

7.9 Flora and fauna

This section assesses the potential impacts of the project on terrestrial and aquatic flora and fauna, vegetation communities and potential fauna habitats. The full details of the study are presented in the Flora and fauna working paper (Volume 4 – Working paper 10). The assessment has been prepared to meet the relevant Director General's requirements in **Table 7-68** below as well as the relevant requirements of Schedule 2, Part 3 of the *Environmental Planning and Assessment Regulation 2000*.

Table 7-68 Director General's requirements – flora and fauna

Director General's requirements	Where addressed
The EIS must address the following specific matters: Flora and fauna – including but not limited to: <ul style="list-style-type: none">▪ impacts on the biodiversity values of the site and adjoining areas, including terrestrial, riparian and aquatic areas;▪ impacts on critical habitats, threatened species, populations or ecological communities and their habitats; and▪ taking into account the Draft Guidelines for Threatened Species Assessment (Department of Environment and Conservation, 2005).	Section 7.9.3 and 7.9.4 Section 7.9.3 and 7.9.4 Section 7.9.1

7.9.1 Guidelines and methodology

This assessment of impacts has been undertaken in accordance with relevant Commonwealth and State legislation, policy and guidelines including:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- Environmental Planning and Assessment Act 1979 (EP&A Act).
- Threatened Species Conservation Act 1995 (TSC Act).
- Fisheries Management Act 1994 (FM Act).
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC, 2004).
- Draft Guidelines for Threatened Species Assessment (DEC and DPI, 2005).
- Significant Impact Guidelines 1.1 Matters of National Environmental Significance (DEWHA 2009).

The assessment has also been undertaken in accordance with the Director General's requirements for this project.

The approach to undertaking the flora and fauna assessment included desktop and field investigations, including targeted surveys for threatened species, populations and ecological communities considered to have the potential to occur within the study area (the area encompassing the construction footprint and any adjoining or adjacent habitat where potential impacts may occur).

The desktop study included a review of existing information and government maintained databases relevant to the study area. A review of literature sources was also undertaken to streamline survey effort for the assessment by confirming the presence or likelihood of occurrence of threatened species, ecological communities and endangered populations within the study area. The following data sources were reviewed as part of the assessment:

- Bionet – Atlas of NSW Wildlife.
- EPBC Protected Matters Database Search.
- OEH vegetation types database.
- OEH BioBanking Threatened Species Profile Database.
- Primary Industries Records viewer.
- DPI Noxious Weeds.
- Flora and Fauna Investigations for Windsor Bridge over the Hawkesbury River (RTA, 2011).
- Native Vegetation Maps of the Cumberland Plain, Western Sydney.
- NSW Ecosystems database mapping unit descriptions.
- Current and preliminary listings on the TSC Act, EPBC Act, FM Act and Fisheries Management Amendment Act.

The condition of the existing environment, together with the findings of a previous report for the project (RTA, 2011) and the limited number of threatened species previously recorded from the area justified an approach that was based largely on opportunistic surveys and habitat assessment over one autumn sampling event. Given the relatively small size of the study area, the random meander surveys and general foot traverses that were undertaken were considered adequate. The lack of freshwater habitats for frogs, habitat for small mammals and lack of records for these threatened taxa in the study area precluded the need for any detailed surveys for these groups.

Field surveys informing the assessment were designed to identify the extent and quality of native vegetation, fauna habitats and species diversity. Threatened biodiversity with a moderate to high likelihood of occurrence were targeted during field surveys. Detailed information on the field surveys are contained in the Flora and fauna working paper (Volume 4 – Working paper 10).

State and nationally listed threatened species with the potential to occur within the locality (a radius of 10 kilometres from the construction footprint) were assessed to identify the likelihood of their occurrence within the study area based on known habitat requirements. This was compared with the habitats and their condition identified during the field survey. Species, communities and populations were assigned an unlikely, low, moderate or high likelihood of occurrence according to the criteria described in **Table 2-5** of the Flora and fauna working paper (Volume 2 – Working paper 10).

7.9.2 Existing environment

The study area is located in the developed central portion of the Hawkesbury LGA. The Hawkesbury River runs north-easterly through the study area in the South Creek sub-catchment of the Hawkesbury-Nepean catchment. The sub-catchment is heavily degraded as a result of historical vegetation clearance and urbanisation, with riparian zones often infested with woody weeds (HNCMA, 2008). The study area is representative of the degraded environment of the broader sub-catchment.

The project is wholly located within the Cumberland Plain sub-region of the Sydney Basin Bioregion on the east coast of NSW. The sub-region extends from Parramatta in the west to the Hawkesbury-Nepean River in the east and from Windsor in the north to Thirlmere in the south, with a total area of about 275,000 hectares (NPWS, 2002). While the bioregion is one of the most species-diverse in the state, the Cumberland Plain sub-region is considered to be the most developed and the most degraded (HNCMA, 2008).

The study area contains a mix of residential, commercial, public reserve, recreation and agricultural land uses. Land use zonings in the study area, as defined in the Hawkesbury LEP, comprise Natural Waterways, Recreation Waterways, Public Recreation, Local Centre, Low Density Residential and Rural Landscape zones.

A number of sensitive ecological sites and protected areas fall within the study area comprising Council managed recreation reserves. These reserves include Macquarie Park to the north of the Hawkesbury River and Thompson Square on the south side of the river within the town centre. Both Windsor Downs Nature Reserve (about 360 hectares in size) and Scheyville National Park (about 900 hectares in size) are located within the locality. No conservation reserves or State Forest lands occur within the study area, nor any areas of critical habitat.

The vegetation in the study area is patchy and is mainly confined to the banks of the Hawkesbury River. No land within the study area or the locality falls into the Priority Conservation Lands identified in the *Cumberland Plain Recovery Plan* (DECCW, 2011). Additionally, the study area does not include any land identified as part of the regional biodiversity corridors identified in the Hawkesbury-Nepean Catchment Management Area (HNCMA, 2008). Key habitats and movement corridors from the Key Habitats and Corridors project (DEC, 2003) and Climate Change Corridors project (DECC, 2007) do not extend into the study area.

The vegetation within the construction footprint is heavily fragmented, with little or no remnant vegetation and numerous exotic species. The construction footprint was not observed to contain and is not expected to support a high diversity or abundance of native fauna species that rely upon high quality habitat or large remnants.

Vegetation communities, flora and fauna are discussed in further detail below.

Vegetation communities

Four vegetation communities were identified during the field survey and have been shown on **Figure 7-39**. The attributes of these communities are outlined in **Table 7-69** and further described below. In general, the existing vegetation was found to be in poor condition and is identified as having low ecological value.

Table 7-69 Vegetation communities and conditions identified in the study area

Vegetation community	Corresponding OEH vegetation type	Area within construction footprint	Condition value
Riparian Casuarina open forest	River Oak open forest of major streams, Sydney Basin and South-East Corner	0.1 ha (1000 m ²)	Low
Modified riparian open forest (highly modified)	River Oak open forest of major streams, Sydney Basin and South-East Corner	0.4 ha (4000 m ²)	Low
Cleared grassland	Nil	0.9 ha (9000 m ²)	Low
Parkland/landscaped areas	Nil	0.3 ha (3000 m ²)	Low

Riparian Casuarina Open Forest

This vegetation community occurs on alluvial soils associated with the Hawkesbury River. Historical land clearing completely removed original native riparian vegetation communities at Windsor during early European colonisation. The resultant re-growth also appears to have been altered in structure and diversity through planting. The community occurs in a narrow strip along the southern bank of the Hawkesbury River and bordered by the footpath of The Terrace which is landscaped with White Cedar (*Melia azedarach*), Jacaranda (*Jacaranda mimosifolia*), Liquid Amber (*Liquidambar styraciflua*) and Peppercorn (*Schinus sp.*). The riverbank is dominated by River Sheoak (*Casuarina cunninghamiana*) and Swamp Oak (*Casuarina glauca*) with White Cedar (*Melia azedarach*) along the mid-bank and higher. Occasional eucalypts occur along the mid bank and the community is generally of low condition with a moderately dense but weedy understory including Green Cestrum (*Cestrum parqui*) interspersed with paperbarks (*melaleuca sp.*) and wattles (*acacia sp.*) (see **Figure 7-40**). The groundlayer is sparse but pockets of vegetation are dominated by exotic species, including "Trad" (*Tradescantia fluminensis*).

This vegetation most closely aligns with the River Oak open forest of major streams, Sydney Basin and South East Corner vegetation type from the OEH Database for the Hawkesbury-Nepean Catchment Management Area. The condition of the community is low, however, with the commonly found understorey and groundlayer species absent due to the highly modified and partially artificial nature of the community.

Modified Riparian Open Forest

This vegetation community also occurs on alluvial soils associated with the Hawkesbury River. Within the study area it exists along the northern bank of the river adjacent to Macquarie Park (see **Figure 7-41**). Historical land clearing completely removed original native riparian vegetation communities at Windsor during early European colonisation. Whether the banks in this part of the study area are representative of highly modified re-growth or have been completely recreated by riparian replanting is unknown. A footpath traverses the mid-bank from east to west and at the time of survey the recent floods had unearthed black plastic matting along the low and mid-banks where mature casuarinas are well established. The community occurs in a narrow strip along the northern bank of the Hawkesbury River both east and west of the bridge.

The riverbank is dominated by River Sheoak (*Casuarina cunninghamiana*) and Swamp Oak (*Casuarina glauca*) with occasional plantings of paperbarks (*Melaleuca* spp.) and White Cedar (*Melia azedarach*). One Swamp Mahogany (*Eucalyptus robusta*) was observed near the bridge on the mid-bank. The understorey is generally absent although exotic vines such as Balloon Vine (*Cardiospermum grandiflorum*) and Blackberry Nightshade (*Solanum nigrum*) persist. The groundlayer is sparse but clumps of Lomandra (*Lomandra longifolia*) occur along the toe of the bank.

This vegetation most closely aligns with the River Oak open forest of major streams, Sydney Basin and South East Corner vegetation type from the OEH Database for the Hawkesbury-Nepean Catchment Management Area. However, the understorey and groundlayer species commonly found in that community are not present at the site due to the highly modified and partially artificial nature of the community. This vegetation community is considered to be in low condition within the study area.

Cleared grassland

Cleared grassland occurs along the riverbank and adjacent floodplain on the northern bank of the Hawkesbury River within the study area east of the bridge. This is an artificially constructed community most likely resulting from intensive land use since the banks were cleared of original vegetation in the first decade of the colonisation of Windsor. The floodplain is managed for turf farming and the creek bank is dominated almost entirely by exotic pasture and roadside weed species, largely herbs and grasses, with the occasional exotic tree such as the willow (*Salix babylonica*) present. One native Kurrajong (*Brachychiton populneus*) and one Swamp Oak (*Casuarina glauca*) were observed to persist in the landscape.

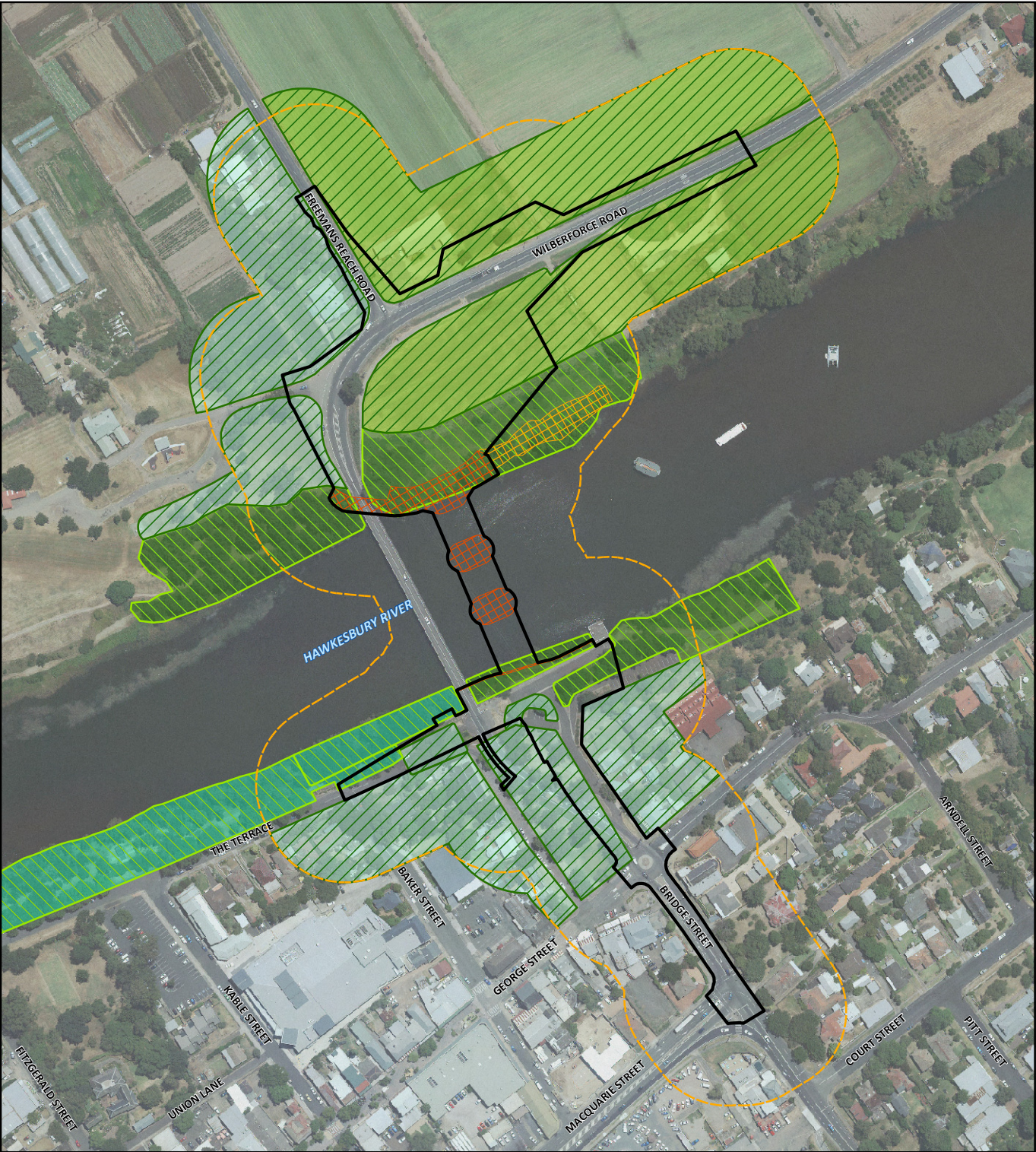
Shrub weeds in this community are clumped across the site and include Castor oil (*Ricinus communis*), Wild Tobacco (*Solanum mauritianum*), Lantana (*Lantana camara*), Fennel (*Foeniculum vulgare*) and Purpletop (*Verbena bonariensis*). Grass and groundcover weeds included Turkey Rhubarb (*Acetosa sagittata*), thistles and Johnson Grass (*Sorghum halapensis*). The exotic Madeira Vine (*Anredera cordifolia*) and Balloon Vine (*Cardiospermum grandiflorum*) were also prolific across the site.

Parkland/Landscaped areas

A number of parkland or landscape environments exist within the study area that are representative of early European colonisation in Australia. These include Thompson Square parkland and associated streetscaping in the southern part of the study area (such as The Terrace), and the more recently landscaped Macquarie Park north of the Hawkesbury River. These areas are typically planted with either introduced horticultural species or Australian natives chosen for their aesthetic properties, but which would not occur in local native vegetation communities. These areas consist of mature trees, with no understorey and a completely maintained exotic grass cover. They are thus of low ecological condition and value in the context of this flora and fauna assessment.

Mature trees of Thompson Square parkland include a number of Liquid Ambers (*Liquidambar styraciflua*), Silky Oaks (*Grevillea robusta*) and Kurrajongs and one Bunya Pine (*Araucaria bidwillii*). The stature of these trees suggests that some of them may be greater than 80 years old. Streetscape plantings along The Terrace and other paths within the study area are landscaped with White Cedar (*Melia azedarach*), Jacaranda (*Jacaranda mimosifolia*), Liquid Amber (*Liquidambar styraciflua*) and Peppercorn (*Schinus* sp.).

Figure 7-39 | Survey results



Indicative only – subject to detailed design

LEGEND

- Concept design footprint
- Study area
- Scour protection
 - Permanent rock scour protection (if required)
 - Temporary rock scour protection (if required)

- Fauna habitats
 - Cleared grasslands
 - Riparian forest

- Vegetation communities
 - Riparian casuarina open forest
 - Modified riparian corridor
 - Cleared grasslands
 - Parklands / landscaped areas

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Figure 7-40 Riparian Casuarina open forest in low condition in the study area (south east of the existing bridge)



Figure 7-41 Modified riparian forest in low condition (north west of the existing bridge)

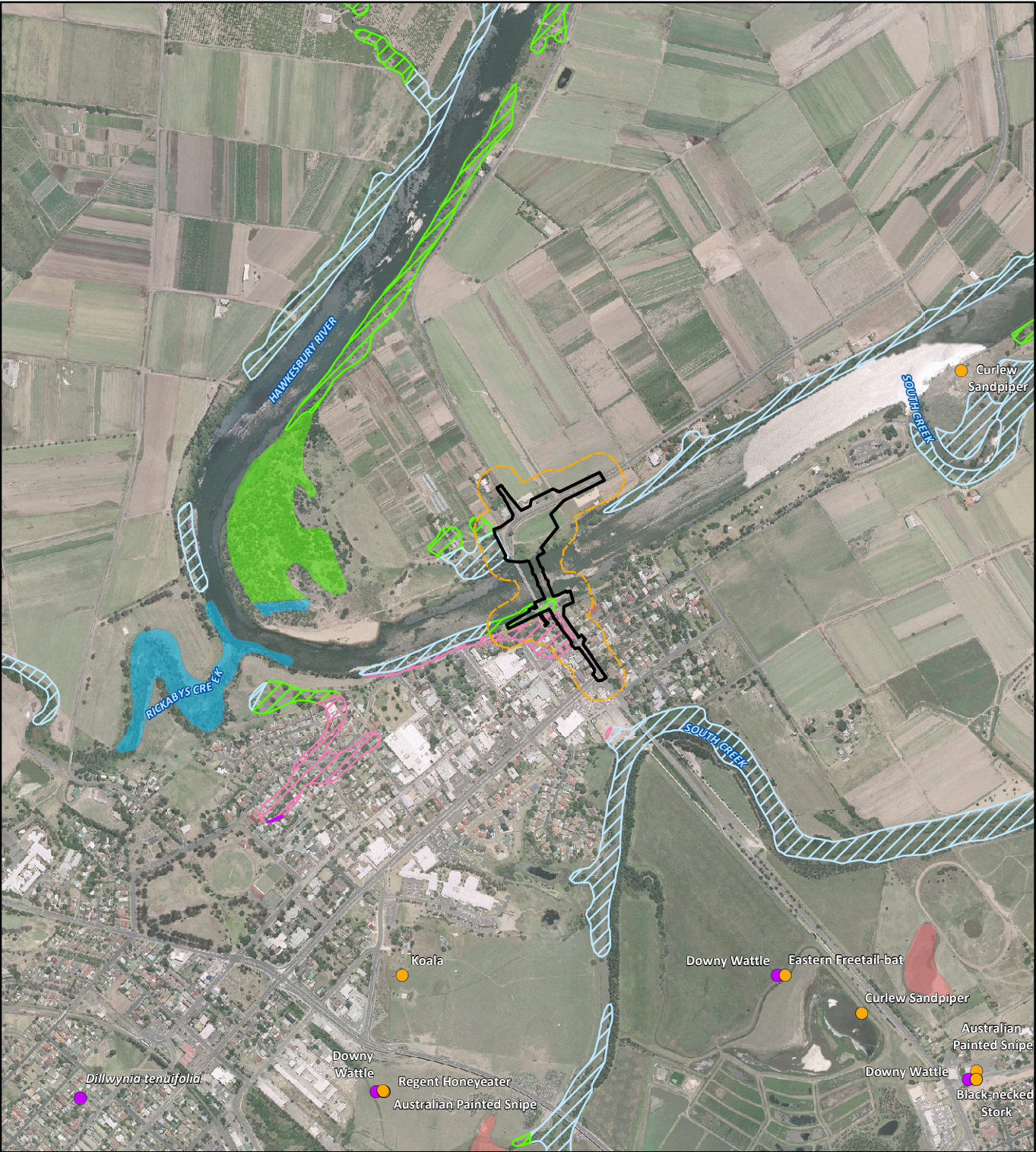
Threatened Ecological Communities

NPWS mapping of the Cumberland Plain (NPWS, 2002) suggested that two threatened ecological communities (TECs) may be present within the study area (see **Figure 7-42**). These TECs included Cumberland Plain Woodland (TSC Act/EPBC Act) and River-flat Eucalypt Forest (TSC Act). Field surveys in the study area did not record vegetation characteristics or key diagnostic species representative of the TECs identified in the NPWS vegetation mapping. Accordingly, no TECs were found during field investigations.

Groundwater dependent ecosystems

The vegetation communities within the study area occur on the Hawkesbury River floodplain. Accordingly, riparian vegetation communities are expected to have a degree of reliance upon groundwater and therefore can be considered to be groundwater dependent ecosystems (GDEs). However, these communities are likely to have evolved to be able to experience short periods of natural groundwater fluctuation without suffering any medium or long-term impacts.

Figure 7-42 | Threatened flora and fauna records and vegetation communities



Indicative only – subject to detailed design

LEGEND

- Concept design footprint Study area
- Threatened fauna record Threatened flora record
- Vegetation communities, over 10% crown cover Vegetation communities, under 10% crown cover
- Alluvial Woodland Shale Plains Woodland
- Riparian Forest Alluvial Woodland
- Freshwater Wetlands Riparian Forest
- Shale/Gravel Transition Forest

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Flora

Flora species

A total of 53 flora species were identified during field surveys, comprising 18 native species and 35 introduced species (see Volume 4 – Working paper 10). These species were generally associated with the vegetation communities described earlier in this section.

Twelve noxious weeds species common to riparian and aquatic habitats were recorded in the study area through field surveys and a search of the DPI noxious weeds listing (see Volume 4 – Working paper 10).

Threatened flora species

A review of the OEH NSW Bionet data (OEH, 2012) and EPBC Act Protected Matters Search Tool (DSEWPaC, 2012) identified 15 threatened flora species previously recorded in the study area (14 listed under the EPBC Act and TSC Act, and one listed under the TSC Act only) (refer to Volume 4 – Working paper 10 and **Figure 7-42**). The assessment of likelihood for these species determined these species would be unlikely or have a low likelihood to occur within the study area. No threatened flora species were identified during field surveys.

Aquatic flora

The river and riparian zone at Windsor has been substantially modified through dredging, bank scour protection, clearing of riparian vegetation and growth of weeds. The South Creek and Hawkesbury River catchment has also been substantially modified and cleared for agricultural and urban development. As a result, there are no ecologically important aquatic flora or vegetation communities of high condition that are present in the study area.

Aquatic macrophytes identified during field surveys include Slender Knotweed (*Persicaria decipiens*), Hydrilla (*Hydrilla verticillata*) and Hornwort (*Ceratophyllum demersum*). No aquatic weeds were sighted during the field survey, however introduced Alligator Weed (*Alternanthera philoxeroides*), Water Hyacinth (*Eichhornia crassipes*), Salvinia (*Salvinia molesta*) and Dense Waterweed (*Egeria densa*) have been previously recorded within the Hawkesbury-Nepean catchment.

Fauna

Fauna habitat and condition

Limited potential fauna habitats occur in the study area, as habitats have been extensively cleared and fragmented during the development of agricultural and rural settlements and urban and residential development. Fauna habitats identified in the study area include riparian forest, cleared grassland and freshwater aquatic habitats (within the Hawkesbury River). The existing bridge was also identified to provide limited roosting habitat opportunities for birds and bats within the study area. These potential habitat areas have been shown on **Figure 7-39**. No critical habitat areas were identified in the study area.

Field surveys identified all vegetation within the study area to provide poor quality fauna habitat, with poor structure of canopy, midstorey and lower groundcover flora. Ground debris was generally absent. No habitat trees (hollow-bearing trees including large dead trees) were identified within the study area.

Additionally, all riparian areas were in poor condition and provided minimal resources for fauna in terms of breeding and foraging opportunities. Shelter and refuge for some bird and arboreal mammal species may be provided in the canopy of riparian areas, particularly for the Common Ringtail Possum (*Pseudocheirus peregrines*). Riparian areas also provide habitat for aquatic species such as the Sydney Hawk Dragonfly (*Austrocordulia leonardi*) and Adams Emerald Dragonfly (*Archaeophya Adamsi*).

While the existing Windsor bridge structure was identified to potentially serve as a man-made roosting habitat, no roosting birds or microbats were observed during the field surveys.

The habitats identified in the study area are likely to provide limited opportunities for shelter, breeding and foraging resources for some common frog and reptile species and a low diversity of bird and mammal species. As a result, the diversity of fauna species recorded within the study area was low.

Fauna species

A total of seven native fauna species were recorded during surveys, comprising two reptile species and five bird species. Two introduced bird species were also recorded during field surveys. The birds identified in the area were predominantly urban birds, tolerant of modified and fragmented habitats such as parrots, miners and swallows. The most abundant species observed included the Magpie (*Gymnorhina tibicen*), Welcome Swallow (*Hirundo neoxena*) and Noisy Miner (*Manorina melanocephala*). The two reptile species recorded were the Eastern Water Dragon (*Physignathus lesueurii*) and Eastern Water Skink (*Eulamprus quoyii*).

No evidence of feral animals was observed during the field survey, however the European Red Fox (*Vulpes vulpes*), Feral Cat (*Felis cattus*) and Feral Dog (*Canis familiaris*) are expected to occur within the study area.

Threatened fauna species

A review of state and federal government databases (OEH, 2012 and DSEWPaC, 2012) identified a total of 48 threatened fauna species records within the locality, comprising 13 mammals, 27 birds, one reptile, three amphibians, one invertebrate and three fish species (see **Figure 7-42**). These species were assessed to have an unlikely or low likelihood of occurring within the study area, with the exception of five species with a moderate likelihood to occur within the study area. These species included the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), the Eastern Freetail Bat (*Mormopterus norfolkensis*), Southern Myotis (*Myotis macropus*) and the Freckled Duck (*Stictonetta naevosa*).

It is possible that the existing bridge may provide suitable roosting habitat for a range of threatened cave-roosting microchiropteran bats in the locality. This includes the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and the Southern Myotis (*Myotis adversus*), both of which have been recorded roosting in artificial structures including concrete bridges. However no bats were observed roosting under the bridge at the time of the field survey.

Field surveys targeted threatened species that were considered to have a moderate or high potential to occur in the study area. No threatened species (or habitats thereof) were identified during the surveys.

Migratory species

A total of 13 migratory species were identified in the EPBC Act Protected Matters Report (February 2012) as potentially occurring within the locality, comprising eight migratory terrestrial species and five migratory wetland/marine species. A preliminary assessment of the likelihood of species occurrence in the study area identified that 10 species were unlikely or would have a low likelihood of being present in the study area (see Volume 2 – Working paper 10). The White-bellied Sea Eagle (*Haliaeetus leucogaster*), White-throated Needletail (*Hirundapus caudacutus*) and Cattle Egret (*Ardea ibis*) were considered to have a moderate likelihood of occurrence within the study area.

No migratory species were observed during the field survey. The study area does not contain any important habitat for any listed migratory species and therefore migratory species were not considered further in the assessment.

Aquatic species

The Hawkesbury River is a Class 1 Waterway, as it is a permanently flowing waterway containing a major fish habitat. No existing barriers to fish passage were observed within the study area. No threatened aquatic fauna species are expected to occur in the study area.

The Sydney Hawk Dragonfly, the Adams Emerald Dragonfly and the Macquarie Perch (*Macquaria australasica*) are threatened aquatic species listed under the FM Act that have been identified as having a potential to occur within the study area. The condition of habitat for these species is low, therefore these species are unlikely to be present in the area.

7.9.3 Construction impacts

The main potential impacts associated with the project would be associated with the loss of vegetation/habitat and resultant impacts on threatened fauna. This section summarises potential impacts discussed in the Flora and fauna working paper (Volume 4 – Working paper 10).

Vegetation communities

The project would require clearing of about 1.7 hectares (17,000 square metres) of vegetated land with about 1.2 hectares (12,000 square metres) being park or grasslands. The clearing of 1.7 hectares (17,000 square metres) of low value vegetation in the study area would not have a significant ecological impact. As part of the project all disturbed areas outside the road corridors would be rehabilitated and landscaped after construction. This would include the planting of both native and exotic trees, shrubs and grasses and planting within the riparian zone where possible. The condition and habitat value of the newly planted areas would be an improvement on the existing vegetation communities.

The project would also require removal of weed species, including noxious weeds. Provided that weeds are disposed of appropriately and weed control measures are implemented, potential impacts resulting from the project would be minimised.

While the vegetation communities in the study area are of low ecological value, there are about 0.5 hectares (5,000 square metres) of riparian vegetation along the Hawkesbury River that would require clearing for the project. This riparian community does not constitute a TEC and also is in relatively poor condition. Construction of the bridge would require the removal of woody debris/snags in addition to clearing of riparian vegetation. This type of activity has been identified to be a key threatening process under the FM Act. However given the relatively poor condition of the riparian vegetation on the river banks and the lack of any substantial snags in this section of the river, as well as the temporary and spatially limited nature of the construction of the project, the resultant impact on aquatic species and ecosystems is not considered to be substantial.

In addition, there would not be any substantial changes to flow velocities, depths of the waterway, realignment of the watercourse or the alteration of natural flow regimes of the river due to the construction of the replacement bridge. As a result, there would not be any impact on aquatic ecosystems from changes in hydrological regimes. Due to the localised nature of the proposal, as well as the temporary nature of construction works, the project would not substantially raise or lower the groundwater table to such an extent that any groundwater dependent ecosystems would be permanently impacted.

Flora

The project would have no impact on the listed threatened flora records identified during Bionet database searches, as none have been recorded within the study area. No threatened flora species are considered to have more than a low likelihood of occurrence in the study area (**Section 7.9.3**), therefore it is unlikely that the project will affect any threatened flora species. Assessments of significance were undertaken for species and species groups with a moderate to high likelihood of occurrence, including the Cumberland Plain Land Snail, Microchiropteran bats, migratory species and the Freckled Duck. These assessments found that the project is unlikely to have a significant impact on these species.

Fauna

The main impacts to fauna from the construction of the project would be associated with the clearing of potential fauna habitat and flow on effects from reduced water quality. Riparian vegetation that would be cleared as part of the project provides some degree of habitat for native and local species. However, only a small amount of low habitat value vegetation would be cleared. In addition, this community is not declared to be critical habitat for any threatened fauna species in the locality. Accordingly, the project is unlikely to have any significant impacts on biodiversity, including any threatened species, populations, ecological communities or their habitats.

The greatest potential for construction impacts on local waterways would be from sedimentation and erosion, water-based construction activities and dredging. These activities would result in increased turbidity and suspended solids in the river. Increased suspended solids can impact fish and macroinvertebrate abundance through clogging gill structures and benthic smothering. Increased particulates in the water column can also reduce light infiltration which may limit plant growth and influence predator foraging behaviour. Increased turbidity can result in a reduction of light penetration and in turn reduce the number of aquatic macrophytes or algae, altering the existing aquatic habitat. Spills of chemicals, fuels and concrete may also occur during construction. These spills would be toxic to aquatic biota and fish. However, the likelihood of this occurring would be relatively low (see **Section 7.6.5**).

About 2,700 square metres of aquatic habitat and adjoining riparian zone and about 2300 square metres of aquatic habitat on the river bed would be lost during construction the project. The potential pollution of waterways also presents a threat to aquatic habitats, however, these would be managed through the use of water quality controls and measures. These have been discussed further in **Section 7.6.6**.

While the impact of construction activities on water quality could potentially be substantial, the risks and impacts would be reduced to acceptable levels through the implementation of appropriate environmental management measures identified in the project Soil and Water Management Plans (for example, silt curtains around dredging operations). These and other environmental management measures are further discussed in **Section 7.9.5**.

Demolition of the existing bridge may result in the loss of potential roosting habitat for birds and microbats, however, construction of the replacement bridge may provide potential roosting habitat. Additionally, the existing bridge is marginal habitat for roosting fauna due to the absence of habitat trees in the study area and the lack of suitable hollow cavities in the concrete bridge structure. Assessments of significance indicate that the project is unlikely to have a significant impact on hollow roosting microchiropteran bats.

The project would not impact on habitat connectivity and fragmentation, as it does not encroach on any land identified as part of regional biodiversity corridors (see **Section 7.9.2**). Fauna injury and mortality is considered to be an unlikely effect of the project, given the low numbers of fauna (and low potential for fauna habitat) observed in the study area. Given the low habitat potential of the study area it is unlikely that noise, vibration or light associated with the construction of the project would have an adverse impact on the surrounding flora and fauna. As bridge construction works would be undertaken from the banks, the project would not block fish passage.

7.9.4 Operational impacts

The main potential impact on biodiversity from the operation of the project would be from stormwater runoff from the approach roads and the bridge or from spills of fuels or chemicals from accidents or during maintenance. These potential impacts were considered during design of the project and a permanent water quality basin has been provided on the northern bank, while a litter net and shut-off valve has been provided on the southern bank.

7.9.5 Environmental management measures

The Biodiversity Guidelines- Protecting and managing biodiversity on RTA projects (RTA, 2011) outline best practice mitigation measures for RMS projects. In accordance with these guidelines, the measures that would be implemented in conjunction with the project to minimise and avoid potential ecological impacts are listed in **Table 7-70**.

Table 7-70 Environmental management measures

Item	Timing	Environmental management measure
Pre-clearing fauna survey	Pre-construction	<ul style="list-style-type: none">Once construction areas have been surveyed and marked, a suitably qualified and experienced fauna ecologist will undertake a pre-clearing survey to identify any concerns to specific species.A survey of the existing bridge structure will be undertaken by boat by an ecologist to confirm the bridge is not providing habitat for microchiropteran bats or other roosting bats.Should the results of the bat survey and roost assessment indicate that the existing bridge occupied by microbats, a bat management plan will be prepared to mitigate the potential impacts on bats. The plan would include details of an appropriate work schedule, any further close inspections that may be required and exclusion and relocation of fauna away from the construction site.WIRES will be made aware of the project and consulted if any injured fauna are encountered or if any fauna are injured as a result of the works.An ecologist or WIRES representative will be present during the clearing of suspected vegetation that may support a habitat for fauna to manage and/or relocate any fauna present.
Site personnel induction	Pre-construction	<ul style="list-style-type: none">The project induction will include relevant information, mitigation measures and procedures on protecting the biodiversity of the area during construction.
Site planning	Pre-construction	<ul style="list-style-type: none">Locate temporary infrastructure (plant sites and offices etc) in cleared areas away from vegetation.Apply clear boundaries for construction and exclusion zones for equipment, machinery and traffic to prevent unnecessary damage to native vegetation and fauna habitats.

Item	Timing	Environmental management measure
Identification of clearing limits	Pre-construction	<ul style="list-style-type: none"> Accurately and clearly mark out the limits of clearing and trees/vegetation to be retained including riparian zones.
Erosion and sediment control and impacts on water quality	Pre-construction and construction	<ul style="list-style-type: none"> Management plans and measures will be developed and implemented to minimise water quality impacts from construction. A discussion on water quality mitigation measures has been provided in Section 7.6.6.
Riparian areas	Pre-construction and construction	<ul style="list-style-type: none"> Minimise the area of disturbance in riparian zones by clearly marking out work zones in riparian areas and protect areas with para-web fencing or similar material. All works near riparian zones will have adequate sediment and erosion control.
Noxious weed management	Pre-construction and construction	<ul style="list-style-type: none"> Establish a noxious weed management protocol. All noxious weeds which are cleared as part of the project will be disposed of appropriately. Inspection/maintenance procedures will be implemented to reduce the carriage of weed material on machinery.
Monitoring	Pre-construction and construction	<ul style="list-style-type: none"> A monitoring program (including a weekly checklist) will be developed to check that all proposed impact mitigation measures have been effectively implemented. In the event that impact mitigation measures do not perform effectively, the management program will be adjusted with further appropriate measures.
Potential impact on fauna habitat	Construction	<ul style="list-style-type: none"> While no substantial trees with hollows were identified during the survey, if trees with hollows are found, their removal will be avoided where practicable. Where this is not possible, the tree will be maintained intact as far as possible and placed on the ground in adjoining vegetation. Habitat trees will be inspected for fauna by ecologist or WIRES carer and habitat trees will be felled carefully to minimise impact.
Riparian and aquatic habitat	Construction	<ul style="list-style-type: none"> In-stream and riparian disturbance will be minimised during construction through clearly delineated working areas. Removal of instream woody snags (>3 m in length and >300 mm diameter) will be avoided where practicable. Any woody snags that require removal during construction will be relocated insitu.
Riparian and aquatic habitat	Construction	<ul style="list-style-type: none"> In-stream disturbance from dredging will be managed and mitigated as appropriate to minimise impacts. Appropriate measures will include insitu measures to limit the risk of sediment plumes and increased turbidity, such as silt curtains (or similar).

Item	Timing	Environmental management measure
Rehabilitation	Construction and post-construction	<ul style="list-style-type: none"> • Areas disturbed as a result of the project will be stabilised and rehabilitated through a progressive landscaping program that takes advantage of optimal growing conditions and is appropriate to the final land use. • Where possible riparian zone rehabilitation will include appropriate native species.