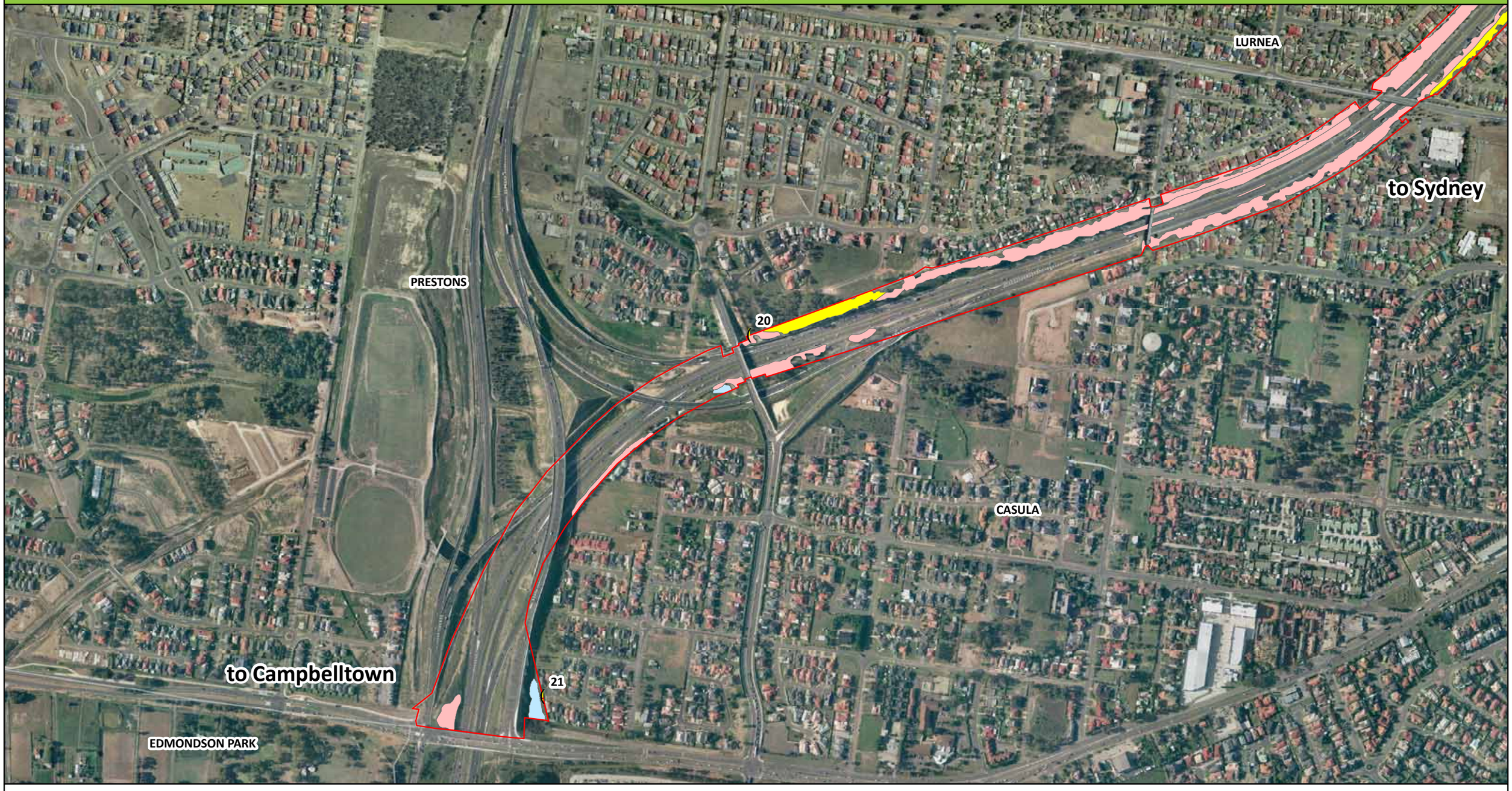
Figure 8g. Vegetation Communities and Green and Golden Bell Frog Habitat



Legend

M5 Motorway Corridor

Photo Point

Green and Golden Bell Frog Habitat

- Potential
- Unlikely

Vegetation Community, Mapping Confidence

- Artificial Wetland
- Landscaping
- Castlereagh Scribbly Gum Woodland (non EEC), Moderate
- Coastal Mangrove Swamp (non EEC)
- Coastal Saltmarsh (EEC), High
- Coastal Saltmarsh (EEC), Moderate
- Cooks River/ Castlereagh Ironbark Forest (EEC), High
- Cooks River/ Castlereagh Ironbark Forest (EEC), Moderate
- Cumberland Plain Woodland (EEC), High
- Cumberland Plain Woodland (EEC), Moderate
- River Flat Eucalypt Forest (EEC)
- Shale Gravel Transition Forest (EEC), High
- Shale Gravel Transition Forest (EEC), Moderate
- Swamp Oak Floodplain Forest (EEC)

0 0.1 0.2 0.4
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

Data Sources:
Imagery - 0.10 m pixels (c) SKM Pty Ltd 2007
ELA (2010)
DECCW (2009)

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3.2.8 Aquatic ecology

The M5 Motorway corridor supports numerous aquatic ecological habitat values ranging from drainage infrastructure such as table drains and sedimentation basins to several bridge crossings over the Georges River and Salt Pan Creek. It is important to note that the proposed upgrade to the M5 Motorway does not involve any works within waterways or require any changes to waterway crossings.

The M5 Motorway drainage infrastructure consists of a network of approximately 30 km of drainage lines and sedimentation basins which capture and treat stormwater runoff before entering surrounding piped or natural stormwater systems. The drainage infrastructure typically consisted of three main forms: natural (earthen), re-enforced and concrete lined (Plate 6, Plate 7 and Plate 8). The re-enforced and concrete lined drainage infrastructure support little in the way of aquatic ecology due to a lack of substrate and the rapid flow the structures are designed to experience. The more natural earthen sedimentation basins and drainage lines supported limited macrophytes such as the invasive native species *Typha orientalis* (Broad-leaf Cumbungi) and would provide limited habitat for disturbance tolerant species. The invasive exotic *Gambusia holbrooki* (Plague Minnow) was observed in a number of drainage lines and sedimentation basins and is likely to reduce the suitability of these areas for breeding of native species (such as fish and amphibians).

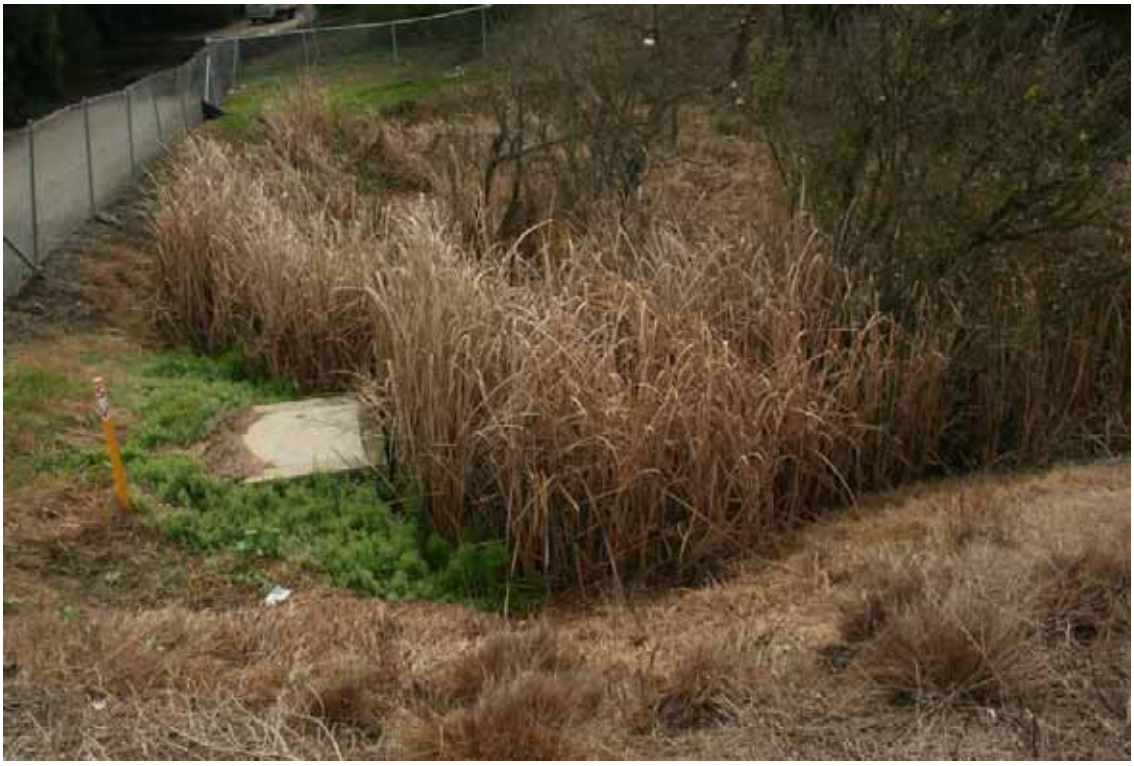


Plate 6: Natural earthen sedimentation basin

Plate 7: Re-enforced sedimentation basin

Plate 8: Concrete-lined sedimentation basin

The M5 Motorway crosses several important creek and river systems including two crossings of the Georges River (Milperra and Moorebank) and one crossing of Salt Pan Creek. Both the eastern

crossing of the Georges River (Milperra) and Salt Pan Creek are subject to tidal flow and support ecology indicative of a saline environment (Plate 9 and Plate 10). Salt Pan Creek is fringed by marine vegetation such as mangroves and saltmarsh which provide important ecosystem functions and are valuable habitat for aquatic species such as fish and crustaceans. These areas also provide essential foraging resources for migratory birds. Other marine vegetation such as seagrass is not expected to occur due to the location of the crossing and turbidity of the water.

The M5 West Motorway crosses each of these creek and river systems via a series of elevated bridges which allows for vegetation connectivity and for unimpeded aquatic fauna (fish) passage upstream or downstream across the Study Area. These creeks and rivers are likely to provide important linkages for a range of aquatic and terrestrial species in the region.

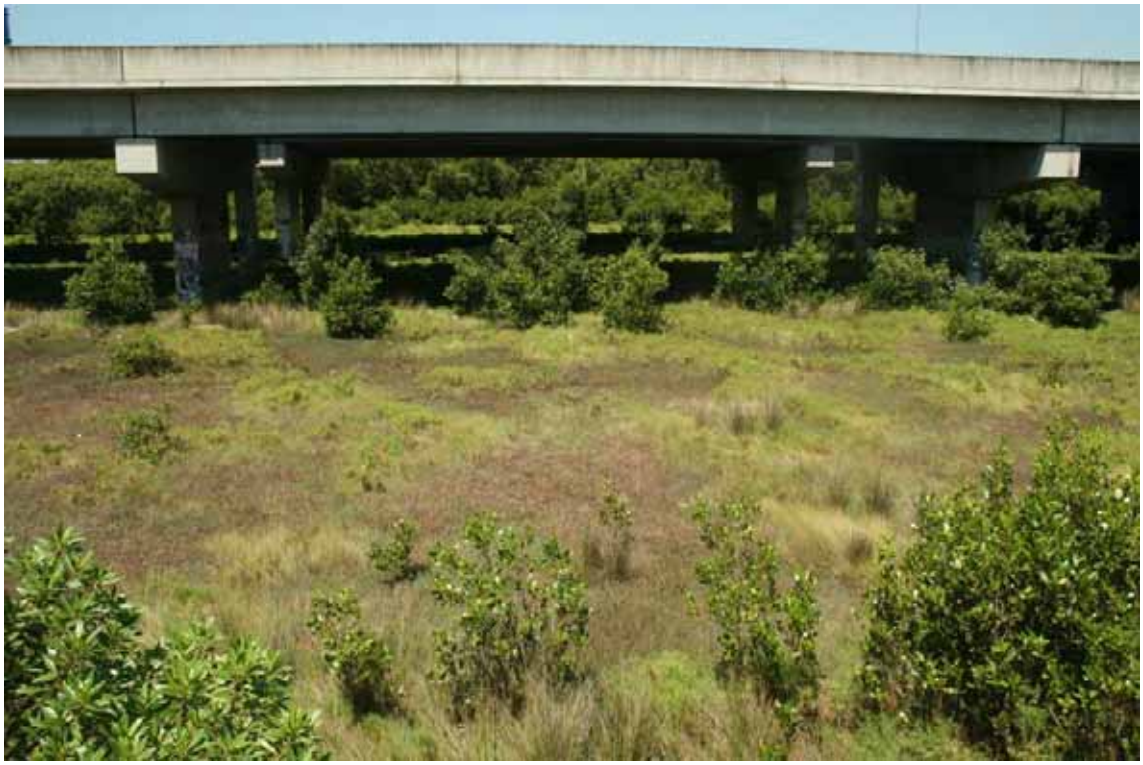


Plate 9: Saltmarsh and mangrove habitat at Salt Pan Creek

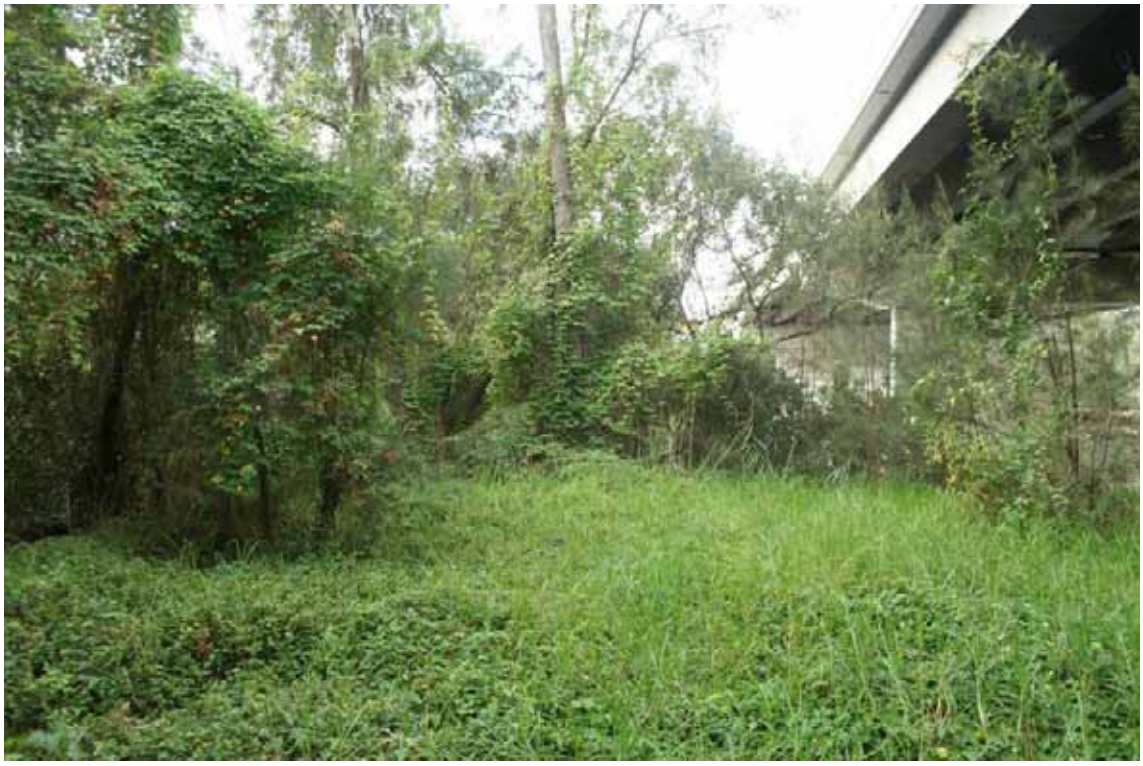


Plate 10: Fringing Swamp Oak and mangrove forest, Georges River, Milperra

3.2.9 Construction compounds

Moorebank Avenue

The potential construction compound site at Moorebank Avenue is located on ex-defence land and is characterised by largely cleared land with an exotic grass understorey. There was a mix of remnant native, planted native and exotic tree species scattered across the site (Plate 11).

Common trees at the Moorebank Avenue site included *Corymbia citriodora* (Lemon-scented Gum), *Corymbia maculata* (Spotted Gum), *Eucalyptus nicholii* (Narrow-leaved Black Peppermint), *Harpephyllum caffrum* (South African Wild Plum) and *Pinus radiata* (Radiata Pine). All of these species have been planted as part of original site landscaping. No hollows were observed in any of the planted species, however the bark of some species of *Eucalyptus* may provide marginal roosting habitat for threatened microbats.

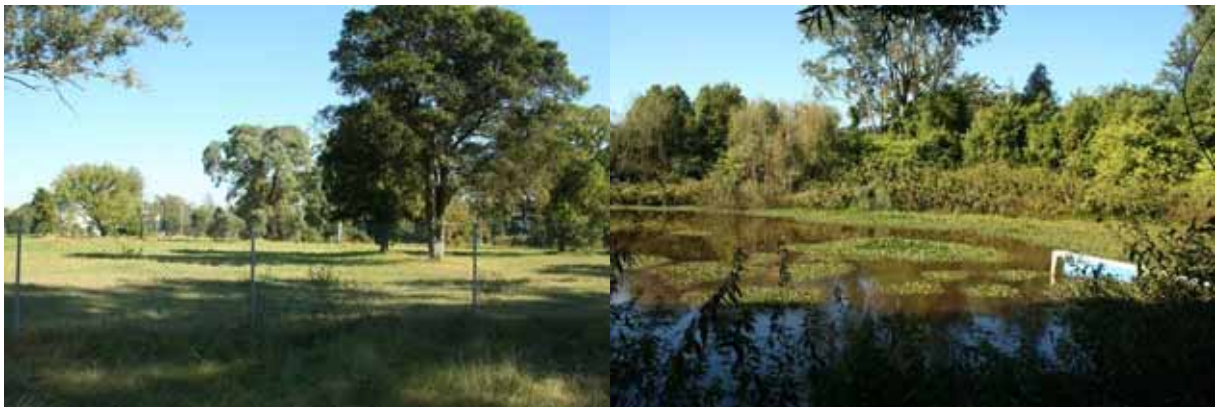


Plate 11: Cleared exotic grasses with scattered planted trees (left), highly disturbed wetland (right)

Eucalyptus nicholii (Narrow-leaved Black Peppermint) is listed as vulnerable under the TSC Act and EBPC Act. The Narrow-leaved Black Peppermint is a commonly planted street and garden tree (DECCW 2010b) and would have been planted as part of the original landscaping of the site. This species has no conservation significance at this site and is unlikely to be disturbed by the potential construction compounds.

A small wetland was observed in the west of the site which was surrounded by remnant *Eucalyptus amplifolia* (Cabbage Gum) and *Eucalyptus tereticornis* (Forest Red Gum) (Plate 11). The wetland itself was observed to be in very poor condition with fringing vegetation dominated by noxious weeds such as *Lantana camara* (Lantana), *Ludwigia peruviana* (Ludwigia) and *Alternanthera philoxeroides* (Alligator Weed) with the surface of the wetland chocked by *Eichhornia crassipes* (Water Hyacinth). Despite the weed infestation, the vegetation around the wetland is still consistent with River-flat Eucalypt Forest, an Endangered Ecological Community listed under the TSC Act.

The majority of the Moorebank Avenue site is considered to have low ecological constraint with the wetland in the west considered to be of high ecological constraint (Figure 9).

M5 Motorway / Graham Avenue

Two potential construction compound sites are located within the M5 corridor adjacent to Graham Ave. These two sites consisted of planted native vegetation on a large fill batter which most likely functions as a noise barrier for adjoining residences. A small concrete lined detention basin was observed between the two potential construction compound sites (Plate 12). No vegetation was observed within the basin due to the concrete lining and the basin was practically empty at the time of inspection.

The planted vegetation on the batters consisted of locally native species such as *Acacia decurrens* (Black Wattle), *Acacia parramattensis* (Parramatta Wattle), *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus fibrosa* (Broad-leaved Red Ironbark), *Eucalyptus moluccana* (Grey Box) and *Eucalyptus sideroxylon* (Mugga). Most of the planted trees were up to approximately 8m in height and were not old enough to support hollow dwelling fauna. Although many of these species are indicative of Cumberland Plain Woodland, it is clear that this vegetation has been planted and does not constitute the Critically Endangered Ecological Community.

While there were occasional native groundcovers, the understorey within the planted areas was dominated by exotic species such as *Pennisetum clandestinum* (Kikuyu) and *Chloris gayana* (Chloris gayana). The two M5 Motorway / Graham Avenue sites are considered to have low ecological constraints (Figure 9).

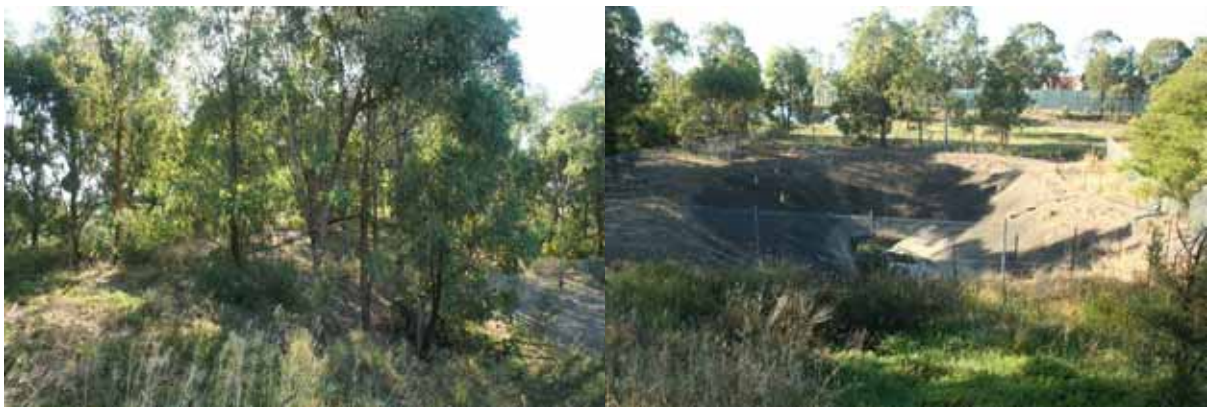
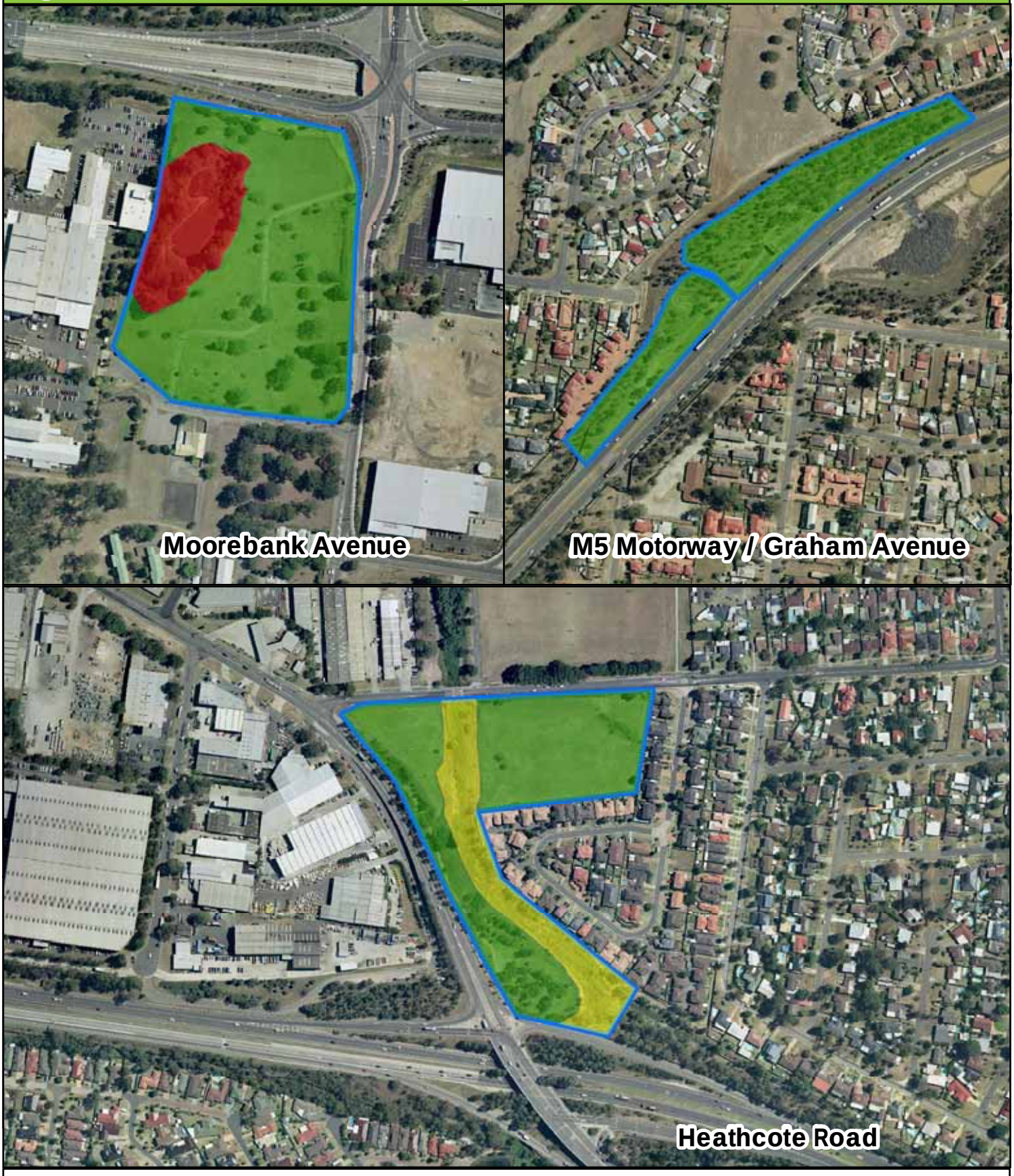


Plate 12: Planted vegetation on a fill batter (left), concrete detention basin (right)

Figure 9. Potential Construction Compounds



Legend

Ecological Constraint

- Low
- Moderate
- High

0 40 80 160

Metres

Datum/Projection:
GDA 1994 MGA Zone 56

Data Sources:
Imagery - 0.10 m pixels (c) SKM 2007
ELA Ecological Survey (2010)

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Heathcote Road

The potential construction compound site at Heathcote Road is located on land adjoining the M5 Motorway and is characterised by two cleared areas on either side of a drainage line (Anzac Creek) which is a tributary of the Georges River.

There is a reasonably large area of planting along the boundary of Heathcote Road and the M5 Motorway which is likely to have been planted as part of the M5 Motorway landscaping. Commonly recorded species included *Casuarina glauca* (Swamp Oak), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus sideroxylon* (Mugga) and *Eucalyptus tereticornis* (Forest Red Gum).

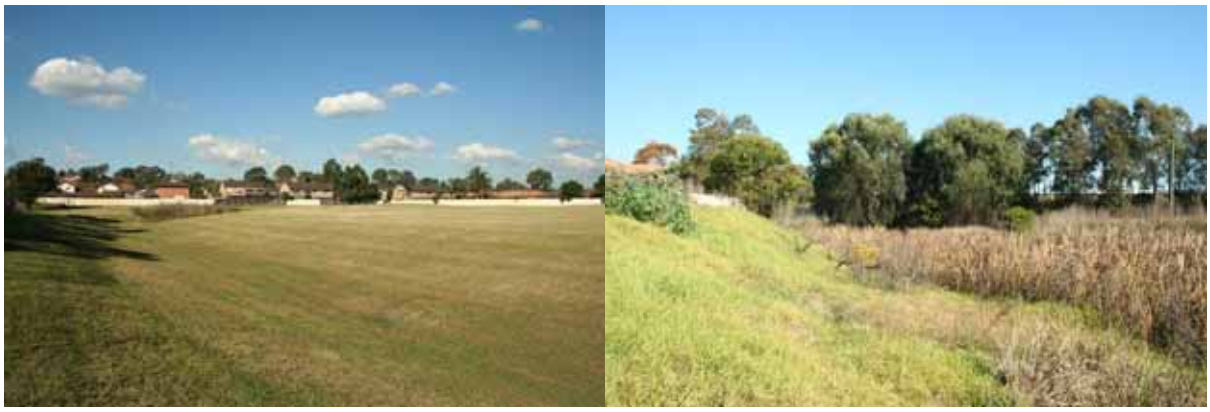

Plate 13: Cleared land (left), Anzac Creek drainage line (right)

The drainage line (Anzac Creek) which runs through the middle of the site was dominated by *Typha orientalis* (Broad-leaf Cumbungi) with occasional native species such as *Bolboschoenus fluviatilis* (Club-rush), *Centella asiatica* (Pennywort) and planted specimens of *Melaleuca ericifolia* (Swamp Paperbark). The drainage line is likely to have undergone significant modification as part of the M5 Motorway construction with much of its length being channelized. *Gambusia holbrooki* (Plague Minnow) was observed to occur in this area.

The Heathcote Road site is considered to be of low ecological constraint except for the drainage line which passes through the middle which is of moderate ecological constraint (Figure 9).

3.2.10 Noxious weeds

Thirteen of the 110 exotic species recorded at the Subject Site and potential construction compounds are declared noxious weeds within the Canterbury, Bankstown and Liverpool Local Government Areas (DPI 2010b). These species, their class and control requirements are listed in Table 4.

Table 4: Noxious Weeds recorded at the Subject Site

Species	Common Name	Control Category	Control Requirements	Location
Alternanthera philoxeroides	Alligator Weed	3	The plant must be fully and continuously suppressed and destroyed	Moorebank Ave
Asparagus asparagoides	Bridal Creeper	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with	Graham Ave and Heathcote Rd

Species	Common Name	Control Category	Control Requirements	Location
Cestrum parqui	Green Cestrum	3	The plant must be fully and continuously suppressed and destroyed	Heathcote Rd
Eichhornia crassipes	Water Hyacinth	3	The plant must be eradicated from the land and the land must be kept free of the plant	Moorebank Ave
Lantana camara	Lantana	4 / 5	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; The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with	Moorebank Ave
Ligustrum lucidum	Broad-leaved Privet	4 (Canterbury LGA only)	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 and the plant may not be sold, propagated or knowingly distributed	M5, Graham Ave and Moorebank Ave
Ligustrum sinense	Small-Leaved Privet	4 (Canterbury LGA only)	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 and the plant may not be sold, propagated or knowingly distributed	Moorebank Ave and Heathcote Rd
Ludwigia peruviana	Ludwigia	3	The plant must be fully and continuously suppressed and destroyed	Moorebank Ave
Nassella neesiana	Chilean Needle Grass	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 and the plant may not be sold, propagated or knowingly distributed	M5, Graham Ave
Olea europaea subsp. *cuspidata*	African Olive	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 and the plant may not be sold, propagated or knowingly distributed	Graham Ave and Moorebank Ave
Oxalis sp.	Oxalis	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with	Moorebank Ave
Ricinus communis	Castor Oil Plant	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	Moorebank Ave and Heathcote Rd
Rubus fruticosus (sp. agg)	Blackberry	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 and the plant may not be sold, propagated or knowingly distributed	M5, Moorebank Ave

4 Impact assessment

This section of the Biodiversity Working Paper outlines the potential impacts from the proposal on the ecological values of the Subject Site. Through careful design of the M5 West Motorway upgrade, a large proportion of potential impacts to biodiversity have been mitigated. This includes potential direct and indirect impacts to threatened species, populations and ecological communities which are known to occur in areas adjoining the M5 West Motorway, particularly in the vicinity of the Georges River and Salt Pan Creek. As the proposed upgrade of the M5 West Motorway is to be largely accommodated within the central grassed median, the proposal is not expected to have adverse effects on the ecological values of the Study Area.

4.1 KEY THREATENING PROCESSES

A number of Key Threatening Processes (KTP) which are listed on the schedules of the TSC Act and *Fisheries Management Act 1994* (FM Act) are likely to be relevant to the proposed upgrade of the M5 West Motorway. These KTP's include:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act);
- Clearing of native vegetation (TSC Act);
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act);
- Invasion of native plant communities by exotic perennial grasses (TSC Act);
- Invasion and establishment of exotic vines and scramblers (TSC Act);
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act);
- Predation by *Gambusia holbrooki* Girard, 1859 (plague minnow or mosquito fish) (TSC Act);
- Degradation of native riparian vegetation along New South Wales watercourses (FM Act);

As majority of the clearing to be undertaken as part of the M5 upgrade is within previously landscaped vegetation, the proposal is unlikely to exacerbate any of these KTP. The removal of the weedy median from the motorway may assist in the reducing the spread of exotic perennial grasses into adjoining native vegetation communities.

4.2 IMPACTS TO THREATENED FLORA

Two threatened plant species were identified within the Subject Site which would require removal as part of the proposed upgrade, namely Downy Wattle and Giant Spear Lily. As the Giant Spear Lily is native to northern NSW and has clearly been planted as part of the M5 West Motorway landscaping, no significant impacts are expected from its' removal.

Approximately 76 Downy Wattle stems would be required to be removed as part of the M5 upgrade. This constitutes the loss of 40% of the planted population of Downy Wattle within the M5 West Motorway corridor. An additional 113 Downy Wattle stems have been observed within the Study Area (within the M5 Motorway corridor) and are unlikely to be impacted by the proposal. Within the region (5km) there are approximately 1,300 Downy Wattle records in the NPWS Atlas including those identified in the M5 Motorway Corridor (DECCW 2010a). Many of the records in the NPWS Atlas do not contain information on the number of individuals at each site, nor were any of the locations visited to confirm whether the populations still existed. In the case that no information was available for the number of individuals at each site, it was assumed that only one plant was recorded. This may have resulted in an underestimate of the size of the regional population, however as the current status of the populations was not verified this estimate is considered to be reasonable assumption. From this data it can be determined that the removal of 76 Downy Wattle stems from the M5 Motorway equates to the removal of 6% of the population from the region.

During the assessment of impact for this species a number of uncertainties arose which are detailed below:

- **The precise nature of the Downy Wattle planting**. The environmental impact assessment for the original M5 Motorway (DMR 1986) noted the presence of the rare plant *Acacia pubescens* (Downy Wattle) and recommended mitigation of impacts through seed collection, propagation and replanting. At the time of the original assessment, Downy Wattle was coded as an endangered species with a very restricted distribution on the Rare or Threatened Plants list (ROTAP); however the ROTAP list does not have any legal status. The federal *Endangered Species Protection Act 1992* (ESP Act) did not come into effect until the project was officially completed in 1992. Hence while the Downy Wattle was included as part of the original M5 Motorway landscaping in order to increase the size of the local population and reduce the potential impacts on this species, there was no legislative requirement to do so.

- **Source material for the planted population**. The original environmental assessment (DMR 1986) identified six populations which would be impacted by the M5 Motorway construction. To minimise the potential impacts of the motorway construction, it was intended that seed from the impacted Downy Wattle populations be collected for replanting. Due to the original M5 Motorway being completed nearly 20 years ago, no records could be located to determine whether seed or cuttings were actually collected from the impacted populations or from adjoining populations. In addition, as Downy Wattle is a clonal species it is impossible to quantify the importance of the original populations and there is potential for all the planted Downy Wattles to have come from one individual. As such, there is potential that the genetic material of the planted Downy Wattle is either of very high or low conservation significance depending on its origin. In the absence of genetic information, the impact assessment has assumed that the planted population is of high conservation significance.

As the Downy Wattle population within the M5 Motorway have apparently been planted as part of the original M5 West Motorway construction, are mentioned in the recovery plan (albeit as an *in situ* planted population), and could include genetic material from populations which no longer exist in the locality, the removal these individuals has the potential to constitute a significant impact (refer Appendix E).

Wilsonia backhousei (Narrow-leafed Wilsonia) was recorded in Coastal Saltmarsh (TSC Act EEC) in Salt Pan Creek, which adjoins the Subject Site. This species was observed to be growing in a relatively large patch adjacent to a bridge pylon and is unlikely to be directly affected by the proposal as no works are required to the bridge structure due to the existing pavement width. In addition, it is proposed to

pipe the drains on the Salt Pan Creek Bridge which currently discharge directly to Salt Pan Creek and direct stormwater flows to detention basins. Therefore it is unlikely that indirect impacts such as increased stormwater, sediment and erosion would impact on this species or the surrounding Coastal Saltmarsh.

Comprehensive impact assessments for species likely to be impacted by the proposal pursuant to the requirements of the EP&A Act and EPBC Act have been completed (Appendix E).

4.3 IMPACTS TO THREATENED FAUNA

Three threatened bat species were deemed to potentially occur within the Subject Site. The Large-eared Pied Bat, Eastern Freetail Bat and Eastern Bent-wing Bat would experience negligible impacts from the proposed road upgrade. Potential habitat within the Subject Site consists of opportunistic foraging habitat which is well represented within the Study Area, and would not be impacted by the current proposal.

Two main areas were identified within the Subject Site as potential habitat for the Green and Golden Bell Frog (Figure 8). Upgrades to drainage infrastructure have been proposed in the vicinity of these locations and are likely to affect the quality of the habitat during construction.

There is potential that habitat for this species could occur at other locations within the vicinity of the Subject Site and would include similar structures (particularly in those areas behind noise walls and outside of the road corridor). While these disturbed areas are considered potential habitat for the Green and Golden Bell Frog, it is acknowledged by DECC (2008) that there is no direct evidence available to suggest these areas function as breeding habitat. The presence of the Plague Minnow at the subject site is likely to reduce the ability of the Green and Golden Bell Frog to breed and have successful recruitment, hence breeding habitat not likely to occur at the subject site. In addition, while a key population of the Green and Golden Bell Frog has been identified in the vicinity of the Subject Site (DECC 2008), the species is most likely to utilise significant wetland habitat on adjoining lands such as Hammondville Golf Course. As such, the potential habitat for the Green and Golden Bell Frog within the Subject Site is considered minor in terms of the long term conservation of the species.

Although the Green and Golden Bell Frog was not recorded in the Study Area during the current surveys, potential habitat for this species was identified during the habitat assessment. The Green and Golden Bell Frog could still be present in low numbers, or otherwise transiently or periodically occupy habitat at the Subject Site during migrations from other areas downstream in the catchment on occasion. Direct impacts on the potential Green and Golden Bell Frog habitat are outlined in Table 5.

Table 5: Impacts to potential Green and Golden Bell Frog habitat

Total Area of potential habitat occupied within M5 Motorway Corridor	Area proposed to be modified	% modified
0.38 ha	0.18 ha	47%

Given this situation a precautionary approach has been taken and appropriate design measures along the drainage lines and sedimentation basins identified as potential habitat have been recommended. Given the potential habitat at the Subject Site is unlikely to constitute significant breeding habitat, a range of mitigation measures have been developed which would negate a significant impact on this species (Table 14).

A range of common and disturbance tolerant native species such as *Cacatua galerita* (Sulfur-crested Cockatoo), *Corvus coronoides* (Australian Raven), *Gymnorhina tibicen* (Australian Magpie), *Pseudocheirus peregrinus* (Common Ringtail Possum), *Rhipidura leucophrys* (Willie Wagtail) and *Trichosurus vulpecula* (Common Brushtail Possum) are likely to utilise the limited foraging resources available at the subject site (including Endangered Ecological Communities) from time to time. Considering that the majority of the proposed works are to be undertaken within the central median and previously landscape areas, the potential impact on these common native fauna species is expected to be low. Potential edge effects as a result of limited clearing (including increased weed invasion and habitat alteration) are not expected to result in any adverse impacts to native fauna. The vegetation within the M5 Motorway corridor is already weedy, disturbed and fragmented to the extent that it does not form any significant buffer to surrounding vegetation and as such it is unlikely that the proposed works would further increase edge effects.

Comprehensive impact assessments for these species pursuant to the requirements of the *EP&A Act* have been completed (Appendix E).

4.4 IMPACTS TO VEGETATION COMMUNITIES

A number of Endangered Ecological Communities (EECs) listed under state and federal legislation, have been mapped within and adjacent to the Subject Site. Field survey has demonstrated that there are several small areas of EECs present within the M5 Motorway corridor (Figure 8). While the species planted as part of the original landscaping of the M5 West Motorway are generally indicative of Cumberland Plain Woodland, they do not represent this Critically Endangered Ecological Community. As the proposed upgrade to the M5 West Motorway will be contained largely within the central median of the motorway, no clearing of native vegetation is required in this area. Several drainage basins and permanent soil re-use areas in the vicinity of EECs require upgrading or installation as part of the proposal. The installation of the proposed noise walls is not expected to result in any direct or indirect impacts on EECs as clearing is only required in and adjoining landscaped areas. The potential impact of the proposal on these EECs is outlined in the following tables.

Potential impacts as a result of the installation of sedimentation basins were determined by calculating the surface area of the proposed basin with an additional 5m buffer added for construction. Potential impacts as a result of the installation of proposed noise walls were calculated through the addition of a 5m construction footprint. Potential impacts as a result of widening along the verges of the motorway have been calculated through the addition of a 2m buffer to the maximum width of each section as outlined in Table 6. For the construction compounds, it has been assumed that all of the landscaping at the Heathcote Road and both of the M5 Motorway / Graham Avenue sites will be cleared as part of the proposed upgrade (Figure 9). It has been assumed that the proposed construction compound at Moorebank Avenue can be accommodated without the removal of any vegetation (Figure 9).

Table 6: Sections for widening

Area	Chainage	Length	Maximum width of widening	Buffer applied to average width
Westbound, Belmore Road On-ramp	Ch 10920 to Ch 11150	230m	2.5m	2m
Westbound, near Queen Street Bridge	Ch 14700 to Ch 15330	630m	2.5m (10m at the emergency bay at Ch 15300)	2m
Westbound, either side of	Ch 15530 to Ch	300m	3m	2m

Area	Chainage	Length	Maximum width of widening	Buffer applied to average width
Beaconsfield Bridge	15830			
Westbound, West of the Hume Highway	Ch 24200 to Ch 24950	750m	2m (6m at the emergency bay at Ch 24700)	2m
Westbound and eastbound, either side of De Meyrick Street Bridge	Ch 25150 to Ch 25650	500m	3m	2m
Westbound, either side of Kurrajong Road	Ch 25800 to Ch 26160	360m	2.5m	2m

Table 7 outlines the potential impacts of the proposal in terms of the road widening within the central median. Table 8 and Table 9 outline the potential impacts of the installation of associated infrastructure including sedimentation basins and permanent spoil re-use areas. Table 10 and Table 11 outline the potential impacts of the installation of proposed noise walls and from verge widening. Table 12 outlines the potential impacts from the construction compounds. Table 13 provides an overall assessment of the level of potential impact of the entire proposal on vegetation communities and includes an analysis of the potential impact on the regional distribution of those communities. The clearing calculations presented in these tables generally constitute a 'worst case' scenario and it is likely that the amount of clearing required for the proposed upgrade to the M5 West Motorway will be lower than estimated.

Table 7: Impacts to vegetation communities within the central median

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared within the median	% Clearing
Landscaping	Not listed	60.10 ha	1.3 ha	2%

Table 8: Impacts to vegetation communities from the construction of sedimentation basins

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared for sedimentation basins	% Clearing
Castlereagh Scribbly Gum Woodland	Not listed	3.70 ha	0.32 ha	9%
Cumberland Plain Woodland	Critically Endangered (TSC Act / EPBC Act)	1.35 ha	0.03 ha	2%
River Flat Eucalypt Forest	Endangered (TSC Act)	1.43 ha	0.14 ha	10%
Swamp Oak Floodplain Forest	Endangered (TSC Act)	0.3 ha	0.18 ha	60%
Landscaping	Not listed	60.10 ha	1.26 ha	2%

Table 9: Impacts to vegetation communities from the installation of permanent spoil re-use areas

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared for permanent spoil re-use areas	% Clearing
Castlereagh Scribbly Gum Woodland	Not listed	3.70 ha	0.35 ha	9%
Cooks River/ Castlereagh Ironbark Forest	Endangered (TSC Act)	3.38 ha	0.25 ha	7%
Cumberland Plain Woodland	Critically Endangered (TSC Act / EPBC Act)	1.35 ha	0.3 ha	22%
Landscaping	Not listed	60.10 ha	4.62 ha	8 %

Table 10: Impacts to vegetation communities from the proposed noise barriers

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared for proposed noise barriers	% Clearing
Landscaping	Not listed	60.10 ha	1 ha	2 %

Table 11: Potential impacts as a result of widening along the verges

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared for verge widening	% Clearing
Landscaping	Not listed	60.10 ha	0.6 ha	1 %
Cumberland Plain Woodland	Critically Endangered (TSC Act / EPBC Act)	1.35 ha	0.01 ha	<1%

Table 12: Potential impacts from construction compounds

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared for verge widening	% Clearing
Landscaping	Not listed	60.10 ha	2 ha	3 %

Table 13: Overall impacts to vegetation communities

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared	% Clearing	% Clearing of regional distribution (5km) from NPWS (2002)
Castlereagh Scribbly Gum Woodland	Not listed	3.70 ha	0.66 ha	18%	0.2%

Vegetation Community	Conservation Significance	Total Area Occupied within M5 Motorway Corridor	Area proposed to be cleared	% Clearing	% Clearing of regional distribution (5km) from NPWS (2002)
Coastal Mangrove Swamp	Protected (FM Act)	0.59 ha	0 ha	-	-
Coastal Saltmarsh	Endangered (TSC Act)	0.67 ha	0 ha	-	-
Cooks River/ Castlereagh Ironbark Forest	Endangered (TSC Act)	3.38 ha	0.25 ha	7%	0.2%
Cumberland Plain Woodland	Critically Endangered (TSC Act / EPBC Act)	1.35 ha	0.33 ha	24%	0.03%
River Flat Eucalypt Forest	Endangered (TSC Act)	1.43 ha	0.14 ha	10%	0.02%
Shale Gravel Transition Forest	Endangered (TSC Act) / Critically Endangered (EPBC Act)	1.2 ha	0 ha	-	-
Swamp Oak Floodplain Forest	Endangered (TSC Act)	0.3 ha	0.18 ha	61%	0.03%
Landscaping	Not listed	60.10 ha	9.8 ha	13%	N/A
Total Clearing		**72.72 ha**	**11.36 ha**	**16%**	

The potential impacts of the proposed M5 West widening on each of the vegetation communities within the Study Area are considered insignificant in terms of the condition, past and current disturbances, fragmentation and isolation of each patch. These small isolated patches of EECs within the M5 Motorway Corridor are unlikely to constitute important habitat for state or federally listed threatened fauna species and provide only limited foraging resources for disturbance tolerant species. The EECs remaining within the Motorway Corridor have been subject to a long history of disturbance and much better examples of these communities occur outside of the Subject Site, particularly in the vicinity of Salt Pan Creek and the Georges River, Milperra.

From the assessment of impacts under state and federal legislation (Appendix E), the proposed M5 West Widening was determined as unlikely to result in significant impacts on these endangered ecological communities.

In respect to the potential construction compound locations (Section 3.2.9), the ecological constraints of each site have been assessed (Figure 9). Given the potential impact of the proposed upgrade to the M5 Motorway has been assessed based on a concept design, it has been assumed that only those areas identified as “low” ecological constraint will be utilised (refer Figure 9). If any additional works are likely to occur in areas identified as either “moderate” or “high” ecological constraint, then impacts are likely to occur and further assessment will be required.

4.5 IMPACTS TO AQUATIC ECOLOGY

The bridges over the Georges River (Milperra and Moorebank) and Salt Pan Creek do not require structural modification as part of the M5 Motorway upgrade as the additional lanes can be accommodated within the existing pavement width. Some minor upgrades (such as the addition of drainage infrastructure and electrical cabling) may be required in some areas but these works can be conducted from the existing carriageway and no physical works are required to be conducted in the surrounding aquatic environment. No disturbance to soils in the vicinity of waterways which could potentially disturb acid sulfate soils or alter salinity is expected and there is not expected to be any loss of mangrove, saltmarsh, aquatic habitat or marine vegetation as a direct result of the proposal. As there are no proposed modifications to these crossings, the proposal is unlikely to affect fish passage.

In terms of indirect impacts, the majority of the pavement runoff from the existing motorway is captured and treated in sedimentation basins (water quality basins) before being released into the Georges River. The greatest potential impact of the proposal to the aquatic environment is through an increase in surface runoff which may result in pollutants such as sediments, suspended soils, litter, oil and grease, hydrocarbons and heavy metals entering the system.

The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

As the proposed upgrade to the M5 West Motorway does not require any clearing or construction in or adjoining aquatic habitats and water quality control measures will be installed where required to capture and treat pollutants, there are not expected to be any significant impacts on the aquatic ecology of the Subject Site and Study Area.

A range of mitigation measures have been developed to minimise the potential indirect impacts to the aquatic ecology of the study area (Table 14).

4.6 IMPACTS TO ECOLOGICAL CORRIDORS

Surrounding the Study Area, there are valuable areas of vegetation including Endangered Ecological Communities (EECs) and riparian vegetation which form part of ecological corridors in the region which may be indirectly impacted by the project through alterations to water quality, erosion and sedimentation. Three ecological corridors of conservation significance were identified within the Study Area (Table 3). These corridors are associated with the remnant vegetation and fauna habitat along the Georges River and Salt Pan Creek.

The M5 West Motorway crosses each of these valuable ecological corridors via a series of elevated bridges which allows for vegetation connectivity and for the north-south movement of fauna across the Study Area. As the proposal does not require any major alterations to the bridge structures, works within waterways, or alterations to waterway crossings, the proposal is not likely to result in any adverse impacts on the connectivity of theses ecological corridors.

4.7 MITIGATION MEASURES

The following site-specific mitigation measures and ecological management procedures have been developed for implementation during the pre-construction, construction and operational phases of the M5 West Motorway Upgrade (Table 14).

Table 14: Mitigation Measures

Item	Mitigation Measure / Ecological Management Procedure	Timing
Acacia pubescens (Downy Wattle)	In order to minimize the impacts on Downy Wattle, a propagation and translocation program has been proposed in consultation with DECCW. **Propagation and Translocation Program** The development of a propagation and translocation program should be undertaken in accordance with the ANPC *Guidelines for the Translocation of Threatened Plants in Australia - Second Edition* (2004). As a minimum, the plan should include details on: • Objectives and performance targets • Appropriate propagation/translocation methods • Genetic research • Identification of appropriate recipient sites for long term conservation • Logistical requirements • Licensing requirements (state and federal) • Post translocation management, monitoring and evaluation A commitment to undertake this propagation and translocation program at four distinct sites within the M5 Motorway corridor has been provided. These sites are situated in the following locations: 1. Northern road verge between King Georges Road and Penshurst Road; 2. Interchange between the M5 Motorway, M7 on ramp and Beech Road; 3. Landscaped area in the M5 Motorway corridor near the corner of Graham Avenue and Grove St; and 4. Northern road verge between the M5 Motorway on ramp and Henry Lawson Drive.	Pre and post construction
Litoria aurea (Green and Golden Bell Frog)	The following recommendations and mitigation measures have been developed in accordance with the various DECCW Recovery Plan initiatives (NPWS 2003b, DEC 2005; DECC 2008a,b) and aim to increase the Green and Golden Bell Frog habitat values over the longer term. A Green and Golden Bell Frog management plan for construction will be developed to manage the risk to this species. Where feasible, proposed drainage works in potential Green and Golden Bell Frog Habitat should be undertaken during the late autumn/early winter months to minimise the potential impacts on the breeding cycle of the Green and Golden Bell Frog A targeted survey for the Green and Golden Bell Frog is to be undertaken in November/December 2010 in areas identified as potential habitat. The results of this targeted survey will inform the preparation of the construction management plan for this species. If the targeted survey or other pre-works survey locates the Green and Golden Bell Frog on the subject site, then compensatory habitat is to be provided as part of any sedimentation and drainage works within areas identified as potential habitat. If any Green and Golden Bell Frogs are observed during construction, work should cease immediately and DECCW should be consulted.	Pre and Post construction

Item	Mitigation Measure / Ecological Management Procedure	Timing
Selection of drainage infrastructure locations	Wherever practicable, road drainage and other associated infrastructure (such as noise walls or electrical conduits) should be located outside of areas identified as potential Green and Golden Bell Frog habitat, EECs or Coastal Mangrove Swamp (refer Figures 8a-g). Drainage works should aim to avoid all impacts on the potential GGBF habitat mapped near the Georges River at Panania (refer Figures 8c and 8d) as this area has the greatest potential for supporting this species and is within the catchment area identified in the Georges River Green and Golden Bell Frog Key Population Management Plan. If road infrastructure is required to be installed in locations identified as EECs, preference should be given to areas mapped as having 'moderate' mapping confidence as these areas are generally more disturbed than those identified with 'high' confidence. Within many of these areas the existing drainage infrastructure could potentially be modified or upgraded rather than creating additional impacts. If road infrastructure is to be located in these areas, additional survey may be required to determine the precise impacts on state and federally listed EECs. Any impacts to state or federally listed EECs which have not been identified as part of the original ecological assessment should be appropriately offset.	Detailed Design
Selection of permanent spoil re-use areas	While the potential impacts of the installation of permanent spoil re-use areas have been assessed as part of this study, there is potential to minimise or negate the impacts on these EECs through further refinement of soil re-use areas. As the design for the M5 West Widening progresses, the final locations for spoil re-use can be determined based on the mapped location of EECs. Wherever practicable, permanent spoil re-use areas should be located outside of areas identified EECs (refer Figures 8a-g).	Detailed Design
Site-specific environmental induction	Ensure that all staff working on the project undertakes a site-specific environmental induction. The induction should include items such as: • Sensitivity of surrounding vegetation (particularly EECs) • Site environmental procedures (vegetation management, sediment and erosion control, protective fencing, noxious weeds) • What to do in case of emergency (chemical spills, fire, injured fauna) • Key contacts in case of environmental emergency	Pre-construction
Clearing of vegetation	Where trees require felling, retain the timber as Coarse Woody Debris for enhancement of degraded habitats (where appropriate) Cease work immediately if any previously unknown threatened flora or fauna species are encountered and consult DECCW. WIRES should be consulted if any injured fauna are encountered.	Construction
Management of erosion and sediment control	Provide appropriate controls to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways, wetlands and fauna habitat. This is particularly important for the crossings of the Georges River and Salt Pan Creek which support numerous EECs and threatened species. Clearly identifying stockpile and storage locations and provide erosion and	Pre and during construction

Item	Mitigation Measure / Ecological Management Procedure	Timing
	sediment controls around stockpiles.	
Riparian Areas	All land within 40 m of the top of bank of a clearly defined drainage line (permanent or intermittent) is protected under the WM Act. Clearly mark out and protect areas with para-web fencing or similar. Ensure all works within close proximity to riparian zones have adequate sediment and erosion control.	Pre and during construction
Weed Management	Establish a noxious weed management protocol. Noxious weeds should be controlled within the work area according to the requirements of the *Noxious Weeds Act 1993* (NW Act). All noxious weeds which are cleared as part of the project must be disposed of appropriately. Implement inspection/maintenance procedures to reduce the carriage of weed material on machinery.	Pre and during construction
Rehabilitation	Disturbed areas will be rehabilitated as soon as practical, through a progressive landscaping regime to ensure stabilisation of bare areas and to take advantage of optimal growing conditions.	During and post construction

5 Conclusions and recommendations

5.1 BIODIVERSITY VALUES

A range of biodiversity values have been identified within and adjoining the M5 Motorway corridor. These values are related to the extent and distribution of threatened species, populations and endangered ecological communities, namely:

- *Acacia pubescens* (Downy Wattle) which has been planted within the Subject Site as part of the original M5 landscaping;
- Potential foraging habitat for a range of insectivorous bats within the Subject Site;
- Potential habitat for *Litoria aurea* (Green and Golden Bell Frog);
- Aquatic habitats associated with the Georges River and Salt Pan Creek and the ecological corridors of Long Point – Casula, Hammondville – Pleasure Point, and Salt Pan Creek; and
- A range of Threatened Ecological Communities which adjoin the Subject Site.

5.2 RECOMMENDATIONS

The proposed upgrade to the M5 West Motorway has the potential to cause a significant impact on the state and nationally listed vulnerable species, *Acacia pubescens* (Downy Wattle). Approximately 76 Downy Wattle stems would be removed as part of the M5 upgrade. This constitutes the loss of the 40% of the planted population of Downy Wattle within the M5 West Motorway corridor. The population of Downy Wattle within the M5 West Motorway was most likely planted as part of mitigation measures from the original M5 West Motorway construction. During the assessment of impact of this species, a number of uncertainties arose in regards to the nature of the mitigation and the source material of the population which could not be determined. As such, a commitment to undertake a propagation and translocation program at four distinct sites within the M5 Motorway corridor has been provided.

As this project has demonstrated that limited natural vegetation remains within the Subject Site due to the complete re-profiling of the soil and subsoil during the original construction of the M5 West Motorway, the overall impact of the project on threatened biodiversity is considered to be low. Even though the proposal is considered to have low potential impacts on biodiversity, a range of mitigation measures have been developed (Table 14). These measures have been developed as there are additional risks to the project which need to be managed such as:

- Accidental construction incursion into areas of high ecological significance;
- Additional impacts to areas unidentified in the concept design; and
- Degradation of local waterways and riparian areas.

The implementation of these measures will help reduce the risk of further impacts occurring during the construction and operational phases of this project.

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Appendix A Mitchell landscapes

Mitchell Landscape	Landscape Description (DECC 2008a)	Relevance to the Subject Site
Ashfield Plains	Undulating hills and valleys on horizontal Triassic shale and siltstone, occasional quartz sandstones especially near the margin of the Port Jackson landscape. General elevation 0 to 45m, local relief <20m. Coastal extension of the Cumberland Plain landscape. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys. Open forest of Broad-leaved Ironbark (*Eucalyptus fibrosa*), Grey Box (*Eucalyptus moluccana*), with Tea-tree (*Leptospermum* spp.) along creeks and forests of Turpentine (*Syncarpia glomulifera*), Red Mahogany (*Eucalyptus resinifera*), Grey Gum (*Eucalyptus punctata*), Sydney Blue Gum (*Eucalyptus saligna*) and Blackbutt (*Eucalyptus pilularis*) with a grassy understorey of Kangaroo Grass (*Themeda australis*) on moister sites.	The Ashfield Plains landscape is associated with woodlands and open forests such as Cumberland Plain Woodland, Cooks River/ Castlereagh Ironbark Forest, Turpentine-Ironbark Forest and Blue Gum High Forest. The Ashfield Plains landscape is generally associated with Wianamatta group shale soils.
Cumberland Plain	Low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline. Intruded by a small number of volcanic vents and partly covered by Tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels landscape). Quaternary alluvium along the mains streams. General elevation 30 to 120m, local relief 50m and sometimes affected by salt in tributary valley floors. Pedal uniform red to brown clays on volcanic hills. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys. Woodlands and open forest of Grey Box (*Eucalyptus moluccana*), Forest Red gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Cabbage Gum (*Eucalyptus amplifolia*) and Broad-leaved Apple (*Angophora subvelutina*). Grassy to shrubby understorey often dominated by Australian Boxthorn (*Bursaria spinosa*), poorly drained valley floors, often salt affected with Swamp Oak (*Casuarina glauca*) and Paperbark (*Melaleuca* sp.).	The Cumberland Plain landscape is associated with woodlands and open forests such as Cumberland Plain Woodland and River-flat Eucalypt Forest. The Cumberland Plain landscape is generally associated with Wianamatta group shale soils.
Georges River Alluvial Plain	Channel, floodplain and terraces of the Georges River on Quaternary and Tertiary alluvial sediments. Mostly clayey sand and sand with limited gravel on the highest terrace, general elevation 0 to 30m, local relief 10m. Massive uniform or gradational profiles on yellow brown to orange clayey sand. Podsols with well developed double pans on limited areas of deep quartz sand, stony, harsh, yellow, texture-contrast soils on higher terraces. Forest and woodland of Cabbage Gum (*Eucalyptus amplifolia*), Rough-barked Apple (*Angophora floribunda*), Broad-leaved Ironbark (*Eucalyptus fibrosa*), Scribbly Gum (*Eucalyptus sclerophylla*) and Narrow-leaved Apple (*Angophora bakeri*). Extensive Swamp Oak (*Casuarina glauca*) along the riverbanks and in low-lying areas often with Prickly-leaved Tea-tree (*Leptospermum styphelioides*), these extend to brackish estuarine swamps with Grey Mangrove (*Avicennia marina*) and limited saltmarsh.	The Georges River Alluvial Plain landscape is associated with woodlands and open forests such as River-flat Eucalypt Forest, Cooks River/ Castlereagh Ironbark Forest, Swamp Oak Floodplain Forest, Freshwater Wetlands, Saltmarsh and Mangroves. The Georges River Alluvial Plain landscape is generally associated with alluvial soils.
Woronora	Extensive plateau developed on Triassic quartz sandstone with benched low angle slopes and a marked break to steep sided deep valleys	Although mapped, this landscape is not likely to

Mitchell Landscape	Landscape Description (DECC 2008a)	Relevance to the Subject Site
Plateau	controlled by joint patterns. General elevation 400 to 500m, local relief 100m. Small areas of nodular ironstone on ridge crests, deep uniform sands or texture-contrast soils on slopes and deep uniform grey or white organic sands on swampy valley floors. Rock outcrop common on ridgelines and in creeks, absent from most slopes. Woodlands with shrubby understorey of Silvertop Ash (*Eucalyptus sieberi*), Sydney Peppermint (*Eucalyptus piperita*), Old Man Banksia (*Banksia serrata*), Smooth-barked Apple (*Angophora costata*), on ridges. Shrublands of Heath Banksia (*Banksia ericifolia*), Hairpin Banksia (*Banksia spinulosa*), Dagger Hakea (*Hakea teretifolia*), She-oak (*Allocasuarina* spp.) and Soft Geebung (*Persoonia mollis*) with *Gahnia* spp., on slopes and extensive hanging swamps in saturated organic sands on the lowest slopes and valley floors with heath of; *Hakea* spp., Swamp Banksia (*Banksia robur*), Button Grass (*Gymnoschoenus sphaerocephalus*) and Grass Trees (*Xanthorrhoea* spp.). Contour parallel patterned ground of ridges and trenches is common.	occur in the vicinity of the Subject Site.

Appendix B Threatened flora and fauna

Table 15: Threatened Flora Records from Database Searches and the Likelihood of Occurrence for each Species within the Study Area

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
FLORA					
Acacia bynoeana	Bynoe's Wattle	E	V	The species is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra (DECCW 2010B). It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (NPWS 1999). The species seems to prefer open and sometimes slightly disturbed sites (NPWS 1999). Characteristic overstorey species include: *Corymbia gummifera, Eucalyptus haemastoma, E. gummifera, E. parramattensis, E. sclerophylla, Banksia serrata* and *Angophora bakeri*. Shrubs often associated with the species include *B. spinulosa, B. serrata, A. oxycedrus, A. myrtifolia and Kunzea* spp. (Winning 1992; James 1997). It flowers from September to March and fruits mature in November.	Unlikely
Acacia terminalis subsp. terminalis	Sunshine wattle	E	E	Open coastal eucalypt woodland or forest, usually in sandy or shallow, on slopes, cliffs or creek banks. Distribution is highly restricted to the eastern suburbs area of Sydney, NSW, between Botany Bay and the northern foreshore of Port Jackson.	Unlikely
Acacia pubescens	Downy Wattle	V	V	Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and	Recorded

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Allocasuarina glareicola		E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis*, *E. fibrosa*, *Angophora bakeri*, *E. sclerophylla* and *Melaleuca decora*. Common associated understorey species include *M. nodosa*, *Hakea dactyloides*, *H. sericea*, *Dillwynia tenuifolia*, *Micromyrtus minutiflora*, *Acacia elongata*, *A. brownei*, *Themeda australis* and *Xanthorrhoea minor*. (DECCW 2010B)	Unlikely
Caesia parviflora var. *minor*	Small Plae Grass-lily	E	—	This variety occurs uncommonly in Tasmania, southern Victoria and south-east South Australia with an outlying population in NSW, in Barcoongere State Forest, between Grafton and Coffs Harbour. This variety may be more common than currently known, as Pale Grass-lilies are often not identified to variety level. Found in damp places in open forest on sandstone (DECCW 2010B)	No
Caladenia tessellata	Thick-lipped Spider-orchid, Daddy Long-legs	E	V	Occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea (DECCW 2010B). Usually in sheltered moist places, in areas of increased sunlight. It flowers from September to November (DECCW 2010B).	No
Callistemon linearifolius	Netted Bottlebrush	V	—	Grows in dry sclerophyll forest on the coast and adjacent ranges (DECCW 2010B). C. linearifolius has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (DECCW 2010B).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Cynanchum elegans	White-flowered Wax Plant	E	E	Climber or twiner with a variable form (DECCW 2010B). It occurs in dry rainforest gullies, scrub and scree slopes. It prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest. However has been found in littoral rainforest; *Leptospermum laevigatum – Banksia integrifolia* subsp *integrifolia* coastal scrub; *Eucalyptus tereticornis* aligned open forest/ woodland; *E. maculata* aligned open forest/woodland; and *Melaleuca armillaris* scrub to open scrub (DECCW 2010B). Flowers between August and May, peaking in November (DECCW 2010B). Seeds are unlikely to persist in the seedbank (DECCW 2010B).	No
Deyeuxia appressa		E	E	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Given that D. appressa hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology. (DECCW 2010B)	No
Diuris aequalis	Buttercup Doubletail	E	V	Montane eucalypt forest with a grassy-heathy understorey, growing in gravelly clay loam, often on gentle slopes (Bishop 1996). Recorded in forest, low open woodland with grassy understorey and secondary grassland on the higher parts of the Southern and Central Tablelands (DECCW 2010B). Always grows with small-flowered wedge-pea (Gompholobium sp) (*ibid*). Flowers between mid-Oct and mid-Nov in the southern part of its range, between mid-Nov and early Dec north of Abercrombie (*ibid*).	No
Doryanthes palmeri	Giant Spear Lily	V			Recorded (planted), but outside the natural range of this species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Epacris purpurascens var *purpurascens*		V	-	Sydney Sandstone Gully Forest and wet heath with strong clay influences (NPWS 1997). Recorded between Gosford in the north to Avon Dam in the south. Found in a range of habitats, but most have a strong shale soil influence. Killed by fire and re-establishes from soil stored seed (DECCW 2010B).	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite (DECCW 2010B). This species is widely planted as an urban street tree and in gardens but is quite rare in the wild (DECCW 2010B). It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield (DECCW 2010B).	Recorded (planted), outside the natural range of this species. One planted individual observed at the Moorebank Avenue site.
Grevillea parviflora subsp. *parviflora*	Small Flower Grevillea	V E	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks. Sporadically distributed throughout the Sydney Basin with the main occurrence centered around Picton, Appin and Bargo. DECCW 2010B)	Unlikely
Gyrostemon thesioides		E	-	Associated with river banks along the Georges and Nepean Rivers in NSW (NPWS 1997). Grows on hillsides and riverbanks and may be restricted to fine sandy soils. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Hibbertia sp. Bankstown (R.T.Miller & C.P.Gibson s.n. 18/10/06)		-	CE	Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone. Habitat of the South Coast population is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone. (DECCW 2010B)	Unlikely
Leucopogon exolasius	Woronora Beard-heath	V	V	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park.The plant occurs in woodland on sandstone. Flowering occurs in August and September. (DECCW 2010B)	Unlikely
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br.subsp, viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas.	EP	–	Grows in vine thickets and open shale woodland. Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Maundia triglochinoides		V	–	Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct (DECC 2007). *Maundia triglochinoides* is an aquatic herbaceous plant found in swamps or shallow fresh water on heavy clay on the north and central NSW coast. (DECCW 2010B)	Unlikely
Melaleuca biconvexa	Biconvex paperback	V	V	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October. (DECCW 2010B)	No, outside the natural range of this species
Melaleuca deanei	Deane's Melaleuca	V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The species grows in heath on sandstone. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate. (DECCW 2010B)	Unlikely
Persoonia hirsuta	Hairy Geebung	E	E	The Hairy Geebung has been recorded in the Sydney coastal area (subsp. *hirsuta* - Gosford to Berowra to Manly to Royal National Park), the Blue Mountains area (subsp. *evoluta* - Springwood, Lithgow, Putty) and the Southern Highlands (subsp. *evoluta* - Balmoral, Buxton, Yanderra and Hill Top areas). The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. (DECCW 2010B)	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Persoonia nutans	Nodding Geebung	E	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).	No
Pimelea curviflora var. *curviflora*		V	V	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. (DECCW 2010B)	Unlikely
Pimelea spicata	Spiked Rice-flower	E	E	Once widespread on the Cumberland Plain, Spiked Rice-flower occurs in two disjunct areas, the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey.	Unlikely
Pomaderris brunnea	Brown Pomaderris	V	V	Associated with open forests in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua* (Maryott-Brown & Wilks 1993). It is found on the Colo River, the Nepean R. floodplain at Menangle, in creeklines at Wirrumbirra Sanctuary (Bargo) and on the Hawkesbury R. (Harden 1990; Peacock 1996; Fairley & Moore 2000). The distribution may extend into the southern section of Yengo NP along major creeklines and floodplains (Maryott-Brown & Wilks 1993).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Pomaderris pruniflora var. *pruniflora*	P.pruniflora in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	EP	–	Known from only three sites within the listed local government areas, at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. At Rydalmere it occurs along a road reserve near a creek, among grass species on sandstone. At Rookwood Cemetery it occurs in a small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils. (DEEC 2005)	Unlikely
Pterostylis nigricans	Dark Greenhood	V	–	Occurs in north-east NSW north from Evans Head, and in Queensland. Grows in Coastal heathland with Heath Banksia (Banksia ericifolia), and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils.(DECCW 2010B)	No, outside the natural range of this species
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Only one population occurs within a conservation reserve (Georges River National Park). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where Pterostylis saxicola occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Pultenaea parviflora		E	V	Endemic to the Cumberland Plain. Core distribution is from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. Eucalyptus fibrosa is usually the dominant canopy species. *Eucalyptus globoidea, E. longifolia, E. parramattensis, E. sclerophylla* and *E. sideroxylon* may also be present or co-dominant, with *Melaleuca decora* frequently forming a secondary canopy layer. (DECCW 2010B)	Unlikely
Pultenaea pedunculata	Matted Bush-pea	E	–	Matted Bush-pea is widespread in Victoria, Tasmania, and south-eastern South Australia. In NSW however, it is represented by just three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). (DECCW 2010B) The Matted Bush-pea occurs in a range of habitats. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. (DECCW 2010B)	Unlikely
Syzygium paniculatum	Magenta Lilly Pilly	E	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Tetratheca juncea	Black-eyed Susan	V	V	Occurs on predominantly low nutrient soils with a dense grassy understorey of grasses although it has been recorded in heathland and moist forest (DECCW 2010B). It is associated with dry open forest or woodland habitats dominated by *Corymbia gummifera, E. capitellata, E. haemastoma* and *Angophora costata* (Payne 1993). *Themeda australis* is generally the dominant ground cover (Payne 1993). *T. juncea* also displays a preference for southern aspect slopes, although is slopes with different aspects (DECCW 2010B). Flowers July to December.	No, outside the natural range of this species
Thelymitra sp. Kangaloon (D.L.Jones 18108)	Kangaloon Sun-orchid	-	CE	The Kangaloon Sun-orchid is endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands. The swamp habitat in which the species occurs has an extent of occurrence of 300 km2 and an area of occupancy of 10 km2. The three swamps are Butlers Swamp (0.125 km2), Stockyard Swamp (once known as Molly Morgan Swamp) (7 km2) and Wildes Meadow Swamp (3 km2), and are all located above what is known as the Kangaloon aquifer. The Kangaloon Sun-orchid is largely self-pollinating. It flowers in late October and early November. The species grows in seasonally swampy sedgeland on grey silty clay loam at 600-700 m above sea level. (Jones 2001)	No
Thesium australe	Austral Toadflax, Toadflax	V	V	Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (Themeda australis) (DECCW 2010B). Flowers in spring–summer. Widespread but rare. NSW subdivisions: NC, CC, SC, NT, ST, NWS, CWS. Other Australian states: Qld, Tas.	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Wahlenbergia multicaulis	Tadgell's Bluebell in the local Government areas of Auburn, Bankstown, Baulkham Hills. Canterbury, Hornsby, Parramatta and Strathfield	EP	–	In Western Sydney most sites are closely aligned with the Villawood Soil Series, which is a poorly drained, yellow podsolic extensively permeated with fine, concretionary ironstone (laterite). However, the sites in Hornsby LGA are on the 'Hawkesbury' soil landscape. Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open. In Hornsby LGA it occurs in or adjacent to sandstone gully forest. In Western Sydney it is found in remnants of Cooks River/ Castlereagh Ironbark Forest. (DECCW 2010B)	No
Wilsonia backhousei	Narrow-leafed Wilsonia	V	–	Grows in coastal saltmarshes in the Sydney Region and Jervis Bay (Harden 1990)	Recorded in Coastal Satlmarsh adjoining the Subject Site.

Table 16: Fauna Records from Database Searches and the Likelihood of Occurrence for each Species within the Study Area

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
AMPHIBIANS					
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	No
Litoria aurea	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made water bodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECCW 2010B).	Potential
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria (DECCW 2010B). It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It hunts either in shrubs or on the ground. Breeding is triggered by heavy rain and can occur from late winter to autumn, but is most likely to occur in spring when conditions are favourable. Males call from low vegetation close to slow flowing pools. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools (DECCW 2010B).	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Litoria raniformis	Growling Grass frog, Southern Bell frog, Green and Golden Frog, Warty Swamp frog	E	V	Relatively still, or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where bulrushes (Typha sp., Eleocharis sp. and Phragmites sp.) are present (DECCW 2010B; Ehmann 1997). This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW (DECCW 2010B). This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps (DECCW 2010B). Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (Ehmann 1997).	No
Mixophyes balbus	Stuttering frog	E	V	A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECCW 2010B) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2002).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Pseudophryne australis	Red-crowned Toadlet	V	—	Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECCW 2010B). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. However they may also occur on plateaus or more level rock platforms along the ridgetop (DECCW 2010B). Associated with open forest to coastal heath (Ehmann 1997). Utilises small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997). Breeding sites are often characterised by clay-derived soils and generally found below the first sandstone escarpment in the talus slope (NPWS 1997).	Unlikely
RAY-FINNED FISH					
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurred in coastal streams from the Grose River southwards through NSW, Vic. and Tas. On mainland Australia, this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Macquaria australiasia	Macquarie Perch	-	E	Habitat for the Macquarie perch is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods. (DECCW 2010B)	No
BIRDS					
Burhinus grallarius	Bush Stone-curlew	E	-	Found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. (DECCW 2010B)	No
Callocephalon fimbriatum	Gang-gang Cockatoo Population, Hornsby and Ku-ring-gai	V E2	—	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	Unlikely
Charadrius mongolus	Lesser Sand-plover	V	M	Favours coastal areas including beaches, mudflats and mangroves where they forage (DECCW 2010B). They may be seen roosting during high tide on sandy beaches or rocky shores (DECCW 2010B).	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Ephippiorhynchus asiaticus	Black-necked Stork	E	—	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains (Marchant & Higgins 1993). Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant & Higgins 1993; DECCW 2010B).	No
Glossopsitta pusilla	Little Lorikeet	V	—	Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. In south-east Queensland (NPWS 2008)	Unlikely
Lophoictinia isura	Square-tailed Kite	V	—	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, DECCW 2010B. May be recorded inland along timbered watercourses (DECCW 2010B. In NSW it is commonly associated with ridge or gully forests dominated by Woollybutt (*Eucalyptus longifolia*), Spotted Gum (*Corymbia maculata*), or Peppermint Gum (*E. elata*, *E. smithii*) (DECCW 2010B).	Unlikely
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	—	Predominantly associated with box-ironbark association woodlands and River Red Gum (NSW Scientific Committee, 2001). Also associated with drier coastal woodlands of the Cumberland Plain and the Hunter, Richmond and Clarence Valleys (NSW Scientific Committee, 2001).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Ninnox connivens	Barking Owl	V	—	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECCW 2010B) It usually roosts in dense foliage in large trees such as River She-oak (Allocasuarina cunninghamiana), other Casuarina and Allocasuarina, eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests. It usually nests near watercourses or wetlands. in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Unlikely
Ninox strenua	Powerful Owl	V	—	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).	Unlikely
Pandion haliaetus now *Pandion cristatus*	Osprey	V	M	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Petroica rodinogaster	Pink Robin	V	M	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. (DECCW 2010B)	No
Ptilinopus supurbus	Supurb Fruit-Dove	V	M	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DECCW 2010B). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (*ibid.*). Part of the population is migratory or nomadic (*ibid.*). At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (*ibid.*). Breeding takes place from September to January (*ibid.*). Will feed in adjacent mangroves or eucalypt forests (Blakers et al. 1984).	No
Tyto novaehollandiae	Masked Owl	V	—	Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland and especially the ecotone between wet and dry forest, and non forest habitat (Environment Australia 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh & Peake 1993).	Unlikely
MIGRATORY BIRDS					

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Anthochaera phrygia	Regent Honeyeater	E	E, M,	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (Casuarina cunninghamiana) (Garnett 1993). Areas containing Swamp Mahogany (Eucalyptus robusta) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	Unlikely
Apus pacificus	Fork-tailed Swift	-	M	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas (Simpson & Day 1999).	Unlikely
Ardea alba *Now known as Ardea modesta*	Great Egret, White Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan, 2005). It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	Unlikely
Ardea ibis *Listed under JAMBA under Bubulcus ibis*	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan, 2005).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1993). Occupies a variety of vegetation around wetlands (Marchant and Higgins 1993) including wetland grasses and open wooded swamps (Simpson and Day 1999).	Unlikely
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	Unlikely
Hirundapus caudacutus	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	Unlikely
Lathamus discolor	Swift parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (Eucalyptus robusta), Spotted Gum (Corymbia maculata), Red Bloodwood (C. gummifera), Mugga Ironbark (E. sideroxylon), and White Box (E. albens) (DECCW 2010B).	Unlikely

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Merops ornatus	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (*ibid*). Nest is a chamber a the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (*ibid*).	Unlikely
Monarcha melanopsis	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	Unlikely
Myiagra cyanoleuca	Satin Flycatcher	-	M	Heavily vegetated gullies in forests, and taller woodlands of coastal south-east Australia. Also occurs in various sites during migration including farms and parks.	Unlikely
Neophema chrysogaster	Orange-bellied Parrot	CE	CE, M	The Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. It is expected that NSW habitats may be being more frequently utilised than observations suggest. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured but they will turn up anywhere within these coastal regions. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Rhipidura rufifrons	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	Unlikely
Rostratula benghalensis s. lat. Now known as *Rostratula benghalensis australis*	Painted Snipe	E	V, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECCW 2010B). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (*ibid.*). Breeding is often in response to local conditions; generally occurs from September to December (DECCW 2010B). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECCW 2010B). Feeds on worms, molluscs, insects and some plant-matter (*ibid.*).	No
INVERTEBRATES					
Archaeophya adamsi	Adams emerald dragonfly	E (FM Act)	-	Known from a few sites in the greater Sydney region. Larvae have been found in small creeks with gravel or sandy bottoms, in narrow, shaded riffle zones with moss and rich riparian vegetation (DPI 2010a).	No
Austrocordulia leonardi	Sydney Hawk dragonfly	E (FM Act)		The known distribution of the species includes three locations in a small area south of Sydney, from Audley to Picton. The species is also known from the Hawkesbury-Nepean, Georges River and Port Hacking drainages (DPI 2010a).	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Meriodolum corneovirens	Cumberland Plain Land Snail	E	-	Lives in a very small area on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains.Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish. (DECCW 2010B)	Unlikely
REPTILES					
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECCW 2010B). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998). Some of the canopy tree species found to regularly co-occur at known sites includes *Corymbia eximia, C. gummifera, Eucalyptus sieberi, E. punctata* and *E.piperita* (DECCW 2010B).	No
MAMMALS					
Cercartetus nanus	Eastern Pygmy-possum	V	—	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature. Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old bird's nests and in the branch forks of tea-trees (Turner & Ward 1995).	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998).	Potential
Dayurus masculatus	Spotted-tailed Quoll *SE mainland population*	V V	- E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECCW 2010B), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECCW 2010B). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats with trees taller than 20m (DECCW 2010B). Roosts in tree hollows but have also been found roosting in buildings or under loose bark (DECCW 2010B).	Potential
Miniopterus orianae oceanensis	Eastern Bent-wing Bat	V	—	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Potential

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Mormopterus norfolkensis	Eastern Freetail Bat	V	—	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998).	Potential
Myotis macropus	Southern Myotis, Large footed Myotis	V	—	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. (DECCW 2010B)	Potential
Petaurus norfolcensis	Squirrel Glider	V	—	Associated with dry hardwood forest and woodlands (Menkhorst et al. 1988; Quin 1995). Habitats typically include gum barked and high nectar producing species, including winter flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995).	No
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. (DECCW 2010B)	No

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
Phascolarctos cinereus	Koala	V	—	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis	No
Potorous tridactylus tridactylus	*Long-nosed Potoroo (SE mainland)*	V	V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004).	No
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Unlikely
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	—	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies (SFNSW 1995). Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V	—	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998).	Potential

Table 17: Endangered Ecological Communities from database searches and the likelihood of occurrence for each community within the Study Area

Scientific Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
	TSC Act	EPBC Act		
COMMUNITIES				
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	CE	The Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest is endemic to the Sydney Basin IBRA Bioregion in NSW. Within this bioregion, it predominantly occupies, but is not limited to, the Cumberland IBRA Sub-region. The geographic area is known as the Cumberland Plain which covers the land west of Sydney city to the Blue Mountains escarpment, including many of the suburbs of western Sydney. (Threatened Species Scientific Committee 2008) The Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest typically occurs on flat to undulating or hilly terrain, at elevations up to approximately 350 metres above sea level. Some occurrences may extend onto locally steep sites at slightly higher elevations (Threatened Species Scientific Committee, 2008).	Recorded in the Study Area (outside of the Subject Site)
Shale Gravel Transition Forest in the Sydney Basin Bioregion	EEC	-	Occurs primarily where shallow deposits from ancient river systems overlay shale soils, but also associated with localised concentrations of iron-hardened gravel. Mainly occurs in the northern section of the Cumberland Plain, western Sydney, in the Richmond, Marsden Park and Windsor districts. Also appears in the Liverpool/ Holsworthy area, and there are small occurrences at Bankstown, Yennora and Villawood and the Kemps Creek area. There are 1,721 ha remaining intact. Good examples can be seen at Windsor Downs Nature Reserve and Kemps Creek Nature Reserve. (DECCW 2010B)	Recorded in the Study Area (outside of the Subject Site)

Scientific Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
	TSC Act	EPBC Act		
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	EEC	CE	Occurs in Sydney and is heavily fragmented, with only 1,182 ha (4.5 percent its original extent) remaining intact. Remnants mostly occur in the Baulkham Hills, Hawkesbury, Hornsby, Ku-ring-gai, Parramatta, Ryde, Sutherland and Wollondilly local government areas. Good examples can be seen in small reserves such as Wallumatta Nature Reserve and Newington Nature Reserve. (DECCW 2010B) Occurs close to the shale/sandstone boundary on the more fertile shale influenced soils, in higher rainfall areas on the higher altitude margins of the Cumberland Plain, and on the shale ridge caps of sandstone plateaus. (DECCW 2010B)	No
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. (DECCW 2010B) Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains (DECCW 2010B)	Recorded in the Study Area (outside of the Subject Site)
Coastal Saltmarsh	EEC	-	This community occurs in the intertidal zone along the NSW coast. Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Characteristic plants include *Baumea juncea*, *Juncus krausii*, *Sarcocornia quinqueflora*, *Sporobolus virginicus*, *Triglochin striata*, *Isolepis nodosa*, *Samolus repens*, *Selliera radicans*, *Suaeda australis* and *Zoysia macrantha*. Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans. (DECCW 2010B)	Recorded in the Study Area (outside of the Subject Site)

Scientific Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
	TSC Act	EPBC Act		
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions includes and replaces Sydney Coastal River-Flat Forest Endangered Ecological Community. Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Typically form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. (DECCW 2010B)	Recorded in the Study Area (outside of the Subject Site)
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. (DECCW 2010B)	No
Cooks River/ Castlereagh Ironbark Forest	EEC	-	Has a very restricted natural distribution and mainly occurs on clay soils derived from the deposits of ancient river systems (alluvium), or on shale soils of the Wianamatta Shales. (DECCW 2010B) Occurs in western Sydney, and the extent of intact remnants is now reduced to 1011 ha, with the most extensive stands occurring in the Castlereagh and Holsworthy areas. Smaller remnants occur in the Kemps Creek area and in the eastern section of the Cumberland Plain. Good examples can be seen at the Castlereagh and Windsor Downs Nature Reserves. (DECCW 2010B)	Recorded in the Study Area (outside of the Subject Site)

Scientific Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
	TSC Act	EPBC Act		
Castlereagh Swamp Woodland Community	EEC	-	Occurs in western Sydney in the Castlereagh and Holsworthy areas, on deposits from ancient river systems along today's intermittent creeklines, often in poorly drained depressions. There is now only 616 hectares remaining intact, which mainly occurs in the Hawkesbury, Liverpool and Penrith local government areas. Good examples can be seen at Windsor Downs Nature Reserve and Kemps Creek Nature Reserve. Intergrades into Ironbark and Scribbly Gum woodland and is subject to periodic fires. Most species are able to quickly regenerate after fires from lignotubers and buds beneath the bark. (DECCW 2010B)	No
Moist Shale Woodland	EEC	-	Largely restricted to the southern half of the Cumberland Plain, western Sydney, and occurs mainly in Wollondilly local government area. Also occurs in smaller amounts further north in the Camden, Campbelltown, Fairfield, Liverpool and Penrith local government areas. There are 604 ha remaining intact. A small remnant can be seen in Western Sydney Regional Park Occurs on clay soils derived from Wianamatta shale and is intermediate between Cumberland Plain Woodland on drier sites and Western Sydney Dry Rainforest on wetter sites. (DECCW 2010B)	No

Scientific Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
	TSC Act	EPBC Act		
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	EEC	-	This community is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community. Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. (DECCW 2010B)	No
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	EEC	-	Occurs on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion. It is known from the Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverley, Botany, Rockdale, Randwick, Sutherland and Wollongong, local government areas, but is likely to occur elsewhere within the bioregion. Has been extensively cleared and filled and remnants are often small and disturbed. (DECCW 2010B) Largely restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains such as those of the Warriewood and Tuggerah soil landscapes. Swampy areas on alluvium with a saline influence do not fall within this community. (DECCW 2010B)	No

Legend:

CE	Critically Endangered
E1 / E	Endangered
E2	Endangered Population
FM Act	Fisheries Management Act 1994
M	Migratory
Mar	Marine
V	Vulnerable

Likelihood of occurrence:

No	The Subject Site is generally outside of the geographic range of these species and they are not expected to occur with a high level of certainty.
Unlikely	Potential habitat for these species is not present on the Subject Site but may be present in the surrounding areas. These species are not expected to occur with a moderate-high level of certainty
Potential	Potential habitat for these species is present on the Subject Site and the species may utilise the resources of the Subject Site on occasion.

Appendix C Photographic Record

Photographic Record

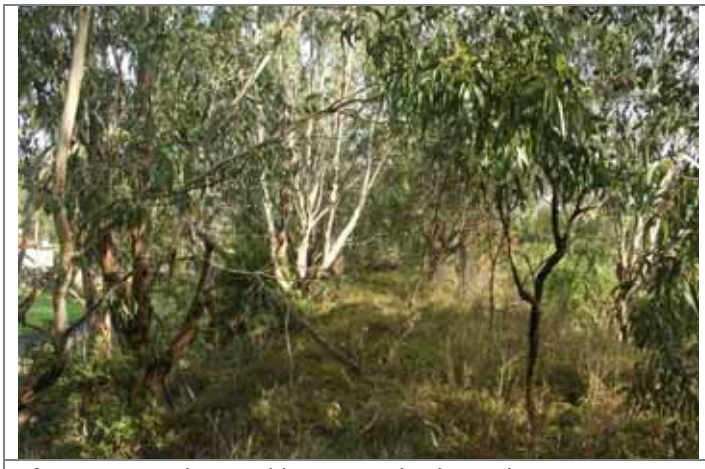

Photo 1. Landscaped batter with planted *Acacia pubescens*

Photo 2. Landscaped batter with occasional remnant trees consistent with Cooks River / Castlereagh Ironbark Forest EEC.

Photo 3. Constructed wetland outside of the M5 Motorway Corridor to the south dominated by *Typha orientalis*

Photo 4. Sedimentation basin – degraded and unlikely to be potential habitat for the Green and Golden Bell Frog.

Photo 5. Sedimentation basin dominated by *Typha orientalis*. Disconnected from adjoining areas of habitat by a concrete channel and unlikely to be potential habitat for the Green and Golden Bell Frog.

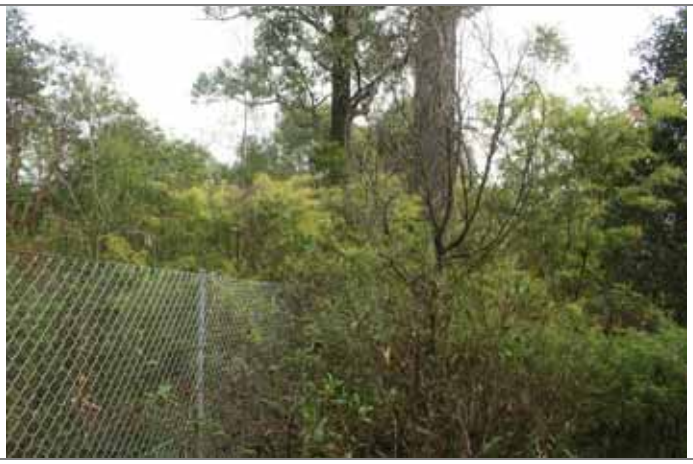

Photo 6. Cooks River / Castlereagh Ironbark Forest EEC with *Acacia pubescens* (foreground) on the boundary of the M5 Corridor.

Photographic Record

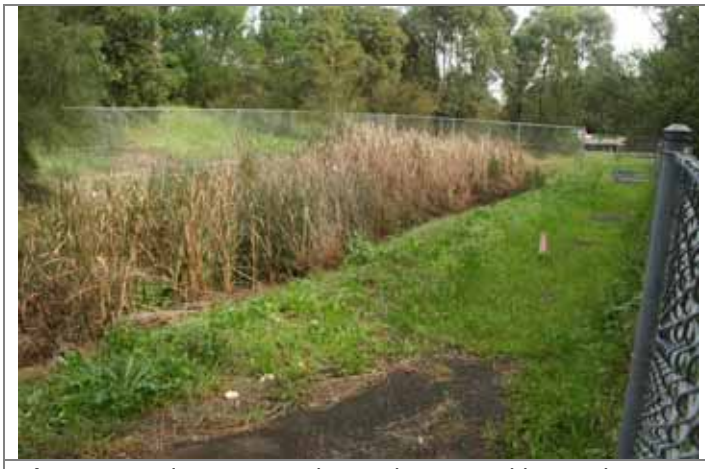

Photo 7. Sedimentation basin dominated by *Typha orientalis* and other macrophytes. Disconnected from adjoining areas of habitat and unlikely to be potential habitat for the Green and Golden Bell Frog.

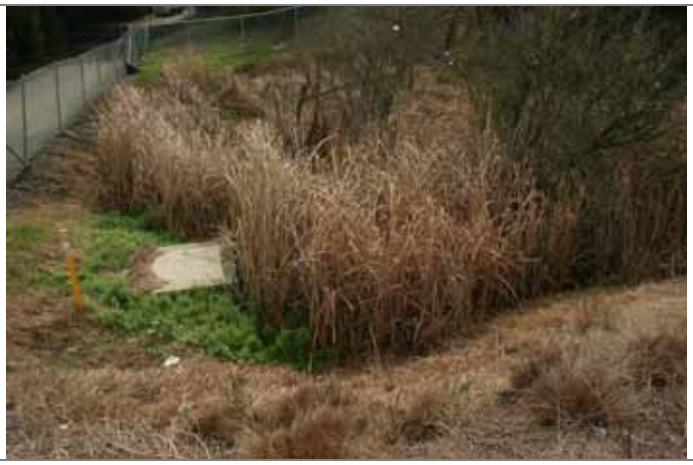

Photo 8. Sedimentation basin dominated by *Typha orientalis* adjoining Salt Pan Creek. Unlikely to be potential habitat for the Green and Golden Bell Frog.

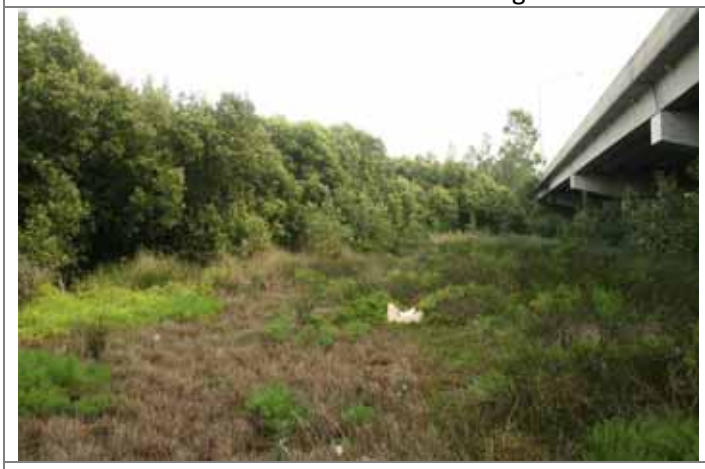

Photo 9. Coastal Saltmarsh EEC (foreground), Coastal Mangrove Swamp (rear).

Photo 10. Large wetland dominated by *Typha orientalis* and *Casuarina glauca*. Potential habitat for the Green and Golden Bell Frog.

Photo 11. Planted *Acacia pubescens* outside of M5 Motorway Corridor to the north.

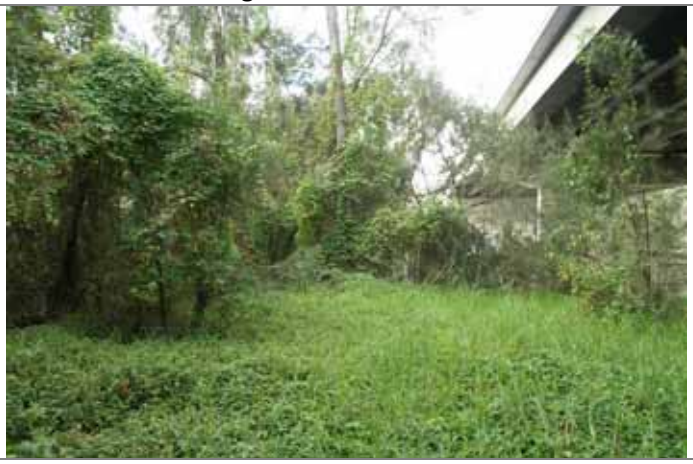

Photo 12. Degraded area adjoining the Georges River with River-flat Eucalypt Forest EEC (left and rear)

Photographic Record

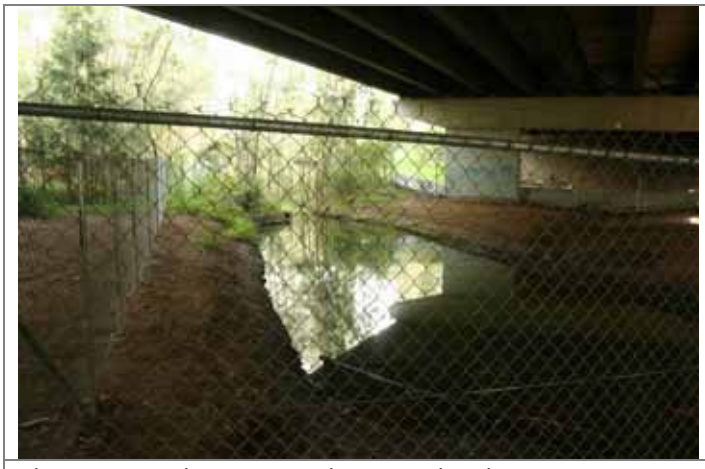

Photo 13. Sedimentation basin under the M5 Motorway with no habitat value for the Green and Golden Bell Frog.

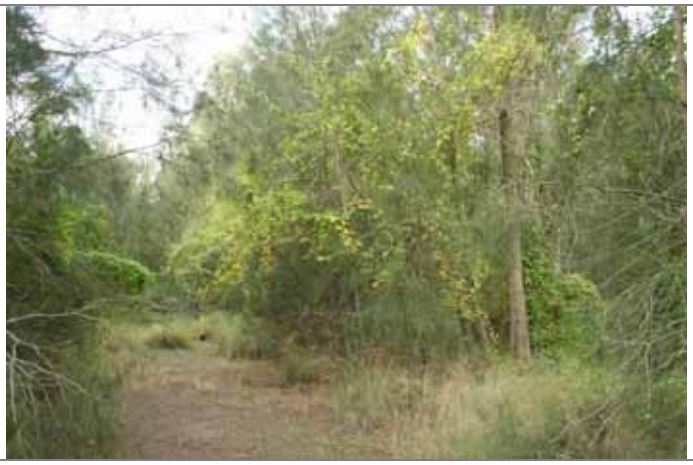

Photo 14. Disturbed River-flat Eucalypt Forest EEC adjoining the M5 Motorway.

Photo 15. Sedimentation basin which is disconnected from adjoining areas of habitat by a concrete channel and unlikely to be potential habitat for the Green and Golden Bell Frog.

Photo 16. Artificial wetland upstream of the M5 Motorway. Suitable habitat for the Green and Golden Bell Frog, however *Gambusia holbrooki* (Plague Minnow) was observed which is likely to reduce the ability of the Green and Golden Bell Frog to breed and have successful recruitment at this location.

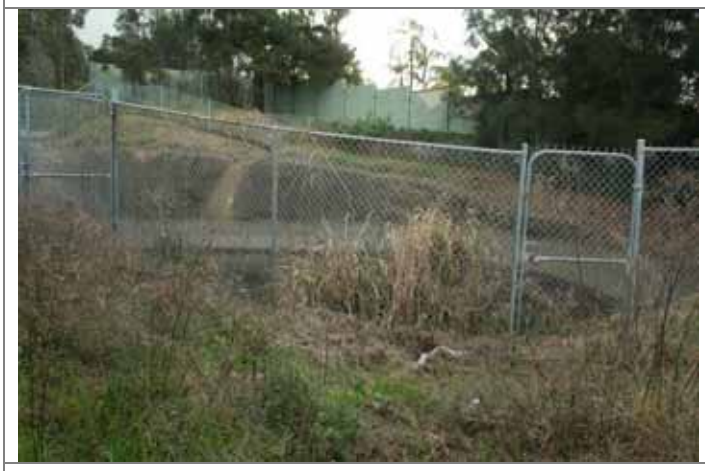

Photo 17. Small concrete lined sedimentation basin. No suitable habitat for the Green and Golden Bell Frog.

Photo 18. Concrete lined sedimentation basin (foreground) with planted vegetation (rear). Unlikely to be potential habitat for the Green and Golden Bell Frog.

Photographic Record

Photo 19. Cumberland Plain Woodland within the M5 Motorway Corridor with dumped rubbish (foreground).

Photo 20. Cumberland Plain Woodland and landscape plantings within M5 Motorway Corridor

Photo 21. Large artificial wetland within the M5 Motorway Corridor. Suitable habitat for the Green and Golden Bell Frog, however unlikely to occur considering proximity to known records.

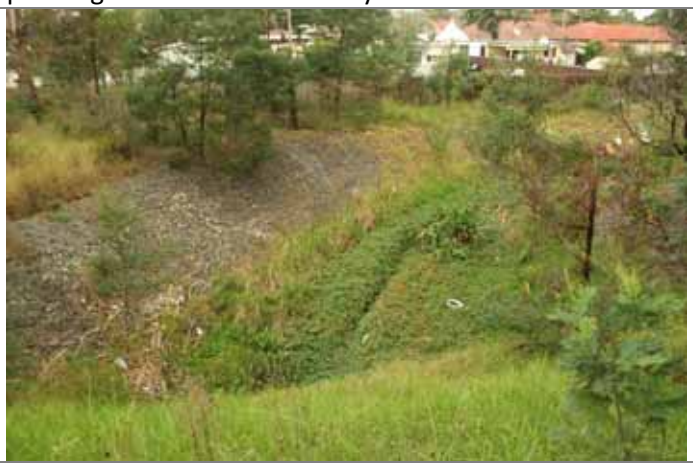

Photo 22. Constructed drainage line dominated by weeds, unlikely to be habitat for the Green and Golden Bell Frog considering proximity to known records and low habitat values.

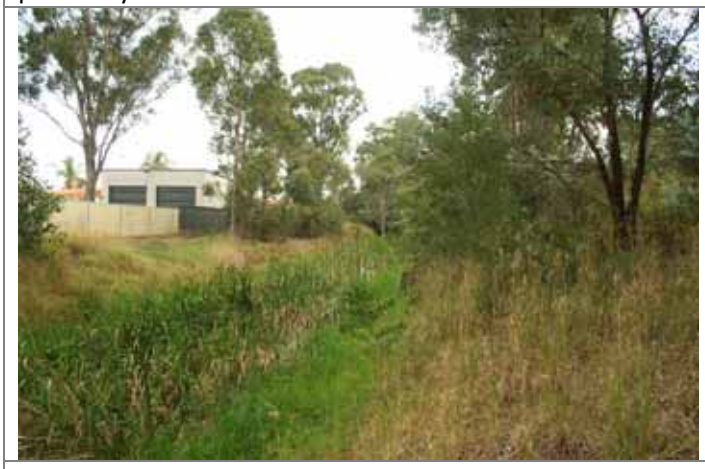

Photo 23. Constructed drainage line dominated by *Typha orientalis*, unlikely to be habitat for the Green and Golden Bell Frog considering proximity to known records.

Appendix D Species recorded

Flora Survey Data - M5 West Motorway - Flora Species List

Note:

1. Families are group under the headings 1. Pteridophytes, 2. Gymnosperms, 3. Dicotyledons, 4. Monocotyledons

2. An '*' before species indicates exotic species, # indicates non-local native

3. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered comprehensive, but rather indicative of the actual flora assemblage.

4. Not all species can be accurately identified to species level in a such a survey due to absence of flowering or fruiting material.

Family		Botname	Common name	M5 Corridor	Graham Ave	Moorebank Ave	Heathcote Rd
1. Pteridophytes							
Davalliaceae	*	*Nephrolepis cordifolia*	Fishbone Fern			X	
2. Gymnosperms							
Pinaceae	*	*Pinus radiata*	Monterey Pine, Radiata Pine			X	X
3. Dicotyledons							
Acanthaceae		*Brunoniella australis*	Blue Trumpet, Blue Yam				
Acanthaceae	*	*Thunbergia alata*	Black-eyed Susan			X	
Aizoaceae		*Tetragonia tetragonioides*	New Zealand Spinach	X			
Amaranthaceae	*	*Alternanthera philoxeroides*	Alligator Weed			X	
Amaranthaceae	*	*Alternanthera pungens*	Khaki Weed		X		
Anacardiaceae	*	*Harpephyllum caffrum*	South African Wild Plum			X	
Apiaceae		*Centella asiatica*	Pennywort	X			X
Apiaceae	*	*Foeniculum vulgare*	Fennel	X		X	X
Apiaceae	*	*Hydrocotyle bonariensis*	Beach Pennywort	X			
Apiaceae		*Hydrocotyle peduncularis*	Pennywort				X
Apocynaceae	*	*Araujia sericifera*	Moth Vine, Cruel Plant	X	X	X	X
Apocynaceae		*Marsdenia rostrata*	Common Milkvine	X			
Apocynaceae	*	*Nerium oleander*	Oleander			X	
Asteraceae	*	*Ageratina adenophora*	Crofton Weed				X
Asteraceae	*	*Aster subulatus*	Wild Aster	X			
Asteraceae	*	*Bidens pilosa*	Farmer's Friend	X	X	X	X
Asteraceae	*	*Bidens subalternans*	Greater Beggar's Ticks				
Asteraceae	*	*Cirsium vulgare*	Black Thistle, Spear Thistle	X	X		
Asteraceae	*	*Conyza bonariensis*	Flaxleaf Fleabane		X	X	X
Asteraceae	*	*Conyza sumatrensis*	Tall Fleabane			X	
Asteraceae	*	*Coreopsis lanceolata*	Calliopsis, Coreopsis	X			
Asteraceae	*	*Galinsoga parviflora*	Potato Weed, Gallant Soldiers	X			
Asteraceae	*	*Hypochaeris radicata*	Catsear, False Dandelion				X
Asteraceae	*	*Lactuca serriola*	Prickly Lettuce, Compass Plant	X			
Asteraceae		*Ozothamnus diosmifolius*	White Dogwood	X			
Asteraceae	*	*Senecio madagascariensis*	Fireweed, Madagascar Ragwort	X	X	X	

Family		Botname	Common name	M5 Corridor	Graham Ave	Moorebank Ave	Heathcote Rd
Asteraceae	*	*Senecio pterophorus*	African Daisy				X
Asteraceae	*	*Sonchus oleraceus*	Common Sow-thistle			X	X
Asteraceae	*	*Tagetes minuta*	Stinking Roger		X		
Asteraceae	*	*Taraxacum officinale*	Dandelion		X	X	X
Avicenniaceae		*Avicennia marina*	Grey Mangrove	X			
Basellaceae	*	*Anredera cordifolia*	Madeira Vine, Lamb's Tail, Jalap		X	X	
Bignoniaceae	*	*Jacaranda mimosifolia*	Jacaranda			X	
Brassicaceae	*	*Brassica sp.*			X		X
Brassicaceae	*	*Lepidium bonariense*	Cut-leaf Peppercress		X		
Brassicaceae	*	*Sisymbrium sp.*		X			
Cactaceae	*	*Opuntia stricta*	Prickly Pear, Common Pest Pear				
Casuarinaceae		*Allocasuarina littoralis*	Black She-Oak		X		
Casuarinaceae		*Casuarina cunninghamiana*	River Oak, River She-oak	X			
Casuarinaceae		*Casuarina glauca*	Swamp Oak, Swamp She-oak	X	X		X
Chenopodiaceae	*	*Atriplex prostrata*	Mat Saltbush, Hastate Orache	X			
Chenopodiaceae		*Atriplex semibaccata*	Creeping Saltbush	X	X		
Chenopodiaceae	*	*Chenopodium album*	Fat Hen		X	X	
Chenopodiaceae		*Einadia hastata*	Berry Saltbush	X	X		
Chenopodiaceae		*Einadia nutans subsp. linifolia*	Climbing Saltbush		X		
Chenopodiaceae		*Einadia nutans subsp. nutans*	Climbing Saltbush	X	X		
Chenopodiaceae		*Einadia trigonos*	Fishweed	X	X		
Chenopodiaceae		*Salsola kali var. strobilifera*	Roly-Poly, Buckbush		X		
Chenopodiaceae		*Sarcocornia quinqueflora*	Glasswort, Samphire	X			
Chenopodiaceae		*Suaeda australis*	Seablite	X			
Convolvulaceae		*Convolvulus erubescens*	Native Bindweed		X		
Convolvulaceae		*Dichondra repens*	Kidney-weed, Mercury Bay Weed	X	X		
Convolvulaceae		*Wilsonia backhousei*	Narrow-leafed Wilsonia	X			
Crassulaceae	*	*Bryophyllum pinnatum*	Air Plant		X		
Euphorbiaceae	*	*Euphorbia peplus*	Petty Spurge, Radium Plant			X	
Euphorbiaceae		*Glochidion ferdinandi*	Cheese Tree			X	
Euphorbiaceae		*Phyllanthus virgatus*					
Euphorbiaceae	*	*Ricinus communis*	Castor Oil Plant			X	X
Euphorbiaceae	*	*Sapium sebiferum*	Chinese Tallow Tree				X
Fabaceae Caesalpinioideae	*	*Senna pendula var. glabrata*	Senna			X	X
Fabaceae Faboideae		*Desmodium varians*	Slender Tick-trefoil				
Fabaceae Faboideae		*Dillwynia sieberi*	Prickly Parrot Pea				
Fabaceae Faboideae	*	*Erythrina crista-galli*	Cockspur Coral Tree			X	
Fabaceae Faboideae	*	*Genista linifolia*	Broom			X	
Fabaceae Faboideae		*Glycine clandestina*	Twining Glycine	X			

Family		Botname	Common name	M5 Corridor	Graham Ave	Moorebank Ave	Heathcote Rd
Fabaceae Faboideae		*Glycine tabacina*	Variable Glycine		X		
Fabaceae Faboideae		*Hardenbergia violacea*	False Sarsaparilla				X
Fabaceae Faboideae		*Indigofera australis*	Native Indigo		X		
Fabaceae Faboideae	*	*Medicago sp.*	Medic		X		
Fabaceae Faboideae	*	*Psoralea pinnata*	African Scurf-pea	X			
Fabaceae Faboideae	*	*Trifolium pratense*	Red Clover	X			
Fabaceae Faboideae	*	*Trifolium repens*	White Clover	X			
Fabaceae Faboideae		*Vicia sativa*				X	X
Fabaceae Faboideae		*Zornia dyctiocarpa*	Zornia				
Fabaceae Mimosoideae	#	*Acacia baileyana*	Cootamundra Wattle	X			
Fabaceae Mimosoideae		*Acacia binervia*	Coast Myall	X			
Fabaceae Mimosoideae		*Acacia decurrens*	Black Wattle	X	X	X	X
Fabaceae Mimosoideae		*Acacia falcata*	Sickle Wattle	X	X		
Fabaceae Mimosoideae		*Acacia fimbriata*	Fringed Wattle		X		X
Fabaceae Mimosoideae		*Acacia implexa*	Hickory Wattle	X			X
Fabaceae Mimosoideae		*Acacia linearifolia*		X			
Fabaceae Mimosoideae		*Acacia longifolia*	Sydney Golden Wattle			X	
Fabaceae Mimosoideae		*Acacia parramattensis*	Parramatta Wattle	X	X	X	
Fabaceae Mimosoideae		*Acacia pubescens*	Downy Wattle	X			
Fabaceae Mimosoideae	#	*Acacia saligna*	Golden Wreath Wattle	X			X
Hamamelidaceae	*	*Liquidambar styraciflua*	Liquidambar, Sweet Gum			X	
Lamiaceae		*Westringia fruticosa*	Coast Rosemary	X			
Lauraceae	*	*Cinnamomum camphora*	Camphor-laurel			X	
Lentibulariaceae		*Utricularia gibba*	Floating Bladderwort			X	
Loranthaceae		*Amyema sp.*	Mistletoe		X		
Lythraceae	*	*Lagerstroemia indica cv. (unidentified)*	Crape Myrtle			X	
Malaceae	*	*Cotoneaster sp.*			X	X	
Malvaceae	*	*Malva sp.*	Mallow		X		
Malvaceae	*	*Modiola caroliniana*	Red-flower Mallow	X	X		
Malvaceae	*	*Sida rhombifolia*	Paddy's Lucerne	X	X	X	X
Meliaceae		*Melia azedarach*	White Cedar, Persian Lilac			X	X
Moraceae	*	*Morus alba*	Mulberry			X	X
Myrsinaceae		*Aegiceras corniculatum*	River Mangrove	X			
Myrtaceae		*Callistemon rigidus*	Stiff Bottlebrush	X			
Myrtaceae	#	*Callistemon viminalis*	Weeping Bottlebrush			X	X
Myrtaceae	#	*Corymbia citriodora*	Lemon-scented Gum			X	
Myrtaceae		*Corymbia ficifolia*	Red Flowering Gum			X	
Myrtaceae		*Corymbia maculata*	Spotted Gum	X	X	X	
Myrtaceae		*Eucalyptus amplifolia*	Cabbage Gum		X	X	

Family		Botname	Common name	M5 Corridor	Graham Ave	Moorebank Ave	Heathcote Rd
Myrtaceae		*Eucalyptus crebra*	Narrow-leaved Ironbark	X	X		
Myrtaceae		*Eucalyptus eugenioides*	Thin-leaved Stringybark				
Myrtaceae		*Eucalyptus fibrosa*	Broad-leaved Red Ironbark		X		
Myrtaceae		*Eucalyptus globoidea*	White Stringybark		X		
Myrtaceae	#	*Eucalyptus microcorys*	Tallowwood			X	
Myrtaceae		*Eucalyptus moluccana*	Grey Box	X	X		
Myrtaceae	#	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint			X	
Myrtaceae		*Eucalyptus punctata*	Grey Gum		X		
Myrtaceae		*Eucalyptus robusta*	Swamp Mahogany			X	X
Myrtaceae		*Eucalyptus sideroxylon*	Mugga, Red Ironbark		X		X
Myrtaceae		*Eucalyptus sp.*		X			
Myrtaceae		*Eucalyptus tereticornis*	Forest Red Gum	X	X	X	X
Myrtaceae		*Kunzea ambigua*	Tick-bush	X			
Myrtaceae		*Kunzea parvifolia*	Violet Kunzea	X			
Myrtaceae		*Leptospermum laevigatum*	Coast Tea-tree	X			
Myrtaceae		*Lophostemon confertus*	Brush Box			X	
Myrtaceae	#	*Melaleuca armillaris*	Bracelet Honey-myrtle	X			
Myrtaceae		*Melaleuca decora*	White Cloud Tree	X			
Myrtaceae		*Melaleuca ericifolia*	Swamp Paperbark				X
Myrtaceae		*Melaleuca linariifolia*	Flax-leaved Paperbark		X		X
Myrtaceae		*Melaleuca nodosa*	Ball Honey-myrtle	X			
Myrtaceae		*Syncarpia glomulifera*	Turpentine	X			
Oleaceae	*	*Jasminum sp.*				X	
Oleaceae	*	*Ligustrum lucidum*	Broad-leaved Privet	X	X	X	
Oleaceae	*	*Ligustrum sinense*	Small-Leaved Privet			X	X
Oleaceae	*	*Olea europaea subsp. cuspidata*	African Olive		X	X	
Onagraceae	*	*Ludwigia peruviana*	Ludwigia			X	
Oxalidaceae		*Oxalis perennans*	Oxalis		X		
Oxalidaceae	*	*Oxalis sp.*				X	
Pittosporaceae		*Bursaria spinosa*	Australian Boxthorn	X	X		
Pittosporaceae		*Pittosporum undulatum*	Sweet Pittosporum	X	X		
Plantaginaceae	*	*Plantago lanceolata*	Plantain, Ribwort	X	X	X	X
Polygonaceae		*Persicaria sp.*	Knotweed				X
Polygonaceae	*	*Rumex crispus*	Curled Dock	X		X	X
Portulacaceae		*Portulaca oleracea*	Pigweed, Purslane	X			
Primulaceae		*Samolus repens*	Creeping Brookweed	X			
Proteaceae		*Banksia spinulosa var. collina*	Hill Banksia	X			
Proteaceae	#	*Grevillea robusta*	Silky Oak	X		X	
Proteaceae	#	*Grevillea sp. (cultivar)*		X	X		
Proteaceae		*Hakea sericea*	Needlebush, Silky Hakea	X	X		

Family		Botname	Common name	M5 Corridor	Graham Ave	Moorebank Ave	Heathcote Rd
Proteaceae		*Hakea sp.*		X			
Ranunculaceae		*Ranunculus sp. (unidentified)*				X	
Rosaceae	*	*Rubus fruticosus (sp. agg)*	Blackberry	X		X	
Rubiaceae		*Asperula conferta*	Common Woodruff				
Rubiaceae	*	*Galium aparine*	Cleavers, Goose-grass				X
Salicaceae	*	*Populus sp. (unidentified)*	Poplar			X	
Salicaceae	*	*Salix babylonica*	Weeping Willow			X	X
Sapindaceae	*	*Cardiospermum grandiflorum*	Balloon Vine	X			
Solanaceae	*	*Cestrum parqui*	Green Cestrum				X
Solanaceae	*	*Datura stramonium*	Common Thornapple				X
Solanaceae	*	*Lycium ferocissimum*	African Boxthorn	X	X		
Solanaceae	*	*Solanum nigrum*	Blackberry Nightshade	X		X	
Solanaceae	*	*Solanum sp.*		X			
Verbenaceae	*	*Lantana camara*	Lantana			X	
Verbenaceae	*	*Verbena bonariensis*	Purpletop	X	X		X
Verbenaceae	*	*Verbena brasiliensis*		X	X		
Verbenaceae	*	*Verbena officinalis*	European Vervain				
Verbenaceae	*	*Verbena rigida*	Purple Verbena			X	
4. Monocotyledons							
Alliaceae	*	*Nothoscordum borbonicum*	Onion Weed				X
Araceae	*	*Monstera deliciosa*	Fruit-salad Plant, Guembe;			X	
Arecaceae	*	*Phoenix canariensis*	Canary Island Date		X		X
Asparagaceae	*	*Asparagus asparagoides*	Bridal Creeper		X		X
Asparagaceae	*	*Asparagus sp.*		X			
Commelinaceae	*	*Tradescantia fluminensis*	Wandering Jew			X	X
Commelinaceae	*	*Tradescantia pallida*	Purple Queen				
Cyperaceae		*Bolboschoenus fluviatilis*	Club-rush				X
Cyperaceae		*Carex inversa*	Knob Sedge		X		
Cyperaceae	*	*Cyperus eragrostis*	Drain Flat-sedge			X	
Cyperaceae		*Cyperus gracilis*	Slender Sedge		X		
Cyperaceae		*Cyperus sp.*		X			
Doryanthaceae	#	*Doryanthes palmeri*	Gigantic Lily	X			
Iridaceae	*	*Crocosmia x crocosmiiflora*	Montbretia				
Juncaceae	*	*Juncus acutus*	Spiny Rush	X		X	X
Juncaceae		*Juncus kraussii subsp. australiensis*	Sea Rush	X			
Juncaceae		*Juncus sp.*	Rush	X			
Juncaceae		*Juncus usitatus*		X			X
Lomandraceae		*Lomandra filiformis subsp. filiformis*	Wattle Mat-rush				
Lomandraceae		*Lomandra longifolia*	Spiny-headed Mat-rush	X	X		
Lomandraceae		*Lomandra multiflora*	Many-flowered Mat-rush	X			

Family		Botname	Common name	M5 Corridor	Graham Ave	Moorebank Ave	Heathcote Rd
Phormiaceae		*Dianella longifolia*	Smooth Flax-lily				
Poaceae		*Aristida vagans*	Threeawn Speargrass				
Poaceae		*Austrodanthonia racemosa*	Wallaby Grass				
Poaceae		*Austrodanthonia sp.*	Wallaby Grass	X	X		
Poaceae	*	*Avena sp.*	Wild Oats	X	X		
Poaceae		*Bothriochloa macra*	Red-leg Grass		X		
Poaceae	*	*Briza subaristata*	Quaking Grass	X		X	
Poaceae	*	*Bromus catharticus*	Prairie Grass	X			
Poaceae	*	*Chloris gayana*	Rhodes Grass	X	X		X
Poaceae		*Chloris truncata*	Windmill Grass		X		
Poaceae		*Chloris ventricosa*	Tall Windmill Grass		X		
Poaceae		*Cymbopogon refractus*	Barbed Wire Grass				
Poaceae	*	*Cynodon dactylon*	Couch, Bermuda Grass	X	X	X	X
Poaceae		*Dichelachne micrantha*	Shorthair Plumegrass			X	
Poaceae	*	*Echinochloa crus-galli*	Barnyard Grass	X			
Poaceae	*	*Ehrharta erecta*	Panic Veldgrass	X			
Poaceae	*	*Eragrostis curvula*	African Lovegrass	X	X	X	
Poaceae		*Eragrostis leptostachya*	Paddock Lovegrass				
Poaceae		*Eriochloa pseudoacrotricha*	Early Spring Grass		X		
Poaceae	*	*Lolium perenne*	Perennial Ryegrass	X			
Poaceae		*Microlaena stipoides*	Meadow Rice-grass			X	
Poaceae	*	*Nassella neesiana*	Chilean Needle Grass	X	X		
Poaceae	*	*Panicum maximum*	Guinea Grass	X	X		X
Poaceae		*Paspalidium distans*	Spreading Panicgrass				
Poaceae	*	*Paspalum dilatatum*	Paspalum	X	X		X
Poaceae		*Paspalum distichum*	Water Couch	X			
Poaceae	*	*Paspalum urvillei*	Vasey Grass	X			X
Poaceae	*	*Pennisetum clandestinum*	Kikuyu	X	X	X	X
Poaceae	*	*Phalaris aquatica*	Phalaris		X	X	
Poaceae	*	*Setaria gracilis*	Slender Pigeon Grass	X	X	X	X
Poaceae	*	*Sporobolus africanus*	Parramatta Grass		X	X	
Poaceae		*Sporobolus creber*	Slender Rat's-tail Grass		X		
Poaceae		*Sporobolus virginicus*	Sand Couch	X			
Poaceae	*	*Stenotaphrum secundatum*	Buffalo Grass	X		X	
Poaceae		*Themeda australis*	Kangaroo Grass				
Pontederiaceae	*	*Eichhornia crassipes*	Water Hyacinth			X	
Typhaceae		*Typha orientalis*	Broad-leaf Cumbungi	X			X

Incidental Fauna Observations

Common Name	Scientific Name	Native
Birds		
Australian Magpie	*Gymnorhina tibicen*	Y
Australian Raven	*Corvus coronoides*	Y
Common Myna	*Acridotheres tristis*	N
Double-barred Finch	*Taeniopygia bichenovii*	Y
Sulfur-crested Cockatoo	*Cacatua galerita*	Y
Variegated Fairy-wren	*Malurus lamberti*	Y
Willie Wagtail	*Rhipidura leucophrys*	Y
Reptiles		
Red-bellied Black Snake	*Pseudechis porphyriacus*	Y
Fish		
Eel	*Anguilla* sp.	Y
Mosquito Fish	*Gambusia holbrooki*	N

Appendix E Impact assessment

E.1 NSW Impact Assessment

An assessment of the impacts of the proposal on species listed on Schedule 2 of the TSC Act has been undertaken. The proposal will be assessed under Part 3A of the EP&A Act and consequently this impact assessment was undertaken in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC 2005).

The Study Area supports large remnants extensive areas of native vegetation including the TSC Act and EPBC Act listed Endangered Ecological Communities which are potential and known habitat for a number of threatened flora and fauna species. The Subject Site itself has been subject to a history of modification due to the original development of the M5 West Motorway, subsequent landscaping and maintenance activities to the extent that only small, isolated patches of remnant vegetation remain.

A full list of threatened species recorded within a 5 km radius of the Subject Site is found in Appendix B, however not all of these species or their habitat are likely to be impacted by the proposal. Potentially impacted species are listed below in Table 18. Each flora species has been assessed separately and the three insectivorous bats have been assessed as a group for potential impacts that may result from the proposal.

Table 18: Threatened species and ecological communities known to or with the potential to occur within the Subject Site.

Scientific Name	Common Name	Conservation Significance		Likelihood of Occurrence
		TSC Act	EPBC Act	
Flora				
Acacia pubescens	Downy Wattle	V	V	Yes
Doryanthes palmeri	Giant Spear Lily	V	-	Yes
Fauna				
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Potential
Miniopterus orianae oceanensis	Eastern Bent-wing Bat	V	—	Potential
Mormopterus norfolkensis	Eastern Freetail Bat	V	—	Potential
Litoria aurea	Green and Golden Bell Frog	E	V	Potential
Endangered Ecological Communities				
Cooks River/Castlereagh Ironbark Forest		E	-	Yes
Cumberland Plain Woodland		CE	CE	Yes
River Flat Eucalypt Forest		E	-	Yes

Scientific Name	Common Name	Conservation Significance		Likelihood of Occurrence
		TSC Act	EPBC Act	
Shale Gravel Transition Forest		E	CE	Yes, however no clearing is proposed within or adjoining this vegetation community, therefore no impact assessments have been prepared.
Swamp Oak Floodplain Forest		E	-	Yes

E.1.1 Threatened flora

Downy Wattle (*Acacia pubescens*)

Acacia pubescens (Downy Wattle) is a spreading to slightly weeping shrub 1-5 m high with bipinnate leaves and conspicuously hairy branchlets. It is chiefly restricted to the Cumberland Plain, with recordings from Bardwell Valley to Oakdale and Mountain Lagoon (NPWS 2003). Downy Wattle is listed as vulnerable on the TSC Act and EPBC Act.

Downy Wattle occurs on alluviums, shales and at the transition between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Downy Wattle occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest (TSC Act EEC), Shale/ Gravel Transition Forest (TSC Act EEC, EPBC Act CEEC) and Cumberland Plain Woodland (TSC Act and EPBC Act CEEC) (DECC 2010b).

Downy Wattle is predominantly a clonal species with the majority of reproduction occurring vegetatively. The percentage of pod production and seed fall are relatively low for this species (DECC 2010b).

Numerous Downy Wattle individuals have been planted along the M5 West Motorway as part of the original landscaping, particularly around bridge abutments east of Moorebank Road. These planted individuals are mentioned in the Recovery Plan for *Acacia pubescens* (NPWS 2003).

Approximately 76 Downy Wattle stems would be required to be removed as part of the M5 upgrade. This constitutes the loss of 40% of the planted population of Downy Wattle within the M5 West Motorway corridor. An additional 113 Downy Wattle stems have been observed within the Study Area (within the M5 Motorway corridor) and are unlikely to be impacted by the proposal. Within the region (5km) there are approximately 1,300 Downy Wattle records in the NPWS Atlas including those identified in the M5 Motorway Corridor (DECCW 2010a). Many of the records in the NPWS Atlas do not contain information on the number of individuals at each site, nor were any of the locations visited to confirm whether the populations still existed. In the case that no information was available for the number of individuals at each site, it was assumed that only one plant was recorded. This may have resulted in an underestimate of the size of the regional population, however as the current status of the populations was not verified this estimate is considered to be reasonable assumption. From this data it can be determined that the removal of 76 Downy Wattle stems from the M5 Motorway equates to the removal of 6% of the population from the region.

During the assessment of impact for this species a number of uncertainties arose which are detailed below:

- **The precise nature of the Downy Wattle planting**. The environmental impact assessment for the original M5 Motorway (DMR 1986) noted the presence of the rare plant *Acacia pubescens* (Downy Wattle) and recommended mitigation of impacts through seed collection, propagation and replanting. At the time of the original assessment, Downy Wattle was coded as an endangered species with a very restricted distribution on the Rare or Threatened Plants list (ROTAP); however the ROTAP list does not have any legal status. The federal *Endangered Species Protection Act 1992* (ESP Act) did not come into effect until the project was officially completed in 1992. Hence while the Downy Wattle was included as part of the original M5 Motorway landscaping in order to increase the size of the local population and reduce the potential impacts on this species, it is unclear as to whether there was any legislative requirement to do so.

- **Source material for the planted population**. The original environmental assessment (DMR 1986) identified six populations which would be impacted by the M5 Motorway construction. To minimise the potential impacts of the motorway construction, it was intended that seed from the impacted Downy Wattle populations be collected for replanting. Due to the original M5 Motorway being completed nearly 20 years ago, no records could be located to determine whether seed or cuttings were actually collected from the impacted populations or from adjoining populations. In addition, as Downy Wattle is a clonal species it is impossible to quantify the importance of the original populations and there is potential for all the planted Downy Wattles to have come from one individual. As such, there is potential that the genetic material of the planted Downy Wattle is either of very high or low conservation significance depending on its origin. In the absence of genetic information, the impact assessment has assumed that the planted population is of high conservation significance.

In accordance with the objectives of the EP&A Act, the precautionary principle has been applied and for this impact assessment it has been assumed that the Downy Wattle within the M5 Motorway Corridor have been planted as compensatory habitat and constitute genetic material from populations which no longer exist within the locality.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposed upgrade to the M5 West Motorway requires the removal of 76 of the 189 (40%) Downy Wattle individuals stems within the Motorway Corridor to facilitate road widening. This equates to a loss of 6% of the regional distribution of this species.

The population of Downy Wattle within the Subject Site was originally sourced from seed sourced from *in situ* plants prior to development. The plants within the Subject Site may be genetically distinct from populations of Downy Wattle that occur in proximity to the study area.

As the Downy Wattle population within the Study Area may be genetically distinct from adjoining populations, the proposal will include measures to preserve the genetic diversity within the study area by gathering seed and cuttings from plants to be removed.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Considering the modifications to the soil profile which were originally undertaken for the construction of the M5 West Motorway, only small, isolated patches of naturally occurring vegetation and soil profiles remain on the Subject Site. As such, whilst the proposal will remove planted Downy Wattle, only limited natural habitat for Downy Wattle remains within the Subject Site.

As the central median and road verges consists predominantly of mown exotic grasses with occasional plantings, it is not considered likely that any of the landscaped vegetation could be considered as suitable habitat for this species. The origins of the soils within the areas supporting Downy Wattle are unknown, but as this species has survived for more than ten years in these locations, they are likely to be local shale soils suitable for the survival of this species.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Downy Wattle is restricted to the Sydney region, with its' distribution concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon (NPWS 2003). The occurrence of Downy Wattle at the Subject Site does not constitute the potential limit of its known distribution.

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the corridor (particularly weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

How is the proposal likely to affect habitat connectivity?

The Subject Site no longer constitutes natural habitat for Downy Wattle considering the modification to the soil profile which were originally undertaken for the construction of the M5 West Motorway. While Downy Wattle is likely to have naturally occurred within the Subject Site, extensive past development within the study area (in particular the median and cut and fill batters) has compromised the habitat for the species. The presence of planted Downy Wattle individuals within the M5 West Motorway may represent additional genetic resources, although considering the current disturbance regime (particularly weed invasion, noise and traffic flow); it is unlikely that genetic material would be successfully transferred to adjoining populations by natural pollinators.

The removal of seventy-six Downy Wattle stems from the M5 Motorway is unlikely to affect the habitat connectivity for adjoining natural populations of these species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Giant Spear Lily (*Doryanthes palmeri*)

Giant Spear Lily is a large, succulent herb which grows as a rosette. The Giant Spear Lily has sword-shaped leaves up to 3 m long and 20 cm wide. The flowering stalk is up to 5 m high, and bears numerous much shorter leaves to 30 cm long (DECCW 2010b). Giant Spear Lily occurs in far north-east NSW and south-east Queensland. In NSW, it occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen (DECCW 2010b). The Giant Spear Lily is listed as vulnerable on the TSC Act.

The Giant Spear Lily is native in northern NSW in the Northern Rivers bioregion and has been included as part of the landscaping adjoining bridge abutments in the west of the Subject Site. This species is a relatively commonly planted landscape species and is easily confused with the Gymea Lily (*Doryanthes excelsa*) with which it is closely related. There is likely to be a mixture of Gymea Lily and Giant Spear Lily in these landscaped areas. No quantification of the number of Giant Spear Lily individuals required to be cleared has been undertaken. This is due to the fact that this species has clearly been planted as part of the M5 landscaping and is well outside the natural range for this species.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposed upgrade to the M5 West Motorway requires the removal of a number of planted Giant Spear Lily individuals within the central median to facilitate road widening. As this species is native to northern NSW, the proposed removal of a number of Giant Spear Lily individuals is unlikely to affect the lifecycle of the naturally occurring population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

As this species is native to northern NSW, the proposal is not likely to affect the habitat of the Giant Spear Lily.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Giant Spear Lily is restricted to far north-east NSW and Queensland and does not naturally occur in the Sydney region. The planted occurrences of Giant Spear Lily at the Subject Site do not constitute the potential limit of its known distribution.

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the median (particularly weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes within the median. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

How is the proposal likely to affect habitat connectivity?

The Subject Site and Study Area do not constitute natural habitat for the Giant Spear Lily and, therefore, the proposal is unlikely to affect the habitat connectivity for this species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

E.1.2 Threatened fauna

Bats

- **Large-eared Pied Bat - *Chalinolobus dwyeri***
- **Eastern False Pipistrelle - *Falsistrellus tasmaniensis***
- **Eastern Bent-wing Bat - *Miniopterus orianae oceanensis***
- **Eastern Freetail Bat - *Mormopterus norfolkensis***
- **Large footed Myotis - *Myotis macropus***
- **Yellow-bellied Sheathtail-bat - *Saccolaimus flaviventris***
- **Greater Broad-nosed Bat - *Scoteanax rueppellii***

Mormopterus norfolkensis (Eastern Freetail Bat) occurs along the east coast of Australia from southeast Queensland to southern New South Wales, mainly in dry eucalypt forest and woodland to the east of the Great Dividing Range (Allison and Hoye 1995). The Eastern Freetail Bat feeds on flying insects over the tops of trees or along the edges of forests and roosts in hollows or under the loose bark of trees in open forests, and may roost together in small colonies.

Miniopterus orianae oceanensis (Eastern Bent-wing Bat) is a wide ranging species which is essentially an obligate cave rooster (although it sometimes roosts in disused mines) that utilises a wide variety of habitats for foraging (Churchill 1998).

Chalinolobus dwyeri (Large-eared Pied Bat) is also a wide ranging species (Rockhampton to the NSW Southern Highlands) and is found in areas with extensive cliffs and caves (DECCW 2010b).

Falsistrellus tasmaniensis (Eastern False Pipistrelle) is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (DECCW 2010b)

Myotis macropusis (Large footed Myotis) is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria (DECCW 2010b)

Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat) is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn (DECCW 2010b).

Scoteanax rueppellii (Greater Broad-nosed Bat) is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland

The majority of these species apparently tolerate relatively high levels of disturbance (having been recorded via ANABAT detection and trapping within environments with frequent traffic-generated noise). It is considered that lighting from the M5 West Motorway could potentially attract prey for these species, allowing the potential for the species to occur within the Subject Site

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

A number of these species which may potentially roost under loose bark have the potential to roost on the Subject Site; however, there are limited opportunities due to the relative age of the landscaped vegetation on the site. In addition, no hollow bearing trees are present within the Subject Site.

All of these species have the potential to forage on the Subject Site on occasion. The proposal is likely to result in the removal of minor foraging habitat these species and is not likely to affect the lifecycle for these species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Only minor foraging habitat is likely to be removed from the Subject Site. This foraging habitat consists of landscaped vegetation within the central median of the M5 West Motorway and is not likely to be important to these species considering the suitability of habitat elsewhere in the Study Area. The proposal is unlikely to modify the conditions (e.g. lighting) which may currently attract these species to the Subject Site.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The potential occurrence of these species at the Subject Site does not constitute the potential limit of their known distribution.

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the median (particularly weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes within the median. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

How is the proposal likely to affect habitat connectivity?

The vegetation proposed to be cleared within the Subject Site consists primarily of mown exotic grasses with occasional landscape plantings. This vegetation is already highly fragmented within the landscape, therefore, the proposal is unlikely to affect the habitat connectivity for these species.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Litoria aurea (Green and Golden Bell Frog)

Green and golden bell frogs are found in marshes, dams and stream-sides and their optimum habitat includes water-bodies that are unshaded, free of predatory fish such as *Gambusia holbrooki* (Plague Minnow), and have a grassy area nearby and diurnal sheltering sites available.

Numerous NPWS Atlas records for the Green and Golden Bell Frog have been recorded within 10 km of the impact area and while it was not recorded in the study area during the current study, it has the potential to occur. Most of the past records for the species occur in the vicinity of the Georges River

bridge at Milperra and the nearest record to the identified potential habitat within the study area is approximately 1km west, closer to the Georges River.

Two areas were identified within the Subject Site as potential habitat for the Green and Golden Bell Frog (Figure 8). The potential habitat for this species includes a drainage line within the M5 Motorway corridor and an adjoining sedimentation basin within close proximity to the Subject Site which are both characterised by the presence of *Typha orientalis* (Broad-leaf Cumbungi). No targeted surveys for the Green and Golden Bell Frog were undertaken as part of this project. The potential habitat identified is linked to the Georges River via open drainage; however there may be some obstacles that hamper frequent migration of adults to and from the potential habitat to the Georges River.

There is potential that habitat for this species could occur at other locations within the vicinity of the Subject Site and would include similar structures (particularly in those areas behind noise walls and outside of the road corridor). While these disturbed areas are considered potential habitat for the Green and Golden Bell Frog, it is acknowledged by DECC (2008) that there is no direct evidence available to suggest these areas function as breeding habitat. The presence of the Plague Minnow at the subject site is likely to reduce the ability of the Green and Golden Bell Frog to breed and have successful recruitment, hence breeding habitat not likely to occur at the subject site. In addition, while a key population of the Green and Golden Bell Frog has been identified in the vicinity of the Subject Site (DECC 2008), the species is most likely to utilise significant wetland habitat on adjoining lands such as Hammondville Golf Course. As such, the potential habitat for the Green and Golden Bell Frog within the Subject Site is considered minor in terms of the long term conservation of the species.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal has the potential to adversely affect the potential Green and Golden Bell Frog habitat identified through temporary alteration of habitat and pollution of habitat through stormwater runoff. The proposed upgrade to the M5 Motorway includes mitigation measures to ensure the potential habitat for the Green and Golden Bell Frog is retained. Additional mitigation measures including habitat reconstruction have been proposed (Table 14).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal will result in the temporary modification to approximately 0.18 ha of potential Green and Golden Bell Frog habitat which constitutes 47% of the potential habitat within the Subject Site.

While these disturbed areas are considered potential habitat for the Green and Golden Bell Frog, it is acknowledged by DECC (2008) that there is no direct evidence available to suggest these areas function as breeding habitat. In addition, while a key population of the Green and Golden Bell Frog has been identified in the vicinity of the Subject Site (DECC 2008), the species is most likely to utilise significant wetland habitat on adjoining lands such as Hammondville Golf Course. As such, the potential habitat for the Green and Golden Bell Frog within the Subject Site is considered minor in terms of the long term conservation of the species.

The potential habitat for the Green and Golden Bell Frog which has been identified at the Subject Site is to be retained as part of the proposal.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The potential occurrence of the Green and Golden Bell Frog at the Subject Site does not constitute the potential limit of its' known distribution.

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the Subject Site (particularly stormwater runoff, weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

How is the proposal likely to affect habitat connectivity?

The vegetation proposed to be cleared within the Subject Site consists primarily of mown exotic grasses with occasional landscape plantings. This vegetation is already highly fragmented within the landscape, therefore, the proposal is unlikely to affect the habitat connectivity for these species.

In addition, mitigation measures including habitat reconstruction have been proposed (Table 14) which are likely to increase the amount of potential habitat within the Study Area.

How is the proposal likely to affect critical habitat?

No critical habitat has been declared for the Green and Golden Bell Frog.

E.1.3 Endangered Ecological Communities

Cooks River/Castlereagh Ironbark Forest

Cooks River/Castlereagh Ironbark Forest only occurs in western Sydney, and the extent of intact remnants is now reduced to 1011 ha, with the most extensive stands occurring in the Castlereagh and Holsworthy areas (DECCW 2010b). Several small remnants of Cooks River/Castlereagh Ironbark Forest have been mapped in the east of the Subject Site between King Georges Road and Salt Pan Creek.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal requires the removal of 0.35 ha of degraded Cooks River/Castlereagh Ironbark Forest from the Subject Site for the installation of a permanent soil re-use area. This small patch is isolated from other areas of Cooks River/Castlereagh Ironbark Forest and has been subject to a history of degradation since the construction of the original M5 Motorway. The removal of 0.35 ha of Cooks River/Castlereagh Ironbark Forest from the Subject Site constitutes a loss of 7% of this community from the Study Area (within the M5 Motorway corridor). The loss of this small patch of Cooks River/Castlereagh Ironbark Forest is not considered to be significant for the ecological community in the locality.

There is potential for this patch of Cooks River/Castlereagh Ironbark Forest to be retained at a later stage as part of the detailed design. Mitigation measures have been proposed to reduce the impact of the proposal on this EEC (Table 14).

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the Subject Site (particularly stormwater runoff, weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

Considering the proposed upgrade to the M5 Motorway is to be largely accommodated within the existing grassed median, it is not expected that the proposal will result in further degradation of surrounding vegetation communities.

How is the proposal likely to affect habitat connectivity?

This Cooks River/Castlereagh Ironbark Forest at the Subject Site is already highly fragmented within the landscape, therefore, the proposal is unlikely to further affect the habitat connectivity for this EEC.

In addition, mitigation measures have been proposed (Table 14) which may result in the retention of this small patch of Cooks River/Castlereagh Ironbark Forest as part of the proposal.

How is the proposal likely to affect critical habitat?

No critical habitat has been declared for Cooks River/Castlereagh Ironbark Forest.

Cumberland Plain Woodland

Cumberland Plain Woodland occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin (DECCW 2010b). Before European settlement, was extensive across the Cumberland Plain, western Sydney. Today, only 9 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain (DECCW 2010b). Several small remnants of Cumberland Plain Woodland have been mapped in the west of the Subject Site between Graham Avenue, Casula and Beech Road, Prestons (Figures 8a-g).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal requires the removal of 0.32 ha of degraded Cumberland Plain Woodland from the Subject Site for the installation of a number of permanent spoil re-use areas and a sedimentation basin. These small patches are isolated from other areas of Cumberland Plain Woodland and have been subject to a history of degradation since the construction of the original M5 Motorway. The Cumberland Plain Woodland remaining in the M5 Motorway corridor consists of scattered remnant trees with a highly disturbed understorey.

The removal of 0.32 ha of Cumberland Plain Woodland from the Subject Site constitutes a loss of 24% of this community from the Study Area (within the M5 Motorway corridor). The loss these small patches of Cumberland Plain Woodland are not considered to be significant for the ecological community in the locality.

There is potential for the majority of these patches to be retained at a later stage as part of the detailed design. Mitigation measures have been proposed to reduce the impact of the proposal on this EEC (Table 14).

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the Subject Site (particularly stormwater runoff, weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

Considering the proposed upgrade to the M5 Motorway is to be largely accommodated within the existing grassed median, it is not expected that the proposal will result in further degradation of surrounding vegetation communities.

How is the proposal likely to affect habitat connectivity?

This Cumberland Plain Woodland at the Subject Site is already highly fragmented within the landscape, therefore, the proposal is unlikely to further affect the habitat connectivity for this EEC.

In addition, mitigation measures have been proposed (Table 14) which may result in the retention of the majority of the small patches of Cumberland Plain Woodland as part of the proposal.

How is the proposal likely to affect critical habitat?

No critical habitat has been declared for Cumberland Plain Woodland.

River Flat Eucalypt Forest

River Flat Eucalypt Forest is found on the river flats of the coastal floodplains, however the remaining area is likely to represent much less than 30% of its original range (DECCW 2010b). Several patches of River Flat Eucalypt Forest have been mapped in the central portion of the Subject Site on either side of the Georges River crossing, Milperra (Figures 8a-g). These patches are contiguous with much large patches of vegetation to the north and south of the M5 Motorway.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal requires the removal of 0.14 ha of degraded River Flat Eucalypt Forest from the Subject Site for the installation of two sedimentation basins. There is already localised disturbance at these locations from the original installation of existing sedimentation basins during the construction of the original M5 Motorway. These two areas have been subject to a history of degradation since the construction of the original M5 Motorway.

The removal of 0.14 ha of River Flat Eucalypt Forest from the Subject Site constitutes a loss of 10% of this community from the Study Area (within the M5 Motorway corridor). The loss these two patches of River Flat Eucalypt Forest is not considered to be significant for the ecological community in the locality.

Mitigation measures have been proposed to reduce the impact of the proposal on this EEC (Table 14).

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the Subject Site (particularly stormwater runoff, weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes.

The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

Considering the proposed upgrade to the M5 Motorway is to be largely accommodated within the existing grassed median, it is not expected that the proposal will result in further degradation of surrounding vegetation communities.

How is the proposal likely to affect habitat connectivity?

The removal of these two small areas of River Flat Eucalypt Forest is unlikely to significantly affect the connectivity of the adjoining areas of River Flat Eucalypt Forest. Extensive areas of this EEC occur to the south and north of the M5 Motorway.

How is the proposal likely to affect critical habitat?

No critical habitat has been declared for River Flat Eucalypt Forest.

Swamp Oak Floodplain Forest

Swamp Oak Floodplain Forest is associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains (DECCW 2010b). The remaining extent of Swamp Oak Floodplain Forest is likely to represent much less than 30% of its original range (DECCW 2010b). Several small patches of Swamp Oak Floodplain Forest have been mapped in the east of the Subject Site on the northern side of Bansgrove Road, Panania (Figures 8a-g). The vegetation within the Subject Site is contiguous with a much large patch of vegetation to the south of the M5 Motorway. The area of Swamp Oak Floodplain Forest identified corresponds directly to the area of potential Green and Golden Bell Frog habitat.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal requires the removal of 0.18 ha of degraded Swamp Oak Floodplain Forest from the Subject Site for the installation of two sedimentation basins. There is already localised disturbance at these locations from the original installation of existing sedimentation basins during the construction of the original M5 Motorway. These two adjoining areas have been subject to a history of degradation since the construction of the original M5 Motorway, however they have been colonised by *Casuarina glauca* (Swamp Oak) and *Typha orientalis* (Broad-leaved Cumbungi) since construction.

The removal of 0.18 ha of Swamp Oak Floodplain Forest from the Subject Site constitutes a loss of 61% of this community from the Study Area (within the M5 Motorway corridor). While this appears to be a relatively large impact within the corridor, there are significant areas of this EEC to the south of the M5 Motorway corridor which will be unaffected by the proposal, therefore the loss these two patches of Swamp Oak Floodplain Forest is not considered to be significant for the ecological community in the locality.

Mitigation measures have been proposed to reduce the impact of the proposal on this EEC (Table 14).

How is the proposal likely to affect current disturbance regimes?

Considering the current disturbances within the Subject Site (particularly stormwater runoff, weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded, the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

Considering the proposed upgrade to the M5 Motorway is to be largely accommodated within the existing grassed median, it is not expected that the proposal will result in further degradation of surrounding vegetation communities.

How is the proposal likely to affect habitat connectivity?

The removal of these two small areas of Swamp Oak Floodplain Forest is unlikely to significantly affect the connectivity of the adjoining areas of Swamp Oak Floodplain Forest. Extensive areas of this EEC occur to the south M5 Motorway and will be unaffected by the proposal.

How is the proposal likely to affect critical habitat?

No critical habitat has been declared for Swamp Oak Floodplain Forest.

E.2 Commonwealth Impact Assessment

An assessment of the impacts of the proposal on species listed on Schedule 1 of the EPBC Act has been undertaken. The proposal will be assessed under Part 3A of the EP&A Act and consequently this impact assessment was undertaken in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC 2005).

The Study Area supports large remnants extensive areas of native vegetation including the TSC Act and EPBC Act listed Endangered Ecological Communities which are potential and known habitat for a number of threatened flora and fauna species. The Subject Site itself has been subject to a history of modification due to the original development of the M5 West Motorway, subsequent landscaping and maintenance activities to the extent that only small, isolated patches of remnant vegetation remain.

A full list of threatened species recorded within a 5 km radius of the Subject Site is found in Appendix B, however not all of these species or their habitat are likely to be impacted by the proposal. Potentially impacted species are listed above in Table 18. Each species has been assessed separately for potential impacts that may result from the proposal.

E.2.1 Threatened flora

Downy Wattle (*Acacia pubescens*)

Significant Impact Criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

lead to a long-term decrease in the size of an important population of a species;

DEH (2006) defines an important population as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

It is unlikely that the population of Downy Wattle on the Subject Site could be considered a key source population for breeding or dispersal considering the disturbances within the M5 Motorway corridor (particularly weed invasion, noise and traffic flow).

The population of Downy Wattle in the corridor is not near the limit of the species range.

As the Downy Wattle individuals were planted as part of the original M5 Motorway landscaping, the genetic status of this population is unknown. If these individuals were grown from seed, they could potentially represent a significant resource for this species within the locality. There is potential that the population of Downy Wattle on the M5 Motorway may be considered an important population due to the source material, however there are a number of uncertainties regarding the nature of the habitat, genetic diversity and source of planted Downy Wattle:

- **The precise nature of the Downy Wattle Planting**. The environmental impact assessment for the original M5 Motorway (DMR 1986) noted the presence of the rare plant *Acacia pubescens* (Downy Wattle) and recommended mitigation of impacts through seed collection, propagation and replanting. At the time of the original assessment, Downy Wattle was coded as an endangered species with a very restricted distribution on the Rare or Threatened Plants list (ROTAP); however the ROTAP list does not have any legal status. Hence while the Downy Wattle was included as part of the original M5 Motorway landscaping in order to increase the size of the local population and reduce the potential impacts on this species, it is unclear as to whether there was any legislative requirement to do so.

- **Source material for the planted population**. The original environmental assessment (DMR 1986) identified six populations which would be impacted by the M5 Motorway construction. To minimise the potential impacts of the motorway construction, it was intended that seed from the impacted Downy Wattle populations be collected for replanting. Due to the original M5 Motorway being completed nearly 20 years ago, no records could be located to determine whether seed or cuttings were actually collected from the impacted populations or from adjoining populations. In addition, as Downy Wattle is a clonal species it is impossible to quantify the importance of the original populations and there is potential for all the planted Downy Wattles to have come from one individual. As such, there is potential that the genetic material of the planted Downy Wattle is either of very high or low conservation significance depending on its origin. In the absence of genetic information, the impact assessment has assumed that the planted population is of high conservation significance.

In accordance with the objectives of the EP&A Act, the precautionary principle has been applied and for this impact assessment it has been assumed that the Downy Wattle within the M5 Motorway corridor have been planted and constitute genetic material from populations which no longer exist within the locality.

reduce the area of occupancy of an important population;

The proposal requires the removal of 76 individual stems of Downy Wattle from the Subject Site (which equates to 40% of the local population and 6% of the regional population) and as a result, the area of occupancy of this population will be reduced.

fragment an existing important population into two or more populations;

The Subject Site no longer constitutes natural habitat for Downy Wattle considering the modification to the soil profile which were originally undertaken for the construction of the M5 West Motorway. While Downy Wattle is likely to have naturally occurred within the Subject Site, extensive past development within the study area (in particular the median and cut and fill batters) has compromised the habitat for the species. The presence of planted Downy Wattle individuals within the M5 West Motorway may represent additional genetic resources, although considering the disturbances within the median (particularly weed invasion, noise and traffic flow); it is unlikely that genetic material would be successfully transferred to adjoining populations by natural pollinators.

The removal of all of the 76 Downy Wattle stems from the Subject Site is not likely to fragment an important population as the entire Downy Wattle population within the Subject Site will be removed as a result of this proposal. An additional 113 Downy Wattle stems have been identified within the Study Area which are unlikely to be affected by the proposal.

adversely affect habitat critical to the survival of a species;

The Subject Site no longer constitutes natural habitat for Downy Wattle considering the modification to the soil profile which were originally undertaken for the construction of the M5 West Motorway. While Downy Wattle is likely to have naturally occurred within the Subject Site, extensive past development within the study area (in particular the median and cut and fill slopes) has compromised the habitat for the species.

The presence of planted Downy Wattle individuals within the M5 West Motorway may represent additional genetic resources, although considering the disturbances within the corridor (particularly weed invasion, noise and traffic flow); it is unlikely that genetic material would be successfully transferred to adjoining populations by natural pollinators.

As such, the proposal is unlikely to affect habitat critical to the survival of Downy Wattle in the locality.

disrupt the breeding cycle of an important population;

The proposed upgrade to the M5 West Motorway requires the removal of 76 of the 189 (40%) Downy Wattle individuals stems within the Motorway Corridor to facilitate road widening. This equates to a loss of 6% of the regional distribution of this species. The population of Downy Wattle within the Subject Site was originally sourced from seed sourced from *in situ* plants prior to development. The plants within the Subject Site may be genetically distinct from populations of Downy Wattle that occur in proximity to the study area. However, considering the current disturbance regime (particularly weed invasion, noise and traffic flow), it is unlikely that genetic material would be successfully transferred from the Downy Wattle to adjoining populations by natural pollinators (assumed to be insects such as beetles, wasps and bees as in other Acacia species).

As the Downy Wattle population within the Study Area may be genetically distinct from adjoining populations, the proposal will include measures to preserve the genetic diversity within the study area by gathering seed and cuttings from plants to be removed.

Therefore, the proposal is considered unlikely to disrupt the breeding cycle of an important population.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Considering the modifications to the soil profile which were originally undertaken for the construction of the M5 West Motorway, only limited naturally occurring vegetation or soil profiles remain on the Subject Site. As such, whilst the proposal will remove planted Downy Wattle, no natural habitat for Downy Wattle remains within the Subject Site.

As the central median and road verges consists predominantly of mown exotic grasses with occasional plantings, it is not considered likely that any of the landscaped vegetation could be considered as suitable habitat for this species. The origins of the soils within the areas supporting Downy Wattle are unknown, but as this species has survived for more than ten years in these locations, they are likely to be local shale soils suitable for the survival of this species.

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

The proposal is unlikely to result in invasive species becoming established in Downy Wattle habitat.

introduce disease that may cause the species to decline; or

The proposal is unlikely to result in the introduction of a disease which may cause local populations of Downy Wattle to decline.

interfere substantially with the recovery of the species.

As the population of Downy Wattle is acknowledged within the recovery plan, has most likely been planted as part of compensatory measures for the original development of the M5 West Motorway, and may represent significant genetic material which no longer exists in the locality, it is likely that the proposed action will substantially interfere with the recovery of Downy Wattle.

E.2.2 Threatened fauna

Large-eared Pied Bat (*Chalinolobus dwyeri*)

Significant Impact Criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

lead to a long-term decrease in the size of an important population of a species;

DEH (2006) defines an important population as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

While the Subject Site may provide occasional foraging resources for this species, given the roosting habitat requirements (cave roosting) for this species it is unlikely that any significant population would utilise the Subject Site regularly. As such, it is unlikely that there is an important population of the Large-eared Pied Bat on the Subject Site.

The proposal is unlikely to result in a long-term decrease in the size of an important population of the Large-eared Pied Bat.

reduce the area of occupancy of an important population;

As no important population is likely to occur on the Subject Site, the proposal is unlikely to reduce the area of occupancy of an important population of the Large-eared Pied Bat.

fragment an existing important population into two or more populations;

As no important population is likely to occur on the Subject Site, the proposal is unlikely to fragment an existing important population of the Large-eared Pied Bat

adversely affect habitat critical to the survival of a species;

Only minor foraging habitat is likely to be removed from the Subject Site. This foraging habitat consists of landscaped vegetation within the central median of the M5 West Motorway and is not likely to be important to the Large-eared Pied Bat considering the suitability of habitat elsewhere in the Study Area. The proposal is unlikely to modify the conditions (e.g. lighting) which may currently attract these species to the Subject Site.

disrupt the breeding cycle of an important population;

As no important population is likely to occur on the Subject Site, it is unlikely that the proposed removal of minor foraging habitat for the Large-eared Pied Bat would affect the breeding cycle of this species.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Considering the modifications to the soil profile which were originally undertaken for the construction of the M5 West Motorway, only limited areas of naturally occurring vegetation or soil profiles remain on the Subject Site. As such, no natural foraging habitat for the Large-eared Pied Bat remains within the Subject Site.

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

The proposal is unlikely to result in invasive species becoming established in habitat for the Large-eared Pied Bat. The removal of the weedy median from the motorway may actually reduce the spread of exotic perennial grasses into adjoining native vegetation communities.

introduce disease that may cause the species to decline; or

The proposal is unlikely to result in the introduction of a disease which may cause the Large-eared Pied Bat to decline.

interfere substantially with the recovery of the species.

The proposal is unlikely to substantially interfere with the recovery of this species.

Litoria aurea (Green and Golden Bell Frog)

Significant Impact Criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

lead to a long-term decrease in the size of an important population of a species;

DEH (2006) defines an important population as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;

- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

While the Subject Site may provide potential habitat for the Green and Golden Bell Frog, it is acknowledged by DECC (2008) that there is no direct evidence available to suggest these areas function as breeding habitat. In addition, while a key population of the Green and Golden Bell Frog has been identified in the vicinity of the Subject Site (DECC 2008), the species is most likely to utilise significant wetland habitat on adjoining lands such as Hammondville Golf Course. As such, the potential habitat for the Green and Golden Bell Frog within the Subject Site is considered minor in terms of the long term conservation of the species.

It is unlikely that any potential populations of the Green and Golden Bell Frog within the Subject Site would be considered to constitute 'important populations'.

reduce the area of occupancy of an important population;

As no important population is likely to occur on the Subject Site, the proposal is unlikely to reduce the area of occupancy of an important population of the Green and Golden Bell Frog. In addition, the proposal includes mitigation measures which may result in an increase in potential habitat for this species at the Subject Site.

fragment an existing important population into two or more populations;

As no important population is likely to occur on the Subject Site, the proposal is unlikely to fragment an existing important population of the Green and Golden Bell Frog. A key population of the Green and Golden Bell Frog has been identified in the vicinity of the Subject Site (DECC 2008), however this population is already fragmented by the existing M5 Motorway.

adversely affect habitat critical to the survival of a species;

The proposed upgrade to the M5 Motorway includes mitigation measures to ensure the potential habitat for the Green and Golden Bell Frog is retained. Upgrades to drainage infrastructure was proposed in the vicinity of the potential habitat, however design alterations have been undertaken to relocate the infrastructure to the northern side of the M5 Motorway and hence mitigate the impacts on the Green and Golden Bell Frog at this location. More suitable habitat for this species occurs in adjoining lands such as Hammondville Golf Course. The potential habitat for the Green and Golden Bell Frog within the Subject Site is not critical to the survival of this species.

disrupt the breeding cycle of an important population;

As no important population is likely to occur on the Subject Site, it is unlikely that the proposal would affect the breeding cycle of an important population of the Green and Golden Bell Frog. It is unlikely that the Subject Site would be utilised by this species for breeding.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The Green and Golden Bell Frog is known to inhabit highly degraded sites including roadsides and sedimentation ponds. Upgrades to drainage infrastructure was proposed in the vicinity of the potential habitat, however design alterations have been undertaken to relocate the infrastructure to the northern side of the M5 Motorway and hence mitigate the impacts on the Green and Golden Bell Frog at this

location. Additional mitigation measures including habitat reconstruction have been proposed (Table 14).

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

Gambusia holbrooki (Plague Minnow) was recorded in a number of sediment basins along the Subject Site and in Anzac Creek at the Moorebank Ave construction compound site. Predation by the Plague Minnow is listed as a Key Threatening Process under the *TSC Act*. The presence of this species in the sediment basins within the study area is likely to reduce the ability of the Green and Golden Bell Frog to breed in these habitats and have successful recruitment.

The proposal is unlikely to result in the Plague Minnow becoming established in Green and Golden Bell Frog Habitat,

introduce disease that may cause the species to decline; or

Considering the presence of the existing M5 Motorway in Green and Golden Bell Frog habitat, the proposed upgrade to the motorway is unlikely to increase the risk of introduction of a disease which may cause the Green and Golden Bell Frog to decline.

interfere substantially with the recovery of the species.

The proposal is unlikely to substantially interfere with the recovery of this species. Additional mitigation measures including habitat reconstruction have been proposed (Table 14).

E.2.3 Critically Endangered Ecological Communities

Cumberland Plain Woodland

Cumberland Plain Woodland occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin (DECCW 2010b). Before European settlement, was extensive across the Cumberland Plain, western Sydney. Today, only 9 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain (DECCW 2010b). Several small remnants of Cumberland Plain Woodland have been mapped in the west of the Subject Site between Graham Avenue, Casula and Beech Road, Prestons (Figures 8a-g).

Significant Impact Criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

reduce the extent of an ecological community;

The proposal requires the removal of 0.32 ha of degraded Cumberland Plain Woodland from the Subject Site for the installation of a number of permanent spoil re-use areas and a sedimentation basin. These small patches are isolated from other areas of Cumberland Plain Woodland and have been subject to a history of degradation since the construction of the original M5 Motorway. The Cumberland Plain Woodland remaining in the M5 Motorway corridor consists of scattered remnant trees with a highly disturbed understorey.

The removal of 0.32 ha of Cumberland Plain Woodland from the Subject Site constitutes a loss of 24% of this community from the Study Area (within the M5 Motorway corridor). The loss these small patches of Cumberland Plain Woodland are not considered to be significant for the ecological community in the locality.

There is potential for the majority of these patches to be retained at a later stage as part of the detailed design. Mitigation measures have been proposed to reduce the impact of the proposal on this EEC (Table 14).

fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;

This Cumberland Plain Woodland at the Subject Site is already highly fragmented within the landscape, therefore, the proposal is unlikely to further affect the habitat connectivity for this EEC.

In addition, mitigation measures have been proposed (Table 14) which may result in the retention of the majority of the small patches of Cumberland Plain Woodland as part of the proposal.

adversely affect habitat critical to the survival of an ecological community;

No critical habitat has been declared for Cumberland Plain Woodland, and the remaining isolated patches would not be considered critical to the survival of Cumberland Plain Woodland in the locality or region.

modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

Considering the current disturbances within the Subject Site (particularly stormwater runoff, weed invasion, noise and traffic flow), the proposal is unlikely to additionally affect the disturbance regimes. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded; the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

Considering the proposed upgrade to the M5 Motorway is to be largely accommodated within the existing grassed median, it is not expected that the proposal will result in further degradation of surrounding vegetation communities.

cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;

While the proposal includes the removal of 0.32 ha of degraded Cumberland Plain Woodland from the Subject Site, the proposal is unlikely to cause a substantial change in the species composition of the remaining patches of Cumberland Plain Woodland in the Study Area.

cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

> ***assisting invasive species, that are harmful to the listed ecological community, to become established, or***

Given the current degraded state of the vegetation along the M5 Motorway, the proposal is unlikely to further exacerbate the impact of invasive species on Cumberland Plain Woodland.

> ***Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or***

Given that the proposal is to be undertaken along the existing M5 Motorway, the proposal is unlikely to further exacerbate any potential impacts of fertilisers, herbicides or other chemicals. The proposed upgrade to the M5 Motorway is likely to result in an increase in the surface water runoff and despite the Georges River and its tributaries already being highly degraded; the proposal includes measures (water quality controls) to mitigate against any increases in pollutant loads.

interfere with the recovery of an ecological community.

Given the relatively small size, fragmentation, isolation and disturbance within the patches of Cumberland Plain Woodland at the Subject Site, the removal of 0.32 ha of degraded Cumberland Plain Woodland from the Subject Site is not expected to interfere with the recovery of the community.

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