Chapter 13
Biodiversity

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13. Biodiversity

Chapter 13 provides a summary of the potential impacts of the Moorebank Intermodal Terminal (IMT) Project (the Project) on the existing biodiversity within and surrounding the Project site. The chapter also addresses the relevant Commonwealth Department of the Environment (DoE)'s Environmental Impact Statement (EIS) Guidelines and the Secretary for the NSW Department of Planning and Environment (NSW DP&E)'s Environmental Assessment Requirements (NSW SEARs) as shown in Table 13.1. A detailed Ecological Impact Assessment was prepared by Parsons Brinckerhoff and is included in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4 of this EIS. Key findings of the assessment are summarised in this chapter.

Table 13.1 Relevant Commonwealth EIS Guidelines and NSW SEARs

Requirement	Where addressed
Commonwealth EIS Guidelines under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	
Information on the presence, status and extent of threatened species and communities listed under the EPBC Act, or endemic, rare, iconic or threatened species listed under NSW legislation which are known or likely to be present in the vicinity of the proposed action area.	Sections 13.1 and 13.2 of this chapter.
Provide a description of the biodiversity values of the site and surrounding areas. This description should include mapping of any areas with biodiversity value, including, but not limited to, remnant vegetation, fauna corridors and foraging, nesting or roosting habitat for species. This description must also include information on the presence of any endemic, rare, threatened or iconic species.	Sections 13.1 and 13.2 of this chapter.
Riparian areas and foraging, nesting, roosting and habitat loss and fragmentation, and edge effects, having regard to the status, distribution and sensitivity of the species or ecological community.	Section 13.2 of this chapter.
Listed threatened species and communities that are known or likely to be present in the vicinity of the proposed action area. In particular: • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • Green and Golden Bell Frog (*Litoria aurea*) • Downy Wattle (*Acacia pubescens*) • Small-flower Grevillea (*Grevillea parviflora ssp. parviflora*) • Nodding Geebung (*Persoonia nutans*) • Macquarie Perch (*Macquaria australasica*); and • Spotted-tailed Quoll (*Dasyurus maculatus* subsp. *maculatus*).	Generally discussed in section 13.2 of this chapter, with further details in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4 (Table 4.5 and 4.6).
The following information must be included in the EIS in relation to the above listed threatened species and communities:	
Information on the abundance, distribution, ecology and habitat preferences of the species or communities.	Section 13.2 of this chapter.
Discussion of the known threats to the species or communities, with reference to threats posed by the proposed action.	Section 13.3 of this chapter.
Details of surveys for these species and communities and their habitat in the proposed action area or surrounding areas.	Generally discussed in section 13.2 of this chapter, with further details in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4 (Table 2.4, and Table 2.5).
An assessment of the quality and importance of potential habitat for these species and communities in the proposed action area and surrounding areas.	Section 3.2 of this chapter.

Requirement	Where addressed
The presence of formal or informal conservation reserves for these species or communities within the proposed action area or surrounding areas.	Section 13.4 of this chapter.
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 that impacts on the species are unlikely to occur.	Section 13.3 of this chapter.
Discussion of the potential impacts on the above species and communities of pest species, disease and fire outbreaks generated by the proposed action.	Generally discussed in sections 13.3 and 13.4 of this chapter, with further details in section 4.8 and section 10 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.
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 publicly available policy statement or conservation advice approved by the Minister in relation to the species or community.	Generally discussed in this chapter and discussed in detail in Appendix C and Appendix D of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.
Provide a local and regional scale analysis of the likely impacts of the action to biodiversity.	Section 13.4 of this chapter.
Provide a description of all residual impacts arising from the action once all avoidance and mitigation measures that can be applied to the project have accrued. Provide a description of proposed environmental offset measures, including a proposed strategy to offset any impacts of the proposed action on matters of national environmental significance. The proposed strategy must demonstrate how it will meet each of the principles described in the Department's Environmental Offset Policy (October 2012) and Assessment Guideline for the use of environmental offsets under the EPBC Act which is available on the Department's website www.environment.gov.au/resource/epbc-act-environmental-offsets-policy.	Section 13.4 of this chapter and Appendix F of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.
NSW SEARs under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)	
Assessment of the biodiversity values of the site and adjoining areas (particularly the Georges River and its riparian areas), including terrestrial and aquatic flora, fauna, habitat and corridors.	Sections 13.2 and 13.3 of this chapter.
An impact assessment of threatened terrestrial and aquatic (including groundwater dependent) species, populations and endangered ecological communities and/or critical habitat under both State and Commonwealth legislation, including the Cumberland Plain Woodland.	Sections 13.3.3 and 13.3.4 of this chapter, with further details in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4 (Section 5 and Appendices C and D).
Ecological surveys in accordance with the relevant State and Commonwealth survey guidelines commensurate with the biology/ecology of species and extent of habitat within and adjacent to the development site.	Generally discussed in section 13.1 of this chapter, with further details in Section 2 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.
Vegetation clearing (resultant foraging, nesting, roosting and habitat loss and fragmentation, weed and edge effects) and operational impacts.	Section 13.3.1 of this chapter.
Identification of riparian corridors to be established on the site and details of the riparian area to be rehabilitated along the Georges River and Anzac Creek.	The proposed conservation zone is described in Chapter 7 – *Project built form and operations* of this EIS, and section 13.4 of this chapter.

Requirement	Where addressed
A strategy to offset unavoidable, residual ecological impacts and native vegetation clearance, consistent with the 'avoid, minimise or offset' principle. This includes an offset strategy for any impacts of the development on matters of environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* and the EPBC Environmental Offsets Policy (October 2012) and on threatened species and endangered ecological communities and/or critical habitat under the *Threatened Species Conservation Act 1995*, in accordance with the NSW Biodiversity Offsets Policy for Major Projects 2014. The proposed strategy must demonstrate how it meets each of the overarching principles of the State and the Commonwealth offset policies to achieve long term conservation outcomes; and	Section 13.4.2 of this chapter, with further details in Appendix F of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.
Taking into account the OEH's Threatened Species Survey and Assessment Guidelines (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm), any relevant draft or final recovery plans, *Fish Passage Requirements for Waterway Crossings, Policy and Guidelines for Fish Friendly Waterway Crossings* (DPI), *NSW Biodiversity Offsets Policy for Major Projects 2014 Commonwealth EIS guidelines* (EPBC 2011/6086, as revised), *Significant Impact Guidelines, information on listed ecological communities and listed species, survey guidelines for nationally threatened species and the EPBC Environmental Offsets Policy* (DSEWPaC 2012).	Sections 13.1, 13.2 and 13.4 of this chapter, with further details in section 2 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.

13.1 Assessment approach

As described in Chapter 1 – *Introduction,* the Project site comprises the main IMT site (being the land to the west of the Georges River) as well as land affected by the northern, southern and central rail access options. This section outlines the assessment approach undertaken for the entire Project site, however, the three rail access options are described separately where appropriate.

13.1.1 Desktop and field-based investigations

The ecological assessment of the Project site included a detailed review of existing information (including previous flora and fauna reports and wildlife databases) and flora and fauna field surveys. In addition, impact significance assessments were undertaken for threatened species known or predicted to occur in the area, as required under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW *Threatened Species Conservation Act 1995* (TSC Act).

A desktop review of ecological values was undertaken for the Project site and surrounding areas to identify the presence of known and/or threatened species and their habitats, and threatened ecological communities. Records of species, including threatened species, known or predicted to occur within the Project site were obtained from a range of ecological databases (refer to Table 2.3 in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4).

Field investigations on the main IMT site

In addition to the desktop review, a detailed field investigation consisting of botanical and fauna surveys was undertaken from 8–12 November 2010 to verify the results of the desktop assessment. A half day tree hollow survey was conducted in September 2011 to estimate the number of hollow-bearing trees likely to be affected by the Project. Additional vegetation and habitat assessment was undertaken in May 2014 to quantify offsets likely to be required as a result of the Project. Targeted threatened species surveys were also undertaken in September 2014. The November 2010 and September 2011 surveys were carried out to identify the species of terrestrial flora and fauna occupying the main IMT site and to assess the extent and condition of vegetation communities and habitats. Both surveys were designed and conducted in accordance with the *Survey Guidelines for Nationally Threatened Species* (SEWPaC 2010), the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (Department of Environment and Conservation 2004) and the *BioBanking Assessment Methodology and Credit Calculator Operation Manual* (BBAM) (Seidel and Briggs 2008).

A botanical survey was carried out using quadrat and random meander surveys to assess the floristic diversity of the main IMT site, the possible presence of threatened species and the identity of vegetation communities. The ecological integrity of vegetation was also assessed through general observation against benchmark data, using parameters such as intactness, diversity, history of disturbance, weed invasion and health.

The late spring timing of the surveys and the range of weather conditions experienced were optimal for the detection of animals such as microchiropteran bats, reptiles and frogs, which are generally more active during warm conditions. The brief heavy rainfall experienced was particularly conducive to the detection of frogs. Conditions were suitable for the detection of almost all other animal species with the exception of winter migrants such as the Regent Honeyeater and Swift Parrot. The likely presence of such species was, therefore, based entirely on previous records and habitat assessment. The timing also coincided with the flowering period of a large proportion of local plant species and was therefore optimal for the identification of plant communities and many of the threatened flora species considered likely to occur.

A fauna survey was carried out using several field survey methods to record the range of species onsite and any threatened fauna species that may inhabit the main IMT site. Field survey methods included point bird surveys, call playback (where recordings of target species vocalisations are broadcast in order to elicit a response), spotlighting, night-time waterbody searches, AnaBat Bat detection, cage trapping, small mammal trapping, hair tubes, harp trapping, habitat searches, track, scat and sign searches, and incidental observations. Fauna survey sites were established throughout the Project site to represent a range of habitat types and to maximise the chance of detecting a variety of species.

The survey methodology followed the *Director General's Policy of Cage Trapping and Animal Care Guidelines for Wildlife Surveys* (Department of Primary Industry 2004) as well as guidelines and policies for wildlife research as set by the Animal Research Review Panel (Australian Government 2004).

A fauna habitat assessment was also undertaken to determine the presence of threatened species. This considered whether suitable potential habitat for these species is present within the main IMT site.

Fauna habitat characteristics assessed included the:

- structure and floristic composition of the canopy, understorey and ground vegetation;
- presence of hollow-bearing trees that provide potential roosting and breeding habitat for arboreal mammals, birds and reptiles;
- presence of groundcover vegetation, leaf litter, rock outcrops and fallen timber, which provide protection for ground-dwelling mammals, reptiles and amphibians; and

- presence of waterways (temporary or permanent) and waterbodies.

Field investigations of the rail access options

Botanical survey and fauna habitat assessment of the land affected by the northern and central rail access options (as identified in Figure 13.2 to Figure 13.4) was undertaken between February 2013 and May 2014. The survey methodology was consistent with that described above for the main IMT site.

General threatened plant surveys were also conducted in 2013 and 2014 on land associated with the northern and central rail access options, despite these areas having a low likelihood of providing habitat for threatened species of plant. Land to the east of the Georges River associated with the southern rail crossing was also surveyed. Surveys were only conducted on the land associated with the southern rail at its northern connection area to the existing rail corridor. Access was denied to affected lands in the southern part of the southern rail access option area, and assessment of the biodiversity values here was limited to desktop investigations of existing mapping and previous reports, and viewing from a distance with the aid of binoculars. While the presence or absence of threatened biodiversity in these areas has not been verified through detailed fieldwork, these areas appear to be moderately to highly modified and therefore have relatively low potential as habitat for most of the threatened biodiversity likely to occur in the locality.

13.1.2 Ecological integrity classification

The ecological values of the Project site were determined by assessing the ecological integrity of the vegetation and habitats. The following criteria were used to classify the importance of the ecological values of the Project site based on interpretation of the existing vegetation mapping, previous studies and flora and fauna surveys:

- High value: This classification includes all native vegetation communities of moderate to high ecological integrity. The high value areas are likely to remain viable as native vegetation communities and/or fauna habitats in the long term under appropriate management.

- Moderate value: This classification includes all native vegetation communities with substantially reduced canopy cover that have poor to moderate ecological integrity. Due to its modified structure and composition, this vegetation has reduced value as potential habitat for threatened species of animals and plants. These moderate value areas are likely to have recovery potential under appropriate management, particularly where they are located along the riparian corridor or adjacent to vegetation of higher ecological integrity.

- Low value: This classification includes all cleared and developed areas of the Project site and areas dominated by introduced plant species. These areas are likely to be of low ecological value and are considered to have low recovery potential.

This classification of ecological values was used in the identification of constraints and the evaluation of potential design options for the Project (refer Figure 13.1). Furthermore, the identification of the nature and extent of clearing as a result of the Project provided a basis for the development of a package of biodiversity offsets (described further in section 13.4.3).

Figure 13.1 Ecological integrity classification

13.1.3 Threatened species likelihood-of-occurrence assessment

The likelihood of threatened species (as listed under the EPBC Act and TSC Act) occurring on site was identified during the desktop and field based investigations, and assigned to one of the following categories:

- low-likelihood-of-occurrence;
- moderate-likelihood-of-occurrence; and
- high-likelihood-of-occurrence.

Species subject to likelihood-of-occurrence assessments were those that had been previously recorded or predicted to occur in the Project site and surrounding area (refer to Technical Paper 3 – *Ecological Impact Assessment* in Volume 4).

13.1.4 Cumulative assessment

In accordance with the NSW SEARs, this EIS includes a cumulative assessment of the biodiversity impacts of the Project in combination with development of the Sydney Intermodal Terminal Alliance (SIMTA) site and other planned developments within the surrounding region. The findings of the cumulative assessment are provided in Chapter 27 – *Cumulative impacts* and within section 4.5 of Technical Paper 3 – *Ecological Impact Assessment* (Volume 4).

13.2 Existing environment

This section outlines the existing environment and provides a description of the vegetation communities, the species and habitat present on the Project site. The description of the existing environment across the broader Project site includes the vegetation communities, threatened species and habitats found within the main IMT site and on land affected by each of rail access options.

13.2.1 Ecological context of the Project site

The Project site is located in an urban setting, comprising mainly residential, industrial and commercial land uses with a narrow open space riparian corridor associated with the Georges River running north to south along the western boundary of the IMT site. The vegetation on the main IMT site has been largely cleared and replaced with roads, buildings, playing fields and exotic grassland.

The vegetation has been thinned out in the central areas of the School of Military Engineering (SME) site, leaving only scattered remnant trees. Native vegetation has largely been retained along the Georges River and along the south-eastern boundary of the Project site. The vegetation communities in these areas are listed as threatened communities under the TSC Act. None are listed under the EPBC Act, but they do have moderate to high value as potential habitat for threatened fauna and flora species, as shown in Figure 13.1.

In order to maintain flexibility for future developers and operators of the Project, the proposal concept, as presented in this EIS, provides three indicative IMT internal layouts; one for each of three proposed rail access options. Once the selected developer/operator has been appointed, the Project would progress to the detailed design phase and one of the three rail access options would be selected.

The northern and southern rail access options are located on predominantly disturbed land associated with the former Casula Powerhouse Golf Course and the Glenfield Landfill site respectively. The central rail access option passes through remnant vegetation within vacant Commonwealth land on the western bank of the Georges River (referred to as the 'hourglass land'). All three rail access options cross the Georges River riparian corridor. The vegetation communities affected by each of the rail access options are listed as threatened communities under the TSC Act. None is listed under the EPBC Act, and they have moderate to high value as potential habitat for threatened fauna species, as shown in Figure 13.1.

The main IMT site and the surrounding landscape to the north and west of the Project (refer to Figure 13.5) form part of the Cumberland Plain of western Sydney. Historically, the Cumberland Plain has undergone extensive clearing, grazing and disturbance for agricultural, urban and industrial development. Vegetation clearance and urbanisation have also dramatically altered the hydrological and sediment regimes in the lower Georges River and its tributaries. This has led to changes in the geomorphology and ecology of the river. Stormwater runoff from urban areas and agricultural runoff have also contributed to the poor water quality of the Georges River (also refer Chapter 16 – *Hydrology, groundwater and water quality*).

To the south and east of the IMT site (refer Figure 13.5), the landscape transitions from the Cumberland Plain, to flat and undulating areas of alluvial plains and then to sandstone-dominated coastal hills and valleys. The vegetation on alluvial soils in this area has also been affected by clearing and other forms of disturbance such as weed invasion and altered fire regimes, and is fragmented by roads, a railway line and electricity transmission easements. However, the vegetation to the southeast of the IMT site retains significant habitat value and landscape connectivity (refer Figure 13.5). The proximity of this vegetation to the IMT site and its connectivity with the riparian corridor of the Georges River contributes to the ecological value of the habitat found on the Project site (refer Figure 13.5).

13.2.2 Ecological characteristics of the rail access options

The vegetation communities affected by each of the three rail access options consist of open grassy woodland of the shale-derived soils of the Cumberland Plain in the west, and shrubby riparian forest of the alluvial plains adjoining the Georges River riparian corridor in the east (refer to Figure 13.2 to Figure 13.4). These vegetation communities provide habitat for the same suite of threatened species of fauna as listed under state and Commonwealth across all three rail access options. There are no threatened flora species present or with potential habitat within the rail access options. A summary of the specific ecological characteristics relevant to each of the rail access options is provided in Table 13.2 below. As reflected in Table 13.2 the main difference between the existing ecological environments of the rail access options is the extent of vegetation, habitat and riparian zone associated with the Georges River.

Northern access

On the eastern bank of the river, the northern access traverses a strip of Riparian Forest, which is consistent with the River-Flat Eucalypt Forest on Coastal Floodplains Endangered ecological community listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The area of this community in the location has been previously disturbed during construction of an access track that runs parallel with the river and exhibits a moderate level of weed infestation and a reduced canopy cover.

The River-Flat Eucalypt Forest on the western bank of the Georges River, adjacent to parkland of the former golf course site, lacks a remnant shrub layer and has little remnant groundcover. Recent weed removal, mulching and tubestock planting in this location is likely, however, to substantially increase the condition of this vegetation and its value as wildlife habitat as planted understorey and groundcover vegetation matures.

The remainder of the area occupied by the northern access consists of cleared areas with scattered, predominantly if not exclusively planted, native and introduced trees and exotic groundcover.

Central access

On the eastern bank of the river, the central access traverses a patch of Alluvial Woodland and a strip Riparian Forest, both of which are consistent with the River-Flat Eucalypt Forest on Coastal Floodplains Endangered ecological community listed under the NSW TSC Act. The Alluvial Woodland has an intact eucalypt canopy and a sparse subcanopy of *Acacia* spp. but contains extensive woody weed cover in the understorey and groundcover strata. The Riparian Forest on the eastern bank has been disturbed by Defence activities associated with the adjacent heavy vehicle training area known as the 'dust bowl'. Native vegetation here consists of a canopy of mature eucalypts consisting predominantly of *Eucalyptus saligna* x *botryoides*. The understorey and groundcover layers are dominated by woody weeds (e.g. *Ligustrum spp.* and *Lantana camara*) with occasional native shrubs such as *Breynia oblongifolia* and patches of native grasses such as *Microlaena stipoides.* On the eastern side of the river the central rail access also includes cleared areas within the 'dust bowl' which have been significantly disturbed by heavy vehicle movement and earthworks activates. Minimal native vegetation exists in this cleared area.

Vegetation within the central option location on the western bank of the river consists of Riparian Forest dominated by *Eucalyptus saligna* x *botryoides* and *Angophora floribunda* with a subcanopy dominated by **Ligustrum spp.* and *Acacia decurrens*. The understorey is characterised by dense infestations of **Lantana camara* with occasion native shrubs such as *Breynia longifolia*. Due to the dense subcanopy and understorey, groundcover vegetation is sparse. On the edges of the vegetation where more light reaches ground level, patches of native grasses such as *Austrostipa verticillata* and herbaceous weeds such as **Bidens pilosa.*

Southern access

On the eastern bank of the river, the southern access traverses a strip of Riparian Forest, which is consistent with the River-Flat Eucalypt Forest on Coastal Floodplains Endangered ecological community listed under the NSW TSC Act. The area of this community in the location has been previously disturbed during construction of the East Hills Railway Line and Tarakan Road and exhibits a moderate to high level of weed infestation. The vegetation of the eastern riverbank immediately adjacent to the Georges River exhibits a high degree of weed infestation and is in poor condition. Native vegetation here consists of a canopy of mature eucalypts including *Eucalyptus saligna* x *botryoides* and *E. longifolia*. The understorey and groundcover layers are dominated by woody weeds (e.g. *Ligustrum sinense* and *Lantana camara*) and vine weeds (e.g. *Cardiospermum grandiflorum* and *Delairea odorata*) (Hyder 2013). Vegetation further upslope on the eastern bank is less disturbed and generally dominated by native plants in all layers with the exception of some highly disturbed land associated with East Hills Railway Line and Tarakan Road. In addition to the eucalypt canopy, this vegetation contains a sub-canopy dominated by *Acacia binervia* and moderately diverse native understorey and groundcover layers. Overall this vegetation is structurally intact and has a low to moderate level of weed invasion.

The River-Flat Eucalypt Forest on the western bank of the Georges River, within and adjacent to the Glenfield Waste Services (GWS) site, is similar in structure and condition to the vegetation on the eastern bank (Hyder 2013). That is, it is mostly in poor condition and weed infested. The southern rail access also includes cleared areas within the GWS site which have been significantly disturbed by extensive sand/gravel extraction activities. Any native vegetation in these cleared areas would only be relatively recent regrowth that is likely to have low ecological conservation value.

A more detailed description of the vegetation communities, habitat requirements and ecological features is provided in relation to the main IMT site (refer to section 13.2.1).

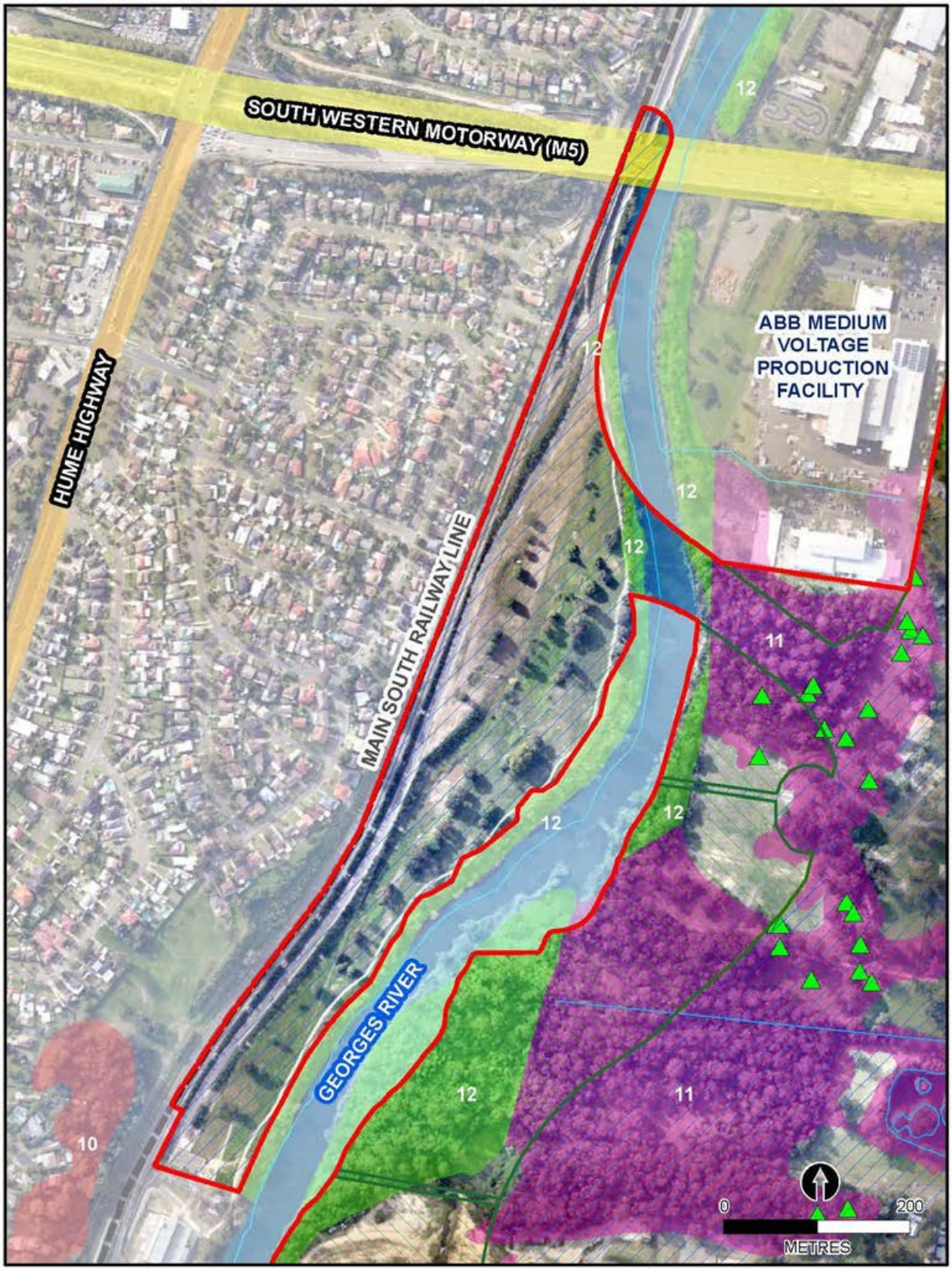

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Figure 13.2 Ground-truthed vegetation communities, threatened species of plant and tree hollows - northern rail crossing access

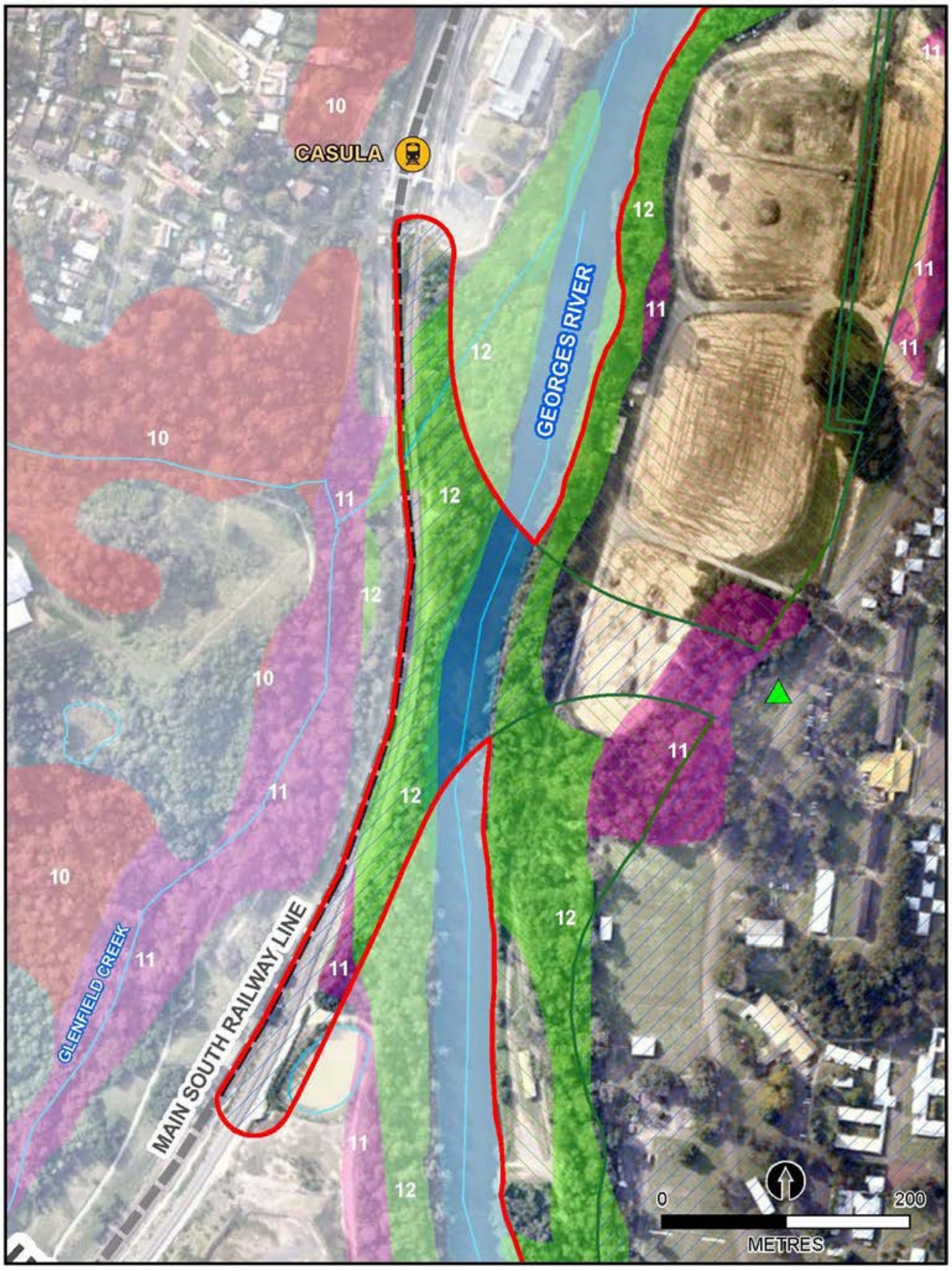


Figure 13.3 Ground-truthed vegetation communities, threatened species of plant and tree hollows - central rail crossing access

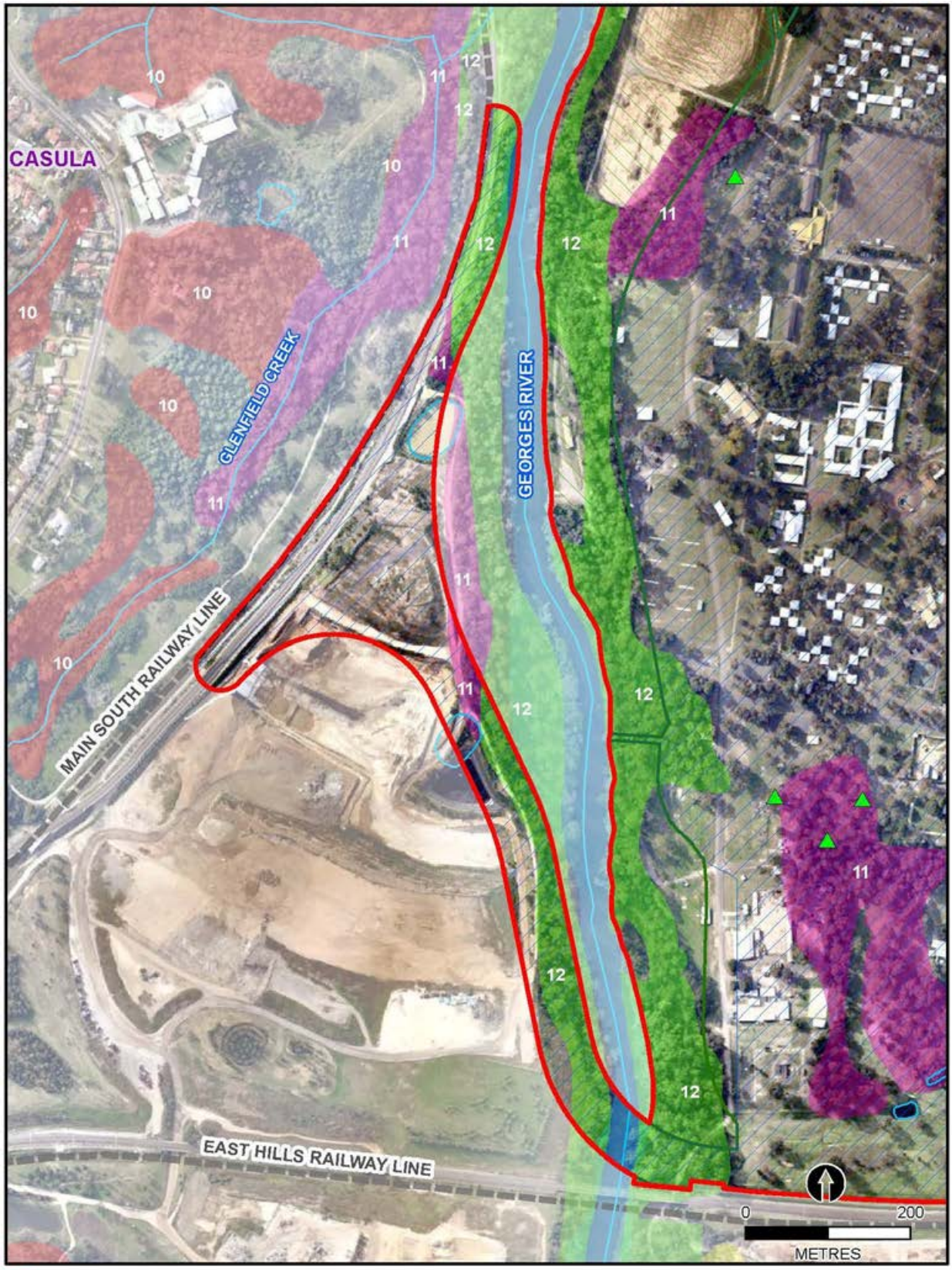


Figure 13.4 Ground-truthed vegetation communities, threatened species of plant and tree hollows - southern rail crossing access

Table 13.2 Summary of the ecological values in the rail access option locations

Rail access option	Vegetation community	Extent of vegetation and habitat	Conservation significance	Fauna habitat types	Threatened fauna species with potential to occur	Threatened flora species habitat	Georges River riparian corridor	Ecological integrity and landscape context
Northern	Riparian Forest	0.24 ha	TSC Act listed endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Riparian vegetation along the Georges River	Barking Owl Cumberland Land Snail Eastern Bent-wing Bat Eastern False Pipistrelle Eastern Free-tail bat Eastern Pygmy-possum Flame Robin Gang-gang Cockatoo Greater Broad-nosed Bat Grey-headed Flying-fox* Koala* Little Eagle Little Lorikeet Powerful Owl Regent Honeyeater* Scarlet Robin Southern Myotis Spotted Harrier	*NA*	A 70 metres (m) corridor crossing over the disturbed Georges River with approximately 10 m of remnant vegetation.	Moderate to poor Remnant vegetation corridor restricted to a 25 m narrow linear strip on the western bank of the Georges River.
Central	Alluvial Woodland and Riparian Forest	0.14 and 2.14 ha					Two separate 70 m corridors over the Georges River, occupying approximately 300 m of the remnant vegetation within the Georges River riparian zone. Alluvial Woodland community potentially groundwater dependent ecosystem.	Moderate to poor Remnant vegetation corridor of an approximately 68 linear strip on the western bank of the Georges River.

Rail access option	Vegetation community	Extent of vegetation and habitat	Conservation significance	Fauna habitat types	Threatened fauna species with potential to occur	Threatened flora species habitat	Georges River riparian corridor	Ecological integrity and landscape context
Southern	Alluvial Woodland and Riparian Forest	0.48 and 2.98 ha			Spotted-tailed Quoll* Square-tailed Kite Squirrel Glider Swift Parrot* Varied Sittella Yellow-bellied Sheathtail Bat		A narrow 70 m corridor crossing of the Georges River. However this option occupies approximately 500 m of the remnant vegetation within the Georges River riparian zone. Alluvial Woodland community potentially groundwater dependent ecosystem.	Moderate to poor Remnant vegetation corridor of an approximately 45 m linear strip on the western bank of the Georges River.

13.2.3 Ecological characteristics of the IMT site

The detailed ecological description of the IMT site's vegetation communities, threatened species and habitats is based on survey results completed across the broader Project site, so the information presented below is also representative of those vegetation communities and species found within each of the rail access options summarised in Table 13.2. The majority of the IMT site has low vegetation cover, consisting of a sparse canopy of introduced and remnant trees within areas of cleared and disturbed land. These areas of land no longer contain the native species diversity or vegetation structure required for them to be classified as native vegetation communities. Patches of moderately to highly disturbed remnant native vegetation are found in the south and east of the Project site along Moorebank Avenue and near Anzac Creek (refer to Figure 13.5 to Figure 13.7). Vegetation that has moderate to high ecological integrity is mainly contained within the riparian corridor of the Georges River, a large patch in the north-west of the IMT site and some patches at the southern end of Moorebank Avenue.

The vegetation communities found within the IMT site consist of open grassy woodland of the shale-derived soils of the Cumberland Plain, west of the Georges River, to the shrubby woodland of the alluvial plains to the east of the Georges River (refer Figure to 13.5 to Figure 13.7).

Four native vegetation communities (Castlereagh Swamp Woodland, Castlereagh Scribbly Gum Woodland, Alluvial Woodland and Riparian Forest) were verified as being present by field investigations (refer to Figure 13.5 to Figure 13.7). These four vegetation communities form part of a threatened ecological community listed under the TSC Act; however, none of these communities corresponds with a threatened community listed under the EPBC Act (refer Table 13.3).

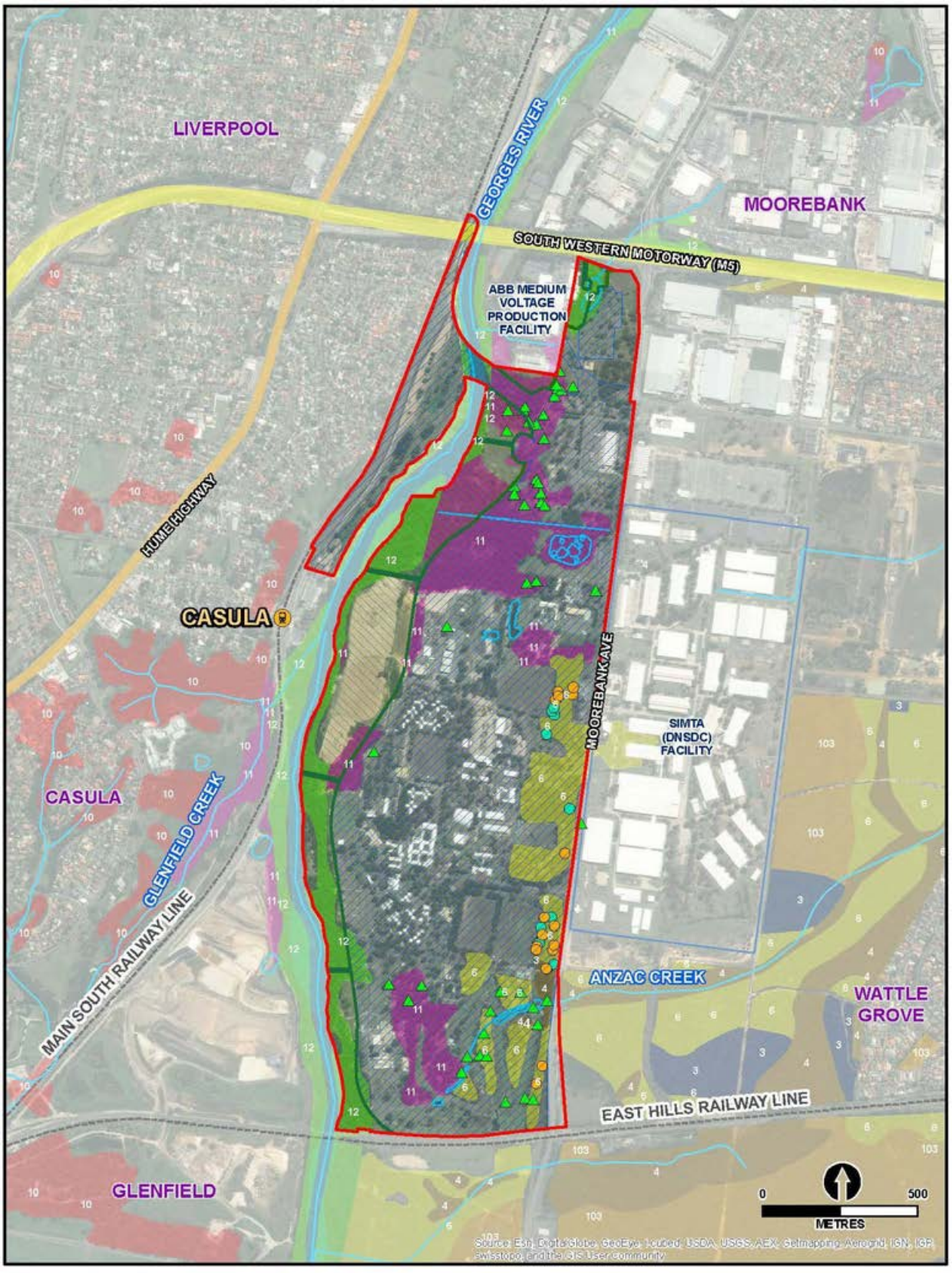
The Riparian Forest and Alluvial Woodland communities are found on the western part of the IMT site. Both are considered to be part of the community known as 'River-Flat Eucalypt Forest on Coastal Floodplains of the NSW Coast, Sydney Basin and South East Corner Bioregions', which is an Endangered ecological community listed under the TSC Act. The Riparian Forest community is found in the wettest areas on the lower banks of the Georges River, on the western boundary of the IMT site, and contains shrubs and small tree species. The Alluvial Woodland community is found on the drier high alluvial terraces with an understorey dominated by Acacia species.

The Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland communities have similar characteristics, but differ in their relative abundance of component species and their location in the landscape. Within the IMT site, more of the Castlereagh Scribbly Gum Woodland is found along Moorebank Avenue, forming a dense canopy of Melaleuca decora along ephemeral drainage lines on the eastern side of the IMT site.

A detailed summary of the dominant species recorded for each vegetation community is presented in Table 13.3. These descriptions are based on surveys results completed across the broader Project site, and are therefore also representative of the vegetation communities found within each of the rail access options.

A total of 233 species of plant were recorded (refer to Appendix A of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4), comprising 155 native species and 78 introduced species. Native species diversity is higher in areas where the Castlereagh Scribbly Gum Woodland and the Riparian Forest communities are present, i.e. along Moorebank Avenue and along the Georges River. Native species diversity is lower in the degraded patches of vegetation within the IMT site.

An assessment of the occurrence of threatened ecological communities on the main IMT site and on land associated with the rail access options is discussed in section 3.2.1.1 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4. The Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest occur on clay soils derived from Wianamatta Group geology, or on the Cumberland Plain. This assessment found that the IMT site does not contain Shale-Gravel Transition Forest and that the Cumberland Plain Shale Woodland is unlikely to be present on the IMT site.



Project site
Vegetation clearing for rail access option
Conservation area
Rail line & station
Tree hollow
Threat-listed plants
Grevillea parviflora subsp. parviflora
Persoonia nutans
Vegetation communities
4 - Castlereagh Swamp Woodland
3 - Cooks River Castlereagh Ironbark Forest
6 - Castlereagh Scribbly Gum Woodland
10 - Shale Plains Woodland
11 - Alluvial Woodland
12 - Riparian Forest
103 - Shale/Gravel Transition Forest

Figure 13.5 Ground-truthed vegetation communities, threatened species of plant and tree hollows - northern rail crossing access

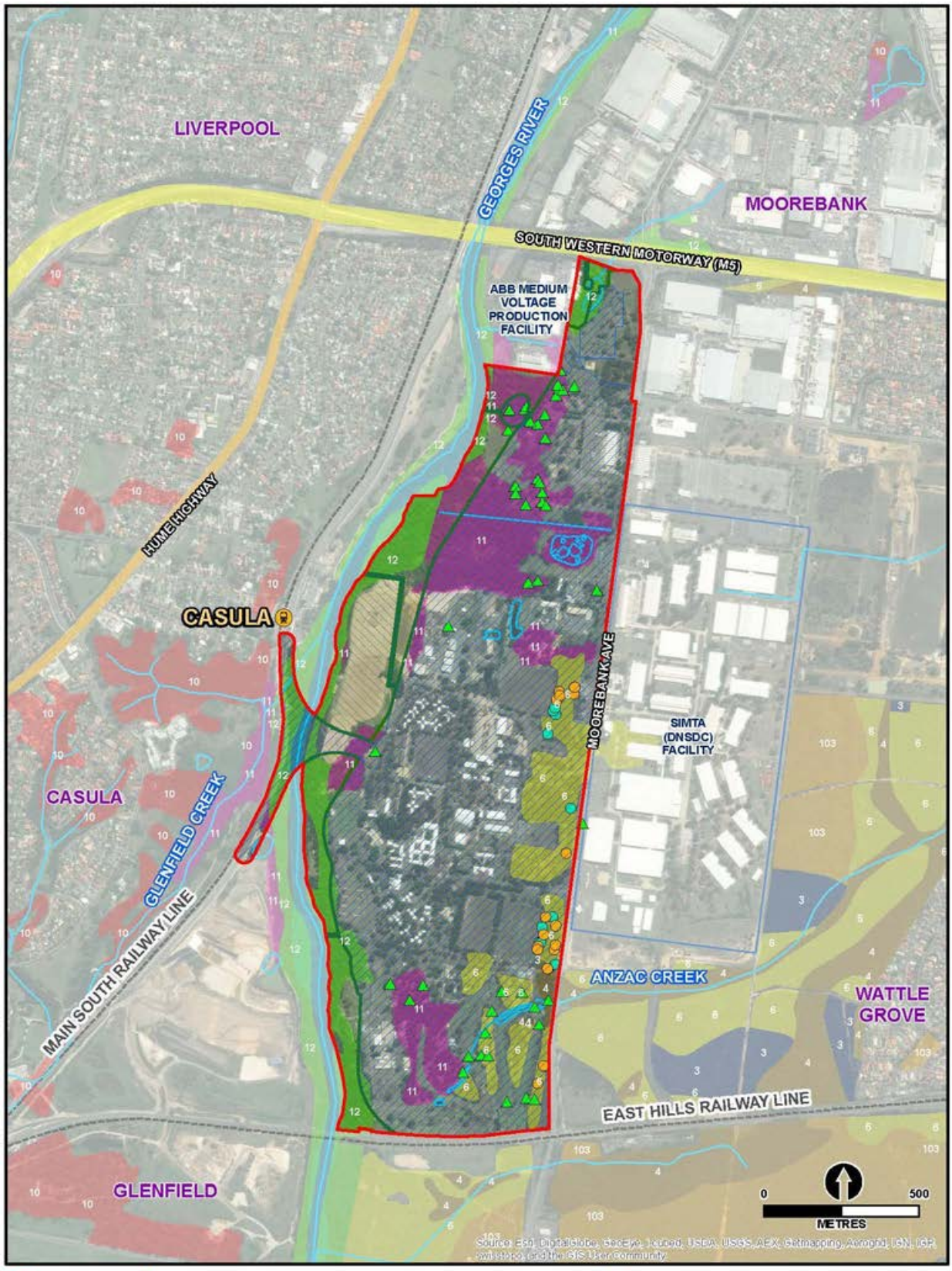


Figure 13.6 Ground-truthed vegetation communities, threatened species of plant and tree hollows - central rail crossing access

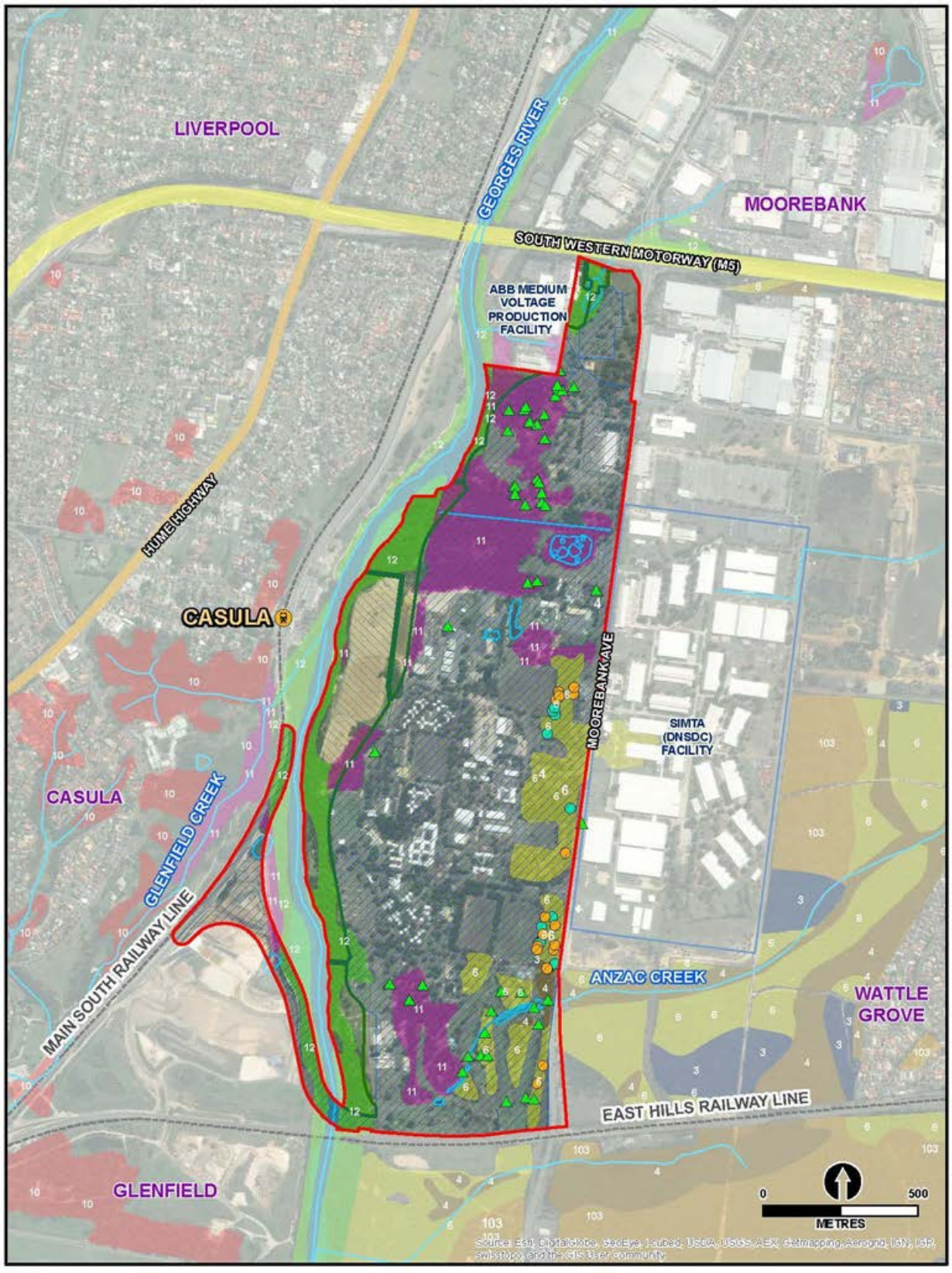


Figure 13.7 Ground-truthed vegetation communities, threatened species of plant and tree hollows - southern rail crossing access

Table 13.3 Composition of vegetation communities on the IMT site

Vegetation community	Biometric vegetation type PCT	Canopy height	Canopy species	Understorey species	Ground cover species	Conservation significance	Ecological integrity
Riparian Forest	ME044 Sydney Blue Gum Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin	25–30 m	*Eucalyptus bosistoana, Eucalyptus botryoides x saligna, Angophora floribunda, Casuarina cunninghamiana*	*Tristaniopsis laurina, Backhousia myrtifolia, Stenocarpus salignus, Jacksonia scoparia, Polyscias sambucifolia, Westringia longifolia, Santalum obtusifolium, Acacia binervia, Acacia decurrens, Callistemon salignus, *Arundo donax, Melia azedarach, *Ligustrum sinense, Phebalium squamulosum*	*Microlaena stipoides, *Eragrostis curvula, *Cardiospermum grandiflorum, Leucopogon juniperinus, Morinda jasminoides, Pteridium esculentum, *Araujia sericifera, *Verbena bonariensis, *Asparagus spp., Gahnia aspera, Pratia purpurascens, Austrostipa ramosissima*	TSC Act listed Endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Moderate to poor
Alluvial Woodland	ME018 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	20–25 m	*Eucalyptus tereticornis, Eucalyptus botryoides x saligna, Eucalyptus baueriana, Angophora floribunda*	*Acacia decurrens, Acacia binervia, Ozothamnus diosmifolius, Kunzea ambigua, *Lantana camara*	*Microlaena stipoides, *Eragrostis curvula, *Senecio madagascariensis, *Conyza bonariensis, Tricoryne elatior, Pratia purpurascens, *Bidens pilosa, *Sida rhombifolia, Cynodon dactylon*	TSC Act listed Endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Moderate to poor
Castlereagh Scribbly Gum Woodland	ME003 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	8 –15 m	*Eucalyptus sclerophylla, Eucalyptus parramattensis ssp. parramattensis, Melaleuca decora, Angophora floribunda*	*Melaleuca nodosa, Kunzea ambigua, Banksia spinulosa, Ozothamnus diosmifolius, Grevillea parviflora var. parviflora, Persoonia nutans, Daviesia ulicifolia, Petrophile sessilis, Hakea dactyloides, Acacia falcata, Persoonia linearis, Hakea sericea, Banksia oblongifolia, Pittosporum undulatum, Glochidion ferdinandi*	*Pomax umbellata, Lomandra longifolia, Dianella longifolia, Opercularia diphylla, Cheilanthes sieberi, Themeda australis, Austrodanthonia spp., Laxmannia gracilis, Cyathochaeta diandra, Billardiera scandens, Microlaena stipoides, *Rubus fruticosus complex, Poranthera microphylla, Pratia purpurascens, *Asparagus asparagoides, Gahnia aspera, Echinopogon caespitosus*	TSC Act listed Vulnerable ecological community Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	Moderate to good

Vegetation community	Biometric vegetation type PCT	Canopy height	Canopy species	Understorey species	Ground cover species	Conservation significance	Ecological integrity
Castlereagh Swamp Woodland	ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	8–10 m	As for Castlereagh Scribbly Gum Woodland, but with a denser canopy of Melaleuca decora	As for Castlereagh Scribbly Gum Woodland	As for Castlereagh Scribbly Gum Woodland	TSC Act listed Endangered ecological community Castlereagh Swamp Woodland Community	Moderate to poor

Source: Table 3.3, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: * denotes introduced species. Castlereagh Swamp Woodland is differentiated from Castlereagh Scribbly Gum Woodland only by location in the landscape, found in wet depressions (land sunken below the surrounding area) in ephemeral drainage channels. Castlereagh Swamp Woodland and Castlereagh Scribbly Gum Woodland are not floristically or structurally distinct.

13.2.4 Threatened species of plant

Threatened species of plant on the IMT site

Two threatened flora species were recorded in the Castlereagh Scribbly Gum Woodland patches along Moorebank Avenue on the south-eastern side of the IMT site (refer Figure 13.2). These are:

- *Persoonia nutans* (listed as Endangered under the EPBC Act and TSC Act); and
- *Grevillea parviflora* ssp. *parviflora* (listed as Vulnerable under the EPBC Act and TSC Act).

A targeted search in areas of potential habitat was conducted in November 2010 for six additional threatened species with a moderate likelihood of occurrence within the IMT site (refer to Table 13.4 below and Appendix B of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). The surveys did not detect these species, but they are considered moderately likely to occur, due to the presence of suitable habitat and historical records of these species from the locality. Additional targeted surveys were undertaken in September 2014 on both the IMT site and on the proposed Wattle Grove Offset Area southeast of the IMT site. These surveys identified both *Persoonia nutans* and *Grevillea parviflora* ssp*. Parviflora,* but also did not detect the other six threatened species.

Table 13.4 Threatened flora known or likely to occur on the IMT site

Family	Scientific name	Common name	EPBC Act[2]	TSC Act[1]	Recorded in locality[3]	Preferred habitat	Likelihood of occurrence in Project site
Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	V	E1	No	Grows mainly in heath and dry sclerophyll forest on sandy soils (Harden 2002). Seems to prefer open, sometimes disturbed, sites such as trail margins and recently burnt areas. Typically occurs in association with *Corymbia gummifera, Eucalyptus haemastoma, Eucalyptus gummifera, Eucalyptus parramattensis, Eucalyptus sclerophylla, Banksia serrata* and *Angophora bakeri* (NSW National Parks and Wildlife Service 1999).	Moderate No historic records of this species exist in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on the IMT site.
Fabaceae (Mimosoideae)	*Acacia pubescens*	Downy Wattle	V	V	Yes 161 records exist in the locality including one near the Project site from 1998	Restricted to the Sydney Region from Bilpin to the Georges River and also at Woodford where it usually grows in open sclerophyll forest and woodland on clay soils. Typically it occurs at the intergrade between shales and sandstones in gravely soils often with ironstone (Harden 2002; NSW National Parks and Wildlife Service 2003).	Moderate Historic records of this species exist in the locality. Marginal habitat present in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on the IMT site.
Fabaceae (Faboideae)	*Dillwynia tenuifolia*		V	V	Yes One record exists near Kemps Creek	Occurs on the Cumberland Plain from the Blue Mountains to Howes Valley area, where it grows in dry sclerophyll woodland on sandstone, shale or laterite (Harden 2002). Specifically, occurs within Castlereagh woodlands, particularly in shale gravel transition forest. Associated species include *Eucalyptus fibrosa, Eucalyptus sclerophylla, Melaleuca decora, Daviesia ulicifolia, Dillwynia juniperina* and *Allocasuarina littoralis* (James 1997).	Moderate One record of this species in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site.

Family	Scientific name	Common name	EPBC Act[2]	TSC Act[1]	Recorded in locality[3]	Preferred habitat	Likelihood of occurrence in Project site
Proteaceae	*Grevillea parviflora* ssp. *parviflora*	Small-flower Grevillea	V	V	Yes Two records exist near the Project site with a recent record from 2002	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with disjunct populations near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (NSW Scientific Committee 1998a; Harden 2002).	Recorded Recorded in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on the IMT site.
Ericaceae	*Leucopogon exolasius*	Woronora Beard-heath	V	V	Yes Three records exist nearby with a record near the Project site from the year 2000	Restricted chiefly to the Woronora and Grose Rivers and Stokes Creek, Sydney catchments and the Royal National Park. One old record from the Grose River. Grows in woodland on sandstone (Royal Botanic Gardens 2011).	Moderate Marginal habitat for this species exists in the Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on the IMT site.
Proteaceae	*Persoonia hirsuta*	Hairy Geebung	E	E1	Yes Three records exist near Holsworthy	Occurs in central coast and central tableland districts where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) and rarely shale (NSW Scientific Committee 1998b). Often occurs in areas with clay influence, in the ecotone between shale and sandstone (James 1997; Office of Environment and Heritage 2011).	Moderate Historic records of this species exist in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on the IMT site.
Proteaceae	*Persoonia nutans*	Nodding Geebung	E	E1	Yes 31 records exist near the Project site including a recent record from 2002	Confined to the western Sydney where it grows in Castlereagh Scribbly Gum Woodlands and Agnes Banks Woodlands (James 1997; NSW National Parks and Wildlife Service 2001; Harden 2002).	Recorded Recorded in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on IMT site.

Family	Scientific name	Common name	EPBC Act[2]	TSC Act[1]	Recorded in locality[3]	Preferred habitat	Likelihood of occurrence in Project site
Fabaceae (Faboideae)	*Pultenaea parviflora*	Sydney Bush-pea	V	E1	Yes One record exists at Potts Hill	Restricted to the Cumberland Plain where it grows in dry sclerophyll forest on Wianamatta shale, laterite or alluvium (Harden 2002). Locally abundant within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays (James 1997; NSW National Parks and Wildlife Service 2002).	Moderate Historic records of this species exist in the locality. Suitable habitat present in Castlereagh Scribbly Gum Woodland along eastern boundary of the IMT site. Unlikely to occur elsewhere on the IMT site.

Source: Table 3.5, Technical Paper 3 - *Ecological Impact Assessment* in Volume 4

Notes: 1 – *Threatened Species Conservation Act 1995*. E1 = Endangered and V = Vulnerable
2 – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. E = Endangered and V = Vulnerable
3 – Based on database searches and field surveys.

Habitat potential for threatened species of plant in the rail access option locations

No threatened flora species were recorded in the rail access options or considered to have a moderate likelihood of occurrence (refer to Table 13.5 below and Appendix B of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4).

The suitability of the habitat in the rail access option locations for threatened species of plants is discussed in Table13.5 below.

Table 13.5 Habitat potential for threatened species of plant in the rail access locations

Rail access options	Habitat characteristics	Potential as habitat for locally recorded threatened species of plant
Northern	Riparian Forest varying with moderately dense to minimal shrub cover with predominantly native groundcover. Riparian Forest with reduced canopy, a recently revegetated and minima native groundcover. Cleared areas with scattered, predominantly planted, trees and exotic groundcover.	**Low** Due to the lack of suitable vegetation communities and generally modified condition of vegetation.
Central	Riparian Forest with moderately dense to dense shrub cover with a mosaic of areas with native species (e.g. *Breynia oblongifolia*) dominant, exotic species (e.g. *Lantana camara*) dominant and mixed areas. Some patches of native groundcover apparent. Alluvial Woodland vegetation with minimal native shrub cover, dominated by exotic shrubs (e.g. *Lantana camara*). Cleared areas with bare ground and minimal vegetation.	**Low** Due to the lack of suitable vegetation communities and generally modified condition of vegetation.
Southern	Riparian Forest with moderately dense to dense shrub cover with a mosaic of areas with native species (e.g. *Breynia oblongifolia*) dominant, exotic species (e.g. *Lantana camara*) dominant and mixed areas. Some patches of native groundcover apparent. Riparian Forest and Alluvial Woodland of unknown but likely modified condition on the western side of the Georges River. Cleared areas with scattered, predominantly planted, trees and exotic groundcover.	**Low** Due to the lack of suitable vegetation communities and generally modified condition of vegetation.

13.2.5 Noxious and nationally significant weeds

In total, 72 non-indigenous species of plant were recorded across the IMT site and on land associated with each of the three rail access options. Of these, 12 are listed under the *Noxious Weeds Act 1993* (NSW) for the Liverpool noxious weed control area (refer Table 13.6) and nine are listed as Weeds of National Significance (Australian Weeds Committee, 2010).

The most abundant and invasive weeds (such as *Lantana camara* and vine weeds *Cardiospermum grandiflorum*) were found within and at the edges of the remnant vegetation of the riparian zone of the Georges River. Aquatic weeds such as *Salvinia molesta*, *Alternanthera philoxeroides* and *Sagittaria platyphylla* were also recorded in patches in Anzac Creek and in artificial ponds within the IMT site.

Table 13.6 Noxious and nationally significant weeds within the Project site

Scientific name	Common name	*Noxious Weeds Act 1993* (NSW) control class[1]	Weeds of National Significance
Alternanthera philoxeroides	Alligator Weed	3	Yes
Asparagus aethiopicus	Ground Asparagus	-	Yes
Asparagus asparagoides	Bridal Creeper	4	Yes
Chrysanthemoides monilifera ssp. Monilifera	Boneseed	2	Yes
Chrysanthemoides monilifera ssp. Rotundata	Bitou Bush	3	Yes
Lantana camara	Lantana	4	Yes
Ligustrum lucidum	Large-leaved Privet	4	–
Ligustrum sinense	Small-leaved Privet	4	–
Ludwigia peruviana	–	4	–
Olea europaea ssp. Cuspidata	African Olive	4	–
Rubus fruticosus	Blackberry complex	4	Yes
Sagittaria platyphylla	–	5	Yes
Salvinia molesta	–	2	Yes

Source: Table 3.7, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: 1) Control categories under the *Noxious Weeds Act 1993* (NSW): Class 2: The plant must be eradicated from the land and the land must be kept free of the plant. Class 3: The plant must be fully and continuously suppressed and destroyed. Class 4: 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. Class 5: the requirements in the *Noxious Weeds Act 1993* (NSW) for a notifiable weed must be complied with.

13.2.6 Terrestrial fauna habitats and threatened animal species

Terrestrial fauna habitats and threatened animal species on the IMT site

The following is a detailed description of the terrestrial fauna habitats and threatened fauna species within the IMT site.

Vegetation in the surrounding area to the north of the IMT site is highly fragmented, with large expanses of urbanised land surrounding small vegetation remnants. Within the IMT site, most patches of vegetation especially to the east of the IMT site are small and are considered poor to moderate habitat for a range of fauna species that require large tracts of continuous habitat.

The riparian corridor along the Georges River is well connected to the vegetation within the south of the IMT site, which also contains other large areas of well-connected native vegetation.

The main terrestrial fauna habitats and threatened and migratory fauna likely to occur within the IMT site and on land affected by the three rail access options are discussed in detail in the Ecological Impact Assessment (refer Table 3.7 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). Based on field verification these terrestrial fauna habitats include:

- riparian vegetation along the Georges River;
- fragmented patches of shrubby woodland;
- highly disturbed areas containing large remnant trees; and
- artificial wetlands.

These habitats are described in Table 13.7 in terms of their potential to be used by threatened fauna species.

Indicative photographs of these habitat types are shown in Photo 13.1 to 13.4 below.

Photo 13.1 Riparian vegetation along the Georges River

Photo 13.2 Fragmented patch of shrubby woodland

Photo 13.3 Highly disturbed area containing large remnant trees

Photo 13.4 Artificial wetland

Table 13.7 Habitats for terrestrial fauna on the IMT site

Habitat	Description	Threatened animal species that may use habitat	Ecological integrity[1]
Riparian vegetation along the Georges River	Riparian forest/Alluvial Woodland corridor with tall eucalypt canopy; sparse subcanopy of *Acacia* spp and mesic shrubs and small trees; understorey ranging from moderately dense native shrub layer to weed (e.g. *Lantana camara*) thickets; groundcover ranging from native herbs and grasses to areas of exotic vines (e.g. *Cardiospermum grandiflorum*), scramblers and grasses. Moderate connectivity to other habitat in the locality. Hollow-bearing trees moderately abundant.	Barking Owl Cumberland Land Snail Eastern Bent-wing Bat Eastern False Pipistrelle Eastern Free-tail bat Eastern Pygmy-possum Flame Robin Gang-gang Cockatoo Greater Broad-nosed Bat Grey-headed Flying-fox* Koala* Little Eagle Little Lorikeet Powerful Owl Regent Honeyeater* Scarlet Robin Southern Myotis Spotted Harrier Spotted-tailed Quoll* Square-tailed Kite Squirrel Glider Swift Parrot* Varied Sittella Yellow-bellied Sheathtail Bat	Moderate to high Provides foraging, roosting and/or breeding opportunities for a wide variety of threatened fauna and has high value as a fauna movement corridor due to its connectivity north and south of the Project site.
Fragmented patches of shrubby woodland	Shrubby woodland with a eucalypt canopy of moderate height; understorey ranging from moderately dense, high diversity native shrub layer to thickets of disturbance tolerant native shrubs (e.g. *Kunzea ambigua*) and weed patches (e.g. *Rubus* sp.) thickets; groundcover ranging from native herbs and grasses to mats of exotic scramblers and grasses. Low connectivity to other habitat in the locality. Very few hollow-bearing trees present. Ephemeral wetlands present after heavy rain.	Grey-headed Flying-fox* Scarlet Robin Little Lorikeet Swift Parrot* Flame Robin Yellow-bellied Sheathtail Bat Cumberland Land Snail	Moderate Provides foraging, roosting and/or breeding opportunities for a limited suite of threatened fauna; little opportunity for hollow-dependent species. Has only moderate value as a fauna movement corridor due to its fragmentation.
Highly disturbed areas containing large remnant trees	Sparse remnant canopy; understorey generally absent or depauperate; groundcover ranging from a mixture of native herbs and grasses with exotic species (co-dominant) to areas dominated by exotic species. Low connectivity to other habitat in the locality. Hollow-bearing trees moderately abundant.	Powerful Owl Barking Owl Grey-headed Flying-fox* Eastern Free-tail bat Yellow-bellied Sheathtail Bat Regent Honeyeater* Gang-gang Cockatoo Spotted Harrier Little Eagle Square-tailed Kite	Poor to moderate Incomplete vegetation structure and lack of canopy connectivity limits its value as habitat for many species. Tree hollows provide potential roost/breeding sites for species capable of using isolated trees.

Habitat	Description	Threatened animal species that may use habitat	Ecological integrity[1]
Artificial ponds/ wetlands	Artificial ponds with varying cover of open water and aquatic macrophytes. Canopy absent or sparse consisting chiefly of relatively small trees; understorey generally absent or depauperate; groundcover ranging from a mixture of native emergent aquatic herbs, grasses and sedges with exotic species (co-dominant) to areas dominated by native species. Low to moderate connectivity to other aquatic habitat in the locality. Hollow-bearing trees scarce. The exotic fish Plague Minnow (*Gambusia holbrooki*) is present in some ponds and absent from others. Access to fresh water for birds and bats.	Eastern Bent-wing Bat Eastern False Pipistrelle Eastern Free-tail bat Greater Broad-nosed Bat Yellow-bellied Sheathtail Bat	Poor to moderate Modified vegetation structure and limited connectivity makes this habitat unsuitable for many species.

Source: Table 3.8, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4)

Notes: Definitions of habitat ecological integrity are provided in section 2.5 above. * indicates species listed under the EPBC Act.

The fauna surveys detected the Grey-headed Flying-fox (listed as Vulnerable under the EPBC Act and TSC Act) flying over the Project site. An earlier study (Lesry 2003) also recorded the presence of two threatened microbat species on the IMT site:

- Large-footed Myotis; and
- Eastern Bent-wing Bat.

The fauna surveys included an analysis of ultrasonic bat calls and revealed the probable recordings of these species (refer to section 3.6 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). The Project site is also likely to provide habitat for 23 additional threatened species of animals identified in the desktop assessment but not detected in the surveys. Many of these species are likely to use the intact riparian habitats along the Georges River and may occasionally use the patches of vegetation in the central and eastern areas of the IMT site. It is important to note that most of these species have large home ranges that would likely extend well beyond the Project site and/or are migratory and so are likely to use the IMT site and land associated with the proposed rail access options on a sporadic or seasonal basis.

Terrestrial fauna habitats and threatened animal species at the rail crossing locations

The terrestrial fauna habitats and threatened fauna species within the land potentially affected by the rail access options are summarised in Table 13.8 below.

Table 13.8 Habitats for terrestrial fauna at the rail crossing locations

Rail access options	Description	Threatened animal species that may use habitat	Ecological integrity[1]
Northern	Tall eucalypt woodland with intact canopy, a sparse subcanopy of Acacia spp and native grass groundcover. Contains a small area of disturbed shrubby forest with reduced canopy and shrub cover. Moderate to Low connectivity to other habitat in the locality, chiefly to the south. Hollow-bearing trees moderately abundant.	Barking Owl Eastern Bent-wing Bat Eastern False Pipistrelle Eastern Free-tail bat Eastern Pygmy-possum Flame Robin Gang-gang Cockatoo Greater Broad-nosed Bat Grey-headed Flying-fox* Koala* Little Eagle Little Lorikeet Powerful Owl Regent Honeyeater* Scarlet Robin Southern Myotis Spotted Harrier Spotted-tailed Quoll* Square-tailed Kite Squirrel Glider Swift Parrot* Varied Sittella Yellow-bellied Sheathtail Bat	Moderate Provides foraging, roosting and/or breeding opportunities for a wide variety of threatened fauna and has moderate value as a fauna movement corridor due to its connectivity but relatively narrow width of riparian vegetation.
Central	Tall eucalypt woodland with extensive woody weed cover in the understorey and groundcover strata and a sparse subcanopy of Acacia spp. Tall shrubby forest with a dense understorey of native and introduced shrubs and occasional areas of native groundcover grasses and herbs. Moderate to High connectivity to other habitat in the locality. Hollow-bearing trees moderately abundant.	Barking Owl Eastern Bent-wing Bat Eastern False Pipistrelle Eastern Free-tail bat Eastern Pygmy-possum Flame Robin Gang-gang Cockatoo Greater Broad-nosed Bat Grey-headed Flying-fox* Koala* Little Eagle Little Lorikeet Powerful Owl Regent Honeyeater* Scarlet Robin Southern Myotis Spotted Harrier Spotted-tailed Quoll* Square-tailed Kite Squirrel Glider Swift Parrot* Varied Sittella Yellow-bellied Sheathtail Bat	Moderate to High Provides foraging, roosting and/or breeding opportunities for a wide variety of threatened fauna and has moderate value as a fauna movement corridor due to its connectivity north and south of the Project site but relatively narrow width of riparian vegetation.

Rail access options	Description	Threatened animal species that may use habitat	Ecological integrity[1]
Southern	Tall eucalypt forest with intact canopy. The condition and structure of the understorey and groundcover on the western bank of the river is unknown. Moderate to High connectivity to other habitat in the locality, chiefly to the south. Hollow-bearing trees moderately abundant.	Barking Owl Eastern Bent-wing Bat Eastern False Pipistrelle Eastern Free-tail bat Eastern Pygmy-possum Flame Robin Gang-gang Cockatoo Greater Broad-nosed Bat Grey-headed Flying-fox* Koala* Little Eagle Little Lorikeet Powerful Owl Regent Honeyeater* Scarlet Robin Southern Myotis Spotted Harrier Spotted-tailed Quoll* Square-tailed Kite Squirrel Glider Swift Parrot* Varied Sittella Yellow-bellied Sheathtail Bat	Moderate to High Provides foraging, roosting and/or breeding opportunities for a wide variety of threatened fauna and has high value as a fauna movement corridor due to its connectivity north and south of the Project site and relatively wide expanse of riparian vegetation.

Source: Table 3.9, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4)

Notes: Definitions of habitat ecological integrity are provided in section 2.5 above. * indicates species listed under the EPBC Act.

13.2.7 Migratory species

The following discussion of the migratory species within the IMT site is also representative of their potential to occur within and to be affected by the rail access options described in section 13.2.3 (refer to Table 13.2).

Ten migratory species have been predicted to occur within the locality of the Project site but were not recorded during the surveys. Migratory species are protected under international agreements to which Australia is a signatory, including the Japan–Australia Migratory Bird Agreement (JAMBA), the China–Australia Migratory Bird Agreement (CAMBA), the Republic of Korea–Australia Migratory Bird Agreement (RoKAMBA) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species comprise 'Matters of National Environmental Significance' and are protected under the EPBC Act.

The Regent Honeyeater (listed as critically endangered under the EPBC Act) has the potential to occur within the Project site. Impacts on this species are considered further in section 4 and Appendix C of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.

Other migratory species of bird may also use the area (refer Table 3.8 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). However, the Project site would not be classed as an 'important habitat' for any migratory species as defined under the Matters of National Significance, Significant Impact Guidelines 1.1 (DoE 2013), because the IMT site is unlikely to contain:

- 'habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining'.

As such, it is unlikely that the Project would significantly affect any migratory species and this group was not considered further in the study.

13.2.8 Aquatic fauna habitats and threatened aquatic animal species

Aquatic fauna habitats and threatened aquatic animal species on the IMT site

No surveys for aquatic animals were undertaken for this study however, an aquatic ecology assessment for the Sydney Intermodal Terminal Alliance (SIMTA) Intermodal Facility EIS which included surveys in the lower reaches of Anzac Creek. The only native fish species found during that study was Flathead Gudgeon (*Philypnodon grandiceps*).

Anzac Creek (located in the south-east of the IMT site) is the IMT site's only major drainage line. The creek has been highly modified as a result of vegetation clearing and the construction of in-line water features associated with the Royal Australian Engineers Golf (RAE) Course. Runoff from the golf course (likely to contain pollutants) has altered the aquatic habitat of the creek promoting the presence of exotic fish species and aquatic weeds. Other onsite waterbodies include four detention basins, two of which have an extensive cover of emergent aquatic vegetation (including native and exotic species). These basins provide breeding and foraging habitat for a variety of frogs, reptiles and waterbirds.

No threatened species of aquatic animal are likely to occur on the IMT site.

Aquatic fauna habitats and threatened aquatic animal species at the rail crossing locations

The following description of aquatic fauna habitats and threatened aquatic fauna species applies to all of the rail access options.

The vegetation along the banks of the Georges River is variable, and dominated by native species within the north of IMT site and mats of vine weeds within the centre and south of the Project site. The Georges River is a major, permanently flowing waterway and is classified as a Class 1 waterway (major fish habitat) (Fairfull and Witheridge 2003).

The aquatic biodiversity of the lower freshwater reaches of the Georges River has been modified as a result of habitat degradation due to changes in abiotic condition such as water flow volumes and velocities, increased nutrients and chemical pollutants and the introduction of invasive species. The most recent water quality assessment of the Georges River (refer Chapter 16 – *Hydrology, groundwater and water quality*) indicated that the upper catchment was generally in good condition, while the middle catchment (within which the project is located) was generally in poor condition (GRCCC August 2011). The degraded condition of this section of the Georges River has led to the presence of disturbance-tolerant species which are less sensitive to alterations in environmental conditions.

A study was previously conducted for the Georges River catchment in which several locations along the Georges River were surveyed (Gehrke et al. 2004). Two sites close to the project recorded a total of 18 fish species, including 15 native and three introduced species (refer to section 3.8 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). The aquatic ecology assessment for the Sydney Intermodal Terminal Alliance (SIMTA) Intermodal Facility EIS (which included surveys in the lower reaches of Anzac Creek and the Georges River at the southern end of the IMT site) also recorded the presence of three species of fish (Hyder Consulting 2012) (refer to Table 3.9 in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). No species currently listed under the NSW Fisheries Management Act 1994 (FM Act) were recorded in the catchment and none are likely to occur in the affected stretch of the Georges River.

13.2.9 Groundwater dependent ecosystems

The following detailed descriptions of groundwater dependent ecosystems within the IMT site are also representative of those ecosystems identified within the rail access options.

Groundwater dependent ecosystems are defined as 'ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater' (Serov P, Kuginis L et al. 2012). Native vegetation communities within the main IMT site, rail access options and the surrounding area may use the existing shallow groundwater aquifers and may be susceptible to any reduction in the abundance or quality of groundwater. The Alluvial Woodland community (refer to Figure 13.2) has been identified as having high potential for using shallow groundwater that may be present on the IMT site and central and southern rail access options (National Water Commission 2003). Groundwater impacts are discussed in section 16.3.6 (Chapter 16 – *Hydrology, groundwater and water quality*), while potential impacts to groundwater dependent ecosystems are discussed in section 13.3 below.

13.3 Impact assessment

The Project would have both direct and indirect impacts on biodiversity during the construction and operation phases, as summarised in Table 13.9. Certain construction impacts, such as vegetation clearing, would have a permanent impact that would therefore continue into the operation phases of the Project. However, these impacts are described as 'construction impacts' in the following sections, recognising that the impacts would be first encountered during construction.

Table 13.9 Potential impacts of the Project on biodiversity

Impacts of the Project on biodiversity	Construction	Operation
Vegetation clearing and habitat loss	•	
Direct mortality	•	•
Fragmentation and loss of connectivity	•	
Noise impacts on fauna	•	•
Light impacts to fauna	•	•
Dust pollution	•	•
Introduction and spread of weeds	•	•
Increased edge effects[1]	•	
Disturbance of aquatic habitat	•	
Hydrological changes	•	

Note 1: 'Edge effects' are zones of changed environmental conditions (e.g. altered light levels, wind speed and/ or temperature) along the edges of habitat fragments.

A phased approach is proposed for the Project's construction and operation (as outlined in Chapter 8 – *Project development phasing and construction*), with the Project site to be developed progressively until Full Build is achieved in 2030. However, for the purpose of assessment of the impacts on biodiversity the Project has been assessed under a 'worst-case' scenario in terms of the overall Project footprint, including associated construction compounds, being the combined development area for all Project development phases. In addition, the Project development phasing is indicative only and would be confirmed by the Project contractor during detailed design. Therefore, while it is likely that the timing of vegetation clearing and associated impacts on biodiversity would be staged, in terms of assessing the impacts, a conservative approach has been adopted to assess all impacts in combination.

One exception to this is the Early Works development phase, which has been considered separately in this biodiversity assessment (refer to section 13.3.1 below). This is because Moorebank Intermodal Company (MIC) is seeking approval to undertake the Early Works as part of this Stage 1 State significant development (SSD) application, without the need for further approvals.

The final layout and footprint of the IMT site will depend on the location of the selected rail access option; there are therefore three IMT layouts proposed in this EIS. As a result, while the impacts of the three rail access options and associated IMT layouts are likely to be similar in nature, there are differences in terms of the extent of vegetation and associated habitat affected. These differences are discussed throughout the following sections and are summarised in Table 13.8.

13.3.1 Proposed avoidance of impacts on ecological values

The assessment has considered whether biodiversity impacts of the Project can be avoided or minimised in accordance with the Framework for Biodiversity Assessment (FBA) methodology wherever possible. The site selection process and planning phases of this Project were completed before the FBA methodology was developed (in 2014), so the assessment methodology can only be generally applied.

This Project has incorporated the principles of avoiding and minimising impacts on biodiversity into the entire life cycle of the Project, in line with the guidelines of the FBA at each of the following stages described below:

Site selection

The Project's site selection is restricted primarily by the need for the site to be located close to rail and road infrastructure, industry and warehouse facilities. The proposed site is located within an existing disturbed environment, characterised predominantly by industrial and Defence uses. The site contains a significant riparian corridor which was identified as a constraint and unsuitable for development of the main IMT. The adjoining properties to the south and south-east are significantly more constrained by high conservation values.

Planning

A detailed analysis of layout and functionality options for the Project site was undertaken and is discussed in Chapter 6 – *Project development and alternatives*.

When considering and analysing the Project site layout, the following matters were addressed:

a) whether there are alternative sites within the property on which the proposed development would be located where siting the proposed 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, and

c) whether an alternative development site to the proposed development site, which would avoid adversely impacts on biodiversity values, might be feasible.

Given the location and nature of the Project and its context in relation to existing road and rail infrastructure, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity. The EIS is for a Stage 1 SSD approval of concept layout options and future avoidance of vegetation will be investigated during detailed design and Stage 2 SSD approvals. It is acknowledged that the current proposal would clear approximately 44–53 hectares (ha) of Threatened ecological communities; however the majority of this vegetation is made up of small, highly fragmented and disturbed patches of vegetation in poor condition. The retention of these isolated patches within an industrial development precinct would provide little long-term conservation benefit to the Threatened ecological community species.

Avoidance of vegetation was considered in the planning phase of the Project and was supported through the ecological integrity classification described in section 2.7 of Technical Paper 3 – *Ecological Impact Assessment*. Through this process the classification of ecological values was used in to identify constraints and evaluate the potential design options for the Project. This assessment considered the Full Build development scenario and ensured that high value conservation lands were considered for avoidance along with a range of other factors.

Through this process, the reduction of impacts on areas of high ecological value was considered throughout the analysis and evaluation of design options for the Project. This resulted in the retention of substantial areas of vegetation and habitat contiguous with the riparian vegetation of the Georges River (refer section 6.4.4 of the EIS).

The areas of high ecological integrity to be affected by the proposal are restricted to narrow linear remnant adjoining Moorebank Avenue that are considered of limited viability for conservation given their small size and fragmentation, high edge to area ratio, and surrounding land uses.

The proposed Early Works also include the proposed restoration of the plant and equipment operation training area (referred to as the 'dust bowl') within the proposed conservation area (refer Figure 8.3 in Chapter 8 – *Project development phasing and construction*). This would create an additional area of Riparian Forest and/or Alluvial Woodland vegetation, thereby increasing the biodiversity value of this location.

13.3.2 Early Works impacts

The Early Works phase of the Project includes activities that would be required to prepare the Project site for the subsequent development phases. These activities are summarised below and described in more detail in section 8.3 of Chapter 8 – *Project development phasing and construction*:

- establishment of construction facilities;
- demolition of existing buildings and structures;
- some contaminated land remediation including removal of unexploded ordnance, explosive ordnance waste and asbestos buildings and remediation of an area known to contain asbestos;
- service utility terminations and diversions;
- heritage impact mitigation works including archaeological salvage of Aboriginal and European potential archaeological deposit (PAD) sites; and
- commencement of restoration works in the large area of bare land in the central portion of the conservation area involving re-contouring, topsoil spreading and revegetation with native species consistent with the natural vegetation of site.

The Early Works are unlikely to result in the clearing of any native vegetation communities; however, they are likely to involve the removal of scattered native and introduced trees and shrubs within the highly modified, park-like grounds in the east of the IMT site, associated with the built-up areas of the IMT site (refer to Figure 8.3, Chapter 8).

This vegetation does not constitute any threatened ecological community or contain any recorded locations of threatened flora and represents relatively poor habitat values for threatened species.

The establishment of construction facilities and the demolition of existing structures are also likely to result in increased dust and noise during construction. Given the relatively poor habitat values and highly disturbed nature of the area associated with the Early Works, these potential impacts are not considered further. The Early Works are, therefore, unlikely to result in a significant adverse impact on biodiversity.

13.3.3 Construction impacts

Direct impacts

Vegetation clearing and habitat loss

The clearing of remnant vegetation is listed as a 'key threatening process' under both the Commonwealth EPBC Act and the NSW TSC Act. Table 13.10 shows the potential loss of vegetation during construction of the Project, which includes loss of habitat features such as tree hollows.

Vegetation clearing would occur throughout the eastern part of the Project site adjacent to Moorebank Avenue and would continue west to the edge of the conservation area along the Georges River (refer Figure 13.5 to Figure 13.7). Vegetation clearing would be excluded from land within 100 m of the channel of the Georges River for most of the length of the Project site, with the exception of the area where the proposed rail access crosses the river (required for all three rail access options), the four narrow overland stormwater drainage channels and, for the southern rail access only, a section about 400 m in length in the north of the site on the eastern side of the river. Some areas of high ecological value (particularly along the southern end of Moorebank Avenue, refer Figure 13.1) would need to be cleared. As part of the Project design, substantial areas of vegetation and habitat adjoining the riparian vegetation of the Georges River would be retained and restored to contribute to the offset for this loss.

The condition of the vegetation to be cleared varies across the Project site. Stands of Castlereagh Scribbly Gum Woodland on the eastern side of the Project site are in moderate to good condition. Patches of Castlereagh Scribbly Gum Woodland, Castlereagh Swamp Woodland and Alluvial Woodland that occur within the central areas of the IMT site are in poor condition, with low diversity and low abundance of native species in the understorey. In areas that would be cleared of Riparian Forest, the condition varies from moderate to good, with weeds dominant in the understorey in some areas and native species present in all layers.

In terms of fauna habitat, the Project would result in the removal of more than 46 hollow-bearing trees. These hollows may be suitable as roosting and/or breeding habitat for a wide range of animal species, including arboreal mammals, reptiles, frogs, microbats and hollow-nesting birds. Many of the hollows that would be lost are in trees located in heavily cleared and open areas of the Project site. These trees are more likely to be used by species typical of open environments (e.g. Common Myna, Common Starling) and opportunistic native species (e.g. Sulphur-crested cockatoo). These trees still have potential to provide roosting and breeding habitat for the following threatened species of birds and bats:

- Little Lorikeet (potential breeding habitat);
- Powerful Owl (potential breeding habitat);
- Eastern Free-tail bat (potential roosting and breeding habitat); and
- Large-footed Myotis (potential roosting and breeding habitat).

However, the heavily cleared location of these trees already limits their suitability as habitat for species such as the Spotted-tailed Quoll (listed as Endangered under the EPBC Act), and the Powerful Owl and Squirrel Glider (listed as Vulnerable under the TSC Act), which require understorey vegetation for cover and foraging opportunities.

Table 13.10 Potential loss of vegetation within the construction footprint

Vegetation community/habitat/ threatened species	Approx. extent (ha) within Project site	Full Build clearing (ha)		
		Northern rail access option	Central rail access option	Southern rail access option
Vegetation				
Castlereagh Swamp Woodland[1]	0.9	0.9	0.9	0.9
Castlereagh Scribbly Gum Woodland[2]	16.1	16.1	16.1	16.1
Riparian Forest (River-Flat Eucalypt Forest)[1]	16.2	2.2	4.7	5.3
Alluvial Woodland (River-Flat Eucalypt Forest)[1]	35.6	25.2	26.7	30.4
Total River-Flat Eucalypt Forest[3]	51.8	27.4	31.4	35.7
Total vegetation	68.8	44.4	48.4	52.7
Fauna habitat				
Shrubby eucalypt woodland	17.0	17.0	17.0	17.0
Tall eucalypt forest	51.8	27.4	31.4	35.7
Waterbodies	2.0	2.0	2.0	2.0
Cleared land	130.1	N/A	N/A	N/A
Threatened flora				
Acacia bynoeana	17.0	17.0	17.0	17.0
Acacia pubescens	17.0	17.0	17.0	17.0
Dillwynia tenuifolia	17.0	17.0	17.0	17.0
Grevillea parviflora ssp. Parviflora	17.0	17.0	17.0	17.0
Leucopogon exolasius	17.0	17.0	17.0	17.0
Persoonia hirsuta	17.0	17.0	17.0	17.0
Persoonia nutans	17.0	17.0	17.0	17.0
Pultenaea parviflora	17.0	17.0	17.0	17.0
Threatened fauna				
Barking Owl	51.8	27.4	31.4	35.7
Black-chinned Honeyeater	68.8	44.4	48.4	52.7
Eastern Bent-wing Bat	68.8	44.4	48.4	52.7
Eastern False Pipistrelle	51.8	27.4	31.4	35.7
Eastern Free-tail bat	68.8	44.4	48.4	52.7
Eastern Pygmy-possum	68.8	44.4	48.4	52.7
Flame Robin	68.8	44.4	48.4	52.7
Gang-gang Cockatoo	68.8	44.4	48.4	52.7
Greater Broad-nosed Bat	68.8	44.4	48.4	52.7
Grey-headed Flying-fox	68.8	44.4	48.4	52.7
Koala	51.8	27.4	31.4	35.7
Large-footed Myotis	51.8	27.4	31.4	35.7
Little Eagle	68.8	44.4	48.4	52.7
Little Lorikeet	68.8	44.4	48.4	52.7

Vegetation community/habitat/ threatened species	Approx. extent (ha) within Project site	Full Build clearing (ha)		
		Northern rail access option	Central rail access option	Southern rail access option
Powerful Owl	51.8	27.4	31.4	35.7
Regent Honeyeater	68.8	44.4	48.4	52.7
Scarlet Robin	68.8	44.4	48.4	52.7
Spotted Harrier	68.8	44.4	48.4	52.7
Spotted-tailed Quoll	68.8	44.4	48.4	52.7
Square-tailed Kite	68.8	44.4	48.4	52.7
Squirrel Glider	68.8	44.4	48.4	52.7
Swift Parrot	68.8	44.4	48.4	52.7
Varied Sittella	68.8	44.4	48.4	52.7
Yellow-bellied Sheathtail Bat	68.8	44.4	48.4	52.7

Source: Table 4.5, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: 1 – Endangered Ecological Community as listed under the TSC Act;
2 – Vulnerable Ecological Community as listed under the TSC Act;
3 – River flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney basin and South East Corner bioregions.

Direct mortality

Specimens of *Grevillea parviflora* ssp. *Parviflora* (listed as Vulnerable under the EPBC Act and the TSC Act) and *Persoonia nutans* would be destroyed during clearing for the IMT Site unless a translocation program for these species were implemented. In addition, fauna injury or death could occur during the construction phases when large areas of vegetation are cleared. This would be likely to occur for those animals that are less mobile, nocturnal and restricted to tree hollows. Threatened species that may be affected by vegetation clearing include:

- microchiropteran bats;
- arboreal mammals; and
- nesting birds.

A clearing protocol would be implemented to minimise fauna injury and mortality: this is discussed in section 13.4.

Disturbance of aquatic habitat

Given that the crossing options are still at the conceptual design stage, the final design of the bridges associated with all of the rail access options will be subject to refinement. However, in each case it is likely that bridges would have multiple piers located both adjacent to the Georges River and within the Georges River floodplain. It is not intended to locate any bridge piers within the river channel itself.

Construction of the bridge is unlikely to require disturbance to the substrate of the river or removal of any submerged or emergent aquatic vegetation present. Changes to the amount of sunlight reaching the substrate of the river may however affect the ability of any submerged aquatic plants to photosynthesise. This may result in changes to the structure and extent of aquatic vegetation and associated habitat for aquatic animals. Given the relatively small area affected, and the existing degraded condition of the river, this possible reduction in vegetation and modification of habitat is unlikely to be significant.

Construction activity and runoff from bare ground created during earthworks also has potential to result in increased turbidity. This increased turbidity may have a negative impact on aquatic biodiversity through reduced light availability for aquatic plants and associated degradation to habitat for aquatic animals. Accidental spills and leakage of construction materials, such as fuels, lubricants and hydraulic oils from construction plant and equipment, could damage the aquatic environment and lead to further habitat degradation and possible mortality of aquatic flora and fauna.

The section of Anzac Creek that runs through the Project site would be redirected through stormwater detention basins. As part of the Project design, the low quality riparian corridor would be affected along this section of Anzac Creek. This is unlikely to result in a significant negative impact on the aquatic ecosystem of the receiving waters of the remainder of Anzac Creek or the Georges River, as inflows from these small and highly modified tributaries are already likely to be polluted with fertilisers, pesticides and silt. The four detention basins on the Project site currently provide foraging and breeding habitat for a variety of native frogs, reptiles and waterbirds. The Project would result in the removal of three of these basins; however, they would be replaced with at least three large detention basins. Although a mixture of native and emergent aquatic vegetation would be removed from the existing basins during construction, opportunities would be explored during the detailed design for planting new detention basins with similar native vegetation (refer to section 13.4).

Disturbance of groundwater dependent ecosystems

Impacts on groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities (refer to section 16.3.6 of Chapter 16 – *Hydrology, groundwater and water quality*). This may affect retained vegetation and habitat using the existing shallow groundwater aquifers present. The Alluvial Woodland community (located on the western side of the site, along the Georges River) has been identified as having high potential for groundwater interaction (National Water Commission 2013).

Without adequate controls, these impacts could affect retained vegetation and habitat within the Project site, potentially resulting in changes in vegetation structure and composition caused by changes in water availability and salinity levels. Changes to vegetation may include a reduction in the diversity and abundance of plants dependent on high water availability, which would then allow for species tolerant of higher salinity and lower soil moisture to thrive. As a result, this may slightly increase the susceptibility of the riparian corridor to fire and may reduce the suitability of habitat onsite for some fauna species.

Potential groundwater impacts would be considered and mitigation measures developed during detailed design.

Indirect impacts

Fragmentation and loss of connectivity

Habitat fragmentation can increase the isolation of remnant vegetation, creating barriers to the movements of small and sedentary fauna such as ground-dwelling mammals, reptiles and amphibians. The existing habitat within the IMT site and rail access options is already isolated and fragmented by existing rail infrastructure, internal and external road networks, sporting fields and a golf course.

The Project would result in the removal of large areas of woodland and forest within the construction footprint of the IMT site. The proposed rail access options across the Georges River would all create a break in the canopy of the riparian vegetation, approximately 70 m wide for the northern and southern rail access options, or approximately 140 m wide for the central rail access option. The Project is not likely to further isolate or fragment retained vegetation along the Georges River. The proposed overland drainage channels that would form part of the stormwater infrastructure for the Project would result in minor (<10 m wide) gaps in the canopy during construction, but vegetation restoration would be expected to restore habitat connectivity.

Noise impacts on fauna

Construction noise from the Project is discussed in detail in Chapter 12 – *Noise and vibration*. The main effects from noise impacts on animals are generally in the form of behavioural changes. The wildlife of the Project site is already likely to be tolerant of frequent noise exposure from the existing rail lines to the west and south of the Project site, current onsite Defence activities and vehicle movements on the internal and external road networks. Construction may cause temporary disturbance to fauna; however, the greatest impacts from noise emissions are likely to be close to the Project site (within 100 m) and are not likely to have a long-term impact on wildlife populations.

Light impacts on fauna

During construction of the Project, light pollution would be greater than existing conditions, due to the presence of fixed lighting within the facility and movement of construction vehicles if night works are carried out. The main effects of light pollution on fauna include increased orientation towards, or disorientation from additional light, which could lead to behavioural changes in foraging, reproduction and communication. For example, some species of insectivorous bats (particularly fast flying species e.g. *Tadarida* spp.) forage on insects attracted to light, while other slow-flying bats (e.g. some *Myotis* and *Rhinolophus* species) avoid lighted areas (Patriarca 2010).

The vegetation restoration measures proposed within the conservation area, along with landscape planting, are likely to mitigate some light pollution impacts through the screening effects of increased vegetation. Lighting for the Project would be designed to minimise light spill (refer to Chapter 22 – *Visual and urban design*) and, along with the proposed vegetation restoration measures, would minimise ecological light pollution impacts. Further investigation would need to be undertaken on this aspect during the detailed design stage and as more information becomes available.

Turbidity impacts

Construction activity and runoff from exposed ground during earthworks could result in increased turbidity, which would lead to reduced light availability for aquatic flora and habitat degradation for aquatic fauna. However, with the implementation of appropriate sediment controls, these impacts are unlikely to significantly affect aquatic biodiversity.

Dust pollution

During construction, soil dust is likely to be generated by movement of spoil, construction vehicles and equipment and may be deposited onto the foliage of vegetation. This could alter processes such as photosynthesis, respiration and transpiration and result in reduced productivity and health of plants (Farmer 1993).

However, retained vegetation within the Project site is already likely to experience dust impacts associated with Defence heavy equipment training in plant and equipment training area known as the ‘dust bowl’. Revegetation of this area during the Early Works development phase would reduce this existing impact. Dust from the Glenfield Landfill site (to the south of the Project site) may also already be affecting the existing vegetation. With the implementation of mitigation measures described in Chapter *17 – Local air quality*, the dust-related impacts on biodiversity are unlikely to be greatly increased from existing conditions.

Introduction and spread of weeds

Of the weeds that are currently present within the Project site, nine are recognised as Weeds of National Significance (Australian Weeds Committee) and are listed below:

- *Alternanthera philoxeroides* (Alligator Weed);
- *Asparagus aethiopicus* (Ground asparagus);
- *Asparagus asparagoides* (Bridal Creeper);
- *Chrysanthemoides monilifera* ssp. Monilifera (Boneseed);
- *Chrysanthemoides monilifera* ssp. Monilifera (Bitou Bush);
- *Lantana camara* (Lantana);
- *Rubus fruticosus* (Blackberry complex);
- *Sagittaria platyphylla*; and
- *Salvinia molesta*.

These also contribute to five key threatening processes listed under the EPBC Act and/or the TSC Act which are as follows:

- Invasion and establishment of exotic vines and scramblers;
- Invasion, establishment and spread of **Lantana camara;*
- Invasion of native plant communities by bitou bush & boneseed (**Chrysanthemoides monilifera*);
- Invasion of native plant communities by exotic perennial grasses; and
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

During construction, vegetation clearing could spread weeds into areas of native vegetation within the Project site, particularly close to cleared areas. Weed dispersal and establishment is likely to occur during earthworks, through the movement of soil and attachment of seeds to vehicles and machinery, where these occur within or adjacent to retained vegetation. To minimise these impacts, the Project would involve substantial weed control and native vegetation restoration works along the Georges River corridor, as discussed in section 13.4.

Increased edge effects

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed and or temperature) along the edges of habitat fragments. The new environmental conditions along the edges can promote the growth of different vegetation types and allow for invasion by species specialising in edge habitats.

The Project site has been extensively cleared, so that all habitats are subject to substantial existing edge effects from areas of exotic grassland, roads and adjacent railway lines. During construction of the Project, there would be an increase in edge effects within the habitat of the Georges River riparian corridor, due to clearing for overland drainage infrastructure to connect to the Georges River. However, in the medium to long term, the Project is likely to reduce edge effects on the habitat of the Georges River riparian corridor habitat due to the proposed restoration of vegetation.

Fire regimes

The Project site has been identified as containing sections of bushfire prone land. The key bushfire threats to the Project site occur in the following locations:

- The south-eastern corner of the Project site, which includes the Holsworthy Military Area and features extensive bushland vegetation; and
- The heavily vegetation area extending north-south along the western boundary western boundary of the Project site, including the Georges River corridor and proposed conservation area.

During construction, fire regimes may alter due to the removal of vegetation: however, as there is no current evidence of high frequency fire regimes on the Project site, the Project is considered unlikely to result in high frequency fire (refer to Table 4.3 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). The indicative IMT site layout options described in this EIS (refer Figures 7.4 to 7.6 in Chapter 7 – *Project built form and operations*) provide some suitable measures to minimise bushfire risk; in particular, the provision of a perimeter road and location of commercial development and warehouses away from the main bushfire threat areas. The risk of the Project causing a change to fire regimes is low if appropriate design and management measures are implemented during the design and pre-construction stages of the Project (refer to section 13.4.1).

13.3.4 Operational impacts

While most of the construction impacts on biodiversity would continue through the operation of the Project, the operational impacts on biodiversity are not expected to be as great once mitigation measures are implemented and the conservation area matures along the Georges River.

Direct impacts

Direct mortality

During operation of the Project, operating equipment and the movement of trucks and trains in and out of the facility could increase fauna injury or mortality. While some mobile species, such as birds, can move away from moving vehicles and trains, other species that are less mobile and/or nocturnal may have difficulty moving over large distances.

Both threatened and non-threatened species of microchiropteran bats, arboreal mammals, nestling birds, frogs and reptiles would be at risk of injury or mortality. Controls such as fencing would be put in place to keep land-based fauna away from the operating terminals, and would be designed to minimise collision by birds and bats. During operation, no further impacts would be expected on vegetation along the riparian corridor.

Indirect impacts

Noise impacts on fauna

Wildlife populations living in the Project site are unlikely to be affected by the Project's operational noise, since they are likely to be habituated to frequent noise exposure from current onsite Defence activities, the existing rail lines to the west and south of the Project site and vehicle movements on the internal and external road networks. Therefore, operational noise from the Project associated with the movement of trucks, trains and gantry operations is not likely to have a significant long-term impact on wildlife populations.

Light impacts on fauna

Light pollution is likely to increase relative to existing levels during operation of the Project, due to fixed lighting within the facility and lighting from trucks and trains. The light-related effects on fauna would be mainly behavioural and could affect foraging behaviour, reproduction and communication, as well as causing orientation towards or disorientation from, artificial light sources. The proposed vegetation restoration within the riparian corridor and landscape planting in the interior of the Project site could mitigate some light pollution through the screening effects of increased vegetation. Other measures would also be implemented to minimise light spill from the facility, as described in Chapter 22 – *Visual and urban design.*

Dust pollution

During operation of the Project, dust in the form of particulate matter from incomplete combustion of diesel fuel would be generated by trucks and diesel trains. The retained vegetation on the riparian corridor and along the rail link to the SSFL may be affected by dust-related impacts, which could reduce the overall health of the vegetation as well as changing the vegetation structure composition. However, retained vegetation is likely to be subject to existing dust impacts from current onsite activities and the overall impacts on biodiversity are therefore unlikely to change substantially from existing conditions. Various measures would also be implemented to minimise dust emissions within and outside the Project site, as described in Chapter 17 – *Local air quality.*

Fire regimes

As discussed in relation to construction impacts (refer to section 13.3.1), the Project site has been identified as containing bushfire prone land. During operation, the risk of the Project causing a change to fire regimes would be low, if appropriate design and management measures were implemented during the design and pre-construction stages of the Project (refer to section 13.4.1).

13.3.5 Summary of key impacts on threatened species

The key potential impacts affecting threatened flora and fauna species on the Project site are summarised below.

Impacts on threatened species of plant

The key potential impacts affecting threatened flora species on the Project site are summarised in Table 13.11. This summary assumes the habitat loss for all threatened flora species relates to 17.0 ha of Castlereagh Scribbly Gum Woodland vegetation that is restricted to the IMT site. No habitat for threatened flora species is present within the three rail access options. Impact significance assessments were undertaken for these species and are discussed in section 13.3.5.

Table 13.11 Potential impacts on threatened flora species known or likely to occur in the Project site (all rail access options)

Threatened species	Status		Potential habitat loss (ha)[4]	Direct mortality	Fragmentation, isolation and edge effects	Weeds, pests and pathogens
	EPBC Act[2]	TSC Act[1]				
Acacia bynoeana	V	E1	17.0	Possible minor[3]	Neutral or positive	Neutral or positive
Acacia pubescens	V	V	17.0	Possible minor[3]	Neutral or positive	Neutral or positive
Dillwynia tenuifolia	V	V	17.0	Possible minor[3]	Neutral or positive	Neutral or positive
Grevillea parviflora ssp. Parviflora	V	V	17.0	Approximately 16 individuals	Neutral or positive	Neutral or positive
Leucopogon exolasius	V	V	17.0	Possible minor[3]	Neutral or positive	Neutral or positive
Persoonia hirsuta	E	E1	17.0	Possible minor[3]	Neutral or positive	Neutral or positive
Persoonia nutans	E	E1	17.0	Approximately 10 individuals	Neutral or positive	Neutral or positive
Pultenaea parviflora	V	E1	17.0	Possible minor[3]	Neutral or positive	Neutral or positive

Notes:
1. V= Vulnerable, E1 = Endangered, E2 = Endangered Population (NSW *Threatened Species Conservation Act 1995*).
2. V = Vulnerable, E = Endangered, M = Migratory, C = Conservation Dependent (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).
3. Species not recorded but impact possible if species occurs on the site in the soil seed bank.
4. Habitat loss for *Grevillea parviflora* subsp. *Parviflora* and *Persoonia nutans* includes 6.5 ha of known habitat and 10.5 ha of apparently unoccupied, degraded potential habitat.

Impacts on threatened species of animal

The key potential impacts affecting threatened fauna species on the Project site are summarised in Table 13.12. The summary identifies the general nature and intensity of impacts and is hence applicable to all three rail access options and associated indicative IMT site layouts. Impact significance assessments were undertaken for these species and are discussed in section 13.3.5.

The rail access options differ in the amount of associated vegetation clearing and also in the extent to which they have potential to reduce fauna habitat connectivity. The potential impact on fauna habitat connectivity is described for each option below. While the crossing will disrupt connectivity, most of the threatened species of animal likely to utilise the corridor are very mobile and are unlikely to be significantly affected.

Northern rail access

The northern rail access would result in the removal of approximately 0.24 ha of Riparian Forest habitat on the eastern side of the river. The width of vegetation along the river narrows significantly immediately north of the northern access location, and hence clearing here has less potential to affect the already quite limited fauna habitat connectivity in this location. The strip of riparian vegetation affected on the western bank is also narrow and has limited connectivity to the north. The northern rail access would therefore have a relatively low impact on fauna movement.

Central rail access

The central rail access option would involve clearing approximately 0.14 ha of Alluvial Woodland and 2.14 ha of Riparian Forest. It would create a break in the riparian vegetation along the eastern side of the river approximately 150 m in width. On the western side of the river the break in the riparian vegetation would be approximately 250 m in width leaving minimal space between the river and the existing railway line for terrestrial fauna habitat connectivity. The central rail access would therefore have a relatively high impact on fauna movement.

Southern rail access

The southern rail access option would involve clearing approximately 0.48 ha of Alluvial Woodland and 2.98 ha of Riparian Forest. Clearing would occur on the eastern bank of the Georges River immediately adjacent to the existing East Hills Railway Line crossing. The existing East Hills Rail Line has created a narrow break in the riparian vegetation in this location and hence limits fauna habitat connectivity along the river; however, some terrestrial fauna habitat connectivity remains underneath the rail bridge. The southern access would widen the break in vegetation on the eastern bank and has potential to further decrease fauna habitat connectivity and animal movement. On the western bank, the southern access would remove most remaining vegetation from an area of the riparian zone approximately 300 m in length. This is also likely to adversely affect fauna movement along the western bank of the river. The southern rail access would therefore have a relatively high impact on fauna movement.

Table 13.12 Potential impacts on threatened fauna species known or likely to occur in the Project site (all rail access options)

Species	Status		Habitat loss		Direct mortality[23]	Fragmentation, isolation and edge effects	Weeds, pests and pathogens	Disturbance to aquatic habitat	Noise impacts	Light impacts
	EPBC Act[2]	TSC Act[21]	Loss of general habitat (refer Table 13.10 for areas)	Loss of discrete potential breeding resources (e.g. tree hollows, caves)						
Barking Owl	–	V	Yes	Yes	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	Minor negative
Black-chinned Honeyeater	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Cumberland Land Snail	–	E	Yes	No	Possible	Minor negative	Neutral or positive	N/A	No	No
Eastern Bent-wing Bat	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	Minor negative
Eastern False Pipistrelle	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	N/A	Minor negative	Minor negative
Eastern Free-tail bat	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	N/A	Minor negative	Minor negative
Eastern Pygmy-possum	–	V	Yes	Yes	Possible	Minor negative	Neutral or positive	N/A	Minor negative	Minor negative
Flame Robin	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Gang-gang Cockatoo	–	V	Yes	Yes	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Greater Broad-nosed Bat	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	N/A	Minor negative	Minor negative
Grey-headed Flying-fox	V	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	Minor negative
Koala	–	V	Yes	No	Unlikely	Minor negative	Neutral or positive	N/A	Minor negative	No
Large-footed Myotis	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	Neutral or positive	Minor negative	Minor negative

Species	Status		Habitat loss		Direct mortality[23]	Fragmentation, isolation and edge effects	Weeds, pests and pathogens	Disturbance to aquatic habitat	Noise impacts	Light impacts
	EPBC Act[2]	TSC Act[21]	Loss of general habitat (refer Table 13.10 for areas)	Loss of discrete potential breeding resources (e.g. tree hollows, caves)						
Little Eagle	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Little Lorikeet	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	N/A	Minor negative	No
Powerful Owl	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	N/A	Minor negative	No
Regent Honeyeater	E	CE	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Scarlet Robin	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Spotted Harrier	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Spotted-tailed Quoll	E	V	Yes	Yes	Possible	Minor negative	Neutral or positive	N/A	Minimal	No
Square-tailed Kite	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Squirrel Glider	–	V	Yes	Yes	Possible	Minor negative	Neutral or positive	N/A	Minor negative	Minor negative
Swift Parrot	E	E1	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Varied Sittella	–	V	Yes	No	Unlikely	Neutral	Neutral or positive	N/A	Minor negative	No
Yellow-bellied Sheathtail Bat	–	V	Yes	Yes	Possible	Neutral	Neutral or positive	N/A	Minor negative	Minor negative

Source: Table 4.5, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: 1 V = Vulnerable, E1 = Endangered, CE = Critically Endangered (NSW *Threatened Species Conservation Act 1995*).
2 V = Vulnerable, E = Endangered, M = Migratory, C = Conservation Dependent (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).
3 Impact possible during clearing if species inhabits tree hollows to be removed; however this risk will be minimised through clearing protocols for habitat tress.

13.3.6 Cumulative impacts

The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts (Contant & Wiggins 1991; Council on Environmental Quality 1978). Cumulative impact assessment considers a project within the context of other past, present and likely future sources of impact. This is necessary to identify any impacts associated with the Project that may have an additive effect or interaction with impacts from other activities within the locality to the extent that the overall (cumulative) impact becomes more significant than the impacts of the Project alone.

The most significant developments underway and planned within the Project locality include residential development and associated infrastructure and the Sydney Intermodal Terminal Alliance (SIMTA) project.

The SIMTA proposal is located on Moorebank Avenue immediately to the east of the IMT site. The potential impacts of the SIMTA proposal that would add to the Project's impacts on ecological values include:

- clearing of native vegetation including the following threatened ecological communities:
  - Castlereagh Scribbly Gum Woodland
  - Castlereagh Swamp Woodland
  - River-flat Eucalypt Forest
- removal of the following Threatened species of plant
  - Persoonia nutans
  - Grevillea parviflora subsp. parviflora
- removal of fauna habitat
- degradation of aquatic habitats.

A detailed summary of the cumulative impacts associated with the Project is provided in Chapter 27 – *Cumulative impacts* and Technical Paper 3 – *Ecological Impact Assessment* in Volume 4).

13.3.7 Impact significance assessment

Impact significance assessments for threatened species populations and ecological communities have been conducted in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (Department of the Environment 2013) and *Threatened Species Assessment Guidelines* (DEC 2007) to consider the potential impacts of the Project and proposed mitigation measures (refer to Appendices C and D of Technical Paper 3 – *Ecological Impact Assessment*). A summary of these assessments relevant to the IMT site and each of rail access option is provided below.

IMT Site

Based on these assessments, no threatened species population or ecological community is likely to be significantly affected by the Project. The results of the impact assessments for EPBC Act listed threatened biodiversity and TSC Act listed biodiversity are provided in Tables 13.13 and 13.14 respectively.

Of the EPBC Act listed threatened species of animal considered to have the potential to occur on the Project site, all have large home ranges (the distance that the species will travel) that would extend well beyond the Project site and/or are migratory or nomadic and likely to use the Project site on a sporadic or seasonal basis. These species are hence unlikely to be significantly affected by the small proportion of locally occurring habitat likely to be affected by the Project.

No EPBC Act or TSC Act listed threatened species, population or ecological community is likely to be significantly affected by the Project.

Northern rail access

Based on these assessments, no threatened species population or ecological community is likely to be significantly affected by the Project. The results of the impact assessments for EPBC Act listed threatened biodiversity and TSC Act listed biodiversity are provided in Tables 13.13 and 13.14 respectively.

Of the EPBC Act listed threatened species of animal considered to have the potential to occur on the Project site, all have large home ranges (the distance that the species will travel) that would extend well beyond the Project site and/or are migratory or nomadic and likely to use the Project site on a sporadic or seasonal basis. These species are hence unlikely to be significantly affected by the small proportion of locally occurring habitat likely to be affected by the Project.

No EPBC Act or TSC Act listed threatened species, population or ecological community is likely to be significantly affected by the Project.

Central rail access

Based on these assessments, no threatened species population or ecological community is likely to be significantly impacted by the Project. The results of the impact assessments for EPBC Act listed threatened biodiversity and TSC Act listed biodiversity are provided in Tables 13.13 and 13.14 respectively.

Of the EPBC Act listed threatened species of animal considered to have the potential to occur on the Project site, all have large home ranges (the distance that the species will travel) that would extend well beyond the Project site and/or are migratory or nomadic and likely to use the Project site on a sporadic or seasonal basis. These species are hence unlikely to be significantly affected by the small proportion of locally occurring habitat likely to be affected by the Project.

No EPBC Act or TSC Act listed threatened species, population or ecological community is likely to be significantly affected by the Project.

Southern rail access

Based on these assessments, no threatened species population or ecological community is likely to be significantly affected by the Project. The results of the impact assessments for EPBC Act listed threatened biodiversity and TSC Act listed biodiversity are provided in Tables 13.13 and 13.14 respectively.

Of the EPBC Act listed threatened species of animal considered to have the potential to occur on the Project site, all have large home ranges (the distance that the species will travel) that would extend well beyond the Project site and/or are migratory or nomadic and likely to use the Project site on a sporadic or seasonal basis. These species are hence unlikely to be significantly affected by the small proportion of locally occurring habitat likely to be affected by the Project.

No EPBC Act or TSC Act listed threatened species, population or ecological community is likely to be significantly affected by the Project.

Table 13.13 Impact assessment summary for EPBC Act listed threatened biodiversity

Scientific name	Common name	EPBC Act status[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central rail access	Southern rail access
Plants								
Acacia bynoeana	Bynoe's Wattle	V	Not significant	• None of these species was recorded within or adjacent to the study area; however, it is possible that they may exist in the study area as a soil-stored seed bank. • The Project site does not contain a known occurrence of these species and is unlikely to contain an important population.	●	N/A	N/A	N/A
Acacia pubescens	Downy Wattle	V	Not significant		●	N/A	N/A	N/A
Dillwynia tenuifolia	–	V	Not significant		●	N/A	N/A	N/A
Leucopogon exolasius	Woronora Beard-heath	V	Not significant		●	N/A	N/A	N/A
Persoonia hirsuta	Hairy Geebung	E	Not significant		●	N/A	N/A	N/A
Pultenaea parviflora	Sydney Bush-pea	V	Not significant		●	N/A	N/A	N/A
Grevillea parviflora ssp. parviflora	Small-flower Grevillea	V	Not significant	• The upper Georges River population of *Grevillea parviflora ssp. parviflora* is recognised as being large. • The Project will lead to a reduction in the size of the *Grevillea parviflora ssp. parviflora* population (less than 2%). • The habitat for *Grevillea parviflora ssp. parviflora* that would be removed to the west of Moorebank Avenue, while in good to moderately degraded condition, is functionally isolated from other areas of *Grevillea parviflora ssp. parviflora* habitat in the locality due to its limited seed dispersal.	●	N/A	N/A	N/A

Scientific name	Common name	EPBC Act status[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central rail access	Southern rail access
Persoonia nutans	Nodding Geebung	E	Not significant	• The proposed action will result in the removal of 6.5 ha of habitat known to be occupied by *Persoonia nutans* within the Project site but this is unlikely to result in a significant long-term reduction in the size of the population. • The Project is unlikely to create any barriers to cross-pollination or seed dispersal between patches of habitat which would affect the breeding cycle of the species.	●	N/A	N/A	N/A
Animals								
Phascolarctos cinereus	Koala	V	Not significant	• The higher value riparian habitat that would be retained and rehabilitated has moderate potential as habitat for the species as it contains potential food sources and potential breeding habitat for the koala but is in moderately degraded condition and is largely surrounded by cleared areas. • The Project is unlikely to result in a long-term reduction in the population of the species, nor to significantly reduce the area of occupancy of the species. • There is unlikely to be a significant loss of habitat for the species.	●	●	●	●

Scientific name	Common name	EPBC Act status[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central rail access	Southern rail access
Pteropus poliocephalus	Grey-headed Flying-fox	V	Not significant	• Much of the higher value riparian habitat containing winter food resources and potential camp site locations for the species would be retained and rehabilitated. • The Project is unlikely to significantly reduce the availability of important habitat or area of occupancy. • Fragmentation is highly unlikely to occur due to the mobility of the species.	●	●	●	●
Dasyurus maculatus	Spotted-tailed Quoll	E	Not significant	• The vegetation on site is considered to be marginal at best due to the paucity of potential den sites and fragmentation. • The species was not recorded within the Project site but it is possible that the species may occupy the site as part of a large home range. • If present in the locality, the species may utilise habitat along corridors of riparian vegetation.	●	●	●	●
Lathamus discolor	Swift Parrot	E	Not significant	• The site is not within the core breeding areas for the Swift Parrot and Regent Honeyeater and these species are unlikely to breed on the site. • The Project site is a potential habitat but is only likely to be used as a foraging habitat by these species. • Unlikely to be affected by minor habitat fragmentation due to the species being highly mobile.	●	●	●	●
Anthochaera phrygia	Regent Honeyeater	E, M	Not significant		●	●	●	●

Source: Table 5.1, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: 1 V= Vulnerable, E= Endangered

Table 13.14 Impact assessment for TSC Act listed biodiversity

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Plants								
Persoonia nutans	Nodding Geebung	E1	Not significant	• The proposed action will result in the removal of 6.5 ha of habitat known to be occupied by *Persoonia nutans* within the proposed Project site and a further 10.5 ha of degraded, apparently unoccupied habitat. • The habitat of the local population of the species is already fragmented by existing roadways and cleared areas. Thus the Project is unlikely to increase the fragmentation or isolation of patches of habitat. • The larger areas of known occurrences of the species and potential habitat to the east of Moorebank Avenue are more likely to represent an area of habitat important to the survival of *Persoonia nutans*.	●	N/A	N/A	N/A

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Grevillea parviflora ssp. Parviflora	Small-flower Grevillea	V	Not significant	• The proposed action may result in the removal of 6.5 ha of habitat known to be occupied by *Grevillea parviflora ssp. parviflora* within the proposed Project site and an additional 10.5 ha of degraded and apparently unoccupied habitat. • The habitat of the local population of the species is already fragmented by existing roadways and cleared areas. • The habitat for *Grevillea parviflora* ssp. *parviflora* that would be removed to the west of Moorebank Avenue, while in good to moderately degraded condition, is functionally isolated from other areas of *Grevillea parviflora* ssp. *parviflora* habitat in the locality due to the species limited seed dispersal.	●	N/A	N/A	N/A
Acacia bynoeana	Bynoe's Wattle	E1	Not significant	• The project is unlikely to significantly affect processes such as pollination, seed dispersal and recruitment, which could affect the breeding cycle of these species. • It is unknown whether a viable population of any of these species exists within the study area.	●	N/A	N/A	N/A
Acacia pubescens	Downy Wattle	V	Not significant		●	N/A	N/A	N/A
Dillwynia tenuifolia	–	V	Not significant		●	N/A	N/A	N/A
Leucopogon exolasius	Woronora Beard-heath	V	Not significant		●	N/A	N/A	N/A
Persoonia hirsute	Hairy Geebung	E1	Not significant		●	N/A	N/A	N/A
Pultenaea parviflora	Sydney Bush-pea	E1	Not significant		●	N/A	N/A	N/A

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Animals								
Cercartetus nanus	Eastern Pygmy-possum	V	Not significant	• The habitat for these species in the study area is considered to be marginal and it is unlikely that a significant proportion of any local population breeds on the site.	●	●	●	●
Petaurus norfolcensis	Squirrel Glider	V	Not significant		●	●	●	●
Meridolum corneovirens	Cumberland Land Snail	E1	Not significant	• Insufficient information about the population dynamics of the species is available to determine whether any extant sub-population that may exist within the study area is likely to be viable. • The size and geographic extent of any extant sub-population is unknown; however, given the small number of individuals recorded it is presumed to be small.	●	●	●	●
Mormopterus norfolkensis	Eastern Free-tail bat	V	Not significant	• A significant proportion of the locally available breeding habitat for hollow-breeding bats may be affected by the removal of more than 46 hollows-bearing trees. • The proposed nest box installation, hollow-relocation and vegetation restoration measures are likely to offset this loss of breeding habitat, to the extent that local populations of these species are unlikely to be placed at significantly increased likelihood of extinction. • Potential foraging habitat for these species is considered to be relatively abundant in the locality.	●	●	●	●
Scoteanax rueppellii	Greater Broad-nosed Bat	V	Not significant		●	●	●	●
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	Not significant		●	●	●	●
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	Not significant		●	●	●	●
Miniopterus schreibersii	Eastern Bent-wing Bat	V	Not significant		●	●	●	●
Myotis adversus	Large-footed Myotis	V	Not significant		●	●	●	●

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Pteropus poliocephalus	Grey-headed Flying-fox	V	Not significant	• No camp sites (roosting and breeding habitat) for the Grey-headed Flying-fox are located within or adjacent to the study area. Breeding habitat for the species is therefore unlikely to be affected. • Approximately 44 to 53 ha of woodland will be cleared. This woodland is likely to be used as a foraging habitat by this species on a seasonal basis, when the dominant eucalypt species are flowering heavily. • As this species is highly mobile, it is unlikely that it would be significantly affected by the additional habitat fragmentation that would occur as a result of the Project.	●	●	●	●
Glossopsitta pusilla	Little Lorikeet	V	Not significant	• The site is unlikely to contain significant breeding habitat. • Approximately 44 to 53 ha of woodland would be cleared. This woodland may be used as a foraging habitat by these species on a seasonal basis when the dominant eucalypt species are flowering heavily. • As these species are highly mobile, it is unlikely that they would be significantly affected by the additional habitat fragmentation that would occur as a result of the project.	●	●	●	●
Lathamus discolour	Swift Parrot	E1	Not significant		●	●	●	●
Melithreptus gularis gularis	Black-chinned Honeyeater	V	Not significant		●	●	●	●
Anthochaera phrygia	Regent Honeyeater	CE	Not significant		●	●	●	●
Callocephalon fimbriatum	Gang-gang Cockatoo	V	Not significant	• The approximately 27 to 36 ha of affected tall forest may be used as a foraging habitat by these species on an occasional basis as part of a large home range.	●	●	●	●
Ninox strenua	Powerful Owl	V	Not significant		●	●	●	●
Ninox connivens	Barking Owl	V	Not significant		●	●	●	●

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Hieraaetus morphnoides	Little Eagle	V	Not significant	• The vegetation of the riparian corridor is more likely to provide suitable nesting habitat for these species.	●	●	●	●
Circus assimilis	Spotted Harrier	V	Not significant		●	●	●	●
Lophoictinia isura	Square-tailed Kite	V	Not significant		●	●	●	●
Petroica boodang	Scarlet Robin	V	Not significant	• These are sedentary species which may breed in the locality, particularly utilising mature and rough-barked trees. • Within the Project site, mature and rough-barked trees are almost exclusively found along the riparian corridor of the Georges River. Much of this vegetation would be retained and substantial vegetation restoration would also be conducted to improve the condition of this retained habitat.	●	●	●	●
Petroica phoenicea	Flame Robin	V	Not significant		●	●	●	●
Daphoenositta chrysoptera	Varied Sittella	V	Not significant		●	●	●	●
Dasyurus maculatus	Spotted-tailed Quoll	V	Not significant	• The vegetation at the site is considered marginal at best due to the paucity of potential den sites and fragmentation. • The species was not recorded within the Project site but it is possible that the species may occupy the site as part of a large home range. • If present in the locality, the species is most likely to utilise habitat along corridors of riparian vegetation on the Georges River.	●	●	●	●

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Phascolarctos cinereus	Koala	V	Not significant	• The higher value riparian habitat that would be retained and rehabilitated has moderate potential as habitat for the species as it contains potential food sources and potential breeding habitat for the koala but is in moderately degraded condition and is largely surrounded by cleared areas. • The Project is unlikely to result in a long-term reduction in the population of the species, or to reduce the area of occupancy of the species. • There is unlikely to be a significant loss of habitat for the species as a result of the Project.	●	●	●	●

Scientific name	Common name	TSC Act[1]	Assessment outcome	Key findings	Development			
					IMT site	Northern rail access	Central Rail access	Southern rail access
Threatened ecological communities								
River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions		E	Not significant	• The Project would result in the clearing of approximately 27 to 36 ha of River-Flat Eucalypt Forest on coastal floodplains, but is unlikely to negatively affect the long-term viability of the local occurrence of the community.	●	●	●	●
Castlereagh Swamp Woodland community		E	Not significant	• The Project would result in the clearing of 0.9 ha of Castlereagh Swamp Woodland: this represents a small proportion of the local ecological community. • The Project is unlikely to result in processes such as substantial hydrological changes or increased weed invasion that would be likely to result in changes to the structure or composition of the community outside of the Project site.	●	●	●	●
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion		V	Not applicable[2]		●	●	●	●

Source: Table 5.2, Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: 1 V = Vulnerable, E = Endangered, CE = Critically Endangered.
2 Vulnerable ecological communities are generally excluded from the provisions of the EP&A Act relating to threatened species, populations and ecological communities, including provisions that require the concurrence of the Director-General of the OEH or the Minister administering the TSC Act, or the preparation of a species impact statement, in respect of development or an activity that is likely to have a significant effect on threatened species, populations or ecological communities.

13.4 Management and mitigation

This section outlines the management and mitigation measures that would be undertaken during the Early Works and the subsequent construction and operation Project phases.

While the Early Works are unlikely to result in the clearing of any native vegetation communities, they are likely to involve the removal of scattered native and introduced trees and shrubs within the main IMT site.

Therefore, the vegetation clearing and direct mortality mitigation measures outlined in section 13.4.1, are to be implemented for the Early Works.

A general principle of the proposed environmental management is to achieve the following, in order of preference:

- avoid environmental impacts;
- reduce impacts;
- mitigate the impacts; and
- as a last resort, compensate for (offset) the residual impacts.

The mitigation measures specific to the ecological impacts identified in section 13.3 are described in section 13.4.1 below. Many of the general impact mitigation measures (e.g. dust suppression, sedimentation controls) would also contribute to the mitigation of construction and operation phase impacts on the ecological values of the IMT site and rail access option during all Project development phases. The proposed offsets package described in section 13.4.2 would address the remaining (residual) impacts that cannot be mitigated through the proposed management measures alone (refer section 6.4 of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4).

13.4.1 Proposed management and mitigation measures

Vegetation clearing

Disturbance of areas of native vegetation and habitat would be unavoidable during the construction process. However, the following management and mitigation measures would be implemented during Early Works and all construction phases of the Project:

- Where possible, areas of habitat contiguous with areas of vegetation already identified for retention would be avoided through the detailed design.
- Following detailed design and prior to construction, detailed flora and fauna impact mitigation measures would be developed and presented as part of the construction environmental management plan (CEMP).
- Vegetation clearing would be restricted to the construction footprint, and sensitive areas would be clearly identified during the construction process as exclusion zones.
- The exclusion zones would be marked on maps provided to contractors, and would be marked on the ground using high visibility fencing (such as barrier mesh).
- A trained ecologist would accompany clearing crews in order to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat.

Direct mortality

To minimise the likelihood of fauna injury or death during the clearing of vegetation, the following measures would be developed and presented as part of the CEMP during Early Works and the construction phases of the Project:

- A staged habitat removal protocol would be developed and would include the identification and marking of all habitat trees in the area.
- Where feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-dependent birds in the locality are also unlikely to be breeding.
- Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor.
- Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave. A minimum 48 hour waiting period would allow animals to leave.
- After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which would then be felled, starting with the trees furthest from secure habitat. Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist.
- All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing.
- Relocation of animals to adjacent retained habitat would be undertaken by an ecologist during the supervision of vegetation removal.
- An ecologist would supervise the drainage of any waterbodies on the Project site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the Project site.
- The design of site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk wherever practicable.
- The potential for translocation of threatened plant species, as individuals or as part of a soil translocation process, would be considered during the detailed development of the CEMP.

Habitat loss

Proposed measures that would be considered to mitigate habitat loss include the following:

- Consideration would be given to fitting roost boxes to the bridge over the Georges River to provide roosting sites for the Large-footed Myotis and other species of microbats (e.g. Eastern Bentwing-bat) that may utilise such structures. Provision of roost boxes under bridges has been identified as priority action for the recovery of the Large-footed Myotis.
- Artificial hollows (nest boxes) would be installed in secure habitat within the Georges River riparian corridor before clearing to replace hollows lost.

- Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the Project site that would not be cleared during the Project or to stockpiles for later use in vegetation/habitat restoration.

- Winter-flowering trees would be preferentially planted in landscaped areas of the Project site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox.

Fragmentation and connectivity

Proposed measures to mitigate fragmentation and reduced habitat connectivity include the following:

- A bridge/viaduct would be used for the railway crossing of the Georges River. This may allow connectivity of terrestrial habitat along the river banks underneath the bridge.

- Options for maintaining habitat connectivity would be investigated at the detailed design stage of the Project, including establishing native vegetation and placing habitat elements such as rock piles and large woody debris under the bridge to provide cover for fauna.

Impact on aquatic habitats

Proposed measures to mitigate impacts on aquatic habitats include the following:

- Erosion and sediment control measures such as silt-fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality.

- The detailed design process for the bridge over the Georges River would consider disturbance of aquatic habitat and fish passage conditions. As a minimum, the design would adhere to the fish friendly passage guidelines (Fairfull and Witheridge 2003) for waterway crossings.

- Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Project and, if practicable, implemented so that they would provide similar habitat in the medium term to that lost through the removal of existing basins.

Weed invasion and introduction of pathogens

Proposed measures to mitigate the impacts of weed invasion and introduction of pathogens include the following:

- The CEMP would include detailed measures for minimising the introduction of weeds and pathogens.

- The Project would also include a long-term program of weed removal and riparian vegetation restoration in the Georges River corridor, which would include monitoring landscaped areas for the presence of noxious and environmental weeds. A preliminary weed management strategy is provided in Appendix E of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4, setting out the principles for the management of the riparian zone.

Biosecurity

The Biosecurity division of the Commonwealth Department of Agriculture would be consulted regarding the detailed design of the Project and its operation, to ensure that all legal requirements and appropriate management measures related to biosecurity are implemented to minimise the risk of the introduction of pest species.

Fire regimes

The proposed site layout and design provides a range of suitable measures to minimise bushfire risk such as the provision of a perimeter road and location of commercial development and warehouses away from any bushfire threat. Additional proposed measures for site design and layout include the development of landscaping/vegetation management, and the development of a fire safety and evacuation plan, along with safety provisions relating to access, water and services. These are discussed in Chapter 14 – *Hazards and risks*.

If appropriate design and landscape/vegetation management measures are implemented, the risk of the Project causing a change to fire regimes that would be detrimental to biodiversity is low.

The management of the conservation lands along the Georges River would include management of fire regimes to promote biodiversity conservation.

Groundwater dependent ecosystems

The detailed design process would consider the potential groundwater impacts on ground-dependent ecosystems and in most cases would be mitigated at the design phase. Where potential impacts are unable to be dealt with through detailed design, suitable mitigation and management measures would be established to ensure that no significant groundwater impacts result directly from the construction or operation of the Project. Mitigation measures for groundwater impacts are listed in section 16.4.3 (in Chapter 16 – *Hydrology, ground water and water quality*).

Operation phase mitigation

The management plan for the Georges River riparian corridor (refer to Appendix E of Technical Paper 3 – *Ecological Impact Assessment* in Volume 4) would be implemented and would include a monitoring program designed to detect operational impacts.

13.4.2 Biodiversity offsets strategy

A biodiversity offsets strategy has been developed for the Project and is summarised in this section (refer to Appendix F of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). The strategy outlines the residual biodiversity impacts to be offset, identifies the ecological values of the proposed offset areas, and outlines the compliance of the offsets strategy with Commonwealth and NSW offsetting principles including:

- *NSW Biodiversity Offset Policy for Major Projects* (NSW Office of Environment and Heritage (OEH) 2014); and
- Commonwealth *Environmental Offsets Strategy under the EPBC Act* (Department of Sustainability, Environment, Water, Population and Communities 2012).

The final NSW SEARs for the Project suggest the offsets strategy must demonstrate how it achieves the overarching principles of the current policy. The offsets strategy was initially developed in accordance with the 2008 principles. In March 2014, the Draft *NSW Biodiversity Offsets Policy for Major Projects* (the Draft Policy) was released for public exhibition. The Draft Policy has now been finalised (Offset Policy 2014) and will be implemented from 1 October 2014 when it will be mandatory for all SSD and SSI projects. Therefore the offsets strategy for the Project has been revised to specifically address the Offset Policy 2014.

Offset measures may include both onsite and offsite or local area lands that contribute to the long-term conservation of threatened species and communities. Offsets would address the following impacts which cannot be mitigated through the proposed onsite management measures alone:

- vegetation clearing and habitat loss;
- direct mortality of threatened plants;
- fragmentation and loss of connectivity; and
- increased edge effects.

Residual biodiversity impacts to be offset

The Project would have direct and indirect impacts on biodiversity during the construction and operation phases. Construction of the Project would require the clearing of vegetation and habitats; this has been identified as the key residual impact in this chapter and the Technical Paper 3 – *Biodiversity Impact Assessment* in Volume 4. The vegetation and habitat loss associated with the Project is outlined in Table 13.10.

While a phased development approach is proposed for the Project, the offsets strategy has been developed with the intent to meet the 'worstcase' scenario in terms of the Full Build footprint, including the associated construction compounds. This is the combined development area for all Project development phases.

As previously identified in section 13.3, the final layout and footprint of the IMT will depend on the location of the selected rail access option and therefore there are three IMT layouts proposed in this EIS. The residual impacts of each of the three options on threatened biodiversity record or considered likely to occur within the study area are listed in Table 13.10, along with an estimate of residual impacts associated with habitat removal for each of the rail connection options. Two EPBC Act listed flora species, *Grevillea parviflora ssp. parviflora* (Vulnerable) and *Persoonia nutans* (Endangered), would be directly affected by the Project. Approximately 16 *Grevillea parviflora ssp. parviflora* and 10 *Persoonia nutans* individuals would be removed. The soil seed bank would also be removed.

Proposed offset areas

The offset strategies chosen for the Project include a combination of:

- onsite offsets – securely conserving and improving the condition of existing riparian habitat or providing a buffer to an area of existing habitat within the Project site; and
- off-site offsets – securing and improving the condition of existing habitats at other sites in the immediate locality of the Project site.

The currently proposed offset areas that have been identified as part of the offsets strategy are on land owned by the Australian Government and therefore state and local legislative obligations do not apply.

Identification of off-site offset areas

The offsets strategy has identified the need for off-site offsets to supplement the existing onsite offsets. These areas will be identified and secured before clearing on the Project site commences. In identifying these offsets the following criteria have been considered:

- Presence of relevant threatened biodiversity: when determining offsets, threatened biodiversity must be targeted and the impacts should be offset on a 'like for like or better' basis. As the Project includes clearing of Threatened ecological communities and threated species, the offsets should include these species and communities.
- Distance from the Project: biodiversity offsets should be located within the same region and as close to the Project site as possible.
- Current condition and potential for improvement: the condition provides an indication of a site's potential to support threatened species.
- Habitat connectivity: this is essential to the long-term survival of many species because it enables species to move from one habitat into another.

A desktop review, assessment and subsequent surveys identified a number of preferred offset sites. When assessing and ranking these sites the following issues were investigated further:

- tenure and zoning of potential sites;
- proximity to the Project site;
- current land ownership and availability of land for purchase;
- likelihood of loss without protection as an offset; considering factors such as physical constraints on land use and proposed developments;
- potential interaction with adjacent land uses; e.g. required fire regimes with regard to bushfire hazard reduction and biodiversity conservation; and
- size, shape and connectivity with other vegetation/habitat.

The additional offset lands will need to contain the biodiversity values that are not fully offset by the two proposed areas identified to date. These additional offset areas will need to include:

- known occurrences of *Persoonia nutans* and *Grevillea parviflora ssp. parviflora*;
- potential habitat for the other threatened species of animals and plants considered likely to occur in the Project area; and
- the same threatened ecological communities affected by the Project.

Three areas are currently proposed for offsets (refer to Figure 13.8 to Figure 13.10) and include:

- Moorebank Offset Area (onsite) – Georges River riparian zone: restoration and management of the Georges River riparian zone (approximately 32.3 – 36.7 ha) including the eastern side of the river corridor from approximately 300 m south of the M5 Motorway for a length of approximately 2.5 km south to the East Hills Railway Line. This offset conserves a corridor extending from the Georges River to the 1 in 1% annual exceedance probability flood line; however, it is possible this corridor will be extended beyond the boundary subject to future development stages not the subject of this EIS.

- Casula Offset Area (hourglass land) (onsite): management and restoration of vegetation within Lot 4 DP 1130937 (Casula Offset Area). The Casula Offset Area is an irregular shaped allotment (known as the 'hourglass land') of approximately 3.2 ha on the western side of the Georges River opposite the main IMT operations.

- Wattle Grove Offset Area (offsite): Part of the eastern portion of Lot 3001 DP 1125930 (east of Moorebank Avenue) contains native vegetation that is proposed to be used to offset vegetation to be cleared for the Project. This area approximately 73.8 ha of vegetation adjoins the East Hills Railway Line to the south, land owned by the SIMTA consortium to the north-west, and the residential area of the suburb of Wattle Grove to the east. This area is currently mapped as Environmentally Significant Land and zoned SP2 (Infrastructure - Defence) under the Liverpool Local Environmental Plan 2008. This land would need to be actively managed in order to maintain or improve the condition of the vegetation and habitats.

In regards to the proposed onsite offsets, the final size of both the Moorebank Offset Area – Georges River riparian zone and the Casula Offset Area (as identified above) would depend on the location of the selected rail access option. Therefore, there are three potential IMT offset layouts proposed in this EIS (refer to Figure 13.8 to Figure 13.10).

Detailed ecological surveys and assessments of these offset sites have been undertaken in accordance with the *NSW BioBanking Assessment Methodology* (BBAM). These surveys included ecological vegetation mapping and targeted threatened flora surveys building on previous ecological surveys within the Casula Offset Area and Wattle Grove Offset Area (GHD 2014) and supplemented by targeted species surveys in September 2014. The general conditions, fauna habitat and vegetation communities of the proposed offset areas are summarised in Table 13.15 below. Detailed vegetation mapping of each of the offsets is provided in Figure 13.11 and Figure 13.12.

Table 13.15 General conditions, fauna habitat and vegetation communities of the offset areas

Offset area	General condition of offset site	Fauna habitat	Vegetation communities	Threatened biodiversity
Moorebank Offset Area	The mapped vegetation of the site varies from patches with native species dominant in all vegetation layers to patches with the understorey and ground layer dominated by introduced vines and shrubs (e.g. *Lantana camara*). Under present conditions there is little light pollution affecting the vegetation along the Georges River. Light pollution is likely to be substantially higher during the construction and operation of the Project due to fixed lighting within the facility and lighting from trucks and trains. The proposed vegetation restoration within the riparian corridor and landscape planting in the interior of the site is likely to mitigate light pollution through the screening effects of increased vegetation.	The fauna habitat of the Georges River riparian corridor consists of a tall eucalypt forest with an understorey varying in its structure and composition including areas with dense weed thickets, diverse native shrubbery and sparse understorey consisting mainly of grasses, leaf litter and scattered shrubs (refer to Figure 13.3). Large mature hollow-bearing trees, potentially hollow-bearing trees and fallen woody debris are moderately abundant in this area. Habitat in this area is connected via the riverbank underneath the East Hills railway line to larger areas of vegetation to the south which extend into the Georges River Nature Reserve. Overall, the fauna habitat in the site is in moderate condition.	Riparian Forest Alluvial Woodland (For list of dominant species refer to Table 3.2 in Appendix F of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4).	TSC Act listed endangered ecological community • River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Offset area	General condition of offset site	Fauna habitat	Vegetation communities	Threatened biodiversity
Casula Offset Area	The vegetation of the site is mapped as Riparian Forest (Tozer 2003). Field verification of the site on 18 February 2013 revealed that most of the site is covered by disturbed Riparian Forest with the exception of an area in the north which is dominated by the woody weeds *Ligustrum lucidum*, *Ligustrum sinense* and *Lantana camara*. The Riparian Forest of the site has a largely intact canopy layer with an understory varying from a mixture of native species (e.g. *Breynia oblongifolia*) to areas dominated by *Lantana camara*. Overall, the native vegetation mapped in the site is in moderate condition. Existing ecological light pollution is likely to affect the Casula Offset Area due to its location immediately adjacent to the Southern Sydney Freight Line. The light conditions here may limit the suitability of the site for some nocturnal animal species, however, some nocturnal species are likely to be habituated to increased light levels and to persist in utilising this habitat.	The fauna habitat of the Casula Offset Area (refer Figure 13.3) consists of a tall eucalypt forest with an understorey varying in its structure and composition including areas with dense weed thickets and native shrubbery. Hollow-bearing trees and fallen woody debris are present in these areas which provide potential microhabitat features for a variety of species of animal. Habitat in this area is connected via the riverbank underneath the East Hills railway line to larger areas of vegetation to the south which extend into the Georges River Nature Reserve. Connectivity to substantial areas of fauna habitat to the north is less pronounced due to the presence of intervening areas with only very narrow bands of riparian vegetation.	Riparian Forest (For list of dominant species refer to Table 3.4 of Appendix F of the Technical Report 3 – *Ecological Impact Assessment* in Volume 4).	TSC Act listed Endangered ecological community • River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Offset area	General condition of offset site	Fauna habitat	Vegetation communities	Threatened biodiversity
Wattle Grove Offset Area	Mapped areas of native vegetation in this site are generally dominated by native species with only minor weed invasion. Areas of more intense weed invasion, where introduced species are dominant in the ground layer, are limited to the periphery of the site and patches of regrowth vegetation in the south-west of the site (refer areas with no vegetation mapped in Figure 13.3). Sporadic weed occurrences also exist along track edges in the core of the site. The site is subject to periodic hazard reduction burning for the protection of the adjacent suburban area of Wattle Grove. The frequency and intensity of burning of the vegetation on the site is likely to influence its suitability as habitat for threatened species. Overall, the native vegetation mapped in the site is in moderate to good condition. Areas with no vegetation mapped generally consist of regrowth native trees and large shrubs with an understorey dominated by introduced species.	The fauna habitat of the Wattle Grove Offset Area consists of eucalypt woodland with an understorey varying in its structure and composition including areas with dense thickets of native shrubbery and areas of sparse understorey consisting mainly of grasses, leaf litter and scattered shrubs. Large mature hollow-bearing and potentially hollow-bearing trees occur at low. Fallen woody debris generally occurs at low density, likely as a result of fuel reduction burning activities. Habitat in this area is separated by a fenced rail corridor limiting connectivity for terrestrial and arboreal fauna. Due to its size (73.8 ha), it is likely to have potential to support viable populations of a variety of fauna species under appropriate management. If populations of less mobile animal species (i.e. non-flying species) are lost, there is limited scope for natural repopulation of this habitat due to its limited connectivity. Overall, the fauna habitat in the site is in moderate to good condition.	Riparian Forest Alluvial Woodland Shale/Gravel Transition Forest Castlereagh Swamp Woodland Castlereagh Scribbly Gum Woodland (For list of dominant species refer to Table 3.2 in Appendix F of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4)	TSC Act listed Vulnerable ecological community • Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion TSC Act listed Endangered ecological community • Castlereagh Swamp Woodland Community • Cooks River Castlereagh Ironbark Forest • River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions • Shale Gravel Transition Forest in the Sydney Basin Bioregion EPBC Act listed critically endangered ecological community • Shale Gravel Transition Forest in the Sydney Basin Bioregion EPBC Act listed species • *Acacia pubescens* • *Persoonia nutans* • *Grevillea parviflora subsp. parviflora*

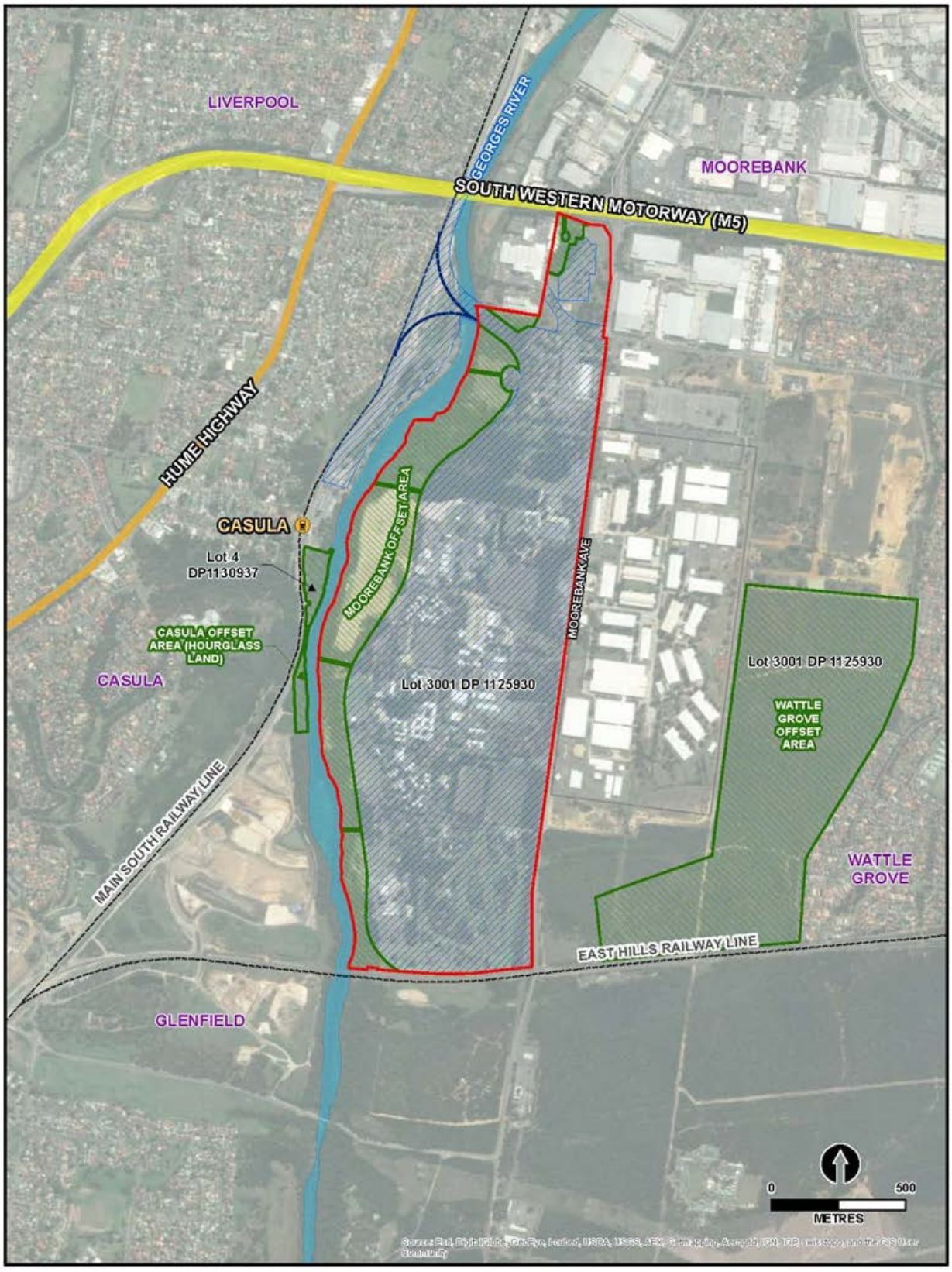


Figure 13.8 Location of proposed biodiversity offset areas - northern rail access option

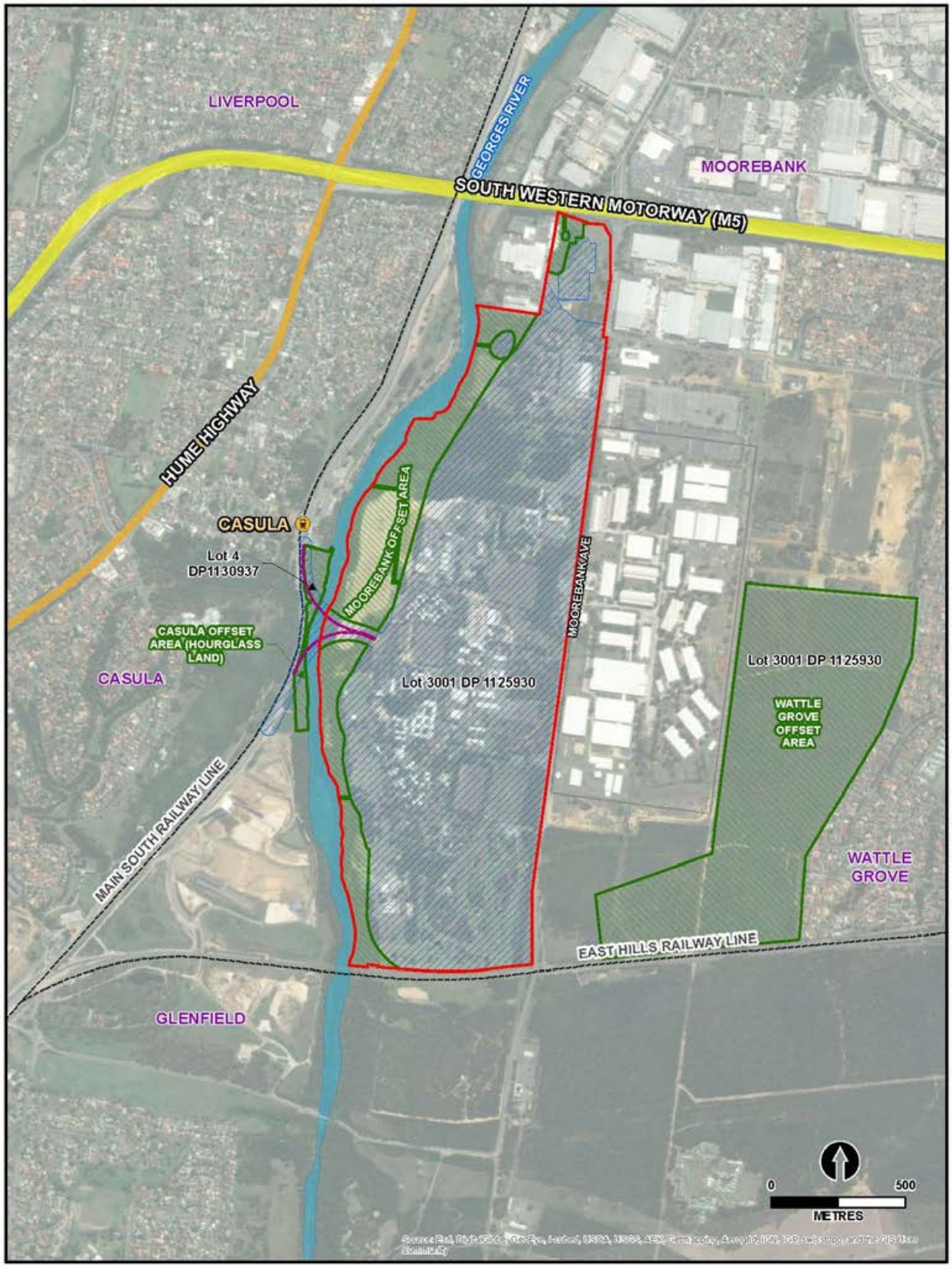
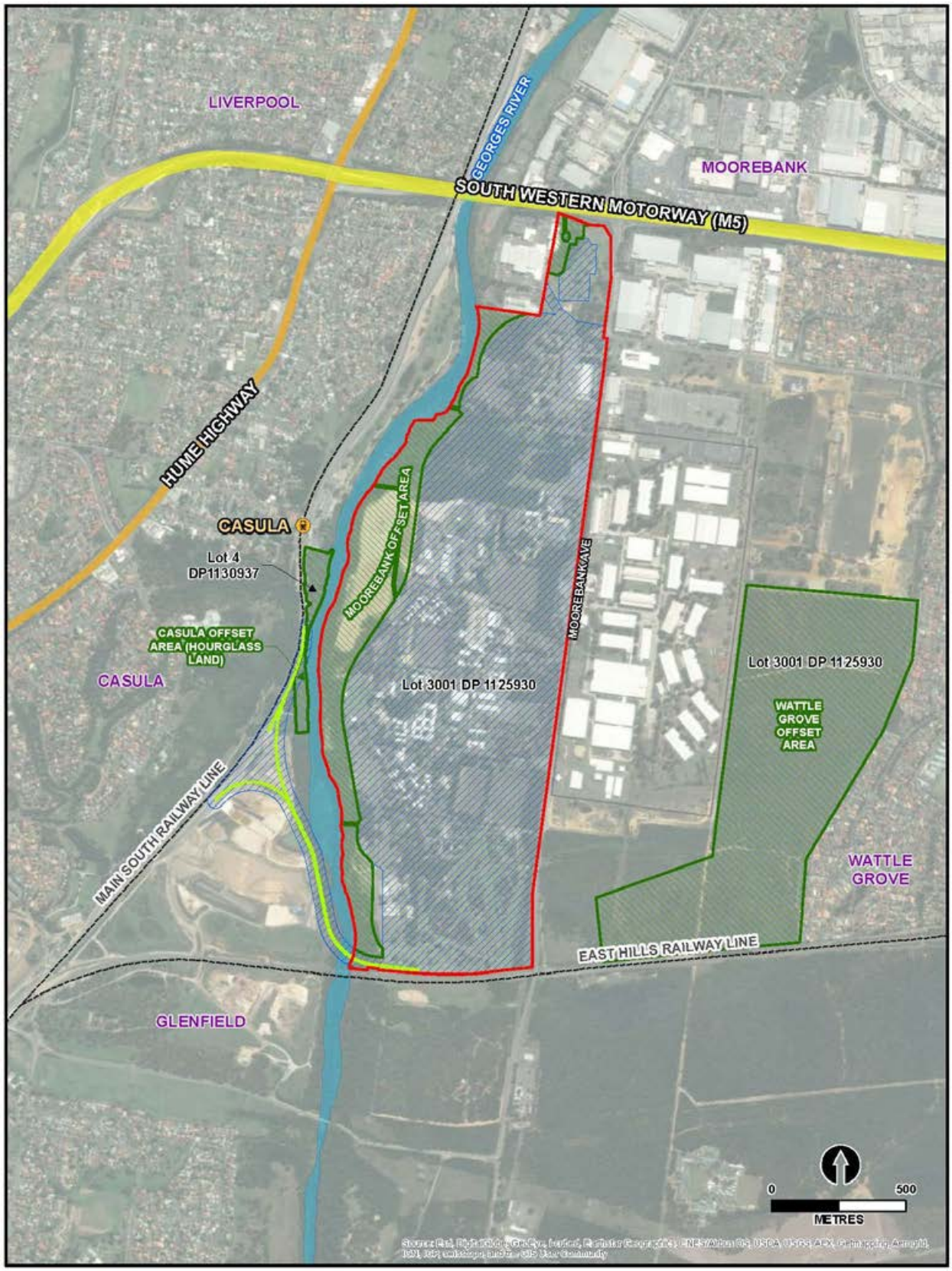


Figure 13.9 Location of proposed biodiversity offset areas - central rail access option



\\Apsyd1\Gis\proj\KW\PMG_Australia\2103829A_Moorebank_Intermodal_Terminal\10_GIS\Projects\ESRI\2103829A_GIS_F339_A4.mxd // suansir // 17/07/2014

Figure 13.10 Location of proposed biodiversity offset areas - southern rail access option

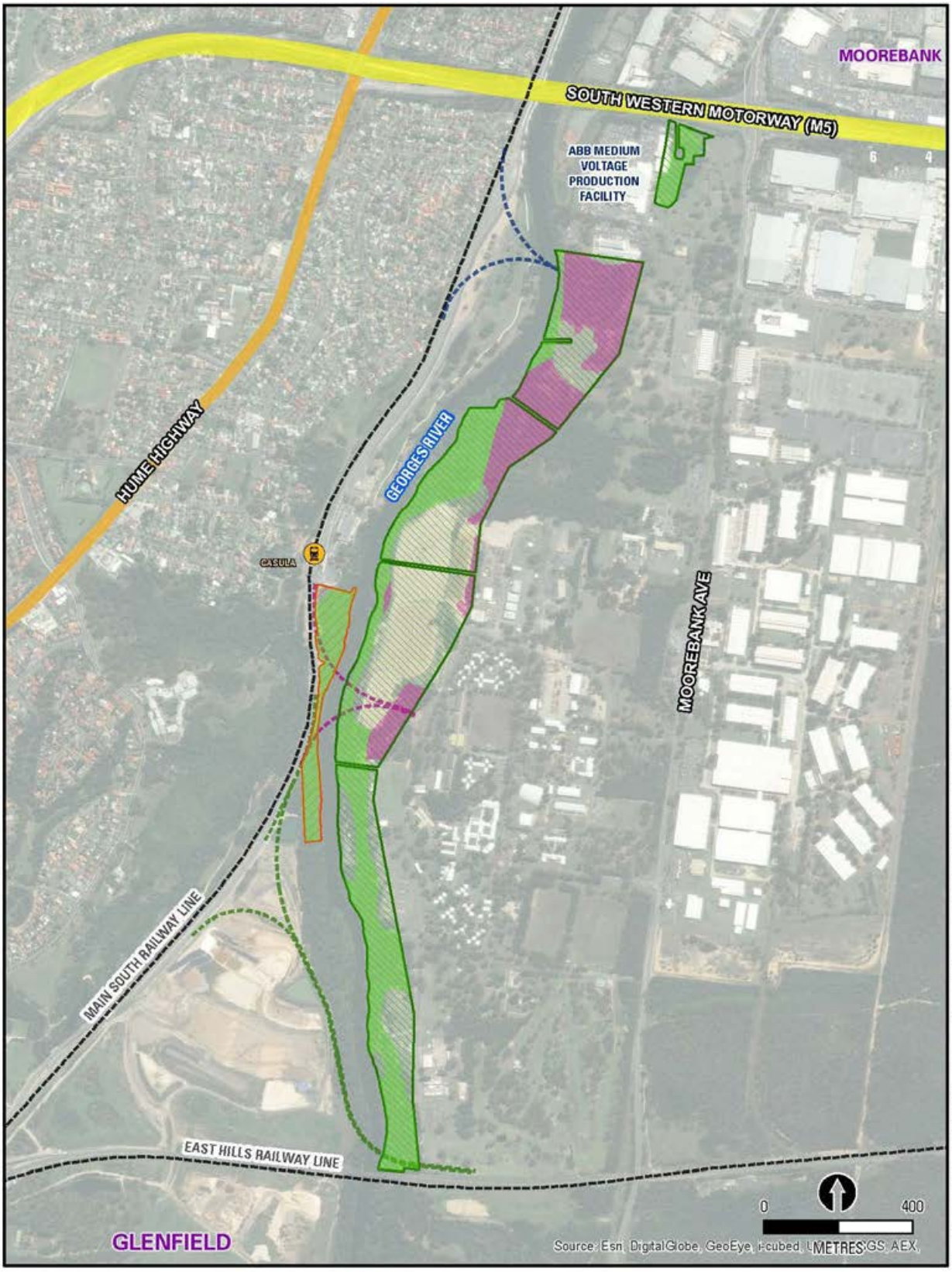


Figure 13.11 Moorebank offset area - Conservation area and Casula offset area (hourglass land) - vegetation communities

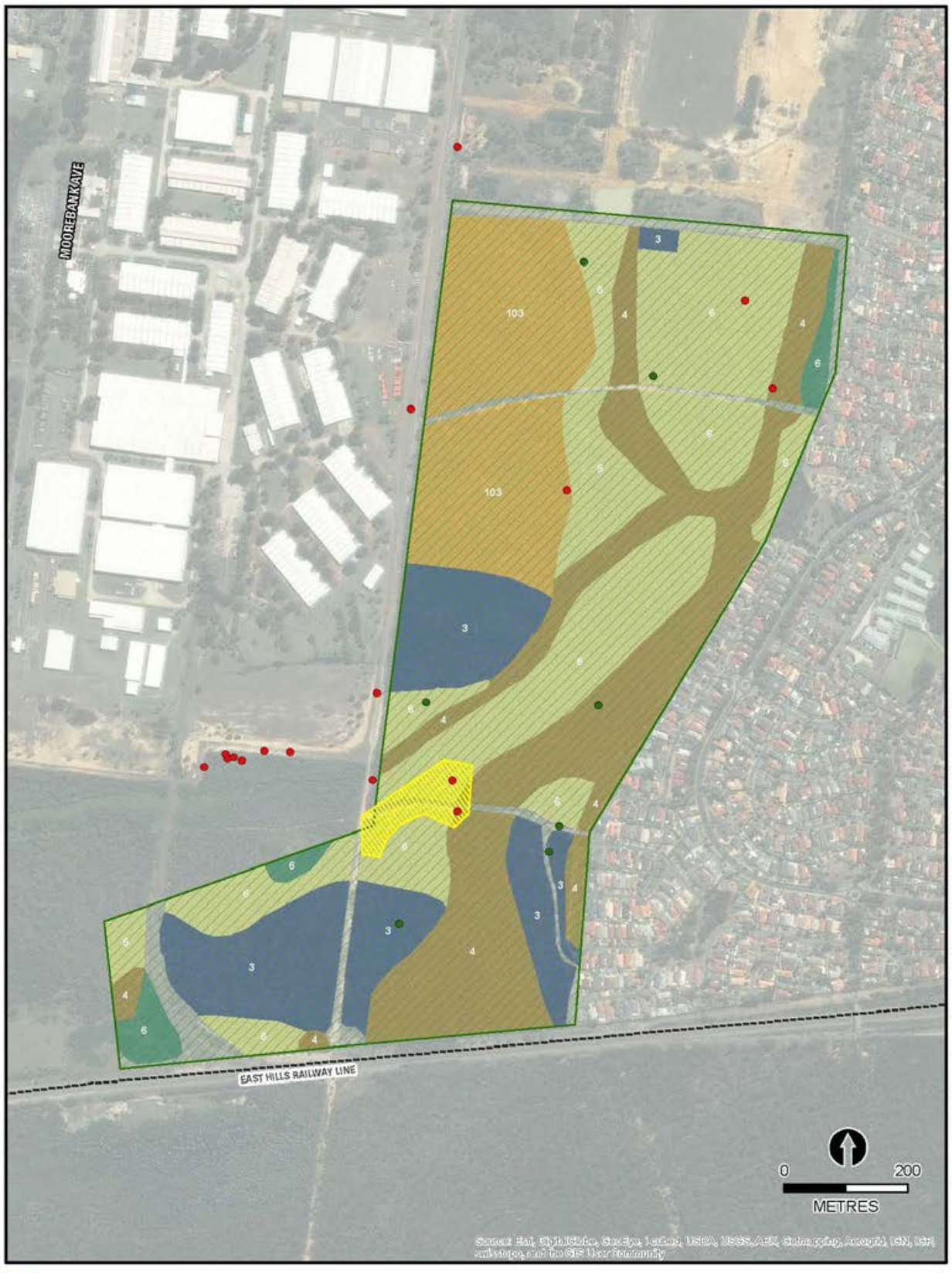


Figure 13.12 Moorebank offset area - Wattle Grove offset area - vegetation communities and threatened plants

Existing management

The proposed offset sites are currently managed by the Department of Defence (Defence). A Weed Management Plan has been prepared by AECOM Pty Ltd (AECOM) for Defence Maintenance Management Pty Ltd (DMM) on behalf of Defence (AECOM Australia 2010). The scope of the plan was to develop and implement all works related to the management and control of weeds on Liverpool Military Area (LMA) for a period of three years (from 1 February 2010 to 31 January 2013). Current and proposed management of biodiversity values on Defence lands in the LMA primarily involves weed management, with a focus on minimising the spread of environmental weeds such as the African Lovegrass (*Eragrostis curvula*). The current management regime of these sites is focused on containing the further spread of weeds rather than large scale reduction in existing weed infestation.

The proposed management described below includes an intensification of weed management and other measures to actively improve the biodiversity values of the offset sites.

Proposed restoration and management of the Georges River riparian zone

A riparian restoration plan for this area has been developed (refer to Appendix E of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4). The purpose of this restoration plan is to guide the restoration of the riparian landform, vegetation and fauna habitat of the site and to improve the quality of water entering the Georges River. The objectives of the plan include:

- restoration and revegetation of the riparian zone of the site to be consistent with, and complementary to, areas of remnant indigenous vegetation within the Georges River corridor (approximately 16.7 ha of land to be revegetated);
- long-term eradication and suppression of the most detrimental weed species on the site including vine and woody weeds (approximately 20.0 ha of land to undergo a weed control program);
- consolidation and widening of the existing vegetation corridor of Georges River where feasible. It is currently proposed to revegetate and conserve a corridor extending from the riverbank to the 1 in 100 year flood line; however, opportunities will be explored during detailed design to extend the conservation area beyond the 1 in 100 year flood line. This opportunity will be subject to future development approval (DA) stages and is not the subject of this EIS;
- improved habitat values for native animals and plants, particularly threatened species; and
- management of undesirable animal species including introduced animal species and some Australian native animals which may be detrimental to the biodiversity of the Project site.

Successful implementation of this strategy would require detailed planning, monitoring and adaptive management.

The detailed planning stage may include management actions involving project management, sourcing of soil and obtaining plants and seeds. A variety of issues may arise in the implementation of the plan which would require actions to be modified or additional actions to be implemented. A monitoring program is thus required to detect issues at an early stage so that appropriate adaptations may be made to strategies to ensure that the relevant objectives can be met. Adaptive management actions may include trial treatments (such as trial weed control) and subsequent modified and/or substitute actions to find alternative methods to achieve the same outcomes if the proposed actions are unsuccessful.

Management of undesirable animal species

Successful management of undesirable animal species requires an integrated approach including habitat manipulation and/or culling programs. Culling of undesirable species over a small spatial area is likely to result in constant re-invasion from adjacent lands and is unlikely to be effective in substantially reducing the impact of these species. Proposed measures to manage undesirable animal species include:

- Monitor the site for the presence of introduced and undesirable animal species as part of fauna monitoring;
- Cooperate with government bodies, interest groups and adjacent landowners in regional pest management programs including the NSW Department of Primary Industries, the OEH, and the Invasive Animal Cooperative Research Centre interest groups (e.g. Australasian Pest Bird Network and local landowners);
- Manage the use of nest boxes by undesirable species by removing the eggs and/or young of introduced animals (e.g. Black Rat and Common Myna) found utilising nest boxes under appropriate permit conditions;
- Remove any insect colonies (bees, wasps, termites, ants found in nest boxes); and
- Modify or move nest boxes to discourage use by undesirable species.

Security of offset lands

Offset sites need to demonstrate ongoing conservation of land in perpetuity for the benefit of future generations. Offset sites must be enduring and must offset the impact of the development for at least the period that the impact occurs. The security of land tenure and ongoing management of offset site(s) is critical to the long-term viability of offsets and must be carefully considered.

To ensure the conservation of lands in perpetuity, the offsets strategy will require the dedication of any identified offset sites under a secure conservation arrangement. There are a number of options available to secure land under permanent conservation agreements. The most suitable conservation arrangement for land should be explored and identified in consultation with the relevant stakeholders. Potential options in order of preference may include:

- obtaining a BioBanking agreement;
- Voluntary Conservation Agreements under the NSW *National Parks and Wildlife Act 1974*;'
- Trust Agreements under the NSW *Nature Conservation Trust Act 2001*;
- a Property Vegetation Plan registered on title under the NSW *Native Vegetation Act 2003*; and
- a Planning Agreement under s93F of the NSW *Environmental Planning and Assessment Act 1979.*

If not conserved under a BioBanking agreement or National Park Estate, the offset sites may be subject to discounting. If public use of offset lands was proposed, this could also reduce the offset credits generated by these offset lands. Such issues would increase the total area of land required to be conserved. This issue should be further considered when formulating the final offset package.

Comparison of vegetation and habitat removal to the extent provided in the currently proposed offset areas

Table 13.14 shows the ratios of the areas proposed as offsets against the extent to be removed by the Project. The comparison assessment and following offset calculations for the quantification of offset requirements in terms of Australian and NSW government policies provide a range of values, reflecting the differences between the impacts of the central, northern and southern rail access options.

Offsets must be proportionate to the impact, in terms of size, scale and habitat type (Department of Sustainability Environment Water Population and Communities 2012). The proposed biodiversity offsets strategy is based around a dual direct offset approach to achieve an improved conservation outcome by:

1. combining the long-term protection of existing habitat in good condition at the IMT site; and

2. restoration, rehabilitation and re-establishment of habitat in poor condition along the Georges River riparian corridor.

The currently proposed offsets would achieve a ratio (offset clearing) of 2.0–2.6:1.

In addition, a comparison of the extent of threatened biodiversity habitat to be cleared with the extent of habitat provided in the currently proposed offset areas is provided in Table 13.16. For the majority of threatened biodiversity, the ratio of offsets to clearing is 2.0–4.3:1.

Table 13.16 Comparison of vegetation and habitat removal (as a range to reflect variation between the northern, central and southern rail access options) with the extent provided in offset areas

Vegetation community/ habitat type	Extent to be removed by the Project (ha)[1]	Extent provided in offset areas (ha)						Ratio (offset: clearing)
		Moorebank Offset Area – Georges River Riparian Zone		Casula Offset Area		Wattle Grove Offset Area	Combined offset areas	
		Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Area	
Vegetation								
Castlereagh Swamp Woodland[1]	0.9	-	-	-	-	19.77	**19.77**	22:1
Castlereagh Scribbly Gum Woodland[2]	16.1	-	-	-	-	27.46	**27.46**	1.7:1
Riparian Forest (River-Flat Eucalypt Forest)[1]	2.2–5.3	13.1–13.5	-	0.5–3.0	1.1	-	**14.7–17.6**	2.7-8.0:1
Alluvial woodland (River-Flat Eucalypt Forest)[1]	25.2–30.4	2.5–6.5	16.7	-	-	-	**19.2–23.2**	0.6-0.9-:1
Shale/Gravel Transition Forest	-	-	-	-	-	13.35	**13.35**	13.35:1
Cooks River Castlereagh Ironbark Forest	-	-	-	-	-	13.23	**13.23**	13.23:1
Total area	**44.4–52.7**	**15.6–20.0**	**16.7**	**0.5–3.0**	**1.1**	**73.81**	**107.7–114.6**	**2.0-2.6:1**

Vegetation community/ habitat type	Extent to be removed by the Project (ha)[1]	Extent provided in offset areas (ha)						Ratio (offset: clearing)
		Moorebank Offset Area – Georges River Riparian Zone		Casula Offset Area		Wattle Grove Offset Area	Combined offset areas	
		Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Area	
Shrubby eucalypt woodland	17.0	-	-	-	-	73.81	**73.81**	4.3:1
Tall eucalypt forest	27.4 – 35.7	15.6-20.0	16.7	0.5-3.0	1.1	-	33.9–40.8	0.9–1.5:1
Total area	**44.4–52.7**	**15.6–20.0**	**16.7**	**0.5–3.0**	**1.1**	**73.81**	**107.7–114.6**	**2.0–2.6:1**

Source: Table 3.2 in Appendix F in Technical Paper 3 – *Ecological Impact Assessment* in Volume 4

Notes: 1 – Endangered Ecological Communities as listed under the NSW *Threatened Species Conservation Act 1995.*
2 – Vulnerable Ecological Community as listed under the TSC Act.
3 – Critically Endangered ecological community as listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

Table 13.17 Comparison on impacts to Threatened biodiversity to extent of habitat provided in offset areas (range presented to address all access options)

Threatened biodiversity	Status		Extent of known or potential habitat to be removed by the Project (ha) Population estimate (where applicable)	Extent provided in offset areas (ha) and population estimate (where applicable)						
				Moorebank Offset Area – Georges River Riparian Zone		Casula Offset Area		Wattle Grove Offset Area	Combined offset areas	Ratio offset : clearing
	EPBC Act[1]	TSC Act[2]		Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Revegetation			
Threatened ecological communities										
Castlereagh Swamp Woodland	-	E	0.9	-	-	-	-	19.77	**19.77**	22:1
Castlereagh Scribbly Gum Woodland	-	V	16.1	-	-	-	-	27.46	**27.46**	1.7:1
River-Flat Eucalypt Forest	-	E	27.4–35.7	15.6–20.0	16.7	0.5–3.0	1.1	-	**33.9–40.8**	0.9–1.5:1
Shale/Gravel Transition Forest	CE	E	-	-	-	-	-	13.35	**13.35**	13.35:1
Cooks River Castlereagh Ironbark Forest		E	-	-	-	-	-	13.23	**13.23**	13.23:1
Total TEC	-	-	**44.4–52.7**	**15.6–20.0**	**16.7**	**0.5–3.0**	**1.1**	**73.81**	**107.7–114.6**	**2.0–2.6:1**

Threatened biodiversity	Status		Extent of known or potential habitat to be removed by the Project (ha) Population estimate (where applicable)	Extent provided in offset areas (ha) and population estimate (where applicable)						
				Moorebank Offset Area – Georges River Riparian Zone		Casula Offset Area		Wattle Grove Offset Area	Combined offset areas	Ratio offset : clearing
	EPBC Act[1]	TSC Act[2]		Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Revegetation			
Threatened flora										
Acacia bynoeana	V	E1	17.0	-	-	-	-	73.81	73.81	**4.3:1**
Acacia pubescens	V	V	17.0	-	-	-	-	73.81	73.81 (>250 individuals)	**4.3:1**
Dillwynia tenuifolia	V	V	17.0	-	-	-	-	73.81	73.81	**4.3:1**
Grevillea parviflora ssp. parviflora	V	V	17.0 (≈16 individuals ≈50 stems)	-	-	-	-	73.81	73.81 (>200 individuals)	**4.3:1**
Leucopogon exolasius	V	V	17.0	-	-	-	-	73.81	73.81	**4.3:1**
Persoonia hirsuta	E	E1	17.0	-	-	-	-	73.81	73.81	**4.3:1**
Persoonia nutans	E	E1	17.0 (≈10 individuals)	-	-	-	-	73.81	73.81 (>2 individuals)	**4.3:1**
Pultenaea parviflora	V	E1	17.0	-	-	-	-	73.81	73.81	**4.3:1**

Threatened biodiversity	Status		Extent of known or potential habitat to be removed by the Project (ha) Population estimate (where applicable)	Extent provided in offset areas (ha) and population estimate (where applicable)						
				Moorebank Offset Area – Georges River Riparian Zone		Casula Offset Area		Wattle Grove Offset Area	Combined offset areas	Ratio offset : clearing
	EPBC Act[1]	TSC Act[2]		Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Revegetation			
Threatened fauna										
Barking Owl	-	V	27.4–35.7	15.6-20.0	16.7	0.5-3.0	1.1	-	33.9–40.8	**0.9–1.5:1**
Black-chinned Honeyeater	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Eastern Bent-wing Bat	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Eastern False Pipistrelle	-	V	27.4–35.7	15.6-20.0	16.7	0.5-3.0	1.1	-	33.9–40.8	**0.9–1.5:1**
Eastern Free-tail bat	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Eastern Pygmy-possum	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Flame Robin	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Gang-gang Cockatoo	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Greater Broad-nosed Bat	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Grey-headed Flying-fox	V	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Koala	V	V	27.4–35.7	15.6-20.0	16.7	0.5-3.0	1.1	-	33.9–40.8	**0.9–1.5:1**
Large-footed Myotis	-	V	27.4–35.7	15.6-20.0	16.7	0.5-3.0	1.1	-	33.9–40.8	**0.9–1.5:1**
Little Eagle	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**

Threatened biodiversity	Status		Extent of known or potential habitat to be removed by the Project (ha) Population estimate (where applicable)	Extent provided in offset areas (ha) and population estimate (where applicable)						
				Moorebank Offset Area – Georges River Riparian Zone		Casula Offset Area		Wattle Grove Offset Area	Combined offset areas	Ratio offset : clearing
	EPBC Act[1]	TSC Act[2]		Weed control – habitat restoration	Revegetation	Weed control – habitat restoration	Revegetation			
Little Lorikeet	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Powerful Owl	-	V	27.4–35.7	15.6-20.0	16.7	0.5-3.0	1.1	-	33.9–40.8	**0.9–1.5:1**
Regent Honeyeater	E	CE	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Scarlet Robin	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Spotted Harrier	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Spotted-tailed Quoll	E	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Square-tailed Kite	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Squirrel Glider	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Swift Parrot	E	E	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Varied Sittella	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**
Yellow-bellied Sheathtail Bat	-	V	44.4–52.7	15.6–20.0	16.7	0.5–3.0	1.1	73.81	107.7–114.6	**2.0–2.6:1**

Source: Table 3.3 in Appendix F, *Ecological Impact Assessment* (Volume 4)

Notes: 1 – V = Vulnerable, E = Endangered, CE = Critically Endangered (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*) (EPBC Act)
2 – V= Vulnerable, E1 = Endangered (*Threatened Species Conservation Act 1995*)

Compliance with offsetting principles

This section provides a brief summary of the Project's biodiversity offsets strategy against the principles for the use of environmental offsets under the EPBC Act (as outlined in the current *Environment Protection and Biodiversity Conservation Act 1999 Environmental Biodiversity Offsets Policy* (Department of Sustainability Environment Water Population and Communities 2012), the *Principles for the use of biodiversity offsets in NSW* (DECC 2008) and the *NSW Biodiversity Offset Policy for Major Projects* (OEH 2014).

Principles for the use of environmental offsets under the EPBC Act

DoE has developed principles for the use of environmental offsets under the EPBC Act which assess any proposed environmental offsets for matters of National Environmental Significance (including threatened species and communities). This is done to ensure consistency, transparency and equity under the EPBC Act. The applicable principles are as follows:

- suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter;
- suitable offsets must be built around direct offsets but may include other compensatory measures;
- suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter;
- suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter;
- suitable offsets must effectively account for and manage the risks of the offset not succeeding;
- suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs;
- suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable; and
- suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

The potential impacts of the Project and the proposed offsets have been assessed against the eight principles and are discussed further in section 4.1, Appendix F of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.

The tool used to quantify the adequacy of biodiversity offsets under the EPBC Act is known as the *Offsets Assessment Guide* (Department of Sustainability Environment Water Population and Communities 2012).

The key steps in the process under this policy (once impacts have been avoided as far as practicable) are to:

- identify the residual impacts to threatened species, their habitats or threatened ecological communities;
- determine likely offsets required via use of the Offsets Assessment Guide calculator; and
- develop an offsets strategy and subsequent offset package to formalise appropriate offsets in consultation with DoE.

For the Project the following approach was taken:

- current known direct impacts of the northern rail option to threatened species, habitats and ecological communities were confirmed; and
- a flora offset calculation and a fauna habitat calculation were undertaken to determine sufficient offset areas in hectares.

Assumptions for the calculation included the following:

- The impacts of the Project that will require offsetting are assumed to be those identified in the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.
- The flora offset calculation was based on habitat for the endangered *Persoonia nutans* and the vulnerable *Grevillea parviflora*, as the endangered status for *Persoonia* results in the maximum offset requirement for threatened flora overall.
- The fauna offset calculation was based on fauna habitat for recorded species such as the Grey-headed Flying Fox and potential habitat for species like the Regent Honeyeater and Swift Parrot. The only recorded threatened fauna species on the site was the Grey-headed Flying Fox, which is listed as vulnerable under the EPBC Act. These species would utilise any of the forested habitats on the site for potential foraging. The calculation was based on these endangered species' likely presence and the assumption that all native forested habitats formed habitat for these fauna species.
- No threatened vegetation communities listed under the EPBC Act were recorded on the site, although the use of fauna habitat for all native forested vegetation impacts ensures that all vegetation impacts are considered for offsetting, whether they are listed as Threatened under the EPBC Act or not.

Table 13.18 outlines the Commonwealth offset balance requirements generated by the calculations using the Commonwealth Offset Guide.

Table 13.18 Commonwealth offset requirement balance

Vegetation community or species	Area to be impacted (ha)	Area to be impacted (adjusted hectares)	Estimated offset area required (ha) using Offset Guide	Proposed Offset Area (ha)	% of impact offset
Persoonia nutans habitat (Endangered)	17	8.5	40	73.8	187.7%
Grevillea parviflora habitat (Vulnerable)	17	8.5	35	73.8	210%
Grey-headed Flying Fox habitat (Vulnerable)	44.4–52.7	22–26.3	92–107	107.1–114.6	100–124.8%
Potential Habitat for Swift Parrot and Regent Honeyeater (Endangered)	44.4–52.7	22–26	103–121	107.1–114.6	90–111.6%
Total*	**44.4–52.7**		**128***	**107.1–114.6**	**N/A**

Note: * indicates that the total equates to the total cumulative requirement of the Threatened fauna and flora, however the proposed offsets fauna habitat includes the flora habitat requirement.

To compensate for the impact upon threatened flora, a minimum area of suitable habitat of 40 ha is required. The current offsets would provide 73.8 ha of suitable habitat with demonstrated occurrence of *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* and would fulfil this requirement.

In terms of native forest fauna habitat impacts of the Project, the calculations have identified that a total offset area of approximately 92–121 ha needs to be provided. The current offsets would provide 107.1–114.6 ha of similar suitable habitat and would fulfil this requirement.

In summary, the proposed biodiversity offsets strategy consists of a dual direct offset approach including offsets both within and outside the Project site to achieve an improved conservation outcome combining the long-term protection and/or enhancement of existing habitat in moderate to good condition with the restoration, rehabilitation and re-establishment of habitat in poor condition. The offsets are proportionate to the impact in both size and scale, providing between 90% and 210% of the offset requirements for affected biodiversity under the EPBC Act, through which a ratio (offset: clearing) of approximately 2.0-2.6:1 has been secured under the currently proposed offsets.

The proposed offsets strategy is:

- efficient – the proposed offset areas are close to the development site and are capable of achieving the desired result with the minimum use of resources, time, and effort;
- effective – will result in the intended result (i.e. an improved conservation outcome), specifically targeting the biodiversity to be impacted by the Project;
- timely – will be secured and functional prior to vegetation clearing within the Project area;
- transparent – clearly recognisable as to what the offsets strategy is trying to achieve and how it has been quantified;
- scientifically robust – the proposed offsets strategy is straightforward, addresses Commonwealth biodiversity offset policy and conforms to current thinking in conservation science and ecological restoration; and
- reasonable – the proposed offsets strategy does not promise more than is possible or achievable.

Principles for the use of biodiversity offsets in NSW

The *NSW Biodiversity Offsets Policy for Major Projects* 2014 (Offsets Policy 2014) reduces the number of offset principles from the 13 identified in *Principles for the use of biodiversity offsets in NSW* (DECC 2008) to six. The biodiversity offsets strategy for the Project has been developed and updated in accordance with the principles of the Offsets Policy 2014, as outlined in detail in section 4.2 of Appendix F of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4.

In addition, the Offsets Policy introduces a new assessment methodology, the FBA. This framework has been used as the basis of assessing impacts on biodiversity and to determine the key offsets required for the Project. Refer to section 4.2.1 of Appendix F of the Technical Paper 3 – *Ecological Impact Assessment* in Volume 4 for further detail on the assessment of the Project under the FBA methodology.

As noted in section 13.4.3, the final NSW SEARs for the Project suggest the offsets strategy must demonstrate how it achieves the overarching principles of the Offsets Policy. A summary of how the Project meets these requirements is provided below.

Principle 1: Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

Given the location and nature of the Project and its context in relation to existing road and rail infrastructure, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity. Reduction of impacts on areas of high ecological value was considered in the analysis and evaluation of design options for the Project, resulting in the retention of substantial areas of vegetation and habitat contiguous with the riparian vegetation of the Georges River (refer section 6.4.4 of the EIS).

Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.

The offsets proposed in the biodiversity offsets strategy will be based on comparison of offset site values with the residual impacts on biodiversity identified in the EIS.

The Project biodiversity offsets areas identified to date have been assessed for adequacy using the Commonwealth Offsets Assessment Guide and NSW FBA methodology.

Under the Commonwealth Offsets Assessment Guide, the offsets are likely to result in a net improvement over time in both size and scale, providing between 90% and 210% of the offset requirements for affected biodiversity under the EPBC Act, through which a ratio (offset: clearing) of approximately 2.0–2.6:1 has been secured under the current proposed offsets.

The maximum offset requirements of the Project under the NSW Offsets Policy 2014 has been quantified using the FBA calculator as up to 1324 ecosystem credits or approximately 134 ha. The residual offset requirement for the Project in accordance with the FBA is between 22-224 ecosystem credits (2.2 and 22.4 ha) of Alluvial Woodland. MIC is committed to providing a biodiversity offsets strategy that adequately meets the quantum of offset requirements under the FBA and Offsets Policy 2014, including any residual offset for Alluvial Woodland.

Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

The proposed offset areas have been targeted to contain the specific species, habitat and vegetation requirements affected by the Project. The proposed offset sites generally contain vegetation types of similar or greater conservation value, are located in the same Interim Biogeographic Regionalisation for Australia (IBRA) subregion, contain similar habitat values for threatened species and threatened ecological communities listed under the TSC Act.

Principle 4: Offsets must be additional to other legal requirements.

The identified offset areas are currently mapped as Environmentally Sensitive Land and Zoned SP2 (Infrastructure – Defence). They are not subject to any specific legal requirements for environmental management. The offsets have also been developed with regard to the requirements and principles of the EPBC Act *Environmental Offsets Policy* (Department of Sustainability Environment Water Population and Communities 2012) which outlines the Australian Government requirements for offsets for matters of national environmental significance.

Principle 5: Offsets must be enduring, enforceable and auditable.

The currently proposed offset areas and additional offset areas identified (as described in Technical Paper 3 – *Ecological Impact Assessment*, Appendix F) would be protected by an agreement that would place legal restrictions on the future use and management of the land this agreement would exist within the title for the land in perpetuity. This would ensure that the offsets are enduring and that they would offset the impact of the development for the entire period that the impact occurs.

Principle 6: Supplementary measures can be used in lieu of offsets.

The offset strategies chosen for the Project include a combination of:

- onsite offsets – securely conserving and improving the condition of existing riparian habitat or providing a buffer to an area of existing habitat within the Project site; and
- offsite offsets – securing and improving the condition of existing habitats at other sites in the immediate locality of the Project site.

The currently proposed offset areas meet 90% and 210% of the direct offset requirements for impacted biodiversity under the EPBC Act.

The maximum offset requirements of the Project under the current Offsets Policy 2014 has been quantified using the FBA calculator as up to 1324 ecosystem credits or approximately 134 ha (refer Table 13.9). The residual offset requirement for the Project in accordance with the FBA is between 22-224 ecosystem credits (2.2 and 22.4 ha) of Alluvial Woodland.

Table 13.19 Summary of vegetation and plants to be impacted and FBA ecosystem credits required to offset the impacts

Vegetation community or species	Assigned Biometric vegetation type	Vegetation formation (Cleared estimate)	Area or number to be Impacted (ha)	Red flag	Conservation status	Estimated credits required	Area (ha)	Estimated credits provided	Propose d Offset Area (ha)	Balance credits	Balance area
Alluvial Woodland	ME018 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	Coastal Valley Grassy Woodlands (95) 16.1	25.2–30.4	Yes	TSC Act E	571–690	63.3–69	183	19.2–23.2	-ve 388 to -ve 507	-ve 38.8 to -ve 50.7
Riparian Forest	ME044 Sydney Blue GumXBangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin[1]	Wet Sclerophyll Forests (45)	2.2–5.3	Yes[2]	TSC Act E	53–129	5.3–12.9	149	14.7–17.6	20–96	2–9.6
Castlereagh Swamp Woodland	ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Dry Sclerophyll Forests (45)	0.9	Yes	TSC Act E	30	3	180	19.77	177	17.7

Vegetation community or species	Assigned Biometric vegetation type	Vegetation formation (Cleared estimate)	Area or number to be Impacted (ha)	Red flag	Conservation status	Estimated credits required	Area (ha)	Estimated credits provided	Propose d Offset Area (ha)	Balance credits	Balance area
Castlereagh Scribbly Gum Woodland	ME003 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Dry Sclerophyll Forests (50)	16.1	Yes[2]	TSC Act V	485	48.5	260	27.46	-ve 225	-ve 22.5
Shale/Gravel Transition Forest	ME004 Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin	Dry Sclerophyll Forests (75)	-	Yes	TSC Act CE EPBC Act CE	-	-	152	13.35	152	13.35
Cooks River Castlereagh Ironbark Forest	ME002 Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin	Dry Sclerophyll Forests (95)	-	Yes	TSC Act E	-	-	156	13.23	156	13.23
TOTAL			**44.4–52.7**			**1139–1334**	**113–1334**	**1080**	**107.7–114.6**	**-ve 59 to –ve 254**	**-ve 5.9 to –ve 25.4**

Note: [1] indicates closest available similar vegetation type in the BBAM calculator.
[2] indicates that a threatened ecological community could not be selected in the calculator despite the observed communities being threatened ecological communities.

Overall, the proposed offsets strategy is underpinned by sound ecological principles to improve or maintain the existing biodiversity values of the local area. Over time this should result in a net improvement in biodiversity. The currently proposed offsets strategy offers a dual offset approach (combining long-term protection of existing habitat and restoration, rehabilitation and re-establishment of the degraded habitats) which would protect, actively manage, and create habitat for the range of threatened species and ecological communities affected by the Project.

13.5 Summary

The key aspects of the Ecological Impact Assessment are summarised below.

During Early Works:

- Early Works activities are unlikely to result in a significant adverse impact on biodiversity; however this phase is likely to involve the removal of scattered native and introduced trees and shrubs within the main IMT site.

During construction:

- Vegetation clearing would occur throughout the eastern part of the Project site, adjacent to Moorebank Avenue and would continue west to the edge of the conservation area along the Georges River. Approximately 44 to 53 ha of vegetation would likely be removed, depending on the rail access option selected, comprising three threatened ecological communities listed under the TSC Act: 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. None of these communities are listed under the EPBC Act.

- The Project would result in the removal of 46 hollow-bearing trees that provide potential roosting and breeding habitat for threatened species of birds and bats.

- The Project would affect two Threatened species of plant, *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans,* which are listed under the EPBC Act and the TSC Act and were recorded during field surveys for this study. Impacts on these species would include direct loss of individuals and loss of habitat.

- Impacts were predicted on 25 Threatened fauna species known or likely to occur on the Project site. Impacts would include potential loss of habitat and breeding resources, noise and light disturbance, and potential for direct mortality (in some species only). However, the Ecological Impact Assessment found that no EPBC Act or TSC Act Threatened species population or ecological community is likely to be significantly affected by the Project, for either the main IMT development or any of the three rail access connection options.

During operation:

- Although the majority of the land disturbance and site clearance for the Project would occur during the construction phase, some biodiversity impacts would continue through the Project operation.

- Potential impacts during operation include fauna injury or mortality, disturbance to habitat and noise, light and dust disturbance.

Table 13.20 summarises the predicted biodiversity impacts (without mitigation) for each rail access option.

Table 13.20 Summary of biodiversity impacts, without mitigation, for each rail access option

	IMT layout and associated rail access connection option		
Impact	**Northern**	**Central**	**Southern**
Loss or disturbance of vegetation including threatened flora species	•	•	•
Loss or disturbance of EPBC listed flora species which have been recorded at the Project site[1]	•	•	•
Impact to threatened fauna species, including potential loss of habitat and breeding resources, noise and light disturbance, and potential for direct mortality	•	•	•
Impact to EPBC listed fauna species that have been recovered at the Project site, including potential loss of habitat and breeding resources, noise and light disturbance, and potential for direct mortality[1]	•	•	•
Removal of hollow-bearing trees	•	•	•

Key: • = impact, - = no impact

Notes: [1] No species or ecological community is likely to be significantly impacted by the Project)

The identified biodiversity impacts would be mitigated and/or offset through a variety of measures. Substantial areas of vegetation would be retained and enhanced along the Georges River riparian corridor (including a permanent conservation area within the main IMT site). A detailed biodiversity offsets strategy would be implemented in accordance with regulatory requirements to offset unavoidable residual impacts. The Project would include long-term weed removal/riparian vegetation restoration in the Georges River corridor. MIC is committed to providing an offsets strategy that adequately meets the quantum of the offset requirements under the FBA and the Offsets Policy 2014.

During Early Works and all construction phases of the Project, measures to minimise the likelihood of flora and fauna injury or mortality would be implemented as part of the CEMP, including: identification of vegetation cleaning exclusion zones; pre-clearing surveys of hollow-bearing trees; and having a trained ecologist onsite to accompany clearing crews. Additional measures have been identified in section 13.4.2.

Further assessment of the potential impacts of the Project and more detailed development of mitigation measures would be conducted during the detailed design phase of the Project, and future Stage 2 SSD approval assessments.