegetation & bird aural and visual detection during the 10	May 2012 in cool weather, 7 dry days and 3 days with light rain.	Unlikely as nest and feeding signs are conspicuous and were not found during surveys. Unlikely to breed on site as species typically nests within 1km of	Yes	Not required

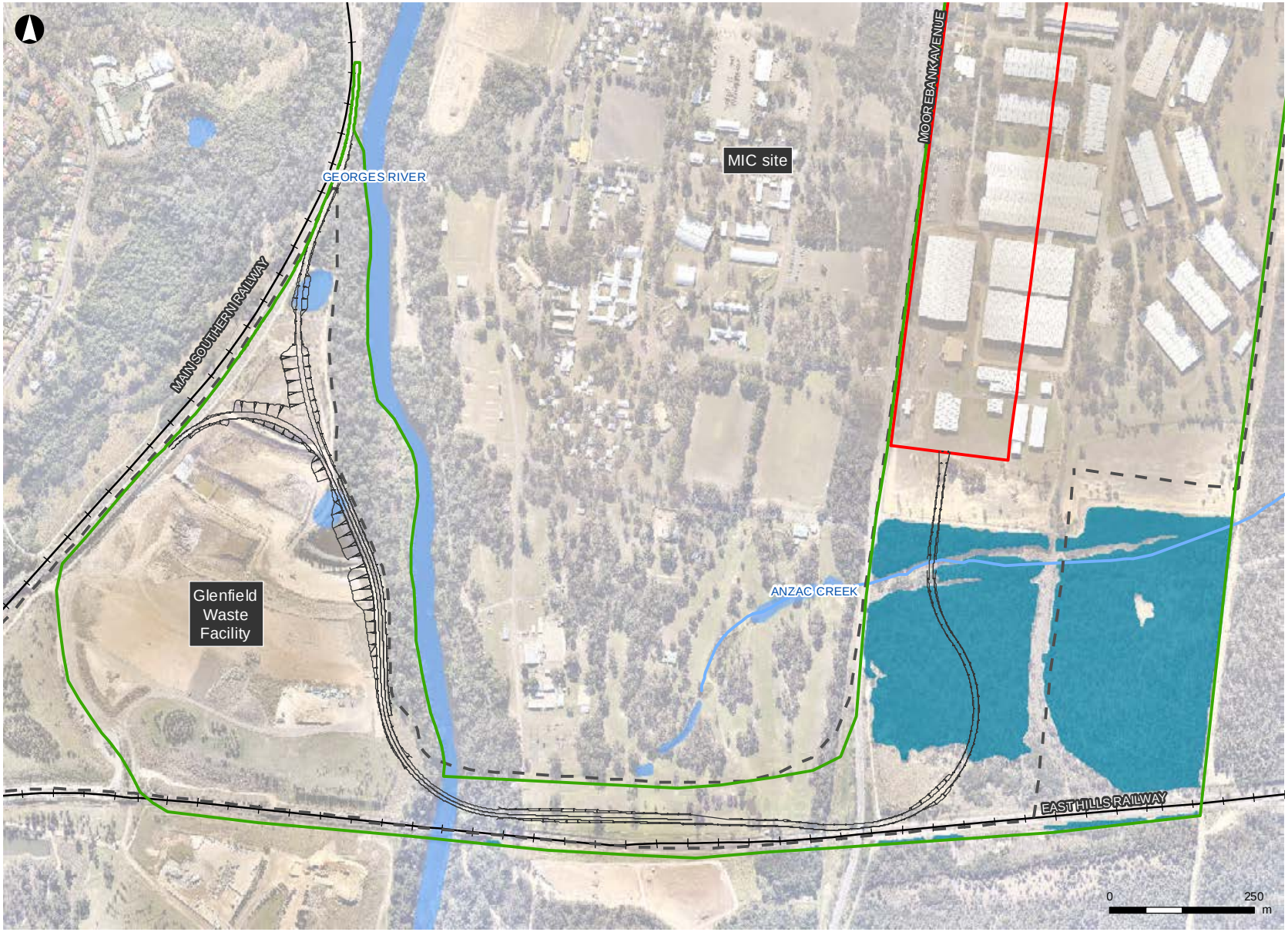
Species	Associated PCTs found on site	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
		live trees, usually within one kilometre of the sea.		days of survey.		the ocean.		
Eastern Pygmy-possum *Cercartetus nanus* V-TSC Act	ME003 ME005 ME018	Inhabits woodlands and heath, occasionally rainforest where it forages for nectar and pollen of banksias, eucalypts and bottlebrushes. Shelters in tree hollows, rotten stumps, holes in the ground or abandoned bird-nests.	Yes – in ME003 and ME005. No habitat present in ME018 as nectar and pollen resources are limited and vegetation is heavily degraded and weedy.	Spotlight survey from a vehicle and along foot traverses for direct visual observations of animal activity over 16 person hours across four nights. MIC trapped using Elliots over 99 trap nights (three transects, each with 6 ground-based and 5 treemounted traps)	May 2012 in cool weather, 3 dry nights and 1 day with light rain. Nov 2010 sunny and warm weather with a thunderstorm/heavy rainfall on one of the evenings.	Assumed present in ME003 and ME005. There are anecdotal sightings of the species in bushland further south which has connectivity to the study area. Species was not recorded during targeted surveys.	Yes	Yes. Species could be impacted and offset may be required. Species polygon prepared in Figure 27.
Green and Golden Bell Frog *Litoria aurea* E-TSC Act V-EPBC Act	ME003 ME005 ME007	Breeding habitat comprises natural and constructed waterbodies including wetlands, stormwater detention basins, marshes, dams and streams-side,	Marginal habitat present in Anzac Creek. The creek contains some preferred habitat features however	Call playback over four nights at Anzac Creek. Upon arrival, listening for vocalisations for	May 2012 in cool weather, 3 dry nights and 1 day with light rain.	Unlikely. Habitat is marginal and species not recorded during targeted surveys.	Yes	Not required

Species	Associated PCTs found on site	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
	ME018	preferably those that are unshaded but with fringing vegetation. Forage for invertebrates within grassy habitats near breeding habitat. May shelter under vegetation, rocks and building materials such as fibro, sheet iron or bricks.	infestation of *Gambusia holbrooki* (a predator of tadpoles) reduced the likelihood of occurrence.	10 minutes was undertaken. Calls were played intermittently for 15 minutes, followed by another listening period of 10 minutes.				
Koala *Phascolarctos cinereus* V-TSC Act V-EPBC Act	ME003 ME005 ME018	Species inhabits eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Habitat present in native vegetation in the Southern Boot Land where Koala feed trees for the Central Coast management region were recorded including primary feed trees *E. paramatensis* and *E. tereticornis. E. baueriana* (secondary food tree in the region) was also recorded in low densities. Marginal habitat is present the riparian zone of Georges River, though site is highly	Spotlight survey from a vehicle and along foot traverses for direct visual observations of animal activity over 16 person hours across four nights.	May 2012 in cool weather, 3 dry nights and 1 day with light rain.	Unlikely. Southern Boot Land with suitable habitat is fenced reducing the likelihood of a viable population occurring. Species not recorded during targeted surveys.	Yes	Not required

Species	Associated PCTs found on site	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
			degraded. Secondary feed tree *E. baueriana* was recorded here.					
Regent Honeyeater *Anthochaera phrygia* CE-TSC Act E-EPBC Act	ME003 ME005 ME018	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Marginal. Native vegetation in the study area supports potential foraging and refuge habitat. Though connectivity is hampered by the SSFL, surrounding development and fencing of the Southern Boot Land reducing likelihood of a viable population or migrating individuals to pass through.	Diurnal visual and aural observations of bird calls by ecologist with experience in bird identification.	May 2012 in cool weather, 7 dry days and 3 days with light rain.	Unlikely. Species records within 10km are 20 years old or more.	Yes	Not required
Rosenberg's Goanna	ME003	Distributed from Wollemi National Parks south to the ACT region and near	No. Termite mounds required for nesting are recorded in low	N/A	N/A	Unlikely	Yes	Not required

Species	Associated PCTs found on site	Habitat requirements	Habitat present in development site?	Targeted survey effort/methods	Targeted survey timing and weather	Presence status	Can species withstand further loss?	Further action?
Varanus rosenbergi V-TSC Act	ME005	Cooma, usually in association with sandstone. Found in heath, open forest and woodland where it forages for carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows. Requires termite mounds for nesting habitat.	densities in study area. Potential habitat in the Southern Boot Land is fenced, reducing the likelihood of a viable population occurring.					
Squirrel Glider *Petaurus norfolcensis* V-TSC Act	ME003 ME005 ME018	Inhabits Blackbutt-Bloodwood forest with heath understorey in coastal areas. Require abundant tree hollows for refuge and nest sites. Forages for nectar, sap, invertebrates and pollen.	No. Species requires abundant hollows. Hollows are a limited resource in the development site.	Spotlight survey from a vehicle and along foot traverses for direct visual observations of animal activity over 16 person hours across four nights.	May 2012 in cool weather, 3 dry nights and 1 day with light rain.	Unlikely	Yes	Not required

CE – Critically Endangered
E – Endangered
V – Vulnerable



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Existing railway
- Watercourse
- Eastern Pygmy Possum species polygon

DATA SOURCES
nearmap

SIMTA

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Figure 27: Species credit species polygon Eastern Pygmy Possum

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Created by : DD
QA by : AW

Southern Myotis (*Myotis macropus*)

A possible ultrasonic call of the Southern Myotis was recorded at two locations in proximity to Georges River; in remnant forest, upslope of Georges River riparian vegetation and under the existing railway bridge abutment that adjoins the study area to the south. Targeted surveys for this species included placement of two Anabats for six nights (a total of 12 locations within the study area) during the survey periods. Surveys were undertaken in May 2012 in cool weather with mostly dry nights and some nights with light rain.

The Southern Myotis occurs across the northern and eastern coasts of Australia (from the Kimberley to Victoria) and is rarely found more than 100 kilometres inland. Although widespread it is considered to be relatively rare and is only patchily distributed within areas of apparently suitable habitat (Lumsden and Menkhorst 1995).

The species is typically found in association with riparian vegetation and also in mangroves, paperbark swamps, rainforest, wet and dry sclerophyll forest and open woodland. The species forages over water for insects and small fish that they catch by raking their large feet of the water surface, however, also forage aerially for moths, beetles, crickets and flies.

The species roosts communally in groups of up to 15 individuals in caves, mine shafts, tree hollows, under bridges and in buildings, stormwater drains and amongst dense vegetation fringing watercourses. Less commonly, the species has been recorded roosting in partly submerged dead trees and within limestone cliffs. Roosts are typically located in proximity to water.

The species is associated with all four PCTs in the study area in the TSPD where it has also been identified as a species that can withstand loss. Potential habitat for the Southern Myotis has been identified in all four PCTs. The Southern Myotis may forage along Georges River and Anzac Creek for fish and invertebrates. Hollow-bearing trees offer potential roosting habitat to the species. There is also potential for the species to roost under the existing rail bridge or amongst dense vegetation of the Georges River riparian zone. The species could also inhabit woodland vegetation in the Southern Boot Land. A species polygon has subsequently been prepared in Figure 29 for this species.

Eastern Freetail-bat (*Mormopterus norfolkensis*)

A definite ultrasonic call of the Eastern Freetail-bat was recorded in the riparian vegetation of the western bank of the Georges River. Targeted surveys for this species included placement of two Anabats for six nights (a total of 12 locations within the study area) during the survey periods. Surveys were undertaken in May 2012 in cool weather with mostly dry nights and some nights with light rain.

The Eastern Freetail-bat is found east of the Great Dividing Range, from Brisbane in south-east Queensland to Picton in NSW. The habitat requirements of the species are poorly known, however, the species has been most commonly recorded in dry eucalypt forest and woodland, and shows a preference for open spaces in woodland or forest. The species has also been recorded in swamp forests and mangrove forests. The Eastern Freetail-bat forages in openings, forest edges and gaps, and over larger waterways (Environment Australia 1999a, Churchill 2008). The diet of this species has not been studied, but is most probably insectivorous (DEC 2005c). The Eastern Freetail-bat roost mainly in tree hollows; usually in hollow spouts of large mature trees, but will also roost under exfoliating bark or in man-made structures and buildings (DEC 2005c, Churchill 2008).

It is associated with all four PCTs in the development site in the TSPD where it has also been identified as a species that can withstand loss. Potential habitat for the Eastern Freetail-bat has been identified in all four PCTs. Within the development site the Eastern Freetail-bat may forage

in openings and gaps within remnant woodland, landscaped areas and over the Georges River. The species may roost in tree hollows occurring on the western bank of the Georges River, or under exfoliating bark of rough-barked eucalypts in riparian habitats. A species polygon has subsequently been prepared in Figure 30 for this species.

Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)

Ultrasonic calls of the Eastern Bentwing-bat were recorded at five locations across the study area. Targeted surveys for this species included placement of two Anabats for six nights (a total of 12 locations within the study area) during the survey periods. Surveys were undertaken in May 2012 in cool weather with mostly dry nights and some nights with light rain.

The Eastern Bentwing-bat occurs along the east and north-west coasts of Australia (DEC 2005b) where it is known from a variety of habitats including rainforest, dry and wet sclerophyll forest, open woodland, paperbark forest and open grassland. The species hunts for moths and other flying insects above the canopy or open areas (DEC 2005b). Eastern Bentwing-bats are known to utilise a number of roost sites throughout the year (Chuchill 1998).

Caves are the primary roosting habitat for this species; however Eastern Bentwing-bats also use derelict mines, storm-water tunnels, buildings and other man-made structures (DEC 2005b). The most significant of these roosts are maternity roosts and those roosts used over winter for hibernation (DEC 2004b).

Female Eastern Bentwing-bats inhabit and congregate in specific caves that provide constant high temperate and humidity to give birth and raise young (Dwyer 1995). Maternity caves are used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within a territorial range of about 300 kilometres from the maternity cave (Churchill, 2008). Movement between territories is rare. Breeding or roosting colonies can range from 100 to 150,000 individuals. As such, they are prone to population damage if their roosting site is disturbed or modified.

The Eastern Bentwing-bat was recorded in remnant woodland and forest, and cleared and disturbed areas, suggesting that these areas may offer foraging habitat to this species. The species may also forage over the larger, continuous canopy of vegetation occurring in the Holsworthy Military Area to the south and on occasion extend its nightly foraging flights into the study area.

The study area does not support cave systems and as such, no preferred roosting habitat was identified. The Eastern Bentwing-bat is known to roost in man-made structures in Sydney (Threlfall 2011) and it is possible that roosting habitat for the species occurs in the buildings on the SIMTA site. It is associated with all four PCTs in the development site in the TSPD where it has also been identified as a species that can withstand loss. Potential foraging habitat for the Eastern Bentwing-bat has been identified in all four PCTs. A species polygon has subsequently been prepared in Figure 31 for this species.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

The Grey-Headed Flying fox was observed foraging amongst eucalypts in the SIMTA site and flying over remnant woodland of the Southern Boot Land of the SIMTA site. Targeted surveys for this species included diurnal searches for evidence of roosting/feeding flying-foxes or incidental observations and visual detection during the 10 days of survey and, spotlight surveys from a vehicle and along foot traverses for over 16 person hours across four nights. Surveys were undertaken in May 2012 in cool weather with seven dry days and three days with light rain.

The Grey-headed Flying-fox occurs from Bundaberg in Queensland in the north to Melbourne in Victoria to the south, typically between the coast and the western slopes of the Great Dividing Range. In NSW, it occurs along the east coast, eastern slopes of the Great Dividing Range and

the tablelands. The species may be found in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, while additional foraging is provided by urban gardens and cultivated fruit crops.

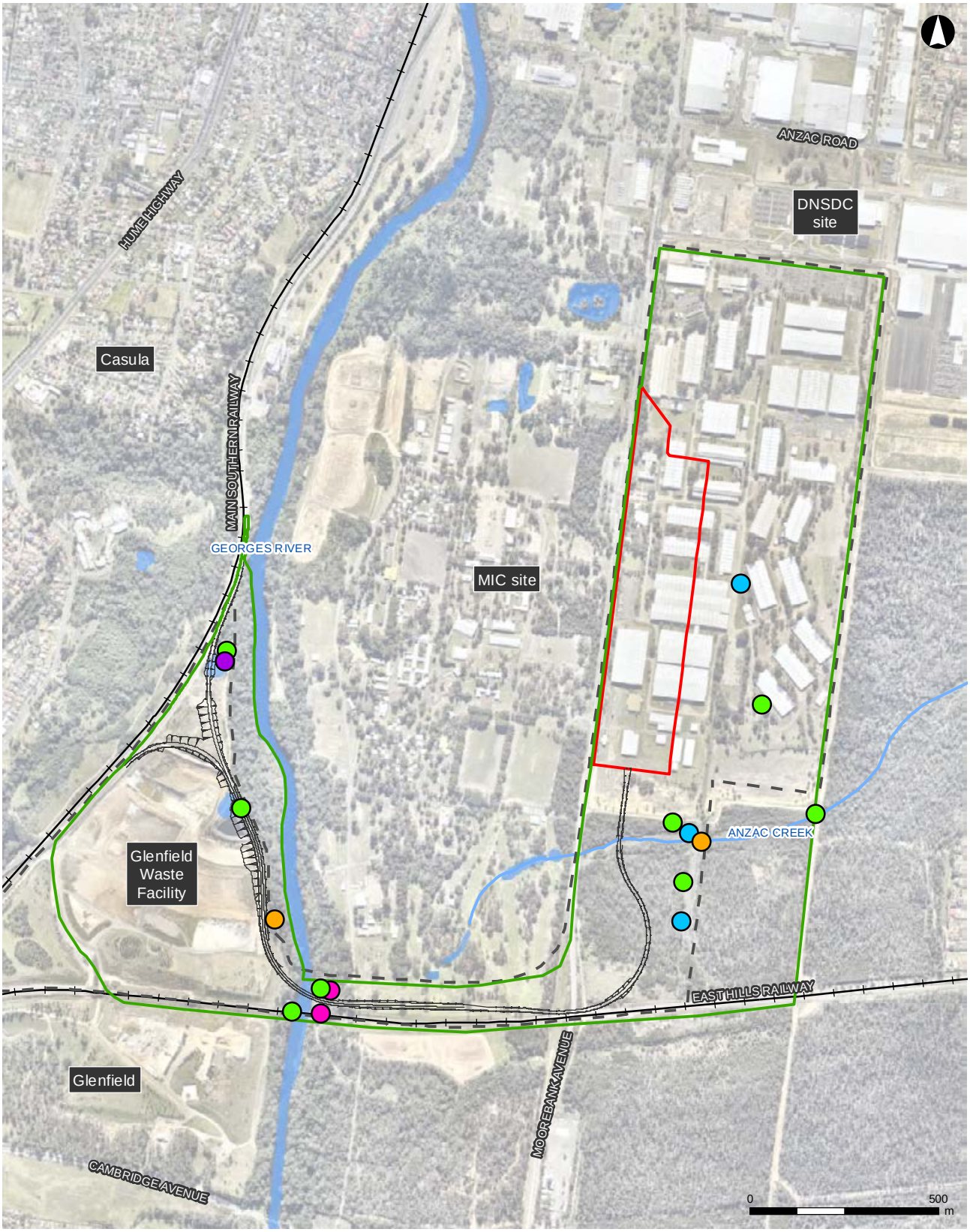
The Grey-Headed Flying-Fox is a highly mobile species with a nightly feeding range of 20 to 50 kilometres from a roosting camp. Diet typically comprises a wide variety of flowering and fruiting plants (Tidemann 1995, Churchill 2008); in summer, diet mainly comprises fruits of rainforest trees and vines in addition to the nectar and blossom of Eucalyptus, Melaleuca and Banksia. In winter, diet is dominated by nectar and blossom.

Non-indigenous and exotic tree species introduced to the urban landscape provide additional foraging habitat for this species within the locality; where previously existed a period of reduced availability of native food resource during the winter months, non-native species now supply food resources throughout the year (Parry-Jones & Augee 2001, Williams *et al.* 2006).

Grey-headed Flying-foxes roost in large numbers, with up to tens of thousands of flying foxes using individual camps for mating, birth and rearing of young. Camps are typically located in gullies, close to water, in vegetation with a dense canopy, within 20 kilometres of a regular food source. Site fidelity to camps is high, with some camps being used for over 100 years (NPWS 2001). The closest known roosting camp to the study area is located at Cabramatta Creek, approximately five kilometres to the north of the study area in Jacqui Osmond Reserve adjoining Cabramatta Creek. Other roosting camps are located within the Botanic Gardens at Farm Cove 27 kilometres to the east and Gordon 35 kilometres to the north-east.

It is associated with all four PCTs in the development site in the TSPD where it has also been identified as a species that can withstand loss. Habitat features of the study area which may support the Grey-Headed Flying-Fox include foraging habitat provided by a number of flowering exotic and native trees, predominantly eucalypts, located within the development site. The study area does not contain a roost camp of this species. A species polygon has subsequently been prepared in Figure 32 for this species.

A tree survey has been conducted on the SIMTA site and 590 trees occurring on the site were mapped. Of those trees identified to species, at least 147 comprise known feed tree species (ABS 2001) for the Grey-headed Flying Fox including *Corymbia maculata* (Spotted Gum), *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus longifolia* (Woolybutt), *Eucalyptus saligna (*Sydney Blue Gum), *Lophostomon confertus* (Brush Box), *Angophora subvelutina* (Broad-leaved Apple) and *Eucalyptus parramattensis* (Parramatta Gum).



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Existing railway

Threatened Fauna Species

- Miniopterus schreibersii oceanensis
- Miniopterus schreibersii oceanensis (probable recording)
- Mormopterus norfolkensis
- Myotis macropus (possible recording)
- Pteropus poliocephalus

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Figure 28: Locations of threatened fauna species recorded in the study area

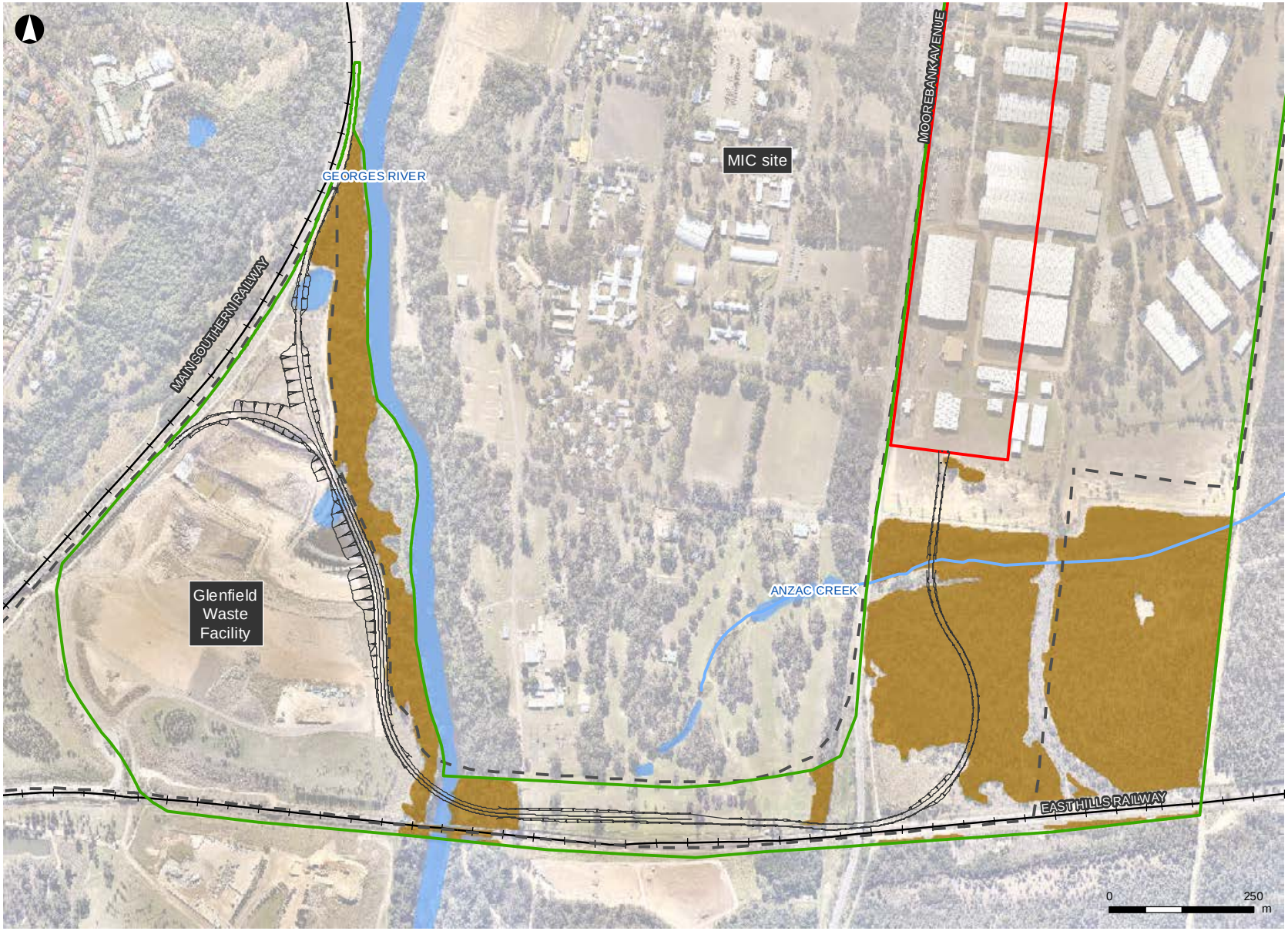

Figure 29: Species credit species polygon Southern Myotis

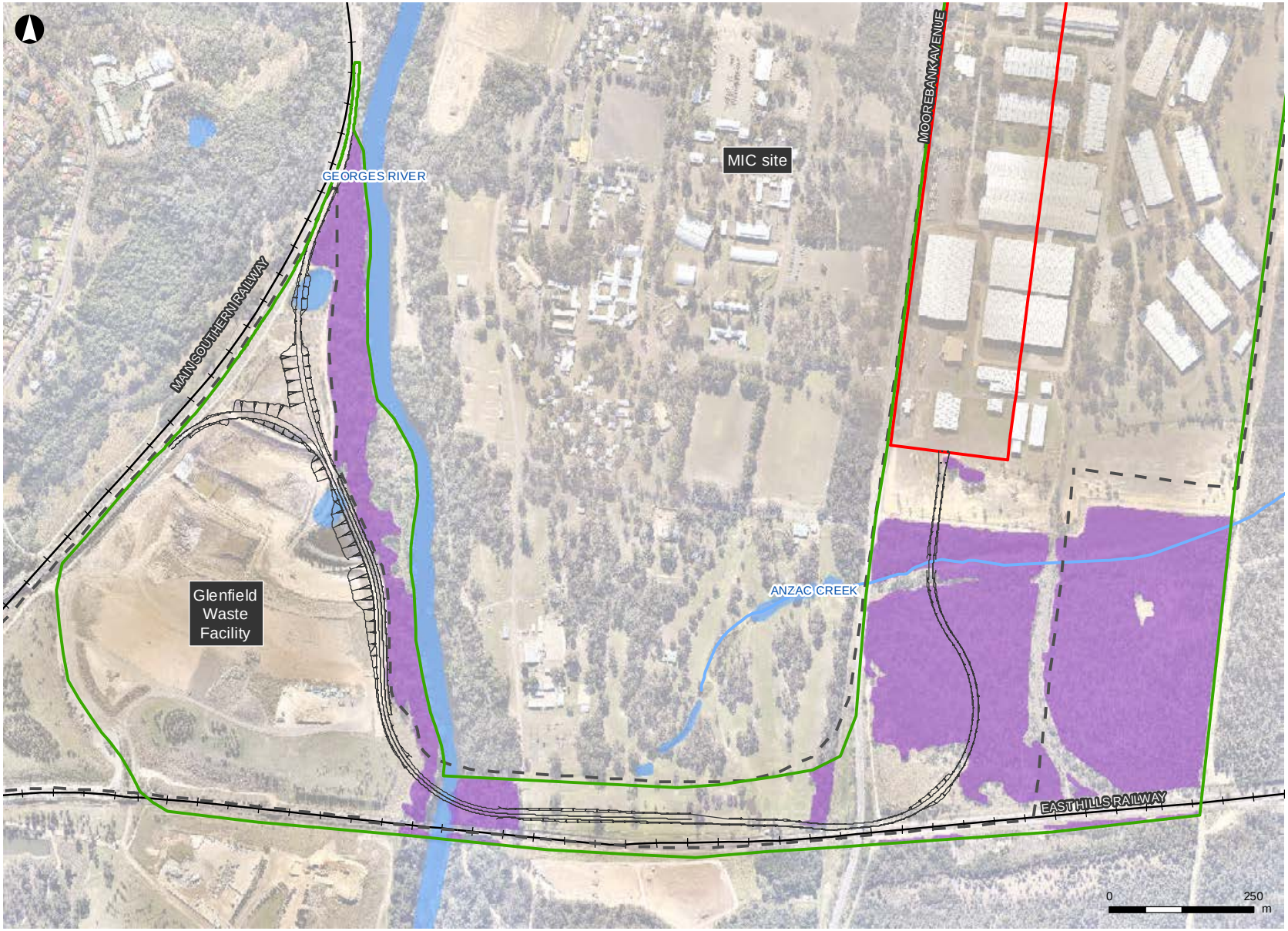

Figure 30: Species credit species polygon Eastern Freetail-bat

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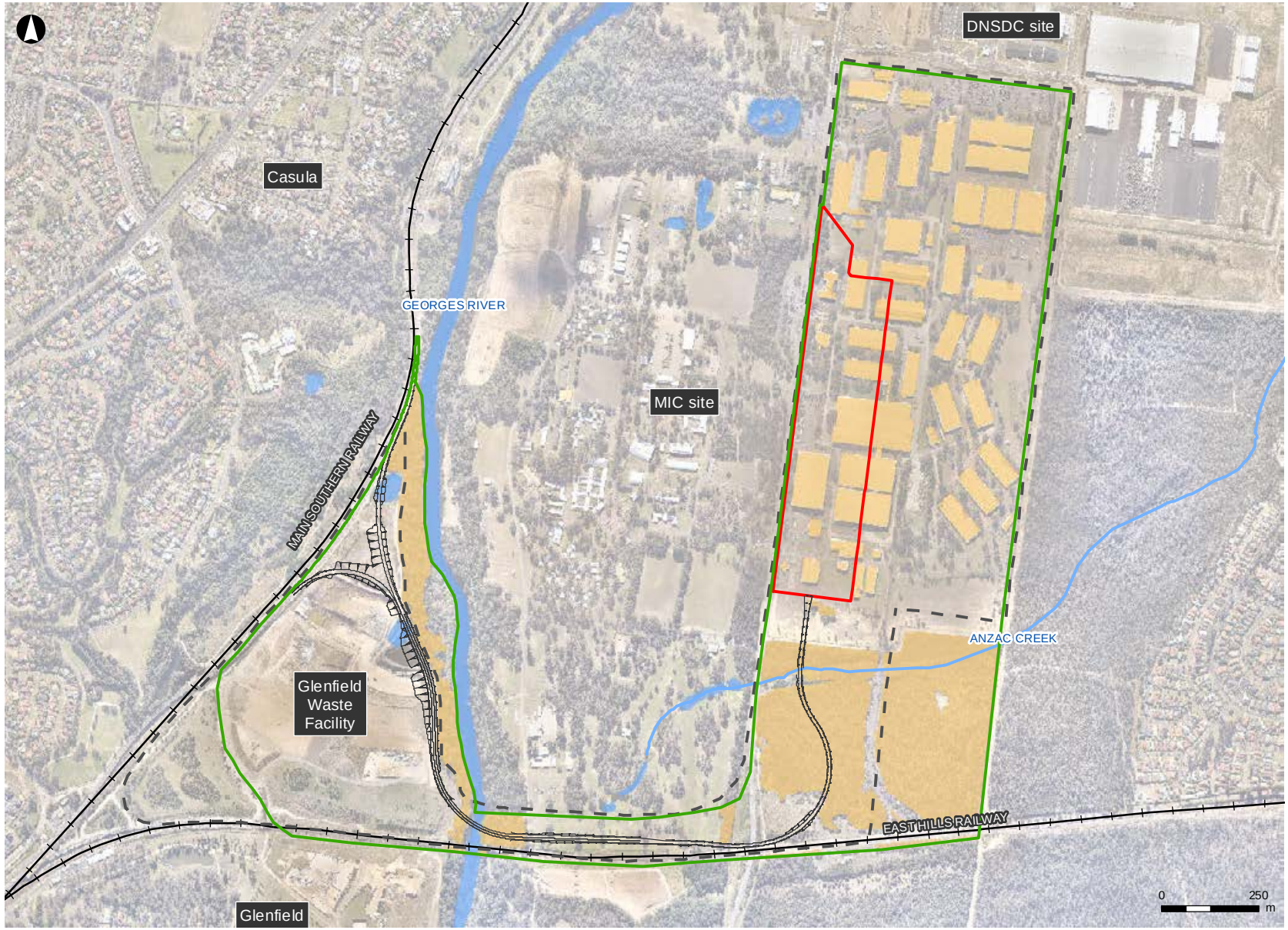

Figure 31: Species credit species polygon Eastern Bentwing-bat

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Figure 32: Species credit species polygon Grey-headed Flying-fox

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5.4 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The Biodiversity Assessments prepared for the Concept Plan and EPBC EIS Approvals assessed seven particular threatened species and communities listed under the EPBC Act that were considered known or likely to be present in the vicinity of the proposed action:

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

Specific information on the ecology, local and regional distribution and habitat, threats and assessment of the above species and communities of concern was required as part of the EPBC EIS Approval prepared for the controlled activity approval (EPBC Approval (No. 2011/6229)). Section 6.2.3 and Appendix G addresses the impacts to these threatened entities in accordance with the Commonwealth's requirements. As these threatened entities were assessed under specific requirements of the Commonwealth, it was not considered necessary to undertake Assessments of Significance in accordance with the *Significant Impact Guidelines 1.1. – Matters of National Environmental Significance* (DotE 2013).

5.5 THREATENED AQUATIC SPECIES

5.5.1 DATABASE SEARCHES

A search of the DPI fisheries records viewer found no threatened or protected fish species are recorded within the Sydney Metropolitan CMA. The EPBC Act Protected Matters Search identified two threatened fish species, also threatened under the FM Act, with the potential to occur or potential habitat within 10km of the study area. These species and their threatened status under the FM Act are provided in Table 30.

Table 30 Fish species protected under the FM Act identified in database searches

Common Name	Scientific Name	Status under the FM Act
Black Rockcod	*Epinephelus daemelii*	Vulnerable
Macquarie Perch	*Macquaria australasica*	Endangered

5.5.2 LIKELIHOOD OF OCCURRENCE

The Black Rockcod is a marine species that occurs in rocky habitats and reefs and as such, would not occur within the Georges River or Anzac Creek.

As noted in Section 4.8.2, the Macquarie Perch has the potential to occur in the Georges River within the Rail Corridor. The species inhabits rivers and lakes breeding during spring and summer in shallow upland streams or flowing rivers. It requires riffles over cobble and gravel substrates in which to deposit eggs. Deep rock pools, overhanging vegetation and snags provide refuge habitat for the species. Georges River in proximity to the study area does not provide preferred breeding habitat though it supports potential foraging and refuge habitat. The species was recorded in 2008 in the Georges River near Campbelltown, approximately 15 kilometres upstream of the study area, the first record from the river since 1894 (Atlas of Living Australia 2015).

6 AVOID AND MINIMISE IMPACTS

The FBA requires consideration of the steps taken to avoid and minimise the direct and indirect impacts of a development proposal on biodiversity values. Section 8.3.2 of the FBA sets out guidelines for the avoidance and minimisation of impacts to biodiversity during all phases of the project life cycle, comprising:

- Site selection phase
- Planning phase
- Construction phase
- Operational phase

The site selection and planning phases of the SIMTA Project were assessed in the approved Concept Plan Environmental Assessment.

6.1 MEASURES TO AVOID IMPACTS

6.1.1 SITE SELECTION PHASE

The guidelines for site selection phase in sections 8.3.2.2 to 8.3.2.6 of the FBA and the biodiversity assessment process undertaken for the Concept Plan Approval of the SIMTA Project are presented in Table 31.

Table 31 Site selection phase FBA guidelines for avoidance and minimisation of biodiversity impacts

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
8.3.2.2	Selecting a suitable development site for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species.	A desktop assessment of the biodiversity values of the study area was undertaken as part of a preliminary assessment of the SIMTA Project and as part of the Ecological Assessment for the Concept Plan Approval.
8.3.2.3	Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase.	Early consideration of biodiversity values was undertaken in preliminary assessments and in the Ecological Assessment for the Concept Plan Approval.
8.3.2.4	The site/route selection process should include consideration and analysis of the biodiversity constraints of the proposed development site and consider the suitability of the Major Project based on the types of biodiversity values present on the development site.	The proposed Georges River rail bridge was location was selected at a narrow part of the riparian corridor, reducing potential impacts to native vegetation in the riparian corridor. The bridge footprint would minimise impacts to riparian corridors with a maximum 20m wide clearing limit.

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
8.3.2.5	When considering and analysing the biodiversity constraints for the purpose of selecting a development site, the following matters should be addressed: (a) whether there are alternative sites within the property on which the proposed development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values (b) how the development site can be selected to avoid and minimise impacts on biodiversity values as far as practicable (c) whether an alternative development site to the proposed development site, which would avoid adversely impacting on biodiversity values, might be feasible.	There were limited alternative options for a viable intermodal facility within the area. The proposed site represents an ideal position for an intermodal facility as: ▪ The site uses existing facilities on the SIMTA site with minimal impact on biodiversity values. ▪ It is situated in close proximity to the SSFL, reducing the length of Rail link needed and subsequently minimising potential clearing. ▪ There is a direct intersection linking the adjacent Moorebank Avenue to the M5 Motorway reducing the need for road works and subsequent additional biodiversity impacts. ▪ It is zoned as industrial land for use as industrial warehousing. ▪ Buffer zones are provided between the facility and nearby residential areas. ▪ It is within the freight catchment for which there is a freight demand, resulting in minimal use of road transport between origins / destinations and theIMT. The location has also been identified in both state and federal strategies as the best and only location for an IMT facility to service a defined catchment in South-Western Sydney.
8.3.2.6	For linear projects, the route selection process must include consideration and an analysis of the biodiversity constraints of the various route options. In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits.	Not applicable – the Proposal is not a linear project.

The Project site has been granted approval, in the form of a Concept Plan, for the development of a Rail link with Rail Corridor, IMT facility with warehousing and ancillary services and therefore is considered suitable for the development.

6.1.2 PLANNING PHASE

The guidelines for planning phase in sections 8.3.2.7 to 8.3.2.8 of the FBA and the biodiversity assessment process undertaken at preliminary and concept plan assessment stages of the SIMTA Project are presented in Table 32.

Table 32 Planning phase FBA guidelines for avoidance and minimisation of biodiversity impacts

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
8.3.2.7	Once a suitable development site has been selected, further analysis of the biodiversity constraints of the proposed development site can then be used to inform concept planning, project siting and design. This includes the proposed location of temporary construction infrastructure such as roads, camps, stockpile sites and parking bays.	The identified biodiversity constraints have been considered during the development of the SIMTA Project, and the biodiversity impacts of the Proposal have been approved within the Concept Plan. The siting of ancillary construction areas has strategically avoided areas with high biodiversity values.
8.3.2.8	The Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value) or which avoid an EEC or CEEC. The following matters should be considered for this purpose: 1. siting of the project – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC. 2. minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised), and/or in areas where other impacts to biodiversity will be the lowest 3. loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile	The location of the Stage 1 site within the SIMTA site was determined based on the location of the Rail link and rail sidings and proximity to Moorebank Avenue to enable access to and from the site by rail and road. In addition to this, the location of the IMT facility has been designed to be the greatest distance from sensitive receivers as possible, and provides for the potential buffering (as part of further stages of development and existing development) with the inclusion of industrial warehousing. As such, the Proposal occupies the south-western portion of the SIMTA site. The Stage 1 site has been historically developed and comprises low-rise buildings, including warehouses and administrative offices, with further development in this site avoiding areas of high biodiversity value. The Rail link was selected to reduce the length over which it connects to the SSFL, minimising vegetation clearing. The Rail link could not be sited to entirely avoid the populations of *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* as it would result in rail, freight handling and truck movements occurring closer to the residences at Wattle Grove and Moorebank, with reduced opportunities for constructed warehouses to effectively attenuate noise and air emissions generated by the terminal

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
	gaps. 4. other site constraints – any other constraints that the assessor has considered in determining the siting and layout of the Major Project, e.g. bushfire protection requirements including clearing for asset protection zones, flood planning levels, servicing constraints.	operations, or provide visual screening of the operation. It would also pose a safety hazard to the site by reducing the separation between truck container transfer points and warehouse container storage areas. The construction footprint incorporating the Rail link footprint and construction access requirements would be reduced as far as possible; the Rail link footprint has been reduced from 35 metres to 20 metres in width within native vegetation in the Southern Boot Land, to minimise impacts on threatened plant species and TECs. Clearing has also been reduced to 20m width at the rail crossing of the Georges River to minimise impacts to riparian vegetation (including Riverflat Eucalypt Forest EEC), impacts to threatened fauna habitat and habitat connectivity.

6.2 UNAVOIDABLE IMPACTS

6.2.1 CONSTRUCTION PHASE

Stage 1 Site

The Stage 1 site, approximately 33 hectares in area, will be developed into an IMT facility over 15 hectares, which will offer container transfer and short term storage with direct rail access to SSFL. A compound site will also be constructed within the Stage 1 site.

A summary of activities to be undertaken for construction of the Stage 1 site are as follows:

- Disconnection, relocation, protection and installation of utilities (where required).
- Establishment of access roads and ancillary facilities.
- Demolition of buildings within the Stage 1 site.
- Removal of existing hardstand areas and roads.
- Stripping of topsoil and clearing of existing vegetation on the site.
- Undertaking of earthworks including initial levelling of the site.
- Installation of bio-retention swale on the Moorebank Avenue frontage and drainage swales on the eastern, northern and southern perimeters of the Stage 1 site (Operational area).
- Pavement, rail siding and building construction.
- Installation of signage and security fencing.
- Landscaping works.

Rail link

Construction of the Rail link would generally be undertaken using conventional construction techniques. A summary of activities to be undertaken for construction of the Rail link are as follows:

- Relocation or protection of existing utilities.
- Establishment of access roads and ancillary facilities.
- Vegetation clearance and topsoil stripping.
- Earthworks including construction of structural support for rail infrastructure (if required).
- Culvert construction at Anzac Creek (details provided below).
- Construction of Bridge over Georges River (details provided below).
- Alterations to increase the span of the existing Moorebank Avenue overbridge.
- Construction of drainage infrastructure along the Rail link and alterations to existing drainage infrastructure within the Main Southern Rail corridor (containing the SSFL) and EHRL corridors.
- Installation of rail infrastructure.
- Installation of fencing (where required).

Watercourse crossings

Two watercourse crossings are proposed for the Proposal, a bridge over the Georges River and a culvert crossing over Anzac Creek. The bridge and culvert crossings have been designed in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013). Watercourse crossing designs have been determined in to consultation with Hyder Consulting's Ecologist, Kate Carroll.

Anzac Creek Culvert

The works undertaken for the construction of the Anzac Creek culvert crossing would be contained within the 20 metre corridor to be cleared for the Rail link. The works would take approximately 2 to 3 months. Approximately 0.03 hectares of instream vegetation (Coastal Freshwater Lagoon) and 0.05 hectares of riparian vegetation (Parramatta Red Gum woodland) would be impacted for installation of the culvert crossing/Rail link at Anzac Creek.

A summary of the likely construction methodology for the Anzac Creek Culvert is as follows:

- Clearing and removal of vegetation at the Anzac creek crossing, within the 20 metre clearing corridor.
- Undertake earthworks to construct suitable areas for construction activities.
- Excavation of the Anzac Creek bed.
- Installation of base course material and concrete slab (cast in-situ) for the base of the culvert.
- Construction of culvert crossing including installation of culvert cells and wing walls.
- Excavation to facilitate construction of wing walls, which would be formed and then cast in-situ on either side of the culvert (or possibly precast units).
- Install rip rap (or similar) on either side of the culvert.
- Construction of rail infrastructure (permanent ways and rail systems)

Anzac Creek is a generally swampy area and therefore, subject to weather conditions, there is likely to be standing water at this location. Where reasonable and feasible, the works would be undertaken during dry weather, when there is no flow or water levels are very low. If water is present at the time of construction, dewatering of the creek would be required and a temporary diversion would be installed with the use of a dam structure such as a low flow earth mound or coffer dam, with water pumped (mechanically) around the construction area of culvert crossing. If the creek is dry at the time of construction, the site would be protected from water flow with a dam structure.

This water diversion would be undertaken with reference to the *Soils and Construction: Managing Urban Stormwater 2004*- 'the Blue Book'. Water transfer and diversion would only be undertaken during construction works, with the existing water flow re-established at completion of construction.

Fish passage requirements were considered when selecting the type of culvert crossing for Anzac Creek, and the following design principles were adopted for design and sizing of the culvert:

- The culvert crossing is aligned with the downstream channel to minimise bank erosion
- The culvert crossing has a combination of elevated "dry" cells to encourage terrestrial movement, and recessed "wet" cells to facilitate fish passage
- The culvert crossing design maximises the geometric similarities of the natural channel profile
- Short debris deflector walls will be installed on the upstream side to reduce the impact of debris blockages on fish passage
- Rip rap (or similar) would be installed at either end of the aprons.

Georges River Bridge

The works undertaken for the construction of the Georges River Bridge would be contained within the 20 metre corridor to be cleared for the Rail link. The construction of the bridge would be undertaken in approximately 10 to 12 months. Approximately 0.28 hectares of riparian habitat would be removed at the river banks for installation of the bridge and abutments. Vegetation removal extends further east past the riverbank where an additional 0.11 hectares of vegetation would be removed. As such, a total of 0.39 hectares of vegetation removal would be required for the construction of the bridge.

A summary of the likely construction methodology for the Georges River railway bridge is as follows:

- Clearing and removal of riparian vegetation.
- Undertake earthworks to construct a temporary access track to the Georges River, and establish area for construction activities.
- Construction of instream crane/piling rig platforms extending into the river from either bank. Platforms would be constructed of clean compacted gravel and be temporary. Another alternative would be to use a river barge rather than constructing these platforms. This would be subject to the construction contractor's discretion and feasibility.
- Construction of bridge piers within river bed and embankments. These would subsequently be extended as formed concrete columns. Piles would be bored into the river bed for the construction of the inner three bridge piers. Once bored, concrete would be poured into the steel tubing to form the bridge piers. These would subsequently be extended as formed concrete circular columns.
- Piles will be bored on dry ground for the remaining piers and abutments.

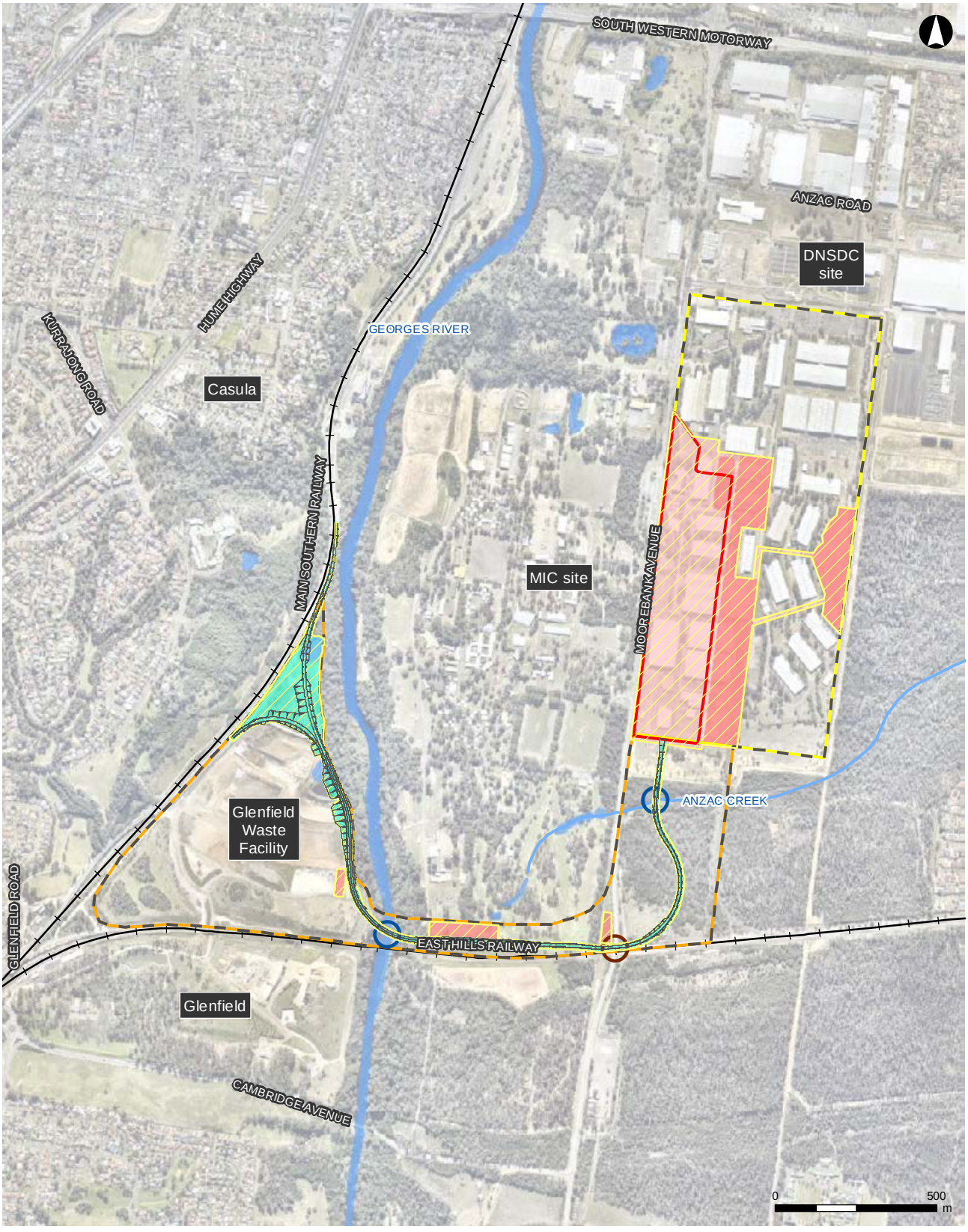
- Excavation would be undertaken to allow cast insitu concrete construction of the abutment headstocks, including wing walls at either end (eastern and western) of the bridge.
- The headstock would be constructed, either formed up and cast in-situ or alternatively precast.
- Precast girders installed.
- Forming and reinforcement placement would be undertaken and then concrete poured to create the bridge deck slab.
- Permanent ways and rail systems would be constructed onto the bridge deck. Rehabilitation of disturbed areas.

The Georges River would continue to flow throughout the construction of the bridge. Any platforms constructed in the Georges River would temporarily impede water movement in these areas, however, they would not dam river flow. Once construction has been completed normal river flow would be re-established.

The proposed bridge has been designed with consideration to the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013). The following design principles have been adopted during the design phase of the Georges River bridge to minimise the impact of the Proposal on aquatic habitats:

- The bridge deck height matches the height of the existing East Hills Railway Line bridge.
- Bridge piers have been designed and orientated to avoid the formation of large scale turbulence or the erosion of the bed and banks of the waterway.
- Bridge width has been minimised to maximise light penetration underneath to encourage fish passage.
- Disturbance to the riparian corridor, including construction and operational footprints, has been kept to a 20 metre wide corridor to minimise impacts to riparian vegetation. Revegetation of the riparian corridor would occur, along with active weed management to re-establish habitat connectivity and improve habitat quality.
- The design would allow for fish passage to be maintained during construction and operation.

The final construction footprint is shown in Figure 33.



LEGEND

- Project site
- Rail corridor
- SIMTA site
- Operational area
- Proposed rail alignment
- Construction area
- Rail link (including 20m width and variable buffer)
- Stage 1 site
- Compound site
- Creek/River crossing
- Road crossing
- Existing railway
- Watercourse

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Figure 33: Final construction footprint

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Combined Impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Proposal.

Loss of native vegetation, including listed Endangered Ecological Communities

Clearing of native vegetation is required for the Proposal. The areas of each PCT to be cleared and the equivalent EEC is provided in Table 33.

Table 33 Native vegetation within the study area and SIMTA Project footprint

PCT	Equivalent EEC under TSC Act	Equivalent EEC under EPBC Act	Area in study area (ha)	Area in development site (ha)	Area to be cleared (ha)	Percentage of the PCT in the study area cleared
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	-	Castlereagh Scribbly Gum and Agnes Banks Woodland in the Sydney Basin Bioregion	20.27	10.42	0.76	4%
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Swamp Woodland	-	4.08	0.94	0.05	1%
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	-	0.67	0.42	0.03	4%

PCT	Equivalent EEC under TSC Act	Equivalent EEC under EPBC Act	Area in study area (ha)	Area in development site (ha)	Area to be cleared (ha)	Percentage of the PCT in the study area cleared
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	-	7.13	7.08	0.41	6%
Total			**32.15**		**1.25**	**4%**

The PCTs to be cleared are shown in Figure 34. The 1.25 hectares of native vegetation communities to be cleared are located within the Rail link. The linear clearing for the Rail link and potential installation of fencing will result in fragmentation of the remaining vegetation in the Rail Corridor and increase the risk of edge effects within this vegetation. All four native vegetation communities fall within the definitions of threatened ecological communities under the TSC Act, and Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion falls within the definition of an EEC under the EPBC Act (Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion).

An Assessment of Significance under the EPBC Act has been undertaken in Appendix H which found that the impacts of the Proposal to Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion would not be significant, therefore offsets for this TEC are not required under the EPBC Act Environmental Offsets Policy. The remaining three TECs are EECs under the TSC Act and impacts to these EECs requires offsetting under the FBA. Offset requirements are discussed in Section 7.2.1.

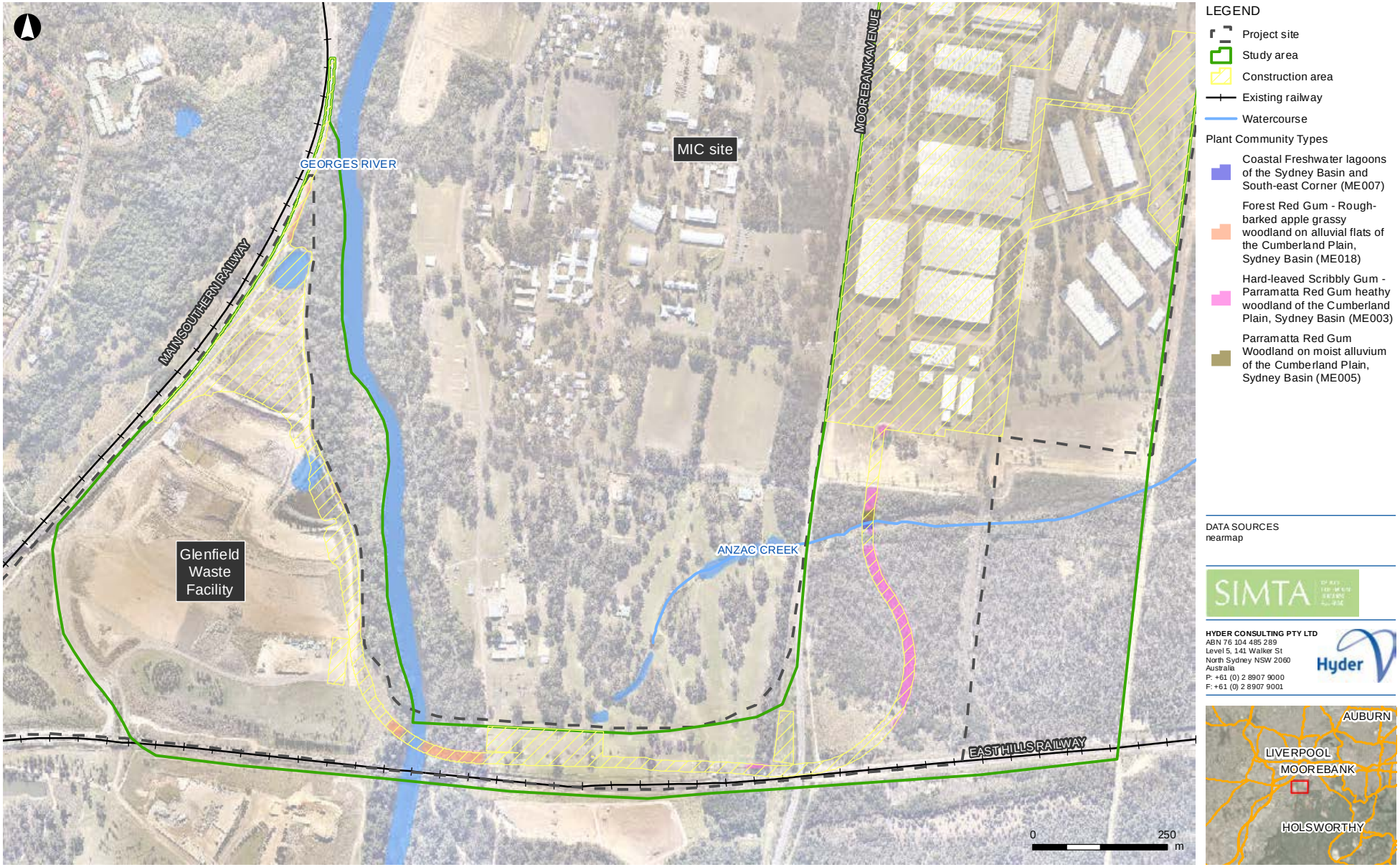

Figure 34: Plant Community Types to be cleared in the construction area

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Loss of threatened plant species and fragmentation of habitat

The construction of the Rail link will have direct impacts on populations of two threatened plant species in the Rail Corridor, both of which are listed under the TSC Act and EPBC Act. The Rail link intersects the centre of the sub-population of the endangered species *Persoonia nutans* (Nodding Geebung) mapped in the Rail Corridor (Figure 41) and the western edge of the core population of the vulnerable species *Grevillea parviflora* subsp. *parviflora* in the Rail Corridor (Figure 42). Table 34 summarises the impacts to these species

Table 34 Threatened flora species within the study area and Proposal footprint

Threatened Flora Species	Status under the TSC Act	Status under the EPBC Act	Number in study area	Number to be cleared	Percentage to be cleared
Persoonia nutans	Endangered	Endangered	126 individuals	11 individuals	9%
Grevillea parviflora subsp. *parviflora*	Vulnerable	Vulnerable	7063 stems (estimated)	641 stems	9%

Impacts to *Persoonia nutans* would be reduced from what was assessed in the Concept Plan Approval which calculated impacts would occur to 17 individuals or 14% of the population. The Stage 1 Proposal would now result in impacts to 11 individuals or 9% of the population. Similarly, impacts to *Grevillea parviflora* subsp. *parviflora* would be reduced in terms of the proportion of the population. The Concept Plan Approval assessed impacts to 634 stems, or 15% of the population. The Stage 1 Proposal would impact 641 stems, comprising 9% of the population. The 20 metre wide construction corridor for the Rail link has been maintained to ensure impacts to both species would be minimised.

Species credits are required to offset the impacts to these species. The credit requirements are provided in Section 7.2.2. No other threatened plant species listed under the TSC Act and/or EPBC Act are anticipated to be impacted by the Proposal.

Loss of terrestrial fauna habitat including habitat for threatened and migratory species

Clearing of native vegetation for the Proposal will result in the removal of terrestrial fauna habitat (Figure 35). The areas of each fauna habitat type that occur within the study area, requiring removal, are listed in Table 35.

Table 35 Areas of terrestrial fauna habitat within the study area and the SIMTA proposal footprint

Fauna habitat type	Area in study area (ha)	Area within construction area (ha)	Percentage within footprint
Remnant Forest	0.56	0.14	25%
Remnant Woodland	22.30	0.76	3%
Riparian Habitat-Anzac Creek	2.26	0.05	2%
Riparian Habitat-Georges River	8.16	0.27	3%

Fauna habitat type	Area in study area (ha)	Area within construction area (ha)	Percentage within footprint
Landscaped	63.20	23.19	37%
Buildings	24.38	10.32	42%
Cleared and Disturbed	53.34	9.93	19%
TOTAL	**174.20**	**44.66**	**26%**

The clearing of vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources (myrtaceous and flowering trees and shrubs), groundlayer habitats such as ground timber and well-developed leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna occurring within the locality. A total of 44.66 hectares of terrestrial fauna habitat occurs within the development site footprint and would be disturbed during construction of the proposal.

Remnant woodland and forest offers the greatest diversity of fauna habitat features, offering habitat to a diversity of birds, reptile and mammal species. Clearing of remnant vegetation would reduce the localised extent of habitat (and the foraging, roosting and breeding areas they provide) for some animals. Three hollow-bearing trees are located in the clearing footprint for the Rail link. Several hollow-bearing trees are located at the edge of the clearing boundaries of the Stage 1 site and Rail link within the Glenfield Waste Facility. These trees would need to be protected during construction to reduce the potential for incidental damage or accidental clearing. The loss of hollow-bearing trees reduces available nesting and roosting habitat to hollow-dependent currently utilising these hollows, such as Rainbow Lorikeet (*Trichoglossus haematodus*) and Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*). The loss of tree hollows also reduces potential roosting habitat for threatened microchiropteran bats species known to occur in the study area.

Impacts to riparian vegetation are expected only where the Rail link will be constructed over Anzac Creek and the Georges River. The clearing corridor would be a maximum of 20 metres (within areas of native vegetation) to minimise impacts to habitat connectivity along the riparian zone. Riparian vegetation associated with Georges River to be removed is highly disturbed and is dominated by woody weeds such as Small-leaved Privet (*Ligustrum sinense*), African Olive (*Olea europaea ssp. cuspidata*) and Lantana (*Lantana camara*) and exotic climbers such as Balloon Vine (*Cardiospermum grandiflorum*).

The area of habitat to be cleared does not comprise a significant area of habitat within the wider locality. Habitat features and vegetation communities that will be cleared are prevalent within the wider landscape, particularly within the Military Area to the south and bushland to the east of the Proposal.

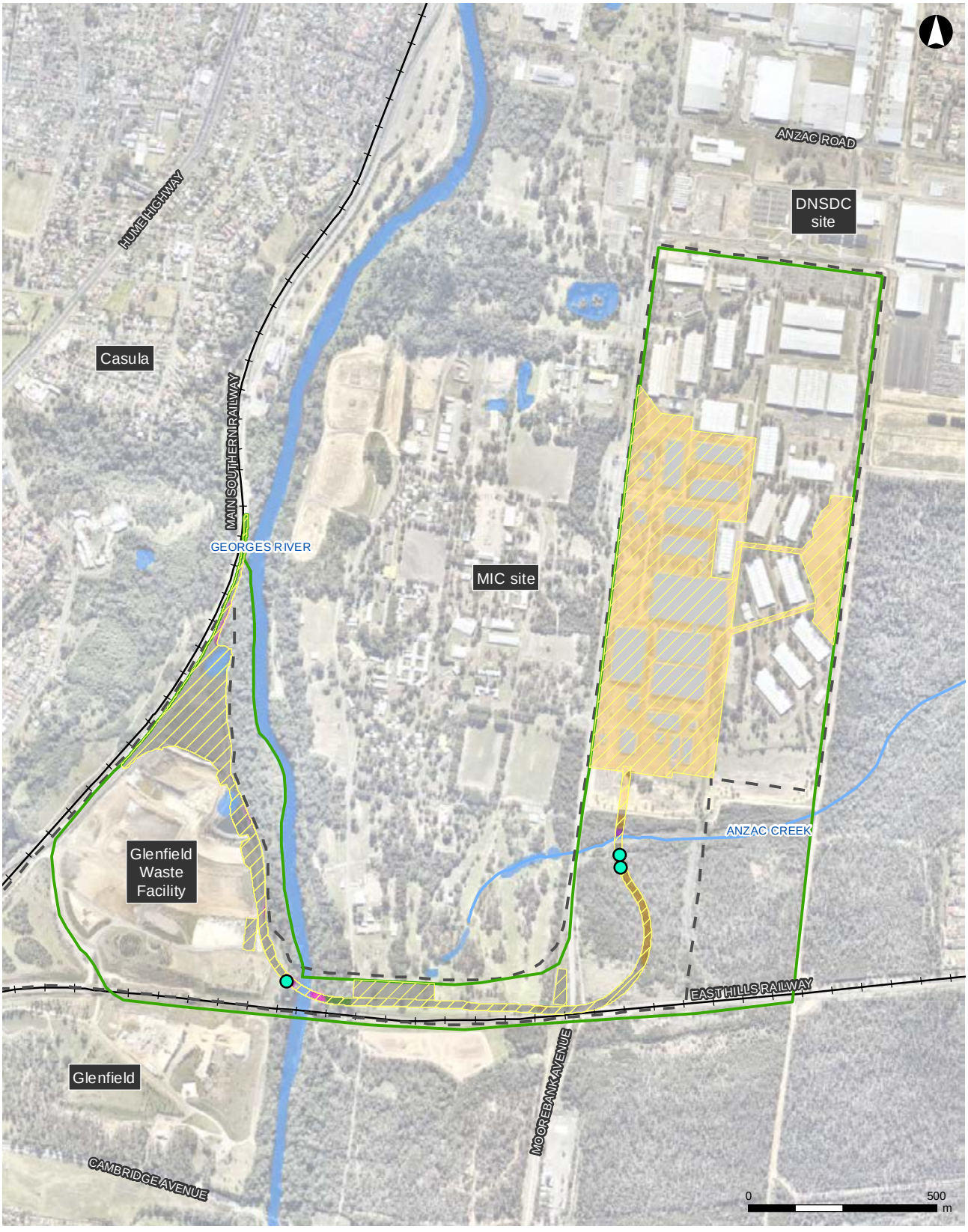


Figure 35: Fauna habitat to be cleared in the construction area

Habitat fragmentation/ loss of fauna habitat connectivity

The study area is located within a relatively industrialised and urbanised landscape. Habitat connectivity is currently severely restricted by significant barriers to fauna movement and is unlikely to be further fragmented as a result of the Proposal. These barriers include Moorebank Avenue, the East Hills Rail Line and chain-mesh fencing surrounding the SIMTA site, East Hills Rail Corridor, Glenfield Waste Facility and MIC site.

The construction phase of the Proposal is not considered likely to reduce fauna movement throughout the locality. However, clearing of vegetation within the study area may reduce the capacity of some less mobile fauna to move within, and between patches of remaining habitat. This is particularly relevant to locally occurring small, ground-dwelling fauna such as amphibians, reptiles and small ground-dwelling and arboreal mammals.

The Proposal would impact on the regional and state significant biodiversity links identified in the study area, namely Cumberland Plain Priority Conservation Lands (PCLs) (regional biodiversity link) and the 50 metre riparian corridor of the Georges River (state significant biodiversity link). Cumberland Plain PCLs are located in the Southern Boot Land and would be impacted by the construction of the Rail link. The Rail link would potentially be fenced and therefore would create an additional barrier to connectivity between the remaining patch of bushland west of the Rail link and remnant bushland within the Boot Land. Some connectivity would be maintained through the provision of dry fauna passage in the Anzac Creek culvert crossing.

The Georges River riparian corridor state significant biodiversity link would be impacted by the removal of vegetation for construction of the proposed rail bridge. Vegetation would be removed to the water's edge, creating a barrier to habitat connectivity along the corridor. Most of the area to be disturbed would be revegetated upon completion of the construction of the rail bridge to restore habitat connectivity and as such, impacts would be temporary and short term.

Alteration and degradation of aquatic habitats including threatened aquatic fauna habitat

Construction activities in proximity to and across Anzac Creek and the Georges River have the potential to adversely affect aquatic habitat, particularly the construction of piers for the Georges River rail bridge that are within the main waterway. Works could include the construction of a working platform instream which would require reclamation of water land. This is likely to increase the volumes of sediments carried downstream and reduce water quality downstream. Further, boring and piling activities carry a high risk of sediments entering the waterway. The mobilisation of sediments and pollutants has the potential to reduce the suitability of aquatic environments for some aquatic flora and fauna species.

Some aquatic vegetation occurring within and fringing Anzac Creek and Georges River would be lost; including submerged, floating and emergent plants such as *Elodea canadiensis*, *Azolla sp., Typha sp*. and exotic species such as *Salvinia molesta.* Approximately 0.03 hectares of instream vegetation and 0.05 hectares of riparian vegetation would be impacted for installation of the culvert crossing/Rail link at Anzac Creek. The rail bridge at Georges River would shadow an approximate area of 0.08 hectares and impacts to instream vegetation within this area could occur from the installation of temporary works platforms installed instream and piling of bridge piers. Furthermore, approximately 0.27 hectares of riparian vegetation would be impacted at the Georges River.

Other minor areas of aquatic habitat will be lost, such as the formalised channels/swales on the MIC site and Moorebank Avenue that support aquatic and fringing vegetation and, offer habitat for reptiles and amphibians such as Common Eastern Froglet (*Crinia signifera*).

Fish passage would be maintained at all times during works at the Georges River. Water flow in the Georges River may be altered during construction through the installation of working

platforms constructed within the river and piling for installation of the bridge piers. These working platforms would be temporary and removed at the end of construction. Five bridge piers would be constructed, two of which will be permanently inundated with water. One pier on the eastern bank is close to the water's edge and likely to be intermittently inundated. The other two piers are higher up the riverbank and only likely to be inundated in periods of high flow/floods. The bridge piers would permanently alter the flow of the river. Though changes to fish movement could occur, the piers would not obstruct the movements of fish up and downstream of the river crossing. Impacts to fish could include the Australian Bass which is known to migrate through the Proposal site in winter to spawn (GRCCC 2012) and the Macquarie Perch that has been recorded 15 kilometres upstream of the site and is listed as Endangered under EPBC Act and FM Act.

Anzac Creek generally only flows in periods of rain within the study area and forms large stagnant pools with dense emergent vegetation. Fish passage could be impacted during the works at Anzac Creek if flow is high due to recent rainfall and as such they would be timed to avoid high flow and when rain is forecast. The culvert crossing construction would result in permanent changes to Anzac Creek. However, changes would be minimal as the culvert crossing has been designed to follow the natural shape of the channel and scour protection would be installed at the outlets to prevent erosion.

Impacts to Groundwater-dependent Ecosystems

The Proposal is not expected to result in impacts on groundwater quality and quantity. Surface water flows from the site are not expected to significantly change as a result of the Proposal.

The only areas where groundwater may be encountered during excavation are:

- Excavation of contaminated soils for remediation in the south-western corner of the SIMTA site
- Construction of bridge over the Georges River.

The temporary nature of these works and the limited extent of potential disturbance to groundwater during construction means that prolonged impacts on groundwater are not predicted as a result of the Proposal. Groundwater quality would be improved as a result of remediation works. Whilst the proposed redevelopment of the site would make the Proposal site more impervious, recharge to groundwater systems would be minimally impacted. Subsequently, impacts to potential GDEs in the study area from changes to groundwater are anticipated to be minimal as groundwater levels and quality are unlikely to change.

Fauna mortality

Fauna injury or mortality is most likely to occur during vegetation clearing activities, but also may result from collisions with construction vehicles or plant, or accidental entrapment in plant, trenches or other earthworks.

The majority of fauna species recorded within the study area were highly mobile bird species and these species are likely to be able to move away from vegetation clearing activities quite readily. Any fauna inhabiting the hollows in hollow-bearing trees may be injured during tree-felling. This could potentially include hollow-dependent birds and mammals and threatened microchiropteran bat species. Those animals that are unable to disperse away from areas under active clearing are also particularly susceptible to injury or death. This includes amphibians, reptiles and fish.

Edge effects and weed invasion

Fragmentation of vegetation results in sections of edge habitat. This is most likely to occur where the Rail link is to be constructed within the Southern Boot Land. Edge effects include alterations in humidity, light, moisture, wind, temperature and noise and soil profile conditions.

These effects impact on the adjoining native vegetation by affecting seed germination, flora and fauna species composition and weed establishment.

Fourteen of the 89 exotic species recorded in the study area are listed as noxious weeds in the Liverpool City Council Local Government Area (Table 23). Nine of the noxious weeds are also listed as Weeds of National Significance under the National Weeds Strategy (Thorp and Wilson 2012). 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). Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the introduction of spread of these weeds within the study area and surrounds, including within native vegetation in the Boot Land east of the SIMTA site.

Alteration to air quality and noise levels

The construction phase of the Proposal may impact upon the roosting, breeding and foraging activities of locally occurring fauna, as a result of increased exposure to light, noise, dust, construction vehicles and people.

Indirect impacts

The Proposal has a risk of indirect impacts to remnant native vegetation adjacent to construction areas. This includes a risk of increased sedimentation and changes to hydrology which could affect the health of native vegetation communities and flora populations. The undeveloped cleared high point located along the eastern boundary of the SIMTA site would be excavated and runoff usually directed from this high point into native vegetation in the adjacent Boot Land would be significantly reduced. This catchment is relatively small and covers an area approximately 3 hectares in size. Reduced runoff from this location is anticipated to have a minor impact on the health of adjacent vegetation.

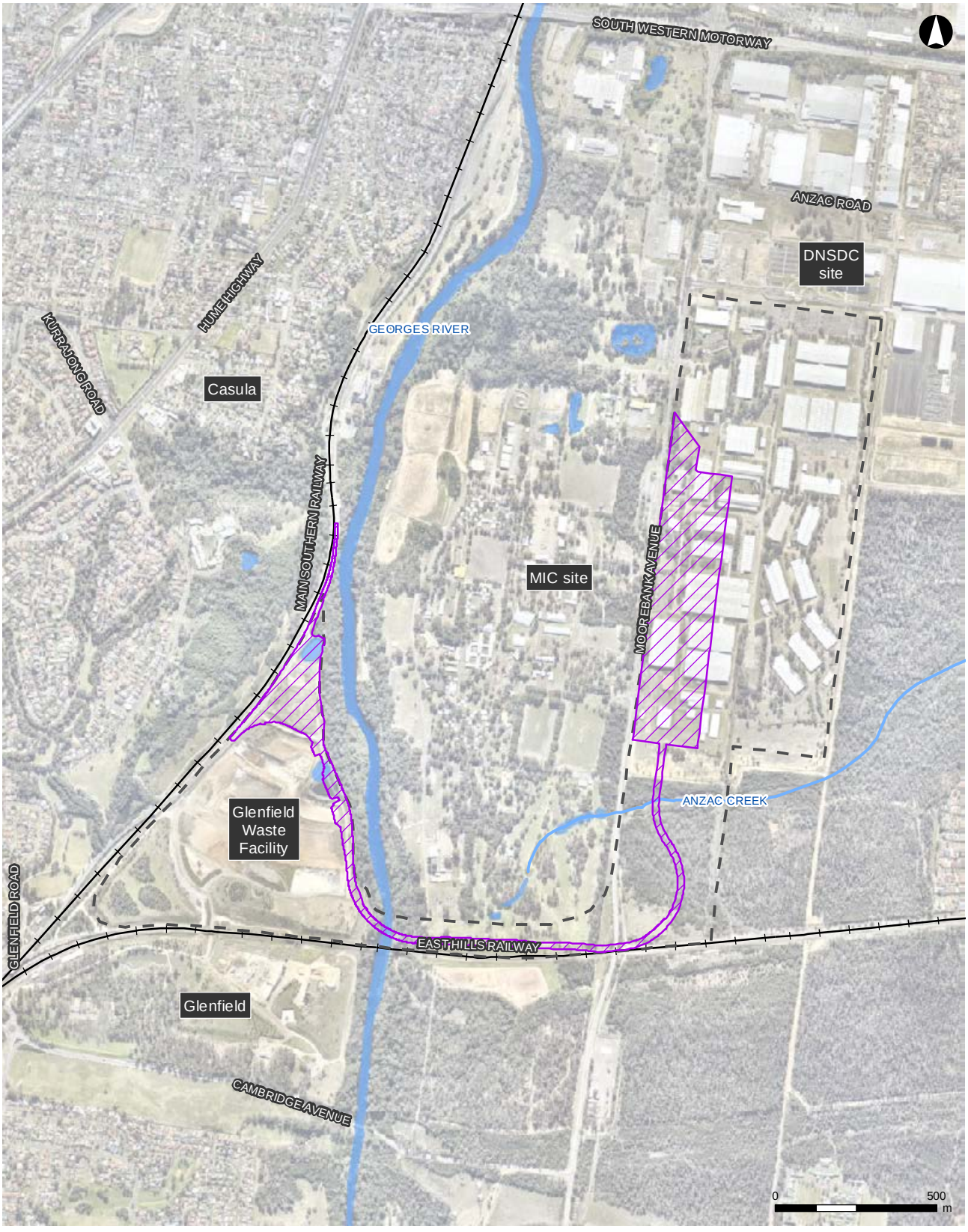
6.2.2 OPERATIONAL PHASE

Operational Activities

The Stage 1 Proposal would operate 24 hours per day and seven days per week. The Stage 1 Proposal would incorporate operational activities as follows:

- Vehicle movements to/from the Stage 1 site as vehicles transport freight to/from logistics centres
- Four rail sidings used for operations with one rail siding used to provide a locomotive escape route
- Container transfer and storage within the Stage 1 site generally either side of the rail sidings
- Train movements to/from the SSFL to enter or exit the Stage 1 site

The final operational footprint is shown in Figure 36.



LEGEND

- Project site
- Operational footprint
- Existing railway
- Watercourse

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Figure 36: Final operational footprint

Date: 21/04/2015 Path: \\hc-aus-ns-fs-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\AA003760_BAR_Stage1_Figure36_Final_operational_area_A4_r2v2.mxd
Created by : GC
QA by : WO

Likely Impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the operation of the Proposal. Likely impacts include:

Fauna mortality

Fauna injury or mortality may result from collisions with vehicles or plant in operation within the Stage 1 site or Rail link, or as a result from increased train and truck movements.

Edge effects and weed invasion

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the introduction or spread of weeds.

Degradation of aquatic habitats

Oils, fuel, lubricants and other chemical substances will be required for the operation of vehicles, plant and machinery on the Proposal site (including the rail link and Stage 1 site). Accidental spills or leaks on the Stage 1 site are unlikely to result in contaminants being transported to the aquatic environments of Anzac Creek or the Georges River via rainfall runoff. . Water quality management across the Stage 1 site would be improved as a result of the Proposal, which has the potential to result in minor increase to the health of aquatic ecosystems downslope of the site.A small portion of rainfall runoff on the Rail link would drain to Anzac Creek and the George River. Water management would be similar to existing. There is a minor risk of spills on the Rail link reaching waterbodies during maintenance activities or from fuel leaks on passing trains.

Alteration to air quality and noise environments

Operation of the development site may increase utilisation of the site by both people and vehicles from current levels. This may impact upon the roosting, breeding and foraging activities of locally occurring fauna, as a result of increased exposure to light, noise, dust, vehicles and people.

6.2.3 IMPACTS TO THREATENED ENTITIES

This section assesses the impacts to threatened entities under the EPBC Act and FM Act. Impacts to ecosystem and species credit species listed under the TSC Act are assessed in Section 0.

Matters of National Environmental Significance

EPBC Approval Requirements

Specific information on the ecology, local and regional distribution and habitat, threats and assessment of the seven species and communities of concern was required as part of the EPBC Approval. The Commonwealth government's requirements for assessment of the seven species and communities of concern are addressed in Appendix G. A summary of the findings is provided in Table 36.

Table 36 Summary of assessments of EPBC Act listed matters

EPBC Act listed Matter	Summary of Assessment	Conclusion
Cumberland Plain Shale Woodlands and	CPSW is restricted to the Cumberland Plain where it occurs in association with clay soils derived from	CPSW does not occur within the study area and

EPBC Act listed Matter	Summary of Assessment	Conclusion
Shale-Gravel Transition Forest (CPSW)	Wianamatta Shale. CPSW was not mapped within the study area in any regional vegetation mapping, but was mapped to the south, east and west. There is no potential habitat for the community in the study area and analysis of vegetation data collected from the study area found that the structure and floristics of the vegetation is not consistent with CPSW.	will not be impacted by the Proposal.
Green and Golden Bell Frog (GGBF)	GGBF occurs along coastal lowland areas of eastern NSW and Victoria and is found in still, shallow, ephemeral waterbodies. The closest known extant population of GGBF is approximately 3.5 km east of the study area at Hammondville. Habitat connectivity between this population and the study area is low. Targeted diurnal and nocturnal surveys for GGBF for the current assessment, as well as other recent projects nearby, did not record this species. While the study area supports some preferred habitat features for GGBF, the presence of Mosquito Fish in aquatic habitats reduces the likelihood that the species occurs in the study area.	GGBF was not recorded in the study area and is unlikely to occur. This species will not be impacted by the Proposal.
Acacia pubescens	*Acacia pubescens* is restricted to the Sydney region where it occurs on alluviums, shales and the intergrade between shale and sandstone soil. *A. pubescens* was not recorded in the study area; two individuals were recorded at the edge of bushland to the east of the study area. These individuals, and potential habitat for the species further east, will be protected from impacts by the buffer that the managed powerline easement represents.	*A. pubescens* was not recorded in the study area and the two individuals of the species recorded to the east of the study area will not be impacted by the Proposal.
Grevillea parviflora subsp. *parviflora*	*Grevillea parviflora* subsp. *parviflora* has a widespread but sporadic distribution extending from Bargo to Heddon Greta. Only small populations have previously been recorded in western Sydney. The most recent targeted surveys for the species in the study area recorded a total of 2,825 stems of *G. parviflora* subsp. *parviflora* in the Rail Corridor lands. It is estimated that the development site supports approximately 7,063 stems, but the number of genetically distinct individuals is likely to be lower than this estimate given the suckering habit of this species. The population of this species in the study area was considered to be significant given its size and location. The proposed action will result in loss of individuals, clearing and fragmentation of habitat for *G. parviflora* subsp. *parviflora.*	A population of *Grevillea parviflora* subsp. *parviflora* was recorded in the Southern Boot Land and will be impacted by the Proposal.
Persoonia nutans	*Persoonia nutans* is endemic to the Cumberland	A population of

EPBC Act listed Matter	Summary of Assessment	Conclusion
	Plain where it is confined to aeolian and alluvial sediments. The majority of the population occurs in the north of the species' range, and isolated and relatively small populations occur in the south of the range including around Moorebank and Holsworthy. Targeted surveys for the species in the study area recorded 126 individuals, of which 110 occurred within the Rail Corridor lands. The population of *P. nutans* in the study area is considered to be significant as it is the largest population recorded in the south of the species' range, and one of only 15 known populations with over 50 mature individuals. The proposed action will result in loss of individuals, clearing and fragmentation of habitat for *P. nutans.*	*Persoonia nutans* was recorded in the Southern Boot Land and former DNSDC South and will be impacted by the Proposal.
Macquarie Perch	The distribution of Macquarie Perch is restricted to the headwaters of rivers in the Murray-Darling Basin and the Hawkesbury-Nepean, Georges River and Shoalhaven basins on the east. The species was recorded in 2008 in the Georges River near Campbelltown, approximately 15 kilometres upstream of the study area, the first record from the river since 1894. The Macquarie Perch was not identified within the study area; Anzac Creek does not support preferred habitat for the species, while the Georges River supports potential foraging and refuge habitat for the species. The SIMTA proposal may temporarily reduce the quality of habitat, but will not impose any restrictions to fish movement through the Georges River during or post construction.	Macquarie Perch was not recorded during surveys of the Georges River, but this waterway supports potential foraging and refuge habitat for the species. The Proposal would have minimal impacts on this species.
Spot-tailed Quoll	The Spotted-tail Quoll occurs along the east coast of Australia from south-east Queensland to Tasmania. Preferred habitat generally comprises mature wet forest habitat which supports a range of den sites, and the species requires large tracts of continuous vegetation. The species was not identified in the study area during fauna surveys; the closest record is six kilometres to the south-east in the Holsworthy Military Area. Suitable habitat is not present in the riparian corridor. Minimal denning resources in the Boot Land (I.e. low volumes of hollow-bearing trees and hollow logs), mean habitat is marginal. As the entire Boot Land is fenced, it is unlikely that a population of this species would be supported in this area given the species requires large tracts of continuous vegetation and habitat is marginal.	This species is unlikely to occur in the study area and consequently unlikely to be impacted by the Proposal.

Of the seven particular threatened species and communities listed, the Proposal would have impacts on two, *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans.* The other five

species and communities of concern do not occur, or are unlikely to occur in the study area, and are not considered likely to be impacted by the Proposal.

Other species considered

As discussed in Section 5.3.2, The Grey-headed Flying-fox was recorded in the study area. The Proposal would result in the removal of 4.8 hectares of potential habitat which is considered to be minor and would not notably impact the species.. Three project approval conditions were provided for this species in the EPBC EIS Approval as listed in Table 4 as follows:

1. For the better protection of the GHFF [Grey-headed Flying-fox], the person taking the action must:

a) not clear more than 11 hectares of GHFF foraging habitat;

b) engage a suitably qualified expert to undertake a pre-clearance survey(s) to confirm the absence of GHFF roosting camps within the rail easement, no more than 48 hours prior to the clearance of potential GHFF roosting habitat; and

c) notify the Department in writing of the results of pre-clearance surveys. If the GHFF is detected roosting on site, all native vegetation clearance activities must halt until the person taking the action has complied with any directions the Minister may wish to issue regarding timing of construction or methods for dispersal of the GHFF.

The Proposal would meet the first condition as there would be less than 11 hectares of habitat cleared. The remaining two conditions would be met through implementation of two mitigation measures listed in Section 6.6.

Threatened Aquatic Species

As discussed in Table 36, the Macquarie Perch was not recorded in the study area, but the Georges River supports potential foraging and refuge habitat for the species. The Macquarie Perch is listed as Endangered under the FM Act. As the Proposal has the potential to impact this species habitat and as such, an Assessment of Significance was undertaken in Appendix H.

6.3 KEY THREATENING PROCESSES

The Proposal is likely to result in the operation of one or more key threatening processes or the exacerbation of one or more key threatening processes currently in operation in the study area. Key threatening processes are listed under the TSC Act, FM Act and EPBC Act.

6.3.1 *THREATENED SPECIES CONSERVATION ACT 1995*

Key threatening processes are processes that “threaten or could threaten the survival or evolutionary development of species, populations or ecological communities”. They are listed under Schedule 3 of the TSC Act and may adversely affect threatened species, populations or ecological communities or could cause species, populations or ecological communities that are not threatened to become threatened. The Proposal may contribute to the following key threatening processes:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Clearing of native vegetation
- Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)
- Infection of native plants by *Phytophthora cinnamomi*
- Invasion of native plant communities by exotic perennial grasses

- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara*
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Loss of hollow-bearing trees.

6.3.2 *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT* 1999

The EPBC Act defines a key threatening process as one that "threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community." The Proposal may contribute to the following key threatening processes:

- Land clearance.

6.3.3 *FISHERIES MANAGEMENT ACT* 1994

Under the FM Act key threatening processes are processes that, in the opinion of the Fisheries Scientific Committee, adversely affect threatened species populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened. The Proposal may contribute to the following Key Threatening Processes:

- Degradation of native riparian vegetation along New South Wales water courses.
- Removal of large woody debris from New South Wales rivers and streams
- Flow regimes of rivers and streams.

6.4 CUMULATIVE IMPACTS

There are two additional major proposed developments within the immediate vicinity of the Stage 1 Proposal, the MIC Proposal and the Glenfield Recycling Facility (Figure 37).

These proposals and the cumulative impacts predicted from the development of both the Proposal and the MIC Proposal and Glenfield Recycling Facility are discussed below.

6.4.1 MIC PROJECT

Moorebank Intermodal Company Ltd (MIC) proposed to develop the Moorebank Intermodal Freight Terminal site, (MIC site), comprising the Moorebank and Steele Barracks, which lies immediately to the west of the SIMTA site west of Moorebank Avenue. Part of the MIC 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 of the SIMTA Project's study area, identified as the Southern Rail Access Option.

Parsons Brinckerhoff (PB) (2011) prepared a report on the existing ecological values of the proposed Moorebank Intermodal Freight Terminal site. The purpose of the Parsons Brinckerhoff (2011) assessment is to provide preliminary assessment of the potential impacts of the proposed MIC intermodal terminal project on flora, fauna and ecological values of the MIC site. Further assessment of the MIC project site was undertaken by Parson Brinckerhoff in 2014 from the results of field surveys undertaken in November 2010, surveys following the biobanking

assessment methodology (BBAM) in May 2014 and targeted threatened species surveys in September 2014.

As a 'worst case' scenario, it has been anticipated that the Stage 1 Proposal would be operational in 2016. The review of the MIC Proposal indicates that the Early Works could occur in 2016. Therefore this cumulative impact assessment considers the Stage 1 Proposal and MIC Proposal Early Works in 2016 as well as the combined impacts of the two projects over the entire project timeframes.

SIMTA Stage 1 and MIC Early Works

The Early Works component comprises establishment of construction facilities, some demolition and relocation works, some contaminated land remediation, some utility terminations and diversions, establishment of a conservation area and heritage impact mitigation works.

PB (2011) state that the Early Works are unlikely to result in the clearing of any native vegetation communities including any threatened species. They are likely to result in the removal of scattered native and introduced trees and shrubs within the highly modified, park-like grounds in the east of the MIC site, associated with the built-up areas of the MIC site. This vegetation removal will result in displacement of fauna species tolerant to disturbed sites, which would have a cumulative impact with the Stage 1 Proposal which would also displace fauna species.

An increase in dust and noise could occur from construction and demolition or relocation of existing buildings. Combined with works associated with the Proposal, a cumulative noise disturbance to fauna species could occur. There could be a cumulative build-up of dust settling on remnant vegetation. This is unlikely to be substantial such that it compromises the health of remnant vegetation.

SIMTA and MIC Projects

The field investigations confirmed that three Threatened Ecological Communities (TECs) are present on the MIC site and that between 44.4 and 52.7 ha of these communities would be removed as a result of the project, comprising: Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion; Castlereagh Swamp Woodland Community; and River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion. All three communities are equivalent to threatened ecological communities listed under the TSC Act. A summary of the impacts on TECs as a result of the MIC Proposal are as follows:

- Castlereagh Swamp Woodland – 0.9 hectares
- Castlereagh Scribbly Gum Woodland – 16.1 hectares
- River-flat Eucalypt Forest:
  - 27.4ha – northern rail option
  - 31.4ha – central rail option
  - 35.7ha – southern rail option

The SIMTA Proposal would also impact on these TECs, though there is some overlap in impact areas with the MIC Proposal and the three rail access options. The total impacts to the TECs for the SIMTA Proposal are as follows:

- Castlereagh Swamp Woodland – 0.05 hectares
- Castlereagh Scribbly Gum Woodland – 0.76 hectares
- River-flat Eucalypt Forest - 0.41 hectares

This would result in a cumulative clearing of the TECs as follows:

- Castlereagh Swamp Woodland – 0.95 hectares
- Castlereagh Scribbly Gum Woodland – 16.86 hectares
- River-flat Eucalypt Forest – 27.81 to 36.11 hectares

Two threatened plant species listed under the EPBC and TSC Acts were recorded on the MIC 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 mapped in Figure E-1 of Appendix C to the Ecological Impact Assessment (PB 2014). The species are shown to be located in Castlereagh Scribbly Gum patches parallel with Moorebank Avenue in the east of the MIC site. Potential habitat for both species was mapped along the southern half of the eastern boundary of the MIC site, and included some of the vegetation within the Rail Corridor.

The size of the population of each species on the MIC site is estimated to be 16 individuals of *Grevillea parviflora* subsp. *parviflora* with approximately 50 stems; and at least 10 individuals of *Persoonia nutans*. It was estimated that there was approximately 17 hectares of potential habitat for both threatened plant species on the MIC site. The report also states that an additional 50 *Persoonia nutans* plants and 300 stems of *Grevillea parviflora* subsp. *parviflora* were recorded by Parsons Brinckerhoff in 2012 to the east of the MIC site, adjacent to the suburb of Wattle Grove. This includes some of the population in the study area for the Stage 1 Proposal. A summary of the impacts to both species on the MIC site and Stage 1 Proposal is shown in Table 37.

Table 37 Cumulative losses of threatened flora species from the study area and MIC site

Threatened Flora Species	Number to be cleared from study area	Number to be cleared from MIC site*	Total number to be cleared from both projects
Persoonia nutans	11 individuals	10 individuals	21 individuals
Grevillea parviflora subsp. *parviflora*	641 stems	16 mature plants with many suckers	Unknown – population has been measured differently in each assessment. 641 stems plus 16 mature plants with many suckers.

* From Parsons Brinckerhoff 2014

An additional six threatened flora species were considered to have a moderate likelihood of occurrence on the MIC 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.

An assessment of the significance of impact of the MIC project on threatened species listed under the EPBC Act was undertaken in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DEWHA, 2009). The assessments concluded that the potential impact from the MIC project on *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* was not considered significant with regards to its context and intensity.

Assessments of the significance of impact from the MIC Proposal on threatened species and ecological communities listed under the TSC Act was undertaken in accordance with the requirements of Part 5A of the EP&A Act. The assessments concluded that, while the MIC Proposal constitutes key threatening processes under the TSC Act the MIC Proposal will not have a significant impact on any threatened flora species or ecological communities listed under the TSC Act.

A biodiversity offset strategy has been prepared for the MIC Proposal in accordance with state and federal policies. Three offsets sites have been proposed: Moorebank, Casula and Wattle Grove offset areas. Ecological surveys and assessments of the offset sites were undertaken in accordance with the BBAM.

The MIC site covers approximately 220 hectares and the construction footprint for the Stage 1 Proposal covers approximately 93 hectares. In the context of the surrounding highly modified landscape, the patches of remnant vegetation and fauna habitat of the MIC site and SIMTA Project study area may assist in the maintenance of biodiversity that persists in the locality.

The development of the two adjoining sites will reduce or remove a diversity of biodiversity values, including available fauna habitat (including roosting, nesting and foraging habitat), potential threatened fauna habitat, threatened plant species, TSC Act listed TECs, local provenance plant species and potential seedbanks. Hollow-bearing trees would be reduced as a result of both proposals and habitat connectivity would be impacted across the landscape through clearing of the SME site and vegetation in the Georges River riparian corridor. Furthermore, concurrent construction activities, particularly instream works, have the potential to exacerbate impacts to aquatic habitats. Development of the SIMTA Project and the MIC site together will result in a greater loss of biodiversity values from the locality.

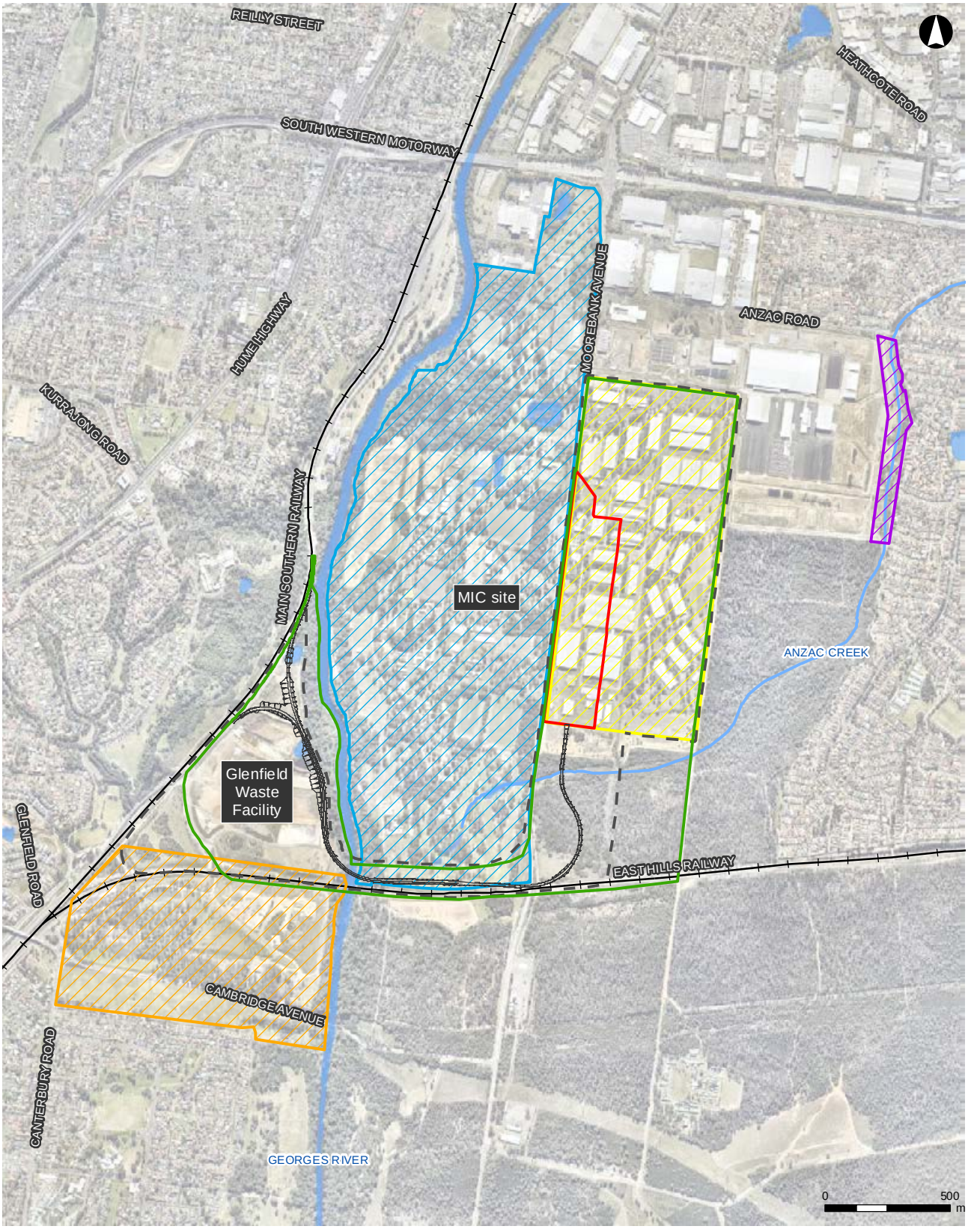
Both proposals would include mitigation measures to minimise impacts and provide offsets for the loss of biodiversity values.

6.4.2 GLENFIELD RECYCLING FACILITY

This proposed SSD involves the development of a Materials Recycling Facility within the bounds of the current landfill site at Glenfield. The proposal has been put forward by Glenfield Waste Services (GWS) and is on land owned by the GWS Group.

The proposal would involve expanding and relocating the existing recycling facility to unfilled (virgin) land on the southern portion of the Glenfield Waste Facility site, south of the EHPL. The proposal will be located across approximately 5 ha in four differentiated but adjoining areas, and positioned to avoid existing landfill cells.

It is noted that vegetation on the Glenfield Recycling Facility proposal site is currently mapped as Cumberland Plain Woodland, which is a TEC under the TSC Act and EPBC Act, of which a large proportion would be cleared. As the Proposal does not impact on Cumberland Plain Woodland, cumulative impacts on this TEC as a result of the Proposal are not predicted. There would be a cumulative loss of fauna habitat within the landscape from vegetation removal at the Glenfield Recycling Facility, the MIC site and the Proposal site, though the extent of the combined impacts cannot be quantified at this stage. Further ecological investigations will be undertaken for the EIS for this proposal, to inform the potential impacts of the Glenfield Recycling Facility Proposal on TECs, threatened species and their habitat. As the Glenfield Recycling Facility Proposal is an SSD, any impacts are likely to require offsetting under the FBA, which aims to achieve no net loss to biodiversity on a regional scale.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Anzac Creek Works (part of DNSDC relocation)
- Glenfield Recycling Facility
- MIC Intermodal Terminal Project Site
- Proposed SIMTA Site
- Existing railway
- Watercourse

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Figure 37: Projects within the immediate vicinity of the SIMTA proposal

Date: 27/04/2015 Path: \\hc-aus-ns-fs-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\AA003760_BAR_Stage1_Figure37_Projects_A4_r3v1.mxd
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QA by : WO

6.5 SUMMARY OF IMPACTS

The extent or scale of values likely to be affected as a result of the SIMTA Proposal is summarised in Table 38.

Table 38 Summary of Impacts

Likely Impact	Details	Extent/scale
Loss and fragmentation of native vegetation	Woodland, forest and wetland vegetation communities	1.25 hectares of native vegetation will be cleared
Loss of threatened ecological communities	Castlereagh Scribbly Gum Woodland	0.76 hectares
	Castlereagh Swamp Woodland	0.05 hectares
	River-flat Eucalypt Forest	0.41 hectares
	Freshwater Wetlands	0.03 hectares
Loss of threatened flora species and fragmentation of habitat	*Persoonia nutans*	11 individuals will be removed
	Grevillea parviflora	641 stems will be removed
Loss of fauna habitat	Remnant woodland and forest, riparian habitats and landscaped areas offer habitat for a diversity of reptiles, amphibians, birds and mammals. A total of 44.67 hectares of terrestrial fauna habitat will be removed for the Stage 1 proposal, comprising 1.23ha of remnant forest, woodland and riparian habitat and 43.44 ha of landscaped, cleared and disturbed habitat.	44.66 hectares of fauna habitat is proposed to be cleared Three hollow-bearing trees will be removed
Fauna fragmentation	May reduce the capacity of some less mobile fauna to move within and between patches of remaining habitat.	Rail link will fragment woodland vegetation south of the SIMTA site (Southern Boot Land) and riparian vegetation of Anzac Creek and Georges River
Fauna mortality	May result from collisions with vehicles or plant, or accidental entrapment in plant, trenches or other earthworks.	Most likely during clearing activities during construction

Likely Impact	Details	Extent/scale
Degradation of aquatic habitats	Caused by changes in runoff, redirection of flows, influences to groundwater, infiltration, pollution and erosion. May influence downstream habitats.	Anzac Creek and Georges River most susceptible during construction
Impacts on fish passage	During construction of Rail link across Anzac Creek and Georges River, particularly construction of piers in Georges River	Temporary and localised scale impacts
Edge effects and weed invasion	Vehicles and plant may transport weed propagules into the study area. Creation of new edges will increase fragmentation and vulnerability of native vegetation to weed incursions	New edges where Rail link will transect woodland vegetation south of the Stage 1 site (Southern Boot Land)
Alteration to air quality and noise environments	May impact upon the roosting, breeding and foraging activities of locally occurring fauna	Temporary and localised scale impacts during construction. Potential minor long term impacts during operation

6.6 MITIGATION OF IMPACTS

Biodiversity impacts cannot be avoided for many aspects of the Proposal as detailed above (Table 38). As such, the measures in Table 39 should be implemented to mitigate these impacts during construction and operation.

Table 39 Measures to be implemented to minimise impacts on biodiversity

Impact	Mitigation measure	Outcome	Timing	Responsibility
General flora and fauna impacts	A Flora and Fauna Management Plan would be prepared as part of the CEMP. Native vegetation clearing would not occur until the Flora and Fauna Management Plan is approved.	Flora and fauna would be managed in accordance with the requirements of the FFMP.	Pre-construction and construction	SIMTA and Contractor
Degradation of aquatic habitats	Install appropriate drainage infrastructure (e.g. sediment basins, diversion drains), sediment and erosion controls prior to the commencement of construction.	Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek.	Pre-construction/Construction	Construction contractor
	Clearing of vegetation would be timed to avoid periods when rain is forecast in accordance with Chapter 4.4.2 of 'the Blue Book'.	Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek.	Construction	Construction contractor
	Locate soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential transport of these substances into the watercourses via runoff.	Prevents soil and mulch reaching waterways.	Construction	Construction contractor
	Dust suppression activities to be undertaken where appropriate.	Prevents sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek.	Construction	Construction contractor
	Stabilisation of disturbed areas, including revegetation in accordance with the Flora and Fauna Management Plan, is to be undertaken as soon as practicable after disturbance.	Prevents sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek.	Construction	Construction contractor and SIMTA

Impact	Mitigation measure	Outcome	Timing	Responsibility
	Emergency response protocols and procedures for implementation in the event of a contaminant spill or leak to be clearly articulated in the Construction and Operational Environmental Management Plans.	Prevents pollution of waterways.	Pre-construction, construction and operation	Construction contractor and SIMTA
	Spill kits to be located to allow for timely response to uncontained spills. Site inductions are to include a briefing on the use of spill kits.	Prevents pollution of waterways.	Pre-construction, construction and operation	Construction contractor and SIMTA
	Bio-retention installed in base of channels and swales to capture and store stormwater consisting of bio-filtration layers, planting and subsoil collection and drainage.	Reduces impacts from altered hydrological regimes leading to an increase in impervious surface such as changes in runoff and infiltration, redirection of flows.	Construction	Construction Contractor
	Maintenance of the bio-retention structures would be in accordance with the maintenance requirements set out in Gold Coast City Council's *Water Sensitive Urban Design Guidelines, 2007.*	Reduces impacts from altered hydrological regimes leading to an increase in impervious surface such as changes in runoff and infiltration, redirection of flows.	Construction, operation	Construction Contractor, SIMTA
	The following management measures would be implemented during works in and adjacent to Anzac Creek to mitigated potential impacts on water quality during construction: ▪ All reasonable efforts would be taken to program construction activities during those periods when flood flows and fish passage is not likely to occur.	Maintains fish passage in periods of high flow in Anzac Creek by avoiding culvert works in these conditions. Prevents sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Anzac Creek.	Construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	▪ Temporary sidetrack crossings would be constructed from clean fill (free of fines) using pipe or box culvert cells to carry flows, or a temporary bridge structure. ▪ All temporary works, flow diversion barriers and in-stream sediment control barriers would be removed as soon as practicable and in a manner that does not promote future channel erosion. ▪ The construction site would be left in a condition that promotes native revegetation. The management principles outlined in Managing Urban Stormwater (Landcom 2004) for sites with high erosion potential would be implemented.			
	Should piling platforms be used for construction of the Georges River bridge the platforms would be designed to minimise impacts on flooding. Flows of the Georges River would be maintained at all times between the two piling platforms. The stream width would be maintained such that there would be minimal erosion of the working platforms from high velocity flows.	Prevents sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River.	Construction	Construction Contractor
	Monitoring of water quality will be undertaken within the Georges River upstream and downstream of the proposed bridge during	Prevents reduction in water quality and degradation of aquatic habitats in Georges River.	Construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	concreting works. Should pH levels outside the range prescribed by ANZECC for lowland rivers be detected, dosing or equivalent measures will be implemented within the silt curtains to bring the pH level back within acceptable limits.			
Impacts to fish and their habitats	Consideration would be given to avoid bridge piling and construction of any temporary work platforms in the Georges River during winter when the Australian bass migrates through the study area.	Prevents impacts to the breeding cycle of the Australian Bass.	Construction	Construction Contractor
	Large woody debris would be retained in watercourses where possible. In the event large woody debris are to be impacted they would be relocated in consultation with an ecologist.	Minimises risk of harm to fish habitat.	Construction	Construction Contractor
	Instream works at Georges River and Anzac Creek would be minimised where possible, including disturbance to aquatic vegetation. Disturbed areas would be contained to the 20m wide corridor.	Minimises harm to fish habitat.	Construction	Construction Contractor
Riparian vegetation impacts	Works areas at each watercourse crossing would be clearly delineated prior to commencement of works.	Minimises disturbance at watercourses including riparian areas.	Construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	Disturbed riparian areas in the Georges River would be revegetated with locally occurring native species as soon as practicable upon completion of bridge works.	Retains habitat connectivity along riparian corridor of the Georges River	Construction	Construction Contractor
	Riparian vegetation within and adjoining areas of impact would be managed in accordance with the measures detailed in the Riparian Vegetation Management Plan.	Minimise impacts to native riparian vegetation, retains habitat connectivity and improves native biodiversity values along riparian corridor of the Georges River	Pre-construction, construction and operation	Construction contractor and SIMTA
Vegetation removal or disturbance	Clearly identifying sensitive areas ('no-go areas') which cannot be impacted by construction and managing clearing such that clearing activities are constrained to these approved areas only.	Prevention of over clearing of vegetation	Pre-construction and Construction	Construction contractor
	No vegetation clearing would occur for works outside the study area such as the sewer main along Moorebank Avenue and culvert in the EHRL. Should any vegetation clearing be required for these works, additional impact assessment would be undertaken.	Prevention of impacts to biodiversity not assessed in this report	Construction	Construction contractor
	Site inductions are to include a briefing regarding the local threatened of the site and protocols to be undertaken if they are encountered.	Prevention of impacts to threatened flora species	Construction and operation	Construction contractor and SIMTA
Weed invasion and spread	Management of weeds in and adjacent to cleared areas will occur in accordance with the FFMP CEMP and OEMP. This plan would include details relating to the monitoring, management and where necessary	Prevention of weed establishment and invasion	Pre-construction, construction and operation	Construction contractor and SIMTA

Impact	Mitigation measure	Outcome	Timing	Responsibility
	eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols if required.			
	Management of noxious weeds is to be undertaken in accordance with the *Noxious Weeds Act* 1993.	Prevention of weed establishment and invasion	Pre-construction and construction	Construction contractor and SIMTA
	Equipment used for treating weed infestation will be cleaned prior to moving to a new area within the Proposal site to minimise the likelihood of transferring any plant material and soil.	Prevents weed establishment and invasion	Pre-construction and construction	Construction contractor and SIMTA
	Soil stripped and stockpiled from areas containing known weed infestations are to be stored on cleared land at least 40 m from native vegetation.	Prevents weed establishment and invasion	Construction	Construction contractor
	Water from the truck wash down in the Rail East Compound would be captured and disposed of offsite to prevent weed spread to adjoining native vegetation.	Prevents weed spread	Construction	Construction contractor
Impacts to fauna and fauna habitat	Fauna microhabitat such as hollow logs should be removed from areas to be cleared and relocated to suitable nearby bushland areas in the presence of an ecologist.	Retaining fauna habitat resources	Pre-construction and Construction	Construction contractor
	A nest box management strategy would be prepared prior to clearing of hollow bearing trees. The strategy would inform the	Replaces lost hollow resources in the landscape	Pre-clearing, construction and	Construction contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	installation of nest boxes in retained native vegetation in the riparian corridor of the Georges River and the woodland in the Southern Boot Land and the on-going monitoring and maintenance of nest boxes through the construction and operational phases.		operation	
	High visibility plastic fencing is to be installed to clearly define the limits of the works area within the Rail link specifically (Southern Boot Land) and works areas at watercourse crossings.	Prevents disturbance or over clearing of fauna habitat and native vegetation outside the construction area	Construction	Construction contractor
	Undertake a pre-start up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials.	Prevents fauna injury/mortality	Construction	Construction contractor
	Undertake a two-stage approach to clearing: ▪ Remove non-hollow bearing trees at least 48 hours before habitat trees are removed. ▪ Hollow bearing trees are to be knocked with an excavator bucket or other machinery to encourage fauna to evacuate the tree immediately prior to felling. ▪ Felled trees must be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further	Prevents fauna injury/mortality	Construction	Construction contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	processing of the trees. ▪ Felled hollow bearing trees must be inspected by an ecologist as soon as possible (not longer than 2 hours after felling).			
	Site inductions are to include a briefing regarding the local fauna of the site and protocols to be undertaken if fauna are encountered.	Prevents fauna injury/mortality	Construction	Construction contractor
	If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by: ▪ Handling fauna with care and as little as possible. ▪ Covering larger animals with a towel or blanket and placing in a large cardboard box. ▪ Placing small animals in a cotton bag, tied at the top. Keeping the animal in a quiet, warm, ventilated and dark location.	Prevents fauna injury/ mortality	Pre-construction, construction and operation	Construction Contractor and SIMTA

Impact	Mitigation measure	Outcome	Timing	Responsibility
	If any pits/trenches are to remain open overnight, they are to be securely covered, where reasonable and feasible. Alternatively, fauna ramps (logs or wooden planks) are to be installed to provide an escape for trapped fauna.	Prevents fauna injury/mortality	Construction	Construction contractor
	The extent of vegetation clearing is to be clearly identified on construction plans.	Prevents impacts to fauna habitat and native vegetation outside the development footprint	Pre-construction	Construction contractor or SIMTA
	In circumstances where native vegetation or mature tree clearing is required outside of the biodiversity study area, an ecologist will inspect the proposed area and provide advice on the impact to flora and fauna and appropriate management.	Prevents impacts to fauna habitat and native vegetation outside the development footprint	Construction	Construction contractor or SIMTA
	Directional lighting will be used where lighting is required in construction areas.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction Contractor
	Frequent maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction Contractor
	Speed limits will be developed so as to minimise the potential for fauna to be struck by a vehicle within the construction areas. All vehicles and plant in operation during construction are to adhere to site rules relating to speed limits.	Prevents fauna injury/ mortality	Construction	Construction Contractor
	An ecologist would undertake pre-clearance surveys to confirm the absence of Grey-	Prevents impacts to the Grey-headed Flying-	Construction	Construction Contractor

Impact	Mitigation measure	Outcome	Timing	Responsibility
	headed Flying-fox roosting camps within the Rail link, no more than 48 hours prior to the clearance of vegetation. The DotE would be notified in writing of the results of pre-clearance surveys. If the species is detected roosting on site, no native vegetation clearance would commence till any directions of the Minister have been complied with.	fox.		
Impacts to fauna habitat connectivity	Rip rap would be ramped down on either side of the outer culvert cells at Anzac Creek to facilitate for dry passage of terrestrial fauna.	Facilitates dry fauna passage through Anzac Creek to retain connectivity for terrestrial fauna in the Southern Boot Land.	Construction	Construction contractor
	Disturbed riparian areas in the Georges River would be revegetated with locally occurring native species as soon as practicable upon completion of bridge works.	Retains habitat connectivity along riparian corridor of the Georges River	Construction	Construction Contractor
Bushfire risk	Bushfire awareness included in staff induction and in toolbox talks pre-commencement.	Reduces risk of possible bushfire events impacting on biodiversity values.	Pre-construction and construction	Construction Contractor

6.6.1 MANAGEMENT OF THREATENED PLANT SPECIES

A Threatened Species Management Plan has been prepared for the *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* populations within the Rail Corridor, largely the South Boot Land that would be affected by the Rail link. Management measures outlined below The objectives of the plan are:

- Protect threatened flora species from the impacts of construction and operation of the Rail link.
- Maintain the size and health of threatened flora species populations in the Southern Boot Land offset site.
- Conserve and enhance threatened flora species habitat in the Southern Boot Land offset site.

These objectives would be achieved by implementation of specific management strategies for *P. nutans* and *G. parviflora* subsp. *parviflora.*

***Persoonia nutans* (Nodding Geebung)**

Mitigation measures are proposed to minimise the potential impacts on *P. nutans* as a result of the Proposal, in accordance with the measures identified in the *Persoonia nutans* Recovery Plan (DEC 2006b) (Table 40). These management actions have been developed for construction and operational areas in proximity to the threatened flora populations including the former DNSDC south and the Rail link in the Southern Boot Land. They also include management within Southern Boot Land offset site.

Table 40 Specific mitigation measures for *Persoonia nutans*

Impact	Mitigation Measure
Removal of individuals of threatened plant species	Investigate options for translocation of individuals removed from the proposal footprint.
	Collection of seed or other genetic material from individuals to be removed, and propagation of tube stock to be replanted in retained areas of habitat, where possible.
Removal of potential habitat for threatened plant species	Retain topsoil and seed bank from the occupied habitat area of threatened species impacted by the Rail link and reapply to areas for rehabilitation and/or restoration works once construction is complete. Stockpiling of topsoil excavated from the Southern Boot Land would be managed to maintain the viability of the seedbank.
Disturbance of threatened species habitat during construction	Fencing of areas of habitat to be retained should be undertaken and individuals of the threatened plant species should be clearly marked in consultation with an ecologist. These areas would be clearly defined as no-go zones.
	Site inductions for staff are to include a briefing on the presence of threatened species and their habitat in and adjacent to the project footprint, its significance and locations and extents of no-go zones.
Fragmentation of habitat and edge effects	Selectively remove large shrubs to encourage expansion of *Persoonia nutans* and on edge habitats (edges of woodland).
	Monitor weeds in the Southern Boot Land and undertake weed removal by hand in areas of threatened species habitat.

Impact	Mitigation Measure
	Given the specific disturbance regimes required by *Persoonia nutans*, the use of fire or other disturbance mechanisms as a long-term management tool should be considered, in consultation with OEH and the Department of the Environment.
	Fencing around the perimeter of the Southern Boot Land would be checked and maintained regularly.
	Consideration would be given to maintaining the Rail link without fencing during the operation period to minimise impacts to habitat connectivity in the Southern Boot Land.
	All waste generated during construction to be handled in accordance with relevant waste management strategies and no dumping of rubbish permitted on site.
Fire management	Use of fire or other disturbance mechanisms in *Persoonia nutans* habitat would be undertaken in consultation with OEH and the DoE and RFS
	Monitor *Persoonia nutans* response to disturbance measures
	Develop a land management protocol within the OEMP, such that an interval of at least 7 to 10 years between fires is maintained within the area of occupied habitat for *P. nutans*
Population decline	Undertake population census and monitor population extents in the Southern Boot Land offset site
	Inspect the health of threatened species populations by checking plant sizes, flowering and extents against benchmarks described in the Threatened Flora Species Management Plan (Appendix A)

Grevillea parviflora subsp. *parviflora* (Small-flowered Grevillea)

Mitigation measures are proposed to minimise the potential impacts on *G. parviflora* subsp. *parviflora* as a result of the Proposal (Table 41). These management actions have been developed for construction and operational areas in proximity to the threatened flora populations including the former DNSDC south and the Rail link in the Southern Boot Land. They also include management within Southern Boot Land offset site.

Table 41 Specific mitigation measures for *Grevillea parviflora* subsp. *parviflora*

Impact	Mitigation Measure
Removal of individuals of threatened plant species	Investigate options for translocation of individuals removed from the proposal footprint.
	Collection of seed or other genetic material from individuals to be removed, and propagation of tube stock to be replanted in retained areas of habitat.

Impact	Mitigation Measure
Removal of potential habitat for threatened plant species	Topsoil within the areas identified as habitat for *G. parviflora* subsp. *parviflora* will be stripped and stored on site for reapplication at those areas identified as *G. parviflora* subsp. *parviflora* habitat once works are complete. Topsoil from these areas will be managed to maintain the viability of the seedbank and *G. parviflora* subsp. *parviflora* suckers.
Disturbance of threatened species habitat during construction	Fencing of areas of habitat to be retained should be undertaken and individuals of the threatened plant species should be clearly marked.
	Site inductions for construction staff are to include a briefing on the presence of threatened species and their habitat in and adjacent to the project footprint, its significance and locations and extents of no-go zones.
Fragmentation of habitat and edge effects	Cleared edges supporting threatened species habitat to be managed with the habitat requirements of the species considered as a priority.
	Monitor weeds in the Southern Boot Land and undertake weed removal by hand in areas of threatened species habitat.
	Selectively remove large shrubs to encourage expansion of *Grevillea parviflora* subsp. *parviflora* population on edge habitats (edges of woodland).
	Selectively remove large shrubs to encourage expansion of *Grevillea parviflora* subsp. *parviflora* in areas of suitable habitat.
	Soil and water management would be undertaken for construction of the Proposal in accordance with *Managing Urban Stormwater: Soils and Construction* Edition 4 (Landcom 2004). This would minimise changes in hydrology and increases in soil nutrients in adjoining areas; particularly in the vicinity of habitat area of *G. parviflora* subsp. *parviflora*.
	Undertake regular checks of erosion and sediment controls and water quality management measures across the Southern Boot Land and adjacent areas/upslope areas.
	Fencing around the perimeter of the Southern Boot Land would be checked and maintained regularly.
	All wastes generated during construction to be handled in accordance with relevant waste management strategies and no dumping of rubbish permitted on site
	Consideration would be given to maintaining the Rail link without fencing during the operation period to minimise impacts to habitat connectivity in the Southern Boot Land.
Fire management	Use of fire or other disturbance mechanisms in *Grevillea parviflora* subsp. *parviflora* habitat would be undertaken in consultation with OEH and the DoE and RFS
	Monitor *Grevillea parviflora* subsp. *parviflora* response to disturbance measures

Impact	Mitigation Measure
	Develop a land management protocol within the OEMP, such that an interval of at least 7 to 10 years between fires is maintained within the area of occupied habitat for *Grevillea parviflora* subsp. *parviflora*
Population decline	Undertake population census and monitor population extents in the Southern Boot Land offset site
	Inspect the health of threatened species populations by checking plant sizes, flowering and extents against benchmarks described in the Threatened Flora Species Management Plan (Appendix A)

7 IMPACT SUMMARY

7.1 IMPACTS NOT REQUIRING ASSESSMENT OR OFFSET DETERMINATION

7.1.1 NATIVE VEGETATION

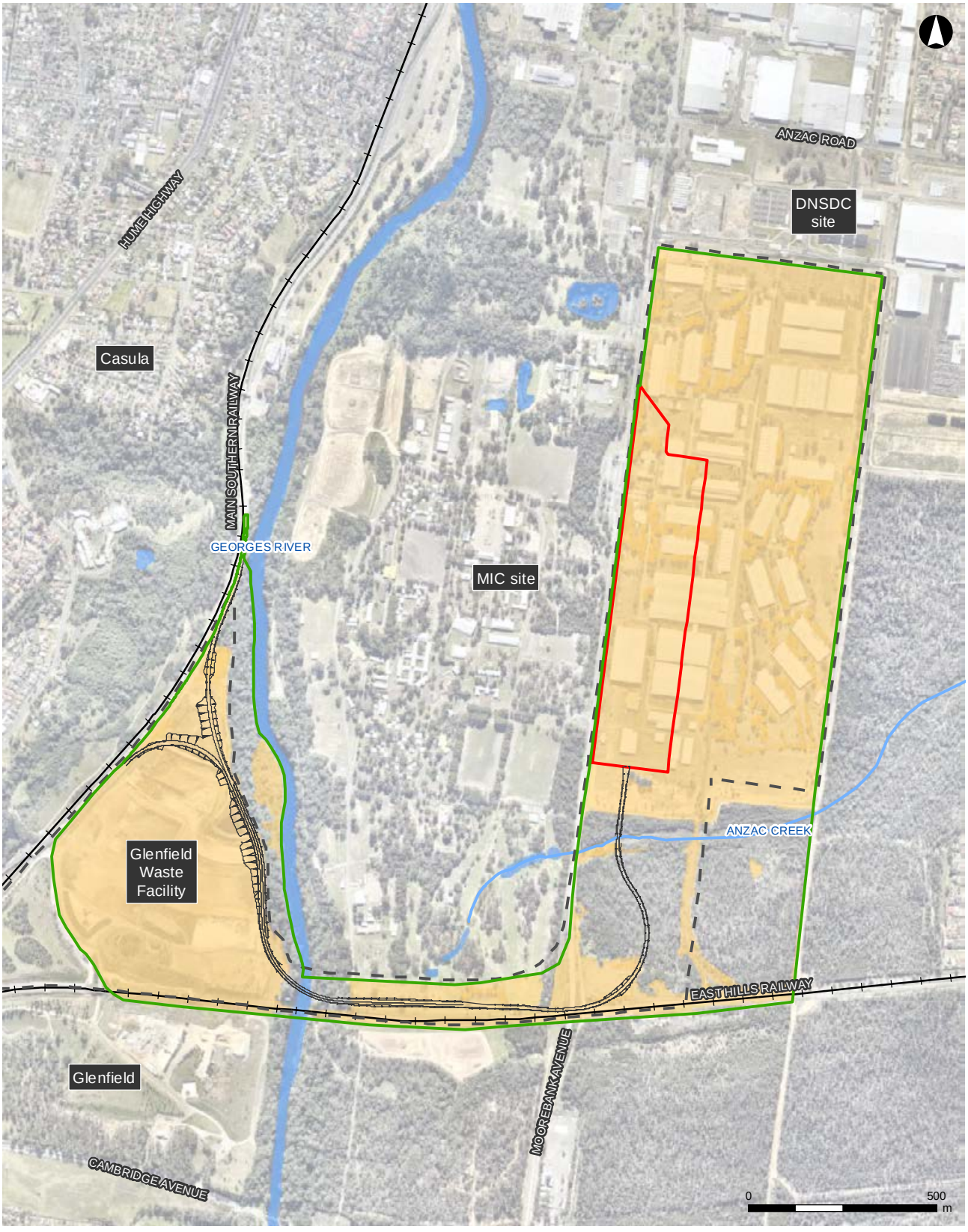
All native vegetation to be impacted requires assessment and offsetting. A Biodiversity Offset Strategy has been prepared in Appendix B.

7.1.2 SPECIES AND POPULATIONS

All parts of the study area require assessment of impacts to threatened species and populations. With the exception of buildings that provide potential habitat for a threatened microbat (Eastern Bentwing-bat), cleared areas and non-native vegetation do not provide habitat for threatened species. As such, these areas do not require offsetting.

7.1.3 AREAS WITHOUT NATIVE VEGETATION

Within the development site, there are several areas of land that do not contain native vegetation and therefore impacts to these areas would not require further assessment (other than for potential threatened species habitat – see Section 7.1.2). This includes land within the Stage 1 site, cleared and disturbed habitats in the Southern Boot Land, cleared land within the MIC site and cleared land in the Glenfield Waste Facility as shown in Figure 38.



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Existing railway
- Watercourse
- Areas without native vegetation

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Figure 38: Areas without native vegetation which do not require further assessment

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Created by : GC
QA by : WO

7.2 IMPACTS REQUIRING OFFSET DETERMINATION

7.2.1 IMPACTS ON NATIVE VEGETATION

Loss of landscape and site value for each PCT and its associated ecosystem species, as determined using the credit calculator, is presented in Table 42. The PCTs to be offset are shown in Figure 34. The vegetation zone Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good – Medium is associated with the most number of EECs and/or threatened species. It has the highest ecosystem credit requirement of 120. Other vegetation zones have much lower ecosystem credit requirements ranging from four to 46. The full credit report is provided in Appendix J.

Table 42 Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystems credits required
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good – Medium	▪ *Persoonia nutans* ▪ *Grevillea parviflora* subsp. *parviflora* ▪ Barking Owl ▪ Black-chinned Honeyeater ▪ Bush Stone-curlew ▪ Diamond Firetail ▪ Eastern Freetail-bat ▪ Gang-gang Cockatoo ▪ Greater Broad-nosed Bat ▪ Hooded Robin ▪ Little Eagle ▪ Little Lorikeet ▪ New Holland Mouse ▪ Scarlet Robin ▪ Speckled Warbler ▪ Spot-tailed Quoll ▪ Swift Parrot ▪ Varied Sittella ▪ Yellow-bellied Sheathtail-bat	24	61.98	91
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good -	▪ *Persoonia nutans* ▪ *Grevillea parviflora* subsp. *parviflora* ▪ Barking Owl ▪ Black-chinned Honeyeater	24	35.94	6

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystems credits required
Poor	▪ Bush Stone-curlew ▪ Diamond Firetail ▪ Eastern Freetail-bat ▪ Gang-gang Cockatoo ▪ Greater Broad-nosed Bat ▪ Hooded Robin ▪ Little Eagle ▪ Little Lorikeet ▪ Spot-tailed Quoll ▪ Varied Sittella ▪ Yellow-bellied Sheathtail-bat			
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005): Moderate/Good - Medium	▪ Castlereagh Swamp Woodland EEC ▪ Barking Owl ▪ Black-chinned Honeyeater ▪ Bush Stone-curlew ▪ Diamond Firetail ▪ Eastern Freetail-bat ▪ Gang-gang Cockatoo ▪ Greater Broad-nosed Bat ▪ Hooded Robin ▪ Little Eagle ▪ Little Lorikeet ▪ New Holland Mouse ▪ Scarlet Robin ▪ Speckled Warbler ▪ Spot-tailed Quoll ▪ Swift Parrot ▪ Varied Sittella ▪ Yellow-bellied Sheathtail-bat	24	62.33	8
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Poor	▪ River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions ▪ Barking Owl	24	56.25	60

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystems credits required
	▪ Black-chinned Honeyeater ▪ Brown Treecreeper ▪ Bush Stone-curlew ▪ Diamond Firetail ▪ Eastern False Pipistrelle ▪ Eastern Freetail-bat ▪ Gang-gang Cockatoo ▪ Greater Broad-nosed Bat ▪ Little Eagle ▪ Little Lorikeet ▪ Spot-tailed Quoll ▪ Swift Parrot ▪ Varied Sittella ▪ Yellow-bellied Sheathtail-bat			
Coastal freshwater lagoons of the Sydney Basin and South-east Corner (ME007): Moderate/Good - Poor	▪ Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions ▪ Australian Painted Snipe ▪ Eastern Freetail-bat ▪ Yellow-bellied Sheathtail-bat	24	58.33	3

7.2.2 IMPACTS ON THREATENED SPECIES

Impacts to threatened species credit species and their associated species are summarised in Table 43. Species polygons for each threatened species credit species are provided in Figures 40 to 46. The full credit report is provided in Appendix J.

Table 43 Impact summary for threatened species credit species requiring offsets and their required credits

Common name	Scientific name	Status	Impacts		Number of species credits required
			Area (ha)	No. of individuals	
Nodding Geebung	*Persoonia nutans*	Endangered	N/A	11	847
Small-flowered Grevillea	*Grevillea parviflora* subsp. *parviflora*	Vulnerable	N/A	641 (stems)	9615 (stems)
Eastern Pygmy Possum	*Cercartatus nanus*	Vulnerable	0.75	N/A	15
Southern Myotis	*Myotis macropus*	Vulnerable	1.25	N/A	28
Eastern Freetail-bat	*Mormopterus norfolkensis*	Vulnerable	1.25	N/A	28
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	11.57	N/A	150
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	4.8	N/A	53

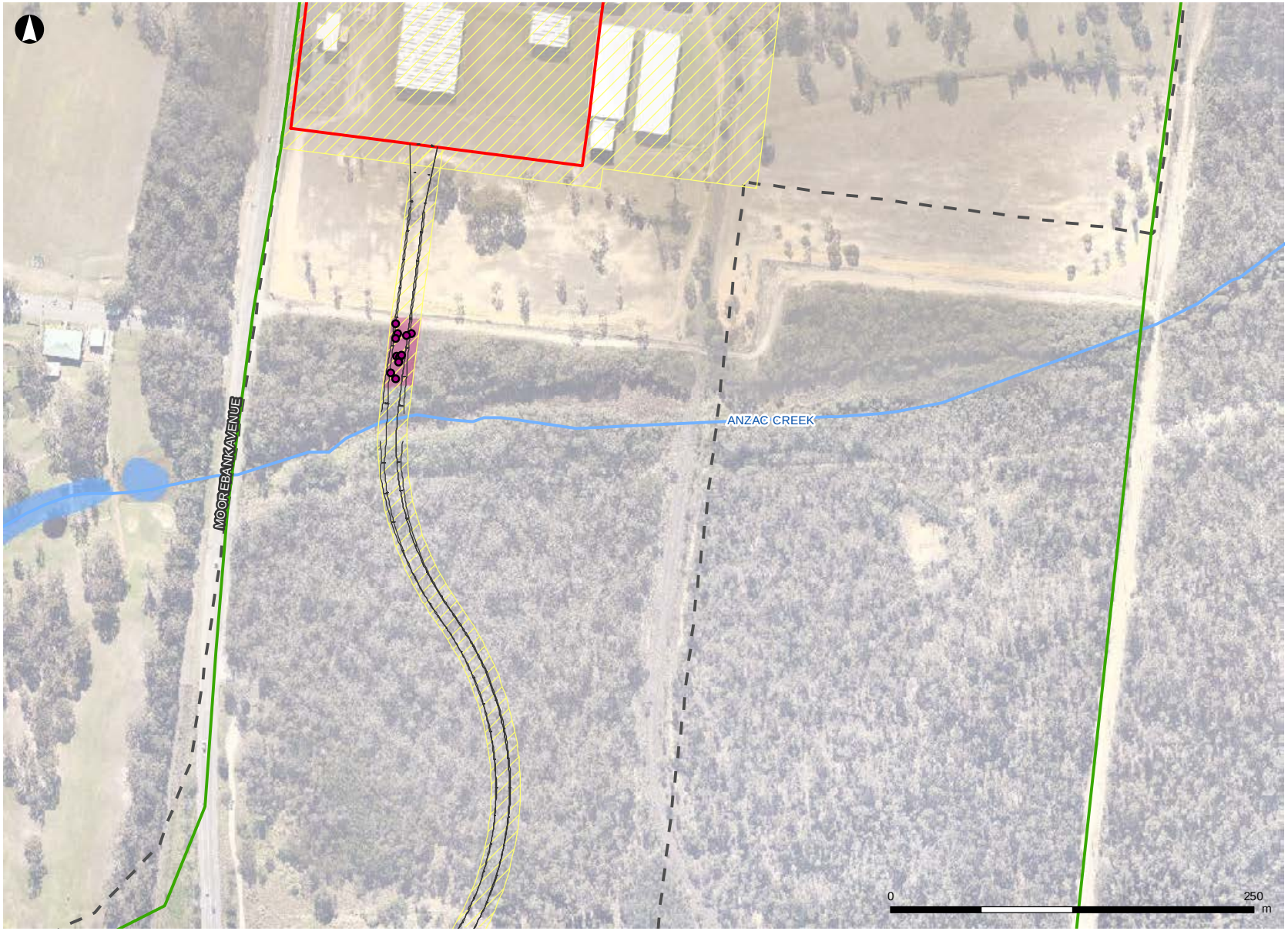

Figure 39: *Persoonia nutans* species polygon requiring offset

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Created by : DD
QA by : AW

Figure 40: *Grevillea parviflora subsp. parviflora* species polygon requiring offset

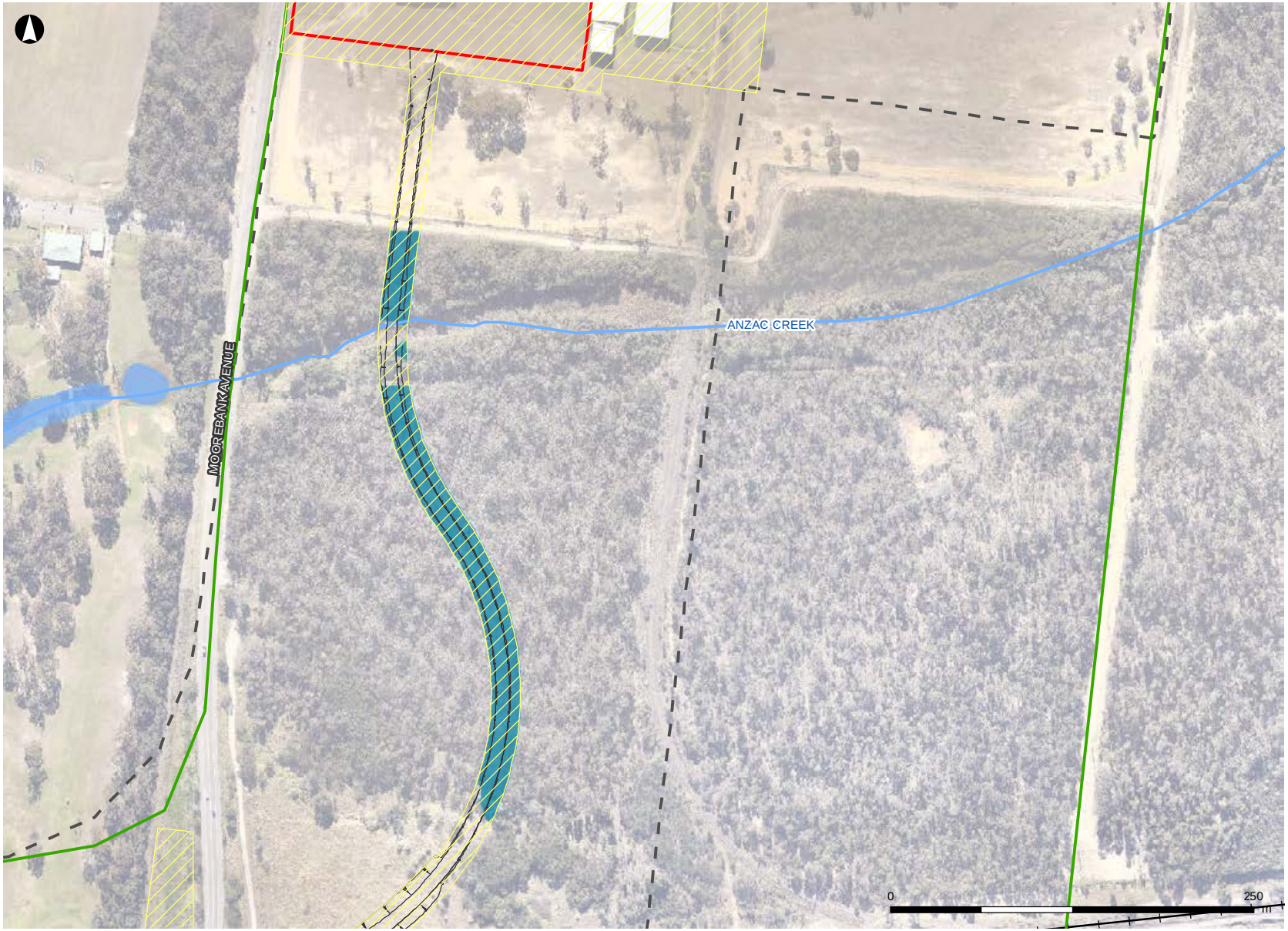

Figure 41: Eastern Pygmy Possum species polygon requiring offset

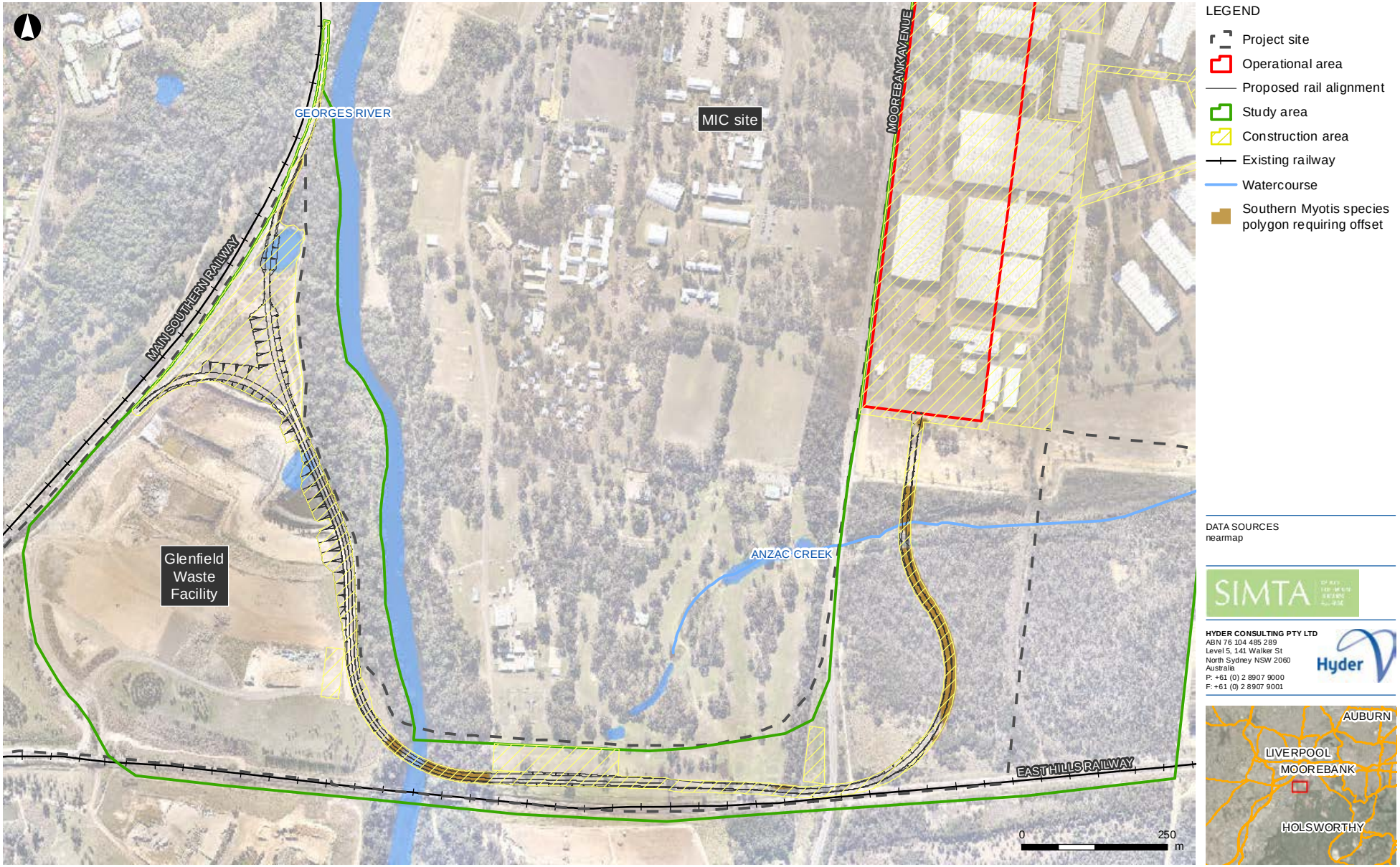

Figure 42: Southern Myotis species polygon requiring offset

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QA by : AW

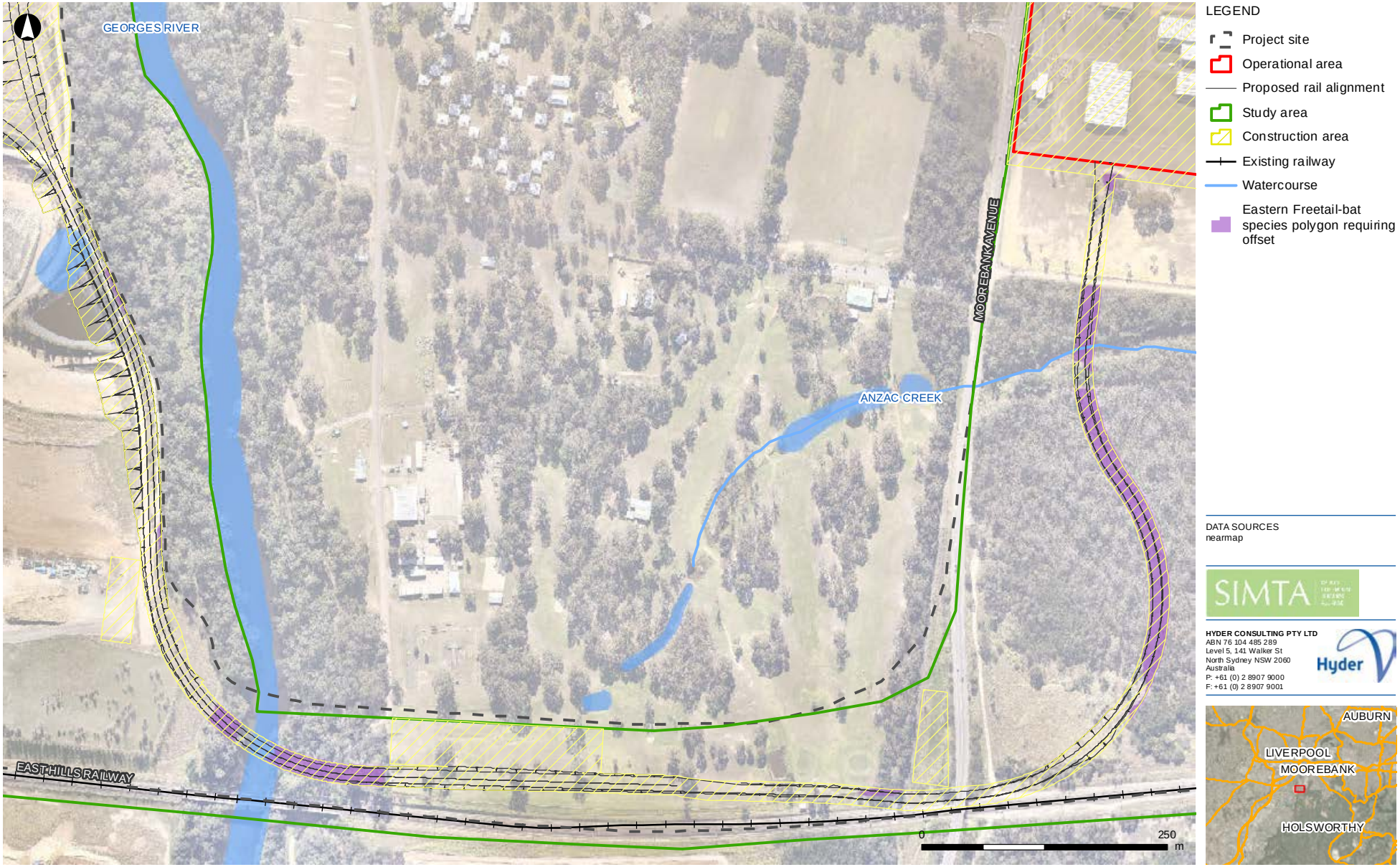
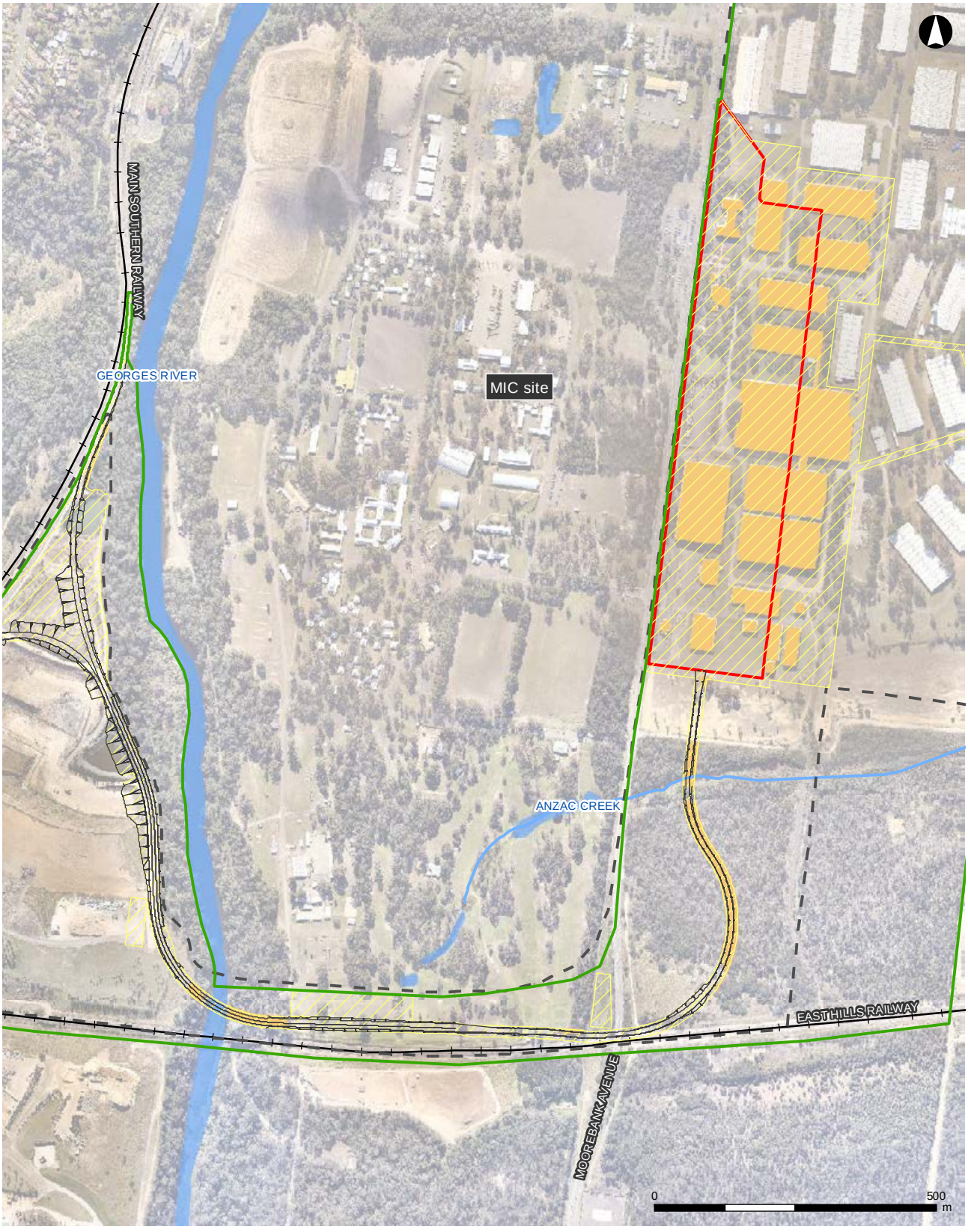


Figure 43: Eastern Freetail-bat species polygon requiring offset



LEGEND

- Project site
- Operational area
- Proposed rail alignment
- Study area
- Construction area
- Existing railway
- Watercourse
- Eastern Bentwing-bat species polygon requiring offset

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Figure 44: Eastern Bentwing-bat species polygon requiring offset

Date: 21/04/2015 Path: \\hc-aus-ns-fs-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\AA003760_BAR_Stage1_Figure44_EasternBentwingbat_Offset_A4_r2v3.mxd
Created by : GC
QA by : WO

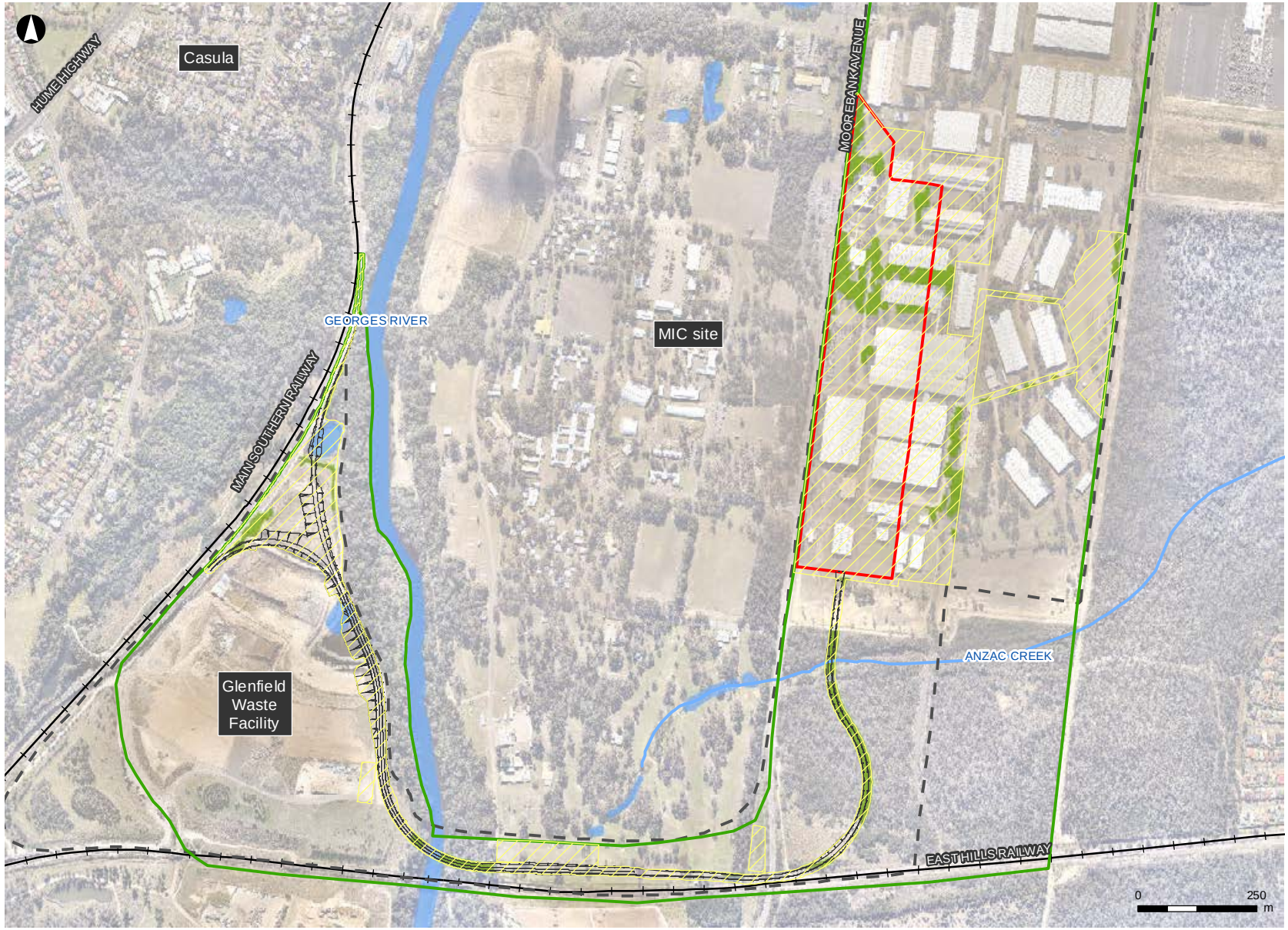


Figure 45: Grey-headed Flying-fox species polygon requiring offset

7.3 IMPACTS REQUIRING FURTHER CONSIDERATION

Under the FBA, certain impacts on biodiversity values require further consideration by the relevant consent authority. These are impacts that are considered to be complicated or severe, and a decision will be made by the relevant consent authority on whether it is appropriate for these impacts to occur, and whether additional offsets, supplementary measures or other actions may be required.

Impacts that require further consideration include:

- Impacts that will substantially reduce the width of vegetation in the riparian buffer zone bordering rivers and streams 4th order or greater.
- Impacts in state biodiversity links.

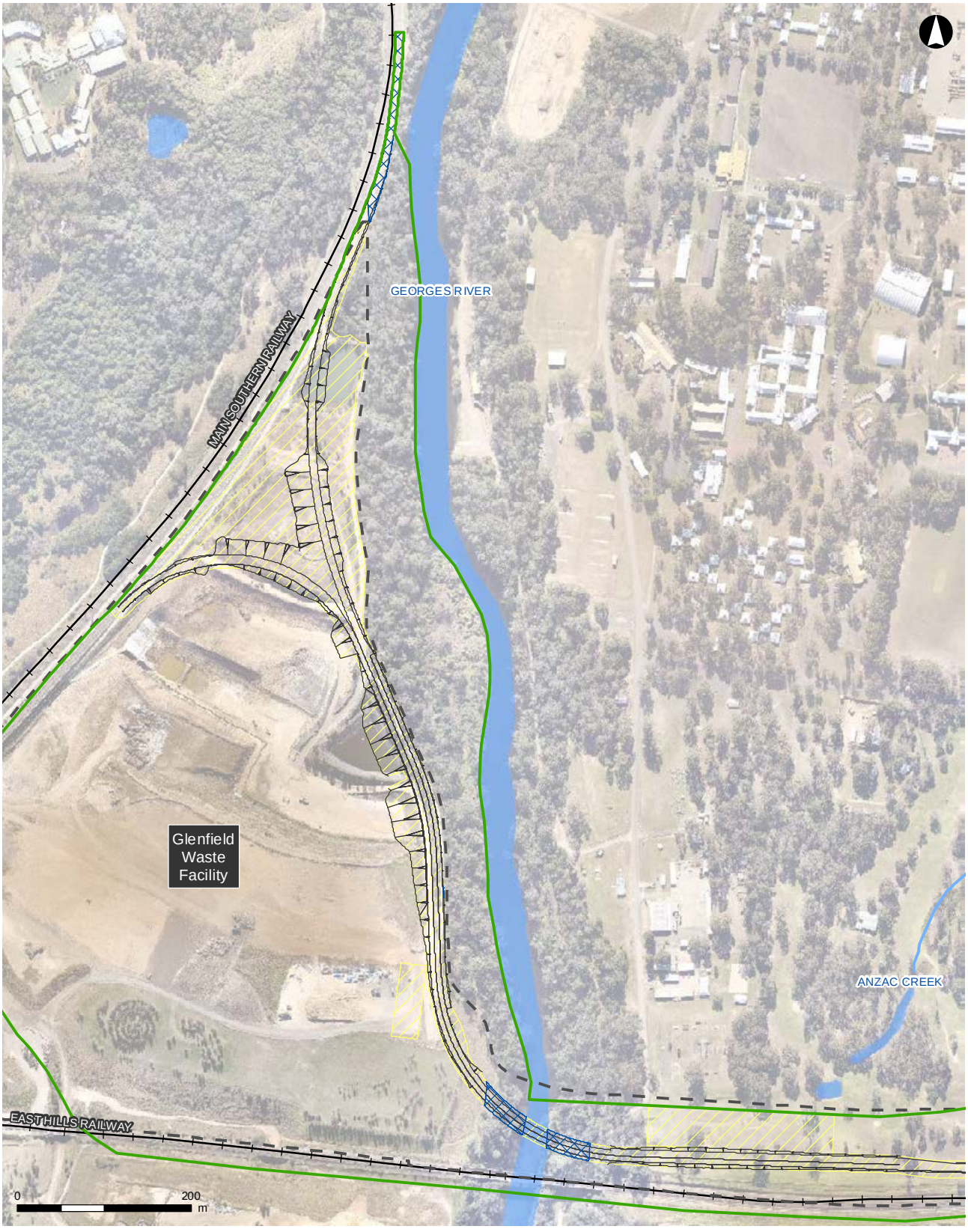
The Georges River is at least a 6th order stream. The area within 50 metres of the Georges River is defined as a state biodiversity link under the FBA, and a small section of this area will be subject to impacts from the Proposal.

The Georges River riparian corridor state significant biodiversity link would be impacted by the removal of vegetation for construction of the rail bridge crossing. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor.

Most of the area to be disturbed would be revegetated upon completion of the construction of the rail bridge crossing to restore habitat connectivity and as such, impacts would be temporary and short term. The partial gap in the riparian corridor vegetation as a result of the proposed Georges River bridge would be approximately 20 metres wide.

The impacts to the Georges River Riparian Corridor are considered unlikely to fall into the category of impacts requiring further consideration as they:

- Will not result in a gap greater than 100 metres between two areas of moderate to good condition native vegetation with a patch size greater than 1 ha.
- Will not remove over-storey cover and mid-storey cover vegetation within the state significant biodiversity link to create a gap in over-storey cover vegetation greater than 100 metres.
- Will not create a hostile barrier within the state significant biodiversity link.



LEGEND

- Project site
- Proposed rail alignment
- Study area
- Construction area
- Existing railway
- Watercourse
- State significant biodiversity link
- Georges River riparian buffer

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Figure 46: Impacts to state significant biodiversity link requiring further consideration

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Created by : GC
QA by : WO

8 REFERENCES

ABS (2001) Diet of Grey-headed Flying Fox Pteropus poliocephalus. Australian Bat Society Inc.

AHMS (2010) *Aboriginal and Historical Impact Assessment.* Archaeological & Heritage Management Solutions, Annandale.

Allen G. R., Midgley S. H. & Allen M. (2002). *Field Guide to the Freshwater Fishes of Australia.* (Western Australian Museum: Perth.)

Andrew D. (2005) *Ecology of the tiger quoll* Dasyurus maculatus maculatus *in coastal New South Wales*. Thesis Collection, University of Wollongong.

ALS (2011) *Assessment of the Sydney Intermodal Terminal Facility, Moorebank: Aquatic Ecology.* Australian Laboratory Services, Penrith.

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

Arup (2008) *Moorebank Intermodal Terminal: Geotechnical Desk Study Report.* Report prepared for Stockland dated December 2008.

Atlas of Living Australia (2015) *Species records by location* http://www.ala.org.au/ Accessed 30 March 2015.

Australian Government Department of Defence (2012) Defence Logistics Transformation Program (DLTP), http://www.defence.gov.au/jlc/infrastructure/sites/moorebank.html, Accessed: 25 October 2012.

Avila-Flores R. & Fenton M.B. (2005) Use of spatial features by foraging insectivorous bats in a large urban landscape. *Journal of Mammalogy* 86(6): 1193-1204.

Bannerman S.M. & Hazelton P.A. (1990) *Soil Landscapes of the Penrith 1:100,000 Map Sheet* (Soil Conservation Service NSW, Sydney)

Barber J. Crooks K.R. & Fristrup K.M. (2010) The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology and Evolution* 25(3): 180-189.

Benson D.H. (1992) The natural vegetation of the Penrith 1:100 000 map sheet. *Cunninghamia* 2(4): 541-596.

Benson D.H. & Howell J. (1990) *Taken for Granted: the bushland of Sydney and its suburbs.*Kangaroo Press, Kenthurst NSW in association with the Royal Botanic Gardens, Sydney.

Benson D. & McDougall L. (2000) *Ecology of Sydney Plant Species Part 7b: Dicotyledon families Proteaceae to Rubiaceae.* Cunninghamia 6(4): 1017-1202.

Bernhardt P. & Weston P.H. (1996) *The pollination ecology of Persoonia in eastern Australia.* Telopea. 6(4):775-804.

BOM (2011) Holsworthy Control Range (station 067117) May 2011 Daily Weather Observations. Bureau of Meteorology Climate Data Online website: www.bom.gov.au/climate/data/. Accessed 4 July 2011.

BOM (2015) *National Atlas of Groundwater Dependent Ecosystems* http://www.bom.gov.au/water/groundwater/gde/map.shtml Accessed 20 March 2015.

Churchill S. (2008) *Australian Bats.* Reed New Holland, Frenchs Forest

Clark N. R. & Jones D. C. (1990) *Geology of the Penrith 1:100 000 map sheet.* NSW Department of Mineral Resources.

Commonwealth of Australia (2012) *Environmental Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy.* Department of Sustainability, Environment, Water, Population and Communities, Australian Government, October 2012,

DEC & DPI (2005) *Draft Guidelines for Threatened Species Assessment.* Department of Environment and Conservation and Department of Primary Industries. Dated July 2005.

DEC (2004a) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities,* Working Draft. Department of Environment and Conservation (NSW) November 2004.

DEC (2004b) *Bat Roosts.* Natural Resource Management Advisory Series: Note 7. Environment Protection and Regulation Division, North East Branch, Department of Environment and Conservation, Coffs Harbour. August 2004.

DEC (2005a). *Environmental Impact Assessment Guidelines: Persoonia nutans.* NSW National Parks and Wildlife Service.

DEC (2005b). *Threatened Species Profile: Eastern Bentwing Bat.* Department of Environment and Conservation (NSW), Hurstville.

DEC (2005c). *Threatened Species Profile: Eastern Freetail-bat.* Department of Environment and Conservation (NSW), Hurstville.

DEC (2005d) *Threatened Species Profile: Spotted-tail Quoll.* Department of Enviroment and Conservation. Available from http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10207. Accessed 17 July 2012.

DEC (2005e) *Threatened Species Profile: Green and Golden Bell Frog.* Department of Enviroment and Conservation. Available from http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10483. Accessed 17 July 2012.

DEC (2006a) *Avoiding and offsetting biodiversity loss: case studies*. Department of Environment and Conservation NSW February 2006.

DEC (2006b) *Persoonia nutans R Br (Nodding Geebung) Recovery Plan.* NSW Department of Environment and Conservation, Hurstville NSW.

DECC (2007a) *Threatened Species Assessment Guidelines: the assessment of significance.* Department of Environment and Climate Change NSW, August 2007.

DECC (2007b) *Spotted-tail Quoll: Den and Latrine Sites.* Private Native Forestry Advisory Note 15. Department of Environment and Climate Change NSW, August 2007

DECC (2008a) *Vegetation Benchmarks Database.* Updated October 2008.

DECC (2008b). *Management Plan for the Green and Golden Bell Frog Key Population of the Georges River*. Department of Environment and Climate Change (NSW), Sydney.

DECC (2008c) *Descriptions for the NSW (Mitchell) Landscapes Version 2 (2002).* Department of Environment and Climate Change (NSW), Sydney.

DECCW (2009) *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area.* Department of Environment, Climate Change and Water NSW, Hurstville.

DECCW (2011) *Cumberland Plain Recovery Plan.* Department of Environment, Climate Change and Water NSW, Sydney. January 2011.

Department of Finance and Deregulation (2012) Moorebank Intermodal Terminal website: http://www.finance.gov.au/property/property/moorebank-intermodal-freight-terminal/index.html Accessed 16 February 2012.

DotE (2015a) *Dasyurus maculatus maculatus* (SE mainland population) in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

DotE (2015b) *Grevillea parviflora* subsp. *parviflora* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

DotE (2015c) *Litoria aurea* -Green and Golden Bell Frog in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

DotE (2015d) *Macquaria australasica* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

DotE (2015e) *Persoonia nutans* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

DPI (2013) *Policy and Guidelines for Fish Friendly Waterway Crossings.* NSW Department of Primary Industries.

DPI (2012). *Profiles for species, populations & ecological communities-Macquarie Perch.* http://pas.dpi.nsw.gov.au/Species/Species_Profile.aspx?SpeciesListingID=16 Accessed 18 July 2012.

Dwyer P. (1995) Common Bentwing Bat. In (Ed) R. Strahan *The Australian Museum Complete Book of Australian Mammals* (pp 494-495) Angus & Robertson, Sydney

Eco Logical (2006) *Simmos Beach Reserve; Plan of Management*. Report prepared for Campbelltown City Council dated April 2006.

Environment Australia (1999a) *The Action Plan for Australian Bats: Taxon summary: East Coast Freetail Bat.* http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/39.html Accessed 19 July 2012.

Environment Australia (1999b) *The Action Plan for Australian Bats: Taxon Summary: Southern Myotis.* Website: http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/25.html Accessed 30 June 2011.

Fairfull S. & Witheridge G. (2003) *Why do fish need to cross the road? Fish Passage requirements for Waterway Crossings*. NSW Fisheries Office of Conservation.

Faulks L. Gilligan D. & Beheregaray L. (2011) The role of anthropogenic vs. natural in-stream structures in determining connectivity and genetic diversity in an endangered freshwater fish, Macquarie perch (*Macquaria australasica*). *Evolutionary Applications*, Vol. 4, P 589-601.

French K., Pellow B. & Henderson M. (2000) Vegetation of the Holsworthy Military Area. *Cunninghamia* **6(4)**: 893-940.

Golder Associates (2013) *SIMTA Transitional Part 3A Concept Plan Application: Preliminary Environmental Site Assessment SIMTA Site and Rail Corridor Lands*, April 2013.

GRCCC (2011) *Community River Health Monitoring Program Report Card - Autumn 2011.* Georges River Combined Councils' Commitee.

Harden G. (1990-1993) *Flora of New South Wales Volumes 1-4.* University of New South Wales Press, Kensington.

Harden G. (2002) *Flora of New South Wales Volume 2 (Revised Edition).* University of New South Wales Press, Kensington.

Hyder Consulting (2011) *SIMTA Moorebank Intermodal Terminal Facility Part 3A Concept Application: Civil Engineering Design.* Hyder Consulting, North Sydney.

Hyder Consulting (2012) *SIMTA Preliminary Biodiversity Offset Strategy.* Hyder Consulting, North Sydney.

JBS&G (2015) *SIMTA Intermodal Terminal Facility – Stage 1, Phase 2 Environmental Site Assessment,* March 2015.

Landcom (2004) *Managing Urban Stormwater – Soils and Construction* Volume 1. 4th edition, NSW Government, Parramatta. March 2004.

Lumsden L. F. & Menkhorst P. W. (1995). Large-footed Myotis *Myotis adversus* (Horsfield 1824). Pp. 131-133 in (ed) P. W. Menkhorst *Mammals of Victoria; Distribution, ecology and conservation*, Oxford University Press, Melbourne.

NFA (2012) *Liverpool Weir Fishway*. Native Fish Australia. http://www.nativefish.asn.au/weir.html Accessed 19 July 2012.

NPWS (1999a) *Threatened Species Information: Spotted Tail Quoll*. NSW National Parks and Wildlfie Service, Hurstville.

NPWS (1999b). *Threatened Species Information: Green and Golden Bell Frog* Litoria aurea. NSW National Parks and Wildlife Service, Hurstville.

NPWS (2001). *Threatened Species Information: Grey-headed Flying Fox.* Department of Environment and Climate Change, Hurstville.

NPWS (2002) *Native vegetation maps of the Cumberland Plain.* NSW National Parks and Wildlife Service.

NPWS (2002a) *Interpretation Guidelines for the Native Vegetation of the Cumberland Plain.* NSW National Parks and Wildlife Service.

NPWS (2002b) *Conservation significance guidelines for the Native Vegetation of the Cumberland Plain.* NSW National Parks and Wildlife Service.

NPWS (2002c) *Threatened Species Information:* Grevillea parviflora *subsp.* parviflora. NSW National Parks and Wildlife Service, August 2002.

NPWS (2002d) *Environmental Impact Assessment Guidelines:* Grevillea parviflora *subsp.* parviflora. NSW National Parks and Wildlife Service, August 2002.

NPWS (2003) Acacia pubescens *(Downy Wattle) Recovery Plan.* NSW National Parks and Wildlife Service, Hurstville, NSW.

NPWS (2004) *Endangered Ecological Community Information: Castlereagh Swamp Woodland.* NSW National Parks and Wildlife Service, February 2004.

Natural Resource Management Ministerial Council (NRMMC) (2010) *Australia's Biodiversity Conservation Strategy 2010-2030.* Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

NSW Scientific Committee and Simpson C. C.(2008) *Changes in the Distribution of Cumberland Plain Woodland.* Mapping and report. October 2008.

OEH (2011) *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects,* OEH June 2011.

OEH (2012a) Bionet Atlas of NSW Wildlife. Accessed 6 July 2012. http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx

OEH (2012b) *Grevillea parviflora* subsp. *parviflora* profile in NSW Threatened Species Database. www.environment.nsw.gov.au/threatenedspecies accessed November 2012.

OEH (2013) *NSW offset principles for major projects (state significant development and state significant infrastructure).* NSW Office of Enviroment and Heritage www.environment.nsw.gov.au/biocertification/offsets.htm accessed 13 September 2013.

Parry-Jones K. & Augee M. (2001) Factors affecting the occupation of a colony site in Sydney, New South Wales by the Grey-headed Flying-fox Pteropus poliocephalus (Pteropodidae). *Austral Ecology*, 26 (1) pp.47-55

Parsons Brinckerhoff (2006) Southern Sydney Freight Line Environmental Assessment. Prepared for ARTC. Dated April 2006.

Parsons Brinckerhoff (2011) *Moorebank Intermodal Freight Terminal – Existing Ecological Values.* Prepared for the Department of Finance and Deregulation. Dated August 2011.

Parsons Brinckerhoff (2014) *Moorebank Intermodal Freight Terminal – Ecological Impact Assessment.* Prepared for the Moorebank Intermodal Company. Dated September 2014

Robertson G., Matthes M. & Smith M. (1996) *Conservation Research Statement and Species Recovery Plan for Persoonia nutans R.Br*. NSW NPWS Hurstville.

SMEC (2010) *Georges River Estuary Data Compilation and Estuary Processes Study.* Prepared for Georges River Combined Councils Committee.

Steller D. & Bryant A. (eds.) (2004) *Biodiversity of the Georges River Catchment: Terrestrial biodiversity.* Department of Infrastructure, Planning and Natural Resources, Sydney.

Strahan R. (ed). (1995) *The Mammals of Australia.* Australian Museum/Reed Books, Chatswood.

Thorp, J.R. and Wilson, M (2012) Weeds Australia - www.weeds.org.au accessed 23 July 2012.

Threlfall C. (2011) *Conserving biodiversity in urban landscapes: mechanisms influencing the distribution, community assembly and resource use of insectivorous bats in Sydney, Australia.*

PhD thesis, Biological, Earth and Environmental Sciences, Faculty of Science, University of New South Wales.

Tidemann C. (1995) Grey-Headed Flying-Fox. In (Eds) Strahan R *The Australian Museum Complete Book of Australian Mammals* (pp 494-495) Angus & Robertson, Sydney

Tozer M. (2003) The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities. *Cunninghamia* **8(1)**: 1-75.

Tozer M.G., Turner K., Keith D.A., Tindall D., Pennay C., Simpson C., MacKenzie B., Beukers P. and Cox S. (2010) Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* **11(3)**: 359-406.

Triggs B. (1996). Tracks, Scats and Other Traces: A Field Guide to Australian Mammals. Oxford University Press, Melbourne.

Turak E. Waddell N. & Johnstone G. (2004). *New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual 2004.* http://ausrivas.canberra.edu.au/man/NSW.

URS (2002*). Investigation Review Report. DNSDC, Moorebank Defence Lands.* Prepared for Property Disposal Task Force, Department of Defence.

Vincent S. Nemoz M. & Aulagnier S. (2011) Activity and foraging habitats of *Miniopterus schreibersii* (Chiroptera, Miniopteridae) in southern France: implications for its conservation. *Hystrix, the Italian Journal of Mammalogy* 22(10): 57-72.

Williams N. McDonnell M. Phelan G. Keim L. & Van Der Ree R. (2006) Range expansion due to urbanization: Increased food resources attract Grey-headed Flying-foxes (*Pteropus poliocephalus*) to Melbourne. *Austral Ecology*, 31 (2) pp. 190-198.

APPENDIX A

THREATENED FLORA SPECIES MANAGEMENT PLAN

SIMTA Intermodal Terminal Facility- Stage 1

Threatened Flora Species Management Plan

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

May 2015

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SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)

INTERMODAL TERMINAL FACILITY - STAGE 1

Threatened Flora Species Management Plan

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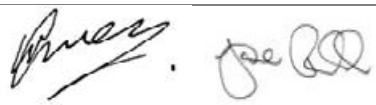
Checker	Westley Owers, Jane Rodd	
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Report No	1	
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1 INTRODUCTION

This Threatened Flora Species Management Plan (TFSMP) has been prepared to guide the management of two threatened flora species: *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans* for Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility (the Proposal).

1.1 PROJECT BACKGROUND

The SIMTA Project involves the development of an intermodal facility, including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank (the SIMTA site). The SIMTA Project also includes a Rail link, within an identified Rail Corridor (the Rail Corridor), which connects from the southern part of the SIMTA site to the Southern Sydney Freight Line (SSFL) This entire area including the SIMTA site and Rail Corridor are collectively referred to as the Project site. The SIMTA Project is to be developed in three key stages:

- Stage 1- Construction of the Intermodal Terminal Facility and Rail link
- Stage 2- Construction of warehouse and Distribution Facilities
- Stage 3- Extension of the Intermodal Terminal Facility and completion of Warehouse and Distribution Facilities.

A summary of the approvals undertaken to date for the SIMTA Project, include:

- **EPBC Approval** (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act).
- **Concept Approval** (No. 10_0193) granted by the Planning Assessment Commission (PAC) on the 29 September 2014 for the 'Concept Approval' of the SIMTA Project under Part 3A of the EP&A Act.

Both of these approvals involved the preparation of design and environmental assessment documentation.

The Stage 1 Proposal, for which this management plan has been prepared, involves the construction and operation of the necessary infrastructure to support a container freight road volume of 250,000 TEU (twenty-foot equivalent units) throughput per annum. Specifically, Stage 1 includes the following key components, which together comprise the intermodal terminal facility (IMT):

- Truck processing, holding and loading areas – entrance and exit from Moorebank Avenue.
- Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively.
- Administration facility and associated car parking – light vehicle access from Moorebank Avenue.
- The Rail link – located within the Rail Corridor, including a connection to the intermodal terminal facility, traversing of Moorebank Avenue, Anzac Creek and Georges River and connection to the SSFL.

- Ancillary works- vegetation clearing, remediation, earth works, utilities installation/connection, signage and landscaping.

The extent of construction works, namely areas to be disturbed during construction of the Stage 1 Proposal, including the Rail link and construction compounds is herein referred to as the 'Construction area'. The SIMTA site and the Rail link (collectively known as the Project site) and construction area are shown in Figure 1-1.

For the purposes of this TFSMP, the study area refers to all areas subject to survey and assessment undertaken for the Stage 1 Proposal, including all surveys for threatened flora species. The study area is shown in Figure 1-1 and includes the main area of interest for this plan – the Southern Boot Land. The Southern Boot Land is fenced land, south of the Stage 1 site and is divided by an existing rail spur that lies to the east of the proposed Rail link. A biodiversity offset is proposed over a portion of the Southern Boot Land and is herein referred to as the 'Southern Boot Land offset site'. The Southern Boot Land offset site covers an area of 13.43 hectares and contains the threatened species pertinent to this plan (*Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans*). It is the main subject of ongoing management actions in this plan and is also the subject of the Biodiversity Offset Strategy (Appendix B of the Biodiversity Assessment Report). It is shown in Figure 1-2. Additional management areas include the former DNSDC south and the Rail link in the Southern Boot Land. The plan generally does not include the management of other parts of the Project site such as the Stage 1 site, Glenfield Waste Facility or the MIC site, with the exception of areas which are adjacent or upslope of the Southern Boot Land offset site and require water quality/erosion and sediment controls,

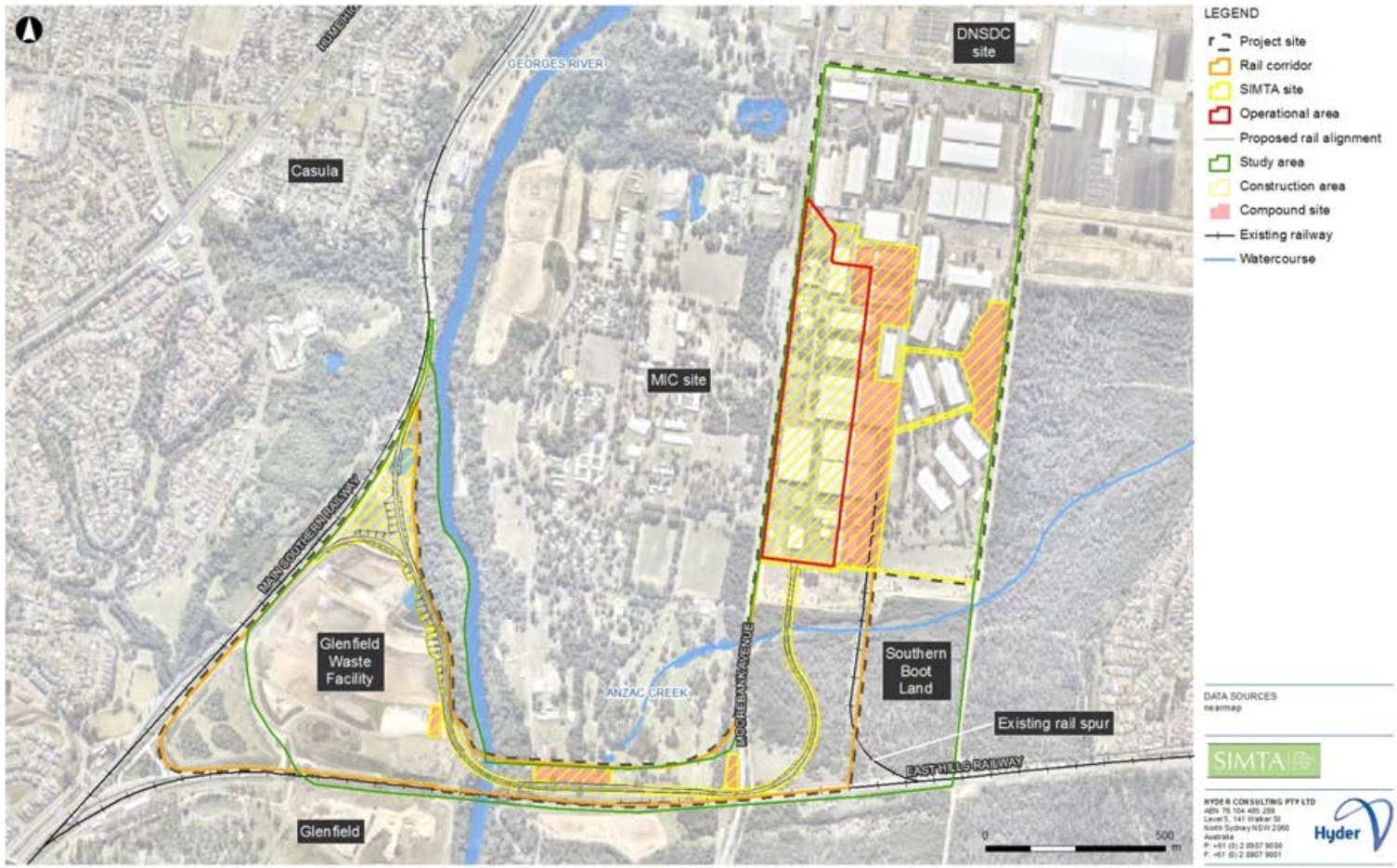

Figure 1-1 Overview of project site and study area

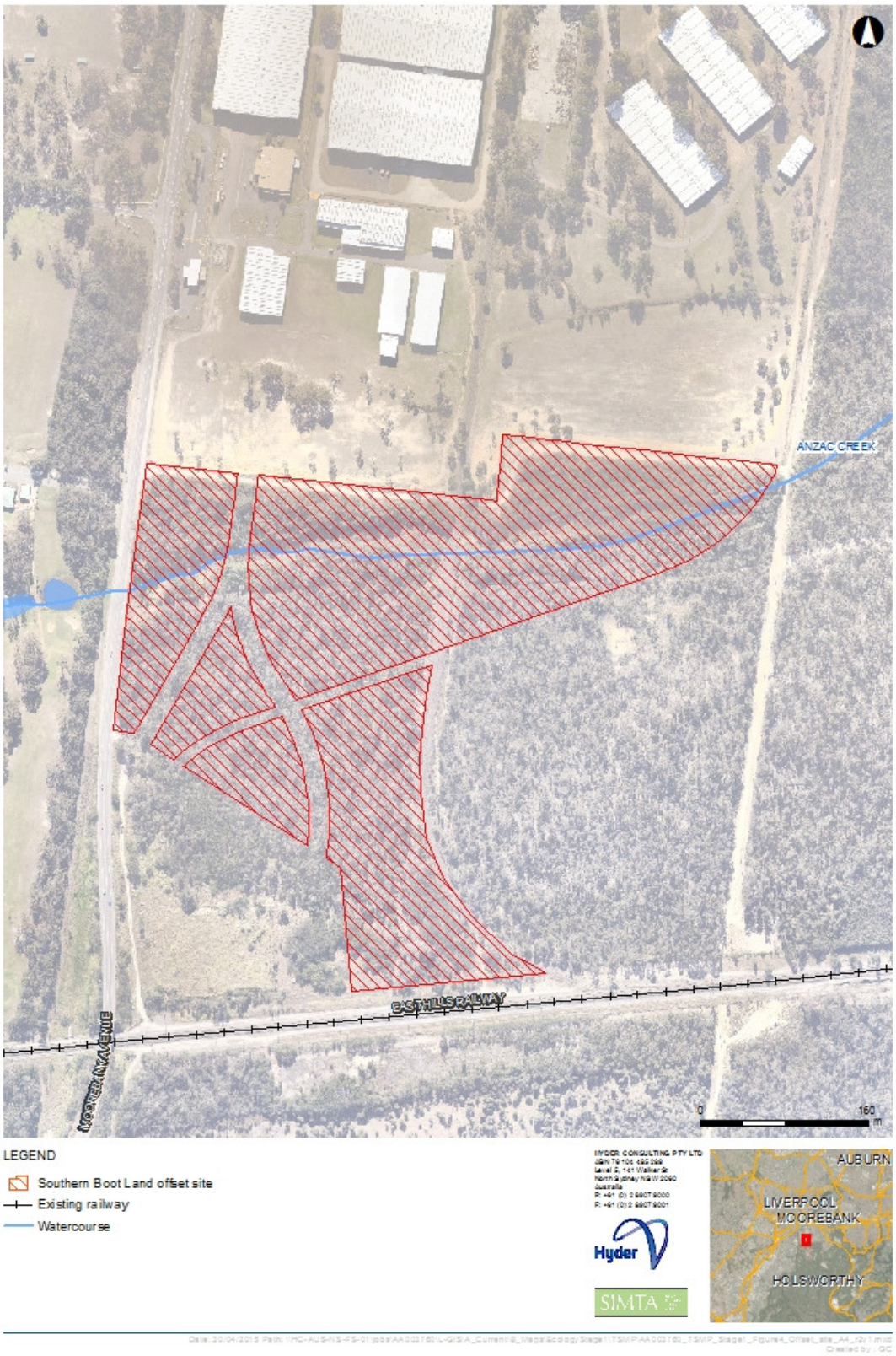

Figure 1-2 Southern Boot Land offset site

1.2 THREATENED SPECIES

The threatened flora species to be impacted by the Proposal include:

- *Persoonia nutans* (Nodding Geebung) – Endangered TSC Act, EPBC Act

  A population was recorded in the Southern Boot Land and would be impacted by the construction of the Rail link.

- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) - Vulnerable TSC Act, EPBC Act

  A population was recorded in the Southern Boot Land and would be impacted by the construction of the Rail link.

Further information on the location of these threatened species is provided in Section 3 of this plan.

1.3 OBJECTIVES

The objectives of this plan are to:

- Protect threatened flora species from the impacts of construction and operation of the Rail link.
- Maintain the size and health of threatened flora species populations in the Southern Boot Land offset site.
- Conserve and enhance threatened flora species habitat in the Southern Boot Land offset site.

1.4 PURPOSE

The Concept Plan Approval Statement of Commitments included a requirement for the preparation of a Threatened Species Management Plan as follows:

The Proponent shall prepare and implement a Threatened Species Management Plan for the P. nutans *and* G. parviflora *populations within the rail corridor that would be affected by the rail link*

The Statement of Commitments identified that this plan was to be provided with the planning application for the first stage of works (including the Rail link) for the SIMTA Project.

As the Proposal is for Stage 1 of the SIMTA Project, this plan has been prepared to meet this Statement of Commitment to manage impacts to these two threatened flora species resulting from the construction and operation of the Rail link.

Furthermore, the EPBC Approval conditions require the preparation of a Threatened Flora Offset Management Plan (TFOMP). The condition for the TFOMP is as follows:

6. *For the better protection of Nodding Geebung, Small-flower Grevillea (and potentially, Hibbertia sp. Bankstown and Bynoe's Wattle) the person taking the action must engage a suitably qualified expert to prepare a Threatened Flora Offset Management Plan (TFOMP) (or plans) for the approval of the Minister. The TFOMP must include (but need not be limited to):*

a) details of a direct offset that satisfies the requirements of the Department's offset policy, in accordance with the offset user guide (including timeframes for the delivery or acquisition of the direct offset);

b) map(s) and shapefiles that identify the location and boundaries of the direct offset;

c) details of the management actions and performance objectives which will maintain and enhance the Nodding Geebung and Small-flower Grevillea habitat and/or population covered by the TFOMP (including the duration, intensity, and timing of management actions);

d) an assessment of the baseline population and distribution for Nodding Geebung and Small-flower Grevillea within the direct offset, including:

i. the number of plants protected and their location; and

ii. plant and habitat condition.

e) measures for regular monitoring of the status of individuals of Nodding Geebung and Small-flower Grevillea and their habitat as measured against the baseline population and distribution, including:

i. fluctuations in population size and distribution; and

ii. response to disturbances and/or management actions.

f) provisions to revise the approved TFOMP in response to monitoring associated with condition 6(e);

This plan has been prepared to meet conditions 6c to 6f. The Biodiversity Offset Strategy for the Proposal addresses conditions 6a and 6b.

1.5 ALIGNMENT TO OTHER RELEVANT PLANS

This plan has been developed in consideration of the proposed offsets for the Proposal for *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* as described in the Biodiversity Offset Strategy and mitigation measures outlined in the Biodiversity Assessment Report (BAR).

Management measures for *Persoonia nutans* have also been developed in accordance with the *Persoonia nutans* Recovery Plan (DEC 2006).

2 LEGISLATIVE AND OTHER REQUIREMENTS

2.1 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 (MNES).

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable under the EPBC Act. *Persoonia nutans* is listed as Endangered under the EPBC Act.

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

EPBC EIS Approval (No. 2011/6229) was granted under the EPBC Act on March 2014 by the Commonwealth Department of Environment for the development of the SIMTA Project, for its impacts on:

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

As discussed above, the EPBC EIS Approval conditions require the preparation of a Threatened Flora Offset Management Plan (TFOMP) to manage offsets for *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans.*

2.2 THREATENED SPECIES CONSERVATION ACT 1995

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

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable under the TSC Act. *Persoonia nutans* is listed as Endangered under the TSC Act. The impacts to these species as a result of the Proposal would be managed in accordance with this plan.

2.3 BIODIVERSITY OFFSET STRATEGY

A Biodiversity Offset Strategy (BOS) has been prepared to establish a commitment to offsetting the impacts of the Proposal on threatened species, populations and communities. The NSW Department of Planning and Environment (DPE) issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal which state that the impacts of the Proposal must be assessed in accordance with OEH's *Framework for Biodiversity Assessment* (FBA) under the NSW *Biodiversity Offsets Policy for Major Projects* published in October 2014. THE BOS has

been prepared to address the Commonwealth conditions of approval, Concept Plan conditions of approval and SEARs for the SIMTA Project and the Proposal in accordance with the FBA and Biodiversity Offsets Policy.

2.4 CONSTRUCTION AND OPERATIONAL ENVIRONMENTAL MANAGEMENT PLANS

This plan would be used to manage threatened flora species during the construction phase of the Proposal and as such would be appended to the Construction Environmental Management Plan (CEMP). It would also be used during the operational period to be updated and adapted to changing site conditions and progress with management milestones. As such, it would also form part of the Operational Environmental Management Plan (OEMP). The content of this plan would be reviewed and updated, as necessary prior to construction and operation of the Proposal.

3 THREATENED SPECIES CONTEXT

3.1 PERSOONIA NUTANS

Persoonia nutans is an erect to spreading shrub 0.5–1.5 m high, with linear leaves and hairy young branches (DoE 2015b). *Persoonia nutans* was recorded in the Southern Boot Land in Castlereagh Scribbly Gum Woodland north of Anzac Creek. The species was identified during flora and fauna surveys of this land in 2011 by Hyder Consulting's Ecologists. Targeted searches in 2012 were subsequently undertaken by Hyder Consulting to determine population extent which was found to be 126 individuals. Repeated targeted searches for this species in 2014/2015 resulted in 126 individual plants being recorded again, though the extent of the population differed between survey periods. The majority of the population is located to north of Anzac Creek. A single individual was found south of Anzac Creek and another individual was found further north, in the land known as the former DNSDC south. The former DNSDC south is an area of land between the SIMTA site and the Southern Boot Land. It is a large area of mown grassland with waterlogged soils in patches. There are scattered large trees, most with native shrubs and groundcover species growing around the bases. The *Persoonia nutans* was recorded in the shrub layer beneath two trees in the west of this area.

The construction of the Rail link will have direct impacts on the population of *Persoonia nutans* with 11 individuals proposed for removal based on 2014/15 survey results. This comprises approximately 8% of the population in the Southern Boot Land.

Many individuals were observed to be flowering and fruiting at the time of both surveys. Plants ranged in size from small individuals that had just seeded or suckered to very large mature individuals which appeared to have a high reproductive value. The overall health of the population appeared to be good and population size was stable.

Approximately 8.67 hectares of Castlereagh Scribbly Gum Woodland is present in the Southern Boot Land offset site which would provide potential habitat for this species and would be subject to the management measures outlined in this document. There are approximately 114 individual *Persoonia nutans* in the offset site area.

A species polygon was prepared for this species as part of the assessment in the BAR showing the extent of the existing population. The locations of threatened flora species in 2012 and 2014/2015 surveys and the species polygon are shown in Figure 3-3.

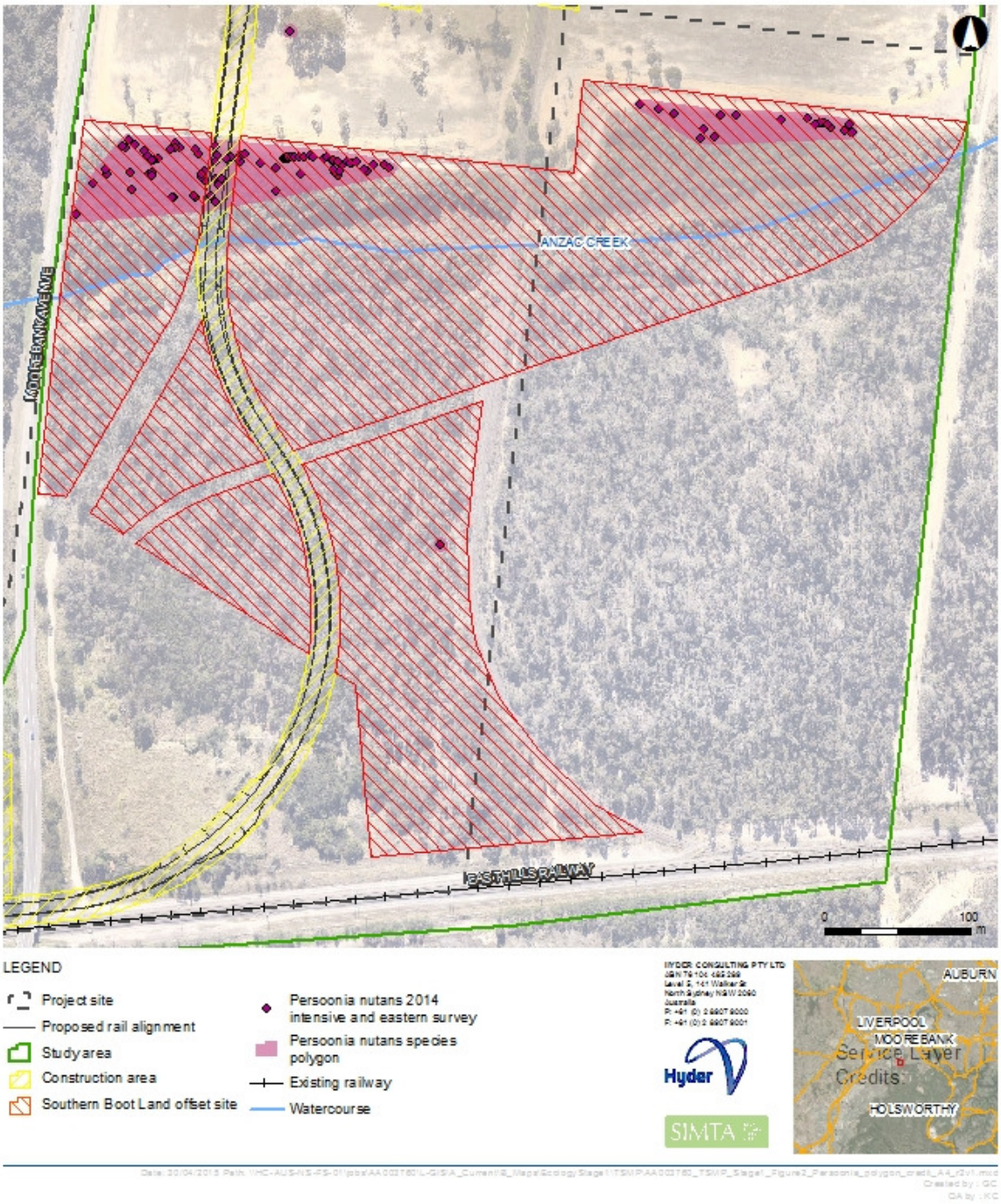

Figure 3-3 ***Persoonia nutans*** **locations and species polygon**

3.2 *GREVILLEA PARVIFLORA* SUBSP. *PARVIFLORA*

Grevillea parviflora subsp. *parviflora* is a spindly shrub varying from prostrate to erect, usually 0.3–1m high but growing up to 1.5 to 2 metres. The species suckers readily from rhizomes, although individuals sometimes have single stems (DoE 2015a). *Grevillea parviflora* subsp. *parviflora* was recorded in the large patch of Castlereagh Scribbly Gum Woodland south of Anzac Creek in the Southern Boot Land. The species was identified during flora and fauna surveys of this land in 2011 by Hyder Consulting's Ecologists. Targeted searches in 2012 were subsequently undertaken by Hyder Consulting to determine population extent. A total of 1644 stems of *G. parviflora* subsp. *parviflora* were recorded from 4 metre wide transects spaced 10 metres apart. The survey method sampled 40 per cent of the survey area therefore the population within the study area was estimated to be approximately 4110 stems. Repeated transect surveys undertaken in 2014 found a total of 3189 stems. Based on these surveys, the entire population was estimated to have grown to approximately 7973 stems.

In addition to transect surveys, intensive surveys were undertaken in 2012 focusing on the population of *G. parviflora* subsp. *parviflora* in the vicinity of the proposed Rail link. These surveys involved counting all stems within approximately 25 metres either side of the centre line of the proposed Rail link. A total of 842 stems were recorded in this area. The number of genetically distinct individuals is likely to be far lower than the number of stems given the suckering habit of this species and the localised high density of plant stems observed.

The construction of the Rail link will have direct impacts on approximately 641 stems (based on the 2012 intensive survey results). This comprises approximately 8% of the population in the Southern Boot Land.

The overall health of the population appeared to be good. The density of suckers was greater in 2014/2015 compared to 2012 which is indicative of the population regenerating. Most plants were small, but within the normal range observed for this species (0.3-1 m). Some individuals were observed to be flowering at the time of surveys.

Approximately 8.67 hectares of Castlereagh Scribbly Gum Woodland is present in the Southern Boot Land offset site would provide habitat for this species and would be subject to the management measures outlined in this plan. There are estimated to be 5668 stems of *Grevillea parviflora* subsp. *parviflora* in the Southern Boot Land offset site.

A species polygon was prepared for this species as part of the assessment in the BAR showing the extent of the existing population. The locations of threatened flora species in 2012 and 2014/2015 surveys and the species polygon are shown in Figure 3-4.

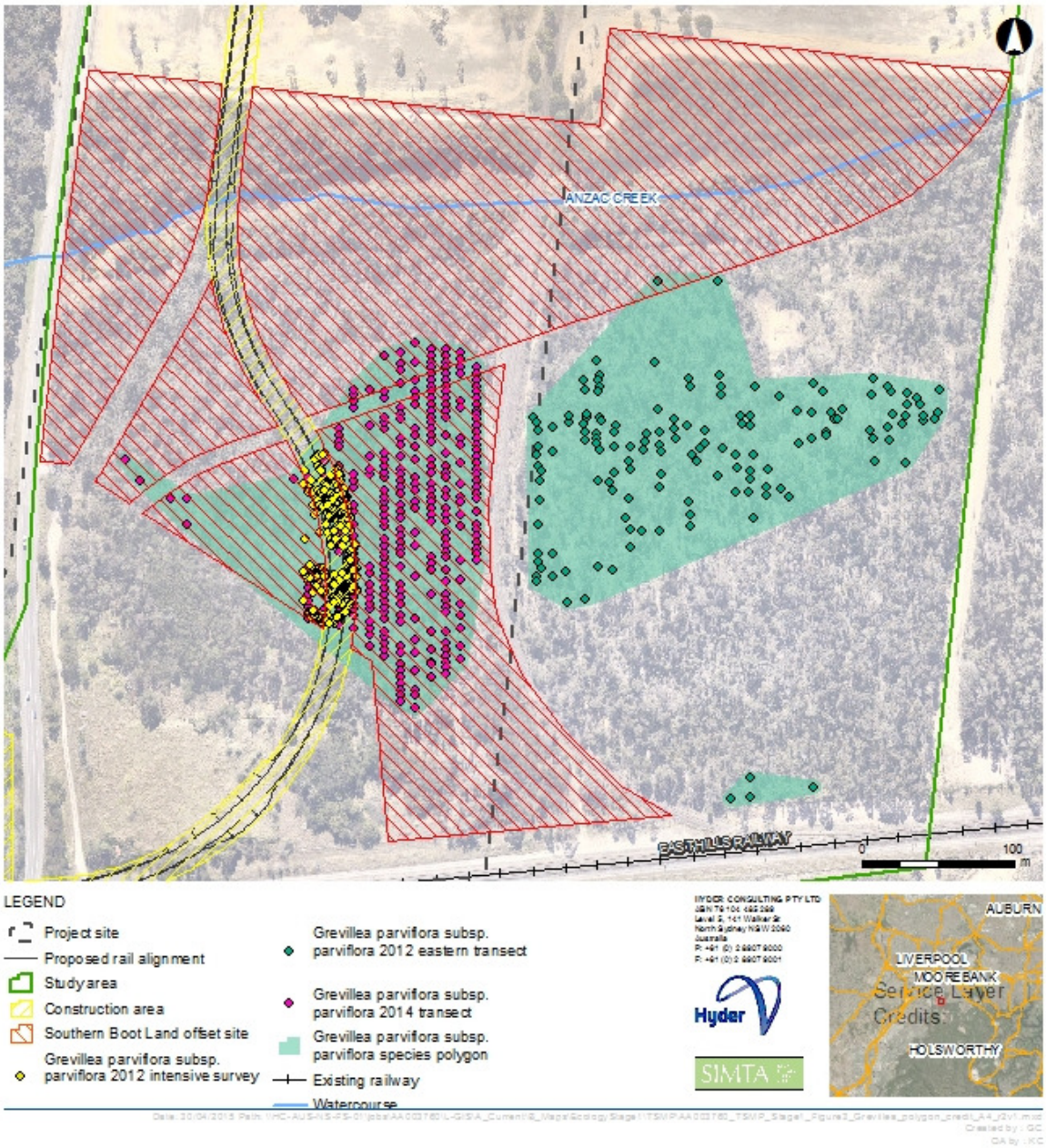

Figure 3-4 ***Grevillea parviflora*** **subsp.** ***parviflora*** **locations and species polygon**

4 MANAGEMENT STRATEGIES AND ACTIONS

The following management strategies are proposed under this plan:

- Investigate potential translocation of impacted threatened plants
- Investigate propagation of threatened plants from the seed bank
- Undertake active weed management and prevent weed spread
- Inform staff and site visitors of threatened species populations and no-go zones
- Protect retained threatened plants from disturbance during construction with fencing
- Manage threatened species habitat to maintain the habitat features that the species prefers
- Manage waste on site and prevent dumping of waste in retained vegetation
- Manage soil and water in the vicinity of threatened species habitats
- Maximise connectivity across cleared areas of threatened flora habitat
- Manage disturbance regimes for *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* through fire or other relevant mechanisms
- Monitor the health of threatened flora species populations against the baseline levels.

Table 4-1 outlines the details of management actions proposed for *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans.* These management actions have been developed for construction and operational areas in proximity to the threatened flora populations including the former DNSDC south and the Rail link in the Southern Boot Land. They also include management within Southern Boot Land offset site.

Management strategies are proposed in to minimise the potential impacts on *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* as a result of the Proposal.

Table 4-1 Management actions for threatened flora species

Performance objective	Action	Responsibility	Timing	Duration
Offset losses of *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans* and improve recruitment within retained populations in the Southern Boot Land offset site	Investigate options for translocation of individuals removed from the Proposal footprint	Bush Regeneration Contractor, Ecologist	Pre-clearing, clearing	N/A
Improve recruitment within retained populations in the Southern Boot Land offset site	Collection of seed or other genetic material from individuals to be removed, and propagation of tube stock to be replanted in retained areas of habitat, where possible	Construction contractor, Bush Regeneration Contractor	Clearing	N/A
	Retain topsoil and seed bank from the occupied habitat area of threatened species impacted by the Rail link and reapply to areas for rehabilitation and/or restoration works once construction is complete. Stockpiling of topsoil excavated from the Southern Boot Land would be managed to maintain the viability of the seedbank.	Construction contractor, Bush Regeneration Contractor	Clearing, rehabilitation	N/A
Protect threatened species populations in areas adjacent to clearing footprint within Southern Boot Land offset site	Fencing of areas of habitat to be retained should be undertaken and individuals of the threatened plant species should be clearly marked in consultation with an ecologist These areas would be clearly defined as no-go zones	Construction contractor, Site Operator, Ecologist	Pre-clearing, clearing	N/A

Performance objective	Action	Responsibility	Timing	Duration
	Site inductions for staff are to include a briefing on the presence of threatened species and their habitat in and adjacent to the Proposal footprint, its significance and locations and extents of no-go zones.	Site Operator, Construction Contractor	Construction, operation	Ongoing
Maintain *Grevillea parviflora* subsp. *parviflora* habitat quality and viability within Southern Boot Land offset site	Undertake regular checks of erosion and sediment controls and water quality management measures across the Southern Boot Land and adjacent areas/upslope areas	Construction contractor, Site operator	Construction, operation	Weekly during construction or during rain events In line with OEMP requirements (ongoing)
Maintain a level of habitat connectivity for threatened species population fragments within Southern Boot Land offset site	Consideration would be given to maintaining the Rail link without fencing during the operation period to minimise impacts to habitat connectivity in the Southern Boot Land	Site Operator	Pre-construction, detailed design	N/A
Improve recruitment of *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* in edge-affected habitats within Southern Boot Land offset site	Selectively remove large shrubs to encourage expansion of *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* population on edge habitats (edges of woodland)	Construction contractor, Bush Regeneration Contractor	Construction, operation	Six monthly or as needed (ongoing)
Improve or maintain *Grevillea parviflora* subsp. *parviflora* population viability within Southern Boot Land offset site	Selectively remove large shrubs to encourage expansion of *Grevillea parviflora* subsp. *parviflora* in areas of suitable habitat	Construction contractor, Bush Regeneration Contractor	Construction, operation	Six monthly or as needed (ongoing)

Performance objective	Action	Responsibility	Timing	Duration
Maintain threatened species habitat quality and viability within Southern Boot Land offset site	Monitor weeds in the Southern Boot Land and undertake weed removal by hand in areas of threatened species habitat	Construction contractor, Bush Regeneration Contractor	Pre-construction, construction, operation	Undertake initial inspection of weed extent and densities pre-construction Monitor quarterly during construction and remove weeds quarterly, or as needed Monitor six monthly during operation and remove as needed
	Fencing around the perimeter of the Southern Boot Land would be checked and maintained regularly	Construction contractor Site operator	Construction, Operation	Six monthly inspections (ongoing) repairs as needed
Maintain *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* habitat quality and viability within Southern Boot Land offset site	Use of fire or other disturbance mechanisms in *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* habitat would be undertaken in consultation with OEH and the DoE and RFS	Site operator, Bush Regeneration Contractor, Ecologist	Operation	Ongoing/as needed
	Monitor *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* response to disturbance measures	Construction contractor, Ecologist	Construction, Operation	Within 1 month of disturbance activity, then 3 months (during construction) Monitoring frequency subsequently reviewed dependent on species response (during operation)

Performance objective	Action	Responsibility	Timing	Duration
	Develop a land management protocol within the OEMP, such that an interval of at least 7 to 10 years between fires is maintained within the area of occupied habitat for *P. nutans* and *Grevillea parviflora* subsp. *parviflora*	Site operator, ecologist	Operation	Update as needed
Improve or maintain recruitment within retained populations in the Southern Boot Land offset site	Undertake population census and monitor population extents for both species in the Southern Boot Land offset site	Construction contractor, Site operator, Ecologist	Construction, operation	Annually Frequency of monitoring to be reviewed in 5 years of operations depending on health of populations
Maintain threatened species population health in the Southern Boot Land offset site	Inspect the health of threatened species populations by checking plant sizes, flowering and extents against benchmarks described in Section 3	Construction contractor, Site operator, Ecologist	Construction, operation	Quarterly during construction and 2 years post-construction, thereafter annually Frequency of monitoring to be reviewed in 5 years depending on health of populations

5 ADAPTIVE MANAGEMENT AND CONTINUAL IMPROVEMENT

5.1 MONITORING, REVIEW AND REPORTING

The content of this plan would be reviewed and updated, as necessary prior to construction and operation of the Proposal. This plan will then be reviewed and updated annually or as needed thereafter. This plan will be incorporated into the Offset Site Management Plan or OEMP and would remain in place in perpetuity.

Monitoring and review of the implementation of the TFSMP against established performance criteria will be undertaken by a qualified ecologist at intervals of six months from the commencement of construction for three years, and subsequently at 12 month intervals. The primary intent of the monitoring program is to demonstrate compliance with the TFSMP via compliance with performance criteria below.

Issues may arise in the implementation of the plan which would require actions to be modified or additional actions to be implemented. The monitoring program will be designed to detect issues at an early stage such that appropriate adaptations can be made to ensure that objectives are met.

5.2 PERFORMANCE CRITERIA

Performance criteria applicable to this TFSMP include:

- Health of retained *Persoonia nutans* and population extent would be maintained or improved
- Health of retained *Grevillea parviflora* subsp. *parviflora* and population extent would be maintained or improved
- Extent and density of weeds in the Southern Boot Land offset site would remain at existing levels or reduced from pre-construction extents and densities

In the event performance criteria are not met, management actions would be reviewed, amended and implemented.

5.3 REPORTING

Reporting would be required annually to assess the success of management actions in accordance with the performance criteria outlined above.

6 REFERENCES

DEC (2006) *Persoonia nutans R Br (Nodding Geebung) Recovery Plan.* NSW Department of Environment and Conservation, Hurstville NSW.

DotE (2015a) *Grevillea parviflora* subsp. *parviflora* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

DotE (2015b) *Persoonia nutans* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat Accessed 31 March 2015.

Natural Resource Management Ministerial Council (NRMMC) (2010) *Australia's Biodiversity Conservation Strategy 2010-2030.* Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

APPENDIX B

BIODIVERSITY OFFSET STRATEGY

SIMTA Intermodal Terminal Facility- Stage 1

Biodiversity Offset Strategy

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

May 2015

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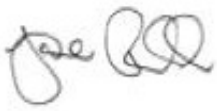
SIMTA INTERMODAL TERMINAL FACILITY- STAGE 1

Biodiversity Offsets Strategy

Author	Jane Rodd	
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Report No AA003760

Date 4 May 2015

This report has been prepared for Sydney Intermodal Terminal Alliance in accordance with the terms and conditions of appointment for Intermodal Terminal Facility - Stage 1 dated August 2012. Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

CONTENTS

APPENDIX

1 INTRODUCTION

This report has been prepared as an Appendix to the Biodiversity Assessment Report (BAR) for Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility (the Proposal). The Proposal includes the construction and operation of an intermodal terminal facility and Rail link at Moorebank, NSW.

The NSW Department of Planning and Environment (DP&E) issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal which state that the impacts of the Proposal must be assessed in accordance with OEH's *Framework for Biodiversity Assessment* (FBA) under the *NSW Biodiversity Offsets Policy for Major Projects* published in October 2014. As such, this report has been prepared in accordance with the FBA requirements, and Section 5 of this report follows the recommended report structure for Biodiversity Offset Strategy in Appendix 7 of the FBA.

This report also meets Commonwealth Department of the Environment conditions of approval (EPBC 2011/6229) for referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Conditions of Approval and Statement of Commitments for the Concept Plan Approval (No. 10_0193) of the SIMTA Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Background

The SIMTA Project involves the development of an intermodal facility, including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank (the SIMTA site). The SIMTA Project also includes a Rail link, within an identified Rail Corridor (the Rail Corridor), which connects from the southern part of the SIMTA site to the Southern Sydney Freight Line (SSFL). This entire area including the SIMTA site and Rail Corridor are collectively referred to as the Project site. The SIMTA Project is to be developed in three key stages:

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A summary of the approvals undertaken to date for the SIMTA Project, include:

- **EPBC Approval** (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act).
- **Concept Approval** (No. 10_0193) granted by the Planning Assessment Commission (PAC) on the 29 September 2014 for the 'Concept Approval' of the SIMTA Project under Part 3A of the EP&A Act.

Both of these approvals involved the preparation of design and environmental assessment documentation.

The Proposal (which includes the first stage of the SIMTA Project, i.e. the Stage 1) will have direct impacts on threatened ecological communities listed under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act) as well as threatened species listed under the EPBC Act and TSC Act.

These impacts are anticipated to occur within the Rail Corridor, with the construction and operation of the Rail link requiring removal of individuals and habitat of these plant species. The impacts of the SIMTA Project on the endangered species *Persoonia nutans* are considered to be significant. The impacts on these threatened species is as a result of the construction and operation of the Rail link (included in the Proposal).

The SIMTA site itself is considered to be of limited conservation significance and ecological impacts within the SIMTA site are likely to be low.

1.2 Purpose of this report

The purpose of this Biodiversity Offset Strategy (this report) is to establish a commitment to offsetting the impacts of the Proposal on threatened species, populations and communities. The Strategy has been prepared to address the Commonwealth conditions of approval, Concept Plan conditions of approval and statement of commitments, and SEARs for the SIMTA Project. This report has been prepared to mitigate (as far as possible) the impacts of the Proposal.

The NSW Department of Planning and Environment (DP&E) issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal which state that the impacts of the Proposal must be assessed in accordance with OEH's Framework for Biodiversity Assessment (FBA) under the NSW Biodiversity Offsets Policy for Major Projects published in October 2014. As such, this report has been prepared in accordance with the FBA requirements and follows the recommended report structure in Appendix 7 of the FBA.

Condition 12 f) of the SEARs states that the assessment shall:

f) Include a comprehensive offset strategy, in accordance with the NSW Biodiversity Offsets Policy for Major Projects including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise or offset' principle.

In addition, Condition 6 of the Commonwealth Department of the Environment conditions of approval (EPBC 2011/6229) for a Referral under the EPBC Act describes the approval requirements for biodiversity offsets:

6. For the better protection of Nodding Geebung, Small-flower Grevillea (and potentially, Hibbertia sp. Bankstown and Bynoe's Wattle) the person taking the action must engage a suitably qualified expert to prepare a Threatened Flora Offset Management Plan (TFOMP) (or plans) for the approval of the Minister. The TFOMP must include (but need not be limited to):

a) details of a direct offset that satisfies the requirements of the Department's offset policy, in accordance with the offset user guide (including timeframes for the delivery or acquisition of the direct offset);

b) map(s) and shapefiles that identify the location and boundaries of the direct offset;

c) details of the management actions and performance objectives which will maintain and enhance the Nodding Geebung and Small-flower Grevillea habitat and/or population covered by the TFOMP (including the duration, intensity, and timing of management actions);

d) an assessment of the baseline population and distribution for Nodding Geebung and Small-flower Grevillea within the direct offset, including:

i. the number of plants protected and their location; and

ii. plant and habitat condition.

e) *measures for regular monitoring of the status of individuals of Nodding Geebung and Small-flower Grevillea and their habitat as measured against the baseline population and distribution, including:*

   i. *fluctuations in population size and distribution; and*

   ii. *response to disturbances and/or management actions.*

f) *provisions to revise the approved TFOMP in response to monitoring associated with condition 6(e);*

g) *provisions to revise the approved TFOMP in response to monitoring associated with condition 6(e);*

A separate Threatened Flora Offset Management Plan (Appendix A of the BAR) has been prepared to address the majority of points under condition 6. This Strategy has addressed conditions 6a and 6b.

1.3 Objectives of the Biodiversity Offset Strategy

The overarching objective for the Proposal's Biodiversity Offset Strategy is to provide guidance for the delivery of a Biodiversity Offset Package that achieves a long-term conservation gain for the threatened species and communities impacted by the Proposal. The measures used to gauge success of this objective will be:

- An outcome that maintains or improves biodiversity values.
- Successfully securing the long-term (in perpetuity) protection and management of lands containing the impacted threatened species and communities, or their habitat.
- Ensuring that the total area of lands used to offset the biodiversity impacts shall exceed the scale of impacts of the Proposal.
- Establishing that the process for setting the scope and quantum of the biodiversity offsets is transparent and justifiable on environmental, social and economic grounds.

2 IMPACTS OF THE PROPOSAL

2.1 Biodiversity impacts

Plant Community Types

Clearing of native vegetation is required for the Proposal. The majority of vegetation to be cleared consists of planted trees within the Stage 1 site. Ecological impacts within the Stage 1 site are considered to be low.

A total of 1.25 hectares of native vegetation is to be cleared for the Rail link, consisting of four Plant Community Types (PCTs) in five vegetation zones. The areas of each PCT to be impacted by the Proposal and the associated ecosystem credit requirements are listed in Table 1.

Table 1: Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

Vegetation zone	Associated EECs	Area cleared	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good – Medium	Castlereagh Scribbly Gum and Agnes Banks Woodland of the Sydney Basin Bioregion EEC (EPBC Act)	0.73	24	61.98	91
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor		0.03	24	35.94	6
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland EEC (TSC Act)	0.04	24	62.33	8
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions EEC (TSC Act)	0.41	24	56.25	60

Vegetation zone	Associated EECs	Area cleared	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions EEC (TSC Act)	0.03	24	58.33	3

The Proposal will require clearing of native vegetation for development of the Rail link, in the 20 metre wide footprint within ecologically sensitive areas. The linear clearing for the Rail link and installation of potential fencing will result in fragmentation of the remaining vegetation and increase the risk of edge effects within this vegetation.

Loss of threatened species and fragmentation of habitat

The construction of the Rail link will also have direct impacts on populations of two threatened plant species. The Rail link intersects the centre of the sub-population of the endangered species *Persoonia nutans* (Nodding Geebung) the western edge of the higher density areas of the population of the vulnerable species *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea).

The Proposal will also have impacts on fauna habitat, including threatened fauna species habitat. One species is predicted to occur in the study area, Eastern Pygmy Possum (*Cercarcetus nanus*) (Vulnerable under the TSC Act), was assumed to be present. Four additional threatened bat species recorded in the study area are considered as candidate species credit species in the BAR.

Impacts to threatened species credit species and their associated species credits are summarised in Table 2.

Table 2: Impact summary for threatened species credit species requiring offsets and their required credits

Common name	Scientific name	Status	Impacts		Number of species credits required
			Area (ha)	No. of individuals/ stems	
Nodding Geebung	*Persoonia nutans*	Endangered	N/A	11 individuals	847
Small-flowered Grevillea	*Grevillea parviflora* subsp. *parviflora*	Vulnerable	N/A	641 stems	9615
Eastern Pygmy Possum	*Cercartetus nanus*	Vulnerable	0.75	N/A	15

Common name	Scientific name	Status	Impacts		Number of species credits required
			Area (ha)	No. of individuals/ stems	
Southern Myotis	*Myotis macropus*	Vulnerable	1.25	N/A	28
Eastern Freetail-bat	*Mormopterus norfolkensis*	Vulnerable	1.25	N/A	28
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	11.57	N/A	150
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	4.8	N/A	53

3 AVOIDANCE AND MITIGATION OF BIODIVERSITY IMPACTS

Measures to manage the impact of the Proposal on biodiversity values have been developed. These are outlined in Section 6 of the BAR. Management measures for biodiversity impacts were developed following three general principles, in order of preference:

- Avoid areas of high biodiversity value wherever possible.
- Mitigate actions and safeguard values identified for retention by prescribing appropriate controls.
- Compensate for or offset the removal of biodiversity values.

A summary of the key measures relevant to avoidance and mitigation of biodiversity impacts is provided in Section 6.6 of the BAR.

4 POLICY FRAMEWORK

4.1 EPBC Act Environmental Offsets Policy

Offsets for impacts on Matter of National Environmental Significance (MNES) are to be determined having reference to the *EPBC Act Environmental Offsets Policy* (EPBC Offsets Policy). Under the EPBC Offsets Policy, environmental offsets are measures that compensate for the residual adverse impacts of an action. Offsets should counterbalance the impacts that remain after avoidance and mitigation measures have been implemented. For assessments under the EPBC Act, offsets are only required if residual impacts are significant.

An offsets package is defined in the EPBC Offsets Policy as a suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project. An offsets package can comprise of a combination of direct offset and other compensatory measures. The EPBC Offsets Policy includes the following:

Direct offsets are actions that deliver a measurable conservation gain for an impacted protected matter. Conservation gains may be achieved by:

- Improving existing habitat for the protected matter;
- Creating new habitat for the protected matter;
- Reducing threats to the protected matter; and/or
- Averting the loss of a protected matter or its habitat that are under threat.

Other compensatory measures are actions that do not directly offset the impacts on the protected matter, but are anticipated to lead to benefits for the impacted protected matter. Other compensatory measures may include funding for suitable research or education programs.

Under the EPBC Offsets Policy, a minimum of 90 per cent of the offset requirements for any given impact must be met through direct offsets.

The EPBC Offsets Policy is guided by ten overarching principles to be applied when determining the suitability of offsets. Suitable offsets must:

1. Deliver an overall conservation outcome that improves or maintains the viability of the protected matter.
2. Be built around direct offsets but may include other compensatory measures.
3. Be in proportion to the level of statutory protection that applies to the protected matter.
4. Be of a size and scale proportionate to the residual impacts on the protected matter.
5. Effectively account for and manage the risks of the offset not succeeding.
6. Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable.
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

In assessing the suitability of an offset, government decision-making will be:

9. Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty.

10. Conducted in a consistent and transparent manner.

These offset principles have been applied in the preparation of this Preliminary Biodiversity Offset Strategy. The EPBC Offsets Policy is accompanied by an Offsets Assessment Guide, including an offset calculator in the form of a balance sheet. This guide was designed for use by the Department of the Environment (DoE) but can be used by applicants to consider offset requirements.

EPBC EIS Approval (No. 2011/6229) was granted under the EPBC Act by DoE on March 2014 for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank. Condition 6 of the approval (as detailed in Section 1.2 of this report) addresses offset requirements for the threatened plant species listed under the EPBC Act that will be subject to impacts from the Proposal, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.*

The only MNES that is considered to be subject to residual significant impacts as a result of the Proposal is *Persoonia nutans;* however, it is proposed to additionally offset impacts on *Grevillea parviflora* subsp. *parviflora.*

4.2 NSW Biodiversity Offsets Policy for Major Projects - Framework for Biodiversity Assessment 2014

The *NSW Biodiversity Offsets Policy for Major Projects* was released in October 2014 and is applicable to projects that are determined via a SSD or State Significant Infrastructure (SSI) under the EP&A Act. The NSW Biodiversity Offsets Policy for Major Projects requires proponents to apply the *Framework for Biodiversity Assessment* (FBA) to assess impacts on biodiversity. The policy provides a standard method for assessing the impacts of major projects on biodiversity and determining offset requirements.

As noted above, the SEARs prescribe the development of an offset strategy in accordance with the FBA, consistent with the 'avoid, minimise, or offset' principle.

Under the *NSW Biodiversity Offsets Policy for Major Projects*, offset requirements can be fulfilled using one or more of the following methods:

- Offsetting through a site secured under a biobanking agreement
- Mine site rehabilitation
- If a suitable offset is unavailable (subject to certain conditions), contributing money to supplementary methods
- Contributing to the NSW Biodiversity Offsets Fund for Major Projects (when established).

The *NSW Biodiversity Offsets Policy for Major Projects* is initially being implemented for a transitional period of 18 months, during which application of the policy will be compulsory but a flexible approach will be permitted. The policy requires that a biobanking agreement is used to secure an offset site, however this requirement will only commence once certain arrangements for the establishment of biobanking agreements are in place. During transitional implementation of the policy, biobanking agreements must be used to secure an offset site if any of the following conditions are met:

- there are appropriate credits available on the market for purchase (noting that 'reasonable steps' to locate offsets includes a requirement that an expression of interest be put on the biobanking credit register for a minimum of six months);
- the NSW Biodiversity Offsets Fund has been established; or

- a service agreement for the establishment of biobanking agreements has been put in place by OEH.

If none of the above conditions are met, a proponent may use an alternative mechanism to secure an offset during the transitional period. The alternative mechanism should meet the following five criteria for an offset site to ensure that actual gains to biodiversity will be achieved:

a. The principal objective of ongoing site management is biodiversity conservation.

b. Management actions are undertaken in accordance with a plan of management.

c. There is reasonable likelihood that sufficient resources will be available to implement the plan of management over time.

d. There are appropriate accountability mechanisms in place to secure the outcomes, and these mechanisms cannot be altered without alternative and comparable offsetting arrangements being put in place.

e. The arrangements are in perpetuity and conservation obligations are transparently transferred and disclosed to any new owners of the land through appropriate administrative procedures.

As of the date of this strategy, the NSW Biodiversity Offsets Fund has not yet been established, and a service agreement for the establishment of biobanking agreements is not yet in place.

4.3 *Persoonia nutans* Recovery Plan

A recovery plan has been prepared for *Persoonia nutans* (DEC 2006). The overall objective of the recovery plan is "to ensure the continued and long-term survival of *P. nutans* in the wild by promoting the in situ conservation of the species across its natural range".

This plan consists of six specific recovery objectives, each of which has a set of associated recovery actions and performance criteria (Table 3).

Table 3: Recovery objectives and associated actions for *Persoonia nutans* (DEC 2006)

Recovery Objective	Actions	Relevant to this offset strategy?
1. To minimise the loss and fragmentation *of P. nutans* habitat using land-use planning mechanisms.	1.1: Councils and the Department of Planning will ensure that all relevant Environmental Planning Instruments (prepared under Part 3 of the EP&A Act) are prepared, or reviewed, with reference to this recovery plan and any future advice from the Department of Environment and Conservation regarding the species.	No
	1.2: All relevant consent and determining authorities (under Part 4 & 5 of the EP&A Act) will assess developments and activities with reference to this recovery plan, environmental impact assessment guidelines and any future advice from the Department of Environment and Conservation regarding the species.	Yes
	1.3: The Department of Environment and Conservation will reconsider the need for a recommendation of critical habitat by the final year of implementation of this plan.	No

Recovery Objective	Actions	Relevant to this offset strategy?
2. To identify and minimise the operation of threats at sites *where P. nutans* occurs.	2.1: The Department of Environment and Conservation (DEC) will prepare site management statements for populations located on DEC estate.	No
	2.2: The Department of Environment and Conservation will implement any necessary threat abatement measures in accordance with the site management statements prepared under Action 2.1.	No
	2.3: The Department of Environment and Conservation to ensure any Plan of Management or Fire Management Plan for DEC estate supporting *P. nutans* provides for the species' conservation.	No
	2.4: Councils will incorporate site specific threat abatement measures for *P. nutans* into Plans of Management for community land.	No
	2.5: Councils will implement threat abatement measures in accordance with the site specific recommendations incorporated into the Plan of Management prepared under Action 2.4.	No
	2.6: Other public authorities that manage land that supports *P. nutans* will prepare a site management statement(s) in consultation with the Department of Environment and Conservation, for *P. nutans* habitat under their management.	No
	2.7: Other public authorities (as identified in action 2.6) will implement any necessary and feasible threat abatement measures within the habitat of *P. nutans* to mitigate against habitat degradation related to unrestricted access, and frequent fire, in accordance with the site management statements prepared under Action 2.6.	No
	2.8: The Department of Environment and Conservation will liaise with the Commonwealth Defence Department to facilitate the implementation of threat abatement measures at sites within Holsworthy Military Area.	Yes – site adjoins the Holsworthy Military Area, although is fragmented from most of it by the East Hills Rail Line
	2.9: The Department of Environment and Conservation will encourage and assist private landholders in the preparation of site management statements for sites located on freehold land.	No
	2.10: The Department of Environment and Conservation will encourage landholders in the implementation of threat abatement measures on freehold land in accordance with the site management statements prepared under Action 2.8.	No

Recovery Objective	Actions	Relevant to this offset strategy?
	2.11: The Department of Environment and Conservation will liaise with the Rural Fire Service and relevant Bush Fire Management Committees to ensure that the fire requirements of *P. nutans* are taken into consideration when relevant Bush Fire Risk Management Plans are drafted and reviewed.	No
	2.12: Department of Environment and Conservation) and the NSW Rural Fire Service will review the mitigative conditions for *P. nutans* on the Threatened Species Hazard Reduction List of the Bush Fire Environmental Assessment Code.	No
3. Develop and implement a survey and monitoring program that will provide information on the extent and viability of P. nutans.	3.1: The Department of Environment and Conservation will design and facilitate a long-term monitoring program that will enable long-term monitoring of the viability of selected populations and in particular will provide insight into the lower and upper thresholds of inter-fire intervals for *P. nutans*.	Yes
	3.2: The Department of Environment and Conservation to facilitate surveys of potential habitat on public lands and to promote community involvement in the surveys.	No
4. To provide public authorities with information that assists in conserving the species.	4.1: The Department of Environment and Conservation will coordinate the prompt distribution of site records through the Atlas of NSW Wildlife.	No
	4.2: The Department of Environment and Conservation will update the profile and environmental impact assessment guidelines for the species to incorporate information acquired during the implementation of this recovery plan.	No
	4.3: Councils and the Department of Planning and Infrastructure (DP&I) will inform the Department of Environment and Conservation (DEC) of decisions (made under the EP&A Act 1979) that may affect *P. nutans.*	No
5. To raise awareness of the species and involve the community in the recovery program.	5.1: The Department of Environment and Conservation will distribute information on the progress of the recovery program to raise awareness of the recovery program and encourage community involvement in its implementation.	No
	5.2: The Department of Environment and Conservation will raise awareness of, and encourage community involvement in, the recovery program.	Yes - indirectly
6. To promote research questions that will assist future management decisions.	6.1: The Department of Environment and Conservation to promote potential research projects as identified in this recovery plan.	Yes - indirectly

Most of the recovery objectives and actions concern the NSW Department of Environment and Conservation (now OEH) and other government agencies' commitments and are not directly

relevant to actions by applicants. The proposed offset measures in this Strategy are to be consistent with the objectives of the National and NSW State Recovery Plan.

5 BIODIVERSITY OFFSET STRATEGY

5.1 Proposed offset measures

This Biodiversity Offset Strategy proposes three potential measures for consideration, in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* and the EPBC Offsets Policy. These are listed in Table 4.

Table 4 .Proposed Offset Measures

Offset Measures	Actions
Offset Measure 1	Secure additional native vegetation on lands adjacent to the impact area, to be protected through establishment of an offset site under a Biobanking Agreement. This offset measure may alternatively be partially or fully delivered through the retirement of an appropriate number and class of biodiversity credits under the NSW Biobanking scheme.
Offset Measure 2	Establishment of an offset site under another suitable mechanism that ensures the land is managed for conservation in perpetuity, in accordance with section 3 of Appendix A of the *NSW Biodiversity Offsets Policy for Major Projects.*
Offset Measure 3	Use of supplementary measures in lieu of offsets (note under the EPBC offsets policy, this is limited to 10% of the total offset requirement

Offset Measure 1 is SIMTA's first priority to achieve the objectives of the Biodiversity Offset Strategy. Offset Measures 2 and 3 would only be considered after further consultation with the Department of the Environment, OEH and DP&E.

5.2 Offset site identification

The proposed biodiversity offset comprises two sites:

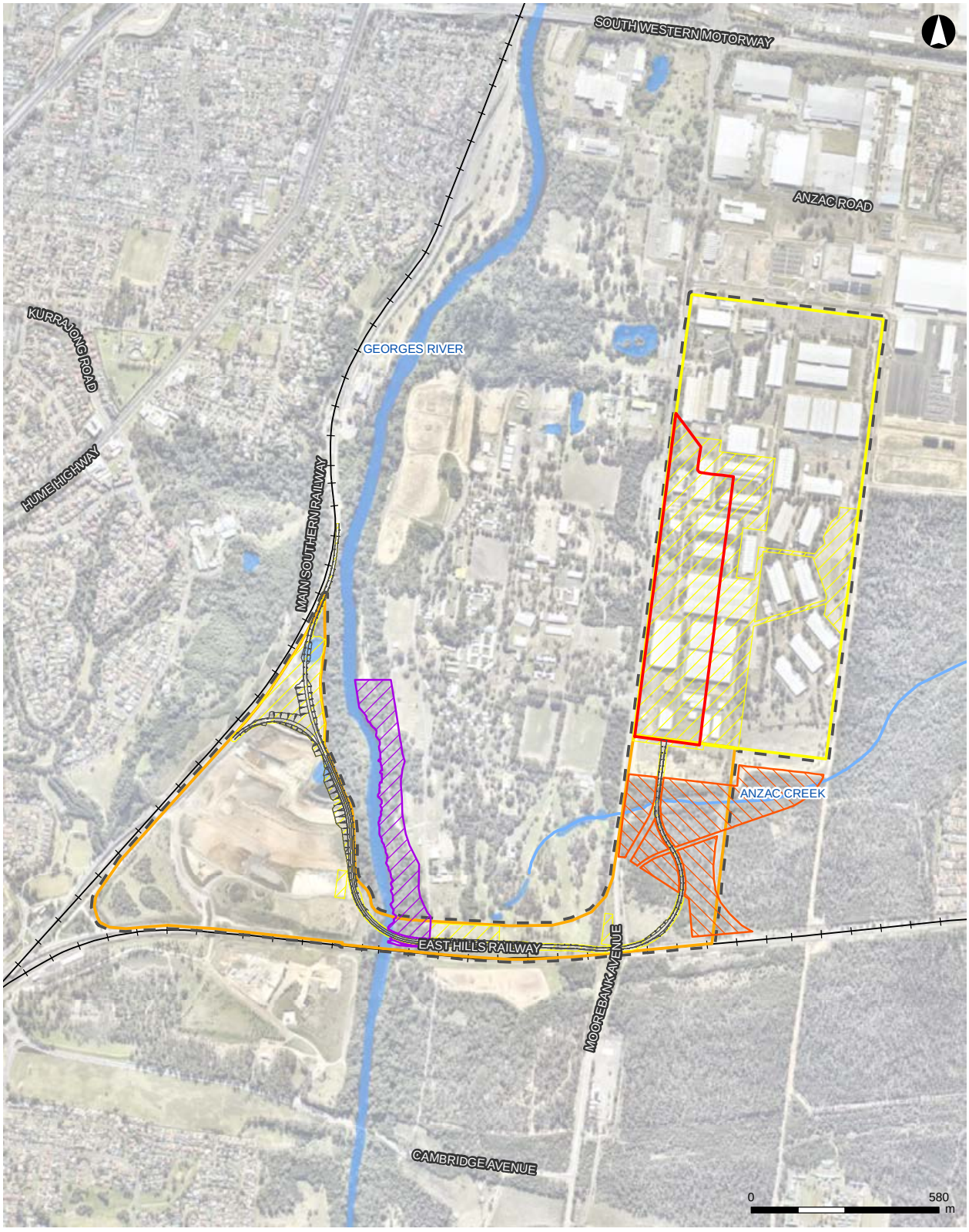
- A portion of the Southern Boot Land (Southern Boot Land offset site)
- A portion of the riparian corridor on the eastern side of the Georges River (Georges River offset site).

Both offset sites are currently part of the portion of land known as Lot 1 DP1125930, and are located immediately adjacent to the areas to be impacted by the Proposal (Figure 1).

Further discussion on each of the offset site is included below.

5.2.1 Southern Boot Land offset site

The Southern Boot Land offset site (Figure 2) is located immediately to the south of the Stage 1 site and east of Moorebank Avenue. The Southern Boot Land offset site comprises a total of 13.43 hectares divided into five separate portions ranging in area from 0.67 hectares to 7.09 hectares. The proposed offset area is located immediately adjacent to the proposed impact area, with the Rail link intersecting the Southern Boot Land offset site.



LEGEND

- Georges River offset site
- Southern Boot Land offset site
- Project site
- Rail corridor
- SIMTA site
- Operational area
- Proposed rail alignment
- Construction area
- Existing railway
- Watercourse

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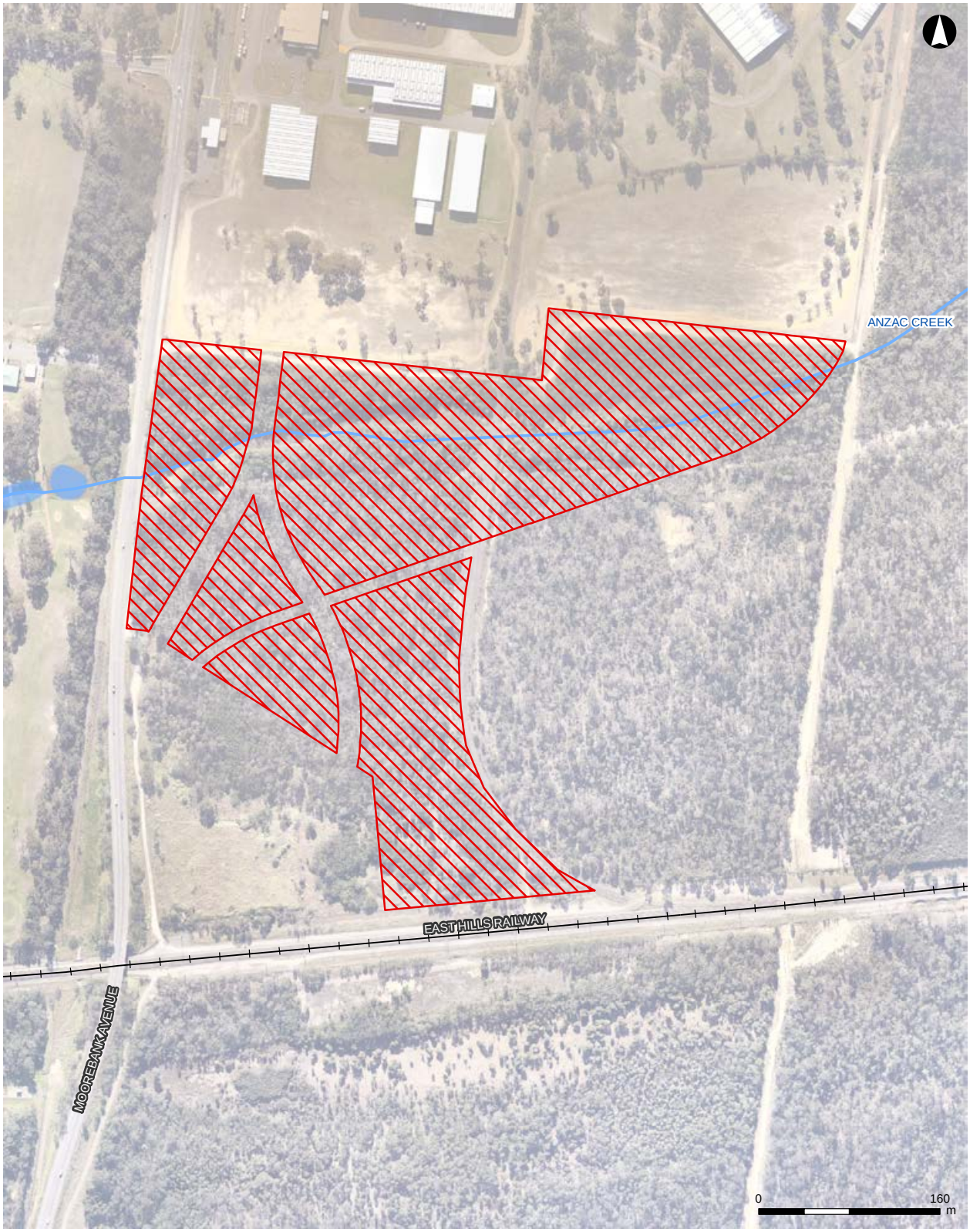
Figure 1: Location of offset sites relative to Proposal site



LEGEND

- Southern Boot Land offset site
- Existing railway
- Watercourse

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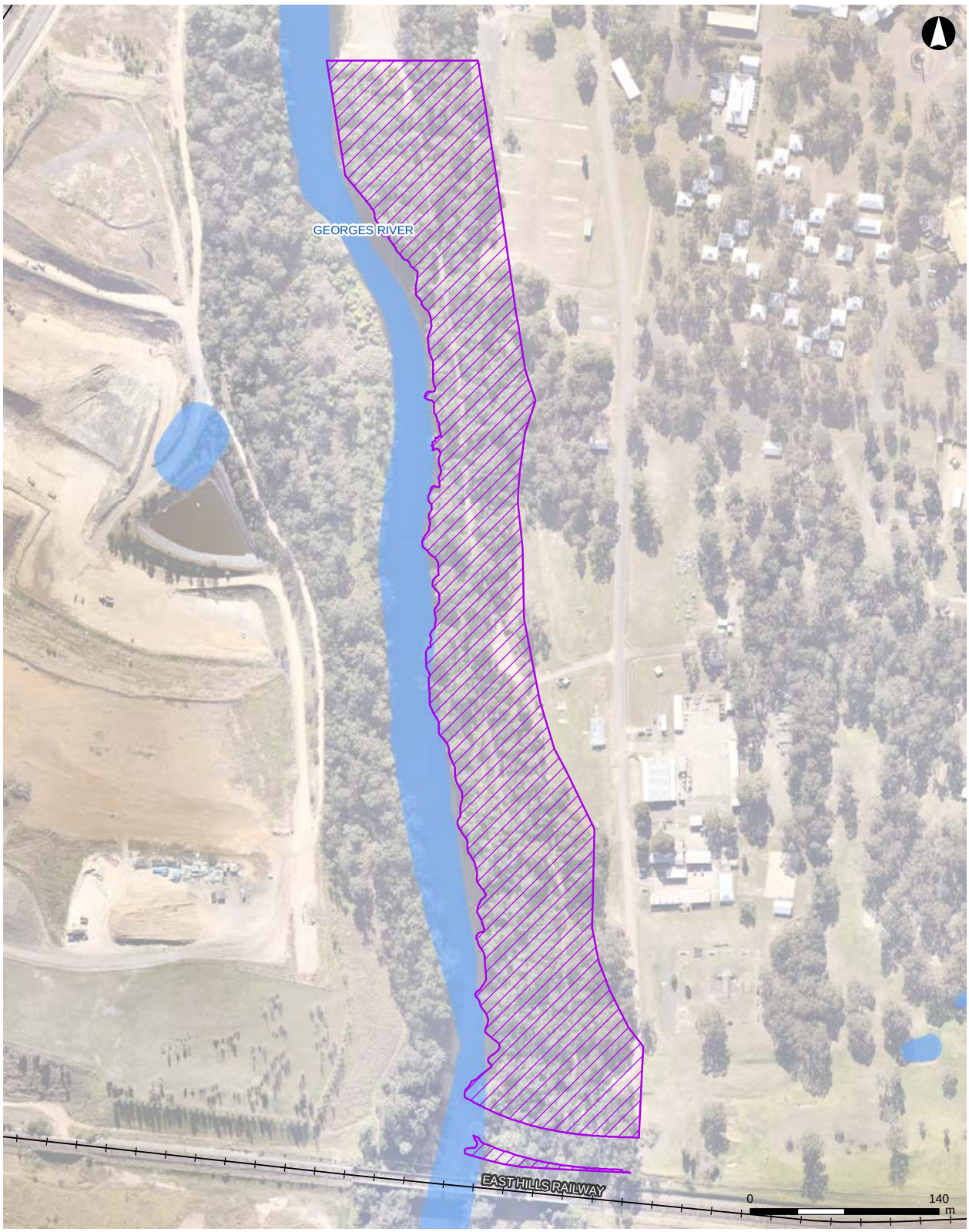
Figure 2: Southern Boot Land offset site



LEGEND

- Georges River offset site
- Existing railway
- Watercourse

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Figure 3: Georges River offset site

The Southern Boot Land offset site is largely covered with native vegetation, with some cleared and disturbed areas located to the south. Anzac Creek extends east across the northern part of the offset site. A largely disused rail spur intersects the centre of the offset site. Within this area there are cleared tracks and historical dumping to the south of Anzac Creek. A cleared powerline easement traverses the northern boundary of the proposed offset site.

Three plant community types were identified in the Southern Boot Land offset site in four vegetation zones (Table 5, Figure 4).

Table 5 .Plant Community Types identified in the Southern Boot Land offset site

Vegetation Zone	Condition	Area mapped in offset site
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin:	Moderate/Good - Medium	7.73 ha
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin:	Moderate/Good - Poor	0.94 ha
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin:	Moderate/Good - Medium	2.17 ha
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner:	Moderate/Good - Poor	0.64 ha

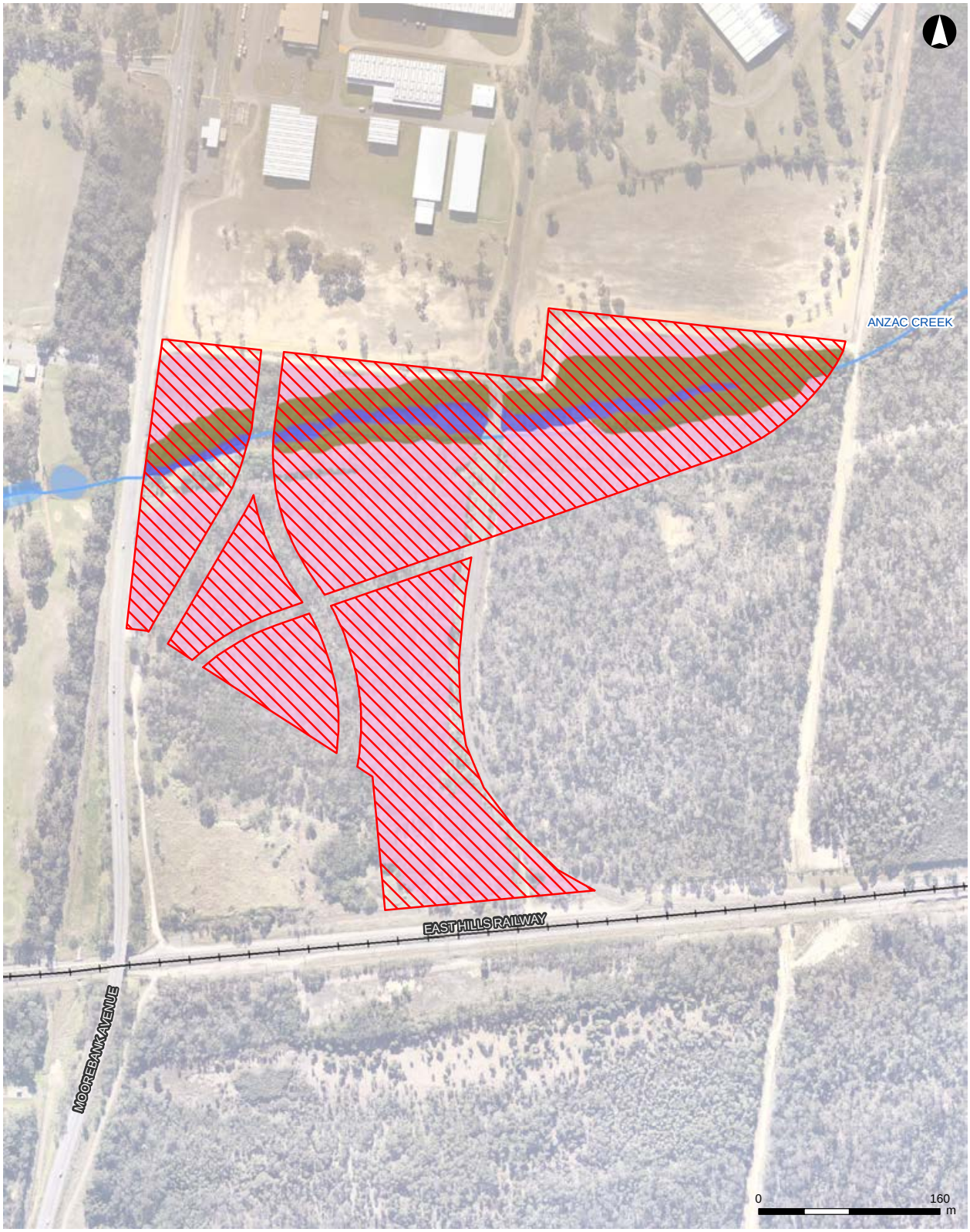
5.2.2 Georges River offset site

The Georges River offset site (Figure 3) comprises an approximately 6.8 hectare area of riparian lands adjoining the eastern bank of the Georges River, bordering the western boundary of the proposed MIC site. The proposed Rail link crosses the southern edge of the Georges River offset site.

The Georges River offset site is characterised by riparian vegetation with a high cover of weeds. The eastern part of the site is cleared. A dirt vehicle track runs parallel to the Georges River through the proposed offset site. One plant community type was identified on the Georges River offset site (Table 6, Figure 5).

Table 6 Plant Community Types identified in the Georges River offset site

Vegetation Zone	Area mapped in offset site (ha)
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	5.8 ha



LEGEND

Southern Boot Land offset site

Plant Community Type

Coastal Freshwater lagoons of the Sydney Basin and South-east Corner (ME007)

Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)

Parramatta Red Gum Woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005)

Existing railway

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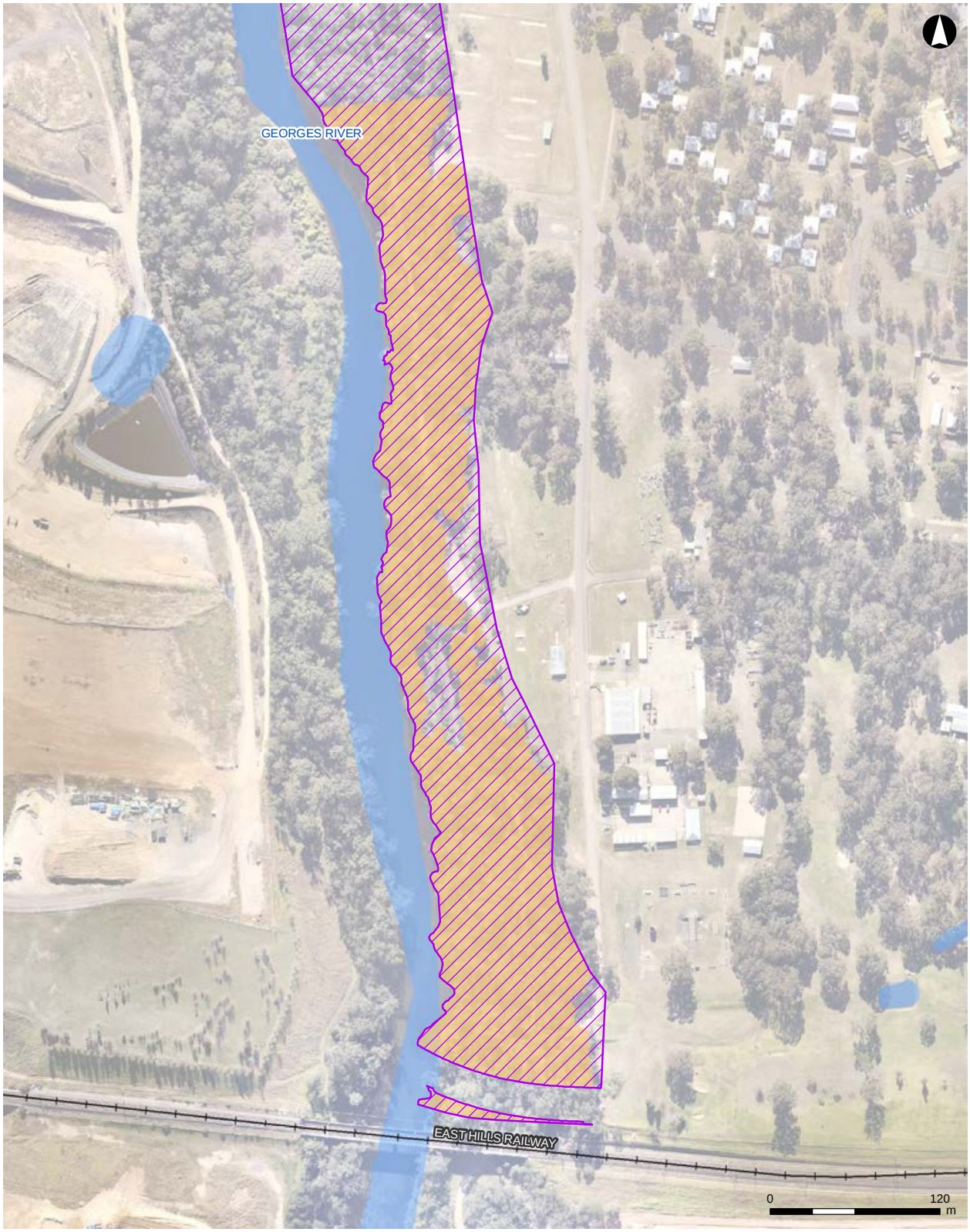
Figure 4: Plant Community Types on the Southern Boot Land offset site



LEGEND

Georges River offset site

Plant Community Type

Forest Red Gum - Rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018)

Existing railway

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Figure 5: Plant Community Types on the Georges River offset site

5.3 Improvement in biodiversity values at an offset site

The proposed offset sites were assessed using the Biobanking assessment methodology (BBAM)(OEH 2014) and with reference to the *Biobanking Assessment Methodology and Credit Calculator Operational Manual* (DECC 2009). The methodology used and vegetation and habitat descriptions of the Southern Boot Land and part of the Georges River offset site are presented in the Biodiversity Assessment Report (BAR). Credit profiles for ecosystem credits and species credits at the offset sites are provided in Appendix 1.

5.3.1 Ecosystem credits created on the offset sites

The gain in landscape and site value on the offset sites, as well as averted loss, were determined using the Biobanking credit calculator (version 4.1). Ecosystem credits created at the Southern Boot Land offset site are detailed in Table 7 and ecosystem credits created at the Georges River offset site are detailed in Table 8.

It is proposed to increase site value in vegetation zones ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good – Poor and ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin through additional weed removal, tree planting and fallen log placement in these areas as part of the offset site management plan. Detailed information on these management actions will be provided with the application for a biobanking agreement.

Table 7 PCTs at the Southern Boot Land offset site and the number of ecosystem credits created

Vegetation Zone	Area	Current site value score	Future site value score	Landscape value score	Averted loss	Ecosystem credits created
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	7.73 ha	79.17	85.42	27	7.30	67
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	0.94 ha	35.94	57.29	27	0.78	10
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	2.17 ha	72.92	87.76	27	5.99	23
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner: Moderate/Good - Poor	0.64 ha	64.10	80.13	27	3.21	6

Table 8 PCTs at the Georges River offset site and the number of ecosystem credits created

Vegetation Zone	Area	Current site value score	Future site value score	Change in landscape value	Averted loss	Ecosystem credits created
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	4.9 ha	88.02	95.31	27	7.29	60

5.3.2 Species credits created on the offset sites

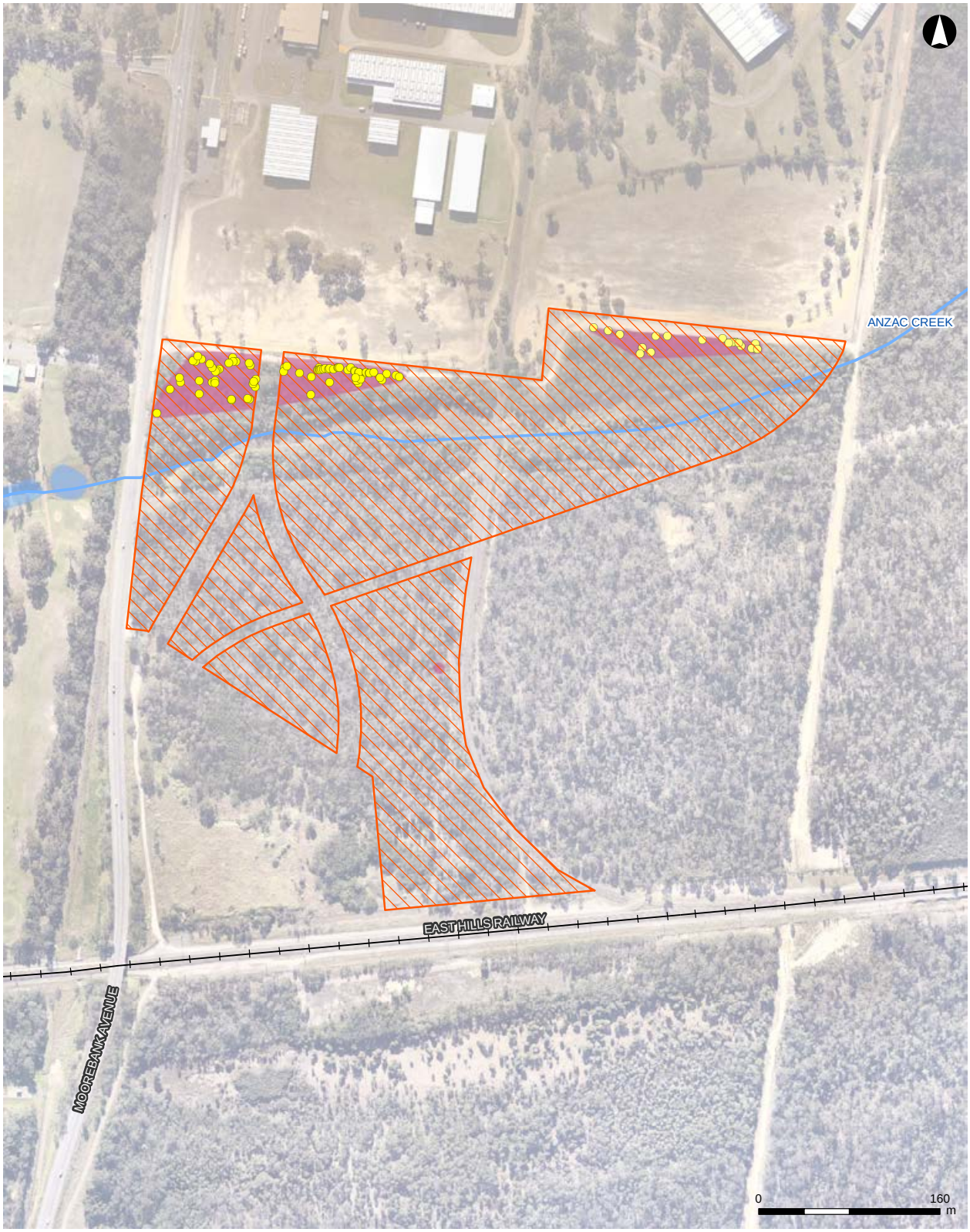
The proposed offset sites are immediately adjacent to the area impacted by the Proposal. Species credits for the proposed offset sites were calculated using counts of individuals or stems of the threatened flora species on the sites, and by measuring the area of the mapped species credit polygons for threatened fauna species. The species credits generated from the proposed offset sites are shown in Table 9 and Figures 6 to 12.

Table 9 Species credits created on the proposed offset sites

Scientific name	Common name	Species polygon area (ha)	No. of individuals/ stems	Number of species credits created
Persoonia nutans	Nodding Geebung	N/A	114 individuals	809
Grevillea parviflora subsp. *parviflora*	Small-flowered Grevillea	N/A	2267 stems*	16096
Cercartetus nanus	Eastern Pygmy Possum	9.92 ha	N/A	70
Myotis macropus	Southern Myotis	17.29 ha	N/A	123
Mormopterus norfolkensis	Eastern Freetail-bat	17.29 ha	N/A	123
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	17.29 ha	N/A	123
Pteropus poliocephalus	Grey-headed Flying-fox	17.37 ha	N/A	123

*This value represents the number of *Grevillea parviflora* subsp. *parviflora* stems recorded in sampling transects only – no extrapolation has been made. The actual number of stems is likely to be higher.

The presence of Eastern Pygmy Possum in the Southern Boot Land offset site was determined through habitat features and anecdotal evidence from adjacent surveys. An expert report will be required to establish the likely presence of this species in the proposed offset site for the purpose of generating species credits.



LEGEND

- Southern Boot Land offset site
- Persoonia nutans species polygon requiring offset
- Persoonia nutans
- Existing railway
- Watercourse

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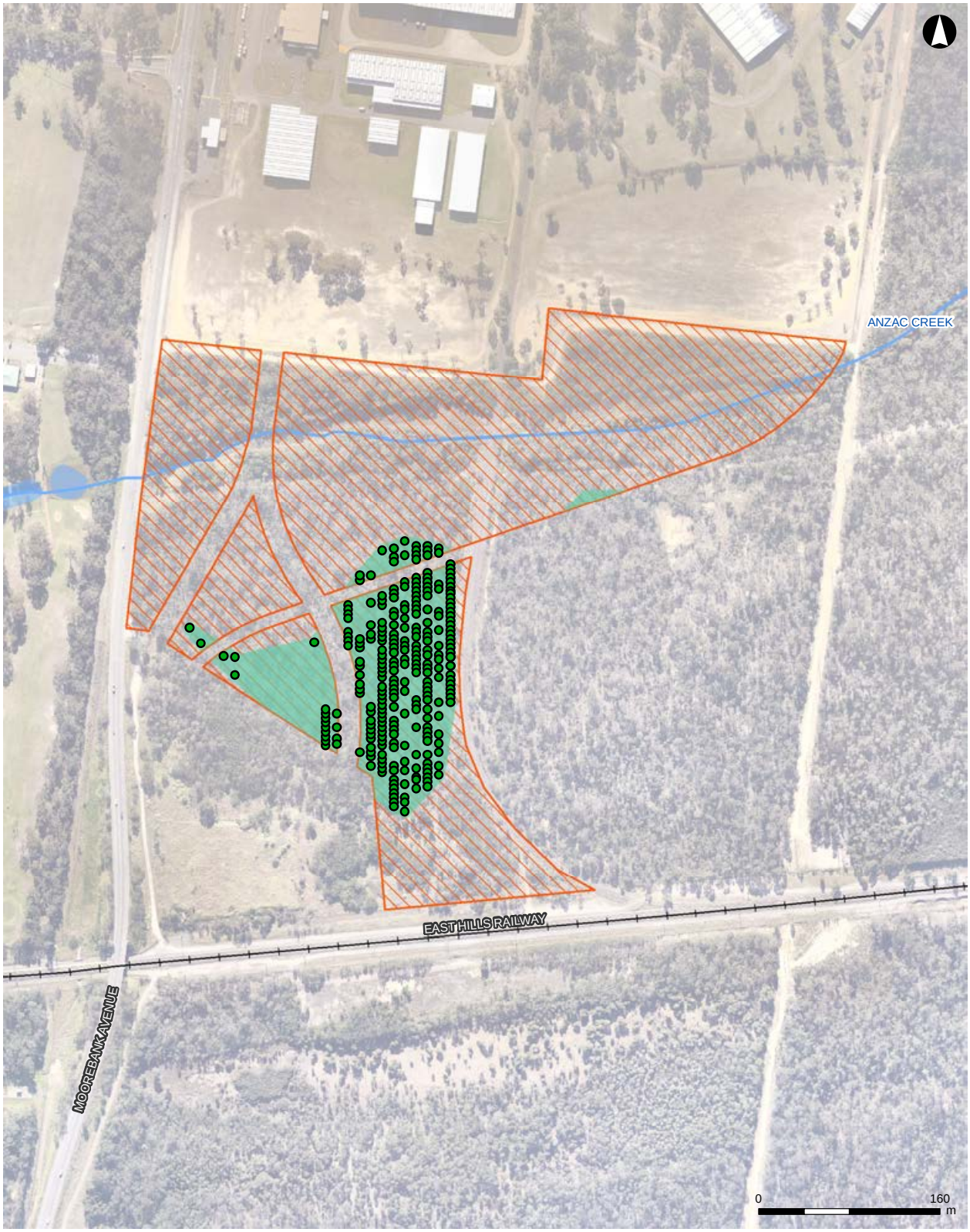
Figure 6: *Persoonia nutans* on the Southern Bootland offset site



LEGEND

- Southern Boot Land offset site
- Grevillea parviflora subsp. parviflora species polygon requiring offset
- Grevillea parviflora subsp. parviflora
- Existing railway
- Watercourse

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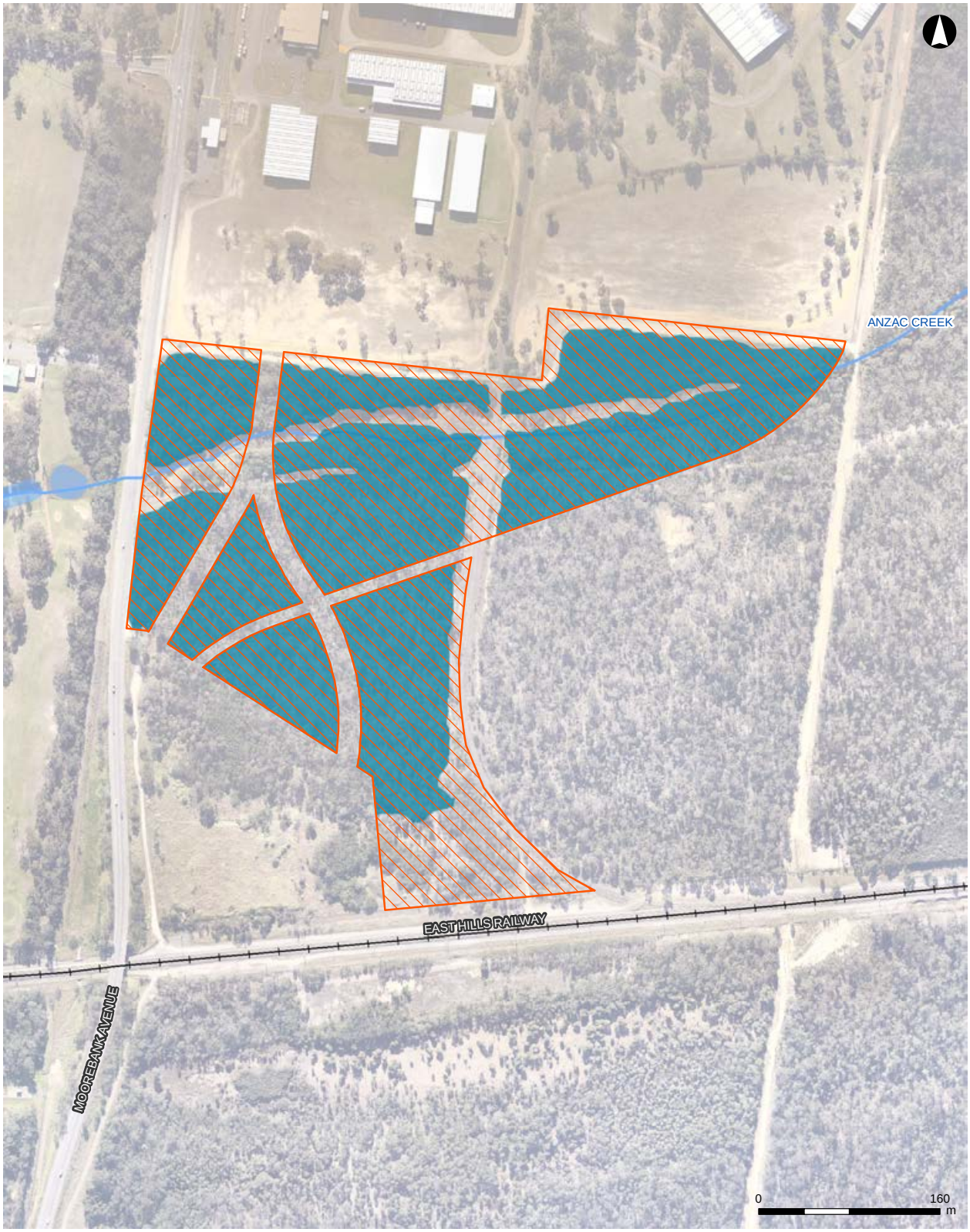
Figure 7: *Grevillea parviflora subsp. parviflora* on the Southern Boot Land offset site



LEGEND

- Southern Boot Land offset site
- Eastern Pygmy Possum species polygon requiring offset
- Existing railway
- Watercourse

Figure 8: Eastern Pygmy Possum species polygon in the Southern Bootland offset site

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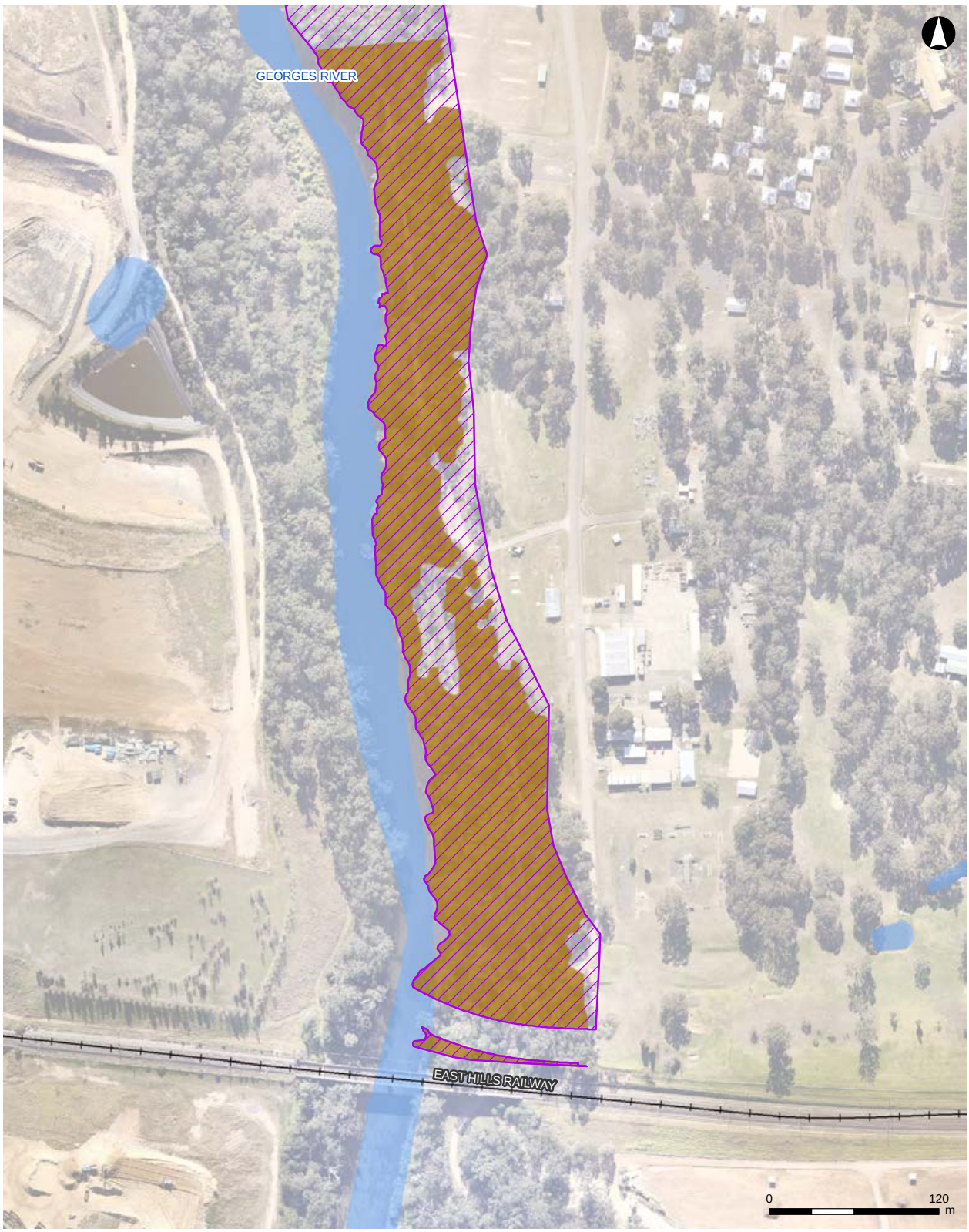
Created by : GC
QA by : JR



LEGEND

- Georges River offset site
- Southern Myotis species polygon
- Existing railway
- Watercourse

Figure 9a: Southern Myotis species polygon on the Georges River offset site

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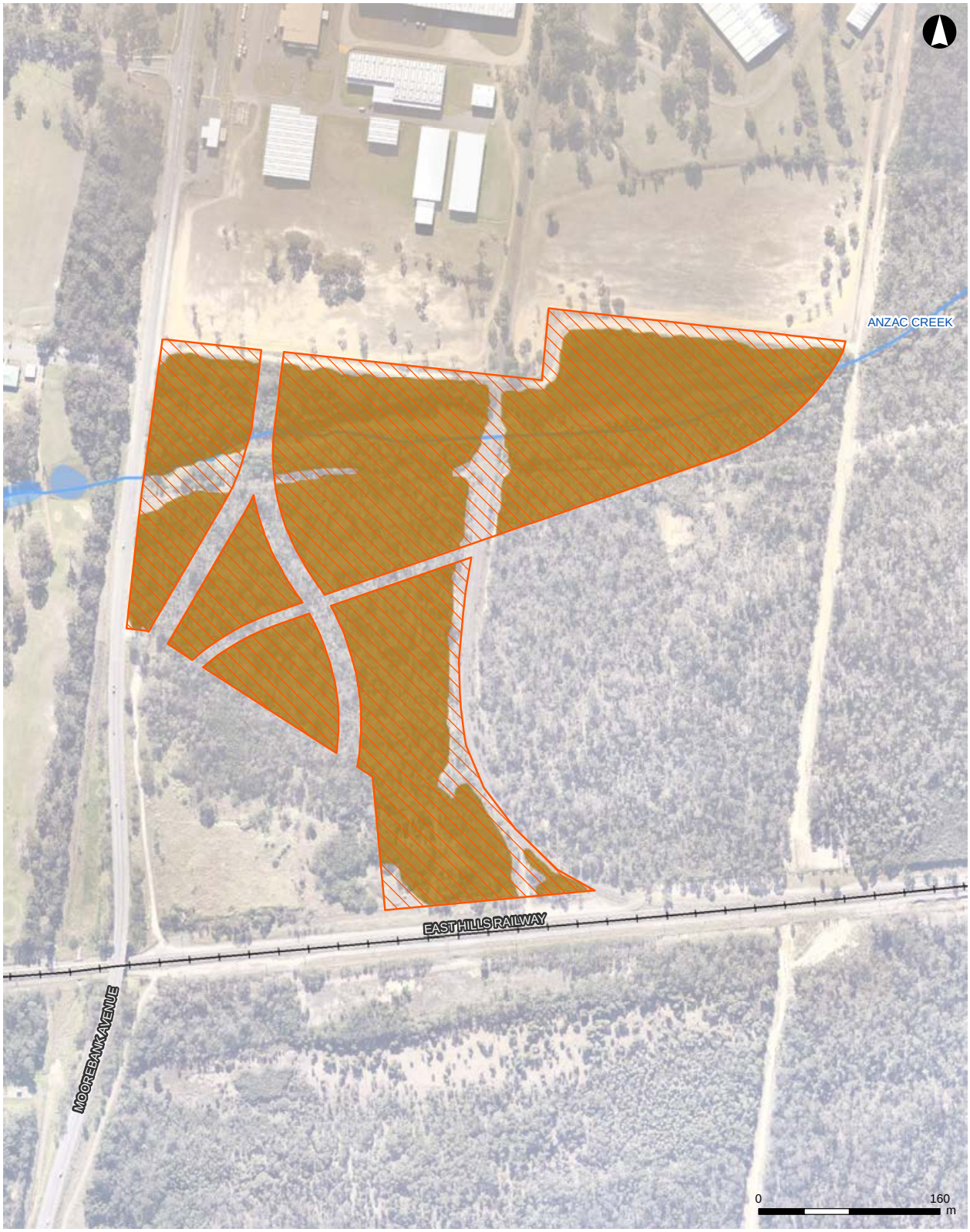
QA by : JR



LEGEND

- Southern Boot Land offset site
- Southern Myotis species polygon requiring offset
- Existing railway
- Watercourse

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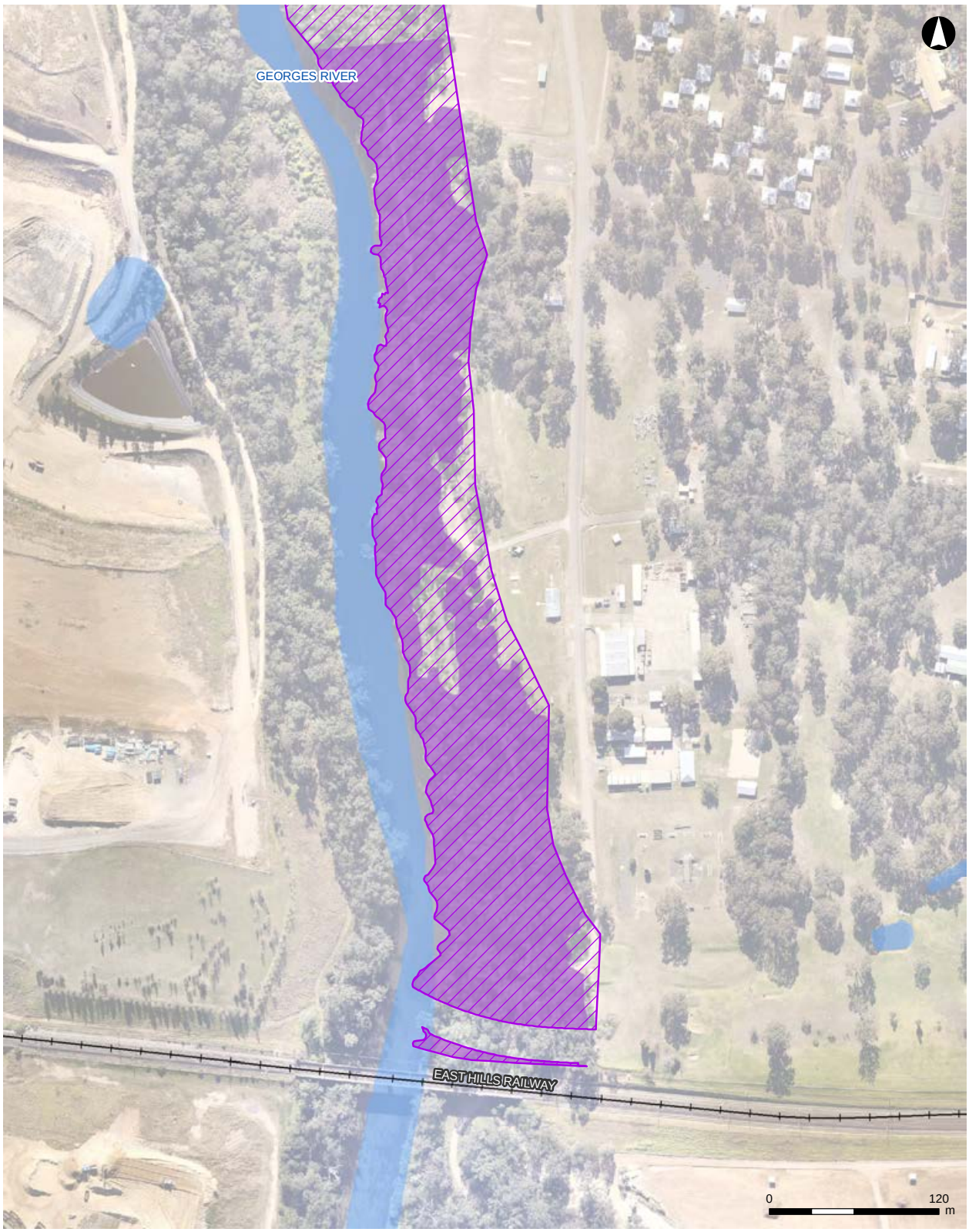
Figure 9b: Southern Myotis species polygon requiring offset on the Southern Bootland offset site



LEGEND

- Georges River offset site
- Eastern Freetail-bat species polygon
- Existing railway
- Watercourse

Figure 10a: Eastern Freetail-bat species polygon on the Georges River offset site

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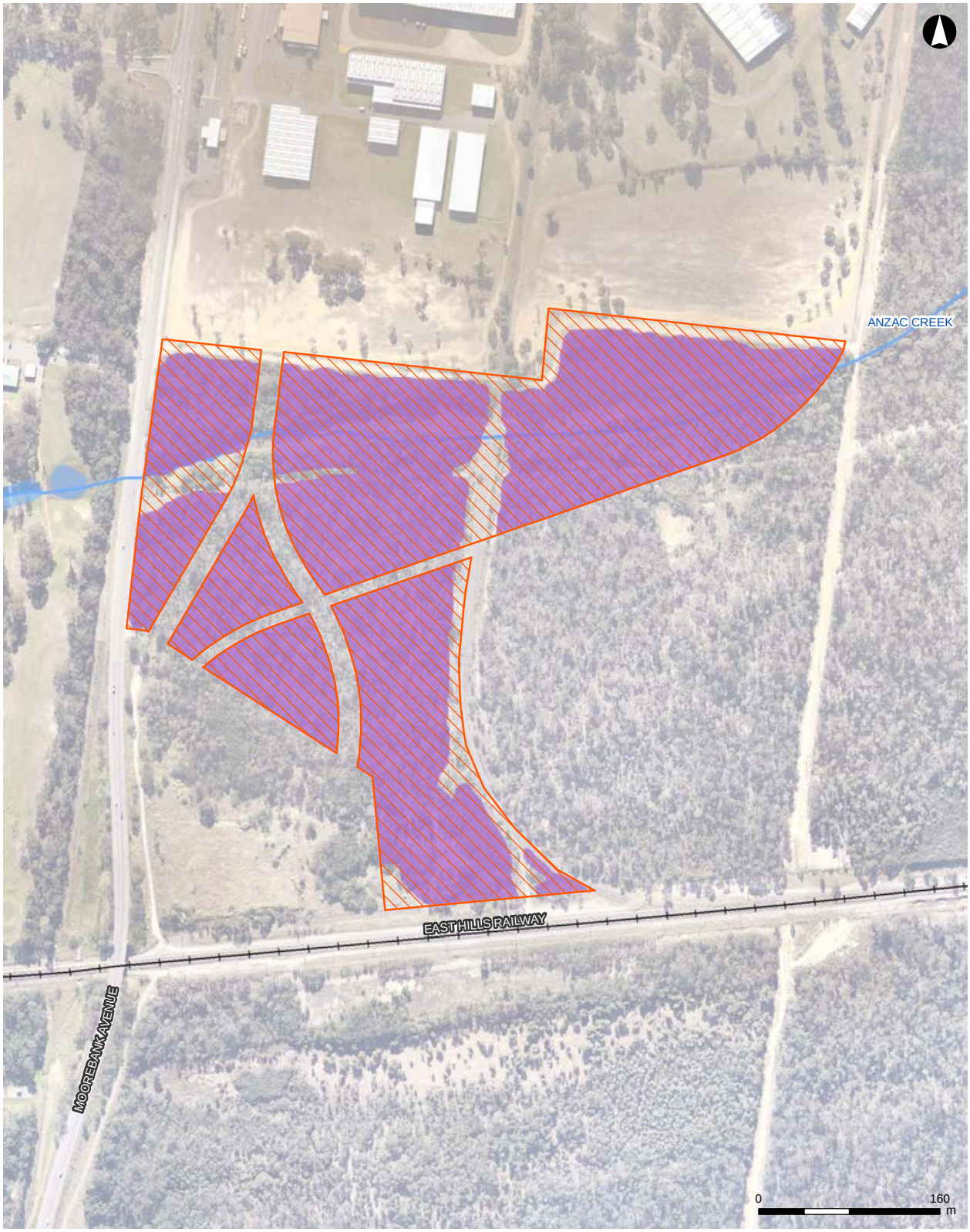
QA by : JR



LEGEND

- Southern Boot Land offset site
- Eastern Freetail-bat species polygon requiring offset
- Existing railway
- Watercourse

Figure 10b: Eastern Freetail-bat species polygon in the Southern Bootland offset site

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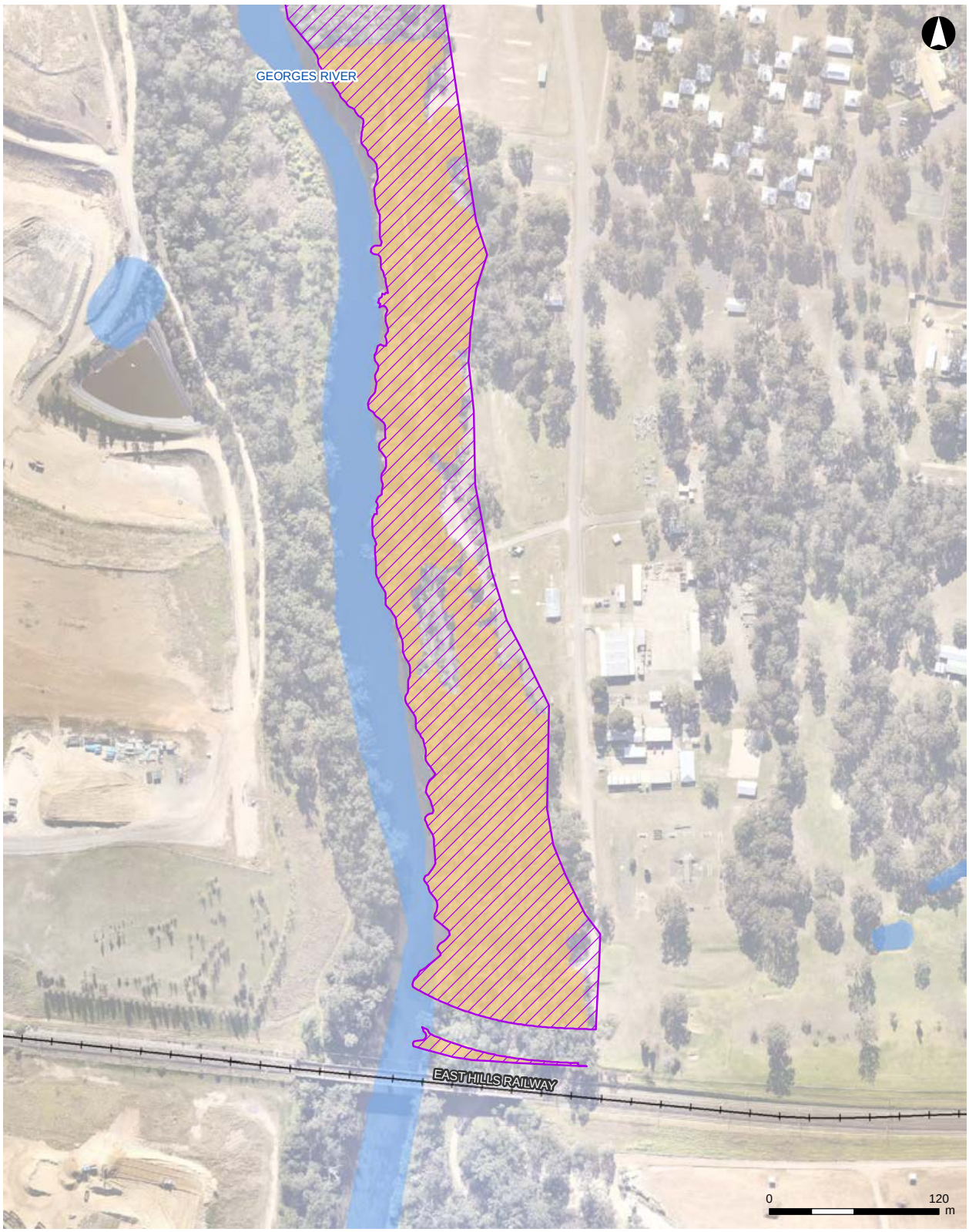

LEGEND

- Georges River offset site
- Eastern Bentwing-bat species polygon
- Existing railway
- Watercourse

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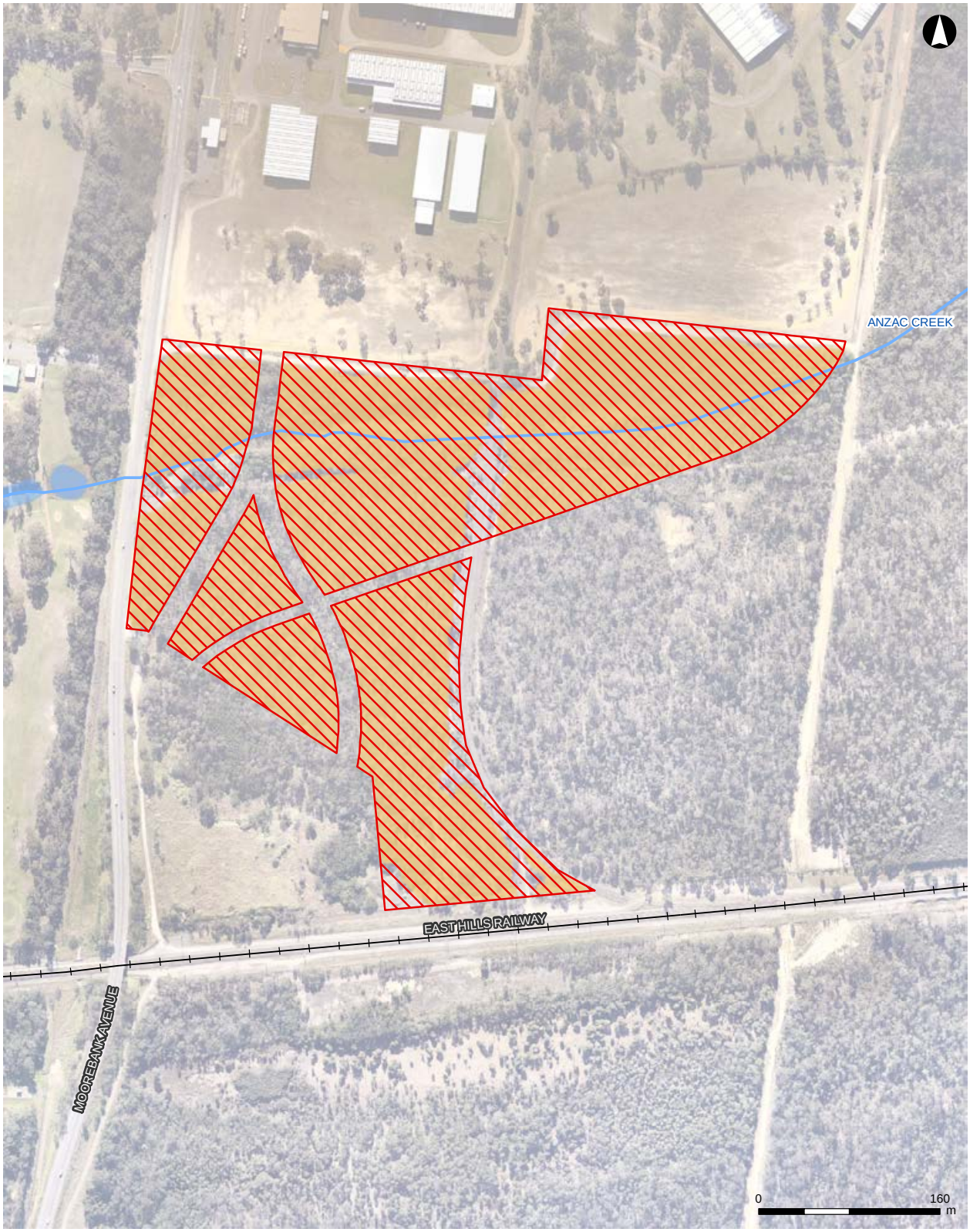
Figure 11a: Eastern Bentwing-bat species polygon on the Georges River offset site



LEGEND

- Southern Boot Land offset site
- Eastern Bentwing-bat species polygon requiring offset
- Existing railway
- Watercourse

Figure 11b: Eastern Bentwing-bat species polygon on the Southern Bootland offset site

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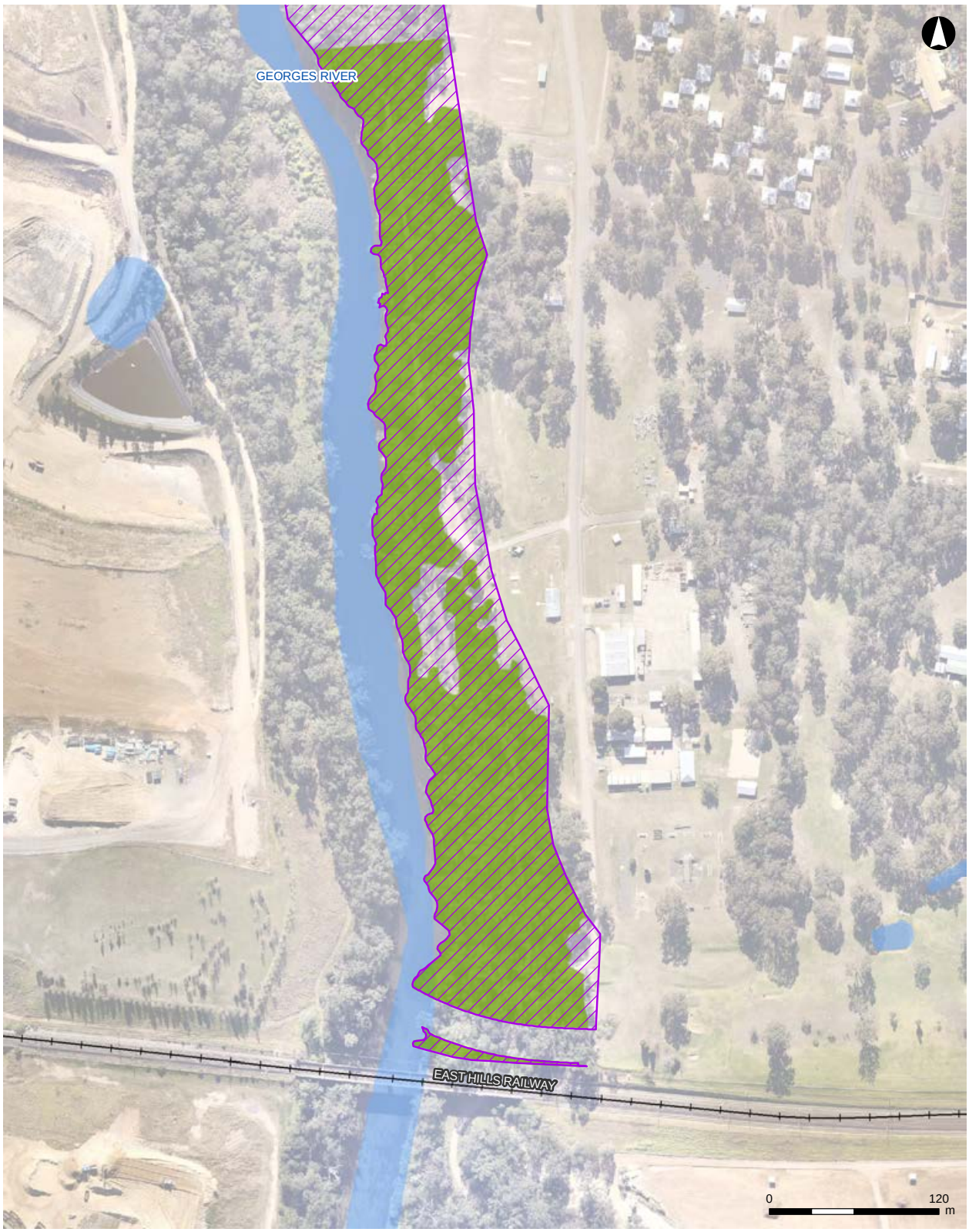
QA by : JR



LEGEND

- Georges River offset site
- Grey-headed Flying-fox species polygon
- Existing railway
- Watercourse

Figure 12a: Grey-headed Flying-fox species polygon on the Georges River offset site

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Created by : GC
QA by : JR

LEGEND

- Southern Boot Land offset site
- Grey-headed Flying-fox species polygon requiring offset
- Existing railway
- Watercourse

Figure 12b: Grey-headed Flying-fox species polygon on the Southern Bootland offset site

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Date: 4/05/2015 Path: \\IHC-AUS-NS-FS-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\BOS\AA003760_BOS_Stage1_Figure12b_OffsetSite_Grey-headedFlying-fox_SBL_A4_r2v1.mxd
Created by : GC
QA by : JR

5.3.3 Credit balance

A comparison of the ecosystem and species credits calculated for the Proposal site and the proposed offset sites (Table 10 and Table 11) indicates that the proposed offset sites will generate surplus credits for most of the PCTs and species requiring offset. There is a credit deficit for one Plant Community Type: ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin; and two threatened species: *Persoonia nutans* and Eastern Bentwing-bat.

Table 10 Ecosystem credit comparison

Plant Community Type	Area cleared	Ecosystem credits required	Area within offset site	Ecosystem credits created	Credit balance
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	0.76 ha	97	8.67 ha	90	-5
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	0.04 ha	8	2.17 ha	26	+18
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner	0.03 ha	3	0.64 ha	7	+4
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	0.41 ha	60	5.8 ha	60	0

Table 11 Species credit comparison

Species Credit species	Individuals/ area cleared	Species credits required	Individuals/ area within offset site	Species credits created	Credit balance
Persoonia nutans (Nodding Geebung)	11 individuals	847	114 individuals	809	-38
Grevillea parviflora subsp. *parviflora* (Small-flowered Grevillea)	641 stems	9615	2267 stems	16096	+6232
Cercartetus nanus (Eastern Pygmy Possum)	0.75 ha	15	9.92 ha	70	+55
Myotis macropus (Southern Myotis)	1.25 ha	28	17.29 ha	123	+95
Mormopterus norfolkensis (Eastern Freetail-bat)	1.25 ha	28	17.29 ha	123	+95
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	11.57 ha	150	17.29 ha	123	-27

Species Credit species	Individuals/ area cleared	Species credits required	Individuals/ area within offset site	Species credits created	Credit balance
Pteropus poliocephalus (Grey-headed Flying-fox)	4.8 ha	53	17.37 ha	123	+70

5.3.4 Variation to offset rules

Where a suitable like-for-like offset cannot be located, the variation rules in section 10.5 of the FBA may be applied. It should be noted that the variation rules do not apply to critically endangered species or communities, or to those threatened species and communities considered nationally significant under the Commonwealth EPBC Act.

One PCT requiring ecosystem credits, ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin, and two species credit species have a credit deficit: *Persoonia nutans* and Eastern Bentwing-bat. Given that ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin and *Persoonia nutans* are both listed as Endangered under the EPBC Act, the variation rules can only be applied to the credit deficit for Eastern Bentwing-bat.

The consent authority (DP&E) may approve a variation of the offset rules, for matching species credits by allowing a different species to that impacted by the Proposal to be used to meet the offset requirement, subject to offset rules. The variation may only be allowed if the proponent (or applicant) can demonstrate that all reasonable steps have been taken to secure the number and types of species credits impacted on at the development site.

The variation to use species credits for a different species must only be approved by the consent authority where:

- the alternative species credits are created on land within the same IBRA region in which the proposed Major Project occurs, and
- for fauna, the alternative species is a species or population from the same Order as the fauna species impacted on at the development site. In addition, the PCT containing threatened species habitat at an offset site is a PCT, which according to the Threatened Species Profile Database, is also associated with the fauna species impacted at the development site, or
- the alternative species credits are for a species or population listed in either Schedule 1 or 1A of the TSC Act, where the species credit required for the proposed development relates to a species or population listed in Schedule 1 of the TSC Act, or
- the alternative species credits are for a species or population listed in either Schedule 1, 1A or 2 of the TSC Act, where the species credit required for the proposed development relates to a species or population listed in Schedule 2 of the TSC Act.

Unless additional species credits can be sourced to address the credit deficit for Eastern Bentwing-bat, it is proposed to use species credits for other threatened microchiropteran bat species (Southern Myotis or Eastern Freetail-bat) to offset this species.

In order to address the deficit for ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin and *Persoonia nutans,* an Expression of Interest (EOI) has been placed on the Biobanking Credits wanted register (EOI dated 4 May 2015).

5.3.5 Management Actions proposed to improve biodiversity values

The proposed offset sites are currently managed by the Commonwealth. The extent of current biodiversity management within the proposed offset sites is unknown. There are no known existing obligations or binding agreements applicable to the proposed offset sites.

It is proposed to establish a biobank site on the Southern Boot land and Georges River Offset sites, to be managed in perpetuity under a Biobanking Agreement. A Biodiversity Offset Management Plan will be prepared for the proposed offset sites. The Biodiversity Offset Management Plan is required to address, as a minimum, the standard and additional management actions specified in the Biobanking Assessment Methodology (OEH 2014) for each Plant Community Type. The standard management actions are:

- Management of grazing for conservation (not applicable to the Proposal site)
- Weed control
- Management of fire for conservation
- Management of human disturbance
- Retention of regrowth and remnant vegetation
- Replanting or supplementary planting where natural regeneration will not be sufficient
- Retention of dead timber
- Erosion control
- Retention of rocks.

The Biobanking credit report (Appendix 2) specifies additional management actions for the PCTs and threatened species on the offset site (Table 12).

Table 12 Additional management actions required

PCTs/threatened species	Management action details
Plant community types	
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Control of feral pigs Exclude commercial apiaries Exclude miscellaneous feral species Feral and/or over abundant native herbivore control Fox control
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Control of feral pigs Exclude commercial apiaries Exclude miscellaneous feral species Feral and/or over abundant native herbivore control Fox control

PCTs/threatened species	Management action details
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner	Control exotic pest fish species (within dams) Control of feral pigs Exclude commercial apiaries Exclude miscellaneous feral species Feral and/or over abundant native herbivore control Fox control Maintain or reintroduce natural flow regimes
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	Feral and/or over abundant native herbivore control Exclude miscellaneous feral species Feral and/or over abundant native herbivore control Fox control
Threatened species	
Persoonia nutans (Nodding Geebung)	Feral and/or over abundant native herbivore control
Grevillea parviflora subsp. *parviflora* (Small-flowered Grevillea)	N/A
Cercartetus nanus (Eastern Pygmy Possum)	Fox control
Myotis macropus (Southern Myotis)	Maintain or reintroduce natural flow regimes
Mormopterus norfolkensis (Eastern Freetail-bat)	N/A
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	Feral and/or over abundant native herbivore control
Pteropus poliocephalus (Grey-headed Flying-fox)	Slashing

The plan must:

- describe the implementation of any additional management actions required by the Threatened Species Profile Database;
- set out the area to which each management action applies and the time frame for implementation of each management action; and
- identify which management actions apply and the timeframe for implementation of each management action on any area of the biobank site that is subject to a legal impediment, such as a covenant or an easement on the land title, that restricts full implementation of the management.

Annual reporting on management actions is required to demonstrate how the conditions set out in the biobanking agreement have been met.

5.4 Calculation of offset requirements under the EPBC Act

Offset calculations have been prepared for the MNES subject to residual significant impacts from the Proposal, based on the guidance provided in the EPBC Offset Assessments Guide. These calculations have been undertaken to assess the suitability of the proposed offset sites to achieve 100% of the required offset for the Proposal.

The offsets calculator provided with the EPBC offsets policy allows for calculation of the level of habitat quality and area or number of individuals required to be offset based on the level of impact from the Proposal. For offset calculations based on areas of community or habitat, the calculator requires a habitat quality 'score' on a scale of 1 to 10 as a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability. Three components contribute to the calculation of this score: site condition, site context and species stocking rate.

Inputs into the calculator for the offset area include:

- Temporal scales including time over which loss is averted (maximum 20 years) and time until ecological benefit.
- Risk scales including risk of loss without and with the establishment of the offset.
- Future habitat quality with and without the establishment of an offset.
- Confidence in the result is the level of certainty about the success of the proposed offset.

Once all the above data attributes are entered into the offsets calculator, a percentage of the impact offset is provided.

5.4.1 *Persoonia nutans* (Nodding Geebung)

Field assessment of the Southern Boot Land (which is impacted by the Rail link) identified a total of 125 plants of *Persoonia nutans.* Of these, 11 will be directly impacted by the Proposal, 114 will be retained in the Southern Boot Land offset site.

According to the calculator, an offset supporting 114 individuals with restoration measures to increase the population by at least 10 individuals would provide a suitable offset for the species. The values entered into the EPBC Offsets Guide and a rationale for the offset measures are provided in Table 13.

Table 13 *Persoonia nutans* – EPBC Offsets guide inputs

Attribute	Value	Rationale
Impact calculator inputs		
Number of individuals impacted	11	A total of 11 individuals would be directly impacted by the Proposal.
Offset calculator inputs		
Time horizon (years)	20	Considering the offset is proposed to be established in perpetuity, the maximum risk-related time horizon of 20 years was assigned.

Attribute	Value	Rationale
Start value (number of individuals)	114	A start value of 114 individuals has been assigned based on surveys identifying this many plants on the Southern Boot Land offset site.
Future value without offset (number of individuals)	108	The *Persoonia nutans* habitat on the Southern Boot Land offset site is in reasonably good condition and there are few threats to habitat. Nevertheless, the current management of the site is not optimal for the species, with many plants observed to be suppressed by dense shrub growth, and young plants recorded in the powerline easement in 2012 no longer extant in 2014. As such, the future value without the offset has been slightly reduced by 6 individuals (approximately 5 percent of the recorded population).
Future value with offset (number of individuals)	124	A future site value of 124 individuals has been assigned based on the potential for translocation and/or plantings, and ongoing management improving habitat conditions to facilitate natural recruitment of individuals increasing the start value by 10 individuals.
Confidence in result (%)	90	There is a high confidence of a potential offset to provide an improved outcome for the species considering the number of individuals that would be protected (114 individuals) providing an improved outcome for the species. This is based on adequate restoration, monitoring and management actions being implemented.
% of impact offset	101%	This scenario would provide for 101% of the required offset.
Other measures (up to 10%)	10	There is potential to provide up to 10% of the offset as other measures. This may include restoration or protection of areas of habitat for the species.

5.4.2 *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea)

Field assessment of the Southern Boot Land identified a total of 3189 stems of *Grevillea parviflora* subsp. *parviflora* in transects sampling the study area, with an estimated total count of 7973 stems. Intensive surveys of the species in the vicinity of the proposed Rail link identified 842 stems, of which 641 will be directly impacted by the Proposal. A total of 2,267 stems were recorded in transects within the Southern Boot Land offset area.

Given the high density of plants of the species across a relatively small area, the assessment is based on the area of impact on habitat occupied by this species. The area of habitat is based on the species polygon mapped for this species.

The total area of direct impacts to this species' occupied habitat comprises 0.28 hectares. According to the calculator, the Southern Boot Land offset site supporting 2.54 hectares of occupied *Grevillea parviflora* subsp. *parviflora* habitat of similar habitat quality would be sufficient to offset the 0.26 hectares directly impacted. The values and a rationale for the offset measures are provided in Table 14.

Table 14 *Grevillea parviflora* subsp. *parviflora* – EPBC Offsets guide inputs

Attribute	Value	Rationale
Impact calculator inputs		
Area (ha)	0.28	Impacts to occupied habitat are 0.28 hectares.
Start quality (scale of 0-10)	9	Given the high density of the species in areas of occupied habitat and relatively good connectivity to adjacent occupied areas, the habitat was assigned a score of 9.
Offset calculator inputs		
Time over which loss is averted (max. 20 years)	20	This describes the timeframe over which changes to the level of risk to a proposed offset site can be considered and quantified. This value is capped at 20 years or the life of an offset whichever is shorter. Considering the offset is proposed to be established in perpetuity, the maximum risk-related time horizon of 20 years was assigned.
Time until ecological benefit (years)	2	Existing threats to the species on offset properties will need to be managed including fencing and weed removal. A 2 year period has been allowed for management actions to be implemented.
Area (ha)	2.54	An offset of 2.54 hectares of habitat occupied by *Grevillea parviflora* subsp. *parviflora* with similar habitat quality would be sufficient to offset the impacts from the Proposal.
Start quality (scale of 0-10)	9	The habitat quality of the potential offset site is the same as that of the impact site, as offsets for this species are located on adjacent land.
Risk of loss (%) without offset	5	The *Grevillea parviflora* subsp. *parviflora* habitat on the Southern Boot Land offset site was observed to be in good condition and there are few threats to habitat.
Future quality without offset (scale of 0-10)	9	Existing threats to populations on the potential offset site have only minor potential to further degrade habitat. It has been assumed the future quality would be maintained at current levels even without the offset.

Attribute	Value	Rationale
Risk of loss (%) with offset	1	An offset site would substantially reduce the risk of loss by eliminating the majority of threats to the species, however some residual risk is considered to be present and a value of 1% has been assigned.
Future quality with offset (scale of 0-10)	10	It is envisaged with the implementation of management and restoration measures, including management to optimise habitat features and enhance connectivity, the future habitat quality score of the offset could be improved by a single point.
Confidence in result (%)	90	There is a high confidence of a potential offset providing an improved outcome for *Grevillea parviflora* subsp. *parviflora,* provided adequate restoration, monitoring and management actions are implemented.
% of impact offset	121	This scenario would provide for 121% of the required offset, depending upon the attributes of any proposed offset, the values can be modified within reason to achieve a minimum of 90% of the offset.
Other measures (up to 10%)	10	There is potential to provide up to 10% of the offset as other measures.

6 CONCLUSION

The purpose of this Biodiversity Offset Strategy is to establish a commitment to offsetting the impacts of the Proposal on threatened species, populations and communities. The Strategy has been prepared to address the EPBC Act and SEARs for the Proposal.

The overarching objective for the Biodiversity Offset Strategy is to provide guidance for the delivery of a Biodiversity Offset Package that achieves a long-term conservation gain for the threatened species and communities impacted by the Proposal.

The Proposal will have direct impacts on threatened ecological communities listed under the TSC Act as well as two threatened plant species, *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) within the Rail link. The Proposal will also have impacts on fauna habitat, including threatened fauna species habitat. One species predicted to occur in the study area, Eastern Pygmy Possum (*Cercarcetus nanus*) (Vulnerable under the TSC Act), was assumed to be present. Four additional threatened bat species recorded in the study area are considered as species credit species in the BAR.

The Biodiversity Offset Strategy is guided by the EPBC Offsets Policy and the NSW Biodiversity Offsets Policy for Major Projects, as well as the recovery objectives and actions in the approved Recovery Plan for *Persoonia nutans.*

The Strategy proposes three potential offset measures for consideration:

- Secure additional native vegetation on lands adjacent to the impact area, to be protected through establishment of offset sites under a Biobanking Agreement. This offset measure may alternatively be partially or fully delivered through the retirement of an appropriate number and class of biodiversity credits under the NSW Biobanking scheme.
- Establishment of an offset site under another suitable mechanism that ensures the land is managed for conservation in perpetuity, in accordance with section 3 of Appendix A of the *NSW Biodiversity Offsets Policy for Major Projects.*
- Use of supplementary measures in lieu of offsets (note under the EPBC offsets policy, this is limited to 10% of the total offset requirement), if required.

Offset Measure 1 is the priority for the Proposal to achieve the objectives of the Biodiversity Offset Strategy. Offset Measures 2 and 3 would only be considered after further consultation with the Department of the Environment, OEH and DP&E.

The proposed biodiversity offset comprises two sites:

- A portion of the Southern Boot Land (Southern Boot Land offset site)
- A portion of the riparian corridor on the eastern side of the Georges River (Georges River offset site).

Both offset sites are located immediately adjacent to the areas to be impacted by the Proposal.

Assessment of the offset sites using the Biobanking assessment methodology (BBAM) found that the proposed offset sites will generate surplus credits for most of the Plant Community Types (PCTs) and species requiring offset. There is a credit deficit for two threatened species: *Persoonia nutans* and Eastern Bentwing-bat. Variation rules for offsetting may be applied for the Eastern Bentwing-bat, but not for *Persoonia nutans* as it is listed under the EPBC Act. Addressing the offset credit deficit for this matter will require additional consultation with OEH and DoE.

A Biodiversity Offset Management Plan will be prepared for the proposed offset sites. The Biodiversity Offset Management Plan will address, as a minimum, the standard and additional management actions specified in the Biobanking Assessment Methodology (OEH 2014) for each Plant Community Type, as well as additional management actions listed in the credit report.

Calculation of offset requirements for *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* in accordance with Commonwealth conditions of approval found that the proposed offset sites will provide for greater than 100% of the offset requirements under the EPBC Offsets Policy.

This Offset Strategy will be further developed and revised prior to the construction of the Proposal, comprising the preparation of a Biodiversity Offset Package.

APPENDIX 1

CREDIT CALCULATOR REPORTS

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE

Date of report: 4/05/2015 Time: 2:53:39PM Calculator version: v4.0

Biobank details

Proposal ID:	0023/2015/1589B
Proposal name:	SIMTA Biobank sites
Proposal address:	Moorebank Avenue Moorebank NSW
Proponent name:	Tactical Group
Proponent address:	Level 15, 124 Walker Street North Sydney NSW 2060
Proponent phone:	0289070700
Assessor name:	Jane Rodd
Assessor address:	Level 5, 141 Walker Street NORTH SYDNEY NSW 2060
Assessor phone:	8907 8266
Assessor accreditation:	0023

Additional information required for approval:

☐ Use of local benchmark

☐ Expert report...
- Eastern Pygmy-possum — Cercartetus nanus

☐ Request for additional gain in site value

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	0.64	7.00
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	5.80	60.00
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	8.67	90.00
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	2.17	26.00
Total	17.28	183

Credit profiles

1. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018)

Number of ecosystem credits created	60
IBRA sub-region	Cumberland - Sydney Metro

2. Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)

Number of ecosystem credits created	26
IBRA sub-region	Cumberland - Sydney Metro

3. Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)

Number of ecosystem credits created	90
IBRA sub-region	Cumberland - Sydney Metro

4. Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (ME007)

Number of ecosystem credits created	7
IBRA sub-region	Cumberland - Sydney Metro

Species credits summary

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	2,267.00	16,096
Nodding Geebung	Persoonia nutans	114.00	809
Eastern Pygmy-possum	Cercartetus nanus	9.92	70
Grey-headed Flying-fox	Pteropus poliocephalus	17.37	123
Eastern Freetail-bat	Mormopterus norfolkensis	17.29	123
Eastern Bentwing-bat	Miniopterus schreibersii subsp. oceanensis	17.29	123
Southern Myotis	Myotis macropus	17.29	123

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Control exotic pest fish species (within dams)
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Control of feral pigs
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Exclude commercial apiaries
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Exclude miscellaneous feral species
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Feral and/or over-abundant native herbivore control
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Fox control
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Maintain or re-introduce natural flow regimes
Eastern Bentwing-bat	Feral and/or over-abundant native herbivore control
Eastern Pygmy-possum	Fox control
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Exclude commercial apiaries
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Exclude miscellaneous feral species
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control

Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Fox control
Grey-headed Flying-fox	Slashing
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Control of feral pigs
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Exclude commercial apiaries
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Exclude miscellaneous feral species
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Fox control
Nodding Geebung	Feral and/or over-abundant native herbivore control
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Control of feral pigs
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Exclude commercial apiaries
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Exclude miscellaneous feral species
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Fox control
Southern Myotis	Maintain or re-introduce natural flow regimes

APPENDIX C

AQUATIC ASSESSMENT

HYDER CONSULTING

ASSESSMENT OF THE SYDNEY INTERMODAL TRANSPORT HUB, MOOREBANK

AQUATIC ECOLOGY

July 2011

The ALS Water Sciences Group is part of the Environmental Division of ALS, one of the largest and most geographically diverse environmental testing businesses in the world.

CERTIFICATE OF APPROVAL FOR ISSUE OF DOCUMENTS

Client: Hyder Consulting
Project Title: **Assessment of the Sydney Intermodal Transport Hub, Moorebank**
Report Title: Aquatic Ecology
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	Position	Name	Signature	Date
Prepared by:	Consultant	Adrian Dickson		21/06/2011
Internal Review by:	Principal Consultant	Peter Hancock		22/06/2011
Peer Review by:	Senior Ecologist - Hyder	Jane Rodd		30/06/2011
Approved by:				

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1	For Review	Adrian Dickson	23/06/2011	
2	For Review - V2	Adrian Dickson	06/07/2011	

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1 Introduction

1.1 Background

Hyder Consulting Pty Ltd (Hyder) is undertaking an environmental assessment for the Sydney Intermodal Terminal Alliance's (SIMTA) proposal for an intermodal freight terminal and warehouse/distribution facility. The project site is located at Moorebank Avenue, Moorebank and is currently the site of the Defence National Storage and Distribution Centre. The site covers approximately 80 hectares and contains several modified stream channels that collect overland flow.

A new rail line will also be constructed on supplementary lands of approximately 65 hectares to the south and west of the warehouse facility. This land currently contains a golf course, vacant land, extractive industries, and a waste disposal depot. Georges River, and its tributary Anzac Creek, cross the supplementary lands. Anzac Creek supports an example of the *Castlereagh Swamp Woodland*, an Endangered Ecological Community.

1.2 Scope of Works

Following the issue of the Director General's Requirements (DGRs), Hyder contracted ALS Water Sciences Group to provide the aquatic ecology component of the environmental assessment. This included:

- An assessment of threatened aquatic (including groundwater dependent) species and populations; and
- Ecological surveys commensurate with the biology/ecology of aquatic species and extent of habitat within and adjacent to the project site.

The aquatic ecosystems of the study area included a stretch of Anzac Creek (approximately 300m in length) to the south of the site and a 100m section of Georges River to the west. Construction of a rail bridge is proposed to traverse both of these waterways.

1.3 Study sites

Two study sites were selected for this study one site on Georges River, and one site on Anzac Creek. The Georges River site was 100m long and extended north from beneath the East Hills Railway Bridge. The Anzac Creek site was downstream of an old and currently unused rail crossing. A location map of the study area is provided in Figure 1-1and approximate locations of macroinvertebrate and fish sampling points are provided in Table 1-1.

Table 1-1: Location of sites selected for the Hyder aquatic ecology assessment

Site Name	Site Code	Latitude	Longitude
Georges River	HYD01Edge1	-33.96501	150.91329
	HYD01Edge2	-33.96417	150.91342
Anzac Creek	HYD02Edge1	-33.96103	150.92451
	HYD02Edge2	-33.96103	150.92497

Source: Hyder Consulting Pty Ltd

Figure 1-1: Study sites (red stars) at the SIMTA Supplementary Land Survey Area (outlined by dashed yellow line)

2 Methodology

2.1 Field sampling

Sampling was conducted on 12 May 2011 following an on-site meeting between representatives of Hyder and ALS. Hyder staff (Jane Rodd and Laura Worthington) escorted the ALS Field Team (Adrian Dickson and Peter Hancock) to both sites.

2.2 Survey methods

2.2.1 Surface Water Physico-chemistry

Water physico-chemistry was measured at each site prior to collecting macroinvertebrate and fish samples, using a multi-parameter water quality meter. The meter was calibrated in accordance with QS/QA (Quality System/Quality Assurance) requirements and the manufacturer's specifications prior to its use in the field. The *in-situ* water quality parameters recorded include;

- Water Temperature (°C)
- pH (pH units)
- Electrical Conductivity (µS/cm)
- Dissolved Oxygen (% saturation and mg/L)
- Turbidity (NTU)
- Alkalinity (mg/L $CaCO_3$)

In-situ water physico-chemistry was compared to the ANZECC (2000) guidelines for lowland aquatic ecosystems of south-eastern Australia. Any parameters outside the guideline value are highlighted and discussed.

2.2.2 Macroinvertebrates

Rapid Bioassessment (RBA) protocols as outlined in the NSW AUSRIVAS Sampling and Processing Manual (Turak *et al*, 2004) were used to collect macroinvertebrate samples. The AUSRIVAS program is a nationally recognised, standardised sampling protocol used to assess the health of Australian Rivers and developed for Australia's National River Health Program (NRHP). Sampling was conducted using a standard ISO 7828 (1983) design sweep-net with 250µm mesh.

At each site, the littoral or edge habitat was sampled by sweeping the collecting net along the edge of the stream in areas of little or no current. The net was swept around overhanging terrestrial vegetation, against snags, in backwaters, and through beds of macrophytes over approximately 10m of edge. Two replicate samples of 10m sweeps were collected at the Georges River and Anzac Creek sites.

The material collected for each sample was placed into a sorting tray, and macroinvertebrates were picked for a minimum of 40 minutes by professionally qualified and experienced aquatic biologists using forceps and pipettes. If new taxa were found between 30 and 40 minutes, sorting continued for a further 10 minutes up to a maximum total sorting time of 1 hour. Any by-catch was noted (e.g. fish, tadpoles, etc.) and fish specimens identified, measured and handled following methods as detailed in section 2.2.3.

The objective of the RBA sorting protocol is to obtain a sample containing as diverse a fauna as possible (and hence provide a useful measure of taxa richness). Attempts were made to collect all taxa present, including rare and cryptic animals. Samples were preserved in 100% ethanol and clearly labelled with information including site, habitat, sampling method, date and sampler.

Nets were cleaned thoroughly between sampling sites to remove any invertebrates retained on them.

2.2.3 Fish

Initially, fish were to be surveyed using a backpack electrofisher, seine nets, and bait traps. However, both sites presented logistical difficulties that prevented the use of the electrofisher and the seine net. Georges River was too deep for effective electrofishing, and contained too many submerged logs for effective seine netting. The lack of open water at Anzac Creek made electrofishing and seine netting impossible. To compensate for this, additional bait traps were deployed at each site. Twelve bait traps were set at Georges River, and six at Anzac Creek. Fewer traps were set in Anzac Creek because of a lack of suitably deep water (>30cm). Commercially available concertina bait traps with 3mm mesh were baited with cat food and left in position for at least 3 hours. Fish specimens caught as by-catch in the macroinvertebrate sweep net samples were also counted. Upon retrieval, fish were identified to species using Allen *et al.* (2002). Fish were measured and all native species were returned to the stream. Non-native species were euthanized and disposed of in accordance with fisheries and ethics permit requirements.

2.2.4 Groundwater Dependent Ecosystems (GDE) surveys

A previous investigation of groundwater in the wider study area (URS, 2002) ascertains the depth to groundwater to generally be between 4.0 to 5.0 mbgl. Groundwater flow is generally radially from the topographic high with the location of the Georges River indicating that groundwater flow underlying the area would be predominantly westerly (URS, 2002). No groundwater monitoring bores were located in the study area so no groundwater invertebrates could be sampled. As there was no groundwater monitoring bores available, groundwater quality could not be collected and compared to surface water. A visual assessment of any potential groundwater dependent ecosystems was made at both sites.

2.2.5 Aquatic and Riparian Habitat Assessment

At each site, the habitat of a 100m reach of river was assessed. The assessment included the habitats sampled, and the surrounding riparian environment. The information recorded was used to assist interpretation of the biological data, and as part of a habitat condition assessment.

Field data was recorded on a number of specialised recording sheets which ALS WSG modified from the First National Assessment of River Health (FNARH) data sheets. The modifications were undertaken to enhance the efficiency of assessment of habitat characteristics without any loss of data accuracy or detail. Descriptions are based on visual estimates of characteristics such as streambed composition (percentage of total composition for each substrate category), aquatic and riparian vegetation cover, amount of instream organic material, area of aquatic habitats and canopy cover. The mean width (wetted width in metres), mean depth and sample depth were determined. The assessment also includes sketches of the longitudinal and cross-sectional profiles of the river reach assessed displaying the biological sampling site, location of *in-situ* water quality sampling, riparian zone width, type and height and location where photos are taken. The cross-section includes the approximate bank height, stream width and depth, and the approximate height of riparian vegetation.

2.3 Data Analysis

2.3.1 Aquatic Macroinvertebrate Communities

In order to elucidate spatial trends in the data and (where possible) determine the underlying environmental factors responsible for any observed trends, a number of univariate and multivariate routines were adopted. Both techniques provide differing levels of information, with univariate indices concentrating mainly on assessing the condition or "health" of sites, whilst multivariate analysis allows comparisons between sites based upon community structure to determine if relationships exist between relevant environmental variables and macroinvertebrate communities.

The univariate and multivariate techniques employed on macroinvertebrate data include:

- Taxa Richness and EPT Taxa Richness
- SIGNAL 2 Biotic Index (Chessman, 2003), and
- Current NSW AUSRIVAS models appropriate for the study region.
- Relative Abundance

Taxa Richness and EPT Taxa Index

Richness refers to the number of different taxa contained in a sample. The EPT taxa index refers to the proportional representation of key macroinvertebrate taxa belonging to the Ephemeroptera, Plecoptera and Trichoptera groups.

SIGNAL2 (Stream Invertebrate Grade Number – Average Level)

SIGNAL is a biotic index based on pollution sensitivity values (grade numbers) assigned to aquatic macroinvertebrate families that have been derived from published and unpublished information on their tolerance to pollutants, such as sewage and nitrification (Chessman, 1995). Each family in a sample is assigned a sensitivity grade between 1 (most tolerant) and 10 (most sensitive), and these grades were improved in Chessman (2003) with the new version called SIGNAL2 with standard errors. Those families in a sample for which no grade can be assigned are excluded from the analysis. The SIGNAL2 index and its associated standard error are calculated as the average grade number for all families present in the sample. The resulting index score can then be interpreted by comparison with reference and/or control sites.

NSW AUSRIVAS Model

All macroinvertebrate data, water quality parameters and habitat variables required by the relevant AUSRIVAS models were collected according to the latest NSW AUSRIVAS manual (Turak *et. al,* 2004) and ANZECC & ARMCANZ (2000) Water Quality Guidelines for aquatic ecosystems in Southeast Australia. NSW-autumn-edge is the AUSRIVAS model which applies to the study area and environmental variables required by the model are provided in Table 2-1.

The appropriate NSW AUSRIVAS model and accompanying scores and bandings have been used to detect any changes in observed and expected macroinvertebrate communities within the sites samples. AUSRIVAS generates site-specific predictions of the macroinvertebrate fauna expected to be present in the absence of environmental stress. The expected fauna from sites with a similar set of physical and chemical characteristics are then compared to the observed fauna, and the ratio derived is used to indicate the extent of the impact. This ratio can range from zero (0), when none of the expected taxa are found at a site, to approximately one (1), when all of the expected taxa are present. The value can also be greater than one (1) when more families are found at the site than

predicted by the model. The ratio scores are placed in bands which indicate whether the site is richer than reference, reference quality, below reference quality, well below reference quality or impoverished (Table 2-2). The AUSRIVAS model also provides a list of missing taxa from individual sampling sites by comparing observed taxa against expected taxa. This data will be analysed and reported to provide a more detailed understanding of the health ratings assigned to individual sampling sites and observed trends in river health.

Table 2-1: Environmental variables required to run the AUSRIVAS NSW-autumn-edge model

Environmental Variable	Physical/Chemical Description
ALKALINITY	Total carbonates. (mg/l)
ALTITUDE	Height above sea level. (m)
BEDROCK	Percent bedrock in habitat. (%)
BOULDER	Percent boulder [>256mm] in habitat. (%)
COBBLE	Percent cobble [64-256mm] in habitat. (%)
LATITUDE	Latitude of site (decimal degrees to 4dp)
LOGDFSM	Log 10 [x] Distance from source. (log 10 [m])
LOGSLOPE1KUS	Log 10 [x] Slope: Elevation difference in metres between the middle of the site and a point 1km upstream. (log 10 [m])
LONGITUDE	Longitude of site (decimal degrees to 4dp)
RAINFALL	Mean annual rainfall. (mm)

Table 2-2: Key to AUSRIVAS O/E bands for NSW-autumn- edge model, scores vary according to model and season

Band Label	O/E 50 Bandwidth	Band Name	Comments
Band X	> 1.18	More biologically diverse than reference sites	More taxa found than expected. Potential biodiversity hot-spot. Possible mild organic enrichment.
Band A	0.82 - 1.17	Reference condition	Most/all of the expected families found. Water quality and/or habitat condition roughly equivalent to reference sites. Impact on water quality and habitat condition does not result in a loss of macroinvertebrate diversity.
Band B	0.47 - 0.81	Significantly impaired	Fewer families than expected. Potential impact either on water quality or habitat quality or both, resulting in loss of taxa.
Band C	0.12 - 0.46	Severely impaired	Many fewer families than expected. Loss of macroinvertebrate biodiversity due to substantial impacts on water and/or habitat quality.
Band D	0 - 0.11	Extremely impaired	Few of the expected families remain. Extremely poor water and/or habitat quality. Highly degraded.

Relative Abundance

The relative abundance of the major taxonomic Orders is derived from the presence/absence (P/A) data for each of the samples. This measure provides an estimate of the percentage contribution of the major macroinvertebrate Orders and, when

presented in graphical form, allows for a visual representation of the macroinvertebrate community within each replicate sample, a pooled total for each site and a pooled total representing the macroinvertebrate community across the study area.

In addition to data analysis techniques macroinvertebrate taxa listed in the relevant legislation including the Environmental Protection and Biodiversity Conservation (EPBC) Act (1999), the Threatened Species Conservation (TSC) Act (1995) and the Fisheries Management (FM) Act (1994) will be highlighted.

2.3.2 Analysis of Fish Populations

At each site the first 50 specimens of each fish species caught were measured, general health condition assessed and identified to species level. This information was collated on an excel spreadsheet and basic univariate descriptive statistics derived. The main statistics generated for each site include the number of species and the maximum, minimum, and average length of each species. Length frequency distribution graphs, of each species with at least 25 specimens caught, were completed in Statistica 9.1 (StatSoft Inc., 2010). These graphs are used to examine the range of size classes and to determine if both adults and juveniles exist, indicating recruitment and consistent habitation of the species. Any species listed in the Environmental Protection and Biodiversity Conservation Act (EPBC) (1999) will be highlighted and possible impacts of the proposed development on the species discussed.

3 Results

3.1 Surface Water physico-chemistry

The majority of water quality parameters were within ANZECC (2000) guideline values for 95% species protection of lowland aquatic ecosystems in south eastern Australia, with the exceptions of pH and DO% (Table 3-1). pH was lowest at Anzac Creek (5.62) and was also below the lower guideline value of 6.5 at Georges River (6.06). DO% was also below the lower guideline value of 60% at both sample sites but was particularly low at Anzac Creek (11.6%). Alkalinity was considerably higher at Anzac Creek (70mg/l $CaCO_3$) compared to Georges River (18mg/L $CaCO_3$) but there is currently no ANZECC guideline value for this parameter.

Table 3-1: Results of *in-situ* water physico-chemistry (results highlighted in yellow are outside the ANZECC guideline values for 95% species protection of lowland aquatic ecosystems in south eastern Australia)

Water Quality Parameter	Georges River	Anzac Creek	ANZECC Guidelines
Sample Depth (m)	0.2	0.2	-
Temperature (°C)	12.45	9.50	-
Conductivity (µS/cm)	134.4	297.6	300
pH	6.06	5.62	6.5-9.0
DO (mg/L)	5.78	1.27	-
DO (% sat.)	48.8	11.6	60-120
Turbidity (NTU)	17.4	28.9	50
Alkalinity (mg/L $CaCO_3$)	18	70	-
Date	12/05/2011	12/05/2011	-
Time	10:00	14:00	-

3.2 Macroinvertebrates

A total of 27 macroinvertebrate taxa at the Family level were recorded across the study area, with a total of 18 taxa in the Georges River samples and 23 in the Anzac Creek samples (Table 3-2). Average taxa richness values were 14 and 18 for Georges River and Anzac Creek respectively. None of the macroinvertebrate taxa recorded are considered endangered or vulnerable by the TSC Act (1994), the FM Act (1995) or are listed in the EPBC Act (1999). Across the study area Odonata (Dragonflies and Damselflies) were the dominant Order accounting for just over 18% of all taxa recorded, and more than 22% in the Georges River samples and 17% in the Anzac Creek samples (Figure 3-1). Other Orders with substantial relative abundance included Coleoptera (Beetles) and Diptera (Flies) which each contributed almost 15% of the total taxa richness across the study area.

SIGNAL2 values for all macroinvertebrate samples were relatively low but the Anzac Creek samples scored slightly higher than the Georges River samples (Table 3-2). The SIGNAL2 results suggest the macroinvertebrate community is dominated by pollution tolerant taxa although low scores are common of lacustrine and low flow environments, and are not likely to be due solely to polluted or poor water quality but also to the limited diversity of habitats, as discussed in section 3.5.

Table 3-2: Summary of macroinvertebrate indices calculated for the Hyder samples collected in autumn (May 2011)

Site	Replicate	Taxa Richness	EPT Taxa Richness	SIGNAL2	AUSRIVAS O/E 50	AUSRIVAS Band
Georges River HYD01	Edge1	12	0	2.78	0.32	C
	Edge2	16	1	3.15	0.32	C
	Combined Samples	18	1	2.97	0.39	C
	Average	14	0.5	2.93	0.32	C
Anzac Creek HYD02	Edge1	20	1	3.35	0.73	B
	Edge2	16	0	3.15	0.37	C
	Combined Samples	23	1	3.15	0.73	B
	Average	18	0.5	3.25	0.61	B
All Samples Combined	**Average**	**16**	**0.5**	**3.11**	**0.48**	**-**
	Total	**27**	**1**	**2.92**	-	-

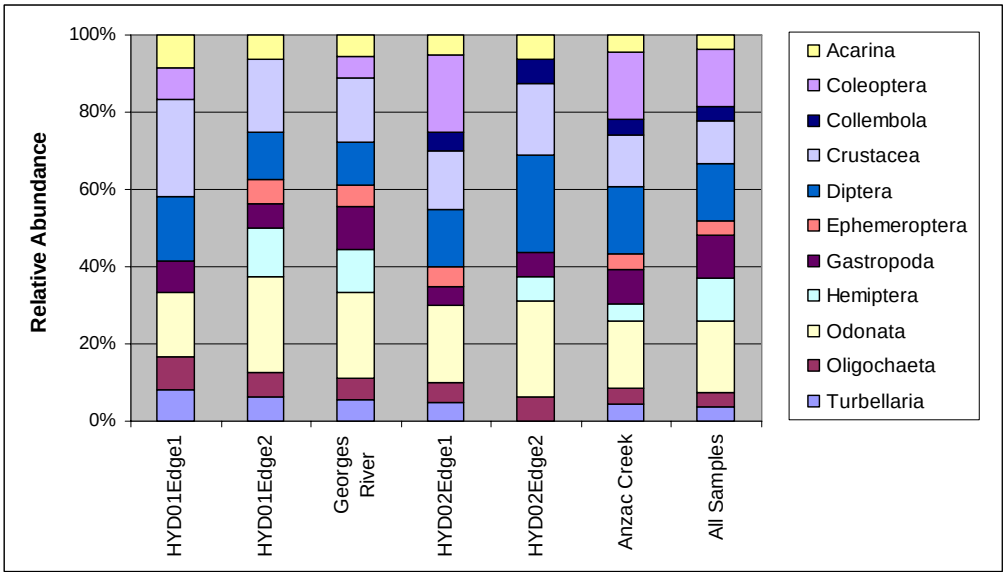


Figure 3-1: Relative abundance of macroinvertebrate taxa at the Order level for each of the Hyder samples, pooled replicate samples for each site (identified by name) and a combined total from both sites

The environmental variables used to run the NSW-autumn-edge AUSRIVAS model are provided in Table 3-3. AUSRIVAS results for the Georges River samples rated this site in Band C, suggesting that it is 'severely impaired' and that fewer macroinvertebrate families were observed than expected. This can indicate a loss of macroinvertebrate biodiversity, compared to reference sites, due to substantial impacts on water and/or habitat quality.

Each of the replicate samples from Anzac Creek scored a considerably different AUSRIVAS O/E 50, the difference being enough to separate the two samples in AUSRIVAS Band. The greater number of macroinvertebrate taxa in HYD02 Edge replicate 1 was the key reason for the difference as the environmental variables required for the model were identical for each replicate. Replicate 1 scored an O/E 50 of 0.73 while replicate 2 scored 0.37, the pooled sampled data scored 0.73 and the average of the two replicate samples was 0.63.

This provides an overall rating of AUSRIVAS Band B indicating that the macroinvertebrate community was 'significantly impaired'. This implies that fewer families than expected were observed and a 'potential impact' either on water quality, or habitat quality, or both.

Across all samples a large number of macroinvertebrate taxa were expected by the AUSRIVAS model to occur but were not observed. Approximately 48% of these missing taxa have a SIGNAL2 value above 5 and are considered to be sensitive to pollution and/or poor water quality. Of these missing taxa approximately 36% are from the EPT taxa groups which are highly sensitive to changes in water quality and/or habitat conditions. A complete list of the taxa expected but not observed is provided in Appendix B.

Table 3-3: Environmental variables used for input into AUSRIVAS NSW-autumn-edge model

Site Code	ALKALINITY	ALTITUDE	BEDROCK	BOULDER	COBBLE	LATITUDE	LOGDFSM	LOGSLOPE1KUS	LONGITUDE	RAINFALL
HYD01Edge1	18	16	0	0	0	-33.97	4.72	0.60	150.91	1300
HYD01Edge2	18	16	0	0	0	-33.96	4.72	0.60	150.91	1300
Georges River	18	16	0	0	0	-33.97	4.72	0.60	150.91	1300
HYD02Edge1	70	20	0	0	0	-33.96	2.69	0.30	150.92	1300
HYD02Edge2	70	20	0	0	0	-33.96	2.69	0.30	150.92	1300
Anzac Creek	70	20	0	0	0	-33.96	2.69	0.30	150.92	1300

3.3 Fish

A total of 65 specimens from 2 species were recorded at the Hyder sampling sites in May 2011 (Table 3-4). The species recorded included the native Flathead Gudgeon (*Philypnodon grandiceps*) and the introduced Gambusia (*Gambusia holbrooki*).Only one specimen of the native *P. grandiceps* was recorded and only at the Georges River site, thus no further summary statistics can be calculated for this species.

Table 3-4: Summary data for fish captured at the Hyder Consulting aquatic monitoring sites

Site Name & Code	Fish Species	Common Name	Count	Mean Length (mm)
Georges River HYD01	*Gambusia holbrooki*	Gambusia	50	26.4
	Philypnodon grandiceps	Flathead Gudgeon	1	32
Anzac Creek HYD02	*Gambusia holbrooki*	Gambusia	14	25.0
Total			**65**	

Gambusia were caught at both sample sites but were more abundant at Georges River (50+ specimens) compared to Anzac Creek (14 specimens). The mean length of Gambusia was 26.4mm and 25.0mm for Georges River and Anzac Creek respectively and both sites displayed a range of size classes (Figure 3-2) suggesting that both adults and juveniles were present and that recruiting populations exist. Bait traps were the most successful collection method at in the Georges River but due to the extensive macrophyte cover and

limited open water at Anzac Creek, the majority of fish specimens were caught as by-catch in the macroinvertebrate samples (Figure 3-3).

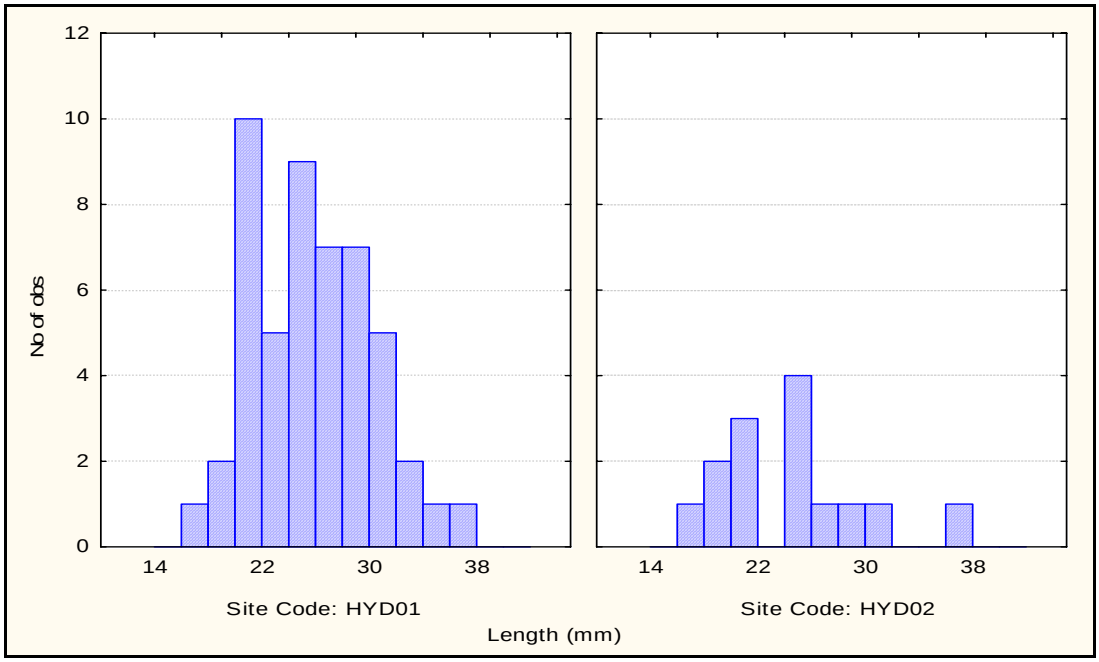


Figure 3-2: Length frequency distribution histograms of Gambusia (*Gambusia holbrooki*) at each of the Hyder aquatic monitoring sites

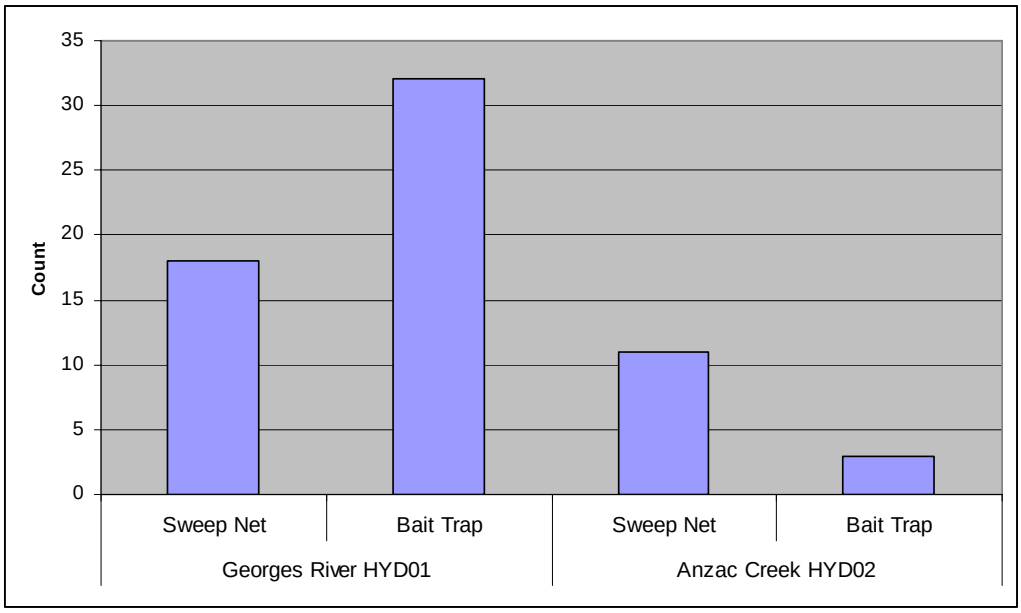


Figure 3-3: Total catch of Gambusia (*Gambusia holbrooki*) per collection method for each of the Hyder Consulting aquatic monitoring sites sampled in May 2011

3.4 Groundwater Dependant Ecosystems

A visual assessment of the site was made to consider the presence of groundwater and the potential for groundwater dependant communities to exist within the study area. No groundwater monitoring bores were located on the study site, so no groundwater samples could be collected.

Results from previous studies (URS, 2002) in an area adjacent to the Hyder study area, have shown the depth to groundwater to be generally between 4 - 5mbgl. This study suggested that groundwater flow is generally radially from the topographic high and that the location of the Georges River indicates groundwater flow underlying the study area would be predominantly westerly. Results from the URS (2002) study indicated that lower salinity waters are present in the shallow groundwater inferring that local recharge is occurring, and that the low/moderate salinity observed at deeper levels may be indicative of deep local recharge. This suggests that groundwater is likely to contribute to the existing surface water, particularly in Anzac Creek, and that there is connectivity between the groundwater and the Georges River. Analysis of the isotopic signature of the various water sources would be required to conclusively demonstrate this connectivity which would require groundwater monitoring bores at various locations across the site. Such bores could be sampled for both water quality and invertebrate communities. To ensure a sample is representative, newly constructed groundwater monitoring bores should not be sampled for at least 6 months post construction. Confirmation of the presence or absence of groundwater fauna is desirable, but construction of monitoring bores and an adequate sampling regime is likely to set back the proposed development considerably.

3.5 Aquatic and Riparian Habitat Assessment

3.5.1 Georges River

The Georges River site (Figure 3-4) was 100m long and extended north from beneath the East Hills Railway Bridge. The river was 40 to 60m wide, and the bank dropped rapidly to a depth of 1.2m before falling away at a steadier grade. Aquatic habitats present included soft substrate pool habitat, large woody debris and extensive macrophyte cover. Riparian vegetation was dominated by dense growth of Lantana (*Lantana camara)*, with occasional tall *Eucalyptus* spp. The western bank could not be sampled due to access restrictions, however observations from the eastern bank suggested that access would be difficult due to vertical banks. Overhanging vegetation, fallen logs, mats of sticks, submerged (*Elodea canadiensis*) and floating aquatic plants (*Azola* sp., *Salvinia molesta*) were present in the littoral and edge habitats throughout the study reach.

Figure 3-4: Georges River facing upstream from the macroinvertebrate and fish sampling site

3.5.2 Anzac Creek

The Anzac Creek site (Figure 3-5, Figure 3-6) was downstream of an old and currently unused rail crossing. The limited aquatic habitat included soft substrate pools and extensive macrophyte cover and there was no open or running water present at the site. The creek was obscured by dense growths of *Typha* sp. and *Salvinia molesta*. Water was mostly static and shallow (1 to 30cm deep) with a small pool of approximately 1m depth immediately downstream of the culvert tunnels running underneath the rail line. Riparian vegetation was dominated by *Melaleuca* sp., *Eucalyptus* spp., and other native shrub species.

Figure 3-5: Anzac Creek facing upstream of the railway culvert, displaying extensive growth of *Typha* sp. and *Salvinia molesta*, and the limited aquatic habitat available for macroinvertebrate and fish sampling

Figure 3-6: Anzac Creek facing downstream of the railway culvert, displaying the limited open water available for macroinvertebrate and fish sampling

4 Discussion

4.1 Surface Water Physico-chemistry

The *in-situ* water physico-chemistry showed that pH and dissolved oxygen were below the ANZECC guideline values at both sites. This maybe a factor influencing the macroinvertebrate community composition, but further monitoring would be required to confirm that the low pH and dissolved oxygen values recorded are consistent over time. The measured variables were limited to *in-situ* parameters and further laboratory analysis of pollutants, nutrients, metal concentrations, bacterial content etc. may find other conditions of water physico-chemistry that may be responsible for some impacts on the macroinvertebrate communities.

4.2 Macroinvertebrates

Results of the macroinvertebrate sampling showed both sites to have relatively depauperate macroinvertebrate communities. Richness values, at the taxonomic level of Family, were generally low and many sensitive taxa were not recorded. SIGNAL2 values for all samples suggest the macroinvertebrate community of these sites is dominated by pollution tolerant taxa. AUSRIVAS rated the Georges River site in Band C 'severely impaired' and results show that fewer macroinvertebrate families were observed than were expected by the AUSRIVAS model. This can indicate a loss of macroinvertebrate biodiversity due to 'substantial' impacts on water and habitat quality or both. Anzac Creek was rated slightly better, AUSRIVAS Band B, indicating that the macroinvertebrate community was 'significantly impaired'. This implies that fewer families than expected were observed and a 'potential' impact has occurred, either on water quality, or habitat quality or both, resulting in a loss of taxa.

Of the macroinvertebrate taxa that were expected but not observed, a large proportion are known to be sensitive to pollution and/or poor water quality (as indicated by their SIGNAL2 scores). The Family Baetidae from the Order Ephemeroptera (Mayflies) was the single representative of the sensitive EPT taxa groups but was recorded in only one replicate sample from each site. This suggests a limited distribution and low abundance of Mayflies across the study area. Across all samples Odonata (Dragonflies and Damselflies) were the most dominant Order, followed by Coleoptera (Beetles) and Diptera (Flies). These taxa generally have a highly motile adult stage. The dominance of these taxa suggests that aerial dispersal is a primary colonisation pathway and a major influence on macroinvertebrate community structure within the study area. None of the macroinvertebrate taxa recorded is considered endangered or vulnerable by the TSC Act (1994), the FM Act (1995) or is listed in the EPBC Act (1999).

The macroinvertebrate community at both sample sites was found to have at least some level of impairment and any further degradation of these sites is likely to influence the macroinvertebrate community on a local scale. The study area of the Georges River is isolated to a 100m stretch of the river. A large proportion of this reach is heavily vegetated with Lantana on the banks and dense submerged and floating aquatic plants including *Elodea Canadensis*, *Azolla* sp. and *Salvinia molesta*. This could be considered as poor quality habitat which lacks the diversity of micro-habitats to support a diverse and healthy macroinvertebrate community. While construction of a rail bridge may have localised impacts on the macroinvertebrate community it is unlikely to have any prolonged or widespread impacts and the community should recover from any disturbance in a short time following construction. Potential impacts such as increased sedimentation or instream habitat alterations should be minimised to ensure the macroinvertebrate community does not degrade further. Ongoing monitoring of the Georges River, both upstream and downstream of the proposed development, may help to identify and minimise any potential impacts to aquatic macroinvertebrate communities.

Assessment of the macroinvertebrate community at the Anzac Creek site showed it to be more diverse and healthy than that of the Georges River site. If development of the site alters the habitat of Anzac Creek, through direct habitat removal or indirect sources such as increased runoff and sedimentation, it is likely to impact the aquatic macroinvertebrate community. As previously mentioned much of the macroinvertebrate taxa recorded at the two sites have aerial adult stages. It is possible that Anzac Creek may be an important source of macroinvertebrate colonisers to the Georges River (and vice versa, but to a lesser extent) and as such consideration should be given to maintaining the condition of the macroinvertebrate community in Anzac Creek. As this site is at the top of the Anzac Creek catchment any changes to the aquatic or riparian habitats, or landuse within the catchment, are likely to have impacts on communities downstream. Ongoing monitoring of macroinvertebrate communities downstream of the development may assist in identifying changes in aquatic communities and help to minimise any potential impacts that may occur.

4.3 Fish

To identify the potential for fish presence at each of the study sites the assessed habitat was compared to the waterway types according to Faithfull and Witheridge (2003). The Georges River at the Hyder study site was a permanent water body which classifies it as a Class 1 Major fish habitat. This site was a wide deep pool with steep vegetated banks which made access to the site difficult. The edge habitats of the river were also densely covered with aquatic macrophyte and any region beyond the macrophyte was too deep to wade. The depth of the river, dense macrophyte cover, and cover of snags and large woody debris, prevented seine netting, fyke netting and backpack electrofishing from being conducted, thus bait traps and sweep nets were the only methodologies able to be employed. This limited the assessment of fish communities at the Georges River study site to the littoral and edge dwelling species only.

Anzac Creek was limited to small static pools with dense covering of macrophytes including *Typha* sp. and *Salvinia molesta* which limited the habitat available for fish sampling. Anzac Creek at the location of the Hyder study site could be considered an intermittent waterway or wetland that would only flow immediately following a substantial rain event. This would classify this site as a Class 3 Minimal fish habitat according to Faithfull and Witheridge (2003). As with the Georges River site bait traps and sweep netting only could be used and the limited open water reduced the number of bait traps able to be deployed.

Only one native fish species was recorded across the study area. One specimen of the native Flathead Gudgeon (*Philypnodon grandiceps*) was recorded within the Georges River and no native fish were recorded in Anzac Creek. Flathead Gudgeon is generally a benthic species that prefers slow flowing areas of lowland streams or lakes and dams and is often found in weedy or muddy areas with abundant cover (Lintermans, 2007). The extensive cover of aquatic macrophyte and woody debris in the edge habitats of the Georges River provide an ideal habitat for this species. Although only one specimen was recorded it is likely that further sampling would record additional specimens and that the species is widely distributed in the lower reaches of the Georges River. The species matures at 42-50mm length and breeds in spring and summer when water temperatures are between 18-27°C and eggs are laid attached to solid objects such as rock and wood (Lintermans, 2007). The specimen observed was 32mm and would be likely to reach sexual maturity in the next breeding season and, with abundant cover of woody debris, a consistent population of this species is highly likely to occur.

Flathead Gudgeon is not considered an endangered or vulnerable species in the FM Act (1994), nor is it listed in the EPBC Act (1999) and is common throughout its range. It occurs throughout the Murray-Darling Basin and in coastal drainages in Victoria, northern Tasmania, New South Wales and Queensland (Lintermans, 2007). Although a widely distributed and common species care should be taken to maintain the aquatic habitats preferable to this species as they are likely to be beneficial to other potential species.

Gambusia (*Gambusia holbrooki*) were caught at both sample sites but were more abundant at Georges River compared to Anzac Creek. This small, introduced fish rapidly reproduce, disperse widely, occupy diverse habitats and is also a highly aggressive predatory species, often to the detriment of native species (NSW National Parks and Wildlife Service, 2003). Predation by *G. holbrooki* is listed as a key threatening process under Schedule 3 of the TSC Act (1995). Gambusia are commonly found in lakes or slow flowing streams, mostly around the edges or amongst freshwater plants. Maturity can be reached after only two months, at about 25mm long, and females produce about fifty young in each batch, and up to nine batches per year (Lintermans, 2007). Both sites displayed a range of size classes and even though the Anzac Creek population was less abundant and possessed fewer size classes, data from both populations suggests that recruitment is occurring. Gambusia tolerates a wide range of water temperatures, oxygen levels, salinities and turbidities and due to it's ability to breed rapidly, it has assumed plague proportions in many habitats (Lintermans, 2007). Changes to the aquatic habitats, such as reduced habitat diversity and increased sedimentation, that may result from construction works are likely to benefit Gambusia and be detrimental to native fish species. Gambusia are known to display aggressive fin-nipping behaviour and often compete with small native fishes (McDowell, 1996). Any further increase in the Gambusia population is highly likely to negatively impact the native Flathead Gudgeon therefore processes which could potentially reduce aquatic habitat diversity, such as siltation during construction works, should be minimised if possible.

Previous studies within the Georges River catchment (Williams *et.al,* 2004) surveyed fish approximately 500m upstream of the Hyder Study site at the Cambridge Avenue road bridge. This survey recorded several other native species including Striped Gudgeon (*Gobiomorphus australis*), Empire Gudgeon (*Hypseleotris compressa*) and Australian Bass (*Macquaria novemaculeata)* and habitat requirements of these species are similar to those of Flat-head Gudgeon. The threatened Macquarie Perch (*Macquaria australasica*) has also been identified in parts of the upper Georges River catchment (NSW Industry & Investment, 2010), but generally, the Macquarie Perch are found upstream of areas inhabited by Australian Bass (Native Fish Australia, 2009b) so it is highly unlikely that Macquarie Perch occur in the lower reaches of the Georges River at or near this site.

It may be possible to conduct a more comprehensive assessment of the fish community at the Georges River site through other methods such as gill netting and/or boat electrofishing. These methods may be more costly and time consuming, as boat access to the river would be required, but are likely to provide more comprehensive and conclusive results of the fish species present at the site. The proposed development is confined to a small stretch of the Georges River and any construction works are likely to be confined to this site and possibly a small distance downstream. Development of a rail bridge at this site is likely to have limited impact on any other potential native fish populations which, if present, are likely to populate a much wider region of the lower reaches of the Georges River.

4.4 Groundwater Dependant Ecosystems

No groundwater monitoring bores were located on the study site, so no groundwater samples could be collected. Confirmation of the presence or absence of groundwater dependant fauna (stygofauna) is desirable, but construction of monitoring bores and an adequate sampling regime is likely to set back the proposed development considerably. Results from the URS (2002) study indicated that that local recharge is occurring, which suggests that groundwater contributes to the existing surface water, particularly in Anzac Creek, and there is connectivity between the groundwater and the Georges River. Although the extent of groundwater distribution in the area is not clear it is probable, due to local hydrogeology, that groundwater across the study area and the wider region is interconnected. This would suggest that if stygofauna were present they are unlikely to be isolated to the vicinity of the proposed developments and while isolated areas of the groundwater may be influenced, a significant impact on the wider region is highly unlikely.

An example of the Castlereagh Swamp Woodland (CSWL), listed as an Endangered Ecological Community in the TSC Act (1995), is located within the study area and surrounding the Anzac Creek study sites. Characteristic tree species in the CSWL are *Eucalyptus parramattensis subsp. parramattensis* and *Melaleuca decora* and small billabongs and/or wetlands may occur within the community (OEH, 2011). As Anzac Creek is likely to be predominantly a result of groundwater recharge specimens of these tree species within the Anzac Creek area are likely to be groundwater dependent. This suggests that the CSWL community within the study area could be considered a groundwater dependant ecosystem. Species composition at any site depends on local topography and drainage conditions and CSWL is typically associated with poorly-drained depressions and creeklines on clay soils associated with Tertiary alluvium (OEH, 2011). Any development within or in close proximity to the Anzac Creek CSWL community should thoroughly consider any potential impacts on groundwater quality and quantity as any localised pollution or reduction in the groundwater table is likely to influence this endangered community.

4.5 Aquatic and Riparian Habitat Assessment

The two sites assessed were vastly different in their habitat types. The Georges River site is a lowland, slow flowing river close to the end of the catchment. Landuse in the catchment upstream of the sampling site is a mixture of residential, light industrial and natural forest. The sampling site had steep heavily vegetated banks which made access difficult and the instream habitat was generally a deep soft bottomed pool and also heavily vegetated with aquatic macrophytes. The combination of these factors made macroinvertebrate and fish sampling difficult and limited the variety of habitats which could be successfully sampled. The extensive macrophyte cover of submerged *Elodea canadiensis* and floating aquatic plants (*Azola* sp., *Salvinia molesta*) present throughout the study reach, reduced the overall heterogeneity of the aquatic habitat and is likely a factor influencing the macroinvertebrate community composition. Riparian and bankside vegetation was dominated by the introduced Lantana (*Lantana camara*) and invasion, establishment and spread of this species is listed as a key threatening process in the TSC Act (1995) while degradation of native riparian vegetation along NSW water courses is also listed in the FM Act (1994). Consideration of these threatening processes should be given with management of the study area and development could consider control/removal of Lantana as an offset to any potential impacts that may result from construction works.

The site on Anzac Creek was quite different and more similar to a swamp or wetland environment than to a river. The dense macrophyte cover and small catchment area up-stream of the site (catchment area approximately 450m^2) provided static water only and the samplable aquatic habitat was limited to two small pools both heavily vegetated with floating and emergent macrophytes. The introduced Salvinia (*Salvinia molesta*) dominated the floating macrophyte composition at the Anzac Creek sample sites. Salvinia is a Weed of National Significance and is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts (Department of the Environment and Heritage and the CRC for Australian Weed Management, 2003). Salvinia is an aquatic weed that can grow rapidly to cover the entire water surface which shades out any submerged plant life and impedes oxygen exchange, making the water unsuitable for fish and other animals. The presence of Salvinia at the Anzac Creek study site has potential to negatively impact the aquatic ecosystem both directly at this site and downstream. Development of a rail bridge at this site should consider the management of Salvinia, both locally and downstream, as it may help to reduce any potential impacts that may result as a consequence of construction works.

The proposed development site is relatively small and only limited areas of development are expected to disturb the aquatic habitats. The section of rail proposed over the Georges River is unlikely to influence any potential surface water to groundwater connectivity as it is limited to a small stretch of the river. Development of the site around the upper areas of Anzac Creek may influence the potential connectivity of surface water and reduce the likelihood of it becoming habitat for native fish species. Consideration of

this connectivity should be given in the design and construction of the rail bridge to minimise impacts at this site that may have implications for ecosystems downstream.

The aquatic ecosystems within the proposed development area could be considered slightly to moderately disturbed and not in pristine condition. However, care should be taken to minimise any further degradation of this site. The proposed development has potential to have a greater impact on the aquatic ecosystem of Anzac Creek compared to the Georges River as this area remains in a more 'natural' state. This area also contains an example of the endangered Castlereagh Swampland Community which is likely to be groundwater dependant and consideration should be given to minimise any potential impacts to this community. The development of the rail bridge across the Georges River should consider any additional sedimentation that may result during construction works, but any potential impacts to the aquatic communities at this site are likely to be negligible, both spatially and temporally.

5 Conclusions and Recommendations

The aquatic ecology survey designed by ALS focused on macroinvertebrate and fish communities and a general assessment of the aquatic habitat at each of the sampling sites was made. A summary of findings of this study follow;

- Results of the macroinvertebrate sampling showed both sites to have relatively depauperate macroinvertebrate communities and any further degradation of these sites is likely to influence the macroinvertebrate community on a local scale.
- The Georges River site was rated in Band C by the AUSRIVAS model indicating that was 'severely impaired'.
- Anzac Creek rated slightly better and the overall rating of AUSRIVAS Band B indicates the macroinvertebrate community was 'significantly impaired'.
- The *in-situ* water physico-chemistry showed that pH and dissolved oxygen were below the ANZACC guideline values at both sites. This maybe a factor influencing the macroinvertebrate community composition, but further monitoring would be required to confirm that the low pH and dissolved oxygen values are consistent over time.
- None of the recorded macroinvertebrate taxa are listed in the EPBC Act.
- The assessment of fish communities within the reach of Georges River was limited to the littoral and edge dwelling species only as access to the river prevented most of the proposed sampling methodologies.
- Flathead Gudgeon (*Philypnodon grandiceps*) was the only native fish species recorded and only one specimen was recorded at the Georges River site. This species is not listed in the EPBC Act and is considered common throughout its range.
- The introduced Gambusia (*Gambusia holbrooki)* was caught at both sample sites but was more abundant in the Georges River. Any further increase in the Gambusia population is likely to negatively impact the native Flathead Gudgeon population therefore processes which could potentially reduce aquatic habitat diversity, such as increased siltation during construction works, should be minimised.
- It is possible that other fish species are present in the open waters of the Georges River site but other sampling methods, such as gill netting or boat electrofishing, would be required to confirm this. The proposed development, confined to a small stretch of the Georges River, is likely to have limited impact on the river and any other potential native fish populations.
- The presence/absence of groundwater fauna could not be confirmed due to the lack of monitoring bores on the study site. Any potential fauna are unlikely to be isolated to the vicinity of the proposed developments and while isolated areas of groundwater may be influenced, a significant impact on the wider region is highly unlikely.
- The Castlereagh Swampland Community within the vicinity of Anzac Creek and within the study area could be considered a groundwater dependant ecosystem. Any development within the Anzac Creek CSWL community should thoroughly consider potential impacts on groundwater quality and quantity as any localised pollution or reduction in the groundwater table is likely to influence this endangered community.
- Management of the study area should consider control/removal of Lantana as an offset to any potential impacts that may result from construction works. The aim would be reducing the impact of Lantana on the aquatic ecosystems through reducing the degradation of streamside vegetation.
- While the aquatic ecosystems within the proposed development area are slightly to moderately disturbed, care should be taken to minimise impact and prevent any further degradation.

6 References

Allen, G. R., Midgley, S. H., and Allen, M., (2002). "Field Guide to the Freshwater Fishes of Australia." (Western Australian Museum: Perth.)

ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

Australian Code of Electrofishing Practice (1997). Standing Committee for Fisheries and Aquaculture (SCFFA). NSW Fisheries Management Publication No. 1.

Chessman BC (2003). New sensitivity grades for Australian river macroinvertebrates. Marine and Freshwater Research, 54: 95-104.

Clarke, K.R. & Gorley, R.N. (2006). PRIMER v6: User Manual/Tutorial. PRIMER-E: Plymouth.

EPBC (1999). Environment Protection and Biodiversity Conservation Act 1999. Prepared by the Office of Legislative Drafting and Publishing, Attorney General's Department, Canberra. Act No. 91 of 1999 as amended, prepared on 10 May 2011 taking into account amendments up to Act No. 5 of 2011

Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp.

FM Act (1994). Fisheries Management Act 1994 No 38 Current version for 17 June 2011 to date (accessed 6 July 2011 at 16:51) http://www.legislation.nsw.gov.au/xref/inforce/?xref=Type%3Dact%20AND%20Year%3D1994%20AND%20no%3D38&nohits=y

ISO (1983). Water Quality: Methods of Biological Sampling - Handnet Sampling of Aquatic Benthic Macroinvertebrates. Draft ISO International Standard.

Lintermans, M. (2007). "Fishes of the Murray-Darling Basin: an introductory guide". Murray-Darling Basin Commission, Canberra. 166 p.

McDowall, R.M. (1996). "Freshwater Fishes of South-Eastern Australia". Reed Books. Pp. 247.

Native Fish Australia (2009a). Australian Bass. Retrieved 21 June 2011, from http://www.nativefish.asn.au/

Native Fish Australia (2009b). Macquarie Perch. Retrieved 21 June 2011, from http://www.nativefish.asn.au/

NSW National Parks and Wildlife Service (2003). NSW Threat Abatement Plan. Predation by Gambusia holbrooki – The Plague Minnow. NPWS. Hurstville, NSW.

OEH (2011). Office of Environment and Heritage. Castlereagh swamp woodland community - endangered ecological community listing. NSW Scientific Committee - final determination. Retrieved 7 July 2011, from http://www.environment.nsw.gov.au/determinations/CastlereaghSwampWoodlandCommunityEndComListing.htm

StatSoft, Inc. (2010). STATISTICA (data analysis software system), version 9.1. www.statsoft.com

TSC Act (1995). Threatened Species Conservation Act 1995 No 101. Current version for 15 April 2011 to date (accessed 6 July 2011 at 16:47). http://www.legislation.nsw.gov.au/maintop/view/inforce/act+101+1995+cd+0+N

Turak E, Waddell N & Johnstone G (2004). New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual 2004. http://ausrivas.canberra.edu.au/man/NSW/ .File last modified 27 June 2011.

URS (2002). Investigation Review Report. DNSDC, Moorebank Defence Lands. Prepared for Property Disposal Task Force, Department of Defence.

Williams R.J., Bryant A. and Ledlin (eds) (2004). Biodiversity of the Georges River Catchment: Aquatic biodiversity. Department of Infrastructure, Planning and Resources: Sydney.

Department of the Environment and Heritage and the CRC for Australian Weed Management (2003). Salvinia (Salvinia molesta) weed management guide. Weeds of National Significance, ISBN 1 9209 3216 X

Appendix A - Macroinvertebrate Data, May2011

Taxa Code	Class/Order	Family/Sub-family	SIGNAL 2 Value	HYD01Edge1	HYD01Edge2	HYD02Edge1	HYD02Edge2
IF619999	Turbellaria	Dugesiidae	2	3	4	4	
KG059999	Gastropoda	Lymnaeidae	1				1
KG079999	Gastropoda	Planorbidae	2		2	1	
KG089999	Gastropoda	Physidae	1	2			
LO999999	Oligochaeta	Oligochaeta	2	4	2	6	3
MM999999	Acarina	sp.	6	51	22	5	17
QA999999	Collembola	sp.	1			2	5
QC099999	Coleoptera	Dytiscidae	2	1		12	
QC119999	Coleoptera	Hydrophilidae	2			5	
QC139999	Coleoptera	Hydraenidae	3			1	
QC209999	Coleoptera	Scirtidae	6			1	
QD099999	Diptera	Ceratopogonidae	4			8	4
QD249999	Diptera	Stratiomyidae	2				1
QDAE9999	Diptera	s-f Tanypodinae	4	2	1	6	8
QDAJ9999	Diptera	s-f Chironominae	3	1	3	7	4
QE029999	Ephemeroptera	Baetidae	5		5	1	
QH539999	Hemiptera	Hebridae	3				16
QH629999	Hemiptera	Belostomatidae	1		1		
QH689999	Hemiptera	Pleidae	2		1		
QO029999	Odonata	Coenagrionidae	2	45	52	10	5
QO129999	Odonata	Aeshnidae	4			1	1
QO179999	Odonata	Libellulidae	4		5	4	1
QO309999	Odonata	Hemicorduliidae	5		1	4	1
QO999998	Odonata	Epiproctophora	3	2	2		
OG999999	Crustacea	Cladocera	N/A	3	2	1	12
OH999999	Crustacea	Ostracoda	N/A	6	5	3	4
OJ999999	Crustacea	Copepoda	N/A	12	11	13	1

Appendix B - List of Macroinvertebrate Taxa Expected in AUSRIVAS model but not observed in Hyder samples.

Taxa Code	Class/Order	Family	SIGNAL2 Value
IF499999	Turbellaria	Temnocephalidae	0
IJ019999	Nematomorpha	Gordiidae	5
KG029999	Gastropoda	Hydrobiidae	4
KG049999	Gastropoda	Thiaridae	4
KG069999	Gastropoda	Ancylidae	4
KP029999	Gastropoda	Corbiculidae	4
LH019999	Hirudinea	Glossiphoniidae	1
OP029999	Amphipoda	Ceinidae	2
OP039999	Amphipoda	Eusiridae	7
OR129999	Isopoda	Cirolanidae	2
OT019999	Decapoda	Atyidae	3
OT029999	Decapoda	Palaemonidae	4
OV019999	Decapoda	Parastacidae	4
QC069999	Coleoptera	Haliplidae	2
QC089999	Coleoptera	Noteridae	4
QC109999	Coleoptera	Gyrinidae	4
QC189999	Coleoptera	Staphylinidae	3
QC349999	Coleoptera	Elmidae	7
QC379999	Coleoptera	Psephenidae	6
QD019999	Diptera	Tipulidae	5
QD069999	Diptera	Dixidae	7
QD079999	Diptera	Culicidae	1
QD109999	Diptera	Simuliidae	5
QD119999	Diptera	Thaumaleidae	7
QD229999	Diptera	Athericidae	8
QDAD9999	Diptera	Podonominae	6
QDAF9999	Diptera	Orthocladiinae	4
QE039999	Ephemeroptera	Oniscigastridae	8
QE059999	Ephemeroptera	Coloburiscidae	8
QE069999	Ephemeroptera	Leptophlebiidae	8
QE089999	Ephemeroptera	Caenidae	4
QH529999	Hemiptera	Mesoveliidae	2
QH549999	Hemiptera	Hydrometridae	3
QH569999	Hemiptera	Veliidae	3
QH579999	Hemiptera	Gerridae	4
QH649999	Hemiptera	Gelastocoridae	5
QH659999	Hemiptera	Corixidae	2
QH679999	Hemiptera	Notonectidae	1
QL019999	Lepidoptera	Pyralidae	3

Taxa Code	Class/Order	Family	SIGNAL2 Value
QM019999	Megaloptera	Corydalidae	7
QM029999	Megaloptera	Sialidae	5
QO039999	Odonata	Isostictidae	3
QO049999	Odonata	Protoneuridae	4
QO059999	Odonata	Lestidae	1
QO079999	Odonata	Megapodagrionidae	5
QO089999	Odonata	Synlestidae	7
QO139999	Odonata	Gomphidae	5
QO169999	Odonata	Corduliidae	5
QP029999	Odonata	Austroperlidae	10
QP039999	Plectoptera	Gripopterygidae	8
QP049999	Plectoptera	Notonemouridae	6
QT019999	Trichoptera	Hydrobiosidae	8
QT039999	Trichoptera	Hydroptilidae	4
QT049999	Trichoptera	Philopotamidae	8
QT069999	Trichoptera	Hydropsychidae	6
QT079999	Trichoptera	Polycentropodidae	7
QT089999	Trichoptera	Ecnomidae	4
QT139999	Trichoptera	Tasimiidae	8
QT159999	Trichoptera	Conoesucidae	7
QT179999	Trichoptera	Helicopsychidae	8
QT189999	Trichoptera	Calocidae	9
QT219999	Trichoptera	Philorheithridae	8
QT229999	Trichoptera	Odontoceridae	7
QT239999	Trichoptera	Atriplectididae	7
QT249999	Trichoptera	Calamoceratidae	7
QT259999	Trichoptera	Leptoceridae	6

Appendix C -
Fish Data, May 2011

Site Code	Date	Collection Method	Common Name	Scientific Name	Length (mm)
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	25
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	17
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	38
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	29
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	33
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	26
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	21
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	20
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	36
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	32
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	26
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	29
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	34
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	29
HYD01	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	32
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	21
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	24
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	25
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	23
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	26
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	30
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	28
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	32
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	29
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	20
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	24
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	27
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	31
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	28
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	25
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	27
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	26
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	24

Site Code	Date	Collection Method	Common Name	Scientific Name	Length (mm)
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	30
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	28
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	28
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	22
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	25
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	26
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	30
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	23
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	32
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	27
HYD01	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	21
HYD01	12/05/2011	Bait Trap	Flathead Gudgeon	*Philypnodon grandiceps*	32
HYD02	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	22
HYD02	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	22
HYD02	12/05/2011	Bait Trap	Gambusia	*Gambusia holbrooki*	25
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	27
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	26
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	37
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	20
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	22
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	25
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	26
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	32
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	29
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	18
HYD02	12/05/2011	Sweep Net	Gambusia	*Gambusia holbrooki*	19

APPENDIX D

FLORA SPECIES LIST

Plant species recorded in the study area

Notes:

* indicates exotic species; # indicates non-local native species; + indicates threatened species.

Columns Q1 to Q12 represent Quadrats 1 to 12. The values for each species are the estimated percentage foliage cover of the species within the 0.04 hectare quadrat.

Species that are not defined as present within a specific sampling location are those that were opportunistically recorded within the study area during surveys.

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
Ferns and Allied Plants															
Blechnaceae	*Doodia caudata*	Small Rasp Fern													
Dennstaedtiaceae	*Hypolepis muelleri*						20								
	Pteridium esculentum	Bracken													
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern								2					
Gleicheniaceae	*Gleichenia dicarpa*	Pouched Coral-fern										2			
Lindsaeaceae	*Lindsaea linearis*	Screw Fern			1										
Pteridaceae	*Adiantum aethiopicum*	Common Maidenhair Fern					2			2					
	Cheilanthes sieberi	Rock Fern			1							1			
Salviniaceae	* *Salvinia molesta*	Salvinia													
Schizaeaceae	*Schizaea bifida*	Forked Comb Fern										1			
Gymnosperms															
Araucariaceae	*Araucaria heterophylla*	Norfolk Island Pine			1										X
Cupressaceae	*Callitris rhomboidea*	Port Jackson Cypress-pine													
	* *Cupressus sempervirens cv. Stricta*	Pencil Pine													X
Pinaceae	* *Pinus sp.*								5						
Zamiaceae	*Macrozamia spiralis*	Burrawang													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
Angiosperms - Dicotyledons															
Acanthaceae	*Brunoniella australis*	Blue Trumpet, Blue Yam													
Amaranthaceae	*Alternanthera denticulata*	Common Joyweed			2										
	* *Alternanthera philoxeroides*	Alligator Weed					2			2	25				
Apiaceae	*Centella asiatica*	Indian Pennywort					1							1	
	* *Hydrocotyle bonariensis*	Beach Pennywort													
	Hydrocotyle peduncularis						1					1			
	Platysace ericoides	Heath Platysace	3			1							1		
	Trachymene incisa		1			1						1	1		
Apocynaceae	* *Araujia sericifera*	Moth Vine, Cruel Plant								1					
	* *Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush													
	* *Nerium oleander*	Oleander													X
	Parsonsia straminea	Common Silkpod		15								1			
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax													
Asteraceae	* *Aster subulatus*	Wild Aster													
	* *Bidens pilosa*	Cobblers Pegs							1						
	Cassinia uncata	Sticky Cassinia													
	* *Chrysanthemoides monilifera subsp. rotundata*	Bitou Bush													
	* *Cirsium vulgare*	Black Thistle								1					
	* *Conyza sp.*	Fleabane			1										
	Coronidium scorpioides	Button Everlasting													
	* *Delairea odorata*	Cape Ivy								10					
	Euchiton sphaericus				1										

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	* *Hypochaeris radicata*	Catsear, False Dandelion													
	Olearia microphylla														
	Ozothamnus diosmifolius	White Dogwood		1	2										
	* *Senecio madagascariensis*	Fireweed			1									1	
	Senecio quadridentatus	Cotton Fireweed													
	* *Sonchus oleraceus*	Common Sow-thistle													
	* *Tagetes minuta*	Stinking Roger													
	Vernonia cinerea														
	Vittadinia pustulata														
	* *Xanthium occidentale*	Noogoora Burr													
Bignoniaceae	* *Jacaranda mimosifolia*	Jacaranda													X
Boraginaceae	* *Echium plantagineum*	Paterson's Curse													
Brassicaceae	* *Brassica sp.*														
Cactaceae	* *Opuntia sp.*	Prickly Pear							1						
Caprifoliaceae	* *Lonicera japonica*	Japanese Honeysuckle							2						
Caryophyllaceae	* *Paronychia brasiliana*	Chilean Whitlow-wort												1	
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak													
	Casuarina glauca	Swamp Oak							2	1					X
Chenopodiaceae	*Atriplex semibaccata*	Creeping Saltbush													
	Einadia hastata	Berry Saltbush							1						
	Einadia nutans subsp. linifolia	Climbing Saltbush													
Clusiaceae	*Hypericum gramineum*	Small St Johns-wort	1			1		1				1			
Convolvulaceae	*Dichondra repens*	Kidney-weed		1					1						
Dilleniaceae	*Hibbertia obtusifolia*	Guinea-flower										1			

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Hibbertia riparia	Erect Guinea-flower	5			1						1	1	1	
Ericaceae Styphelioideae	*Astroloma humifusum*	Cranberry Heath													
	Epacris microphylla	Coral Heath				1						2			
	Leucopogon ericoides	Beard-heath		1								1			
	Lissanthe strigosa	Peach Heath													
	Melichrus procumbens													1	
Euphorbiaceae	* *Triadica sebifera*	Chinese Tallow Tree													X
Fabaceae Caesalpinioideae	* *Senna pendula var. glabrata*	Easter Cassia													
Fabaceae Faboideae	*Bossiaea heterophylla*	Variable Bossiaea			1	2						1	1		
	Bossiaea scolopendria											1			
	Chorizema parviflorum	Eastern Flame Pea													
	Daviesia ulicifolia	Gorse Bitter-pea												1	
	Dillwynia parvifolia														
	* *Erythrina x sykesii*	Coral Tree													X
	Glycine clandestina	Twining Glycine		1			2						1		
	Glycine tabacina								1						
	Gompholobium glabratum	Dainty Wedge Pea	1			1		1							
	Gompholobium pinnatum	Pinnate Wedge Pea	1												
	Hardenbergia violacea	False Sarsaparilla			1	1	1							1	
	Jacksonia scoparia	Dogwood					2								
	* *Lathyrus sp.*														
	* *Lupinus angustifolius*	Narrow-leaved Lupin													
	* *Medicago polymorpha*	Burr Medic													
	* *Melilotus indica*	Sweet Melilot													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Pultenaea retusa	Notched Bush-pea													
	Pultenaea tuberculata		1			1							1		
	Pultenaea villosa	Hairy Bush-pea													
	* *Trifolium arvense*	Haresfoot Clover													
	* *Trifolium repens*	White Clover													
	* *Vicia sp.*	Vetch													
	* *Wisteria sinensis*	Chinese Wisteria													
Fabaceae Mimosoideae	*Acacia binervia*	Coast Myall		10					40	5					X
	Acacia brownii	Golden Prickly Moses	1			2		1							
	Acacia decurrens	Black Wattle						2	1			1		5	
	Acacia falcata	Sickle Wattle			2								2		
	Acacia floribunda	White Sally							1	2		2		1	
	Acacia implexa	Hickory Wattle													
	Acacia longifolia	Sydney Golden Wattle													
	Acacia parramattensis	Parramatta Green Wattle					5							1	X
	# *Acacia podalyriifolia*	Queensland Wattle			1										
Fagaceae	* *Quercus palustris*	Pin Oak													X
Goodeniaceae	*Dampiera stricta*	Blue Dampiera				1									
	Goodenia hederacea	Ivy Goodenia	1			1								1	
	Goodenia paniculata														
Haloragaceae	*Gonocarpus tetragynus*	Common Raspwort	1									1			
	* *Myriophyllum aquaticum*	Parrot's Feather													
Hamamelidaceae	* *Liquidambar styraciflua*	Liquidambar													X
Lamiaceae	*Plectranthus parviflorus*								1						

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
Lauraceae	*Cassytha glabella*					1	1					1	1	1	
	Cassytha pubescens	Devil's Twine	1	2	1				2	1			1		
	* *Cinnamomum camphora*	Camphor-laurel													X
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1			1					1	1		
Loganiaceae	*Mitrasacme polymorpha*	Mitre Weed	1			1									
Loranthaceae	*Amyema gaudichaudii*	Paperbark Mistletoe													
Malaceae	* *Cotoneaster sp.*														
	* *Sorbus sp. (unidentified)*														X
Malvaceae	* *Modiola caroliniana*	Red-flower Mallow													
	* *Sida rhombifolia*	Paddy's Lucerne		1	1				1						
Myrtaceae	*Acmena smithii*	Lilly-pilly													
	# *Agonis flexuosa*	Willow-myrtle													
	Angophora bakeri	Small-leaved Apple			5	5	2					7	5	15	X
	Angophora costata	Sydney Red Gum													X
	Angophora floribunda	Rough-barked Apple													X
	Angophora subvelutina	Broad-leaved Apple													
	Backhousia myrtifolia	Grey Myrtle, Ironwood													
	Callistemon citrinus	Scarlet Bottlebrush													
	Callistemon linearis	Narrow-leaved Bottlebrush				2		1							
	Callistemon pinifolius	Pine-leaved Bottlebrush	2			2						10	1		
	Callistemon salignus	White Bottlebrush								2					X
	# *Corymbia citriodora*	Lemon-scented Gum													X
	Corymbia eximia	Yellow Bloodwood													X
	Corymbia maculata	Spotted Gum													X

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Eucalyptus amplifolia	Cabbage Gum													X
	Eucalyptus baueriana	Blue Box													
	Eucalyptus botryoides	Bangalay													X
	Eucalyptus camaldulensis	River Red Gum													X
	Eucalyptus crebra	Narrow-leaved Ironbark													X
	Eucalyptus eugenioides	Thin-leaved Stringybark													
	Eucalyptus fibrosa	Red Ironbark													X
	Eucalyptus longifolia	Woollybutt													X
	Eucalyptus microcarpa	Western Grey Box													X
	Eucalyptus moluccana	Grey Box													X
	Eucalyptus parramattensis	Parramatta Red Gum	7		5	2	2					5	10	5	X
	Eucalyptus punctata	Grey Gum													X
	Eucalyptus racemosa	Snappy Gum													X
#	*Eucalyptus saligna*	Sydney Blue Gum													X
	Eucalyptus saligna x botryoides			15			1		10	5					
	Eucalyptus sclerophylla	Scribbly Gum	7		5	10		30					2		X
	Eucalyptus sideroxylon	Mugga, Red Ironbark													X
	Eucalyptus tereticornis	Forest Red Gum													X
	Kunzea ambigua	Tick-bush			5	2		30				15		10	
	Leptospermum juniperinum	Prickly Tea-tree													
	Leptospermum parvifolium	Small-leaved Tea-tree				1									
#	*Leptospermum petersonii*	Lemon-scented Tea-tree													
	Leptospermum polygalifolium	Tantoon				2	1				1	5		2	
	Leptospermum trinervium	Slender Tea-tree	5			2	2					5			

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	# *Lophostemon confertus*	Brush Box													X
	Melaleuca armillaris	Bracelet Honey-myrtle													
	Melaleuca decora	White Cloud Tree	4									10	20	1	X
	Melaleuca erubescens		1										1		
	Melaleuca linariifolia	Flax-leaved Paperbark			1		40		1		2	20			
	Melaleuca nodosa	Ball Honey-myrtle	6		2	5		2				20	60	15	
	Melaleuca quinquenervia	Broad-leaved Paperbark													
	Melaleuca thymifolia	Thyme Honey-myrtle	1			5						1	1		
	Syncarpia glomulifera	Turpentine													X
Nyctaginaceae	* *Bougainvillea cv. (unidentified)*	Bougainvillea													X
Ochnaceae	* *Ochna serrulata*	Mickey Mouse Plant							1	1					
Oleaceae	* *Ligustrum lucidum*	Broad-leaved Privet							2	10					
	* *Ligustrum sinense*	Small-Leaved Privet		2					20	20					
	Notelaea longifolia	Mock-olive		1											
	* *Olea europaea subsp. cuspidata*	African Olive		1					50	10					
Onagraceae	* *Ludwigia peruviana*	Peruvian Primrose									1				
Oxalidaceae	*Oxalis perennans*			1					1						
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		1					1						
	* *Phyllanthus tenellus*														
Picrodendraceae	*Micrantheum ericoides*						1								
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	1							1			
	Bursaria spinosa	Blackthorn		1					1						
	Pittosporum undulatum	Pittosporum													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
Plantaginaceae	* *Plantago lanceolata*	Plantain, Ribwort			1				1						
Polygonaceae	* *Acetosa sagittata*	Rambling Dock													
	Persicaria decipiens	Slender Knotweed									1				
	Persicaria hydropiper	Water Pepper													
	Persicaria praetermissa						1				1				
	* *Rumex sp.*	Dock													
Proteaceae	*Banksia ericifolia*	Heath-leaved Banksia											2		
	Banksia oblongifolia	Fern-leaved Banksia				2	2					2			
	Banksia serrata	Saw Banksia													
	Banksia spinulosa var. spinulosa	Hairpin Banksia	8			1									
	+ *Grevillea parviflora subsp. parviflora*		2										1		
	# *Grevillea robusta*	Silky Oak													X
	Hakea dactyloides	Finger Hakea	1			2	2								
	Hakea salicifolia	Willow Hakea													
	Hakea sericea	Needlebush	5			10	2					20	5	1	
	Hakea teretifolia	Needlebush													
	Isopogon anemonifolius	Broad-leaf Drumsticks													
	Lambertia formosa	Mountain Devil			2										
	Lomatia silaifolia	Crinkle Bush					1								
	Persoonia lanceolata	Geebung													
	Persoonia laurina subsp. laurina	Laurel Geebung			2										
	Persoonia linearis	Narrow-leaf Geebung			2			1							
	+ *Persoonia nutans*							1							

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Petrophile sessilis					10									
Ranunculaceae	*Clematis aristata*	Traveller's Joy		2			1								
	Clematis glycinoides	Headache Vine							1						
	Ranunculus inundatus	River Buttercup					1								
Rhamnaceae	*Alphitonia excelsa*	Red Ash, Soap Tree													
	Pomaderris ferruginea														
Rosaceae	* *Rubus anglocandicans*	Blackberry			1		1								
	Rubus parvifolius	Native Raspberry													
Rubiaceae	* *Galium aparine*	Cleavers, Goose-grass													
	Morinda jasminoides	Morinda													
	Opercularia varia	Variable Stinkweed			1			1							
	Pomax umbellata	Pomax						1					1		
	* *Richardia humistrata*														
Rutaceae	*Phebalium squamulosum*	Scaly Phebalium													
	Philotheca salsolifolia	Philotheca													
Salicaceae	* *Salix alba*	White Willow													
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart		2	2										
Sapindaceae	* *Cardiospermum grandiflorum*	Balloon Vine								5					
	Dodonaea triquetra	Hopbush													
Solanaceae	* *Lycium ferocissimum*	African Boxthorn													
	* *Solanum nigrum*	Blackberry Nightshade													
Stylidiaceae	*Stylidium graminifolium*	Grass-leaf Triggerplant	1			1									
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	1		1	1		1						1	
Ulmaceae	* *Ulmus parvifolia*	Chinese Elm													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
Verbenaceae	* *Lantana camara*	Lantana		2					25	20					
	* *Verbena bonariensis*	Purpletop			1									1	
	* *Verbena rigida*	Veined Verbena													
Angiosperms - Monocotyledons															
Agavaceae	* *Agave americana*	Century Plant													
Alismataceae	*Alisma plantago-aquatica*	Water-plantain													
Alliaceae	* *Agapanthus praecox subsp. orientalis*	Agapanthus													
Anthericaceae	*Caesia parviflora*	Pale Grass Lily					1								
	Laxmannia gracilis	Slender Wire Lily						1					1		
	Tricoryne simplex		1											1	
Arecaceae	* *Syagrus romanzoffiana*	Cocos Palm, Queen Palm													
Asparagaceae	* *Asparagus aethiopicus*	Asparagus Fern		1											
	* *Asparagus asparagoides*	Bridal Creeper		2					1						
	* *Asparagus officinalis*	Asparagus					1								
Asphodelaceae	* *Aloe maculata*	Common Soap Aloe													
Colchicaceae	*Burchardia umbellata*	Milkmaids			1										
Commelinaceae	*Commelina cyanea*	Blue Spiderwort					2			1					
	* *Tradescantia fluminensis*	Wandering Jew					2		30	20					
Cyperaceae	*Baumea articulata*	Jointed Twig-rush													
	Baumea sp.														
	Bolboschoenus fluviatilis	Club-rush									50				
	Carex appressa	Tall Sedge			1		1								
	Carex breviculmis														
	Chorizandra cymbaria	Heron Bristle-rush													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Cyathochaeta diandra		5		1	5						2	2	1	
	Cyperus brevifolius														
	* *Cyperus eragrostis*	Drain Flat-sedge													
	Eleocharis sphacelata	Tall Spike-rush									1				
	Fimbristylis dichotoma				1									1	
	Fimbristylis ferruginea														
	Gahnia clarkei	Tall Saw-sedge		1			5								
	Gahnia sp.														
	Isolepis inundata	Water Club-rush					1				1				
	Lepidosperma laterale	Variable Sword-sedge	2											1	
	Ptilothrix deusta		20										1		
	Schoenus apogon	Fluke Bog-rush													
Haemodoraceae	*Haemodorum planifolium*	Strap-leaf Bloodroot			1										
Iridaceae	*Patersonia sericea*	Native Iris	5										1		
Juncaceae	* *Juncus cognatus*	Argentine Rush			1										
	Juncus continuus	Rush													
	Juncus prismatocarpus	Branching Rush													
	Juncus usitatus	Common Rush													
Lomandraceae	*Lomandra cylindrica*	Needle Mat-rush													
	Lomandra longifolia	Spiny-headed Mat-rush		1	1	2			1					1	
	Lomandra multiflora	Many-flowered Mat-rush												1	
Orchidaceae	*Dipodium punctatum*	Hyacinth Orchid													
	Eriochilus cucullatus	Parson's Bands													
	Orthoceras strictum	Bird's-mouth Orchid													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Pterostylis acuminata	Sharp Greenhood Orchid													
Philydraceae	*Philydrum lanuginosum*	Woolly Waterlily													
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	1				1						1	1	
	Dianella revoluta	Blue Flax-lily				1		1						1	
Poaceae	* *Andropogon virginicus*	Whisky Grass													
	Anisopogon avenaceus	Oat Spear Grass													
	Aristida ramosa	Wiregrass						5					1		
	Aristida vagans	Threeawn Speargrass						2						2	
	Aristida warburgii	Wiregrass											1		
	* *Arundo donax*	Giant Reed													
	Austrodanthonia fulva	Wallaby Grass						2							
	Austrodanthonia tenuior	Wallaby Grass													
	Austrostipa pubescens	Speargrass	10		2	10									
	Austrostipa ramosissima	Bamboo Speargrass		3					1						
	Austrostipa rudis														
	* *Axonopus fissifolius*	Narrow-leaved Carpet Grass												5	
	Bothriochloa macra	Redleg Rass													
	* *Briza subaristata*				1									1	
	* *Bromus catharticus*	Prairie Grass													
	* *Chloris gayana*	Rhodes Grass							1					1	
	* *Cortaderia selloana*	Pampas Grass												1	
	Cynodon dactylon	Couch, Bermuda Grass		1										5	
	* *Dactylis glomerata*	Cocksfoot													
	Dichelachne micrantha	Shorthair Plumegrass			2										

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	* *Digitaria sanguinalis*	A Summer Grass													
	Digitaria sp.														
	Echinopogon ovatus	Forest Hedgehog Grass		1	1		5								
	* *Ehrharta erecta*	Panic Veld-grass		30					10						
	Entolasia marginata	Bordered Panic													
	Entolasia stricta	Wiry Panic	2		2	1		2	2			5	2	2	
	Eragrostis brownii	Brown's Lovegrass													
	* *Eragrostis cilianensis*	Stinkgrass												1	
	* *Eragrostis curvula*	African Lovegrass		1	1	1		1						30	
	Eragrostis leptostachya	Paddock Lovegrass			2							1	1		
	Hemarthria uncinata	Mat Grass													
	Imperata cylindrica	Blady Grass			2		10					1			
	* *Melinis repens*	Red Natal Grass													
	Microlaena stipoides	Weeping Grass	1	20	1		15	5	20	1		2			
	Oplismenus aemulus	Broad-leaved Basket Grass							2						
	Oplismenus imbecillis	Narrow-leaved Basket Grass								1					
	Panicum simile	Two-colour Panic												1	
	Paspalidium distans													1	
	* *Paspalum dilatatum*	Paspalum			1									2	
	* *Paspalum urvillei*	Vasey Grass													
	* *Pennisetum clandestinum*	Kikuyu Grass													
	Phragmites australis	Common Reed													
	* *Phyllostachys aurea*	Yellow Bamboo													

Family	Scientific name	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	SIMTA site
	Poa sp.												1		
	* *Setaria parviflora*				3		2							2	
	* *Sporobolus africanus*	Rat-tail Grass													
	Themeda triandra	Kangaroo Grass	10		2	5						1	1	10	
Pontederiaceae	* *Eichhornia crassipes*	Water Hyacinth													
Restionaceae	*Empodisma minus*	Tanglefoot												1	
	Leptocarpus tenax						2					30			
	Lepyrodia muelleri	Common Scale-rush													
	Lepyrodia scariosa		2			1						10			
Typhaceae	*Typha orientalis*	Broad-leaf Cumbungi									2				
Xanthorrhoeaceae	*Xanthorrhoea media*	Grass Tree	5		1		1					1	1		

APPENDIX E

EPBC ACT PROTECTED MATTERS SEARCH

Australian Government
Department of the Environment

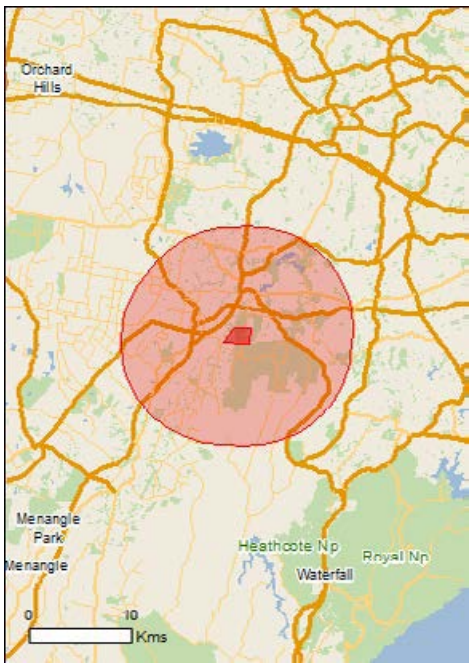
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 07/11/14 09:07:20



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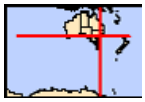

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	69
Listed Migratory Species:	34

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	19
Commonwealth Heritage Places:	3
Listed Marine Species:	35
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	29
State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	54
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Historic		
Vietnam War Comradeship Memorial	NSW	Nominated place

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
Shale/Sandstone Transition Forest	Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta salvini Salvin's Albatross [82343]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (Eastern) [68050]	Endangered	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat likely to occur within area
Allocasuarina glareicola [21932]	Endangered	Migration route known to occur within area
Asterolasia elegans [56780]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Deyeuxia appressa [7438]	Endangered	Species or species habitat likely to occur within area
Eucalyptus camfieldii Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat known to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Hibbertia puberula subsp. glabrescens [86645]	Critically Endangered	Species or species habitat likely to occur within area
Leucopogon exolasius Woronora Beard-heath [14251]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat likely to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
Persoonia hirsuta Hairy Persoonia [19006]	Endangered	Species or species habitat likely to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat likely to occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat likely to occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area
Pomaderris brunnea Rufous Pomaderris [16845]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat known to occur within area
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat likely to occur within area
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat likely to occur within area
Thelymitra kangaloonica Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Nuclear Science & Technology Organisation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - CAMP SAPPER-EAST HILLS (Lot 2) : CAMP SAPPER TRAINING AREA (Lot 1)
Defence - EAST HILLS BARRACKS - OP SAFE HAVEN
Defence - INGLEBURN AREA (Bardia Barracks)
Defence - MOOREBANK AREA INC SME
Defence - Suite 8, Library Plaza
Defence - VILLAWOOD - MOTOR REPAIR W/SHP (VILLAWOOD GEMS BASE)

Name
Defence - WET BRIDGING SITE - CASULA

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Indigenous		
Cubbitch Barta National Estate Area	NSW	Listed place
Historic		
Defence National Storage and Distribution Centre	NSW	Listed place
Old Army / Internment Camp Group Holsworthy	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Georges River Wetlands	NSW	Indicative Place
Voyager Point	NSW	Registered
Indigenous		
Cubbitch Barta National Estate Area	NSW	Registered
Historic		
Bankstown Airport	NSW	Indicative Place
Fairfield Fire Station	NSW	Indicative Place
Liverpool Fire Station	NSW	Indicative Place
The 13th Jyotirlinga (icon)	NSW	Indicative Place
Defence National Storage and Distribution Centre	NSW	Interim List
Bernera including Site and Knoll	NSW	Registered
Collingwood	NSW	Registered
Denham Court and St Marys Anglican Chapel	NSW	Registered
Glenfield Farm	NSW	Registered
Horningsea Park	NSW	Registered
Hoxton Park Airport	NSW	Registered
Ingleburn Army Camp	NSW	Registered
Kitchener House	NSW	Registered
Lansdowne Bridge	NSW	Registered
Liverpool Courthouse (former)	NSW	Registered
Liverpool Dam	NSW	Registered
Liverpool Hospital (former)	NSW	Registered
Macquarie Field Garden	NSW	Registered
Macquarie Field House	NSW	Registered
Old Army / Internment Camp Group Holsworthy	NSW	Registered
Prefabricated Cottages Ingleburn Village	NSW	Registered
Robin Hood Farm	NSW	Registered
St Lukes Anglican Church	NSW	Registered
The Homestead	NSW	Registered
The Homestead	NSW	Registered
Varro Ville	NSW	Registered

State and Territory Reserves [Resource Information]

Name	State
Gandangara	NSW
Georges River	NSW
Leacock	NSW

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Ulex europaeus		
Gorse, Furze [7693]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Liverpool Military Training Area	NSW
Voyager Point	NSW

Coordinates

-33.954838 150.91173,-33.954838 150.91173,-33.954624 150.927179,-33.965089 150.925548,
-33.965232 150.920828,-33.965232 150.914476,-33.964449 150.907438,-33.964449
150.902288,-33.954838 150.91173

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX F

FAUNA SPECIES LIST

General Status	
*	Exotic/introduced species
(?)	Uncertain identification
P	Protected
U	Unprotected

Conservation Status	
CE	Critically Endangered - listed under Schedule 1A of the TSC Act
E	Endangered - listed under Schedule 1 of the TSC Act
V	Vulnerable - listed under Schedule 2 of the TSC Act

Observation Type			
Fl	Flying over the site	Hp	Harp
Vi	Visual observation	El	Elliot
Au	Aural (call recognition)	An	Anabat
Ul	Ultrasonic call recognition (Anabat)	Cg	Cage
Sc	Scat or scent	CP	Call Playback
T	Tracks	Pt	Pittfalls
Scr	Scratch marks on tree trunks or other	A	Anecdotal
D	Diggings	E	Eggs or juvenille morphs
N	Nest	F	Fur or feathers
B	Burrow	H	Hollows (in trees, trunks or other)

Status	Group	Scientific Name	Common Name	Obs Type	Certainty
P	Amphibian	*Crinia signifera*	Common Eastern Froglet	Au	
P	Amphibian	*Litoria fallax*	Dwarf Tree Frog	Au	
*	Bird	*Acridotheres tristis*	Indian Myna	Vi	
P	Bird	*Anas superciliosa*	Pacific Black Duck	Vi	
P	Bird	*Anthochaera carunculata*	Red Wattlebird	Au	
P	Bird	*Cacatua galerita*	Sulphur-crested Cockatoo	Au	
P	Bird	*Cacatua roseicapilla*	Galah	Vi	
P	Bird	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	Au	

Status	Group	Scientific Name	Common Name	Obs Type	Certainty
P	Bird	*Calyptorhynchus funereus*	Yellow-tailed Black Cockatoo	Vi	
P	Bird	*Chenonetta jubata*	Australian Wood Duck	Vi	
P	Bird	*Colluricincla harmonica*	Grey Shrike-thrush	Vi	
P	Bird	*Coracina novaehollandiae*	Black-faced Cuckoo Shrike	Au	
P	Bird	*Corcorax melanorhamphos*	White-winged Chough	Vi	
P	Bird	*Corvus coronoides*	Australian Raven	Vi	
P	Bird	*Cracticus torquatus*	Grey Butcherbird	Au	
P	Bird	*Dacelo novaeguineae*	Laughing Kookaburra	Au	
P	Bird	*Egretta novaehollandiae*	White-faced Heron	Vi	
P	Bird	*Eopsaltria australis*	Eastern Yellow Robin	Au	
P	Bird	*Gallinula tenebrosa*	Dusky Moorhen	Vi	
P	Bird	*Gerygone mouki*	Brown Gerygone	Au	
P	Bird	*Grallina cyanoleuca*	Magpie Lark	Vi	
P	Bird	*Gymnorhina tibicen*	Australian Magpie	Vi	
P	Bird	*Hirundo neoxena*	Welcome Swallow	Vi	
P	Bird	*Lichenostomus flavicollis*	Yellow-faced Honeyeater	Vi	
P	Bird	*Malurus cyaneus*	Superb Fairy Wren	Vi	
P	Bird	*Malurus lamberti*	Variegated Fairy Wren	Vi	
P	Bird	*Manorina melanocephala*	Noisy Miner	Vi	
P	Bird	*Manorina melanophrys*	Bell Miner	Au	
P	Bird	*Myzomela sanguinolenta*	Scarlet Honeyeater	Au	
P	Bird	*Neochmia temporalis*	Red-browed Finch	Vi	
P	Bird	*Ocyphaps lophotes*	Crested Pigeon	Vi	
P	Bird	*Pachycephala pectoralis*	Golden Whistler	Au	
P	Bird	*Pachycephala rufiventris*	Rufous Whistler	Au	
P	Bird	*Pardalotus punctatus*	Spotted Pardalote	Au	
P	Bird	*Phalacrocorax melanoleucos*	Little Pied Comorant	Vi	
P	Bird	*Platycercus elegans*	Crimson Rosella	Vi	
P	Bird	*Platycercus eximius*	Eastern Rosella	Vi	
P	Bird	*Porphyrio porphyrio*	Purple Swamphen	Vi	
P	Bird	*Psephotus haematonotus*	Red-rumped Parrot	Vi	
P	Bird	*Psophodes olivaceus*	Eastern Whipbird	Au	

Status	Group	Scientific Name	Common Name	Obs Type	Certainty
P	Bird	*Pycnonotus jocosus*	Red-whiskered Bulbul	Vi	
P	Bird	*Rhipidura leucophrys*	Willie Wagtail	Vi	
P	Bird	*Strepera graculina*	Pied Currawong	Au	
P	Bird	*Trichoglossus haematodus*	Rainbow Lorikeet	Vi	
P	Bird	*Vanellus miles*	Masked Lapwing	Vi	
*	Mammal	*Canis lupus familiaris*	Dog	T	
P	Mammal	*Chalinolobus gouldii*	Gould's Wattled Bat	An	C
P	Mammal	*Chalinolobus morio*	Chocolate Wattled Bat	An	C
*	Mammal	*Felis catus*	Cat	Vi	
*	Mammal	*Lepus capensis*	Brown Hare	Vi	
P	Mammal	*Macropus sp.*	Kangaroo	T	
V	Mammal	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat*	An	C
P	Mammal	*Mormopterus sp.*	Freetail-bat	An	C
V	Mammal	*Myotis macropus*	Southern Myotis*	An	Po
P	Mammal	*Nyctophilus sp.*	Unidentified Long-eared Bat	An	Po
P	Mammal	*Pseudocheirus peregrinus*	Ringtail Possum	Vi	
V	Mammal	*Pteropus poliocephalus*	Grey-headed Flying Fox	Vi	
P	Mammal	*Tachyglossus aculeatus*	Echidna	Vi	
P	Mammal	*Tadarida australis*	White-striped Mastiff Bat	An	C
P	Mammal	*Vespadelus vulturnus*	Little Forest Bat	An	C
*	Mammal	*Vulpes vulpes*	Fox	Vi	
P	Reptile	*Lampropholis sp.*	Skink	Vi	
P	Reptile	*Pseudechis porphyriacus*	Red-bellied Black Snake	Vi	
P	Reptile	*Pseudonaja textilis*	Eastern Brown Snake	Vi	
P	Fish	*Anguilla australis*	Short-finned Eel	Vi	
*	Fish	*Gambusia holbrooki*	Gambusia	Vi	
P	Fish	*Philypnodon grandiceps*	Flathead Gudgeon	Vi	

APPENDIX G

EPBC ACT REFERRAL MNES ASSESSMENT REQUIREMENTS

Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest

Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest is listed as a critically endangered ecological community under the EPBC Act.

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities**

Cumberland Plain Woodland and Shale-Gravel Transition Forest occurs in the Sydney Basin bioregion and is restricted to the Cumberland Plain. The community is associated with clay soils derived from Wianamatta Group geology.

Cumberland Plain Woodland and Shale-Gravel Transition Forest incorporates grassy eucalypt shale hills and plains woodlands and shale-gravel transition forests. The tree canopy is typically dominated by *Eucalyptus moluccana* (Grey Box), *E. tereticornis* (Forest Red Gum) and/or *E. fibrosa* (Red Ironbark). Ground layer vegetation consists of a mixture of native grasses and herbs.

The community is currently known to occur across western Sydney, within the local government areas of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly. In 2009, the ecological community occupied a maximum area of approximately 12 300 hectares (ha) but is highly fragmented across its distribution, with most occurrences small remnants, mostly under 10 ha in size (Threatened Species Scientific Committee, 2008).

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action**

The conservation advice for Cumberland Plain Woodland and Shale-Gravel Transition Forest identifies the main and ongoing threats to Cumberland Plain Woodland as clearing for industrial or rural development, consequent fragmentation of remnants, inappropriate grazing and fire regimes, weed invasion and low level of protection in reserves. Vegetation clearance is considered to be the major contributor to the loss and fragmentation of native vegetation across the Cumberland Plain. The proposed action will require clearing of native vegetation; none of the vegetation to be cleared was identified as Cumberland Plain Woodland and Shale-Gravel Transition Forest.

The closest area of Cumberland Plain Woodland and Shale-Gravel Transition Forest is located to the east of the 20 to 25 metre wide powerline easement adjoining the eastern boundary of the SIMTA site. The Shale Gravel Transition Forest in this location appears from historical aerial photographs to have been previously subject to clearing and disturbance and is currently subject to edge effects, including weed invasion, from the maintenance of the cleared easement, which is dominated by exotic grasses and regularly slashed. The Proposal is not expected to have further impacts on this vegetation.

- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;**

There have been numerous vegetation surveys and regional mapping projects on the Cumberland Plain (Benson 1992, NPWS 2002, Tozer 2003, DECCW 2009). 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. Three of the mapped communities are equivalent to Cumberland Plain Woodland and Shale-Gravel Transition Forest: Shale Plains Woodland, Shale Hills Woodland and Shale-Gravel Transition Forest. The communities are mapped in the locality (within 5 kilometres) of the study area (Table 1), but none were mapped within the study area.

Table 1: Cumberland Plain Woodland mapped in the locality of the study area

Vegetation Communities equivalent to CPW	Total area (>10% canopy cover) mapped on Cumberland Plain (ha)	Total area (>10% canopy cover) mapped within 5km of study area (ha)
Shale Plains Woodland	6732	266
Shale Hills Woodland	4309	4
Shale-Gravel Transition Forest	1721	358
Total	**12762**	**628**

A comprehensive vegetation assessment was undertaken as part of terrestrial flora and fauna surveys in the study area. The structure and floristics of each plant community present in the study area were sampled using twelve 0.1 hectare quadrats. The quadrats were in the form of a 20 metre x 50 metre plot with a nested 20 metre x 20 metre plot. Vegetation communities were mapped based on desktop analysis and ground truthing of published soil, geology and vegetation maps, interpretation of aerial photographs, data on vegetation structure and floristics collected in vegetation quadrats and site observations. Comparison of vegetation data with the Tozer (2003) diagnostic species for each vegetation unit was also undertaken. Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest was not identified within the study area; vegetation communities were more typical of soils derived from Tertiary Alluvium, with Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland recorded in the rail corridor.

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

There is no potential habitat for Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest within the proposed action area. It is likely that the community formerly occurred in the east and north-east of the SIMTA site and was contiguous with the Shale Gravel Transition Forest to the east of the study area; the SIMTA site has been cleared and developed since 1951 and currently supports buildings, mown grass, and landscaped areas including planted trees. There are mapped areas of equivalent communities in the locality, with large contiguous patches to the south of the study area in the Holsworthy Training Area and smaller fragmented patches in the more developed areas west of the Glenfield Waste Disposal site.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

Approximately 10 hectares of Shale Plains Woodland were mapped within Leacock Regional Park, adjoining the Main Southern railway line to the west of the study area.

Large areas of Shale-Gravel Transition Forest and Shale Hills Woodlands have been mapped to the south of the study area in the Holsworthy Training Area, which functions as an informal conservation area. This area has been identified as part of the Priority Conservation Lands in the Cumberland Plain Recovery Plan (DECCW 2011).

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

There is no potential habitat for Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest within the proposed action area. The community occurs on shale-derived soils, which do not underlie the study area. Mapped areas of the community to the west, east and south of the study area will not be impacted by the proposed action.

- **discussion of the potential impacts on the above species and communities of pest species, disease and fire outbreaks generated by the proposed action;**

Weed invasion is considered a threat to Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest, with a range of weed species occurring in the community including perennial grasses, pasture weeds, vines and scramblers and woody shrubs. African Olive (*Olea europaea* subsp. *cuspidata*) and Bridal Creeper (*Asparagus asparagoides*) have been identified as particularly significant weeds as they appear able to suppress understorey species. African Olive was observed to be widespread in the River-flat Eucalypt Forest adjoining the Georges River in the study area, but it is considered unlikely that the Proposal will encourage the spread of this species, particularly to areas of Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest which are not contiguous with the vegetation in the study area.

The Shale-Gravel Transition Forest to the east of the 20 to 25 metre wide powerline easement adjoining the eastern boundary of the SIMTA site is currently subject to edge effects, including weed invasion, from the maintenance of the cleared easement, which is dominated by the exotic grass *Eragrostis curvula.* The Proposal is not expected to further exacerbate the weed invasion of this bushland. Fire and its frequency can affect the structure and composition of the ecological community, particularly the understorey component. The proposed action is unlikely increase the frequency of fire in the locality.

- **consideration of each species or community must have regard to any recovery plan prepared by the Commonwealth, NSW or other State government, in relation to the species and any publically available policy statement or conservation advice approved by the minister in relation to the species or community**

DECCW (2011) prepared the Cumberland Plain Recovery Plan, focusing on the threatened species, populations and ecological communities that are endemic to or primarily distributed on the Cumberland Plain. Cumberland Plain Woodland is one of the threatened ecological communities addressed in the recovery plan.

DECCW (2011) has identified approximately 25,566 hectares of Priority Conservation Lands (PCLs), representing the best opportunities in the region to secure long-term viable conservation outcomes. The recovery plan identifies the current extent Cumberland Plains Shale Woodlands and Shale-Gravel Transition Forest consistent with the EPBC Act listing for the community as approximately 10,726 hectares, of which 5,045 hectares is located within the Priority Conservation Lands.

The native vegetation in and to the south of the study area has been mapped as part of the Cumberland Plain Priority Conservation Lands, a 2,314 hectare area extending across the Holsworthy Military Area.

Green and Gold Bell Frog (*Litoria aurea*)

The Green and Golden Bell Frog (*Litorea aurea*) is listed as an Endangered species under the TSC Act, and a Vulnerable species under the EPBC Act.

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities**

The Green and Golden Bell Frog is found along coastal lowland areas of eastern NSW and Victoria, from Yuraygir National Park near Grafton in northern NSW to Lake Wellington, in south-eastern Victoria, to the south. Green and Golden Bell Frog populations are also known from three offshore islands: Bowen Island in Jervis Bay; Kooragang Island and Broughton Island north of Port Stephens (DotE 2015c). The former distribution of the species has contracted to eight known locations in the Sydney Region: Homebush Bay/Sydney Olympic Park; Kurnell; Greenacre (Upper Cooks River); Clyde/Rosehill (Parramatta River); Merrylands (Parramatta River); St Marys/Mt Druitt/Riverstone; Arncliffe/Lower Cooks River and Hammondville (Georges River) (DECC 2008b).

In NSW, the Green and Golden Bell Frog has been found in a wide range of water bodies that are still, shallow, ephemeral, unpolluted; however, the species has been found in polluted habitats. This includes marshes, dams, stream sides and disturbed sites, including abandoned mines and quarries. The species is not found in fast flowing streams. Optimum habitat includes water bodies which are unshaded with emergent aquatic vegetation (bullrushes *Typha spp.* or spikerushes *Eleocharis spp*), that are free of predatory Mosquito Fish (*Gambusia holbrooki*). Diurnal sheltering and foraging sites comprise of grasses, tussock vegetation and emergent sedges, rock piles, ground timber, crevices in the ground, plant root systems and ground debris adjacent to the water body (NPWS 1999b, DotE 2015c).

The Green and Golden Bell Frog is known to breed during late winter to early autumn, but generally during September–February with a peak around January–February after heavy rain or storms. Breeding habitat in NSW includes water bodies that are still, shallow, ephemeral, unpolluted. Spawn is laid among aquatic vegetation (DotE 2015c). Ephemeral swale habitat that supports plant species such as *Juncus spp., Schoenoplectus spp., Isolepis spp.* and *Baumea spp*, may also provide breeding habitat (DECC 2008b).

The Green and Golden Bell Frog is highly mobile and may move between breeding sites, however, dispersal patterns can vary between populations. The species is capable of moving long distances in a single day or night of up to one kilometre; some individuals have been recorded travelling up to three kilometres on one night. Movements of up to five kilometres may be common, and the frog may possibly disperse as far as 10 kilometres, and may occasionally be found several hundred metres from major drainage lines or other waterbodies (NPWS 1999b, DotE 2015c).

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action**

Known threats to the Green and Golden Bell Frog (DotE 2015c) include:

- habitat removal

- habitat degradation (which includes siltation, changes to aquatic vegetation diversity or structure reducing shelter, increased light and noise, grazing, mowing, fire)
- habitat fragmentation
- reduction in water quality and hydrological changes (for example, pollution, siltation erosion and changes to timing, duration or frequency of flood events)
- disease (for example, infection of the frog with chytrid fungus (*Batrachochytrium dendrobatidis*) resulting in chytridiomycosis)
- predation (for example, by the introduced Mosquito Fish (*Gambusia holbrooki*), Cats (*Felis catus*) or Foxes (*Vulpes vulpes*))
- introduction or intensification of public access to Green and Golden Bell Frog habitats
- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;**

Targeted diurnal and nocturnal surveys for this species, including habitat searches, spotlighting and call-playback, did not identify Green and Golden Bell Frogs within the study area.

There are 30 records of the Green and Golden Bell Frog within 10 kilometres of the study area (OEH 2012a), dated between 1963 and 1999, including the Georges River population at Hammondville (Table 2). This population is located approximately 3.5 kilometres east of the study area and is known to occupy the wetlands associated with the lower Georges River floodplain. The species has been found to inhabit the wetlands, water bodies and ponds that are interspersed amongst green space (such as golf courses and playing fields), residential development and major transport and infrastructure routes (DECC 2008b). This population was considered extant in 2009 (DotE 2015c); however, this population has apparently undergone severe declines in recent years and its current status is likely precarious (DEC 2005e).

Table 2: Locations and status of Georges River populations of Green and Golden Bell Frog

Population	Location	Status
Georges River	Hammondville	Extant
Georges River	Holsworthy	Probably Extinct
Georges River	Liverpool	Probably Extinct

Parsons Brinckerhoff (2006) undertook targeted diurnal and nocturnal surveys for this species at the end of the summer breeding season during periods of rain at Glenfield Creek. Glenfield Creek flows into the Georges River approximately 200 metres north of the study area. These surveys did not find any evidence of the species, and it was stated in the assessment that there were no recent records of Green and Golden Bell Frog near Leacock Regional Park. Parsons Brinckerhoff (2006) also recorded Mosquito

fish in Glenfield Creek. The likelihood of the species to occur in the study area for the proposed Moorebank Intermodal Freight Terminal was assessed in October 2014. This area consists of the Moorebank and Steele Barracks, adjacent to the Proposal. The assessment concluded that "Marginal habitat and local records in Holsworthy area however local population considered likely to be extinct (White & Pyke 2010). Not detected despite targeted surveys conducted in ideal conditions" (Parson Brinckerhoff 2014).

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

The study area supports marginal habitat for the species; water in Anzac Creek is static and shallow; small pools were heavily vegetated with floating and emergent macrophytes such as *Typha sp.* and *Salvinia molesta*; the creek is mostly unshaded; and potential sheltering and foraging sites such as grasses, ground timber and ground debris occur in proximity to the creek banks. Formalised drainage channels in the south-east of the SIMTA site that support aquatic and fringing vegetation, such as *Typha* may also provide potential habitat. While the study area supports some preferred habitat features, Mosquito fish (*Gambusia holbrooki*), a predator of tadpoles, was recorded in Anzac Creek.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

There are no formal conservation reserves for the Green and Golden Bell Frog in the proposed action area or surrounding areas. The Georges River key population is located nine kilometres west southwest of the Sydney central business district and approximately 3.5 kilometres east of the study are. This population on the lower Georges River occurs in several locations, including in proximity to the wetlands at Hammondville, at Holsworthy and East Hills, and along Prospect Creek and Orphan School Creek. The population occurs on public and privately-owned land, including council reserves, Commonwealth lands (military areas) and some golf courses (DECC 2008b).

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

While the study area supports some preferred habitat features, the presence of Mosquito fish reduces the likelihood of the species to occur in the study area. Habitat connectivity between potential habitat of the study area and known habitat of the population at Hammondville is low, reducing the likelihood of Hammondville frogs to colonise the study area. As a result, the probability of occurrence of the species in the study area was assessed as being Unlikely and further consideration of this species is not required.

Downy Wattle (*Acacia pubescens*)

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities**

Acacia pubescens 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 LGAs.

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.

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action**

The recovery plan for *Acacia pubescens* (NPWS 2003) identifies the following threats to the species: habitat loss due to clearing, and habitat degradation as a result of weed invasion, mechanical damage, rubbish dumping, illegal track creation, arson, horses and hybridisation.

- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;**

Acacia pubescens was identified at 75 sites in the Urban Bushland Biodiversity Survey (UBBS) undertaken by the NPWS in 1996. An inventory of all records of *A. pubescens* was compiled prior to preparation of the recovery plan (NPWS 2003) and sites not previously surveyed for UBBS were surveyed by NPWS in 1997 to 1998. In 2003 *A. pubescens* was known from 151 sites.

A. pubescens was targeted in threatened plant searches in the study area. The species is distinctive in appearance and surveys can be conducted at any time of year (NPWS 2003). The species was not recorded in the study area; two individuals were recorded at the edge of bushland to the east of the study area.

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

The vegetation in the study area forms potential habitat for *Acacia pubescens,* however the species was not recorded here despite intensive targeted searches. The species was recorded at the edge of bushland to the east of the SIMTA site and may occur further east.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

Acacia pubescens is not formally conserved at any reserves within the locality. The species is conserved at four sites in Scheyville National Park and at one site in Windsor Downs Nature Reserve in north-west Sydney.

There are few records of the species in the northern parts of Holsworthy Training Area, registered as the Cubbitch Barta National Estate Area on the Register of the National Estate, which could function as an informal conservation area for the species.

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

The two *A. pubescens* located to the east of the study area are separated from the proposed action by a boundary fence and powerline easement. The *A. pubescens* occur at the cleared edge of bushland and it is possible that the species occurs further east; this potential habitat will be protected from impacts by the buffer that the managed powerline easement represents.

- **discussion of the potential impacts on the above species and communities of pest species, disease and fire outbreaks generated by the proposed action;**

A. pubescens adjacent to the study area occurs on the disturbed edge of woodland habitat that adjoins cleared land containing an electricity transmission line. *A. pubescens* has been recorded in open and disturbed areas, in association with exotic species, and as a result, appears to tolerate some levels of disturbance (NPWS 2003). *E. curvula* was observed growing in proximity to *A. pubescens* where it occurs adjacent to the study area. As the species occurs outside and upslope of the study area, the species is unlikely to be adversely affected by any potential introduction and spread weeds that may result from the proposed action.

A. pubescens has been identified as a species that may be adversely affected by *Phytophthora cinnamomi,* a soil borne pathogen that infects roots and is associated with plant damage and death. *P. cinnamomi* may be dispersed over large distances in flowing water, such as storm runoff, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of *P. cinnamomi* may also be dispersed by vehicles (e.g. cars and earth moving equipment), animals, walkers and movement of soil. No evidence of. *P. cinnamomi* was observed in the study area, but there is an increased risk of *P. cinnamomi* dispersal as a result of the proposed action. As *A. pubescens* occurs outside and upslope of the study area, the likelihood that *P. cinnamomi* could be dispersed from the study area to *A. pubescens* is low.

A. pubescens may require a fire-free period of up to seven years in order to allow an adequate soil seedbank to develop. A fire interval of less than seven years may adversely affect the soil seed bank of the species. However, the proposed action is unlikely to result in an increase in the frequency or intensity of fire.

- **consideration of each species or community must have regard to any recovery plan prepared by the Commonwealth, NSW or other State government, in relation to the species and any publically available policy statement or conservation advice approved by the minister in relation to the species or community**

NPWS (2003) prepared a recovery plan for *Acacia pubescens.* The recovery plan has been reviewed for information to support the assessment of this species. The species has also been assigned to the site-management stream under the NSW OEH Saving Our Species program. Threatened species in this management stream can be successfully secured by carrying out targeted conservation projects on specific sites

around NSW. OEH has established three management sites for *Acacia pubescens*. The study area is located within the Bankstown-Liverpool site which encompasses the LGAs of Auburn, Bankstown, Burwood, Canterbury, Fairfield, Holroyd, Hurstville, Kogarah, Liverpool, Parramatta, Rockdale, Strathfield and Sutherland. The following management methods/actions are proposed on this site:

- Land manager consultation to minimise illegal collection of the species
- Trial ecological burn to maintain appropriate fire regimes for the species
- Site-based weed control
- Monitor habitat condition
- Monitor pest/weed threat
- Species monitoring to track abundance and condition over time

Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities**

Grevillea parviflora subsp. *parviflora* is a spindly shrub varying from prostrate to erect, usually 0.3–1 m high but growing up to 1.5 to 2 m. The species has a widespread but sporadic distribution, with the main occurrence centred south of Sydney in the Appin-Wedderburn-Picton-Bargo districts, disjunct northern populations at Kurri Kurri and Heddon Greta and on the western shores of Lake Macquarie, and small populations in western Sydney at Kemps Creek and Voyager Point (NPWS 2002c).

G. parviflora subsp. *parviflora* occurs on sandy clay loam soils, often with lateritic ironstone gravels, mostly derived from Tertiary sands or alluvium and from the Mittagong Formation (NPWS 2002c).

The recorded populations of *G. parviflora* subsp. *parviflora* vary in size from single individuals to over 2000 plants. There are only four populations recorded from the Liverpool and Campbelltown LGAs; these are listed as follows in the SPRAT profile for the species (DotE 2015b)(Table 36).

Table 3: *Grevillea parviflora* subsp. *parviflora* populations in the Liverpool and Campbelltown LGAs

Locality	Number of Plants
Kemps Creek, Liverpool LGA	1 (note: Wildlife Atlas records in this area from 2006 suggest there are at least 90 plants in this location)
Voyager Point, Liverpool LGA	Small
Upper Georges River, Liverpool LGA	Large
Wedderburn, Campbelltown LGA	

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action;**

The SPRAT profile for *G. parviflora* subsp. *parviflora* (DotE 2015b) list three threats to the survival of the species:

1. Habitat loss and degradation

Clearing for urban and agricultural development has resulted in the loss of individuals of *G. parviflora* subsp. *parviflora* as well as habitat modification including overshading, altered hydrology, grazing, mowing, dumping of fill and waste and increased soil nutrients.

The proposed action will result in the clearing of habitat and loss of individuals of *G. parviflora* subsp. *parviflora.* The proposed rail link is unlikely to have any significant overshading effect on the *G. parviflora* subsp. *parviflora* habitat; although the rail link will be raised above the existing ground level, it will not be high enough to cast a large shadow. It is expected that soil and water management actions will be implemented during the construction and operation of the rail corridor to prevent changes in hydrology and increases in soil nutrients in adjoining areas. The proposed action will not result in dumping of fill and waste; the population is in an area that has restricted public access and this will be maintained following construction of the project.

Isolation of populations through habitat fragmentation can result in reduced gene flow and low genetic diversity, which may affect the long-term viability of populations.

The proposed rail link will fragment *G. parviflora* subsp. *parviflora* habitat; a fenced gap of 20 metres will intersect areas of occupied and potential habitat to the south of Anzac Creek. Most of the population of *G. parviflora* subsp. *parviflora* recorded in the study area occurs to the east of the proposed rail link; 364 stems were counted to the west of the rail link, compared with an estimated 2825 stems to the east of the rail link.

G. parviflora subsp. *parviflora* is considered to be gravity dispersed (Benson and McDougall 2000) and have limited natural seed dispersal (probably less than two metres) (NPWS 2002d), so even minimal clearing may act as an effective barrier to gene flow. Given that the existing disused rail line adjoining the eastern edge of the rail corridor is at least five metres in width and raised above the ground level, there is already an existing barrier within the population in the study area.

2. Weed invasion

The weedy native species *Imperata cylindrica* (Blady Grass) and *Kunzea ambigua* (Tick Bush) are considered to be a threat to *G. parviflora* subsp. *parviflora* as they can aggressively colonise disturbed areas, especially following fire, thus reducing available habitat and create barriers for the species.

Kunzea ambigua was recorded in the study area and, although locally abundant in some parts of the Castlereagh Scribbly Gum Woodland, was not dominating the shrub layer in the vicinity of the *G. parviflora* subsp. *parviflora* population. This species could aggressively colonise any areas cleared for construction operations following completion of the project.

3. Recruitment and disturbance frequency

Disturbance of habitat through clearing of edges for road widening and maintenance, slashing or mowing of easements, trail bike riding, rubbish dumping and grazing by domesticated animals can all threaten adjacent populations of *G. parviflora* subsp. *parviflora.* Any activity that impacts on the accumulation of seed in the soil seed bank, seedling germination or seedling recruitment is likely to reduce numbers. *G. parviflora* subsp. *parviflora* populations appear to have low levels of seedling recruitment; most populations are large due to suckering, but the health and viability of populations is likely to be dependent on seedling recruitment, so that genetic diversity can be maintained. The proposed rail link would increase disturbance of adjacent habitat where the species is known to occur. This could impact on the health of the population, though it is likely to remain viable.

G. parviflora subsp. *parviflora* is fire-killed, but can regenerate from underground rhizomes and germination of seed in the soil seed bank. High frequency fire may result in a decline in the soil seed bank and limited seedling recruitment, whereas low frequency fire may result in poor germination rates and dense growth of the shrub layer, which shades out *G. parviflora* subsp. *parviflora.*

The proposed action is unlikely increase the frequency of fire. Fire prevention and control measures undertaken as part of the operation of the intermodal terminal are more likely to decrease the frequency of fires, which could have impacts on the habitat of the *G. parviflora* subsp. *parviflora* population in the study area; low fire frequency may result in poor levels of seed germination and dense growth of the shrub layer (NPWS 2002d).

- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and**

communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;

Targeted surveys for *G. parviflora* subsp. *parviflora* in the study area were undertaken in May 2011 and July 2012 and repeated in November 2014 and January 2015. The areas of identified habitat for the species, south of Anzac Creek, were surveyed using north-south transects four metres wide, spaced 10 metres apart. GPS waypoints were recorded at points where the species occurred and the number of stems within four metre x four metre quadrats was recorded. Potential *G. parviflora* subsp. *parviflora* habitat north of Anzac Creek and adjoining the western side of Moorebank Avenue was also searched intensively, with no individuals recorded.

The Environmental Impact Assessment Guidelines for *G. parviflora* subsp. *parviflora* (NPWS 2002d) recommend that the species is best surveyed during the main flowering period between July and December, when it is easier to identify. The species was considered to be easy to detect during surveys in May, July and November due to its distinctive foliage and habit; there were no similar *Grevillea* species in the study area that it could be confused with. *G. parviflora* subsp. *parviflora* was recorded in high densities in some parts of the study area, and was considered highly likely to be suckering; rhizomes could not easily be seen from above ground due to soil and vegetation cover, and given the large number of stems present, no attempt was made to estimate the number of individuals in the population. The number of stems in the population in the study area was estimated based on extrapolation from the number of stems recorded in transects.

Most of the survey effort for this species detailed on the SPRAT profile has been in the Lake Macquarie and Lower Hunter Valley populations (DotE 2015b). The only western Sydney survey referred to, at Kemps Creek, did not record any *G. parviflora* subsp. *parviflora.*

Parsons Brinckerhoff (2014) recorded *G. parviflora* subsp. *parviflora* on the MIC site to the north and west of the study area. The total number of individuals on the MIC site is not specified, but it is stated that at least 16 individuals with many suckers, and approximately 17 hectares of potential habitat, will be removed for the MIC intermodal terminal project development. This population is not included in the recovery plan.

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

Grevillea parviflora subsp. parviflora recorded in Castlereagh Scribbly Gum Woodland south of Anzac Creek in the rail corridor lands and adjoining areas to the east of the existing rail spur. A total of 1644 stems of *G. parviflora* subsp. *parviflora* were recorded in July 2012 from the 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 at this time was approximately 4,110 stems. Replicate surveys undertaken in 2014 found a total of 2825 stems with a population estimate of approximately 7063 stems.

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 the rail corridor where there was a dense shrubby midlayer. The *G. parviflora* subsp. *parviflora* habitat in the study area was in relatively good condition.

The population of *G. parviflora* subsp. *parviflora* in Castlereagh Scribbly Gum Woodland to the south of Anzac Creek is considered highly significant as the

population size is relatively large and there is a very low occurrence of this species in the western Sydney region.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

There are no formal conservation reserves containing known records of the species in the western Sydney distribution of the species. The Holsworthy Training Area, registered as the Cubbitch Barta National Estate Area on the Register of the National Estate, also functions as an informal conservation area for *G. parviflora* subsp*. parviflora* habitat, although few records occur on these lands to date.

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

Not applicable. *G. parviflora* subsp*. parviflora* is expected to be impacted by the proposed action.

- **discussion of the potential impacts on the above species and communities of pest species, disease and fire outbreaks generated by the proposed action;**

The vegetation communities that constitute habitat for *G. parviflora* subsp*. parviflora* grow on acidic, nutrient poor soil which is not highly susceptible to weed invasion, so weed invasion is not considered a major threat to populations; however a number of weedy exotic perennial grass species were observed growing in disturbed habitat for the species at the cleared edge of the existing rail spur in the east of the rail corridor, including *Eragrostis curvula* (African Lovegrass), *Setaria parviflora, Paspalum dilatatum* (Paspalum) and *Andropogon virginicus* (Whiskey Grass). There is potential for weed propagules to be spread into the *G. parviflora* subsp*. parviflora* habitat as a result of the Proposal , through soil disturbance for construction of the rail link and via trains.

Grevillea parviflora subsp. *parviflora* has been identified as a species that may be adversely affected by *Phytophthora cinnamomi,* a soil borne pathogen that infects roots and is associated with plant damage and death. *P. cinnamomi* may be dispersed over large distances in flowing water, such as storm runoff, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of *P. cinnamomi* may also be dispersed by vehicles (e.g. cars and earth moving equipment), animals, walkers and movement of soil. No evidence of. *P. cinnamomi* was observed in the study area, but there is an increased risk of *P. cinnamomi* dispersal as a result of the proposed action. Precautionary measures are recommended during construction of the rail corridor.

The fire sensitivity of *G. parviflora* subsp. *parviflora* is discussed above. The proposed action is unlikely to result in an increase in the frequency or intensity of fire.

- **consideration of each species or community must have regard to any recovery plan prepared by the Commonwealth, NSW or other State government, in relation to the species and any publically available policy statement or conservation advice approved by the minister in relation to the species or community**

No recovery plan has been prepared for *Grevillea parviflora* subsp. *parviflora.* The species has been assigned to the site-management stream under the NSW OEH Saving Our Species program. Threatened species in this management stream can be successfully secured by carrying out targeted conservation projects on specific sites

around NSW. OEH has established five management sites for *Grevillea parviflora* subsp. *parviflora*. The study area is not located within any of the management sites.

Nodding Geebung (*Persoonia nutans*)

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities;**

Persoonia nutans is an erect to spreading shrub 0.5–1.5m high, with linear leaves and hairy young branches. *P. 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 2006b).

Robertson *et al.* (1996) estimated the total population size at approximately 6278 plants based on counts from nine different populations. DEC (2006b) 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.

Parsons Brinckerhoff (2014) recorded *Persoonia nutans* on the MIC site to the north and west of the study area. Approximately 10 individuals were present and it is noted that additional individuals may also be represented in the soil seed bank.

An analysis of the populations within five kilometres of the study area was undertaken with reference to information in the recovery plan, SPRAT profile and Wildlife Atlas records (Table 4)

Table 4: *Persoonia nutans* populations within five kilometres of the study area

Site code (DEC 2006b)	Location	Population size (if known)
C1a	Simmos Beach Reserve	11-50
L1a	North Holsworthy Military Area	Not stated
L2a	Pleasure Point, on track parallel and north of Heathcote Road	? – potentially extinct
L3a	Western side of Georges River at Voyager Point, north of footbridge	<10
L3b	North of East Hills military barracks at Voyager Point	<10
n/a	MIC site: patches of CSGW to west of Moorebank Road	Approximately 10

The species also occurs at Kemps Creek and Villawood, in small populations (<10 individuals). All known populations of *Persoonia nutans* in the south of the species range are small in size, with no recorded populations of over 50 individuals.

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.

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 in 2012 recorded 126 individual plants, of which 110 occurred within the rail corridor, with 17 of those occurring within the construction footprint of the rail link. Sixteen occurred in adjoining lands to the east (in the Southern Boot Land). Targeted searches in 2014 and 2015 recorded 113 individual plants, of which 92 occurred within the rail corridor, with 11 of those occurring within the construction footprint of the rail link. There were two distinct sub-populations in the study area, separated by an approximately 170 metre gap. Plants ranged from 20cm to about 1.8m in height, and many individuals were observed to be flowering and/or fruiting.

The areas supporting *P. nutans* appeared to have been disturbed, with mounded earth bunds running roughly east-west. Based on observations of the historical aerial photographs, this disturbance occurred between 1950 and 1960. There was a higher density of individuals recorded at the edge of the bushland. There were also individuals of *P. nutans* observed regenerating in the transmission line easement, which is regularly slashed.

The population of *P. nutans* in the study area is considered to be significant as it is the largest population recorded in the south of the species' range, and one of only 15 known populations with over 50 mature individuals.

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action;**

The recovery plan for *P. nutans* (DEC 2006b) lists three main threats to the survival of the species:

1. Habitat loss and fragmentation

Clearing and fragmentation of habitat for *P. nutans* is one of the major threats to the survival of the species. Extensive clearing of habitat has occurred for sand and gravel extraction and for industrial and residential development. Loss of habitat has direct impacts to *P. nutans* populations through loss of individuals and indirect impacts through fragmentation of populations; habitat fragmentation can reduce the long-term viability of populations as the species is dependent on recolonisation via seed dispersal.

The proposed action will include clearing of occupied and potential habitat for *P. nutans,* resulting in the loss of individual plants and fragmentation of the remaining population as well as areas of potential habitat.

2. Inappropriate fire regimes

P. nutans is an obligate seed regenerator; plants are killed by fire and regeneration is dependent upon recruitment from a soil stored seed bank. If fires occur too frequently to allow re-establishment of the soil stored seed bank, local extinction of the species may occur. The critical fire frequencies for *P. nutans* have not been determined, but an interval of at least 7 to 10 years between fires has been recommended (DEC 2006b).A long-term absence of fire or other disturbance may also be detrimental to the persistence of *P. nutans* populations, however frequent rather than infrequent fires pose the greater threat.

The proposed action is unlikely to result in an increase in the frequency or intensity of fire. Fire prevention and control measures undertaken as part of the operation of the intermodal terminal are more likely to decrease the frequency of fires.

3. Habitat degradation and rubbish dumping related to unrestricted access

The majority of populations of *P. nutans* outside of nature reserves are subject to high levels of disturbance associated with unrestricted access. The habitat is commonly dissected by tracks, and populations have been damaged by vehicles and smothered by large quantities of rubbish (DEC 2006b).

The *P. nutans* habitat in the study area is currently fenced with no public access, and this restricted access will continue during the construction and operation of the Proposal.

- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;**

Targeted surveys for *P. nutans* in the study area were undertaken in May 2011, July 2012, November 2014, January and March 2015. Survey methods included detailed targeted searches of areas of potential habitat: the main areas of occupied habitat identified in general site inspections, north of Anzac Creek, were intensively searched by two ecologists walking in east-west aligned transects spaced no more than two metres apart. GPS waypoints were recorded at points where the species occurred. The species was also targeted in 2011 and 2012 surveys with north-south transects spaced 10 metres apart in potential habitat south of Anzac Creek, but only one individual of the species was found in this area. The strip of potential *P. nutans* habitat adjoining the western side of Moorebank Avenue was also searched intensively at this time, with no individuals recorded.

The Environmental Impact Assessment Guidelines for *P. nutans* (DEC 2005a) recommend targeted survey should be conducted during peak flowering in summer, as the species is most easily detected when in flower. The species was considered to be easy to detect during surveys in May and July due to its distinctive foliage; many individuals were observed to be in flower or fruit. The guidelines also recommend that surveys of potential habitat at recently burnt or long unburnt sites may not detect the species, as it may only occur in the soil stored seed bank or as young seedlings.

P. nutans populations were surveyed in detail in 1996 during preparation of the first recovery plan for the species (Robertson *et al.* 1996). No further formal surveys of *P. nutans* populations have been undertaken; previously unrecorded populations have been located by consultants on an ad hoc basis and recorded in the NSW Wildlife Atlas, and brief surveys were conducted by DEC prior to preparation of the most recent recovery plan in 2005.

There are large areas of potential habitat for *P. nutans* mapped in the Holsworthy lands, but few records of the species in this area. One individual was recorded to the south of the study area in 1996 and there is another record in the east of the Holsworthy lands near Voyager Point from 1998. This lack of records reflects the limited targeted survey for the species in the area and the possibility that the species may not be detected by targeted survey even if present at a site given that it is an obligate seeder and the number of above ground individuals will fluctuate in space and time (DEC 2006b).

Parsons Brinckerhoff (2011) recorded approximately 10 *Persoonia nutans* on the MIC site to the north and west of the study area. This population is not included in the recovery plan.

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

The recorded populations of *P. nutans* vary in size from a few individuals to thousands of plants, but the majority of populations support a low number of plants. Less than 1% of individuals occur within the southern part of the species range.

Persoonia nutans was recorded in the Castlereagh Scribbly Gum Woodland north of Anzac Creek in the study area. A targeted search for this species recorded 126 individual plants in 2012, of which 110 occurred within the rail corridor. Seventeen of these plants occurred within the construction footprint of the rail link. Sixteen occurred in adjoining lands to the east. Targeted searches in 2014 and 2015 recorded 113 individual plants, of which 92 occurred within the rail corridor, with 11 of those occurring within the construction footprint of the rail link. Plants ranged from 20cm to about 1.8m in height, and many individuals were observed to be flowering and/or fruiting.

The areas supporting *P. nutans* appeared to have been disturbed, with mounded earth bunds running roughly east-west. Based on observations of the historical aerial photographs, this disturbance occurred between 1950 and 1960. There was a higher density of individuals recorded at the edge of the bushland. There were also individuals of *P. nutans* observed regenerating in the transmission line easement, which is regularly slashed. It is considered likely that soil and vegetation disturbance in and adjoining the habitat has encouraged germination of *P. nutans*. The habitat for *P. nutans* in the rail corridor is generally in good condition, with low incidence of exotic species.

The population of *P. nutans* in the study area is considered to be very important as it is the largest population recorded in the south of the species' range, and one of only 15 known populations with over 50 mature individuals.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

There are no formal conservation reserves in the southern part of the species range. The southernmost population of *P. nutans* at Macquarie Fields is relatively protected within Simmos Beach Recreation Reserve, managed by Campbelltown City Council. The Holsworthy Training Area, registered as the Cubbitch Barta National Estate Area on the Register of the National Estate, also functions as an informal conservation area for *P. nutans* habitat, although few populations have been recorded on these lands to date.

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

Not applicable. *P. nutans* is expected to be impacted by the proposed action.

- **discussion of the potential impacts on the above species and communities of pest species, disease and fire outbreaks generated by the proposed action;**

The vegetation communities that constitute habitat for *P. nutans* grow on acidic, nutrient poor soil which is not highly susceptible to weed invasion, so weed invasion is not considered a major threat to populations; however a number of weed species have

been observed growing in proximity to individuals, including *Opuntia* sp. (Prickly Pear), *Eragrostis curvula* (African Lovegrass) and *Andropogon virginicus* (Whiskey Grass). All three of these species were recorded in the study area and *E. curvula* was observed growing in abundance at the cleared edge of *P. nutans* habitat in the rail corridor.

Persoonia nutans has been identified as a species that may be adversely affected by *Phytophthora cinnamomi,*a soil borne pathogen that infects roots and is associated with plant damage and death. *P. cinnamomi* may be dispersed over large distances in flowing water, such as storm runoff, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of *P. cinnamomi* may also be dispersed by vehicles (e.g. cars and earth moving equipment), animals, walkers and movement of soil. No evidence of. *P. cinnamomi* was observed in the study area, but there is an increased risk of *P. cinnamomi* dispersal as a result of the proposed action. Precautionary measures are recommended during construction of the rail corridor.

The fire sensitivity of *P. nutans* is discussed above. The proposed action is unlikely to result in an increase in the frequency or intensity of fire.

- **consideration of each species or community must have regard to any recovery plan prepared by the Commonwealth, NSW or other State government, in relation to the species and any publically available policy statement or conservation advice approved by the minister in relation to the species or community**

A recovery plan has been prepared for *Persoonia nutans* (DEC 2006b). The overall objective of the recovery plan is "to ensure the continued and long-term survival of *P. nutans* in the wild by promoting the in situ conservation of the species across its natural range". The recovery plan has been reviewed and is the major reference source for this assessment of *P. nutans.* The Proposal is being assessed with reference to the recovery plan, environmental impact assessment guidelines and all publicly available information regarding the species.

The species has been assigned to the site-management stream under the NSW OEH Saving Our Species program. Threatened species in this management stream can be successfully secured by carrying out targeted conservation projects on specific sites around NSW. OEH has established one management sites for *Persoonia nutans*. The study area is not located within this management site.

Macquarie Perch (*Macquaria australasica*)

Macquarie Perch (*Macquaria australasica*) is listed as Endangered under the EPBC Act and the FM Act.

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities**

The distribution of Macquarie Perch is restricted to the headwaters of the Lachlan, Murrumbidgee, Murray, Kiewa, Ovens, Goulburn-Broken and Campaspe Rivers in the Murray-Darling Basin to the west of the Great Dividing Range, and the Hawkesbury-Nepean, Georges River and Shoalhaven basins on the east. The species was recorded in 2008 in the Georges River near Campbelltown, approximately 15 kilometres upstream of the study area, the first record from the river since 1894. The species persists in the Burrinjuck, Cotter (Murrumbidgee) and Wyangala impoundments (ALS 2011, Faulks *et al.* 2011, DotE 2015d).

The Macquarie Perch is a riverine, schooling species. It prefers clear water of upper reaches of river catchments where siltation loads are reduced and undisturbed. Habitat requirements are deep, rocky holes interspersed with shallow riffles with lots of cover, such as aquatic vegetation, large boulders, debris and overhanging banks. The area of riffles within a reach was found to be one of the best predictors of the species presence; species-habitat association modelling indicates that at least one hectare and an optimum of three hectares of riffle habitat per kilometre of stream are required for *M. australasica* to be present (Faulks *et al.* 2011, DotE 2015d).

The Macquarie Perch feeds mainly on insects and larvae. The diet of the Macquarie Perch may also include crustaceans, bugs, damselflies and molluscs. This species is generally a bottom feeder and only takes a small proportion of its food at the water surface (DotE 2015d, DPI 2012).

Females do not spawn until three years of age, at approximately 300 millimetres in length. Spawning generally occurs in spring to early summer when the water temperature reaches approximately 15°C. The timing of spawning migration and spawning most likely differs from river to river due to difference in temperature regimes.

The species spawns just above riffles in shallow, fast-flowing water over gravel beds, in shallow upland streams or flowing parts of rivers. Downstream reaches of rivers or still or stagnant stretches are generally not favourable for spawning, as any silt present typically fills deep holes and settles on the river bottom, covering rocky substrates and filling small spaces between the gravel and cobbles. This prevents the eggs from settling among stones and gravel of the stream or river bed. The Macquarie Perch may undertake small-scale migrations from pools to riffles to spawn; migration may not be necessary in stream-dwelling fish. Recaptures of tagged fish suggest some fish use the same river each year for spawning (Faulks *et al.* 2011, DotE 2015d, DPI 2012).

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action**

Known threats to the species (Faulks *et al.* 2011, DotE 2015d, DPI 2012) include:

- Changes in water quality associated with agricultural and forestry practices. For example, siltation (as a result of clearing) can destroy the deep rock pools used by adults as well as smothering spawning areas.
- Loss of riparian vegetation causes riverbanks to become unstable and to erode, causing siltation of the riverbed. The cumulative effect of these changes is habitat

degradation and a reduction of the stream's capacity to support its natural fish community (DIPNR 2004).

- Modification of natural river flows and temperatures as a result of river regulation (construction of dams and weirs), leading to reduced opportunities for dispersal and reduced habitat quality.
- Spawning failures resulting from cold water releases from dams.
- Competition from introduced fish species such as trout and redfin perch.
- Diseases such as EHN (epizootic haematopoietic necrosis), which is carried by redfin perch.
- Over-fishing has probably contributed to past declines. Macquarie perch are now totally protected in NSW, but illegal fishing (and possibly hooking injuries in accidentally caught fish) still poses a threat.
- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;**

Macquarie Perch are difficult to survey since they are an evasive, nocturnal species (DotE 2015d). Both the Georges River and Anzac Creek presented logistical difficulties that prevented the use of the electrofisher and the seine net. Georges River was too deep for effective electrofishing, and contained too many submerged logs for effective seine netting. To compensate for this, additional bait traps were deployed at each site (ALS 2011).

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

The Macquarie Perch was not identified from Anzac Creek or the Georges River within the study area. Anzac Creek does not support preferred habitat for the species, while the Georges River supports potential foraging and refuge habitat for the species. Large woody debris, overhanging vegetation, fallen logs, mats of sticks, submerged (*Elodea canadiensis*) and floating aquatic plants (*Azola sp., Salvinia molesta*) were present in the littoral and edge habitats throughout Georges River within the study area (ALS 2011).

The Georges River does not support preferred breeding habitat for the species, as there is an absence of required riffle habitat and water quality is variable. The autumn 2011 sampling effort for the Community River Health Monitoring Program included sampling of the Georges River at Cambridge Avenue, approximately 550 metres upstream of the study area. At this location, the overall grade of river health at this location was assessed as Fair. The measure of freshwater macroinvertebrates was Good, water quality was Good, and riparian and estuarine vegetation was Fair. Poor water quality and low aquatic biodiversity in the Georges River in the wider locality can be attributed to industrial discharge and urban run-off entering the river system in the upper catchment (GRCCC 2011).

Movement of the species into the study area is partly limited to migration from upstream reaches of the Georges River, due to the presence of the Liverpool weir, located approximately 3.5 kilometres downstream of the study area. The weir is located approximately 40 kilometres upstream from the mouth of the Georges River and forms

its tidal limit. A vertical slot fishway has attempted to restore fish passage and re-establish native fish in the Georges River (NFA 2012); however, as the Macquarie Perch does not inhabit estuarine waters it should not usually be found downstream of the weir.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

There are no formal or informal conservation reserves for the Macquarie perch in the proposed action area or surrounding areas.

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

The likelihood of occurrence of the Macquarie Perch in the study area was assessed as Possible. Due to the presence of potential foraging and refuge habitat, an Assessment of Significance has been undertaken for the species (Appendix H).

Although the Georges River water quality is variable, the study area supports potential refuge and foraging habitat for the Macquarie Perch with a variety of habitat features present. The Georges River does not support preferred breeding habitat for the species, as there is an absence of required riffle habitat and water quality is variable. The recent (2010) remediation of the Ingleburn Weir system upstream of the study area has also removed a significant physical barrier which may have historically restricted the movement of Macquarie Perch to the study area.

The Proposal involves the construction of a rail bridge across the Georges River. Piers would be located at both banks of the river and instream. Temporary construction platforms would be installed in the creek bed, though flow would be maintained throughout the construction period with no obstruction of fish passage. Locating piers within the river channel and construction of instream platforms will have temporary impacts during the construction period where there would be an increase in sedimentation and there is a high risk of pollution. This may reduce the quality of habitat in the immediate vicinity and downstream of the study area. Permanent localised impacts would occur through changes to turbulence around instream pier structures.

Installation of appropriate drainage and erosion and sediment controls (e.g. silt boom), will minimise this potential impacts and any long-term impacts on drainage patterns or water quality are unlikely.

The Proposal will not impose any restrictions to fish movement through the Georges River during or post construction. Given the high mobility of the Macquarie Perch (recorded to travel distances of up to 50 km), the proposal will not fragment of isolate areas of habitat for this species.

Despite these potential impacts, given that no breeding habitat occurs within the study area the Proposal is unlikely to have an adverse effect on the life cycle of the Macquarie Perch, such that a viable local population of the species is likely to be placed at risk of extinction.

Spot-tailed Quoll (*Dasyurus maculatus*)

The Spotted-tail Quoll (*Dasyurus maculatus*) is the largest carnivorous marsupial to occur on the Australian mainland (Kerr 1995). It is listed as a Vulnerable species under the TSC Act, and an Endangered species under the EPBC Act.

- **information on the abundance, distribution, ecology and habitat preferences of the species or communities**

The Spotted-tail Quoll occurs along the east coast of Australia from south-east Queensland to Tasmania and has been found on both sides of the Great Dividing Range. The Spotted-tail Quoll is partly arboreal, and is known from a variety of habitats including rainforest, open forest, woodland, coastal heathland and inland riparian forest. Preferred habitat generally comprises mature wet forest habitat, which supports a range of den sites such as trees with hollows, hollow logs on the ground, rocky outcrops, caves, rock crevices or underground burrows and an abundance of prey. The species may utilise up to 20 different den sites within their home range (Kerr 1995, NPWS 1999a, DEC 2005d, DECC 2007b).

The species requires large tracts of continuous vegetation; females establish home ranges of up to 750 hectares and males up to 3500 hectares. A study of Spotted-tail quolls at Limeburners Creek Nature Reserve (Andrew 2005) found that individuals moved widely on a daily and weekly basis. Females were recorded making daily journeys of 5 kilometres, while males were recorded travelling 8.5 kilometres. Over longer periods, males were recorded travelling over 20 kilometres in nine days.

The Spotted-tail Quoll predates upon small mammals (such as gliders, possums, small wallabies, rats and bandicoots), birds, reptile, insects and carrion from dingo and wild dog kills. The Spotted-tail Quoll is highly mobile and may forage over several kilometres in one night. The species is usually nocturnal, although it may bask in the sun during the day.

Within its home range, an individual establishes latrine sites that are often visited several times during nightly foraging activities. Latrines, that may define territories or reproductive status, may be found on exposed rocks, flat boulders, on exposed ground at the base of a cliff or adjacent to tracks. The Spotted-tail Quoll mates during late autumn to winter and the gestation period is 21 days. The young are fully independent at 18 weeks of age. Males rarely assist in the rearing of young. The species is mature at one year of age and generally lives between three and four years (in captivity) (DotE 2015a).

- **discussion of the known threats to the species or communities with reference to threats posed by the proposed action**

Known threats to the Spotted-tail Quoll (DotE 2015a) include:

- Loss, fragmentation, disturbance and degradation of habitat through clearing of native vegetation, timber harvesting and other forest management practices
- Predation from Red Foxes, Dingos (*Canis lupus dingo*) and Domestic Dogs (*Canis lupus familiaris*)
- Fire affecting the availability of prey and causing habitat patchiness
- Direct killing by landholders in response to poultry coop raids
- Road mortality in forested areas fragmented by roads, and a tendency to scavenge road-killed carcasses may increase this threat

- Potential for the species to be poisoned by cane toads (based on anecdotal evidence)
- Indirect mortality from ingestion of 1080 baits targeting red foxes, dingoes and wild dogs
- **details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas. This should include details of survey effort, timing, location and methodologies for studies and surveys undertaken and the regional status, population size and distribution within the area surrounding the proposed action identified for these species and communities. Survey methodology must have regard to any relevant publicly available guidance issued by the department;**

The species was not identified in the study area during fauna surveys. There are 137 records of the Spotted-tail Quoll within 50 kilometres of the study area (OEH 2015). The closest records (within 20 kilometres) of the species are listed in Table 5.

Table 5: Records of Spotted-tail Quoll within 20km of study area

Date recorded	Observation Type	Distance from study area	Location
2007	Seen	16 kilometres to the south-east	Royal National Park
2004	Seen	6 kilometres to the south-east	Holsworthy Military Area
2002	Trapped	9 kilometres to the north-east	Fairfield East, Fairfield LGA
1996	Seen	12 kilometres to the south	Holsworthy Military Area
1993	Dead	7 kilometres to the south-east	Holsworthy Military Area
1993	Trapped	14 kilometres to the north-east	Granville, Parramatta LGA
1990	Seen	7 kilometres to the north-west	Green Valley, Liverpool LGA

Given that the species lives for between three to four years, it is unlikely that the individuals listed most recently (Table 5) persist in the locality.

- **an assessment of the quality and importance or potential habitat for these species and communities in the proposed action area and surrounding areas;**

Remnant woodland and forest habitats within the study area supports suitable habitat for the Spot-tailed Quoll. However, the species requires large tracts of vegetation and the study area contains and is bound by significant barriers to movement. These barriers include Moorebank Ave, the East Hills Railway Line and chain-mesh fencing surrounding the Boot Land, SIMTA site, rail corridor and Royal Engineers Golf Course. These physical barriers restrict access of Spotted-tail quolls to habitat within the study area

The Spotted-tail quoll could travel through the Georges River riparian vegetation within the study area that is linked to the expanse of native vegetation contained within the Holsworthy Military Area. Holsworthy Military Area comprises approximately 18,000 hectares of forests, woodland and heath communities and may contain preferred habitat for the species. However, large areas of residential and industrial development reduce potential dispersal of this species throughout the locality.

- **the presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas;**

There are no formal conservation reserves within the proposed action area or surrounding areas. Holsworthy Military Area, located to the south of the study area, contains approximately 18,000 hectares of forests, woodland and heath communities and may contain preferred habitat for the species.

- **for all species and communities that are considered unlikely to be impacted by the proposed action, but for which apparently suitable habitat is present and could be impacted by the proposed action, detailed information to demonstrate impacts of the species are unlikely to occur;**

Due to the absence of recent records of the species in the locality and the significant barriers to movement within and surrounding the study area, the species is considered unlikely to occur in the study area.

APPENDIX H

ASSESSMENTS OF SIGNIFICANCE

Assessments of Significance

Macquarie Perch (*Macquaria australasica*)

Macquarie Perch (*Macquaria australasica*) is listed as Endangered under the EPBC Act and the NSW FM Act.

The distribution of Macquarie Perch is restricted to the headwaters of the Lachlan, Murrumbidgee, Murray, Kiewa, Ovens, Goulburn-Broken and Campaspe Rivers in the Murray-Darling Basin to the west of the Great Dividing Range, and the Hawkesbury-Nepean, Georges River and Shoalhaven basins on the east. The species was recorded in 2008 in the Georges River near Campbelltown, approximately 15 kilometres upstream of the study area, the first record from the river since 1894 (Atlas of Living Australia 2015). The species persists in the Burrinjuck, Cotter (Murrumbidgee) and Wyangala impoundments (ALS 2011, Faulks *et al.* 2011, DotE 2015d).

The Macquarie Perch is a riverine, schooling species. It prefers clear water of upper reaches of river catchments where siltation loads are reduced and undisturbed. Habitat requirements are deep, rocky holes interspersed with shallow riffles with lots of cover, such as aquatic vegetation, large boulders, debris and overhanging banks. The area of riffles within a reach was found to be one of the best predictors of the species presence; species-habitat association modelling indicates that at least one hectare and an optimum of three hectares of riffle habitat per kilometre of stream are required for Macquarie Perch to be present (Faulks *et al.* 2011, DotE 2015d).

The Macquarie Perch feeds mainly on insects and larvae. The diet of the Macquarie Perch may also include crustaceans, bugs, damselflies and molluscs. This species is generally a bottom feeder and only takes a small proportion of its food at the water surface (DotE 2015d, DPI 2012).

Females do not spawn until three years of age, at approximately 300 millimetres in length. Spawning generally occurs in spring to early summer when the water temperature reaches approximately 15°C. The timing of spawning migration and spawning most likely differs from river to river due to difference in temperature regimes.

The species spawns just above riffles in shallow, fast-flowing water over gravel beds, in shallow upland streams or flowing parts of rivers. Downstream reaches of rivers or still or stagnant stretches are generally not favourable for spawning, as any silt present typically fills deep holes and settles on the river bottom, covering rocky substrates and filling small spaces between the gravel and cobbles. This prevents the eggs from settling among stones and gravel of the stream or river bed. The Macquarie Perch may undertake small-scale migrations from pools to riffles to spawn; migration may not be necessary in stream-dwelling fish. Recaptures of tagged fish suggest some fish use the same river each year for spawning (Faulks *et al.* 2011, DotE 2015d, DPI 2012).

Anzac Creek does not support preferred habitat for the species, while the Georges River supports potential foraging and refuge habitat for the species. Large woody debris, overhanging vegetation, fallen logs, mats of sticks, submerged (*Elodea canadiensis*) and floating aquatic plants (*Azola sp., Salvinia molesta*) were present in the littoral and edge habitats throughout Georges River within the study area (ALS 2011). The Georges River does not support preferred breeding habitat for the species, as there is an absence of required riffle habitat and water quality is variable.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Georges River does not support preferred breeding habitat for the species, as there is an absence of required riffle habitat and water quality is variable. The autumn 2011 sampling effort for the Community River Health Monitoring Program included AUSRIVAS sampling of the Georges River at Cambridge Avenue, approximately 550 metres upstream of the study area. At this location, the overall grade of river health at this location was assessed as Fair. The measure of freshwater macroinvertabrates was Good, water quality was Good, and riparian and estuarine vegetation was Fair. Poor water quality and low aquatic biodiversity in the Georges River in the wider locality can be attributed to industrial discharge and urban run-off entering the river system in the upper catchment (GRCCC 2011).

Although the Georges River water quality is variable, the study area supports potential refuge and foraging habitat for the Macquarie Perch with a variety of habitat features present. The recent (2010) remediation of the Ingleburn Weir system upstream of the study area has also removed a significant physical barrier which may have historically restricted the movement of Macquarie Perch to the study area.

The Proposal involves the construction of a rail bridge across the Georges River. Piers would be located at both banks of the river and instream. Temporary construction platforms would be installed in the creek bed, though flow would be maintained throughout the construction period with no obstruction of fish passage. Locating piers within the river channel and construction of instream platforms will have temporary impacts during the construction period where there would be an increase in sedimentation and there is a high risk of pollution. This may reduce the quality of habitat in the immediate vicinity and downstream of the study area. Permanent localised impacts would occur through changes to turbulence around instream pier structures.

Installation of appropriate drainage and erosion and sediment controls (e.g. silt boom), will minimise this potential impacts and any long-term impacts on drainage patterns or water quality are unlikely.

Despite these potential impacts, given that no breeding habitat occurs within the study area the Proposal is unlikely to have an adverse effect on the life cycle of the Macquarie Perch, such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Macquarie Perch does not comprise an endangered population.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

> ***(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
>
> ***(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction***

Not applicable. The Macquarie Perch does not comprise an endangered ecological community.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

Anzac Creek does not support preferred habitat for the species, while the Georges River supports potential foraging and refuge habitat for the species. Large woody debris, overhanging vegetation, fallen logs, mats of sticks, submerged (*Elodea canadiensis*) and floating aquatic plants (*Azolla sp., Salvinia molesta*) were present in the littoral and edge habitats throughout Georges River within the study area (ALS 2011). The SIMTA proposal involves the construction of a rail bridge across the Georges River. Piers would be located at both banks of the river and instream. Temporary construction platforms would be installed in the creek bed, though flow would be maintained throughout the construction period with no obstruction of fish passage. Locating piers within the river channel and construction of instream platforms will have temporary impacts during the construction period where there would be an increase in sedimentation and there is a high risk of pollution. This may reduce the quality of habitat in the immediate vicinity and downstream of the study area. Permanent localised impacts would occur through changes to turbulence around instream pier structures.

The Proposal will not impose any restrictions to fish movement through the Georges River during or post construction. Given the high mobility of the Macquarie Perch (recorded to travel distances of up to 50 km), the proposal will not fragment of isolate areas of habitat for this species.

Construction of a single track rail bridge across the Georges River is unlikely to remove, significantly modify, fragment or isolate potential foraging or refuge habitat located within the study area. Construction of the rail link across the Georges River, particularly of piers within the main waterway and working platforms, will have temporary impacts through increased sedimentation during construction, increased risk of pollution and permanent localised impacts through changes to turbulence around in stream pier structures. These impacts are likely to have minor impacts on the quality of potential foraging and refuge habitat within the Georges River. No significant long-term impacts on existing habitat values of the study area and downstream are expected.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat has been identified for the Macquarie Perch.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is no recovery plan or threat abatement plan for the Macquarie Perch. There are nine Priority recovery strategies for the Macquarie Perch (DPI 2012) that aim to promote the recovery of the species. The Proposal is not inconsistent with these recovery strategies.

The following threats are listed within the Action Plan for Australian Freshwater Fishes as contributing to the decline of the Macquarie Perch (Wager and Jackson 1993);

1. Competition with introduced species
    a. Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*) and Redfin (*Perca fluviatilis*) may prey on juveniles.
    b. Competition for food resources with trout.
2. Increased catchment erosion leading to siltation of spawning sites, destruction of invertebrate fauna (food source) and infilling of deep holes;
3. Increased nutrient loads associated with urban development (septic systems, fertilisers, etc.);
4. Over exploitation due to recreational fishing; and,
5. River regulation and water extraction.

The Proposal is not likely to exacerbate these threats within the study area.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Proposal may contribute to the following key threatening processes within the study area.

Degradation of native riparian vegetation along NSW water courses:

Degradation of native riparian vegetation along NSW water courses is listed under the FM Act. Impacts of this KTP include:

- Increasing the amount of sediment and nutrients reaching streams as runoff, and increasing light penetration of the water body;
- Reducing the inputs of organic carbon, via leaves, twigs, and branches;
- Reducing the amount of large woody debris entering the aquatic ecosystem and thereby negatively impacting on habitat and spawning sites of several vulnerable and endangered species listed under the FM Act; and,
- Destabilising river banks.

The Proposal will require the removal of riparian vegetation from Anzac Creek and the Georges River. The following mitigations measures will reduce potential impacts on aquatic habitats:

- Installation of appropriate drainage infrastructure (e.g. sediment basins, diversion drains), sediment and erosion controls prior to the commencement of construction;
- Clearing of vegetation is not to be undertaken during overland flow events;
- Locating soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential for transport of these substances into the watercourses via runoff; and,
- Stabilisation of disturbed areas, including revegetation in accordance with the VMP, is to be undertaken as soon as practicable after disturbance.

Removal of large woody debris from NSW rivers and streams

Removal of large woody debris from NSW rivers and streams is a KTP listed under the FM Act. Any large woody debris removed from Georges River during construction of the rail link should be stockpiled, and upon the completion of work, reinstated within the river.

Changes in drainage patterns and water quality

Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands is listed under the TSC Act. Alteration to natural flow regimes can occur through reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and sub-surface water levels and changing the rate of rise or fall of water levels (NSW Scientific Committee 2002).

Construction activities in proximity to and across Anzac Creek and the Georges River will result in temporary alterations to the flow regimes of both waterbodies including the construction of piers for the Georges River rail bridge, construction of instream work platforms in Georges River and installation of a temporary coffer dams at Anzac Creek.

Furthermore, the works would result in permanent changes to the flow regimes of both waterbodies from the installation of bridge piers at the Georges River rail crossing and a concrete box culvert at the Anzac Creek rail crossing. Changes to flow regimes are anticipated to be very minor and would not exacerbate this KTP.

Conclusion

In light of the consideration of the above factors, the Proposal is unlikely to have “a significant impact on the Macquarie Perch in the study area or wider locality, as:

- The Proposal will not adversely affect the lifecycle of the species.
- The Proposal will not remove, modify or further fragment or isolate a significant area of habitat for the species.

Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion

Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion is listed as Endangered under the EPBC Act.

Castlereagh Scribbly Gum and Agnes Banks Woodlands occurs primarily on Tertiary sands and gravels of the Hawkesbury-Nepean river system. The main occurrence of the community is in the Castlereagh area in the north-west of the Cumberland Plain, with other occurrences at Kemps Creek, Longneck Lagoon and around Holsworthy; the floristic composition of the community in the Holsworthy area.

In the study area, this community occurred to the north and south of Anzac Creek in the Southern Boot Land to the south of the SIMTA site, and in a narrow strip adjoining the eastern edge of the MIC site. The community was in relatively good condition, with high native species diversity and occurrence of exotic species mostly limited to bushland edges and tracks. There were also remnant scattered *E. sclerophylla* over patches of shrub and grass cover in the cleared grassland on the DNSDC south site. This patch is was in relatively good condition, but at 0.13 hectares in areas does not meet the patch size threshold of > 0.5 hectares for Castlereagh Scribbly Gum and Agnes Banks Woodlands as defined under the EPBC Act.

The Proposal will have direct impacts on the Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area, with 0.73 hectares of vegetation meeting the condition criteria for the community to be removed.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

(a) reduce the extent of an ecological community

The Proposal will have direct impacts on the Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area. The construction of the rail link will require the removal of 0.73 hectares of this community within the rail link construction footprint.

The Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area occupies the western extent of a large area of this community that is effectively, although not formally, conserved in the Holsworthy Military Area. The areas to the east of the study area, while not inspected as part of the current study, are larger and likely to be less disturbed than the vegetation in the study area. Given the large area of remnant Castlereagh Scribbly Gum and Agnes Banks Woodlands to the east, it is not considered likely that the Castlereagh Scribbly Gum and Agnes Banks Woodlands to be removed is of high importance to the long-term survival of the ecological community in the locality.

(b) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposed rail link will result in further fragmentation of the already fragmented Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area. Construction of the Rail link will create an approximately 20 metre wide fenced linear gap in the vegetation community within the Southern Boot Land. This will increase the current fragmentation between the Castlereagh Scribbly Gum and Agnes Banks Woodlands in the Project site and adjacent areas of this community to the east. The area of Castlereagh Scribbly Gum and Agnes Banks Woodlands within the Southern Boot Land is currently fenced along Moorebank Avenue to the west and along the East

Hills rail link to the south, so there is already a barrier to adjacent areas of the community in these directions. The areas of Castlereagh Scribbly Gum and Agnes Banks Woodlands mapped to the west and north-west of the Project site by DECCW (2009) appear to be fragmented patches of urban trees, some of which were observed to be planted trees in the MIC site.

(c) adversely affect habitat critical to the survival of an ecological community

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for Castlereagh Scribbly Gum and Agnes Banks Woodlands.

(d) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The proposed action would result in modifications to hydrological regimes and likely impacts to soil and water increased sedimentation and runoff during construction. Whilst these changes could impact on the ecological community, they would be on a relatively small scale and would be unlikely to affect its survival.

(e) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

The proposed action is unlikely to result in a substantial change to the species composition of the occurrence of Castlereagh Scribbly Gum and Agnes Banks Woodlands in the Project site or a decline or loss of functionally important species within this community. The removal of 0.73 hectares of Castlereagh Scribbly Gum and Agnes Banks Woodlands would have a minimal impact on these factors. The fenced 20 metre wide Rail link will create a large area of additional edge for the remaining patches of Castlereagh Scribbly Gum and Agnes Banks Woodlands, making them more vulnerable to invasion by exotic grasses and other weeds. A weed control program is proposed as part of the conservation management of the remaining patches of the community.

It is unlikely that the retained area of Castlereagh Scribbly Gum and Agnes Banks Woodlands will be subject to frequent hazard reduction activities, however this will depend on the requirements for bushfire protection adjacent to the rail link. There may be scope to co-ordinate hazard reduction activities with management of this community.

(f) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- assisting invasive species, that are harmful to the listed ecological community, to become established, or

As discussed above, the proposed action could result in further spread of weeds in retained stands of Castlereagh Scribbly Gum and Agnes Banks Woodlands. The edges of retained areas are already subject to minor weed invasion, but the Proposal is not likely to substantially reduce the quality or integrity of the ecological community. Weed control measures would be implemented during construction to minimise impacts, and it is proposed to maintain the retained areas in perpetuity as an offset site.

- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or

Fertilisers, herbicides and other chemicals could be used during and post-construction. This would occur within the construction area, but any inadvertent usage beyond which could impact the growth of species within the ecological community would be at a minor scale. Mitigation measures are proposed to reduce the risk of chemical spills into the retained areas of Castlereagh Scribbly Gum and Agnes Banks Woodlands. As such, the quality or integrity of the community would not be reduced substantially.

(g) interfere with the recovery of an ecological community.

No recovery plan has been prepared specifically for Castlereagh Scribbly Gum and Agnes Banks Woodlands. DECCW (2010) prepared the Cumberland Plain Recovery Plan, focusing on the threatened species, populations and ecological communities that are endemic to or primarily distributed on the Cumberland Plain. Castlereagh Scribbly Gum and Agnes Banks Woodlands is not included in the list of threatened ecological communities addressed in the recovery plan, although it is acknowledged that Castlereagh Scribbly Gum Woodlands was the subject of a preliminary listing under the TSC Act at the time of publication of the recovery plan.

Conclusion

The Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area forms the western extent of an approximately 62 hectare area of this community that is effectively, if not formally, conserved in the Holsworthy Military Area. The Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area will be directly impacted by the Proposal: an area of this community will be removed for construction of the rail corridor and the remaining patches will be fragmented and have an increase in edge length, making them more vulnerable to weed invasion and changes in vegetation structure. However, given the current fragmentation of the Castlereagh Scribbly Gum and Agnes Banks Woodlands in the study area and the large area of remnant Castlereagh Scribbly Gum and Agnes Banks Woodlands to the east, it is considered unlikely that the Proposal represents a significant impact to the community, particularly if mitigation measures are implemented.

APPENDIX I

RIPARIAN VEGETATION MANAGEMENT PLAN

SIMTA Intermodal Terminal Facility- Stage 1

Riparian Vegetation Management Plan

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

May 2015

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SIMTA INTERMODAL TERMINAL FACILITY-STAGE 1 INTERMODAL TERMINAL FACILITY

Riparian Vegetation Management Plan

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Checker	Brad Searle	
Approver	Westley Owers	
Report No	AA003760	
Date	20 April 2015	

CONTENTS

1 INTRODUCTION

This Vegetation Management Plan (VMP) has been prepared to guide the restoration of riparian vegetation adjoining both banks of the Georges River and Anzac Creek within the Rail Corridor. Crossings are proposed over the Georges River (proposed bridge) and Anzac Creek (proposed culvert) for the Rail link included for Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility (the Proposal).

This document has been prepared to align with the management requirements, provided by the NSW Office of Water (NOW), outlined in Section 1.2 of this VMP. It is important to note that the content of this document would be reviewed and updated, as necessary prior to construction of the Proposal.

This report should be read in conjunction with the following:

- *Biodiversity Assessment Report* (Hyder Consulting, 2015)
- *Biodiversity Offset Strategy* (Hyder Consulting, 2015).

1.1 KEY TERMS

Table 1 provides a summary of the key terms which are included within this report. Figure 1 also provides an indication of the site areas discussed in this table.

Table 1 Key terms

Term	Description
Concept Plan Approval	Concept Plan Approval (MP 10_0193) granted on 29 September 2014 for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank. This reference includes the associated Conditions of Approval (CoA) and Statement of Commitments (SoC) which form the approval documentation for the Concept Plan Approval.
EPBC Approval	Approval (No. 2011/6229) granted under the EPBC Act on March 2014 by the Commonwealth Department of Environment for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank.
SIMTA Project	The SIMTA Moorebank Intermodal Terminal Facility at Moorebank as approved by the Concept Plan (MP_10_0913).
SIMTA site	Includes the former Defence National Storage and Distribution Centre (DNSDC) site, the land owned by SIMTA which is subject to the Concept Plan Approval (refer to Figure 1).
Rail Corridor	Area defined as the 'Rail Corridor' within the Concept Plan Approval. The rail link is also included within this area (refer to Figure 1).
Stage 1 site	The subject of this EIS, the western part of the SIMTA site which includes all areas to be disturbed by the Stage 1 Proposal (including the Operational area and Indicative Construction area) (refer to Figure 1). This area does not include the Rail Corridor.
Construction area	Extent of construction works, namely areas to be disturbed during construction of the Stage 1 Proposal (refer to Figure 1).

Term	Description
Operational area	Extent of operational activities for the operation of the the Proposal (refer to Figure 1).
Proposal site	Includes the Stage 1 site and the Rail Corridor, i.e. the area for which approval (construction and operation) is sought within this EIS.
Rail link	The rail link including the area on either side to be impacted by the construction works included in the Stage 1 Proposal.
Former DNSDC South	The land to the south of the operational footprint of the Intermodal Terminal, to the boundary fence of the former DNSDC.
Southern Boot Land	Commonwealth owned land to the south of Former DNSDC South, and to the north of the RailCorp Land (part of the Boot Land in the MIC proposal).
RailCorp Land	Lot 1 DP 825352 (part of the Rail Corridor) and owned by RailCorp.
The Proposal	Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility including construction and operation of the intermodal terminal facility and rail link, i.e. all works and built form for which approval is sought in this EIS/Technical Report.
MIC Proposal	The development of an intermodal facility, associated commercial infrastructure (warehousing) and a rail link (3 options have been provided) to be located on the MIC site, for which an approval, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979.* This proposal is currently under assessment by the Department of Planning and Environment.
MIC site	The former School of Military Engineering site to the immediate west of the SIMTA site, across Moorebank Avenue.

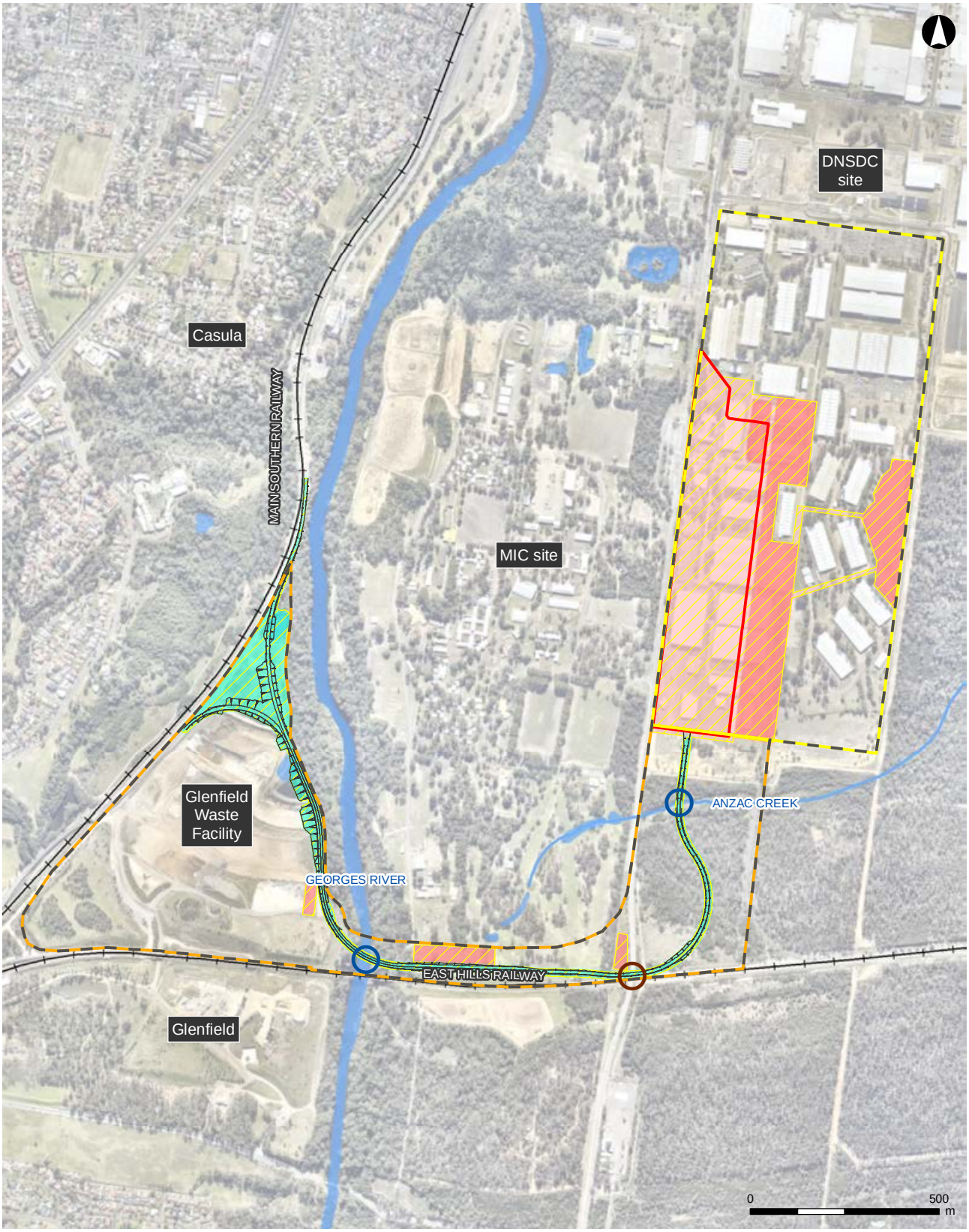
1.2 SITE LOCATION

This VMP applies to two management sites:

- The stretch of riparian vegetation adjoining both banks (east and west) of the Georges River within the SIMTA Rail Corridor (the Georges River management site)
- The section of Anzac Creek within the SIMTA Rail Corridor (the Anzac Creek management site)

Figure 2 indicates the location of these two management sites in relation to the Proposal, with more detail of the extent of each site on Figure 3 and Figure 4.

It should be noted that both management sites form part of the proposed offset sites for the Proposal (see Appendix B of the Biodiversity Assessment Report). The boundaries of the management sites provisionally include the areas of riparian vegetation within the Project site, however these are likely to be expanded to encompass all areas of riparian vegetation within the proposed offset sites once these offsets have been confirmed.



LEGEND

- Project site
- Rail corridor
- SIMTA site
- Operational area
- Proposed rail alignment
- Construction area
- Rail Link (including 20m width and variable buffer)
- Stage 1 site
- Compound sites
- Creek/River crossing
- Road crossing
- Existing railway
- Watercourse

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Figure 1: Site map

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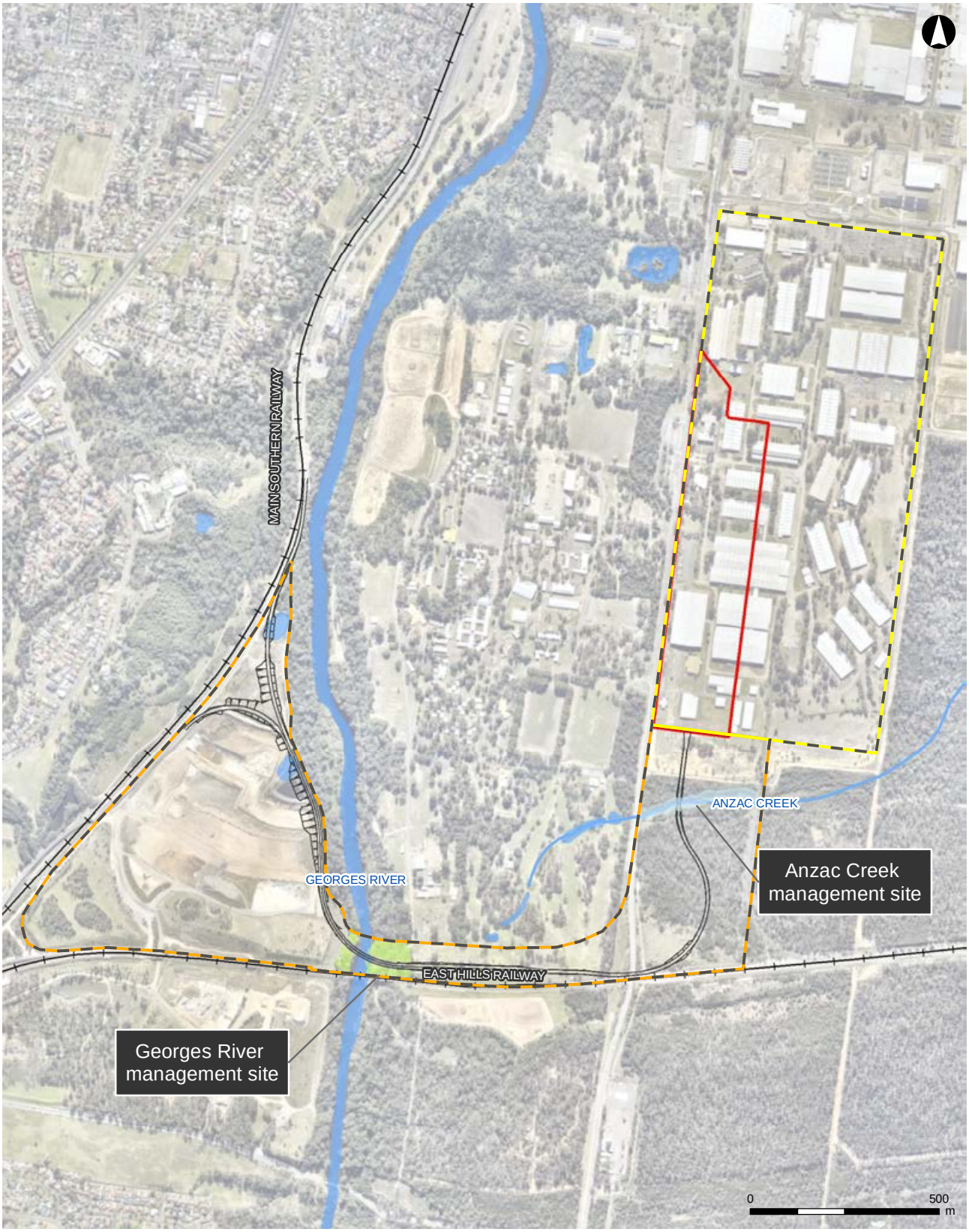
QA by : WO



LEGEND

- Project site
- Rail corridor
- SIMTA site
- Operational area
- Anzac Creek management site
- Georges River management site
- Proposed rail alignment
- Existing railway
- Watercourse

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Figure 2: Location of management sites in relation to the Proposal

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Figure 3: Georges River management site

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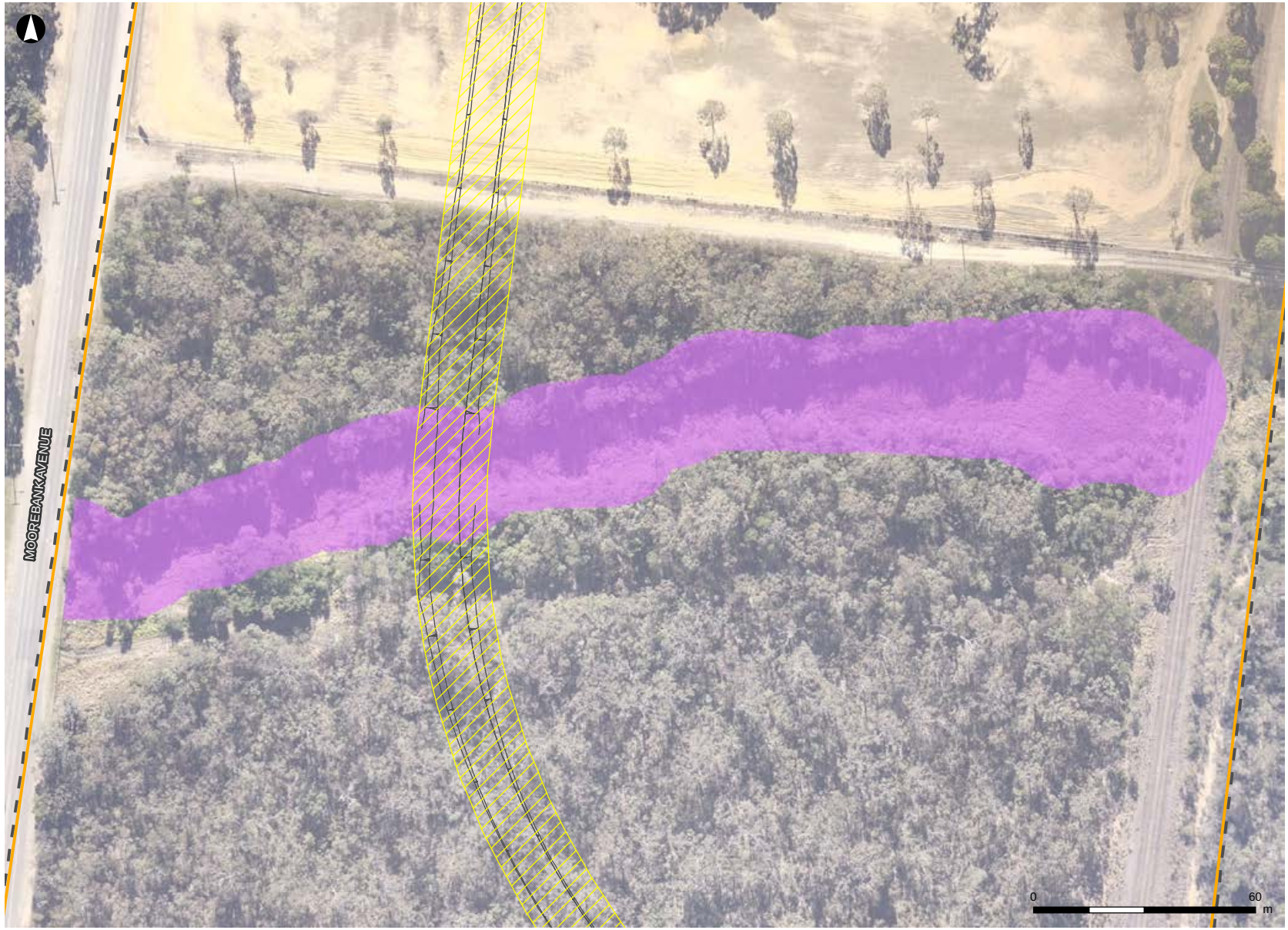
QA by : AW



LEGEND

- Project site
- Rail corridor
- Anzac Creek management site
- Construction area
- Proposed rail alignment

DATA SOURCES
nearmap

[redacted]

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Figure 4: Anzac Creek management site

Date: 20/04/2015 Path: \\HC-AUS-NS-FS-01\jobs\AA003760\L-GIS\A_Current\B_Maps\EcologyStage1\VMP\AA003760_VMP_Stage1_Figure4_AnzacCreekMS_A4_r1v2.mxd
Created by : DD
QA by : AW

1.3 MANAGEMENT PLAN REQUIREMENTS

NSW Office of Water

The NSW Department of Planning and Environment (DPE) issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal in December 2014 (SSD 14-6766). Condition 12(c) of the SEARs states that the Flora and Fauna Assessment is to include a Vegetation Management Plan that has been prepared in consultation with the NSW Office of Water (NOW).

NOW provided correspondence dated 16 April 2015, including the following advice:

> *Riparian corridors along the Georges River and Anzac Creek*
>
> *…approximately 0.22 hectares of riparian vegetation would be removed at the river banks for the installation of the bridge and abutments and 0.08 hectares of riparian vegetation would be impacted by the installation of the culvert/rail link at Anzac Creek. It is recommended the EIS includes:*
>
> - *details on the existing and proposed riparian corridor widths to be established along the river and Anzac creek (measured from top of bank)*
> - *a scaled plan which shows the proposed crossing options, existing riparian vegetation, the riparian corridor width and the riparian corridors that will be affected by the crossings*
>
> *Riparian corridors along the Georges River and Anzac Creek that are affected by the project should be appropriately revegetated to restore the ecological functional and habitat values. The EIS should provide details on the riparian corridor widths to be established to inform the riparian areas that are proposed to be disturbed by the project and areas that need to be revegetated/rehabilitated with local providence species.*
>
> *A Vegetation Management Plan (VMP) should be prepared which details the riparian corridor areas affected by the proposal and the regeneration/rehabilitation of riparian vegetation.*

Other relevant Management Plans (MIC site)

Parsons Brinckerhoff (2014) prepared a Management Plan for Restoration of the Riparian Zone of the Georges River as part of the Ecology Assessment for the MIC Proposal. The management plan was prepared for the riparian lands adjacent to the eastern bank of the Georges River within the MIC site. The riparian area addressed in the MIC management plan includes the Georges River management site in this plan. This plan has been prepared to maintain consistency with the MIC plan, where feasible and reasonable.

1.4 OBJECTIVES

The objectives of the VMP are to:

- Restore, conserve and enhance the riparian vegetation in the Georges River and Anzac Creek site that fall within the SIMTA Rail Corridor
- Long term eradication of weed species from the management sites
- Maintain an adequate width of riparian vegetation adjoining Georges River and Anzac Creek

- Protect and enhance fauna habitat connectivity along the Georges River and Anzac Creek riparian zone.

1.5 APPROACH

This VMP has been prepared in accordance with the following:

- *Guidelines for vegetation management plans of waterfront land*, NSW Office of Water
- *SIMTA Intermodal Terminal Facility – Stage 1 Biodiversity Assessment Report* (Hyder Consulting 2015).

This VMP also aims to be complementary to, and consistent with, the adjacent Management Plan for Restoration of the Riparian Zone of the Georges River prepared as part of the *Ecological Impact Assessment* for the MIC Proposal prepared by (Parsons Brinckerhoff,2014).

1.6 STRUCTURE OF THIS PLAN

This VMP has been structured according to the following:

- Section 2 outlines legislation and guidelines applicable to this VMP
- Section 3 provides an overview of the site context, including landuse, landform, soil conditions and vegetation
- Section 4 establishes management strategies for rehabilitation of the riparian corridor, including protection of native vegetation, weed management and general habitat management and restoration
- Section 5 details the adaptive management and continual improvement framework which applies to this plan.
- Section 6 defines roles and responsibilities associated with the plan.

2 LEGISLATION AND GUIDELINES

2.1 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 (MNES). MNES 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).

The part of the site on the eastern bank of the Georges River is located within Commonwealth Land, and therefore all impacts on the environment of this section of the site are governed by the EPBC Act.

Also of relevance the EPBC Approval (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act). This approval facilitates, subject to state approval, the construction of the proposed Georges River and Anzac Creek crossings.

2.2 THE AUSTRALIAN WEEDS STRATEGY

The Australian Weeds Strategy (Natural Resource Management Ministerial Council 2006) replaces the National Weeds Strategy, providing a national framework for the reduction of the economic, environmental, and social impacts of weeds. Weed management is recognised as essential to the sustainable management of natural resources, the economy, the environment, human health and amenity. The Strategy addresses the prevention of new weed problems, abatement of existing weed problems, and the enhancement of capacity to combat weed problems.

The Strategy aims to complement and guide the efforts of state, territory, regional, and local government strategies and initiatives by providing a national framework. Building on the National Weeds Strategy created in mid-1997, the Australian Weeds Strategy continues the core objective of the National Weeds Strategy by identifying Weeds of National Significance (WONS) and the resultant coordinated actions across Australia. Weeds of National Significance are determined by the following four criteria:

- level of invasiveness
- environmental impacts
- potential for spread

- socio-economic and environmental values (Natural Resource Management Ministerial Council 2006).

Of relevance to the managements sites within the Proposal site which are the subject of this VMP are the management guidelines for the WONS which occur on the Proposal site.

2.3 NSW THREATENED SPECIES CONSERVATION ACT 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides for the protection and management of threatened species, populations and ecological communities listed under schedules 1, 1A and 2 of the Act. The TSC Act also lists Key Threatening Processes (KTPs) that "threaten or could threaten the survival or evolutionary development of species, populations or ecological communities". They are listed under Schedule 3 of the TSC Act and may adversely affect threatened species, populations or ecological communities or could cause species, populations or ecological communities that are not threatened to become threatened. KTPs identified as potentially associated with management of riparian and aquatic values on the site include:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Infection of native plants by *Phytophthora cinnamomi*
- Invasion of native plant communities by exotic perennial grasses
- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara*
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Loss of hollow-bearing trees.

2.4 NSW WATER MANAGEMENT ACT 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of the water sources of NSW. The WM Act regulates controlled activities carried out in, on or under waterfront land through a requirement for a permit; clause 89J of the EP&A Act provides an exemption for these permits for SSD assessed under Part 4, Division 4.1 of the EP&A Act (under which approval of the Proposal is sought).

When a proposed controlled activity disturbs or substantially modifies the riparian corridor, a VMP detailing how restoration or rehabilitation of the corridor will be carried out would be required. Although a controlled activity permit is not required for the Proposal, management of riparian corridor values would maintain consistency with the guidelines issued by NOW for vegetation management plans on waterfront land.

2.5 NSW NOXIOUS WEEDS ACT 1993

The *Noxious Weeds Act 1993* (NW Act) aims to reduce the negative impact of weeds on the economy, community and environment and to provide for the monitoring of and reporting on the effectiveness of the management of weeds in NSW. The NW Act provides for the identification, classification and control of noxious weeds, and imposes obligations on occupiers of land to control noxious weeds declared for their area.

3 CURRENT SITE CONDITIONS

3.1 LAND USE

The vegetation of the Georges River site adjoins the Glenfield Waste Facility to the west, and the RAE Golf Course currently on the MIC site to the east. The Georges River management site is located immediately to the north of the East Hills railway line.

The Anzac Creek management site is within the Southern Boot Land to the south of the SIMTA site and Stage 1 site. The Southern Boot Land supports native vegetation with some historical disturbance. Anzac Creek flows east across the northern section of the Southern Boot Land, with native vegetation adjoining the drainage line to the north and south. The creek passes through a culvert beneath an existing rail spur that runs north-south across the eastern edge of the Rail corridor.

3.2 LANDFORM

The Georges River management site is characterised by the floodplain and banks of the section of Georges River which the management site adjoins. The approximately 100 metre extent of the riparian corridor in the management site comprises:

- A flat alluvial terrace of variable width, only slightly elevated above the river
- A moderately to steeply sloped embankment
- A gently sloped to flat upper bank and floodplain.

The eastern bank of the Georges River within the management site is generally higher and with a steeper embankment than the western bank.

The section of Anzac Creek within the management site consists of a shallow muddy waterbody, with gently sloping creek banks.

3.3 HYDROLOGY

Georges River

The Georges River is located within the Georges River catchment and the Liverpool District sub-catchments and Mid Georges River catchment. It enters the Liverpool LGA from the south on the western side of the Defence Lands at Holsworthy and flows north, meeting with Glenfield Creek at Casula. From here the Georges River continues to flow north past the Liverpool City Centre, under Newbridge Road, past Lighthorse Park and over the Liverpool Weir. Downstream of the Liverpool Weir, the Georges River becomes slightly salty (estuarine) and is more subject to tidal influences.

Anzac Creek

Anzac Creek originates from within the Royal Engineers Golf Course, to the west of Moorebank Avenue, and flows in a north-east direction across the Rail Corridor, just south of the SIMTA site and Stage 1 site. The creek flows north past the adjoining suburbs of Wattle Grove and Moorebank before draining into Lake Moore in Chipping Norton, which in turn flows into the Georges River.

3.4 SOIL CONDITIONS

The soil landscapes of the Penrith 1:100 000 sheet were mapped by Bannerman and Hazelton (1990). The features and locations of the mapped soil landscapes of the management sites are detailed in Table 2.

Table 2 Soil landscapes mapped in management sites by Bannerman and Hazelton (1990)

Soil Landscape	Features (Bannerman and Hazelton 1990)	Location in Proposal site
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.	Eastern bank of Georges River and Anzac Creek site.
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.

3.5 AQUATIC ENVIRONMENT

An aquatic ecology assessment was undertaken as part of the *Flora and Fauna Assessment* (Hyder Consulting, 2011) for the Concept Plan Approval.

The aquatic survey conducted in the proximity of the proposed Georges River railway crossing, identified two species of fish, including one specimen of the native Flathead Gudgeon (*Philypnodon grandiceps*) and the introduced Gambusia (*Gambusia holbrooki*) (Hyder Consulting 2011). The AUSRIVAS macroinvertebrates results for the Georges River rated the sampling site in Band C, suggesting that it is 'severely impaired' with fewer macroinvertebrate families observed than expected.

The Georges River in the vicinity of the Proposal site was 40 to 60 metres wide, and the bank dropped rapidly to a depth of 1.2 metres before falling away at a steadier grade. Aquatic habitats present included soft substrate pool habitat, large woody debris and extensive macrophyte cover. Overhanging vegetation, fallen logs, mats of sticks, submerged (*Elodea canadiensis*) and floating aquatic plants (*Azola* sp., *Salvinia molesta*) were present throughout the Proposal site and reach along the bank.

Fish surveys of Anzac Creek identified only one species, introduced Gambusia (*Gambusia holbrooki*). The overall AUSRIVAS rating for macroinvertebrates in Anzac Creek was Band B indicating that the macroinvertebrate community was 'significantly impaired'.

3.6 VEGETATION

3.6.1 VEGETATION COMMUNITIES

Georges River management site

The land within approximately 100 metres of the eastern bank of the Georges River supports forest vegetation. On the steep slope adjacent to the riverbank was severely degraded riparian vegetation, currently reduced to mature trees of *Eucalyptus saligna* x *botryoides* (Blue Gum/Bangalay hybrid) and *Eucalyptus longifolia* (Woollybutt) with an understorey dominated by *Ligustrum sinense* (Small-leaved Privet) and smothered by exotic weeds, mainly

Cardiospermum grandiflorum (Balloon Vine), *Lantana camara* (Lantana) and *Delairea odorata* (Cape Ivy) (Plate 1, Plate 2).

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

Plate 1. Degraded riparian vegetation on eastern bank of Georges River

Plate 2. Degraded riparian vegetation

On the western bank of the Georges River, adjacent to the Glenfield Waste Facility, the vegetation was similar in structure and condition to that on the eastern bank. The width of native riparian vegetation on the western side of the river ranges from 20 metres to 50 metres. The riparian forest supported a canopy dominated by *Eucalyptus saligna x botryoides* to 20 metres in height (Plate 3).

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

Plate 3. Edge of riparian vegetation on western bank of Georges River in south of site

The vegetation adjoining the Georges River in the management site was classified as Plant Community Type ME018: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin, based on previous regional mapping as an equivalent vegetation type, landscape position, and absence of any other appropriate equivalent PCT in the VIS database. This vegetation meets the criteria for the endangered ecological community River-flat Eucalypt Forest as listed under the TSC Act.

Riparian vegetation associated with Georges River maintains connectivity with riparian vegetation to the north and south, including the Holsworthy Military Area. This riparian corridor may facilitate the movement of less mobile species, including cover-dependent species, larger terrestrial mammals and arboreal mammals. The riparian vegetation also forms potential habitat for a number of threatened fauna species identified as potentially occurring in the Rail Corridor.

Anzac Creek

The section of Anzac Creek within themanagement site 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 *Alternanthera philoxeroides* (Alligator Weed) abundant in the lower stratum. In 2011 and 2012, a dense infestation of *Salvinia molesta* (Salvinia) was observed on the creek surface immediately to the west of the railway line (Plate 4, Plate 5). This was not observed during vegetation surveys in 2014.

Plate 4. Anzac Creek to west of existing rail spur, showing *Salvinia molesta* infestation in foreground and native sedges and rushes further upstream

Plate 5. Ground layer of wetland in Anzac Creek

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

Adjoining the southern bank of the western section of Anzac Creek the vegetation is disturbed and dominated by exotic vegetation, with a large stand of *Phyllostachys aurea* (Golden Bamboo), thickets of *Acacia decurrens* (Black Wattle) and *Pennisteum clandestinum* forming a carpet over a raised, uneven ground surface, likely to be fill material deposited in this location decades ago (Plate 6). Exposed soil beneath a fallen tree showed soil mixed with broken concrete tiles (Plate 7). *Agave americana* (Century Plant) and *Aloe maculata* (Common Soap Aloe) were also growing in this location, suggesting dumped landscape or garden waste.

Plate 6. Disturbed area south of Anzac Creek: *Pennisetum clandestinum, Agave americana* and *Phyllostachys aurea*

Plate 7. Exposed fill material in disturbed area

3.6.2 WEEDS

Noxious Weeds

There are 11 plant species recorded in the riparian management zones listed as noxious weeds in the Liverpool City Council LGA (Table 3). Six of the noxious weeds are also listed as Weeds of National Significance under the National Weeds Strategy (Thorp and Wilson 2012).

Table 3 Noxious weeds recorded in the management sites

Scientific name	Common name	Noxious weed control class	Weed of National Significance	Location
Alternanthera philoxeroides	Alligator Weed	3	Yes	Anzac Creek, wetlands on western side of Georges River
Asparagus asparagoides	Bridal Creeper	4	Yes	Banks of Georges River
Lantana camara	Lantana	4	Yes	Banks of Georges River
Ligustrum lucidum	Broad-leaved Privet	4	No	Western bank of Georges River
Ligustrum sinense	Small-leaved Privet	4	No	Banks of Georges River
Ludwigia peruviana	Peruvian Primrose	3	No	Anzac Creek, in wetland on western side of Georges River
Olea europaea subsp. *cuspidata*	African Olive	4	No	Banks of Georges River
Opuntia sp.	Prickly Pear	4	Yes	Banks of Georges River
Phyllostachys aurea	Golden Bamboo	4	No	Southern bank of Anzac Creek

Scientific name	Common name	Noxious weed control class	Weed of National Significance	Location
Rubus fruticosus agg. spp. (includes *R. anglocandicans*)	Blackberry	4	Yes	Banks of Georges River, in disturbed bushland south of Anzac Creek
Salvinia molesta	Salvinia	2	Yes	On Anzac Creek adjacent to existing culvert

The most severe weed 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).

The control requirements for the classes of noxious weeds recorded in the management sites are presented in Table 4.

Table 4 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.

Environmental Weeds

In addition to the declared noxious weeds on the management site, there are a number of weedy exotic species which pose a threat to the biodiversity values of the management sites (Table 5).

Table 5 Environmental weeds recorded in the management sites

Scientific name	Common name
Asparagus aethiopicus	Asparagus Fern
Bidens pilosa	Cobblers Pegs
Cardiospermum grandiflorum	Balloon Vine
Chloris gayana	Rhodes Grass

Scientific name	Common name
Delairea odorata	Cape Ivy
Ehrharta erecta	Panic Veld-grass
Eragrostis curvula	African Lovegrass
Lonicera japonica	Honeysuckle
Ochna serrulata	Mickey Mouse Plant
Sida rhombifolia	Paddy's Lucerne
Tradescantia fluminensis	Wandering Jew

4 VEGETATION MANAGEMENT MEASURES

Management and restoration strategies for the site include:

- Protection of remnant native vegetation
- Site preparation, including demolition of structures and clearing
- Weed control
- Revegetation
- Soil erosion control and drainage works
- Fauna habitat enhancement.

Each of these strategies includes a number of specific actions designed to meet the objectives of the plan, namely to:

- restore and revegetate the riparian zone to be consistent with and complementary to areas of remnant indigenous vegetation within the Georges River Corridor
- eradicate weed species on the sites, with a particular focus on priority weeds
- maintain an adequate width of riparian vegetation adjoining Georges River and Anzac Creek.
- improve habitat for aquatic fauna as well as terrestrial species
- protect and enhance fauna habitat, including habitat for threatened species.

4.1 SITE ESTABLISHMENT AND PROTECTION OF NATIVE VEGETATION

Prior to commencement of on-site works, all areas of retained riparian forest not within the Proposal footprint will be identified and marked on site. Exclusion fences will be installed and maintained around this vegetation for the duration of the construction period of the Proposal.

Vegetation clearing will be carried out to the extent required for the proposed bridge and culvert construction. Clearing of the Construction area should avoid spread of weed propagules into adjoining retained vegetation. It will be important to remove as much of the existing weed source as possible prior to clearing if reserved topsoil and/or mulched vegetation are to be re-used within management sites as part of the restoration process.

Site preparation undertaken prior to planting will ensure that bank stabilisation is not compromised.

4.2 WEED CONTROL

4.2.1 PRIMARY WEED CONTROL

Primary weed control will ideally be carried out prior to the commencement of the proposed bridge and culvert construction works. Planning would allow for sufficient time to remove target weeds or treat them with herbicide to achieve a complete kill (i.e. root death).

Weed management of the site requires the continual suppression of noxious and invasive weeds, with a focus on weed species that are currently present in dense infestations on the sites, namely:

- *Alternanthera philoxeroides* (Alligator Weed) – abundant cover in Anzac Creek
- *Cardiospermum grandiflorum* (Balloon Vine) – smothering native vegetation on east bank of Georges River
- *Lantana camara* (Lantana) – dense cover in riparian forest on both banks of the Georges River.
- *Ligustrum lucidum* and *L. sinense* (Privet) – dense cover on both banks of the Georges River.

It is important to avoid disturbance, where possible, to the unstable alluviums which form the banks of the Georges River by removing the stabilising vegetation. As much of the stabilising vegetation currently comprises woody weeds and exotic grasses, progressive removal of weed thickets is recommended.

To reduce impacts on water quality, soil disturbance and herbicide use in proximity to waterways should be minimised. Silt traps downstream of any soil disturbance should reduce sediment and nutrient pollution. The use of "cut and paint" techniques is preferable to broad spectrum spraying as they will minimise the potential transport of herbicide into waterways.

The aim of weed management is the long-term eradication of noxious and invasive weeds from the management sites, which will contribute to regional management outcomes for the Georges River riparian corridor. Successful long-term weed management will require long-term maintenance as it is likely that weeds will be re-introduced to the site from upstream areas, given the wind, water and animal-assisted dispersal abilities of many of the weed species present on the site. Restoration of native vegetation on the site should eventually result in lower weed densities and will require regular monitoring and spot-treatment of weed infestations.

4.3 WEED CONTROL METHODS

Table 6 provides a summary of the priority weeds and the strategies for their removal from the management sites. Table 7 identifies other noxious weeds and associated control strategies.

Table 6 Priority weeds and proposed control strategies

Weed species	Location and extent of species within management sites	Control strategy
Alternanthera philoxeroides Alligator Weed	Present in high abundance in the channel of Anzac Creek and has also been recorded in the Georges River management site.	This species is difficult to control and may require an integrated long-term management approach using both physical removal and chemical control techniques. Removal of this weed from Anzac Creek may be problematic as it is an established infestation and has formed large aquatic mats across the water surface, interspersed with native sedges. The recommended method for ongoing suppression of an infestation of the size in Anzac Creek is a long-term program of annual herbicide application using metsulfuron-methyl (DPI 2007). It should be noted that metsulfuron-methyl products are registered only for use on terrestrial alligator weed, and they may be applied to aquatic infestations only under the

Weed species	Location and extent of species within management sites	Control strategy
		conditions of a current Australian Pesticides and Veterinary Medicines Authority (APVMA) permit.
Cardiospermum grandiflorum Balloon Vine	Forms a dense layer smothering vegetation on the flats and steep eastern bank of the Georges River.	A combination of manual and chemical control is recommended. Areas of dense infestation should be sprayed with herbicide, targeting vines at the base of native trees as a priority. Cut vine stems and paint with herbicide. Remove canopy growth if possible with a brush hook or similar tool.
Lantana camara Lantana	Dense stands present on both banks of the Georges River.	Mechanical control of dense infestations may be undertaken where practicable, otherwise manual removal is recommended. Follow up with herbicide control and ongoing spot-spraying while native vegetation re-establishes.
Ligustrum lucidum and *L. sinense* Privet	Dense stands present on both banks of the Georges River.	A range of manual and chemical control methods should be used for both Privet species, including strategic hand removal of small to medium plants and stem injection or frilling and pasting of herbicide for larger individuals. Long term integrated management of these species will be necessary.

Table 7 Other noxious weeds and proposed control strategies

Scientific name	Management site	Control methods
Asparagus asparagoides Bridal Creeper	Georges River	Ongoing herbicide control.
Ludwigia peruviana Peruvian Primrose	Anzac Creek, Georges River	Manual removal or chemical control.
Olea europaea subsp. *cuspidata* African Olive	Georges River	Manual removal of small to medium plants and cutting and painting with herbicide for larger individuals.
Opuntia sp. Prickly Pear	Georges River	Manual removal followed up with spot spray.
Rubus fruticosus agg. spp. (includes *R. anglocandicans*) Blackberry	Georges River	Manual removal and chemical control.

Scientific name	Management site	Control methods
Salvinia molesta Salvinia	Anzac Creek	The infestation of this weed in Anzac Creek observed in 2011 and 2012 appears to have been significantly reduced in 2015 observations. Further control should focus on monitoring and containing any new infestations.

4.3.1 SECONDARY WEED CONTROL

Given that weed species are likely to be re-introduced to the management sites from adjoining and upstream areas, ongoing maintenance will be required. There is also likely to be a large amount of weed seed stored in the soils of the sites, particularly at the Georges River management site. Controlling weeds in their early stages of growth is preferable.

Secondary weed control will be undertaken quarterly with consideration given to the life cycle of the species and will follow the requirements as described for primary weeding. Weed control effort will increase as growth is accelerated in the warmer seasons. As weeds in the riparian zone may have been transported from upstream areas, opportunities to co-ordinate site weed control activities with regional weed control programs will be investigated through contact with Liverpool and Campbelltown Councils and Greater Sydney Local Land Services.

4.3.2 PREVENTING FURTHER SPREAD OF WEEDS

All construction machinery used within the construction site and/or management sites to clear weed-infested vegetation or to remove weeds is to be thoroughly cleaned by removing all plant material and soil (potentially containing weed seeds and propagules) prior to leaving site.

Equipment used for treating weed infestation will be cleaned prior to moving to a new area within the management sites to minimise the likelihood of transferring any plant material and soil.

4.3.3 HERBICIDES

The type of herbicides used will be in accordance with the *NSW Pesticides Act 1999* and follow the species specific recommendations made in the *Noxious and Environmental Weed Control Handbook - A guide to weed control in non-crop, aquatic and bushland situations* (6th Ed) (NSW DPI 2014). Only herbicides registered for aquatic use should be applied in areas adjacent to waterbodies. Additionally, the use of herbicides must comply with label instructions and the Material Safety Data Sheet (MSDS) for the product.

4.4 REVEGETATION

Plants will be propagated from native seed collected from the management sites and surrounding areas prior to vegetation clearing. Revegetating the site with local provenance species will maximise the recovery potential of the site as these are adapted to the local environmental and climatic conditions. Where species cannot be sourced from the site but are required to assist in regeneration, these should be collected from within 5 kilometres of the site. Material collected from native vegetation to be cleared for bridge construction, such as seed-bearing branches and mulched native vegetation, should be used as far as is practicable.

Collection of seed will be undertaken in accordance with Florabank Guidelines and by an experienced Bushland Regenerator in possession of the appropriate licenses under the *National Parks and Wildlife Act 1974.*

A potential species list or planting list for the site has been prepared, based on the native species recorded within and adjacent to the management sites at the time of survey (Table 8). The final planting list will be based largely on the seed available to be collected from the site and the suitability of the seed stock to be germinated and propagated under nursery conditions.

Table 8 Indicative species list for revegetation

Species	
Canopy trees	**Herbs and groundcovers**
Eucalyptus saligna x botryoides	*Dichondra repens*
Eucalyptus longifolia	*Einadia hastata*
Casuarina glauca	*Gahnia clarkei*
	Lomandra longifolia
Small trees and shrubs	*Oxalis perennans*
Acacia binervia	*Plectranthus parviflorus*
Acacia decurrens	*Pratia purpurascens*
Acacia floribunda	**Climbers and twiners**
Breynia oblongifolia	*Billardiera scandens*
Bursaria spinosa	*Cassytha pubescens*
Exocarpos cupressiformis	*Clematis aristata*
Leucopogon ericoides	*Clematis glycinoides*
Melaleuca linariifolia	*Glycine clandestina*
Notelaea longifolia	*Glycine tabacina*
Ozothamnus diosmifolius	*Parsonsia straminea*

Planting methods should include a combination of direct seeding, branch spread, and tubestock planting. Hydromulching of highly disturbed, unstable slopes with native grass seeds may be undertaken if considered appropriate.

Tubestock planting

- Tubestock should be planted in spring or autumn.

- Tubestock is to be planted in a mixed species order. One tree or shrub and four groundcovers are to be planted per square metre (possibly more on steep slopes). Given that patches of remnant vegetation are already present on the site, tubestock planting will prioritise those areas where large numbers of weeds have been removed.
- Protect tubestock with guards and mulch well to minimize weeds and retain moisture. Mulch is to be sourced from the site and certified not to contain weed species.
- Water in well and replant failed plants as necessary after 1 month. Water weekly if conditions are hot.
- Maintain weed control in planted areas.
- A watering program is to be implemented for established plants and continued for at least 12 months.

4.5 SOIL EROSION CONTROL AND DRAINAGE WORKS

Soil stabilisation may be required for riparian areas where bank erosion is deemed a risk and advice will be sought from the Engineering Manager or Environmental Officer as to whether stabilisation is a requirement in areas where construction is occurring adjacent to the creek banks, or where weed removal may result in bank instability. Where required, a thick jute mesh or suitable alternative will be applied to these areas, which will also act as a weed suppressant. Should invasive bank stabilisation works be required along the riparian embankment, this will occur after primary weed control.

The risk of bank erosion may also be reduced through revegetation. Hydromulching using native grass seeds may be effective for initial erosion control of recently cleared areas. When undertaking tubestock planting of slopes, selection of hardy, deep-rooted native shrub species should further contribute to bank stability.

4.6 FAUNA HABITAT ENHANCEMENT

Georges River

The vegetation of the Georges River riparian corridor forms an important habitat linkage for native fauna species. The Biodiversity Assessment report for the Proposal (Hyder Consulting, 2015) found:

- Canopy trees supporting small to medium-sized branch hollows are located on the western bank of the Georges River. These hollows offer potential nesting and roosting habitat to hollow-dependent fauna. Decorticating bark of eucalypts on both sides of the river offers potential roosting habitat to microchiropteran bat species.
- Dense infestations of weedy shrubs such as *Lantana camara* and *Ligustrum* spp. offer potential sheltering and foraging habitat to native birds.
- Leaf litter and small ground timber offers shelter and foraging habitat to small terrestrial mammals and reptiles.

The construction of the bridge over the Georges River will require clearance of a 20 metre wide corridor across the riparian zone. The bridge abutments are located approximately 60 to 70 metres from the water's edge on either side of the Georges River, and two groups of piers will be installed on either side of the river between the abutments and the water.

The gap between the East Hills Rail Line bridge and the proposed 11.3 metres wide rail bridge will be between 20 and 30 metres on the eastern bank of the Georges River and between 50

and 70 metres on the western side of the Georges River. The vegetation between the two bridges will be retained and managed under this plan, and the area beneath and adjoining the proposed rail bridge which would be cleared for construction will be revegetated with the objective of maintaining and enhancing fauna habitat.

Revegetation of the 20 metre wide gap cleared for the bridge will be primarily with shrub, small tree and groundcover species. Planting and management of adjacent areas will ensure that trees are located as close as possible to the bridge, without posing a safety risk to the operation of the Rail link. Species in the revegetation area will be selected to provide habitat resources for native fauna, such as structural habitat components or food sources.

Additional measures proposed to enhance fauna habitat in the Georges River corridor include:

- Installation of nest boxes in retained native vegetation. A Nest Box Management Plan would be prepared which would outline the installation and monitoring requirements of the nest boxes.
- Placement of cut logs and branches cleared from the construction zone into retained vegetation to provide fauna habitat components.

Anzac Creek

The proposed Anzac Creek culvert is an eight cell concrete box culvert, each cell being 1800 mm high and 2100 mm wide. It features six wet cells, following the natural contours of the creek, to allow for fish passage and two dry cells, one on either end of the culvert, to allow for terrestrial fauna passage. The dry cells would be constructed by filling the two concrete cells with rock to a height of 800 mm. This would allow a height of one metre from the roof of the cell to the fill surface for dry passage. The dry cells are located adjacent to the wing walls at the creek bank. Provision of the dry cells should maintain fauna connectivity across the rail corridor to the north and south of Anzac Creek.

4.7 SUMMARY OF VEGETATION MANAGEMENT MEASURES

Table 9 provides a summary of the vegetation management activities to be undertaken as part of this VMP, as well as information on the proposed timing, frequency and expected outcomes of each action.

Table 9 Summary of vegetation management measures

Action	Timing			Frequency	Location		Outcome	Responsibility
	Pre-clearing	Construction/ clearing	Maintenance		Georges River	Anzac Creek		
Site establishment and protection of native vegetation								
Clearly identifying sensitive areas ('no-go areas') which cannot be impacted by construction and manage clearing such that clearing activities are constrained to these approved areas only.	✓	✓		Once only and then maintained	✓	✓	Prevent over clearing	Construction contractor and Stage 1 Proposal operator
High visibility plastic fencing is to be installed to clearly define the limits of the Construction area, including the Rail link and works areas around watercourse crossings.	✓	✓		Once only and then maintained	✓	✓	Prevent disturbance or over clearing of fauna habitat and native vegetation outside the development footprint	Construction contractor
The extent of vegetation clearing is to be clearly identified on construction plans.	✓			Prior to construction	✓	✓	Prevent impacts to fauna habitat and native vegetation outside the development footprint	Construction contractor or Site Operator
Instream works at Georges River and Anzac Creek would be minimised as much as possible, including disturbance to aquatic vegetation. Disturbed areas (within the riparian corridors) would be contained to the 20m wide Rail Corridor.		✓		As clearing occurs	✓	✓	Minimise harm to fish habitat.	Construction contractor

Action	Timing			Frequency	Location		Outcome	Responsibility
Weed control								
Primary weed control of the management sites	✓	✓	✓	Monthly prior to and during construction period and for a 12 month period following construction.	✓	✓	Removal of dense weed cover from management sites (where practicable)	Bush regeneration contractor
Follow-up weed control and inspection			✓	Quarterly for a three to five year period following construction.	✓	✓	Ongoing suppression of weeds	Bush regeneration contractor
Management of noxious weeds is to be undertaken in accordance with the *Noxious Weeds Act* 1993.	✓	✓	✓	As per weed control frequency.	✓	✓	Prevent weed establishment and invasion	Construction contractor and Site Operator
Equipment used for treating weed infestation will be cleaned prior to moving to a new area within the management site to minimise the likelihood of transferring any plant material and soil.	✓	✓	✓	As per weed control frequency.	✓	✓	Prevent weed establishment and invasion	Construction contractor and Bush regeneration contractor
Soil stripped and stockpiled from areas containing known weed infestations are to be stored on cleared land at least 40 m from native vegetation.		✓		As soil disturbance occurs.	✓	✓	Prevent weed establishment and invasion	Construction contractor
Soil excavated from the Anzac Creek corridor must be disposed of in accordance with the guidelines in the *Alligator Weed Control Manual* (DPI 2007), as it will likely contain fragments of Alligator Weed.		✓		As excavation occurs.		✓	Prevent further spread of the noxious weed *Alternanthera philoxeroides*	Construction contractor
Revegetation								
Undertake seed collection, where possible, at least	✓	✓	✓	Initial seed collection	✓	✓	Maintain genetic integrity of	Bush regeneration

Action	Timing			Frequency	Location		Outcome	Responsibility
12 months prior to the commencement of revegetation.				period prior to and during construction. Further collections may be required over time for replacement of tubestock planting.			native vegetation in management sites.	contractor
Propagation of tubestock from collected seed	✓	✓	✓	For initial planting and ongoing replacement planting	✓	✓	Provision of healthy, viable local native plants for revegetation	Bush regeneration contractor
Planting and direct seeding in areas of retained vegetation after completion of primary weed control works		✓	✓	Initial planting and then as required	✓	✓	Revegetation of disturbed areas using local native plants	Bush regeneration contractor
Riparian areas cleared for construction adjoining the Georges River would be revegetated as soon as practicable upon completion of bridge works.			✓	Initial planting with ongoing replacement planting to be determined through ongoing quarterly/annual monitoring.	✓		Retain habitat connectivity along riparian corridor of the Georges River	Construction contractor or Bush regeneration contractor
Fauna habitat enhancement								
Fauna microhabitat such as logs should be removed from areas to be cleared and relocated to suitable nearby bushland areas in the presence of an ecologist.		✓		Once during clearing.	✓		Retain fauna habitat resources	Construction contractor
Install nest boxes in retained native vegetation in the riparian corridor of the Georges River and the woodland in the Boot Land prior to clearing of hollow-bearing trees. A plan including nest box	✓	✓		Once prior to clearing, with annual monitoring and maintenance.	✓		Replace lost hollow resources in the landscape	Construction contractor

Action	Timing			Frequency	Location		Outcome	Responsibility
management procedures would be prepared which would outline the installation and monitoring requirements of the nest boxes.								
Large woody debris would be retained in watercourses where possible. In the event large woody debris are to be impacted they would be relocated in consultation with an ecologist.		✓		Ensure minimal disturbance during construction.	✓		Minimise harm to fish habitat.	Construction contractor
Soil erosion control and drainage works								
Install appropriate drainage infrastructure (e.g. sediment basins, diversion drains), sediment and erosion controls prior to the commencement of construction.	✓	✓		Once during construction, with regular maintenance checks.	✓	✓	Prevent sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek	Construction contractor
Clearing of vegetation is not to be undertaken during overland flow events.		✓		As clearing occurs.	✓	✓	Prevent sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek	Construction contractor
Locate soil or mulch stockpiles away from watercourses and key stormwater flow paths and include appropriate erosion and sediment controls to limit potential transport of these substances into the watercourses via runoff.		✓		As clearing occurs.	✓	✓	Prevent soil and mulch reaching waterways	Construction contractor

Action	Timing			Frequency	Location		Outcome	Responsibility
Dust suppression activities to be undertaken where appropriate.		✓		As clearing occurs.	✓	✓	Prevent sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek	Construction contractor
Stabilisation of disturbed areas, including revegetation, is to be undertaken as soon as practicable after disturbance.		✓	✓	As clearing occurs and as required during 12 month maintenance period.	✓	✓	Prevent sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats in Georges River and/or Anzac Creek	Construction contractor and Stage 1 Proposal operator
Approvals and permits								
Permit to collect seed and plant propagules from River Flat Eucalypt Forest EEC under S132C of the *National Parks and Wildlife Act 1974* (from OEH).	✓			Once only unless personnel change	✓	✓	Collection of seed in accordance with regulations.	Construction contractor or Bush regeneration contractor
Permit to undertake revegetation and restoration works within River Flat Eucalypt Forest and Freshwater Wetlands EECs under S132C of the *National Parks and Wildlife Act 1974* (from OEH).	✓			Once only unless personnel change	✓	✓	Revegetation and restoration in accordance with regulations	Construction contractor or Bush regeneration contractor
Appropriate APVMA permits for herbicide use, particularly if a non-registered use is proposed (i.e. for Alligator Weed)	✓			Once only unless personnel change	✓	✓	Use of herbicide in accordance with regulations.	Construction contractor or Bush regeneration contractor

Action	Timing			Frequency	Location		Outcome	Responsibility
Monitoring and reporting								
Preparation of monitoring reports during the construction and maintenance period		✓	✓	Quarterly during construction period and for the following 12 months upon completion of construction, then annual reports thereafter as part of offset management.	✓	✓	Determine whether the restoration works are achieving performance criteria, implementing corrective actions as required.	Ecologist/Bush regeneration contractor

5 ADAPTIVE MANAGEMENT AND CONTINUAL IMPROVEMENT

5.1 MONITORING, REVIEW AND REPORTING

Monitoring and review of the implementation of the VMP against established performance criteria will be undertaken by a qualified ecologist at intervals of six months for the first three years of the management period, and subsequently at 12 month intervals. The primary intent of the monitoring program is to demonstrate compliance with the VMP via compliance with performance criteria for the restoration works.

Issues may arise in the implementation of the plan which would require actions to be modified or additional actions to be implemented. The monitoring program will be designed to detect issues at an early stage such that appropriate adaptations can be made to ensure that objectives are met.

5.2 PERFORMANCE CRITERIA

Performance criteria applicable to this VMP include:

- Certification that all plant stock used for revegetation are of local botanical provenance
- Gradual improvement of native plant establishment with the aim of achieving 80% establishment of each species after five years following initial planting
- Gradual reduction in weed density to 5% of total area of each management site (Georges River and Anzac Creek)
- Gradual extension of native plant cover in each management site through natural regeneration
- Stability of riparian banks, including maintenance or reduction of erosion within management sites
- Re-establish and maintain connectivity for fauna habitat, particularly in the Georges River management site.

5.3 REPORTING AND TIMING

Reporting would be required annually to assess the success of works in accordance with the performance criteria outlined above. Reporting undertaken during maintenance inspections of each management site will be undertaken by the Contractor's bush regeneration representative and ecologist.

6 ROLES AND RESPONSIBILITIES

Key roles and responsibilities associated with the implementation of this Plan are presented in Table 10. Broadly, the management and implementation of the VMP will be the responsibility of a qualified and experienced ecologist reporting directly to the applicant, with on-ground regeneration works and maintenance the responsibility of a qualified and experienced Bush regeneration contractor. Specific management actions associated with each role are identified in Table 9.

Table 10 Roles and responsibilities

Role	Responsibility
Site Operator	Co-ordination of VMP with Construction contractor and bush regeneration contractor and ecologist (where required). Completion of site management to ensure ongoing protection of regenerated sites post-construction period.
Construction Contractor	Co-ordination of VMP associated conditions with the clearing and construction works ensure native vegetation is protected and enhanced through the life of the Proposal. Completion of site management to ensure ongoing protection of management sites during construction period. Compliance with the relevant conditions of the VMP
Bush Regeneration Contractor	On-ground works associated with the VMP, maintenance inspections and meeting of performance criteria, where required. Certification of supply and installation of local provenance native seed.
Ecologist	Management and implementation of VMP, including performance indicator monitoring, provision of technical advice and statutory reporting.

APPENDIX J

CREDIT CALCULATOR REPORTS

BioBanking Credit Calculator

Ecosystem credits

Proposal ID :	0023/2014/1055D
Proposal name :	SIMTA Stage 1 SSD
Assessor name :	Jane Rodd
Assessor accreditation number :	0023
Tool version :	v4.0
Report created :	04/05/2015 13:47

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
Circle 1	24.00	ME003_Moderate/Good_Medium	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Medium	Yes	MZ1 - retained	8.86	61.98	61.98	0.00	0	53	Barking Owl	0.00	3.00	53
Circle 1	24.00	ME003_Moderate/Good_Medium	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Medium	Yes	MZ2 - cleared	0.73	61.98	0.00	61.98	0	38	Barking Owl	60.00	3.00	38
Circle 1	24.00	ME005_Moderate/Good_Medium	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Medium	Yes	MZ1 - retained	0.89	62.33	62.33	0.00	5	5	Barking Owl	0.00	3.00	5
Circle 1	24.00	ME005_Moderate/Good_Medium	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Medium	Yes	MZ2 - cleared	0.05	62.33	0.00	62.33	3	3	Barking Owl	33.33	3.00	3
Circle 1	24.00	ME007_Moderate/Good_Poor	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate/Good_Poor	Yes	MZ1 - retained	0.39	58.33	58.33	0.00	2	2	Spotted-tailed Quoll	0.00	2.60	2
Circle 1	24.00	ME007_Moderate/Good_Poor	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate/Good_Poor	Yes	MZ2 - cleared	0.03	58.33	0.00	58.33	1	1	Spotted-tailed Quoll	53.33	2.60	1
Circle 1	24.00	ME003_Moderate/Good_Poor	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Poor	Yes	MZ1 - retained	0.80	35.94	35.94	0.00	0	5	Barking Owl	0.00	3.00	5
Circle 1	24.00	ME003_Moderate/Good_Poor	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Poor	Yes	MZ2 - cleared	0.03	35.94	0.00	35.94	0	1	Barking Owl	50.00	3.00	1

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
Circle 1	24.00	ME018_Moderate/Good_Poor	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Poor	Yes	MZ1 - retained	6.67	56.25	56.25	0.00	40	40	Barking Owl	0.00	3.00	40
Circle 1	24.00	ME018_Moderate/Good_Poor	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good_Poor	Yes	MZ2 - cleared	0.41	56.25	0.00	56.25	20	20	Barking Owl	83.33	3.00	20

BioBanking Credit Calculator

Species credits

Proposal ID :	0023/2014/1055D
Proposal name :	SIMTA Stage 1 SSD
Assessor name :	Jane Rodd
Assessor accreditation number :	0023
Tool version :	v4.0
Report created :	04/05/2015 13:47

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	1.50	No		641.00	0.00	Yes	9,615
Persoonia nutans	Nodding Geebung	7.70	No		11.00	0.00	Yes	847
Cercartetus nanus	Eastern Pygmy-possum	2.00	No		0.75	0.00	No	15
Miniopterus schreibersii subsp. oceanensis	Eastern Bentwing-bat	1.30	No		11.57	0.00	No	150
Mormopterus norfolkensis	Eastern Freetail-bat	2.20	No		1.25	0.00	No	28
Myotis macropus	Southern Myotis	2.20	No		1.25	0.00	No	28
Pteropus poliocephalus	Grey-headed Flying-fox	1.10	No		4.80	0.00	Yes	53

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 4/05/2015 Time: 1:45:52PM Calculator version: v4.0

Major Project details

Proposal ID:	0023/2014/1055D
Proposal name:	SIMTA Stage 1 SSD
Proposal address:	Moorebank Avenue Moorebank NSW 2170
Proponent name:	Tactical Group
Proponent address:	Level 15, 124 Walker Street North Sydney NSW 2060
Proponent phone:	02 8907 0700
Assessor name:	Jane Rodd
Assessor address:	Level 5, 141 Walker Street NORTH SYDNEY NSW 2060
Assessor phone:	8907 8266
Assessor accreditation:	0023

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	0.42	3.83
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	7.08	60.02
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	10.42	97.00
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	0.94	8.34
Total	18.86	169

Credit profiles

1. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018)

Number of ecosystem credits created	60
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018) Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526) Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)

Number of ecosystem credits created	8
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002) Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (ME004) Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005) Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (ME021) Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (ME041)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)

Number of ecosystem credits created	97
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (ME007)

Number of ecosystem credits created	4
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (ME007)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Nodding Geebung	Persoonia nutans	11.00	847
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	641.00	9,615
Eastern Pygmy-possum	Cercartetus nanus	0.75	15
Grey-headed Flying-fox	Pteropus poliocephalus	4.80	53
Southern Myotis	Myotis macropus	1.25	28
Eastern Bentwing-bat	Miniopterus schreibersii subsp. oceanensis	11.57	150
Eastern Freetail-bat	Mormopterus norfolkensis	1.25	28