Transport for NSW

Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program Improvements on The Northern Road and Londonderry Road Flood Evacuation Routes

Biodiversity Assessment Report

July 2024

NSW GOVERNMENT

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Cover photo: *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea) flower

Executive summary

Introduction

The NSW and Australian Governments have committed to improvements that will make the Hawkesbury-Nepean Valley flood evacuation road network more resilient to flooding. Road infrastructure improvements have been identified across four Western Sydney Local Government areas. The proposed improvements include road shoulder widening, culvert upgrades, new bridge structure, road raising, pinch point upgrades and drainage improvements. These improvements will make evacuation routes better able to withstand local flash flooding which can cause early closure of evacuation routes.

The Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program has two components – State Road Improvements (on the Transport for NSW managed road network) and Regional/Local Road Improvements (on the local council managed road network), this proposal refers to the State Road Improvements only. The State Roads include The Northern Road and Londonderry Road flood evacuation routes.

Key features of the proposal include:

- Widening of the southbound shoulder pavement on Londonderry Road and The Northern Road to provide a second outbound lane reserved for drivers to use during emergency flood evacuations
- Drainage improvements including upgrades to culvert crossings, drainage channels, and pit and pipe networks at identified locations to improve resilience in localised flooding events
- Raising of low point sections of The Northern Road
- Realignment of The Northern Road, Cranebrook (within the road corridor) to reduce project impacts on adjacent sensitive receivers and improve road safety
- Adjustments of intersections to facilitate a secondary outbound lane for drivers to use during a flood evacuation event
- Adjustments as required to connect Londonderry Road and The Northern Road to local roadways, side roads and access roads
- Utility and driveway adjustments as required within the proposal area
- Landscaping as required
- Provision of temporary ancillary facilities to support the construction works including office and staff amenities, site compound and laydown areas.

The construction footprint with a variable buffer was used as the biodiversity study area for surveys to assess direct impacts. Indirect impacts and habitat suitability were considered within the remainder of the road reserve.

The Proposal site is wholly within the Cumberland Plain subregion of the Sydney Basin Bioregion. The surrounding area is mainly used for small farms and other semi-rural properties. In the southern part of the study area the Proposal passes through suburban residential areas. Castlereagh Nature Reserve and Wianamatta Nature Reserve lie adjacent to parts of the study area. Rickabys Creek crosses under Londonderry Road.

Native vegetation

Vegetation identification, assessment of vegetation zones and plot-based survey have been undertaken in accordance with Chapter 4 of the Biodiversity Assessment Method. Vegetation surveys identified five Plant Community Types stratified into 14 vegetation zones (low, moderate and good condition):

- PCT 3320: Cumberland Shale Plains Woodland
- PCT 3448: Castlereagh Ironbark Forest
- PCT 3628: Castlereagh Shrubby Swamp Woodland
- PCT 3629: Castlereagh Scribbly Gum Woodland
- PCT 4025: Cumberland Red Gum Riverflat Forest.

Each of the plant communities is associated with a threatened vegetation community under the NSW *Biodiversity Conservation Act 2016* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Plot-based full floristic survey was collected for six plots. Rapid Data Points were also collected in areas of low condition or exotic vegetation.

Threatened species

The habitat suitability assessment identified 13 flora and 19 fauna species that have a moderate or high likelihood of occurring in the study area based on recent records and the availability of suitable habitat.

Targeted flora surveys identified five threatened flora species and one threatened flora population:

- *Dillwynia tenuifolia*
- *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea)
- *Marsdenia viridiflora* subsp. *viridiflora* (threatened population)
- *Micromyrtus minutiflora*
- *Persoonia nutans* (Nodding Geebung)
- *Pultenaea parviflora*.

Opportunistic sightings were made of two threatened fauna species: the Southern Myotis (*Myotis macropus*) and Square-tailed Kite (*Lophoictinia isura*). Several other species are assumed present based on the availability of suitable habitat within the study area.

Impact assessment

The proposal would result in the removal of 20.93 hectares of native vegetation identified as TEC for construction. An additional 0.26 hectares of 'planted (non-native)' and 1.42 hectares of 'planted native' vegetation would also be removed. This vegetation includes habitat and individuals of five threatened flora species and one threatened flora population. Vegetation and habitat features for 17 threatened fauna species that have been assumed present in the study area would be impacted.

No significant impacts are expected to threatened entities under either the EPBC or BC Acts.

Impact avoidance and minimisation

Direct impacts on native vegetation and habitat have been avoided and minimised by locating the proposal in areas where the native vegetation or threatened species habitat is in the lowest condition.

The location of temporary ancillary construction and maintenance facilities has avoided and minimised clearing of native vegetation and habitat by:

- Reducing the clearing footprint of the proposal
- Locating ancillary facilities in areas:
  - Where there are no biodiversity values, or
  - Where the native vegetation or threatened species habitat is in the lowest condition, or
  - That avoid habitat for threatened species and vegetation in high threat status categories.

Construction will take place in stages, potentially minimising impacts to mobile fauna species that can relocate to other parts of their home range to avoid high levels of disturbance.

Mitigation measures have been proposed to minimise residual impacts of the proposal.

Offsetting

Biodiversity offset thresholds or tree and hollow replacement requirements have been triggered under the No Net Loss Guidelines and Tree and Hollow Replacement Guidelines and therefore a Biodiversity Offset Strategy and Tree and Hollow Replacement Plan are required. The following offsets are required:

- 266 credits for the loss of threatened ecological communities.
- 1,017 credits for the loss of habitat for threatened species.

Tree replacement requires planting 8,114 trees or a $952,375 contribution into the Transport Conservation Fund.

1. Introduction

1.1 Proposal background

The NSW and Australian Governments have committed $33 million towards planning for more than 100 improvements that will make the Hawkesbury-Nepean Valley flood evacuation road network more resilient to flooding. Road infrastructure improvements have been identified across four Western Sydney Local Government areas: Penrith, Hawkesbury, Blacktown, and The Hills. The proposed improvements include road shoulder widening, culvert upgrades, new bridge structure, road raising, pinch point upgrades and drainage improvements. These improvements will make evacuation routes better able to withstand local flash flooding which can cause early closure of evacuation routes.

The Hawkesbury-Nepean Valley has the highest flood risk in NSW due to its unique landscape and large existing population. Floods in the Hawkesbury-Nepean Valley can and have had a significant impact on people's lives, livelihoods, and homes.

The key objective of Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program is to improve drainage on the road network to better withstand local flash flooding and to increase capacity to evacuate by road during major flood.

The Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program has two components – State Road Improvements (on the Transport for NSW managed roads of The Northern Road and Londonderry Road) and Regional/Local Road Improvements (on the mostly local council managed road network), this proposal refers to the State Road Improvements only, being The Northern Road and Londonderry Road flood evacuation routes.

Refer to Figure 1–1 for the regional context of the proposal.

1.2 The proposal

The proposal area generally includes the road corridors of The Northern Road, Londonderry Road, Andrews Road and Vincent Road as follows:

- The Northern Road between the intersection with Richmond Road/Blacktown Road, Bligh Park in the north, and Borrowdale Way, Cranebrook in the south
- Londonderry Road from 270m south of Southee Road, Hobartville to the intersection with The Northern Road, Llandilo excluding approximately 270m north and 300m south of the existing intersection at The Driftway, Londonderry
- Route A9 (The Northern Road/Richmond Road) from 130m north of Andrews Road, Cranebrook to Boomerang Place, Cambridge Gardens in the south
- Andrews Road, Cranebrook from The Northern Road to the Andrews Road Baseball Complex west of Greygums Road, Cranebrook
- Vincent Road, Cranebrook, for approximately 70m west from The Northern Road
- Identified isolated areas along Route A9 (Richmond Road/Parker Street) between Gascoigne Street and Great Western Highway, Kingswood for the installation of flood evacuation signage.

The proposal area includes a buffer from the outer edge of the designed works to facilitate construction work. The buffer is generally 10m in width but is reduced to 6m or less in specific areas, to minimise impacts on sensitive areas.

Key features of the proposal include:

- Widening of the southbound shoulder pavement on the following roads, a total of approximately 20 kilometres, to provide a second outbound lane reserved for drivers to use during emergency flood evacuations. This will include culvert and drainage extensions to accommodate a wider road corridor, and connecting drainage along:
  - Londonderry Road between 270m south of Southee Road and The Northern Road, Londonderry
  - The Northern Road between Richmond Road and Borrowdale Way, in Londonderry, Berkshire Park, Cranebrook, Llandilo, and Jordan Springs
- Drainage improvements including upgrades to culvert crossings, drainage channels, and pit and pipe networks at identified locations to improve resilience in localised flooding events. Work would include:
  - Culvert upgrades, and associated drainage channel work:

    - Along sections of The Northern Road associated with raising of low points as outlined below
    - On Carrington Road at the intersection with The Northern Road, Londonderry
    - At two locations on The Northern Road approximately 50 metres and 130 metres north of the intersection of Carrington Road, Londonderry
    - On The Northern Road approximately 250 metres north of Toorah Road, Londonderry
    - On Vincent Road at the intersection with The Northern Road, Cranebrook
    - On Fifth Avenue at the intersection with The Northern Road, Llandilo
  - New roadside drainage channels (including vegetated and concrete of various widths):
    - Along Londonderry Road (adjacent to the southbound shoulder), from 270m south of Southee Road, Hobartville to the intersection with The Northern Road, Llandilo
    - Along The Northern Road (adjacent to the southbound shoulder), from the intersection with Blacktown Road/Richmond Road, Bligh Park to Ninth Avenue, Llandilo
    - Along The Northern Road (adjacent to the northbound shoulder) at road raising areas
  - Underground drainage network upgrades:
    - Along The Northern Road (southbound), Cleeve Place and Star Crescent, Cambridge Gardens from Trinity Drive to Boomerang Place, including approximately 60 metres along Trinity Drive, Cambridge Gardens
    - Along The Northern Road, Cranebrook (northbound) from approximately 115 metres north of Andrews Road, Cranebrook to Trinity Drive, Cambridge Gardens including new drainage crossings underneath The Northern Road
    - Along Andrews Road from The Northern Road up to the Andrews Road Baseball Complex in Cranebrook
- Raising of low points along sections of The Northern Road, affecting all road lanes located:
  - starting from around 120m North of Whitegates Road, Londonderry heading northwards (about 345m length)
  - starting from around 200m North of Spinks Road, Llandilo heading northwards (about 920m length)
  - starting from around 270m north of Fifth Avenue to around 435m south of Fifth Avenue, Llandilo
  - starting from around 185m north of Vincent Road to around 105m south of Vincent Road, Cranebrook
  - starting from around 50m south of Ninth Avenue to about 365m south of Ninth Avenue, Cranebrook
- Extend, replace or add new culverts at selected locations along Londonderry Road and The Northern Road to maintain property access (eg driveways) as required.
- Realignment of The Northern Road, Cranebrook (within the road corridor), between around 330 metres north of Seventh Avenue, Llandilo to around 280 metres south of Vincent Road, Cranebrook to reduce project impacts on adjacent sensitive receivers and improve road safety.
- Adjustments to the following intersections to facilitate a secondary outbound lane for drivers to use during a flood evacuation event. These may include changes to existing median, traffic islands, kerbs and line marking at:
  - The Northern Road and Richmond Road and Blacktown Road, Bligh Park
  - Londonderry Road and The Northern Road and Cranebrook Road, Cranebrook
  - The Northern Road and Vincent Road, Cranebrook
  - The Northern Road and Ninth Avenue, Jordan Springs
- Installation of new signage to be displayed during emergency flood evacuations to facilitate a second left turn at the existing Parker Street/Great Western Highway intersection in Penrith under traffic control
- Adjustments as required to connect Londonderry Road and The Northern Road to local roadways, side roads and access roads
- Relocation and/or adjustments of various road furniture (such as signage, road safety barriers, street lighting, kerb and island adjustment etc) throughout the proposal area

- Relocation of bus stops at:
  - The Northern Road (northbound) approximately 30m south of Vincent Road. To relocate this bus stop approximately 130m to the south.
  - The Northern Road (southbound) approximately 210m south of Ninth Avenue. To relocate this bus stop approximately 20m to the north.
- Utility and driveway adjustments as required within the proposal area
- Landscaping as required
- Provision of temporary ancillary facilities to support the construction works including office and staff amenities, site compound and laydown areas:
  - Road reserve adjacent to the Francis Greenway Correctional Complex, Berkshire Park (site 1)
  - Road reserve adjacent to 245 The Northern Road, Berkshire Park (site 2)
  - 557 The Northern Road, Berkshire Park (site 3)
  - Road reserve adjacent to 107 Fifth Avenue, Llandilo (site 4)
  - Road reserve adjacent to 902 The Northern Road, Llandilo (site 5)
  - 1042 The Northern Road, Llandilo (site 6)
  - Council reserve, Greenwood Parkway, Jordan Springs (site 7)
  - Part of the Richmond Race Club, Londonderry Road, Londonderry (site 8)
  - Council reserve, Andrews Road, Penrith (site 9)
  - Council reserve, Parker Street, Penrith (site 10).

The final construction staging of the proposal would be determined by Transport and the construction contractor. However, it is anticipated that the permanent works would be carried out in stages, with an early works component. Subject to funding availability, the construction is expected to commence in 2026 and completed in 2030.

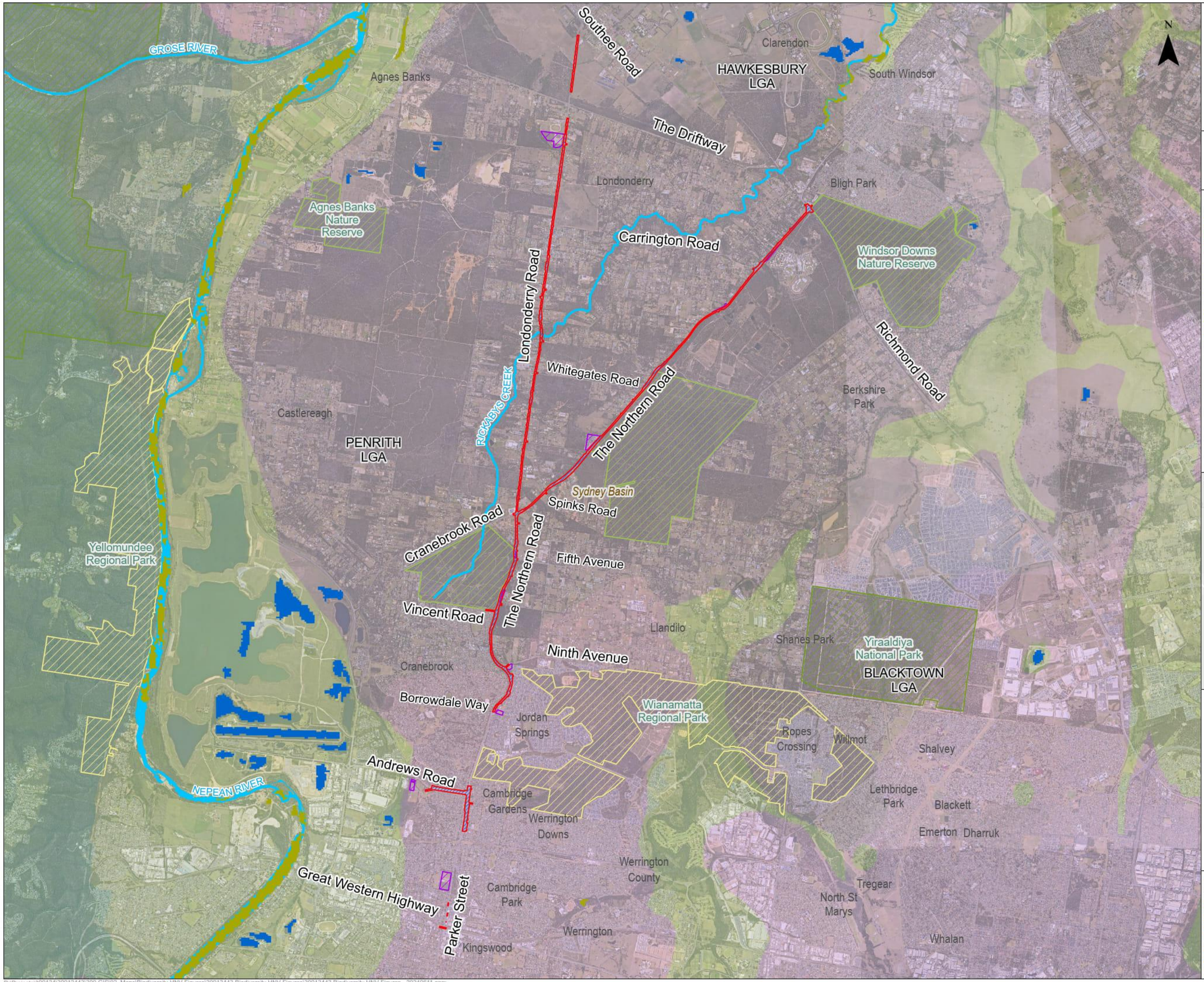
1.2.1 Assessment areas

The assessment areas used in this report are described in Table 1–1 and shown on Figure 1–2. Due to the nature of impacts, size and shape of the proposal, the decision was made to use the construction footprint with a variable buffer as the biodiversity study area for surveys to assess direct impacts. Indirect impacts and habitat suitability were considered within the remainder of the road reserve (or to the limits of the construction footprint if this extended further at a particular location), but no detailed surveys were undertaken in this area. The proposal also includes ten potential locations for site compounds, also shown on Figure 1–2.

Table 1–1: Description of proposal assessment areas

Assessment area	Description
Construction footprint (temporary works footprint) **Subject land**	Concept design footprint including drainage design with variable buffer calculated as: • 10 metres in general proposal area • 6 metres in areas with biodiversity constraint • Cadastral boundary where the proposal borders National Park, Nature Reserves or Biodiversity Offset areas • 2.5 metres in highly sensitive biodiversity areas (to be determined during detailed design phase). Ten potential site compound areas
Operational footprint (permanent works footprint)	Concept design footprint including drainage design
Study area	Road reserve boundary and site compound areas

Assessment area	Description
REF study area	Wider proposal study area for the Review of Environmental Factors (REF) based on the construction footprint plus a 10 metre buffer, except where adjacent to National Park estate boundary where it is trimmed to road reserve cadastral boundary
Landscape assessment area	The proposal is linear in nature and under Subsection 3.1.2 of the Biodiversity Assessment Method (BAM), a 500 metre buffer zone is used to define the assessment area in which native vegetation cover and other landform attributes are assessed.



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Metres

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LEGEND

- Subject land
- REF Boundary
- Site Compounds
- Waterbodies

NPWS Estate

- National Park
- Nature Reserve
- Regional Park

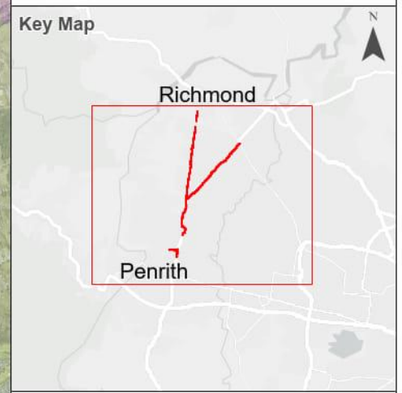
Wetlands

- Floodplain Wetland
- Reservoir
- IBRA7 regions

NSW (Mitchell) Landscapes v3.1

- SB Burragorang; Silverdale Slopes
- SB Cumberland; Cumberland Plain
- SB Cumberland; Hawkesbury - Nepean Channels and Floodplains
- SB Cumberland; Hawkesbury - Nepean Terrace Gravels
- SB Volcanics; Sydney Basin Diatremes
- SB Wollemi; Grose River Gorge
- SB Wollemi; Kurrajong Fault Scarp

Key Map



SOURCES:
1. Roads © Roadnet MD5 2020
2. Waterways © Department of Customer Service 2020
3. Wetlands © State Government of NSW and Department of Planning and Environment 2010
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5. MetroMap Imagery © Aerometrex Pty Ltd
6. Basemap ©Light Gray Base: Esri, TomTom, Garmin, Foursquare, FAO, METI/ NASA, USGS

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 1-1
FIGURE TITLE: Proposal context
CREATED BY: LL16284
DATE: 12/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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LEGEND

- Subject land
- REF Boundary
- Site Compounds

NPWS Estate

- National Park
- Nature Reserve
- Regional Park

SOURCES:

1. Roads © Roadnet MDS 2020
2. Waterways © Department of Customer Service 2020
3. NPWS © Estate Office of Environment and Heritage
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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 1 - 2
FIGURE TITLE: The proposal
CREATED BY: LL16284
DATE: 11/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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1.3 Legislative context

A Review of Environmental Factors (REF) is prepared to satisfy Transport for NSW (Transport) duties under section 5.5 of the EP&A Act to *"examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity"* and section 5.5 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Improvements and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

The *Biodiversity Conservation Act 2016* (BC Act) requires that the significance of the impact on threatened species, populations and threatened ecological communities is assessed using the test listed in section 7.3 of the BC Act. Similarly, Part 7A of the *Fisheries Management Act 1994* (FM Act) requires that significance assessments are undertaken in accordance with Division 12 of the FM Act. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the head of the NSW Department of Climate Change, Energy, the Environment and Water's (NSW DCCEEW) requirements, or a biodiversity development assessment report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM) (DPIE 2020a).

In September 2015, a 'strategic assessment' approval was granted by the Australian Minister for the Environment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The approval applies to Transport road proposals being assessed under Division 5.1 (formerly Part 5) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. Transport road proposals assessed under a REF:

- Must address and consider potential impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species, including application of the "avoid, minimise, mitigate and offset" hierarchy.
- Do not require referral to the Australian Department of Climate Change, Energy, the Environment and Water (Australian DCCEEW) for these matters, even if the activity is likely to have a significant impact.
- Must use the BAM to calculate credits that would offset significant impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species.

Assessments of impact significance are required for all relevant biodiversity values in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013).

2. Methods

2.1 Personnel

Personnel involved in the assessment and an overview of their qualifications and experience is provided in Table 2–1.

Table 2–1: Personnel

Name	Role	Qualifications and experience
Rebecca Carman	Senior Ecologist	BSc, MPhil, PG Cert Wildlife Management Twelve years' experience as an ecological consultant, including assessments for various road projects in NSW
Gregg Goldin	Experienced Scientist BAM Accredited Assessor BAAS18170	BSc (Hons), MSc 7 years' experience as an ecological consultant

2.2 Background research

Background research was used to collect and review information on the presence or likelihood of occurrence of:

- Threatened terrestrial and aquatic species and their habitat
- Threatened ecological communities
- Important habitat for migratory species
- Areas of outstanding biodiversity value.

The *Hawkesbury-Nepean Valley Flood Resilience Road Upgrade Program (Package 1) – The Northern Road / Londonderry Road Preliminary Environmental Investigation* was prepared in 2022 (TfNSW 2022). The report identified a number of potential biodiversity constraints including:

- Potential impact to threatened ecological communities:
  - Shale Gravel Transition Forest in the Sydney Basin Bioregion (BC Act - Endangered) / Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act - Critically Endangered)
  - Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (BC Act - Endangered, EPBC Act - Critically Endangered)
  - River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act Endangered and EPBC Act Critically Endangered)
  - Cumberland Plain Woodland in the Sydney Basin Bioregion (BC Act and EPBC Act - Critically Endangered)
  - Castlereagh Swamp Woodland Community (BC Act - Endangered)
- Known occurrence of eight listed threatened flora species within the study area
- Known occurrence of five listed threatened fauna species within the study area
- Presence of biodiversity offsets the subject of a Biobanking Agreement
- Presence of Priority Conservation Lands as identified in the Cumberland Plain Recovery Plan (former Department of Environment, Climate Change and Water (NSW) 2010)
- Presence of Key Fish Habitat (Rickabys Creek)
- Increase in impact of Key Threatening Processes listed under the BC and/or EPBC Act
- Requirement to offset biodiversity impacts.

Databases searched for the preparation of this report are provided in Table 2–2.

Table 2–2: Databases and information sources

Reference	Author/source	Search parameters	Search date
BioNet Atlas	NSW DCCEEW	20x20km search boundary centred on study area	9 May 2023, updated 12 April 2024
BioNet Vegetation Classification database	NSW DCCEEW	PCT definitions, known PCT/TEC associations.	Various dates September 2023 – April 2024
BAM calculator (BAM-C)	NSW DCCEEW	N/A	18 Nov 2023, updated 23 April 2024
Protected Matters Search Tool	Australian DCCEEW	10 km buffer around study area	9 May 2023, updated 16 April 2024
SEED Maps	Soil Landscapes of Central and Eastern NSW – v2.1	N/A	Various dates November 2023
SEED Maps	NSW State Type Vegetation Map (Edition C1.1.M1) (DPE 2023) Updated – NSW State Type Vegetation Map (Edition C2.0M2.0) (DPE 2023)	N/A	Various dates August 2023 – April 2024
SEED Maps	NSW (Mitchell) Landscapes – version 3.1 (DPE 2016)	N/A	12 December 2023
NSW DPI Fisheries Spatial Data Portal	Department of Primary Industries	Key fish habitat, threatened fish habitat.	18 October 2023
Atlas of Groundwater Dependent Ecosystems	Bureau of Meteorology	N/A	18 October 2023
National Flying-fox monitoring viewer	Australian DCCEEW	N/A	18 October 2023
Core Koala Habitat	NSW DCCEEW	N/A	18 October 2023
BioNet Threatened Biodiversity Profiles data collection	NSW DCCEEW	Threatened species associated with PCTs in the subregion	9 May 2023, updated 18 October 2023
Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act	NSW Threatened Species Scientific Committee	N/A	21 December 2023
Final Priority Assessment List	Australian DCCEEW	N/A	21 December 2023

2.3 Vegetation assessment

Vegetation identification, assessment of vegetation zones and plot-based survey has been undertaken in accordance with Chapter 4 of the BAM (DPIE 2020a). Methods are described in the following sub-sections. Identification of PCTs uses current naming conventions and descriptions provided by the BioNet Vegetation Classification database.

2.3.1 Vegetation mapping

The NSW State Vegetation Type Map (DPE 2022) for the project area was reviewed in a Geographic Information System (GIS). Mapping indicated the presence of five native Plant Community Types (PCTs) in the study area. The PCTs and their association with threatened ecological communities listed under both the BC and EPBC Acts are summarised in Table 2–3.

Table 2–3: Plant community types

Plant community type (PCT)	Threatened ecological community (BC Act)	Threatened ecological community (EPBC Act)
PCT 3320: Cumberland Shale Plains Woodland	Cumberland Plain Woodland (CE) Shale Gravel Transition Forest (E)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CE)
PCT 3448: Castlereagh Ironbark Forest	Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (E)	Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (CE)
PCT 3628: Castlereagh Shrubby Swamp Woodland	Castlereagh Swamp Woodland (E)	Not listed
PCT 3629: Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (V)	Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion (E)
PCT 4025: Cumberland Red Gum Riverflat Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (E)	River-flat Eucalypt Forest on Coastal Floodplains (CE)

2.3.2 Vegetation survey and classification

SMEC conducted site specific vegetation surveys to revise and update the existing vegetation mapping for the project, noting identified constraints. Vegetation surveys were undertaken by two ecologists on 22 May, 12 September and 26 September 2023. The vegetation within the site was assessed to examine and verify the mapping of the condition and extent of the different vegetation communities. The following methods based on the BAM were utilised as part of the vegetation mapping process:

- Transects and traverses using a hand-held tablet to record boundaries of, and variation within stratification units not apparent from aerial imagery
- Collection of data from Rapid Data Points (RDP) to obtain information on vegetation community structure and distribution, to accurately assign zones to vegetation communities
- Collection of plot and transect data in line with the BAM as required for the number of vegetation zones identified.

PCT mapping initially involved ground truthing the latest State-wide Vegetation Type Mapping by noting the dominant canopy and mid-story species, landscape position and other diagnostic features. Reference was also made to soil and topography mapping. Georeferenced maps on hand-held tablets were uses to refine the extent of PCTs into patches to be confirmed through BAM plot-based assessment. Wooded native vegetation is typically mapped to the outer extent of the tree, however in this proposal, trees frequently overhang existing roads and hard surfaces where construction activities would not result in tree removal or other impacts to vegetation. Vegetation patches in the construction zone have therefore been mapped up to permanently cleared road edges.

In locations with low condition vegetation, Rapid Data Points (RDPs) were recorded to confirm alignment to a best fit PCT. The following information was collected at each RDP within a radius of at least 11.5 metres (approximately a 400 square metre area):

- Dominant species in each stratum
- Approximate percentage native cover in each stratum
- Presence of functional attributes used in BAM assessment (e.g. large trees, fallen logs and leaf litter).

2.3.3 Zones stratification

The vegetation within the project footprint (construction and operation) as well as the immediate surrounds was divided into stratification units (known as 'zones' which represent PCT types within a broad condition class) in accordance with the BAM. The three condition classes identified for vegetation in the study area are outlined in Table 2–4. Not all PCTs contained all three condition classes.

Table 2–4: Vegetation zone criteria

Zone condition	Description
Low	PCT is likely to be present however it is so highly modified that it does not meet the Transport offsetting requirements. Typical cases found were remnant trees with a completely exotic lawn, very narrow strips of vegetation along the roadside, or scattered trees in home gardens. Functional attributes which contribute to vegetation integrity scores under the BAM, including fallen timber and litter cover are largely absent. Estimating individual trees to be impacted by the proposal most appropriate means of calculating an offset, given the ground lacks functional habitat.
Moderate	Much of the vegetation was narrow and linear, disturbed and edge effected on two sides (for example – the subject road on one side and houses/easements, fire trails etc. on the other). Although often weed infested, this vegetation still meets condition criteria for offsetting. Typically canopy trees indicative of the community were present and a native shrub layer as well as several ground covers.
Good	In a limited number of situations vegetation for clearing is contiguous with large remnant patches of vegetation and disturbance is primarily found along the road edge. The proposal will therefore be reducing the area of the remnant patch and assessment of its representative condition (not just the edge affected zone) is warranted under the TfNSW assessment methodology. A few smaller patches of good condition vegetation were also found in situations where the road is below the surrounds and therefore avoided run-off, dumping and other edge effects. In Good condition zones weed density was low to moderate and native diversity higher than the moderate category.
Planted and exotic vegetation (no condition score)	Areas where trees have been clearly planted and the vegetation does not conform to a native vegetation community. Plants could include a mix of native, non-locally indigenous and exotic species.

'Low condition' vegetation has an important distinction from the other condition classes because it represents vegetation with a vegetation integrity below the thresholds for offsetting as outlined in section 9.2.1 of the BAM. The thresholds for vegetation integrity scores (VI) below which the vegetation has been classified as 'low' are as follows:

- VI <15, where the PCT is representative of an EEC or a CEEC
- VI <17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community
- VI <20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

BAM plots were not performed in low condition vegetation, which was generally too narrow, fragmented, or inaccessible in private land for practical plot-based assessment. A criterion for assessing vegetation in low condition without a vegetation integrity score recommended by Transport was used (Table 2–5), or data from RDPs was tested using the BAM calculator.

Table 2–5: Criteria for assessing vegetation in low condition without a vegetation integrity score

Cat	Vegetation formation	Criteria
A	Rainforest Wet-sclerophyll forest Dry-sclerophyll forest Grassy woodland Semi-arid woodland Forested wetland	Native tree cover <25 % of the tree cover benchmark for the PCT. **AND** Less than 50% of ground cover vegetation consists of either: • *species listed in the BioNet Vegetation Classification PCT profile for medium to high classification confidence PCTs;* ***or*** • *any native species for very low to low classification confidence PCTs.* **OR** Greater than 90% of ground cover vegetation is cleared.

2.3.4 Plot-based vegetation survey

Plot-based full floristic survey was completed in accordance with subsection 4.3.4 of the BAM. In addition to the plot data that must be collected, the number of trees in each stem size class was counted in each plot to provide a representative sample of tree counts in each vegetation zone and an estimate of tree replacement requirements where applicable in accordance with the Tree and Hollow Replacement Guidelines.

Table 2–7 summarises the number of plots required (in accordance with Table 2–6) and the number of plots undertaken for each vegetation zone. Plot data was not collected in low condition vegetation, as detailed in Table 2–8. Instead, only tree plot (TP) data was collected.

Table 2–6: Minimum number of plots required per zone area

Vegetation zone area (ha)	Minimum number of plots/midlines
<2	1 plot/midlines
>2-5	2 plots/midlines
>5-20	3 plots/midlines
>20-50	4 plots/midlines
> 50–100	5 plots/midlines
> 100–250	6 plots/midlines
> 250–1000	7 plots/midlines; more plots may be needed if the condition of the vegetation is variable across the zone.
> 1000	8 plots/midlines; more plots may be needed if the condition of the vegetation is variable across the zone.

Table 2–7: Minimum number of plots required and completed per vegetation zone

Veg zone	PCT	Condition	Area (ha)	No. plots required	No. plots completed (plot IDs)	Tree plots completed
3320_Moderate	3320: Cumberland Shale Plains Woodland	Moderate	0.58	1	1 (P06)	N/A
3320_Low		Low	2.24	0	0	TP05, TP10
3448_Good	3448: Castlereagh Ironbark Forest	Good	0.96	1	1 (P03)	N/A
3448_Moderate		Moderate	3.02	2	2 (P01, P05)	N/A
3448_Low		Low	2.82	0	0	TP01, TP08
3628_Moderate	3628: Castlereagh Shrubby Swamp Woodland	Moderate	0.29	1	0[1]	TP03
3628_Low		Low	0.21	0	0	TP06
3629_Good	3629: Castlereagh Scribbly Gum Woodland	Good	3.01	2	1 (P02)[2]	N/A
3629_Moderate		Moderate	4.40	2	1 (P04)[2]	N/A
3629_Low		Low	3.30	0	0	TP02, TP04
4025_Low	4025: Cumberland Red Gum Riverflat Forest	Low	0.10	0	0	TP07
Planted	N/A	N/A	0.26	0	0	TP09
Planted native	N/A	N/A	1.42	0	0	TP11
Exotic	N/A	N/A	0.18	0	0	N/A
[1] Reasoning for the incomplete plot record is provided below						
[2] Prior to boundary changes in March 2024, only one plot was required						

For each of the zones, the survey method summarised in Table 2–8 was used.

Table 2–8: Survey method in each vegetation zone

Zone condition	Survey summary
Low	Walk through observations and Rapid Data Points Areas mapped as low condition native communities were also assessed by estimating numbers of individual trees for removal. Evidence for the categorization of this vegetation type will be recured by including typical tree species and presence of any other native species, approximate cover densities and photographic evidence. Plot-based assessment is not seen as giving any meaningful data given the inconsistency of the quality in this zone.
Moderate	Plot-based assessment in accordance with the Biodiversity Assessment Guidelines
Good	Plot-based assessment in accordance with the Biodiversity Assessment Guidelines
Planted and exotic vegetation (no condition score)	Rapid Data Points Although the Biodiversity Assessment Guideline requests that 'Non-native woody vegetation be assessed by plot-based survey', this is not seen as practical for this project. Planted and exotic vegetation to be impacted by the proposal are not contiguous patches. They are typically scattered trees and garden plants of varying age, species, and density as is expected within an urban environment. The impacts to this community are proposed to be best quantified through the recording of individual trees for removal as is specified in the TfNSW guidelines.

Vegetation plot sampling included establishment of 20 metre by 50 metre plots (or an equivalent 10 metre by 100 metre plot in areas with limited space) within which the following composition, structure, and function data was collected:

- Within the 20 m x 20 m flora sub-plot:
  - The percentage cover and abundance count of all vascular plant species present
  - Percentage foliage cover for each growth form.
- Function data attributes within the 20 m x 50 m plot including:
  - Number of large trees present
  - Presence of tree regeneration
  - Tree stem size classes present
  - Total length of fallen logs
  - Litter cover
  - High threat exotic vegetation cover
  - Hollow-bearing trees.

In addition, the species, diameter at breast height (DBH) and number of hollows of each tree in the 20 metre by 50 metre plot were recorded. Tree data was also collected in low condition or planted vegetation to inform the Transport offsetting requirements. Tree plots were 20 by 50 metres where possible or adjusted an equivalent size or half size where space was limited.

No plot data was collected in Castlereagh Swamp Woodland (PCT 3628) due to the small size of the area available. PCT 3628 only occurred in the study area along the drainage lines and is usually meandering through a channel no more than a few metres wide, meaning there is insufficient space for a 20 by 50 metre or 10 by 100 metre plot. For these areas rapid assessment was used to determine the PCT and benchmark values for vegetation condition scores were used for entry into the BAM calculator and tree data was also collected in a 20 by 20 metre plot.

2.3.5 Patch size

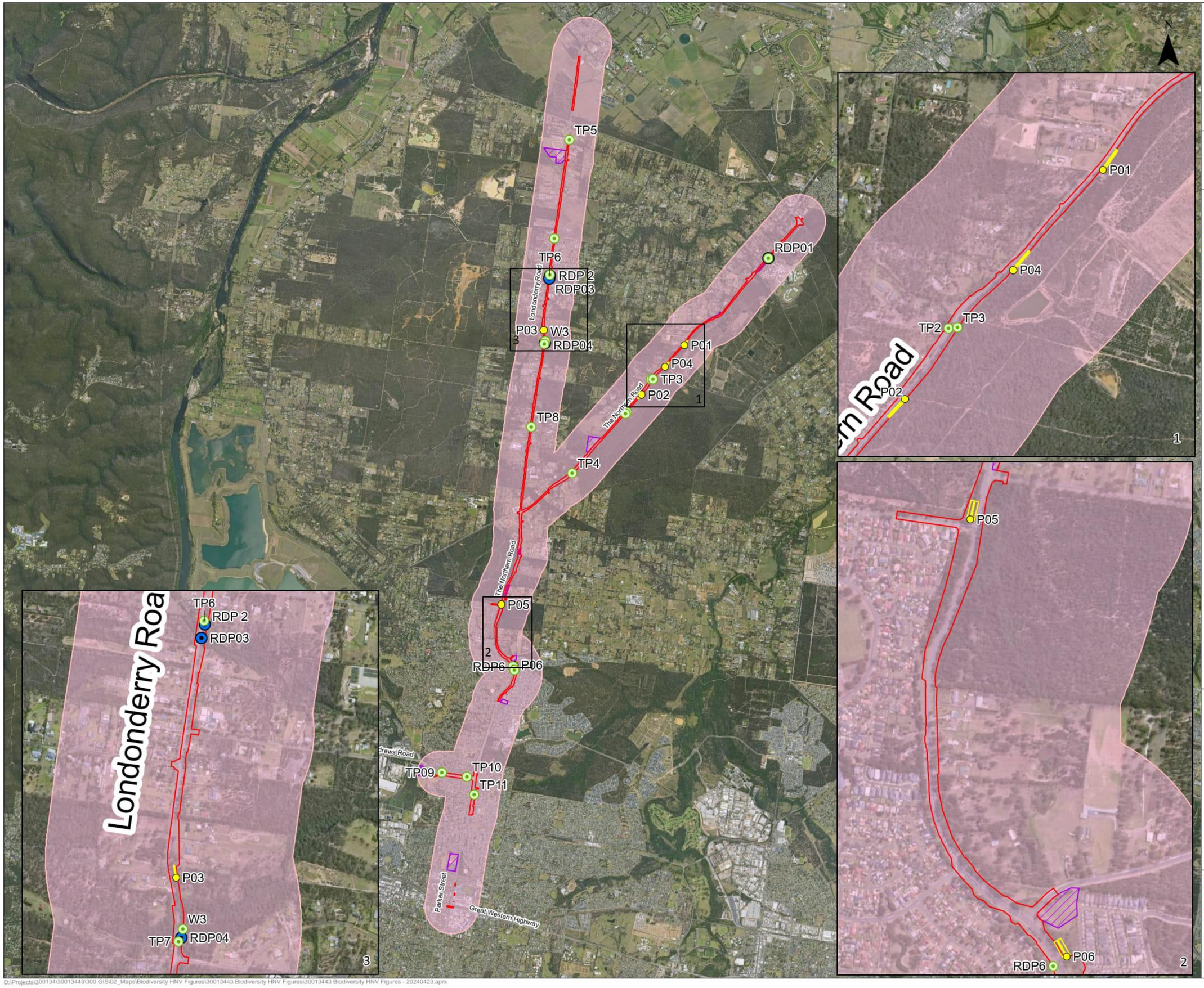
All vegetation communities identified within the subject land were wooded vegetation communities. A patch is defined as a continuous area of native vegetation that occurs on the subject land that may extend onto land adjoining the subject site. It includes all native vegetation that has a gap of less than 100 metres from the next area of native vegetation (DPIE 2020a). Native vegetation in the locality is generally well connected and most native vegetation has continuous links to nature reserves or other vegetated areas with areas totalling well over 100 hectares. Connectivity to vegetation outside the study area was confirmed using a combination of the NSW PCT mapping and aerial image interpretation to confirm the presence of tree canopy connectivity.

2.3.6 Native vegetation cover

The native PCTs mapped on the NSW State Vegetation Type mapping (DPE 2023) were used to determine the percentage cover of native vegetation within the landscape assessment area (see Figure 2–1).

Table 2–9: Native vegetation cover in the landscape assessment area

Landscape assessment area (ha)	2,542.81
Total area of native vegetation cover (ha)	1,246.04
Percentage of native vegetation cover (%)	49.00
Class (0-10, >10-30, >30-70 or >70%)	>30-70



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LEGEND

- Subject land
- Site Compounds
- Landscape Assessment Area
- BAM Plot
- BAM Plot Start Point
- Rapid Data Points
- Tree Data Plot

SOURCES:
1. Roads © Roadnet MDS 2020
2. MetroMap Imagery © Aerometrex Pty Ltd, World Imagery: Earthstar Geographics
World Imagery: Maxar

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 2 - 1
FIGURE TITLE: Vegetation plot-based survey locations
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2.4 Threatened species assessment

This section outlines the process of threatened species habitat assessment and describes the surveys that were undertaken, using Chapter 5 of the BAM as a guide. Database searches and the BAM-C were used to generate a list of threatened species that require assessment. Threatened species are separated into two groups for assessment:

- 'Ecosystem-credit' species listed only under the BC Act – these species are assessed by habitat suitability assessment and do not strictly require targeted surveys
- 'Species-credit' species listed under the BC Act and any species listed under the EPBC Act – any of these species that are associated with PCTs (as defined by the TBDC and BAM-C) being impacted and have a moderate to high likelihood of occurrence (an outcome of Appendix B) should be targeted by surveys in accordance with applicable guidelines.

2.4.1 Habitat suitability assessment

A habitat suitability assessment was used to assess the likelihood of each threatened and/or migratory species, identified from the background searches, to occur in the study area. The assessment was based on the habitat profile for the species and any other habitat information in the Threatened Biodiversity Profile Data Collection, PlantNet, species profiles and scientific literature where available. The likely occurrence of threatened biodiversity was determined based on the presence, condition and type of habitat and previous records using the criteria in Appendix B where relevant. A species may be considered likely to occur where:

- The geographic distribution of the species is known or predicted to include the IBRA subregion in which the proposal site is located, and
- The proposal site contains habitat features associated with the species, or
- Past surveys undertaken at the proposal site indicate that the species is present.

The initial site visit and subsequent observations of available habitat were used to inform the assessment. Results of the habitat suitability assessment are provided in Appendix B.

2.4.2 Targeted flora surveys

The Preliminary Environmental Investigation (TfNSW 2022) identified 17 threatened flora species as occurring within a five-kilometre radius of the site including the following eight species previously recorded in the study area:

- *Marsdenia viridiflora* subsp. *viridiflora*
- *Allocasuarina glareicola*
- *Dillwynia tenuifolia*
- *Pultenaea parviflora*
- *Acacia bynoeana* (Bynoe's Wattle)
- *Micromyrtus minutiflora*
- *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea)
- *Persoonia nutans* (Nodding Geebung).

The BAM methodology suggests several more species should be considered because of known associations with the PCTs in the study area (Appendix B). The habitat suitability assessment identified the 13 species listed in Table 2–10 as requiring further survey.

Vegetation survey initially identified 6.06 hectares of native vegetation in good to moderate condition to be directly impacted by the proposal, which is scattered along the length of the project alignment. Vegetation in these condition classes is potential habitat for the threatened flora species known to be present in the locality. Low condition vegetation with cleared or an exotic understorey was not considered for survey, however opportunistic sightings of isolated threatened species in these areas were recorded.

Threatened flora surveys were undertaken in accordance with *Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method* (DPIE 2020b). Most of the species for survey are medium to small shrub, the exception being *Marsdenia viridiflora*, which is a climber and *Hibbertia puberela*, *H.* sp *Bankstown* and *Pimelea spicata* that

have small forb-like growth forms. The guidelines recommend a maximum distance between parallel field traverses for shrubs and smaller sub-shrubs is 15 metres in open vegetation and 10 metres in dense vegetation. Transects of 10 metres spacing is recommended for smaller forbs and vines in open vegetation or 5 meters spacing in dense vegetation. Native vegetation with the subject land was narrow and linear and typically between 5 and 10 metres wide with a moderately dense structure. Surveys were conducted by two ecologists, each searching for 3-5 species, depending on the PCT. Surveyors walked single traverse parallel to the road 3 to 10 metres from the edge of the roadside vegetation. Each traverse was recorded by a handheld GPS (see Figure 2–2).

Threatened flora surveys were undertaken on 22 November, 5 December, and 12 December 2023. Five species were recorded in the study area during the initial site visit, habitat assessment and completion of BAM plots. Vegetation zones that each species was recorded in was determined and these zones were excluded from further threatened flora searches for the relevant species. Enough individuals were identified that it can be assumed that all equivalent vegetation zones contain suitable habitat for the species and therefore further surveys are not warranted. Opportunistic sightings of these species continued to be recorded using a handheld GPS. Threatened flora species and the PCT in which they were recorded is provided in Table 2–10.

Table 2–10: Targeted threatened flora survey details

Species name	Common name	Required survey period	Associated PCTs in the subject land[1]	Minimum survey requirements[2]	Survey completed
Acacia bynoeana	Bynoe's Wattle	All year	3448, 3628, 3629	Transect surveys at any time of year in all associated PCTs.	26.61 kilometres of total transects by two observers Included all vegetation zones in 'moderate' or 'good' condition 22 November, 5 December and 12 December 2023
Acacia pubescens	Downy Wattle	All year	3320, 3448, 3629	Transect survey at any time of year in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Allocasuarina glareicola		All year	3448, 3628, 3629	Transect surveys at any time of year in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Dillwynia tenuifolia		Aug – Oct	3320, **3448**, **3629**	Transect survey during required survey period in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	All year	3320, **3448**, 3628, 3629, **4025**	Transect survey at any time of year in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	Aug – Nov	3448, 3628, 3629	Transect surveys during required survey period in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Hibbertia puberula		Oct – Dec	3320, 3448, 3629	Use flowers to locate and identify as species is cryptic. Survey when temperature is below 25 degrees (drops petals at higher temperatures). Use local	Surveyed between 22 November, 5 December and 12 December 2023

Species name	Common name	Required survey period	Associated PCTs in the subject land[1]	Minimum survey requirements[2]	Survey completed
				reference site within 10 km and at similar elevation, to determine flowering period.	
Hibbertia sp. Bankstown		Sep – Dec	3448, 3628, 3629, 4025	Use flowers to identify – Flowers Sep - Dec. Will flower sporadically throughout the year in response to rainfall and warmer autumn/winter temperatures.	Surveyed between 22 November, 5 December and 12 December 2023
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs	Nov - Feb	3320, 3448, 3628, 3629, 4025	Transect surveys during required survey period in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Micromyrtus minutiflora		All year	3320, 3448, **3629**	Transect survey at any time of year in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023
Persoonia nutans	Nodding Geebung	All year	3320, 3448, 3628, **3629**	Transect survey at any time of year.	Surveyed between 22 November, 5 December and 12 December 2023
Pimelea spicata	Spiked Rice-flower	All year	3320, 4025	Use flowers to locate and identify as species is inconspicuous. Flowering is unpredictable and rain dependent. Survey 4 weeks after at least a 30 mm rainfall event. In drier times plants are often not visible above ground unless soils remain moist. Multiple surveys may be required. Survey at least 3 times, each at least a month apart unless found.	Surveyed between 22 November, 5 December and 12 December 2023
Pultenaea pa–viflora		Sept - Nov	3320, **3448**, 3628, 3629	Transect surveys during required survey period in all associated PCTs.	Surveyed between 22 November, 5 December and 12 December 2023

[1] Species has been recorded in bolded PCTs prior to commencement of targeted surveys

[2] Based on BAM survey guidelines (DPIE 2020c).

2.4.3 Targeted fauna surveys

A habitat assessment was used to determine the availability of suitable habitat for threatened fauna species. Habitat characteristics considered included the presence of fallen logs, leaf litter and other ground debris, drainage lines, ponds, culverts, the structure of vegetation communities and the presence of fruiting/flowering plant species. The habitat assessment also noted the presence of hollow-bearing trees and any potential koala habitat within the proposed project footprint.

No targeted fauna surveys were undertaken. It was determined that targeted surveys adjacent to a major road would be unlikely to detect any threatened species that would not be assumed present based on the presence of suitable habitat.

Opportunistic sightings of vertebrate fauna species were recorded while undertaking other field activities.

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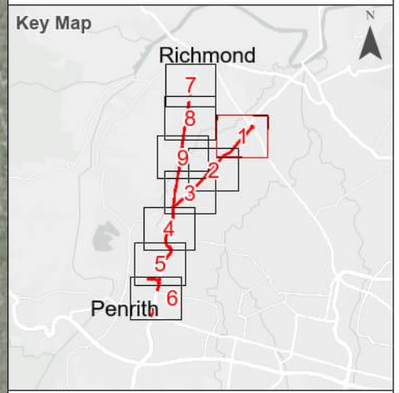
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)

Key Map



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PROJECT NO: 30013443
FIGURE NO: 2 - 2(1)
FIGURE TITLE: Threatened species survey locations
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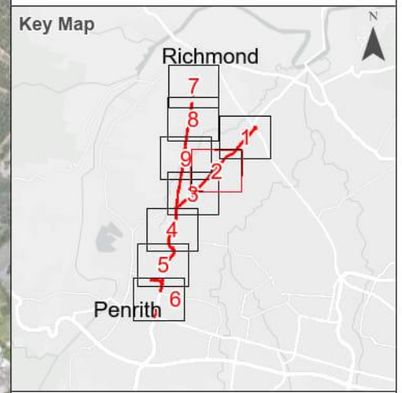
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3448 Castlereagh Ironbark Forest (Moderate)
- 3628 Castlereagh Shrubby Swamp Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)

Key Map



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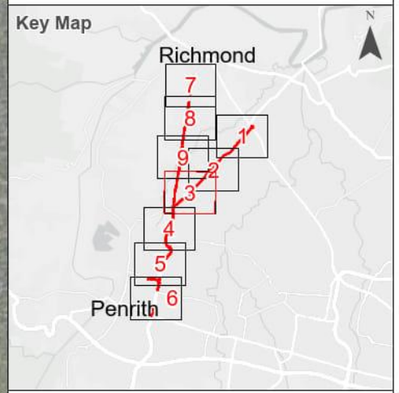
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3448 Castlereagh Ironbark Forest (Moderate)
- 3628 Castlereagh Shrubby Swamp Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)

Key Map



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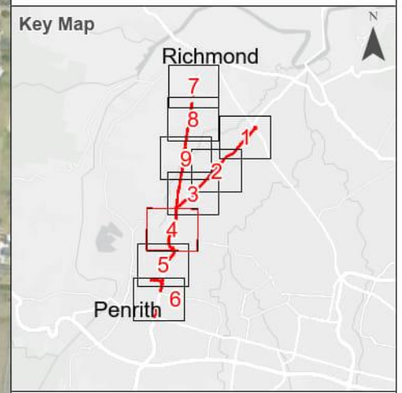
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)

Key Map



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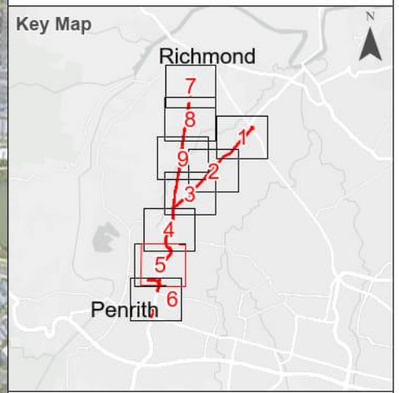
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3320 Cumberland Shale Plains Woodland (Moderate)

Key Map



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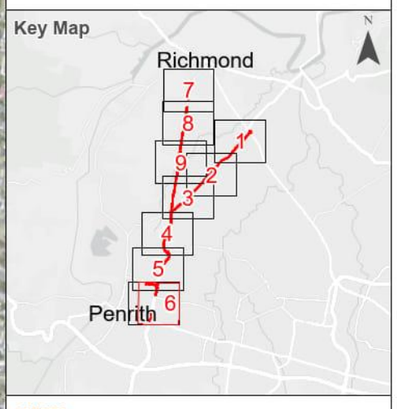
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

Key Map



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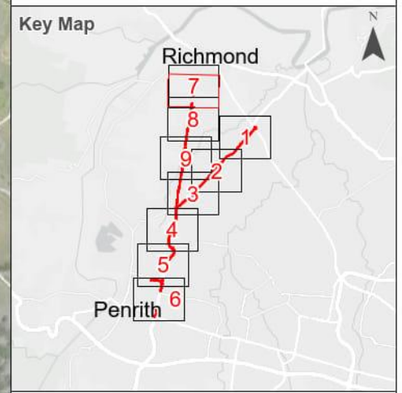
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3320 Cumberland Shale Plains Woodland (Moderate)

Key Map



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	2 - 2(7)
FIGURE TITLE:	Threatened species survey locations
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERSION 1
PAGE SIZE:	A3

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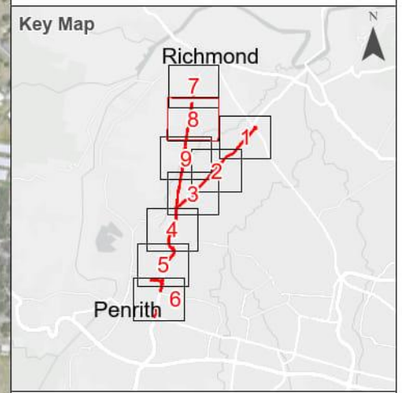
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)

Key Map



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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 2 - 2(8)
FIGURE TITLE: Threatened species survey locations
CREATED BY: LL16284
DATE: 11/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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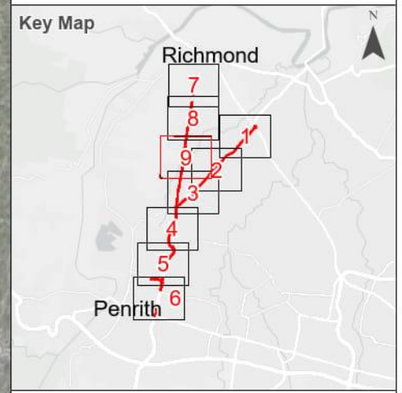
LEGEND

- Subject land
- Threatened flora survey transects (from GPS)

PCT and Condition

- 3448 Castlereagh Ironbark Forest (Good)
- 3628 Castlereagh Shrubby Swamp Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)

Key Map



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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 2 - 2(9)
FIGURE TITLE: Threatened species survey locations
CREATED BY: LL16284
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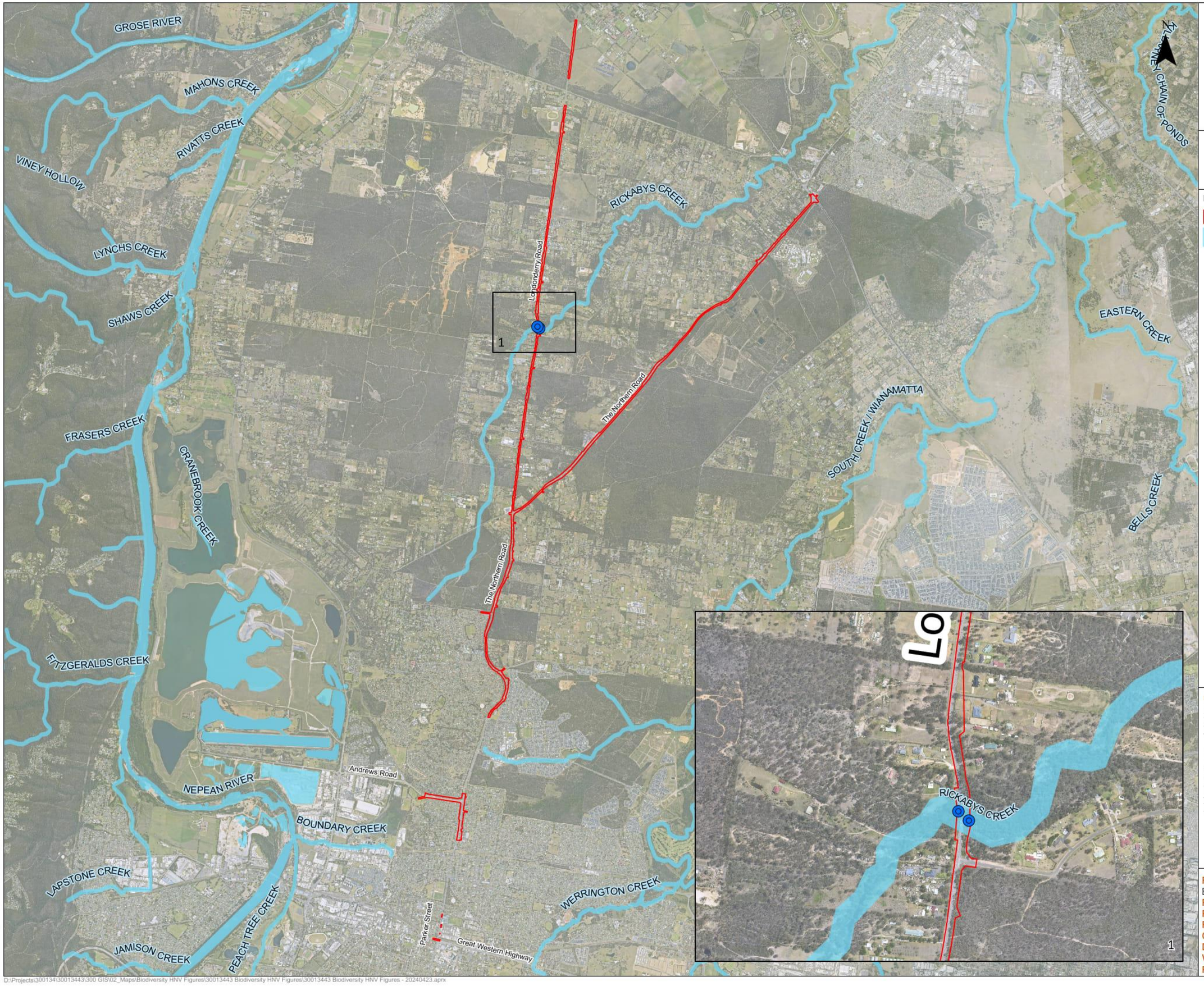
2.5 Aquatic surveys

The waterway habitat assessment included record of:

- The ecosystem type
- Dimensions of waterway and depth of water
- Flow characteristics and hydrological features of aquatic habitat, including changes to drainage and filtration and flow regime
- Bed substrate and habitat features
- Existing infrastructure and barriers to fish movement (natural or artificial)
- Width and species composition of riparian vegetation including the type of vegetation present and condition
- Water quality (dissolved oxygen, pH, turbidity, temperature, nutrients and salinity).

Rickabys Creek is identified as Key Fish Habitat. Water quality sampling was undertaken using a multiparameter water quality meter (Hanna Instruments, Keysborough, Victoria) at two locations along Rickabys Creek, on the east and west of Londonderry Road on 8 February 2024 (Figure 2–3).



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LEGEND

- Subject land
- Key Fish Habitat
- Aquatic Survey

SOURCES:

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2. Waterways © Department of Customer Service 2020
3. Fish Habitat © NSW Department of Primary Industries
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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	2 - 3
FIGURE TITLE:	Aquatic survey locations
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERSION 1
PAGE SIZE:	A3

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2.6 Limitations

Limits to the survey and assessment of impacts were:

- BAM plots may underrepresent the overall quality of larger vegetation patches as access for plots was restricted to more disturbed areas in the road reserves.
- PCT 3628: Castlereagh Shrubby Swamp Woodland represented small zones in riparian areas crossing the construction footprint. BAM plots were not feasible to be performed in these areas and rapid data assessment was used to determine the PCT and benchmarks were used for vegetation integrity scores.
- High levels of exotic perennial grasses were found along road verge in response to recent wetter than average seasons – These made smaller threatened plants more difficult to see or may have out competed them during the survey season.
- Surveys for some threatened flora species were undertaken outside their defined survey period. All species had been previously identified in their preferred survey period and are shrubs that were still observed in the following months. The survey period is not expected to have affected the observer's ability to detect these species:
  - *Grevillea juniperina* subsp. *juniperina* occurred in the road reserve and stood taller than the surrounding grasses and is readily identified without flowers
  - *Dillwynia tenuifolia* continued to flower into November and early December, beyond its recommended survey period and non-flowering individuals were easily observed
  - *Pultenaea parviflora* was also surveyed for in December, with many individuals still flowering beyond their recommended survey period.
- No targeted threatened fauna surveys were undertaken in the study area. Predictions of the occurrence of threatened fauna species was based on the presence of associated PCTs and suitable habitat, which is expected to be a more accurate indicator based on the proximity of the study area to a major road and the generally lower quality of habitat in comparison to nearby vegetation.
- Access to private properties was not granted so all observations of potential impacts to site compound areas or indirect impacts were made from within the road reserve or publicly accessible lands.
- A limited amount of vegetation in the study area was not ground surveyed in detail due to modifications to the proposal after conclusion of the site surveys and therefore PCT type and condition for these areas were determined by vegetation mapping and aerial imagery assessment.
- Threatened species were assumed present in vegetation not subject to threatened flora transects if there is a known habitat association.

3. Existing environment

3.1 Landscape context

The study area is located on the peri-urban fringe of the rapidly expanding Sydney metropolitan area. The location is within the north-western corner of the Cumberland Plain, an area of relatively fertile soil and gentle topography desirable for farmland and development. Much of the native vegetation of the Cumberland Plain has accordingly been cleared and its biodiversity is now identified as among the most threatened in New South Wales (DEC 2005b).

3.1.1 Land use

The study area is based around two major roads, each single lane with a speed limit of 80km/hour. Both roads are used continuously by cars and heavy vehicles and provide a major thoroughfare between Richmond, Windsor and Penrith.

The surrounding area is mainly used for small farms and other semi-rural properties, except in the south where residential suburbs occur. Some areas are left as uncleared scrub. The Castlereagh State Forest, consisting of approximately 320 hectares of native forest, borders The Northern Road to the East. Wianamatta Nature Reserve is located west of The Northern Road. Within Berkshire Park, north of the Castlereagh Nature Reserve is a 60 hectare area of bushland preserved under the Castlereagh Biobanking Agreement. The road reserve of The Northern Road shares a boundary over two kilometres in length with this bushland.

3.1.2 Bioregion

The project site is wholly within the Cumberland Plain subregion of the Sydney Basin Bioregion (IBRA 7).

3.1.3 Landscape and hydrology

The assessment area has a gently undulating landform located within the Hawkesbury – Nepean Terrace Gravels NSW (Mitchell) Landscape. The description of this landscape explains the distribution typical vegetation types seen across the locality.

Landscape	
Hawkesbury – Nepean Terrace Gravels	**Description:** Three levels of river terrace dating into the Tertiary. General elevation 20 to 45m, local relief 10m. Planar, poorly drained terraces with harsh texture-contrast soils and heavy clays in swamps and cut-off meanders. In places deep sands of crevasse splays support scribbly gum (*Eucalyptus sclerophylla*), narrow-leaved apple (*Angophora bakeri*) and old man banksia (*Banksia serrata*) on podsols with adjacent sedgelands. Most clay-based soils (harsh texture-contrast profiles) are very gravelly and carry broad-leaved ironbark (*Eucalyptus fibrosa* ssp. *fibrosa*) and narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*), paperbarks (*Melaleuca* sp.) and drooping red gum (*Eucalyptus parramattensis*). Several vegetation communities are now rare especially that on the Pliocene/Pleistocene sand body with podsol soil profiles at Agnes Banks.
Soil landscape	
Berkshire Park	Landscape—dissected, gently undulating low rises on the Tertiary terraces of the Hawkesbury/Nepean River system. Geology—the soils of this landscape are the result of three depositional phases of Tertiary alluvial/colluvial origin. The lowest deposit is the St Marys formation. This is overlain by the Rickabys Creek gravel formation, which is of varying thickness and in turn is topped by the Londonderry Clay formation. All of these formations are derived from sandstone and clay. Erosion of the surface has led to exposure of all three formations in different locations.
South Creek	This soil landscape comprises the present active floodplain of many drainage networks of the Cumberland Plain and is only represented on the site along Rickabys Creek. Quaternary alluvium derived from Wianamatta Group shales and Hawkesbury Sandstone.

The majority of the assessment area watershed is into Rickabys Creek. The creek crosses under Londonderry Road through a culvert as a 2nd Order stream (Strahler stream order). Several other smaller first and second order tributaries of Rickabys Creek cross the study area at various locations (see Figure 2–3). Despite the length of the study area, the site remains within a low altitude range of between approximately 20 and 55 metres above sea level.

3.1.4 Climate

Sydney falls in the temperate climate zone, which experiences warm to hot summers and no dry season. Temperature fluctuations are more pronounced in the western suburbs than the coast.

The few months prior to the survey period experienced hotter conditions that the long-term averages (Figure 3–1; BOM 2024). Rainfall varied with April and December seeing significantly high falls, but lower amounts in most months in between. These conditions provided optimal conditions for plant growth.

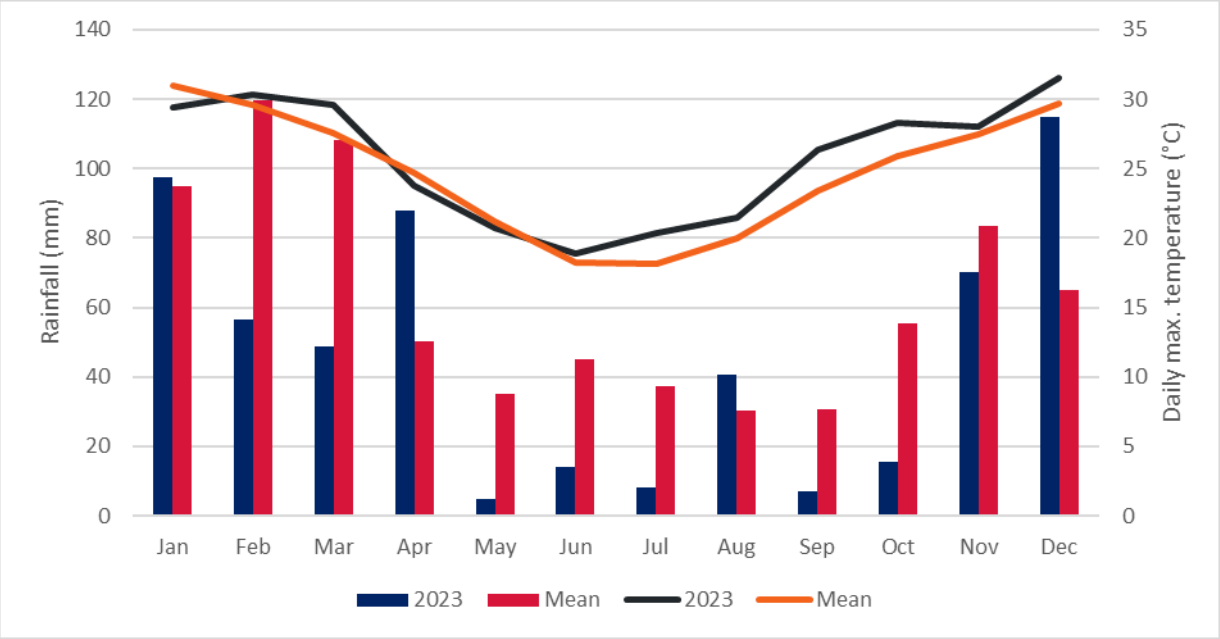

Figure 3–1: Monthly rainfall and daily maximum temperatures for 2023 compared to mean for Penrith Lakes AWS [Station number 067113]

3.2 Plant community types and vegetation zones

Five PCTs were mapped within the study area (Figure 3–2) and confirmed during survey and are presented in Table 3–1. The vegetation in the study area spans a nearly 20 kilometre length and is subject to a large range of differing historical and current disturbance and management regimes. As such it is relatively heterogeneous in condition. PCTs were stratified into three condition classes prior to performing plot-based assessment using the criteria in Table 2–4.

Table 3–1: Plant community types and vegetation zones including patch size and vegetation integrity (VI) score

Plant community type Name	Vegetation zone	Threatened ecological community	Area (ha) Subject land	Patch size class	VI score
PCT 3629: Castlereagh Scribbly Gum Woodland	3629 _Good	BC Act – Vulnerable EPBC Act – Endangered	3.01	>100	49.2
	3629_Moderate	BC Act – Vulnerable EPBC Act – Endangered	4.40	>100	42.1
	3629_Low	Not listed	3.30	n/a	<17
PCT 3448: Castlereagh Ironbark Forest	3448_Good	BC Act – Endangered EPBC Act – Critically Endangered	0.96	>100	79.3
	3448 Moderate	BC Act – Endangered EPBC Act – Critically Endangered	3.02	>100	48.4
	3448_Low	Not listed	2.82	n/a	<15
PCT 3320: Cumberland Shale Plains Woodland	3320_Moderate	BC Act – Critically endangered	0.58	>100	25
	3320_Low	BC Act – Critically endangered	2.24	n/a	<15
PCT 3628: Castlereagh Swamp Forest	3628_Moderate	BC Act – Endangered	0.29	>100	100[1]
	3628_Low	BC Act – Endangered	0.21	n/a	100[1]
PCT 4025: Cumberland Red Gum Riverflat Forest	4025_Low	BC Act – Critically Endangered	0.10	>100	<15
Weeds and exotic	Exotic	n/a	0.06	n/a	n/a
Planted urban trees	Planted	n/a	0.26	n/a	n/a
Planted native trees	Planted native	n/a	1.42	n/a	n/a

[1] Benchmark score due to absence of plot data

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LEGEND

Subject land

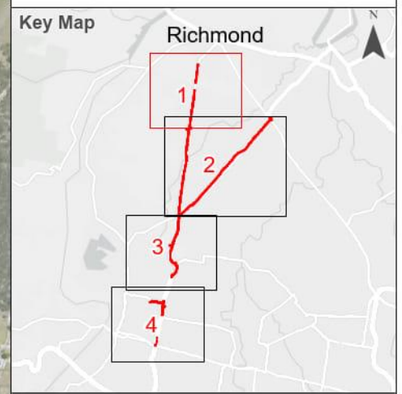
PCT

1111 Planted native
3320 Cumberland Shale Plains Woodland
3629 Castlereagh Scribbly Gum Woodland

Vegetation Zone

3320 Good
3320 Low
3320 Moderate
3629 Low
3629 Moderate
Planted

Key Map



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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 2 (1)
FIGURE TITLE: Plant community types and vegetation zones
CREATED BY: LL16284
DATE: 12/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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LEGEND

- Subject land
- BAM Plot Start Point
- BAM Plot

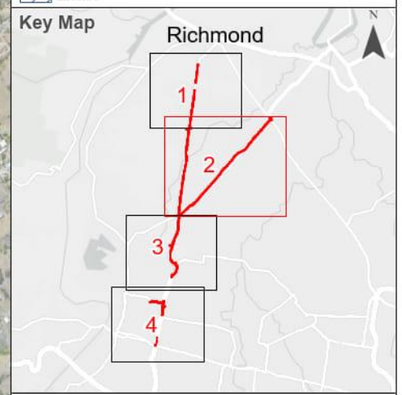
PCT

- 0 Exotic
- 3448 Castlereagh Ironbark Forest
- 3628 Castlereagh Shrubby Swamp Woodland
- 3629 Castlereagh Scribbly Gum Woodland
- 4025 Cumberland Red Gum Riverflat Forest

Vegetation Zone

- 3448 Good
- 3448 Low
- 3448 Moderate
- 3628 Low
- 3628 Moderate
- 3629 Good
- 3629 Low
- 3629 Moderate
- 4025 Low
- Cleared
- Exotic

Key Map



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PROJECT NO: 30013443
FIGURE NO: 3 - 2 (2)
FIGURE TITLE: Plant community types and vegetation zones
CREATED BY: LL16284
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VERSION: VERSION 1
PAGE SIZE: A3

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LEGEND

- Subject land
- BAM Plot Start Point
- BAM Plot

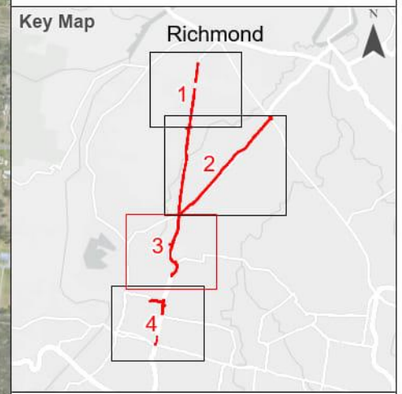
PCT

- 0 Exotic
- 3320 Cumberland Shale Plains Woodland
- 3448 Castlereagh Ironbark Forest
- 3629 Castlereagh Scribbly Gum Woodland

Vegetation Zone

- 3320 Low
- 3320 Moderate
- 3448 Good
- 3448 Low
- 3448 Moderate
- 3629 Low
- 3629 Moderate
- Planted native

Key Map



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PROJECT NO: 30013443
FIGURE NO: 3 - 2 (3)
FIGURE TITLE: Plant community types and vegetation zones
CREATED BY: LL16284
DATE: 12/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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LEGEND

Subject land

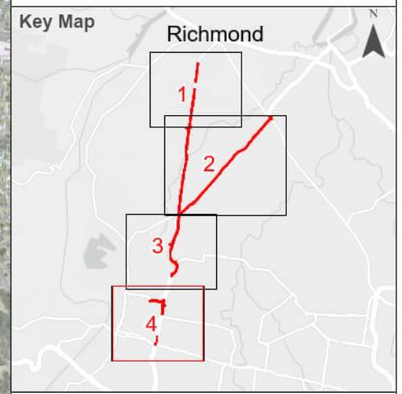
PCT

0 Exotic
1111 Planted native
3320 Cumberland Shale Plains Woodland

Vegetation Zone

3320 Low
Planted
Planted native

Key Map



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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 2 (4)
FIGURE TITLE: Plant community types and vegetation zones
CREATED BY: LL16284
DATE: 12/06/2024
VERSION: VERSION 1
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3.2.1 PCT 3320: Cumberland Shale Plains Woodland

Description

BioNet Vegetation Classification describes the community as follows:

A tall sclerophyll open forest or woodland with a sparse mid-stratum of soft-leaved shrubs and small trees with a grassy ground cover on the undulating Wianamatta Group shale plains of western Sydney. The canopy very frequently includes Eucalyptus tereticornis and Eucalyptus moluccana, with ironbarks (Eucalyptus crebra and Eucalyptus fibrosa) occasionally present and sometimes prominent in localised areas. The sparse shrub to small tree layer very frequently includes Bursaria spinosa and one or more species of Acacia, of which Acacia parramattensis, Acacia decurrens and Acacia falcata are the most frequent and abundant. The mid-dense ground layer typically includes grasses, forbs, twiners and hardy small ferns. Microlaena stipoides is almost always present and Themeda triandra, Dichondra repens, Brunoniella australis, Cheilanthes sieberi subsp. sieberi, Desmodium varians, Aristida vagans and Glycine tabacina are very frequent. This is the most widespread PCT on the Cumberland Plain, occupying much of the plain between Bankstown and the Hawkesbury and Nepean rivers.

The community in the study area had an open forest structure with a sparse shrub layer and grassy understorey. The canopy trees were mostly Coastal Grey Box (*Eucalyptus moluccana*), particularly at Plot 6. *Eucalyptus tereticornis*, *Eucalyptus fibrosa* and *Angophora floribunda* were present at some locations. The shrub layer was almost completely absent, most likely because of historic clearing. Occasional *Bursaria spinosa*, *Dodonea viscosa* and *Eremophila debilis* were found. The grassy ground cover of the community contained a high percentage of exotic grasses but retained some characteristic natives and forbs such as *Microlaena stipoides*, *Aristida vagans*, *Centella australis* and *Brunoniella australis*.

PCT ID	3320
PCT name	Cumberland Shale Plains Woodland
Vegetation class	Coastal Valley Grassy Woodlands
Vegetation formation	KF_CH3 Grassy Woodlands
Estimate of per cent cleared	93.03 %
Area in subject land	2.82 hectares
Conservation status	Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered (BC Act) Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest – Critically Endangered (EPBC Act)
Vegetation zones (condition) and plots	3320_Moderate (Moderate) – Plot P06 3320_Low (Low) – Individual trees on managed lawn not suitable for plot analysis

Justification for PCT selection:

Cumberland Shale Plains Woodland is mapped in scattered locations across the study area. The plant community type is well-known to occur in the locality and is restricted to the Sydney Basin Bioregion, mostly with the Cumberland subregion but also found in Wollemi and Yengo subregions. The elevation of the study area is within the known range of 9 to 208 metres and is typical of the landscape description of an undulating landscape on the Cumberland Plain. The soil landscape within the study area is underlain by Wianamatta group shales on the Cumberland Plain, the community is therefore found in its expected landscape. The patchy distribution of sands, clays and gravels typical of the Berkshire Park Soil landscape can support several other vegetation communities, which are described in later sections.

Most areas mapped by this study as PCT 3320 were indicated on the current Statewide Vegetation Type mapping as such. The grassy woodland formation and composition of plant species provide the main justification for assignment of the PCT. The typical floristic composition is described below.

Floristic and structural summary of PCT 3320 within the study area

Growth form	Typical species
Trees	*Eucalyptus moluccana, Eucalyptus tereticornis, Angophora floribunda, Eucalyptus fibrosa* (occasional)
Shrubs	Generally absent or very sparse from historic clearing: *Bursaria spinosa, Eremophila debilis, Dodonaea viscosa* (all occasional)
Grass and grass-like	*Microlaena stipoides*, *Aristida ramosa*
Forb	*Dichondra repens, Einadia nutans, Brunoniella australis, Dianella longifolia*
Fern	*Cheilanthes sieberi*
Other	*Convolvulus erubescens*
Exotic	*Eragrostis curvula, Cenchrus clandestinus, Chloris gayana*
High Threat Exotic	*Eragrostis curvula*

Condition states

Two condition classes were identified:

- Low. This condition class included trees with no discernible native component (typically mown lawn) and also lacking natural tree regeneration (Photo 3-1). In more urban areas many of the trees may be planted or included non-local species. In some situations the zone was represented by narrow strips of isolated remnant trees close to the road). Recording individual trees to be impacted by the proposal most appropriate means of calculating an offset given the ground lacks functional habitat for the community.

Photo 3-1: Low Condition PCT 3320 on Londonderry Road

- Moderate. Typical mature canopy species were present, however large trees were absent (Photo 3-2). This condition class still had a largely exotic understory, with some limited native species in the shrub and ground layer. The most prevalent high threat weed in the community were grasses, mostly African lovegrass (*Eragrostis curvula*) and Rhodes Grass (*Chloris gayana*). The condition of this vegetation community is generally lower than for the other communities assessed in the study area as grassy woodlands were historically more highly sought after for agricultural land. A vegetation integrity of only 25 was measured at Plot 6.

Photo 3-2: Plot 6 showing PCT 3320_Moderate

3.2.2 PCT 3448: Castlereagh Ironbark Forest

Description

BioNet Vegetation Classification describes the community as follows:

A tall sclerophyll open forest with a dense mid-stratum of Melaleucas and a patchy ground layer of grasses and graminoids or a dense thicket of Melaleucas with emergent eucalypts that is found on the Cumberland Plain to the west of Sydney. It is one of a suite of forests that are associated with the subtle intergrade between clay-rich shale soil and the sandier substrates. The canopy almost always includes ironbark eucalypts (primarily Eucalyptus fibrosa), occasionally accompanied by stringybark eucalypts (Eucalyptus sparsifolia, Eucalyptus oblonga or Eucalyptus globoidea). The dense shrub to small tree layer almost always includes melaleucas and acacias of which Melaleuca decora and Acacia falcata are the most frequent. The smaller shrubs Bursaria spinosa and Daviesia ulicifolia are both common. The ground layer is a sparse cover of graminoids, forbs, twiners and a hardy fern. Entolasia stricta is almost always present while Aristida vagans, Cheilanthes sieberi subsp. sieberi, Microlaena stipoides, Dianella revoluta, Lomandra multiflora subsp. multiflora, Lepidosperma laterale and Opercularia diphylla are very frequent. The ground layer may be depauperate in locations where the dense mid-stratum excludes light and suppresses plant growth. This PCT is associated with moderately fertile soils derived from Tertiary alluvial deposits, shale and ironstone gravels and residual soils derived from shale or from sandstone with enrichment from nearby shales.

Within the study area PCT 3448 had a canopy of predominantly Broad-leaved ironbark (*Eucalyptus fibrosa*), with occasional *Eucalyptus globoidea* at some sites. A dense layer of paperbarks was usually present, mostly *Melaleuca decora*. Most of the other ground layers species mentioned in the BioNet description above were typically present in the better quality areas.

PCT ID	PCT 3448
PCT name	Castlereagh Ironbark Forest
Vegetation class	Cumberland Dry Sclerophyll Forests
Vegetation formation	KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub-formation)
Estimate of per cent cleared	86.89 %
Area in subject land	6.80 hectares
Conservation status	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – Endangered (BC Act) Cooks River Castlereagh Ironbark Forest – Critically Endangered (EPBC Act)
Vegetation zones (condition) and plots	3448_Good (Good) – Plot P03 3448_Moderate (Moderate) – Plots P01, P05 3448_Low (Low) – Individual trees on managed lawn not suitable for plot analysis

Justification for PCT selection:

Castlereagh Ironbark Forest is known only within the Sydney Basin Bioregion, including the subregions Cumberland, Cataract, Wollemi and Yengo. The site is within the know elevation range of between 0.9 and 391 metres. As described by both the NSW Mitchell Landscape and the NSW Eastern Soil Landscape, the study area contains localised occurrences of varying dominance of sand, clays and gravels providing the required soils and geology. The community is mapped extensively on the Statewide Vegetation Type Map across the study area. Vegetation composition in the study area has provided the main diagnostic feature for differentiating this PCT from other dry Sclerophyll communities. Vegetation in wet drainage lines, was considered for Castlereagh Shrubby Swamp Woodland or other forested wetlands. The typical floristic composition of the community found is presented below.

Floristic and structural summary of PCT 3448 within the study area

Growth form	Typical species
Trees	Broad-leaved (*Eucalyptus fibrosa*) - dominant
Shrubs	*Melaleuca decora, Melaleuca nodosa, Daviesia ulicifolia, Dillwynia tenuifolia, Lissanthe strigosa*
Grass and grass-like	*Entolasia stricta*, *Lepidosperma lateral*, *Cyathochaeta diandra*
Forb	*Dianella revoluta*, *Laxmannia gracillis*
Fern	*Cheilanthes sieberi*
Other	*Hardenbergia violacea*
Exotic	*Eragrostis curvula*
High Threat Exotic	*Eragrostis curvula*

Condition states

As described in the classification method for vegetation in Section 2.3.2, three condition classes were identified:

- Low: found along various sections of the project site. The shrub and ground layer usually cleared of native vegetation, typically mown lawn with only canopy trees retained. Recording individual trees impacted is the most appropriate means of calculating an offset given the ground lacks functional habitat for the community.

Photo 3-3: Low condition PCT 3448 Castlereagh Ironbark Forest along The Northern Road in Berkshire Park at location of RDP1

- Moderate: The most prevalent condition class which represented a disturbed example of the community typically narrow, and edge affected but with some elements of all strata present including mature Ironbark trees and a midstory of small paperbark trees usually present. There was a moderate diversity of ground-layer species despite a high prevalence of weeds. Most sites had a high cover of African Lovegrass (*Eragrostis curvula*) at least 50% cover or more.

Photo 3-4: Plot 2 showing PCT 3448 in moderate condition

- Good: Patches with this condition class were identified in locations where the subject site was directly connected to large high-quality remnants such as along Wianamatta Nature reserve and Castlereagh Nature Reserve. Some edge effects are still present in this condition class, namely infiltration of weeds from the road edge, firewood collecting and rubbish dumping. Exotic weed cover is lower than in the moderate zones and flora diversity higher.

Photo 3-5: Plot 1 showing PCT 3448 in good condition

3.2.3 PCT 3628: Castlereagh Shrubby Swamp Woodland

Description

BioNet Vegetation description describes the community as follows:

A tall swamp sclerophyll woodland with a mid-stratum of melaleucas, or a thicket of melaleucas with emergent trees, occurring in periodically wet areas on creek lines on Tertiary alluvial deposits, gravels or shale-enriched residual sandstone soils on the Cumberland Plain, western Sydney. At least one species of tree is almost always present, however cover of the tree layer varies from very sparse to mid-dense. Eucalyptus parramattensis and Melaleuca decora are both common, while Eucalyptus

longifolia occasionally occurs and a range of other Eucalyptus and Angophora species are rare with variable cover. The PCT includes a sparse to mid-dense tall shrub or small tree layer of Melaleucas, almost always including Melaleuca linariifolia and commonly Melaleuca thymifolia. The lower shrub layer is sparse to very sparse, very frequently including Goodenia paniculata, occasionally Pultenaea villosa, Leptospermum polygalifolium, and occasionally to rarely species of Acacia. The ground layer may be dry, damp or covered by water at different times, depending on the prevailing climatic conditions and local topography. This leads to a diversity of grasses, forbs and sedges, very frequently including Microlaena stipoides, Centella asiatica, Hydrocotyle sibthorpioides and Lobelia purpurascens and commonly Entolasia stricta. On presently available information all plots have at least one, usually a few, species of sedge, rush or aquatic forb reflective of the periodically moist to wet soils in creek line habitats. Isolepis inundata, Lepyrodia muelleri, Juncus usitatus, Paspalum distichum, Persicaria decipiens and Schoenus apogon all occur occasionally, while Machaerina teretifolia is rare. This PCT occurs in poorly-drained areas either on low-lying Tertiary alluvial deposits (below elevations of around 20 metres asl) or on uplifted river gravels or enriched residual soils near the interface of sandstone and shale geologies (up to around 250 metres asl near Mount Henry and in the Wollondilly Shire). This community may be adjacent to PCT 3448, which occurs on better-drained soils away from the creek line. PCT 3448 also commonly contains Melaleuca decora, however almost always contains ironbarks in the canopy and only very rarely contains Melaleuca linariifolia or species of sedge, rush or aquatic forb.

In the study area the community was restricted to creek flats and drainage lines at places where creek lines cross the road through culverts. The upper canopy was typically dominated by *Eucalyptus parramattensis.* There was a dense midstory of *Melaleuca decora*, and some *Melaleuca linariifolia*. The shrub and ground layer were typically low in native diversity however some native sedges and forbs typical of wet areas were present which indicated occasional inundation, for example *Carex appressa*, *Ranunculus inundatus* or *Juncus usitatus*. All sites were invariably impacted by heavy weed growth, because of seed and nutrient deposition from flooding events.

PCT ID	3628
PCT name	Castlereagh Shrubby Swamp Woodland
Vegetation class	Sydney Sand Flats Dry Sclerophyll Forests
Vegetation formation	KF_CH5B Sclerophyll Forests (Shrubby sub-formation)
Estimate of per cent cleared	67.86 %
Area in subject land	0.50 hectares
Conservation status	Castlereagh Swamp Woodland – Endangered (BC Act) – part association
Vegetation zones (condition) and plots	3628_Moderate (Moderate) – no plots (see Section 2.3.2 for reasoning) 3628_Low (Low) – Scattered trees or shrubs in weed dominated creek beds.

Justification for PCT selection:

Castlereagh Shrubby Swamp Woodland is known only within the Sydney Basin Bioregion within the Cumberland Plain and Wollemi subregion. The study area is within the know range and elevation between 13 and 246 metres. The PCT was identified within periodically wet areas on creek lines within a soil landscape composed of tertiary alluvial deposits, gravels, or shale-enriched residual sandstone soils on the Cumberland Plain. PCT 4025 - Cumberland Red Gum Riverflat Forest occupies similar landscape positions however tends to be found on broader alluvial river flats where it graduates into surrounding grassy woodlands.

The community was found as narrow occurrence in stream beads flowing through dry sclerophyll forests – either Castlereagh Ironbark Forest or Scribbly Gum woodland. Cumberland River-flat forests typically contain tall River red gums (*Eucalyptus tereticornis*) and a relatively sparse mid storey of melaleucas and acacias. The flora structure of the community providing floristic justification of the PCT selection are provided below.

Floristic and structural summary of PCT 3628 within the study area

Growth form	Typical species
Trees	*Eucalyptus parramattensis* (common), *Eucalyptus amplifolia* (occasional)
Shrubs	*Melaleuca decora*, *Melaleuca linariifolia*, *Acacia floribunda, Bursaria spinosa*
Grass and grass-like	*Microlaena stipoides*
Forb	*Centella asiatica*,
Fern	-
Other	-
Exotic	Small-leaved privet (*Ligustrum lucidum*), Honeysuckle (*Lonicera japonica*), Kikuyu (*Cenchrus clandestinus*)
High Threat Exotic	Small-leaved privet (*Ligustrum lucidum*)

Condition states

Two condition classes were identified:

- Low: Most areas of the community near the road were highly disturbed from past construction, and flooding events which tend to exacerbate weed invasion. Low condition areas were identified by their landform position in periodically inundated drainage lines and the presence of scattered remnant native trees or shrubs typical of the community. The weed Small-leaved Privet (*Ligustrum sinense*) was invariably very prevalent. The dense thickets of Privet excluded native ground cover, and exotic grasses and weeds dominated in more open areas.

Photo 3-6: Rapid Plot 2 showing PCT 3628 in low condition.

- Moderate: An upper stratum of scattered mature *Eucalyptus parramattensis* trees were present and a midstory of paperbark trees. A high prevalence of Privet was still usually present resulting in a low diversity of other native shrubs and ground covers.

Photo 3-7: PCT 3628 in moderate condition

3.2.4 PCT 3629: Castlereagh Scribbly Gum Woodland

Description

The Bionet classification system describes the community as follows:

A mid-high to tall sclerophyll woodland with a mid-stratum of Melaleuca trees and dry shrubs found on consolidated Tertiary sand deposits in western Sydney. It is one of several dry sclerophyll forest and woodland PCTs associated with spatially disjunct older sand deposits found on gently undulating terrain in coastal and hinterland valleys of the Sydney Basin. The tree canopy very frequently includes Eucalyptus sclerophylla with Eucalyptus parramattensis and/or Angophora bakeri, the former species with a higher foliage cover than the latter two. The mid-stratum commonly includes a sparse cover of taller Melaleuca decora, which also may be recorded in the tree canopy. A lower mid-dense to dense shrub stratum of Melaleuca nodosa, Banksia spinulosa, Hakea sericea, Hakea dactyloides, Leptospermum trinervium and Acacia macrostachya are all very frequent or common. The ground layer usually includes a diverse mix of grasses, graminoids and small shrubs. Entolasia stricta and Pimelea linifolia are almost always present while Themeda triandra, Dianella revoluta, Cyathochaeta diandra and Xanthorrhoea minor are all very frequent.

The community is mapped extensively across the study area and locality, being one of the main PCTs across the Castlereagh Nature Reserve. The forest was typically lower than surrounding vegetation types with a canopy of between 10 to 15 metres. Hard-leaved scribbly gums (*Eucalyptus sclerophylla*) were usually the dominant tree. *Angophora bakeri* was also common and dominant in some areas of relatively young regrowth. Ironbarks were also sometimes present although it was more likely to be Narrow-leaved ironbark (*Eucalyptus crebra*), than *Eucalyptus fibrosa*.

PCT ID	3629
PCT name	Castlereagh Scribbly Gum Woodland
Vegetation class	Sydney Sand Flats Dry Sclerophyll Forests
Vegetation formation	KF_CH5B Sclerophyll Forests (Shrubby sub-formation)
Estimate of per cent cleared	64.78 %
Area in subject land	10.71 hectares
Conservation status	Castlereagh Scribbly Gum Woodland – Vulnerable (BC Act) Castlereagh Scribbly Gum and Agnes Banks Woodlands – Endangered (EPBC Act)
Vegetation zones (condition) and plots	3629_Good (Good) – Plot P02 3629_Moderate (Moderate) – Plot P04 3629_Low (Low) – Individual trees on managed lawn not suitable for plot analysis

Justification for PCT selection:

Castlereagh Scribbly Gum Woodland is known only within the Sydney Basin Bioregion, including the subregions Cumberland and Wollemi subregions. The site is within the know elevation range of between 13 and 246 metres. The NSW Landscape of the site is known to contain disjunct sand deposits on gently undulating terrain and sand dominant areas provide suitable habitat for this community. It is the dominant PCT indicated across the study area by the Statewide Vegetation Type Map. Vegetation composition provides the main diagnostic feature for differentiating this PCT from other dry sclerophyll communities. Vegetation in wet drainage lines, was considered for Castlereagh Shrubby Swamp Woodland or other forested wetlands. The typical floristic composition of the community found is presented below.

Floristic and structural summary of PCT 3629 within the study area

Growth form	Typical species
Trees	*Eucalyptus sclerophylla*, *Angophora bakeri*
Shrubs	*Melaleuca decora*, *Melaleuca nodosa*, *Leptospermum trinervium*, *Hakea sericea*
Grass and grass-like	*Entolasia stricta*, *Cyathochaeta diandra*, *Lepidosperma laterale*
Forb	*Dianella revoluta*, *Pomax umbellate*, *Laxmannia gracillis*
Fern	-
Other	*Xanthorrhoea minor*
Exotic	*Eragrostis curvula*, *Chloris gayana*, *Verbena bonariensis*, *Sida rhombifolia*
High Threat Exotic	*Eragrostis curvula*.

Condition states

As described in the classification method for vegetation in Section 2.3.2, three condition classes were identified:

- Low: found along various sections of the project site. The ground layer was cleared of native vegetation and was typically exotic mown lawn. Up to three mature canopy tree species could be present, but native shrubs and ground covers were generally absent. Offsetting by individual trees impacted is the most appropriate given the ground layer is no-longer functional habitat for the community.

Photo 3-8: Low condition PCT 3629

- Moderate: This zone was heavily fragmented, or edge effected from past disturbance, with an exotic dominant ground layer usually with a high cover of African Lovegrass. Mature trees were usually present as was a shrub layer, which at times was atypically dense in areas of regrowth. There was a moderate diversity of ground-layer species despite the high prevalence of weeds.

Photo 3-9: PCT 3269 in moderate condition

- Good: This condition class was identified in locations where the subject site was directly connected to large high-quality remnants, primarily adjacent to Cumberland Nature Reserve. Some edge effects were still present in this condition class, namely infiltration of weeds from the road edge, firewood collecting and rubbish dumping. Mature trees were present and native species richness and cover was notably higher than in moderate zones.

Photo 3-10: Good condition PCT 3629 adjacent to the Castlereagh Nature Reserve

3.2.5 PCT 4025: Cumberland Red Gum Riverflat Forest

Description

A tall to extremely tall sclerophyll open forest with a mid-stratum of soft-leaved shrubs and small trees and dense, grassy ground layer situated on the alluvial flats alongside streams that drain the Cumberland Plain or more rarely the broad alluvial flats of the Hawkesbury and Nepean River systems to the west of Sydney. The canopy almost always includes red gums (*Eucalyptus tereticornis*, *Eucalyptus amplifolia*), occasionally associated with an apple (*Angophora floribunda*, *Angophora subvelutina*), which may be locally prominent. A sparse mid-stratum almost always includes *Bursaria spinosa* and one or more Acacia species, of which *Acacia parramattensis* is the most frequent and abundant. The ground layer is typically characterised by a dense cover of grasses along with soft-leaved forbs and ferns. A high cover of *Microlaena stipoides* is almost always present with more scattered *Dichondra repens*, *Oplismenus aemulus* and *Solanum prinophyllum* being very frequent.

In the study area the PCT is restricted to the riverbank of the main arm of Rickabys Creek. A tall canopy of *Eucalyptus tereticornis and Eucalyptus amplifolia* and the landscape position are the primary indicators that the community is consistent with the NSW Statewide vegetation type mapping.

PCT ID	4025
PCT name	Cumberland Red Gum Riverflat Forest
Vegetation class	Coastal Floodplain Wetlands
Vegetation formation	KF_CH9 Forested Wetlands
Estimate of per cent cleared	88.84 %
Area in subject land	0.10 hectares
Conservation status	River-Flat Eucalypt Forest on Coastal Floodplains – Endangered (BC Act) River-flat Eucalypt Forest on Coastal Floodplains – Critically Endangered (EPBC Act)
Vegetation zones (condition) and plots	4025_Low (Low) – Individual trees on managed lawn not suitable for plot analysis

Justification for PCT selection:

Cumberland Red Gum Riverflat Forest is found only within the Sydney Basin Bioregion within the Cumberland and Wollemi subregions. The site is within the know elevation range of between 13 and 246 metres. Alluvial flats besides Rickabys Creek provides a suitable landform for the community. This PCT was considered as it is indicated on the Statewide Vegetation Type Map in this location and it the only area of the South Creek Soil landscape within the study area, which represent areas of alluvial flats. Within the accessible subject land the condition of the community was very low and a limited range of juvenile regrowth provide evidence for the presence of the community the species, which are listed below.

Floristic and structural summary of PCT 4025 within the study area

Growth form	Typical species
Trees	*Eucalyptus amplifolia, Eucalyptus tereticornis*, (Juvenile)
Shrubs	*Acacia floribunda, Melaleuca linariifolia*
Grass and grass-like	*Lomandra longifolia, Juncus usitatus*
Forb	*Ranunculus inundatus, Centella asiatica*
Fern	-
Other	-
Exotic	*Ligustrum sinense, Cenchrus clandestinus, Rumex crispus, Lonicera japonica*
High Threat Exotic	*Ligustrum sinensis, Ludwigia peruviana, Watsonia meriana*

Condition states

Low: The only condition of the community within the subject land was low. Previous clearing and possibly high flow rates near the culverts have limited the establishment of large canopy trees. Scattered juvenile eucalyptus and shrubs are present and the ground cover is exotic dominant with occasional native sedges and forbs. A garden escapee Watsonia (*Watsonia meriana*) formed dense swaths in the zone (Photo 3-11).

Photo 3-11: Low condition PCT 4025 near culverts at Rickabys Creek crossing

3.2.6 Other zones

Three other zones were mapped where vegetation did not clearly conform to a PCT, as shown on Figure 3–2. The built environment and green spaces clearly not containing native vegetation, such as suburban lawns or garden beds without substantial trees, have generally not been included in zone mapping.

Exotic

This zone indicates areas colonised by non-native vegetation, i.e. weeds. This category was used where differentiation of exotic woody vegetation from neighbouring native vegetation was required. Examples include stands of privet or willow trees. Clearing of this vegetation is not subject to offset.

Planted Native

Areas of vegetation containing trees that are mostly native to the Sydney region, however, the community lacks a clear indication of local plant community type. Spotted gum (*Corymbia maculata*) is a popular tree and bottle brushes (*Callistemon* species) are frequently planted as shrubs/small trees. Trees are often of similar age and evenly spaced. There is a lack of diversity of native shrubs and ground covers (Photo 3-12).

Photo 3-12: Planted native vegetation

Planted

Areas of trees planted with species dominated by non-locally indigenous trees planted for amenity value. Common species include Tallowwood (*Eucalyptus microcorys*), Lemon-scented gum (*Corymbia citriodora*) and *Grevillea robusta*. A range of exotic trees are also present in some cases.

3.3 Threatened ecological communities

Five TECs listed under the BC Act are associated with the PCTs identified in the study area (Figure 3–3). A description of each TEC is provided in the following sub-sections, including a description of why the PCTs meet the definition of a TEC, using relevant identification guidelines, listing advice or scientific determinations.

3.3.1 Cumberland Plain Woodland in the Sydney Basin Bioregion

Vegetation in PCT 3220, was assessed against the NSW Final Determination for the TEC (NSW Scientific Committee 2011) and the findings are provided in Table 3–2.

Table 3–2: Areas meeting criteria for the Cumberland Plain Woodland TEC

Species composition and structure	
NSW determination	Cumberland Plain Woodland is characterised by the assemblage of species listed in Paragraph 3 of the determination and typically comprises an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees. An upper-storey that is usually dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Grey Ironbark), *E. eugenioides* (Narrow-leaved Stringybark), *Corymbia maculata* (Spotted Gum) or other less frequently occurring eucalypts, including *Angophora floribunda*, *A. subvelutina* (Broad-leaved Apple*), E. amplifolia* (Cabbage Gum) and *E. fibrosa* (Broad-leaved Ironbark). The community may have an open stratum of small trees that may include any of these eucalypts, as well as species such as *Acacia decurrens* (Black Wattle), *A. parramattensis* (Parramatta Wattle), *A.implexa* (Hickory Wattle) or *Exocarpos cupressiformis* (Native Cherry). Shrubs are typically scattered in the understorey but may be absent or locally dense as a result of clearing activity or changes in grazing or fire regimes. *Bursaria spinosa* (Blackthorn) is usually dominant, while other species include *Daviesia ulicifolia* (Gorse Bitter Pea), *Dillwynia sieberi, Dodonaea viscosa subsp. cuneata* and *Indigofera australis* (Native Indigo). The ground cover is dominated by a diverse range of grasses including *Aristida ramosa* (Purple Wiregrass), *A. vagans* (Three-awn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass), *Dichelachne micrantha* (Plumegrass), *Echinopogon caespitosus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass), and with graminoids *Carex inversa* (Knob Sedge), *Cyperus gracilis, Lomandra filiformis subsp.* filiformis (Wattle Mat-rush) and *L. multiflorus* subsp. *multiflorus* (Many-flowered Mat-rush). The ground cover also includes a diversity of forbs such as *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Dianella longifolia* (Blue Flax Lily), *Dichondra repens* (Kidney Weed), *Opercularia diphylla*, *Oxalis perennans* and *Wahlenbergia gracilis* (Australian Bluebell), as well as scramblers, *Glycine spp*. and *Hardenbergia violacea* (Native Sarsaparilla) and the fern *Cheilanthes sieberi* (Poison Rock Fern).
3320_Moderate	Six species in the BAM plot match those of the characteristic species listed in the final determination (see Appendix C). The canopy species were mainly *Eucalyptus moluccana*. Shrubs were not recorded in the plot and ground cover included a limited number of forbs including *Dianella longifolia*, *Cheilanthes sieberi, Brunoniella australis* and *Einadia nutans.*
Soils and distribution	
NSW determination	Cumberland Plain Woodland is the name given to the ecological community in the Sydney Basin bioregion associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain
All PCT 3320	The site is clearly on the Cumberland Plain and the Berkshire Park soil landscape in which the community contains clay dominant zones and alluvial substrates which may also be suitable if floristic characteristics of the community are met.
Condition and other attributes	
NSW determination	A range of condition states are included in the definition of the listed community including tree dominated stands, scattered trees with <10% cover, shrub dominated vegetation and derived grassland. There are no patch size restrictions. Smaller remnants are considered important in a local and regional context (Cumberland Plain Recovery Plan 2011 and NSW Scientific Committee 2009)
PCT 3220 Moderate PCT 3220 Low	All zones of PCT 3220 were considered to meet the TEC determination.

3.3.2 Cooks River/Castlereagh Ironbark Forest

The full name of the community under the NSW BC Act is Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion. Vegetation in PCT 3448, was assessed against the NSW Final Determination for the TEC (NSW Scientific Committee 2011) and the findings are provided in Table 3–3.

Table 3–3: Areas meeting criteria for the Cooks River/Castlereagh Ironbark Forest TEC

Species composition and structure	
NSW determination	Characterised by the species assemblage listed in paragraph 2 of the Determination. The community is predominantly of open-forest to low woodland structure usually with trees of *Eucalyptus fibrosa* and *Melaleuca decora*, sometimes with *Eucalyptus longifolia*. A relatively dense shrub stratum is typical, commonly with *Melaleuca nodosa* and *Lissanthe strigosa*, and to a lesser extent *Melaleuca decora*. A variety of shrub species may occur, including *Acacia pubescens*, *Dillwynia tenuifolia*, *Daviesia ulicifolia*, *Pultenaea villosa* and *Grevillea juniperina*. Commonly occurring species in the ground stratum include *Entolasia stricta, Lepidosperma laterale, Opercularia diphylla, Dianella revoluta, Themeda australis, Microlaena stipoides* and *Pratia purpurascens*.
3448_Good	22 species in the BAM plot match those of the characteristic species listed in the final determination (see Appendix C). A canopy of predominantly *Eucalyptus fibrosa* was present. Additional shrubs mentioned in the description – *Grevillea juniperina*, *Dillwynia tenuifolia* and *Daviesia ulicifolia* were present in most sites. All other commonly occurring species in the ground stratum were as described above were present in the community across the study area.
3448_Moderate	21 species in the BAM plots match those listed in the final determination. Structurally the community strongly matches the description in the final determination, having both a canopy of *Eucalyptus fibrosa*, and dense midstory of *Melaleuca decora* and *M. nodosa*.
Soils and distribution	
NSW determination	Usually occurs on clay soils on Tertiary alluvium, or on shale soils on Wianamatta Shale including the Birrong Soil Landscape and associated shale lowlands. Known to occur in the Auburn, Bankstown, Blacktown, Canterbury, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Strathfield local government areas, but may occur elsewhere in the Sydney Basin Bioregion
All PCT 3448 zones	The site is within the known localities and the Berkshire Park soil landscape over much of the project site contains suitable soils in parts.
Condition and other attributes	
NSW determination	Disturbed Cooks River/Castlereagh Ironbark Forest remnants are considered to form part of the community including remnants where the vegetation would respond to assisted natural regeneration such as where the natural soil and associated seedbank is still at least partially intact.
3448_Good 3448_Moderate	Only one or two canopy species was usually present in the low condition class representing the canopy tree layer. This zone contained vegetation that has been isolated and disturbed to an extent that they would be unlikely to respond to assisted natural regeneration and has been excluded from the TEC. Good and Moderate-quality zones, meet the condition attributes described.

3.3.3 Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion

Vegetation in PCT 3629, was assessed against the NSW Final Determination for the TEC (NSW Scientific Committee 2011) and the findings are provided in Table 3–4.

Table 3–4: Areas meeting criteria for the Castlereagh Scribbly Gum Woodland TEC

Species composition and structure	
NSW determination	Characterised by the species assemblage listed in paragraph 2 of the determination. The community is dominated by *Eucalyptus parramattensis subsp. parramattensis, Angophora bakeri* and E. *sclerophylla*. A small tree stratum of *Melaleuca decora* is sometimes present, generally in areas with poorer drainage. It has a well-developed shrub stratum consisting of sclerophyllous species such as *Banksia spinulosa var. spinulosa, M. nodosa*, *Hakea sericea* and *H. dactyloides* (multi-stemmed form). The ground stratum consists of a diverse range of forbs including Themeda australis, *Entolasia stricta*, *Cyathochaeta diandra*, *Dianella revoluta subsp. revoluta*, *Stylidium graminifolium*, *Platysace ericoides, Laxmannia gracilis* and *Aristida warburgii*.
3629_Good	The most common trees were *Eucalyptus sclerophylla*, *Angophora bakeri* and occasional *Eucalyptus parramattensis*. 17 species from the BAM plot match those of the characteristic species listed in the final determination (see Appendix C).
3629_Moderate	The most common trees were *Eucalyptus sclerophylla*, *Angophora bakeri.* 16 species from the BAM plot match those of the characteristic species listed in the final determination (see Appendix C).
Soils and distribution	
NSW determination	Occurs almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium. It is most often found on sandy soils and tends to occur on slightly higher ground than Castlereagh Ironbark Forest or Shale Gravel Transition Forest in the Sydney Basin Bioregion. The boundary between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest or Shale Gravel Transition Forest in the Sydney Basin Bioregion appears to be a function of the interaction of localised drainage conditions and the thickness of the Tertiary alluvium mantle. Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion occurs within the local government areas of Bankstown, Blacktown, Campbelltown, Hawkesbury, Liverpool and Penrith but may occur elsewhere within the Sydney Basin Bioregion.
All PCT 3629 zones	Within the known distribution areas and found in sandy areas within the Berkshire Park soil landscape.
Condition and other attributes	
NSW determination	The determination does not specifically include any references to eligible condition class. The Species composition of a site will be influenced by the size of the site, recent rainfall or drought condition and by its disturbance (including fire) history.
PCT 3629 Good PCT 3629 Moderate	Low condition zones lack major components of the community, usually having no shrubs and ground layer species. The long-standing nature of the disturbance of Low-quality zones though past clearing and ongoing maintenance are considered permanent and this condition class is not included as the TEC. Good and Moderate zones meet the description of the TEC.

3.3.4 Castlereagh Swamp Woodland

Vegetation in PCT 3628, was assessed against the NSW Final Determination for the TEC (NSW Scientific Committee 1999) and the findings are provided in Table 3–5.

Table 3–5: Areas meeting criteria for the Castlereagh Swamp Woodland TEC

Species composition and structure	
NSW determination	The structure of the community is generally woodland or may occur as remnant trees. Characteristic tree species are *Eucalyptus parramattensis* subsp. *parramattensis* and *Melaleuca decora.* Small billabongs and/or wetlands may occur within the community. Species composition at any site depends on local topography and drainage conditions; understorey may be seasonally waterlogged. has an understorey that may be either grassy or herbaceous with many annual and ephemeral species which respond to wet conditions. The shrub layer can be mid-dense to sparse depending on frequency and period since the last fire.
3628_Moderate	*Eucalyptus parramattensis* and *Melaleuca decora* were the dominant canopy cover. Diversity of other species was low but included some characteristic species indicating wet areas such as *Callistemon linearis*, *Melaleuca erubescens* and *Gratiola pedunculata*.
Soils and distribution	
NSW determination	The TEC has been recorded from the local government areas of Bankstown, Hawkesbury, Liverpool and Penrith. It is associated with poorly drained depressions and creeklines on clay soils associated with Tertiary alluvium.
All PCT 3628	The vegetation zones are all located within creeklines and depressions within the known landscape and distribution of the TEC.
Condition and other attributes	
NSW determination	The determination does not specifically include any references to eligible condition class although the structural definition suggests remnant trees without other floristic elements are eligible for listing.
PCT 3628 Low PCT 3628 Moderate	Both condition classes have some remnant trees and meet the TEC criteria.

3.3.5 River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

Vegetation in PCT 4025, was assessed against the NSW Final Determination for the TEC (NSW Scientific Committee 2011) and the findings are provided in Table 3–6.

Table 3–6: Areas meeting River-flat eucalypt forest on coastal floodplains TEC

Species composition and structure	
NSW determination	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. amplifolia* (cabbage gum*), Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple*). Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river peppermint) may be common south from Sydney, *E. ovata* (swamp gum) occurs on the far south coast, *E. saligna* (Sydney blue gum) and *E. grandis* (flooded gum) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain. Other eucalypts including *Eucalyptus longifolia* (woollybutt), *E. moluccana* (grey box) and *E. viminalis* (ribbon gum) may be present in low abundance or dominant in limited areas of the distribution. A layer of small trees may be present, including *Melaleuca decora*, *M. styphelioides* (prickly-leaved teatree), *Backhousia myrtifolia* (grey myrtle), *Melia azedarach* (white cedar), *Casuarina cunninghamiana subsp. cunninghamiana* (river oak) and *C. glauca* (swamp oak). Scattered shrubs include *Bursaria spinosa subsp. spinosa* (blackthorn), *Solanum prinophyllum* (forest nightshade), *Rubus parvifolius* (native raspberry), *Breynia oblongifolia* (coffee bush), *Ozothamnus diosmifolius, Hymenanthera dentata* (tree violet), *Acacia floribunda* (white sally) and *Phyllanthus gunnii*. The groundcover is composed of abundant forbs, scramblers and grasses including *Microlaena stipoides* (weeping grass), *Dichondra repens (kidney weed), Glycine clandestina, Oplismenus aemulus, Desmodium gunnii, Pratia purpurascens* (whiteroot), *Entolasia marginata* (bordered panic), *Oxalis perennans* and *Veronica plebeia* (trailing speedwell). The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs.
4025_Low	The small zone identified was highly disturbed juvenile regrowth. Tree species included *Eucalyptus amplifolia*, *Angophora floribunda* and *Acacia floribunda*. Occasional *Bursaria spinosa* was present. The ground layer was largely exotic with only *Centella asiatica* indicative of the community.
Soils and distribution	
NSW determination	The community associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.
4025_Low	This PCT is corresponds to the only area of South Creek soil landscape mapped in the study area which is a landscape described as “floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain.”
Condition and other attributes	
NSW determination	Although typically a very tall forest the determination describes shorter re-growth stands as part of the community. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs.
4025 Low	Low quality regrowth in this zone is considered the TEC.

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LEGEND

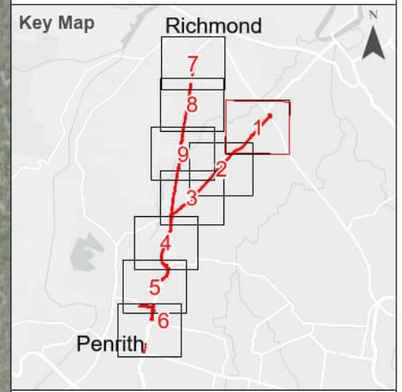
Subject land

Threatened vegetation community

Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

Key Map



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PROJECT NO: 30013443
FIGURE NO: 3 - 3 (1)
FIGURE TITLE: Threatened ecological communities
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VERSION: VERSION 1
PAGE SIZE: A3

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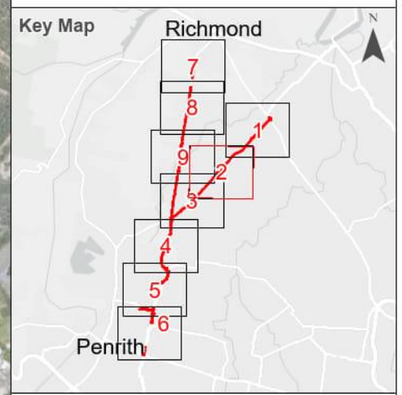
LEGEND

- Subject land

Threatened vegetation community

- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion
- Castlereagh Swamp Woodland
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

Key Map



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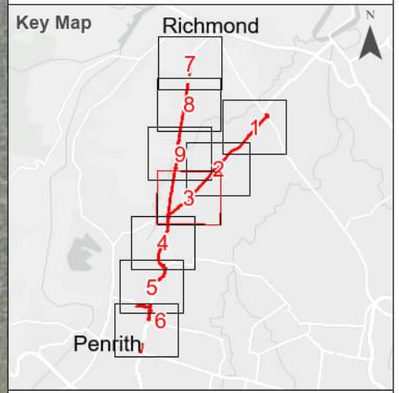
LEGEND

- Subject land

Threatened vegetation community

- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion
- Castlereagh Swamp Woodland
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion



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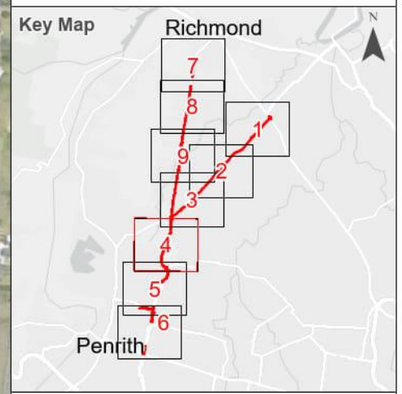
LEGEND

- Subject land

Threatened vegetation community

- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion
- Cumberland Plain Woodland in the Sydney Basin Bioregion

Key Map



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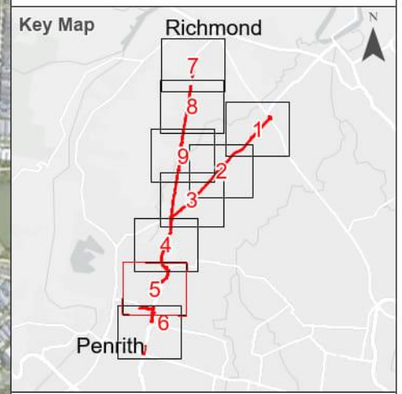
LEGEND

Subject land

Threatened vegetation community

Cumberland Plain Woodland in the Sydney Basin Bioregion

Key Map



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LEGEND

Subject land

Key Map

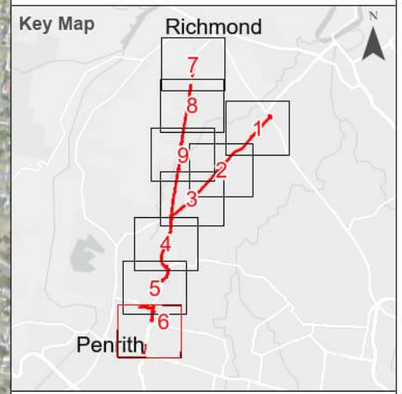

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FIGURE TITLE: Threatened ecological communities
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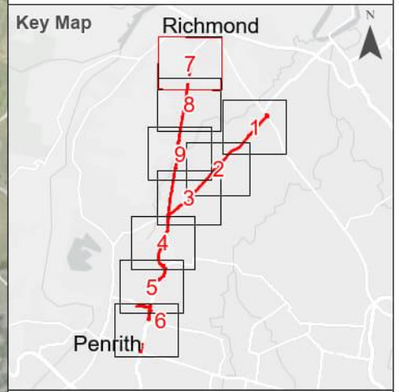
LEGEND

Subject land

Threatened vegetation community

Cumberland Plain Woodland in the Sydney Basin Bioregion

Key Map



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LEGEND

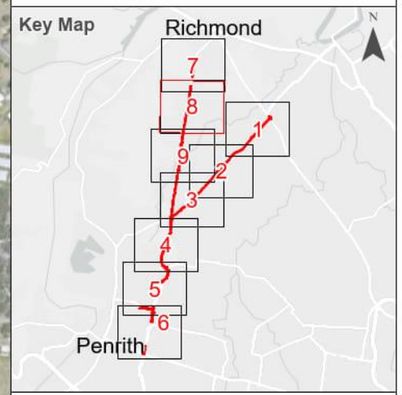
Subject land

Threatened vegetation community

Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion

Cumberland Plain Woodland in the Sydney Basin Bioregion

Key Map



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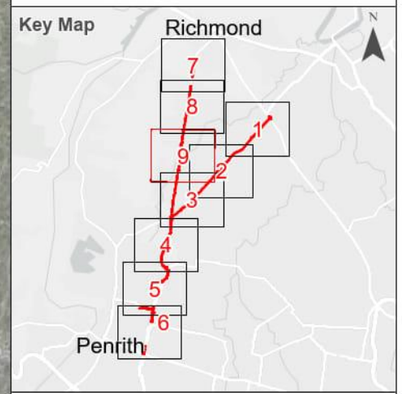
LEGEND

- Subject land

Threatened vegetation community

- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion
- Castlereagh Swamp Woodland
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

Key Map



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PROJECT NO: 30013443
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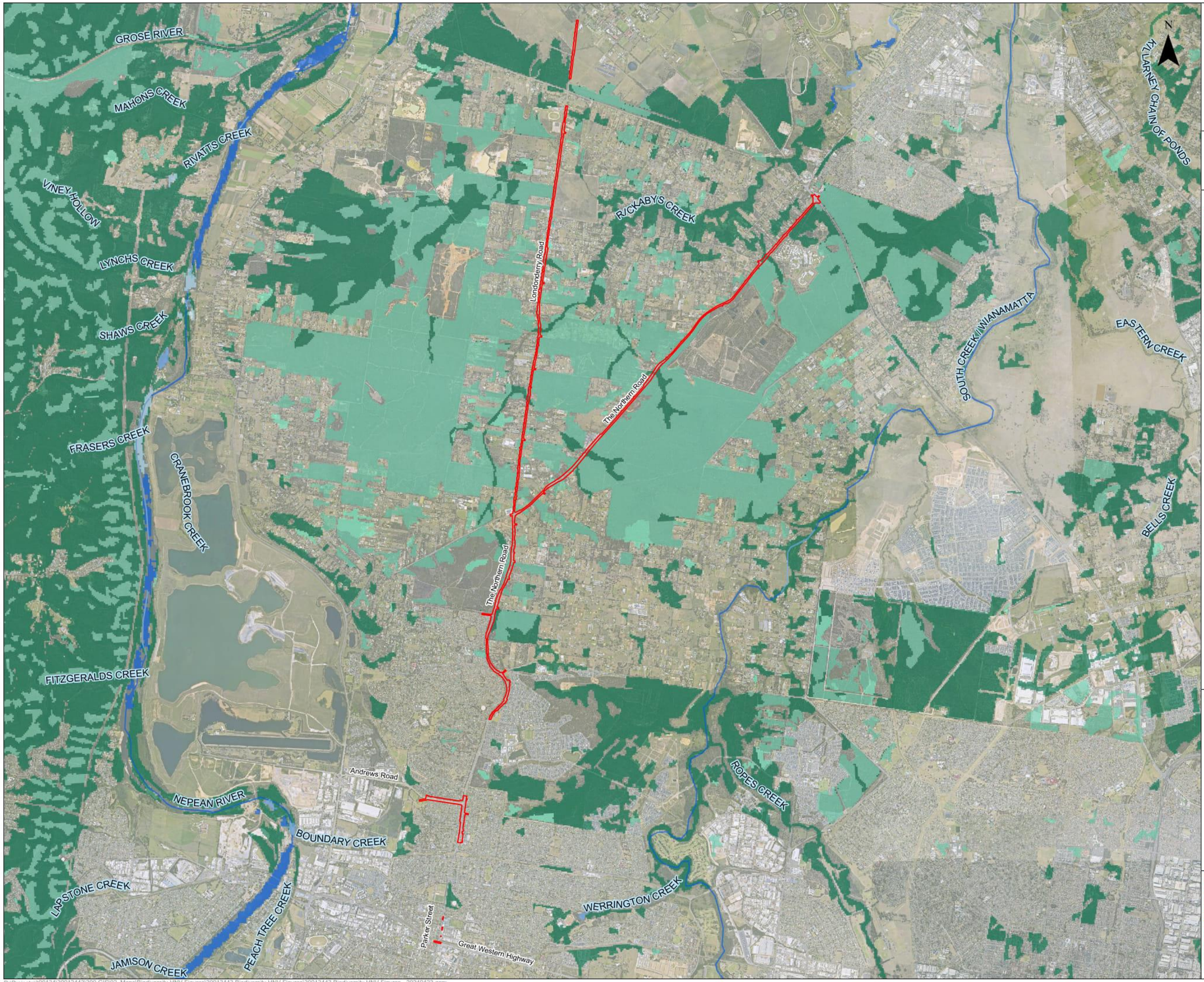
3.4 Groundwater dependent ecosystems

Six groundwater dependent terrestrial ecosystems have been identified in the study area (BOM 2023) (Figure 3–4). The ecosystem name and GDE potential are provided in Table 3–7. Some of these ecosystems occur with varying GDE potential in different parts of the study area. No aquatic GDEs have been identified in the study area.

Table 3–7: GDEs identified in the study area

Ecosystem	GDE potential
Castlereagh Scribbly Gum Woodland	Low/Moderate
Castlereagh Swamp Woodland	High
Cumberland River Flat Forest	High
Castlereagh Shale-Gravel Transition Forest	High
Cumberland Shale Plains Woodland	High
Castlereagh Ironbark Forest	Moderate



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LEGEND

- Subject land

Aquatic GDE

- Unclassified potential GDE - from regional studies
- High potential GDE - from national assessment
- Moderate potential GDE - from national assessment
- Low potential GDE - from national assessment

Terrestrial GDE

- High potential GDE - from national assessment
- Moderate potential GDE - from national assessment
- Low potential GDE - from national assessment

SOURCES:

1. Roads © RoadNet MDS 2020
2. Waterways © Spatial Services 2021
3. Aquatic and Terrestrial GDE © Commonwealth of Australia 2024, Bureau of Meteorology
4. MetroMap Imagery © Aerometrex Pty Ltd

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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 4
FIGURE TITLE:	Groundwater dependent ecosystems
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERSION 1
PAGE SIZE:	A3

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3.5 Threatened species

The habitat suitability assessment identified 13 flora and 17 fauna species (seven birds, nine mammals and one invertebrate) that have a moderate or high likelihood of occurring in the study area based on recent records and the availability of suitable habitat (Appendix B). All flora and four of the fauna are species credit species; Powerful Owl, Cumberland Plain Land Snail, Southern Myotis and Koala. Six fauna species are dual credit species; Regent Honeyeater, Swift Parrot, Square-tailed Kite, Little Bent-winged Bat, Large Bent-winged Bat and Grey-headed Flying-fox. The remaining fauna species are ecosystem credit species only.

The results of the targeted surveys for threatened flora are provided in Table 3–8 and discussed in Section 3.5.1. The location of threatened species recorded in the study area is shown on Figure 3–5. Some of the points represent more than one plant where there was a large group in close proximity (discussed further in Section 3.5.1).

Opportunistic sightings of threatened species credit fauna, and species credit fauna (including dual credit species) assumed present based on the availability of suitable habitat, are also provided in Table 3–8 and shown on Figure 3–5. Suitable habitat for threatened fauna species is discussed in Section 3.5.2.

Table 3–8: Threatened species surveys results

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?[1]	Results
Acacia bynoeana (Bynoe's Wattle)	E	V	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'
Acacia pubescens (Downy Wattle)	V	V	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'
Allocasuarina glareicola	E	E	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'
Dillwynia tenuifolia	-	V	Recorded	Yes*	Species credit Recorded in PCTs 3629 and 3448 Minimum 195 plants recorded in the study area
Grevillea juniperina subsp. *juniperina* (Juniper-leaved Grevillea)	-	V	Recorded	Yes*	Species credit Recorded in PCTs 3629 and 3448 Minimum 234 plants recorded in the study area
Grevillea parviflora subsp. parviflora (Small-flower Grevillea)	V	V	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'
Hibbertia puberula	E	-	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?[1]	Results
Hibbertia sp. Bankstown	CE	CE	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'
Marsdenia viridiflora subsp. *viridiflora*	-	EP	Recorded	Yes	Species credit One plant recorded in PCT 3320
Micromyrtus minutiflora	E	V	Recorded	Yes	Species credit Recorded in PCT 3629 Minimum 4 plants recorded in the study area
Persoonia nutans (Nodding Geebung)	E	E	Recorded	Yes	Species credit Recorded in PCT 3629 Minimum 22 plants recorded in the study area
Pimelea spicata (Spiked Rice-flower)	E	E	Not recorded	Yes	Species credit Extensive searches during suitable survey period did not identify the species Likelihood of occurrence revised to 'low'
Pultenaea parviflora	V	E	Recorded	Yes*	Species credit Recorded in PCT 3448 and PCT 3629 Minimum 58 plants recorded in the study area
Square-tailed Kite (*Lophoictinia isura*)	-	V	Recorded	Yes^	Ecosystem/species credit No targeted surveys undertaken Recorded flying over the study area on The Northern Road Assumed present in all PCTs.
Powerful Owl (*Ninox strenua*)	-	V	Assumed present	Yes^	Species credit No targeted surveys undertaken Assumed present in all PCTs based on the occurrence of hollow-bearing trees with very large hollows >20cm
Cumberland Plain Land Snail (*Meridolum corneovirens*)	-	E	Assumed present	Yes^	Species credit No targeted surveys undertaken Assumed present in 'moderate' and 'good' condition habitat in PCTs 3320, 3448, 3628, 3629, 4025. All other habitat deemed too disturbed to support this species.
Southern Myotis (*Myotis macropus*)	V	-	Recorded	Yes^	Species credit No targeted surveys undertaken Recorded in a culvert near PCT 3629 Assumed present in all PCTs, except 3628, within 200 metres of waterways.

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?[1]	Results
Koala (*Phascolarctos cinereus*)	E	E	Assumed present	Yes^	Species credit No targeted surveys undertaken. Assumed present in all PCTs based on the occurrence of suitable feed trees and known records in the region.

Note: 1. As identified in Section 2.4 of this BAR

** Some surveys undertaken outside required survey period with justification provided in Section 2.6*

^ No fauna surveys undertaken so species assumed present or were recorded opportunistically

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LEGEND

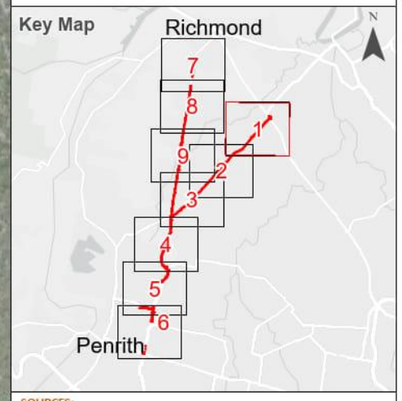
Subject land

Threatened Species (SMEC)

- Pultenaea parviflora
- Persoonia nutans
- Dillwynia tenuifolia
- Square-tailed Kite

PCT and Condition

- 3448 Castlereagh Ironbark Forest (Low)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Low)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- Cleared



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 5 (1)
FIGURE TITLE:	Recorded threatened species
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERISON 1
PAGE SIZE:	A3

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LEGEND

Subject land

Habitat Features

Hollow-bearing tree

Threatened Species (SMEC)

Pultenaea parviflora

Persoonia nutans

Micromyrtus minutiflora

Grevillea juniperina subsp. juniperina

Dillwynia tenuifolia

PCT and Condition

3448 Castlereagh Ironbark Forest (Low)

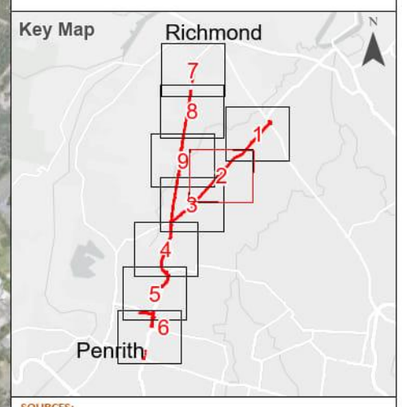
3448 Castlereagh Ironbark Forest (Moderate)

3628 Castlereagh Shrubby Swamp Woodland (Moderate)

3629 Castlereagh Scribbly Gum Woodland (Low)

3629 Castlereagh Scribbly Gum Woodland (Moderate)

3629 Castlereagh Scribbly Gum Woodland (Good)



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 5 (2)
FIGURE TITLE:	Recorded threatened species
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DATE:	11/06/2024
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LEGEND

Subject land

Habitat Features

Hollow-bearing tree

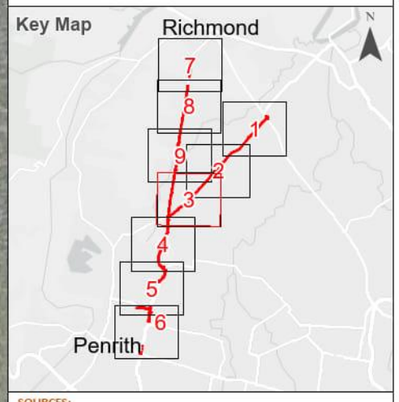
Threatened Species (SMEC)

Pultenaea parviflora
Persoonia nutans
Micromyrtus minutiflora
Grevillea juniperina subsp. juniperina
Dillwynia tenuifolia

PCT and Condition

3448 Castlereagh Ironbark Forest (Low)
3448 Castlereagh Ironbark Forest (Moderate)
3628 Castlereagh Shrubby Swamp Woodland (Moderate)
3629 Castlereagh Scribbly Gum Woodland (Low)
3629 Castlereagh Scribbly Gum Woodland (Moderate)
3629 Castlereagh Scribbly Gum Woodland (Good)

Key Map



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 5 (3)
FIGURE TITLE:	Recorded threatened species
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERISON 1
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LEGEND

- Subject land

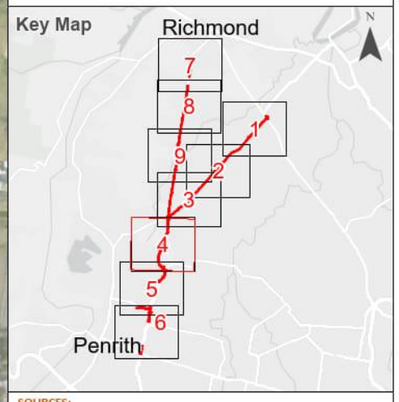
Threatened Species (SMEC)

- Pultenaea parviflora
- Marsdenia viridiflora subsp. viridiflora
- Grevillea juniperina subsp. juniperina
- Dillwynia tenuifolia

PCT and Condition

- 3320 Cumberland Shale Plains Woodland (Low)
- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Low)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Low)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)

Key Map



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
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LEGEND

Subject land

Threatened Species (SMEC)

Marsdenia viridiflora subsp. viridiflora

Grevillea juniperina subsp. juniperina

PCT and Condition

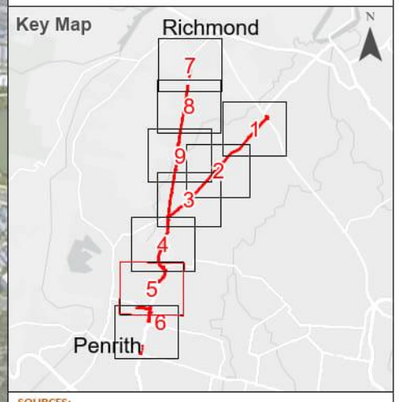
3320 Cumberland Shale Plains Woodland (Low)

3320 Cumberland Shale Plains Woodland (Moderate)

Planted

Planted native

Key Map



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 5 (5)
FIGURE TITLE:	Recorded threatened species
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERISON 1
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LEGEND

Subject land

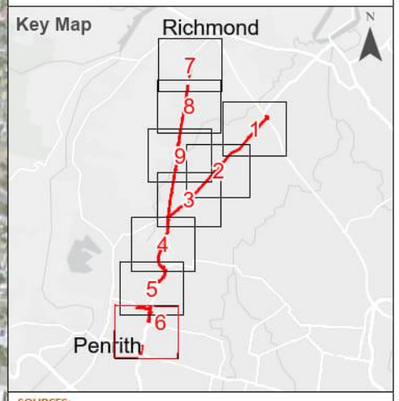
PCT and Condition

3320 Cumberland Shale Plains Woodland (Low)

Planted

Planted native

Key Map



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 5 (6)
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VERSION:	VERISON 1
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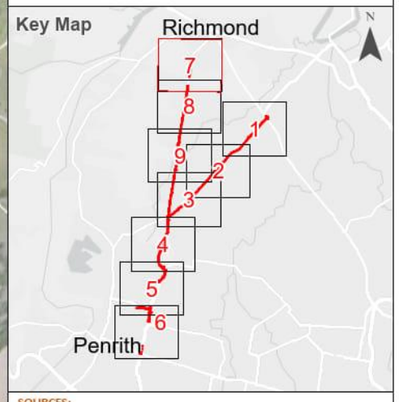
LEGEND

Subject land

PCT and Condition

- 3320 Cumberland Shale Plains Woodland (Low)
- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3320 Cumberland Shale Plains Woodland (Good)
- Planted



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
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LEGEND

Subject land

Habitat Features

Hollow-bearing tree

Threatened Species (SMEC)

Micromyrtus minutiflora

Dillwynia tenuifolia

Southern Myotis

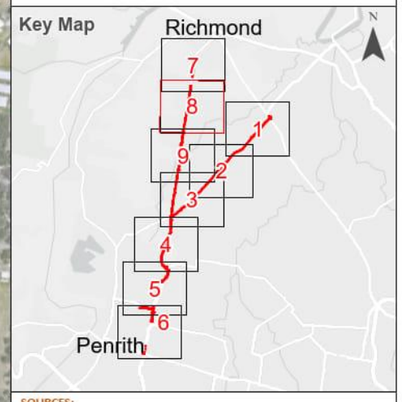
PCT and Condition

3320 Cumberland Shale Plains Woodland (Low)

3320 Cumberland Shale Plains Woodland (Moderate)

3629 Castlereagh Scribbly Gum Woodland (Low)

3629 Castlereagh Scribbly Gum Woodland (Moderate)



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
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FIGURE TITLE:	Recorded threatened species
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LEGEND

Subject land

Habitat Features

Hollow-bearing tree

Threatened Species (SMEC)

Pultenaea parviflora

Persoonia nutans

Micromyrtus minutiflora

Grevillea juniperina subsp. juniperina

Dillwynia tenuifolia

PCT and Condition

3448 Castlereagh Ironbark Forest (Low)

3448 Castlereagh Ironbark Forest (Good)

3628 Castlereagh Shrubby Swamp Woodland (Low)

3628 Castlereagh Shrubby Swamp Woodland (Moderate)

3629 Castlereagh Scribbly Gum Woodland (Low)

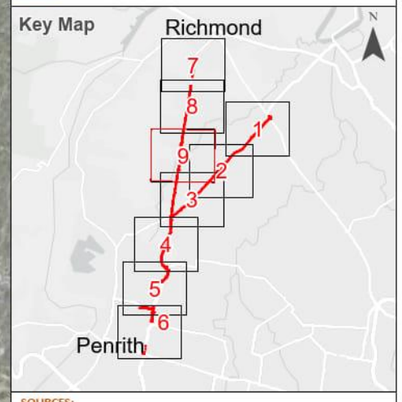
3629 Castlereagh Scribbly Gum Woodland (Moderate)

3629 Castlereagh Scribbly Gum Woodland (Good)

4025 Cumberland Red Gum Riverflat Forest (Low)

Exotic

Key Map



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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
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3.5.1 Threatened flora

Targeted surveys identified five threatened flora species and one threatened flora population (Table 3–8). Each of these species were previously known to occur in the locality and some had previously been recorded in the study area.

Threatened flora were mainly found within moderate to good quality vegetation zones, primarily Castlereagh Ironbark Forest and Scribbly Gum woodlands. *Dillwynia tenuifolia* and *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea) were locally common within these vegetation types. These shrub species appear to be able to persist in relatively disturbed situations and in some limited instances small individuals were noted in low quality habitat. Low condition vegetation was generally not considered to provide suitable habitat for any threatened flora species due to the high level of disturbance and continuing groundcover maintenance. The outlier plants were found either at the base of trees where they are protected from mowing or in dense swaths of exotic grasses neighbouring better habitat. No threatened species were found in PCT 3320 – Cumberland Shale Plains Woodland except one *Marsdenia viridiflora* subsp. *viridiflora*. The understorey of this community was in lower condition than in other PCTs. Castlereagh swamp woodland did not support any threatened species most likely because of the high density of exotic Small-leaf privet (*Ligustrum sinense*).

The number of individuals at each recorded sighting is an approximate count of those within the subject land – in many instances the group extended beyond the study area into a neighbouring nature reserve. Species polygon for each of the species recorded are provided in Figure 3–6. Species polygons are vegetation zone polygons in which the species was either found during survey or is well connected by structurally intact vegetation in which there are BioNet records of the species within reasonable distance – typically within 200m. Vegetation polygons within or connected directly to priority conservation lands were also considered for inclusion as species polygons if there were BioNet records further away – up to 500 metres, and the polygons were very well connected by broad corridors of suitable habitat.

3.5.2 Threatened fauna

One species of threatened microbat, Southern Myotis (*Myotis macropus*), was opportunistically identified roosting in a culvert under Londonderry Road south of Wilshire Road (Photo 3-13). The drainage line is an unnamed tributary of Rickabys Creek and only one of the joins in the culvert cell provided suitable space for a microbat to roost. At least six individuals were observed, some of them juveniles, making this a maternity colony. The species polygon showing suitable habitat for the Southern Myotis is provided in Figure 3–6.

Some other culverts were also opportunistically inspected for potential microbat roosting sites and the culverts are either too low (insufficient drop space for microbats to start flight) or the gaps between the culvert components are too narrow to allow a microbat to fit. It is expected that currently 13 culverts are of suitable size to provide habitat (greater than 900 millimetres height or diameter), however their suitability is unknown as there may be no roosting locations or the culvert may be occasionally inundated by floodwater.

Photo 3-13: Entrance to culvert where the Southern Myotis was recorded

The Cumberland Plain Land Snail has been assumed present in ‘good’ and ‘moderate’ quality vegetation in the study area based on the availability of suitable habitat and an abundance of records within and nearby the study area. Although the

habitat is often degraded, stumps, grass clumps and roadside rubbish may be used by the Cumberland Plain Land Snail for shelter. The species polygon showing suitable habitat for the Cumberland Plain Land Snail is provided in Figure 3–6.

One Square-tailed Kite (*Lophoictinia isura*) was recorded flying over the study area on The Northern Road near Carrington Road. This species uses very large hunting ranges and therefore it is likely that the study area forms only a small part of this range. No suitable nesting trees were observed in the study area, therefore only the ecosystem component of this species will be considered further in this report.

The Powerful Owl (*Ninox strenua*) has been identified as having a moderate likelihood of occurring in the study area based on recent records and the presence of suitable habitat (Appendix B). Some tree hollows in the study area (such as those shown in Photo 3-14) are greater than the 20 centimetre minimum size for Powerful Owl breeding habitat. Not all tree hollows in the study area have been mapped and no surveys have been undertaken to determine if the species breeds in the study area, although data from volunteer programs studying the Powerful Owl in Greater Sydney don't indicate the presence of a nest in the study area (Birdlife Australia 2024). All trees identified were on the edge of a major road and may not provide preferred breeding habitat, however, this species is known to occupy hollows in disturbed areas. The species polygon showing suitable habitat for the Powerful Owl is provided in Figure 3–6.

Photo 3-14: Examples of very large hollow-bearing trees in the study area

The Koala (*Phascolarctos cinereus*) has specific requirements for feed trees. Some of the species recorded in the study area that are known to be used by the Koala in the region (OEH 2018) are:

- High use: Forest Red Gum (*Eucalyptus tereticornis*) and Hard-leaved Scribbly Gum (*Eucalyptus sclerophylla*)
- Significant use: Grey box (*Eucalyptus moluccana*), Red Ironbark (*Eucalyptus fibrosa*), Narrow-leaved Ironbark (*Eucalyptus crebra*) and Red Bloodwood (*Corymbia gummifera*)
- Low use: Black She-Oak (*Allocasuarina littoralis*) and Narrow-leaved Apple (*Angophora bakeri*).

The species polygon showing suitable habitat for the Koala is provided in Figure 3–6. All PCTs contain trees that have been documented as used by koalas, even if only occasionally. Koala habitat was refined to areas that have canopy connectivity to larger areas of intact vegetation.

Five other dual credit species were identified by the habitat suitability assessment (Appendix B). The species credit component of each in relation to the study area is:

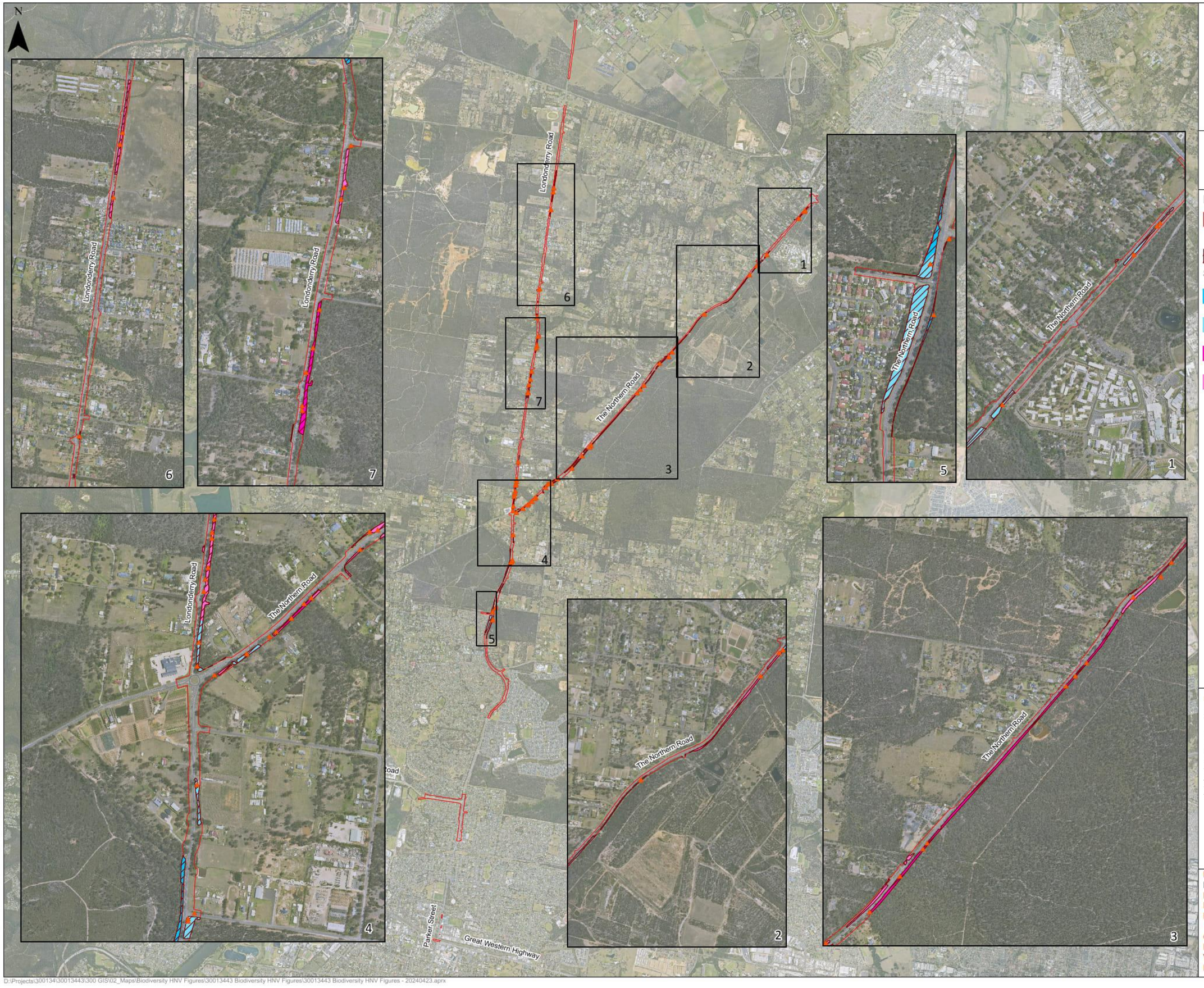
- Regent Honeyeater (*Anthochaera phrygia*) – no important habitat mapped in the study area
- Swift Parrot (*Lathamus discolor*) – no important habitat mapped in the study area
- Little Bent-winged Bat (*Miniopterus australis*) – no suitable roost sites in the study area
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) – no suitable roost sites in the study area
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – no camps in the study area.

Due to the absence of breeding habitat (species credit component) for these species, only the ecosystem credit component will be considered further in this report.

Seven additional ecosystem credit species have been assumed present based on a moderate or high likelihood of occurrence in the study area (Appendix B):

- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Varied Sittella (*Daphoenositta chrysoptera*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).

Suitable foraging, nesting, sheltering and/or roosting habitat for these species occurs in the open woodland habitat throughout the study area.



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LEGEND

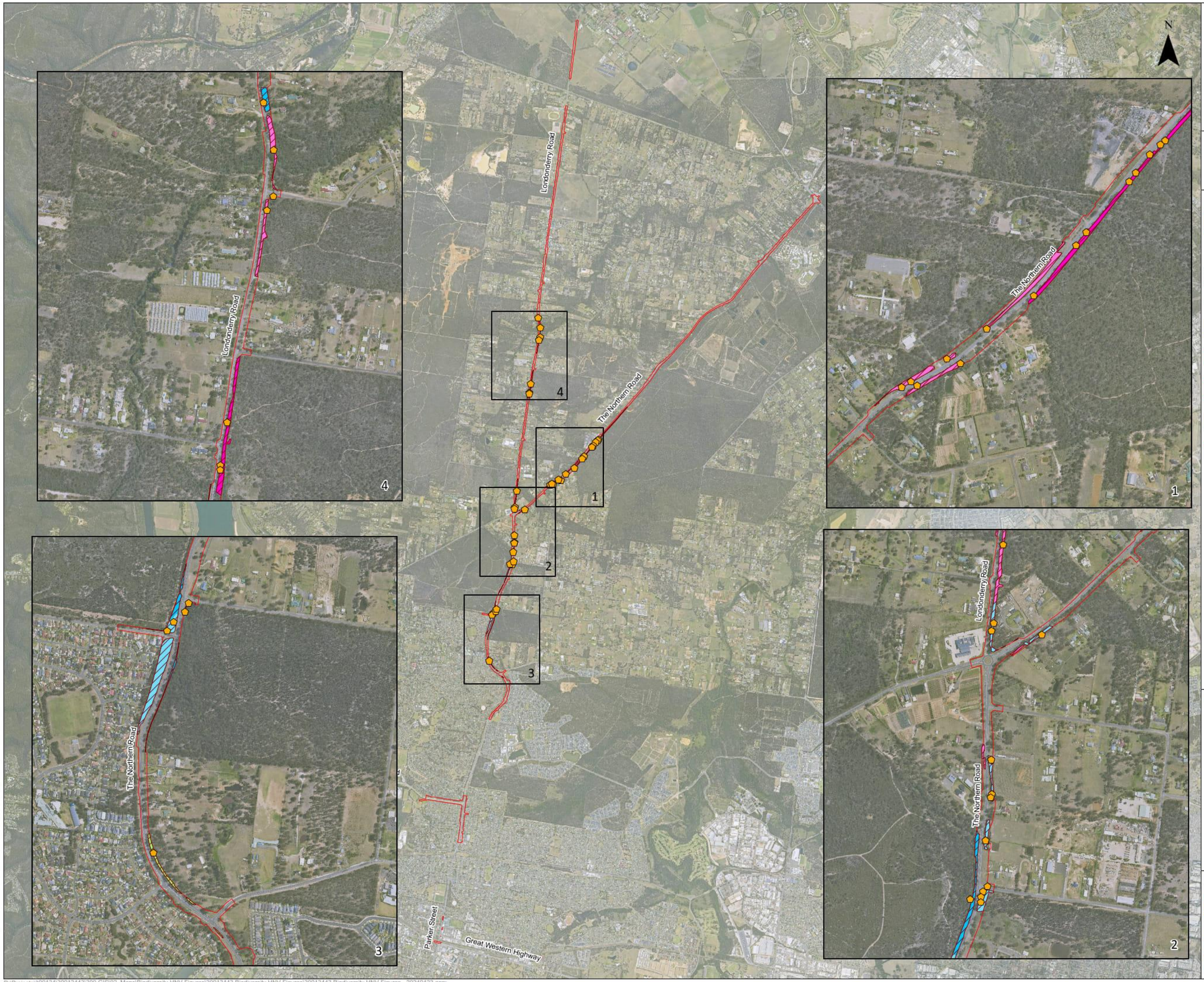
- Subject land
- Dillwynia tenuifolia
- Dillwynia tenuifolia Species Polygon

Species polygon vegetation zones

- 3448 Castlereagh Ironbark Forest (Good)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)

SOURCES:
1. Roads © Roadnet MDS 2020
2. Basemap: MetroMap Imagery © Aerometrex Pty Ltd

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Dillwynia tenuifolia)
CREATED BY: LL16284
DATE: 11/06/2024
VERSION: VERSION 1
PAGE SIZE: A3



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Metres

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LEGEND

- Subject land
- Grevillea juniperina subsp. juniperina
- Grevillea juniperina subsp. juniperina Species Polygon

Species polygon vegetation zones

- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribby Gum Woodland (Good)

SOURCES:
1. Roads © Roadnet MDS 2020
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PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 6
FIGURE TITLE:	Species polygons for species credit species (Grevillea juniperina subsp. juniperina)
CREATED BY:	LL16284
DATE:	11/06/2024
VERSION:	VERSION 1
PAGE SIZE:	A3

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LEGEND

- Subject land
- Marsdenia viridiflora subsp. viridiflora
- Marsdenia viridiflora subsp. viridiflora Species Polygon

Species polygon vegetation zones

- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)

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1. Roads © Roadnet MDS 2020
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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Marsdenia viridiflora subsp. viridiflora)
CREATED BY: LL16284
DATE: 12/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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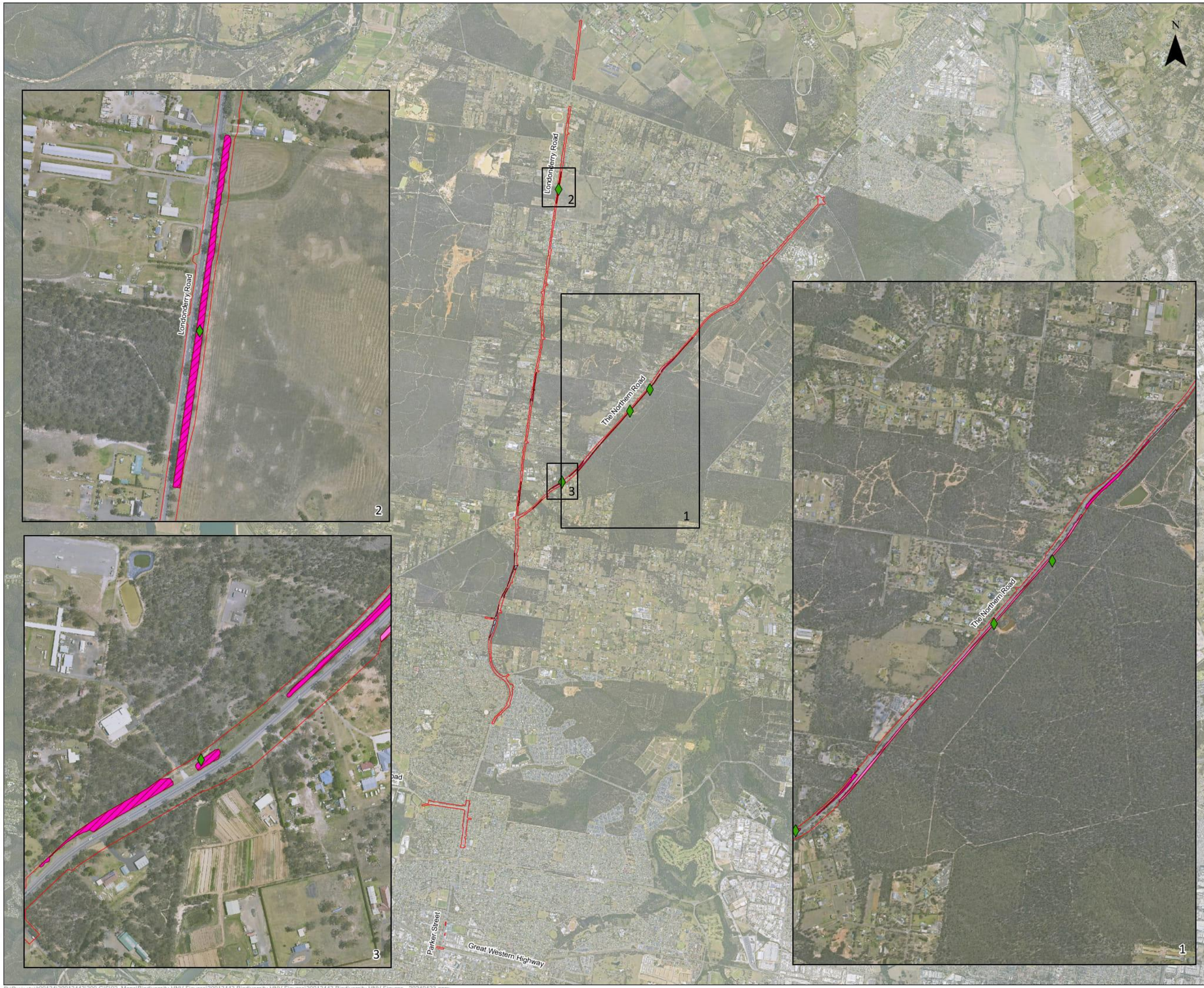

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LEGEND

- Subject land
- Micromyrtus minutiflora
- Micromyrtus minutiflora Species Polygon

Species polygon vegetation zones

- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)

SOURCES:
1. Roads © Roadnet MDS 2020
2. MetroMap Imagery © Aerometrex Pty Ltd

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Micromyrtus minutiflora)
CREATED BY: LL16284
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PAGE SIZE: A3

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LEGEND

- Subject land
- Persoonia nutans
- Micromyrtus minutiflora Species Polygon

Species polygon vegetation zones

- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribby Gum Woodland (Moderate)
- 3629 Castlereagh Scribby Gum Woodland (Good)

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1. Roads © Roadnet MDS 2020
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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Persoonia nutans)
CREATED BY: LL16284
DATE: 12/06/2024
VERSION: VERSION 1
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LEGEND

- Subject land
- Pultenaea parviflora
- Pultenea Parviflora Species Polygon

Species polygon vegetation zones

- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribby Gum Woodland (Moderate)
- 3629 Castlereagh Scribby Gum Woodland (Good)

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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Pultenaea parviflora)
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LEGEND

- Subject land
- Hollow-bearing tree
- Powerful Owl Species Polygon

Species polygon vegetation zones

- 3320 Cumberland Shale Plains Woodland (Low)
- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Low)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3628 Castlereagh Shrubby Swamp Woodland (Low)
- 3628 Castlereagh Shrubby Swamp Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Low)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)
- 4025 Cumberland Red Gum Riverflat Forest (Low)

SOURCES:
1. Roads © Roadnet MDS 2020
2. Basemap: MetroMap Imagery © Aerometrex Pty Ltd

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Powerful Owl)
CREATED BY: LL16284
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PAGE SIZE: A3

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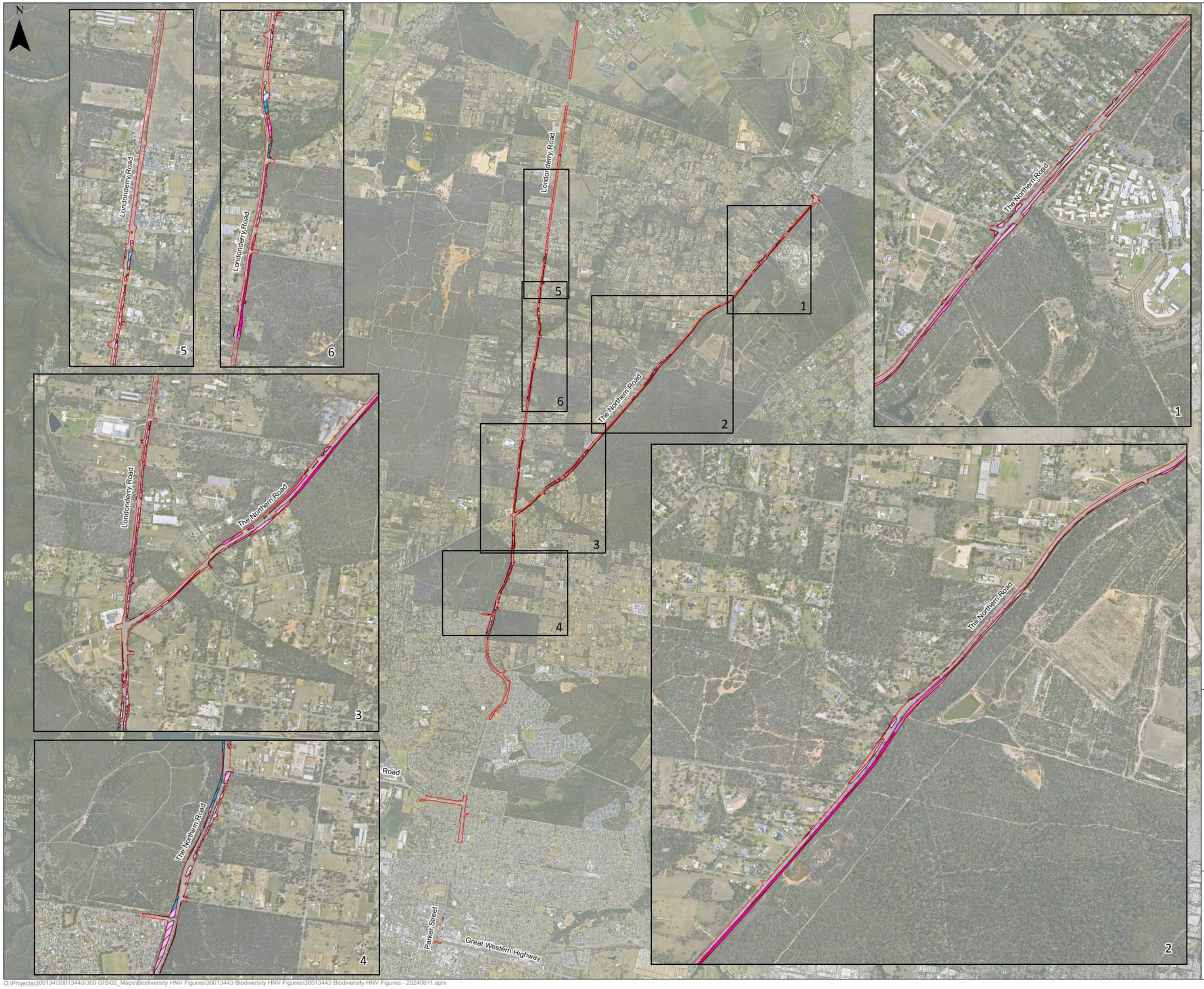

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LEGEND

- Subject land
- Koala Species Polygon

Species polygon vegetation zones

- 3448 Castlereagh Ironbark Forest (Low)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3628 Castlereagh Shrubby Swamp Woodland (Low)
- 3628 Castlereagh Shrubby Swamp Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Low)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)
- 4025 Cumberland Red Gum Riverflat Forest (Low)

SOURCES:
1. Roads © Roadnet MDS 2020
2. Basemap: © Aerometrex Pty Ltd

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Koala)
CREATED BY: LL16284
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VERSION: VERSION 1
PAGE SIZE: A3

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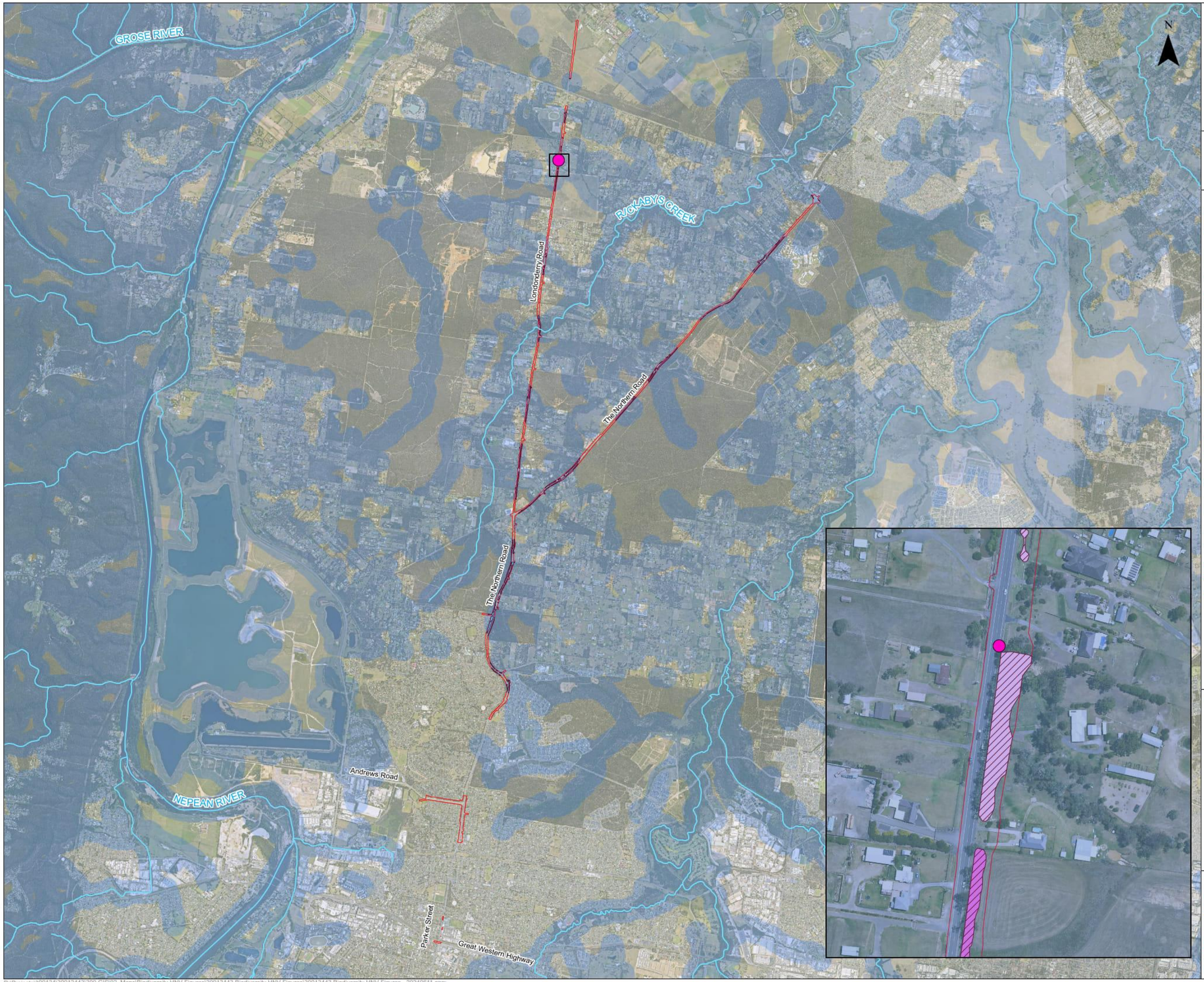

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LEGEND

- Subject land
- Southern Mypotis
- Waterbodies and 200 m buffer
- Watercourse
- Southern Myotis Species Polygon

Species polygon vegetation zones

- 3320 Cumberland Shale Plains Woodland (Low)
- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Low)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3629 Castlereagh Scribbly Gum Woodland (Low)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)
- 4025 Cumberland Red Gum Riverflat Forest (Low)

SOURCES:
1. Roads © Roadnet MDS 2020
2. Stream © Order WaterNSW
2. Basemap: MetroMap Imagery © Aerometrex Pty Ltd

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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Southern Myotis)
CREATED BY: LL16284
DATE: 11/06/2024
VERSION: VERSION 1
PAGE SIZE: A3

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Metres

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LEGEND

- Subject land
- Cumberland Plain Land Snail Species Polygon

Species polygon vegetation zones

- 3320 Cumberland Shale Plains Woodland (Moderate)
- 3448 Castlereagh Ironbark Forest (Moderate)
- 3448 Castlereagh Ironbark Forest (Good)
- 3628 Castlereagh Shrubby Swamp Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Moderate)
- 3629 Castlereagh Scribbly Gum Woodland (Good)

SOURCES:
1. Roads © Roadnet MDS 2020
2. Basemap: MetroMap Imagery © Aerometrex Pty Ltd

PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 6
FIGURE TITLE: Species polygons for species credit species (Cumberland Plain Land Snail)
CREATED BY: LL16284
DATE: 11/06/2024
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3.6 Aquatic results

Database searches did not identify any threatened fish populations that may occur in the study area.

Aquatic surveys were undertaken at Rickabys Creek, which is identified as Key Fish Habitat in the study area. The creek flows in an easterly direction under Londonderry Road through a series of box culverts (Photo 3-15). Usual flow uses only one of the cells, however additional cells are provided to accommodate higher flows as the creek is located on a floodplain and is subject to frequent flooding events. Floods frequently carry large, discarded household and farm items downstream.

The riparian corridor is in a highly degraded condition with invasive flora species and erosion evident. However, the invasive flora species are the predominant groundcover vegetation and are stabilising the banks. Large pieces of rubbish, tree roots and fallen logs form snags at various locations, which pool stagnant water during times of low flow.

Photo 3-15: Rickabys Creek passing under Londonderry Road culvert

Water quality sampling results are provided in Table 3–9. Results vary over time and sampling was taken on a single day. In the week prior to sampling, heavy rainfall had occurred resulting in continuous flow of Rickabys Creek through the study area.

The dissolved oxygen level indicates a poor-quality habitat for fish and other aquatic animals. Higher levels of dissolved oxygen, usually greater than six parts per million (ppm), are required to provide suitable habitat for aquatic animals.

Table 3–9: Aquatic survey results

Location	Dissolved oxygen	pH	Total dissolved solids	Temperature	Salinity
Rickabys Creek (east)	4.81ppm	6.27	617 mg/L TDS	22.81°C	1233 µS/cm
Rickabys Creek (west)	4.39ppm	6.36	610 mg/L TDS	22.5°C	1219 µS/cm

3.7 Areas of outstanding biodiversity value

No areas of outstanding biodiversity value occur in the study area.

3.8 Register of the National Estate

The following sites listed on the Commonwealth DCCEEW Register of the National Estate adjoin the site of the Proposal:

- Castlereagh State Forest and Adjacent Area (RNE 16369)
- Riverstone Natural Area (RNE 16372)
- University of Western Sydney Hawkesbury Native Vegetation (RNE 16583)
- Western Sydney Shale Woodland St Marys (RNE 19034)
- Castlereagh Jewel Beetle Habitat and Movement Corridor (RNE 19182)

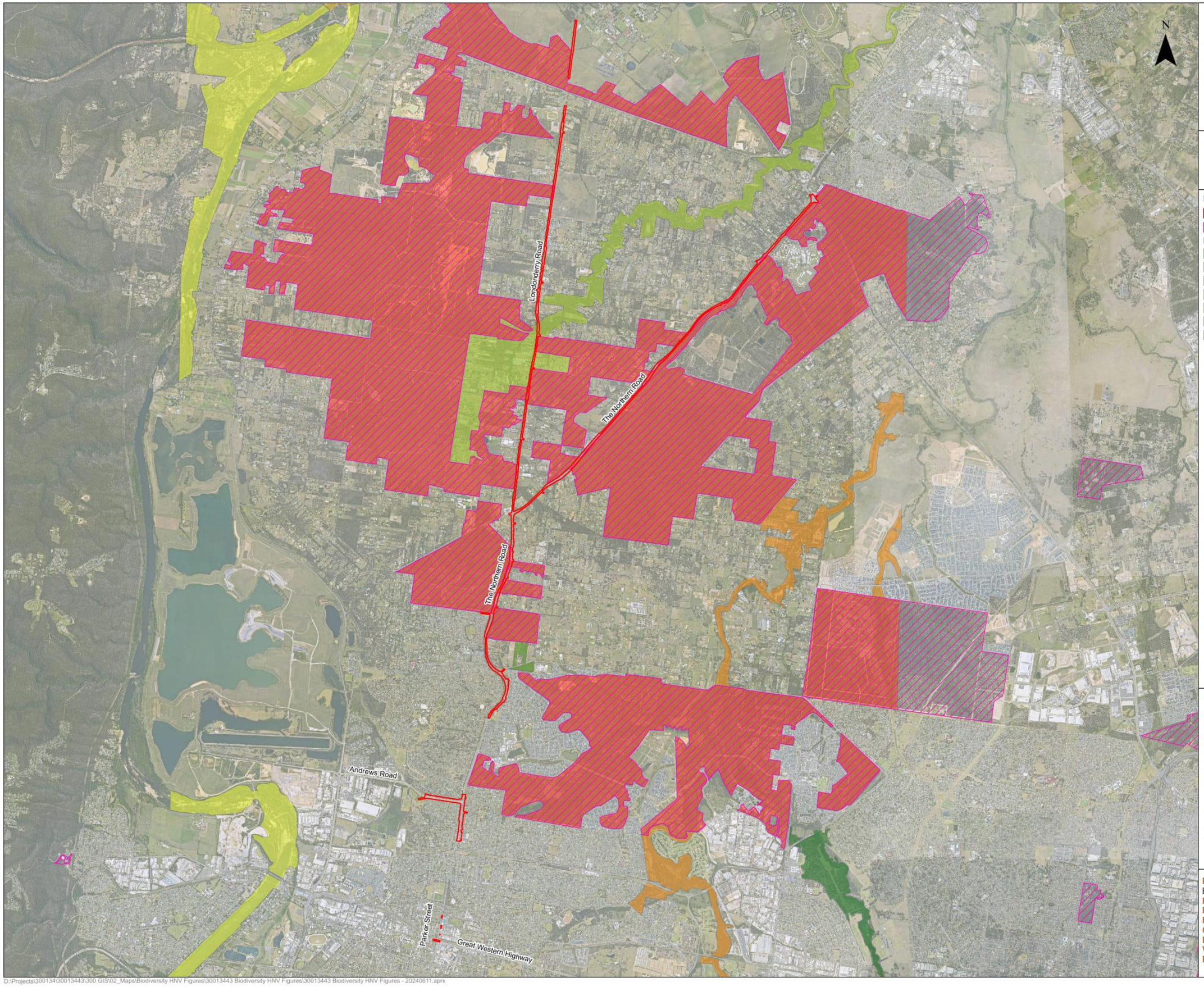
3.9 Wildlife connectivity corridors

Biodiversity Corridors of Regional Significance have been identified for the Cumberland Subregion in the Cumberland Plain Recovery Plan (DECCW 2011). These corridors are mapped as Priority Conservation Lands (Figure 3–7) and are identified as important areas for threatened vegetation communities and species. They facilitate the movement of animals for foraging, seeking shelter, breeding and dispersal. They also allow the transfer of plant genetic material between patches of vegetation through wind and by animal dispersal.

Regional corridors are associated with Rickabys Creek and other remaining large areas of native vegetation including Castlereagh Nature Reserve, Windsor Downs Nature Reserve and Wianamatta Nature Reserve, which all border the study area (Figure 1–2). The Rickabys Creek corridor joins the Hawkesbury River corridor approximately 4.5 kilometres north-west of the study area. Land cleared for farming and residential developments has isolated large areas of vegetation on the Cumberland Plain, with often on narrow riparian corridors connecting these areas to others in the region. Sufficient native vegetation remains for mobile species to move throughout the study area and locality. Less mobile species may be isolated by gaps in vegetation, roads and other physical barriers.

3.10 State Environmental Planning Policies

Neither Koala SEPP applies to land in Penrith Council. Koala SEPP 2021 applies in the City of Hawkesbury, which covers land north of The Driftway. No habitat in any part of the study area is considered core koala habitat.



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LEGEND

- Subject land
- Cumberland Plain Priority Conservation Lands

Bio Corridor

- Regional Corridor 21
- Regional Corridor 22
- Regional Corridor 25
- Regional Corridor 32
- Regional Corridor 33
- Regional Corridor 5
- Regional Corridor and Core Area

SOURCES:

1. Roads © RoadNet MDS 2020
2. Bio Corridor © State Government of NSW and Department of Planning and Environment 2015
3. Cumberland Plain Priority Conservation Lands © State Government of NSW and NSW Department of Climate Change, Energy, the Environment and Water 2011
4. Basemap:© Aerometrex Pty Ltd

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PROJECT: Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO: 30013443
FIGURE NO: 3 - 7
FIGURE TITLE: Wildlife connectivity corridors
CREATED BY: LL16284
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PAGE SIZE: A3

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3.11 Matters of national environmental significance

Four of the vegetation communities discussed in Section 3.2 partially meet criteria of Threatened Ecological Communities under the EPBC Act. Sections 3.11.1 to 3.11.4 are descriptions of how each community is represented by vegetation in the study area. The four communities are:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

The three threatened flora species that were recorded in the study area and are listed under the EPBC Act are also listed under the BC Act and discussed in Section 3.5:

- *Micromyrtus minutiflora*
- *Persoonia nutans* (Nodding Geebung)
- *Pultenaea parviflora*.

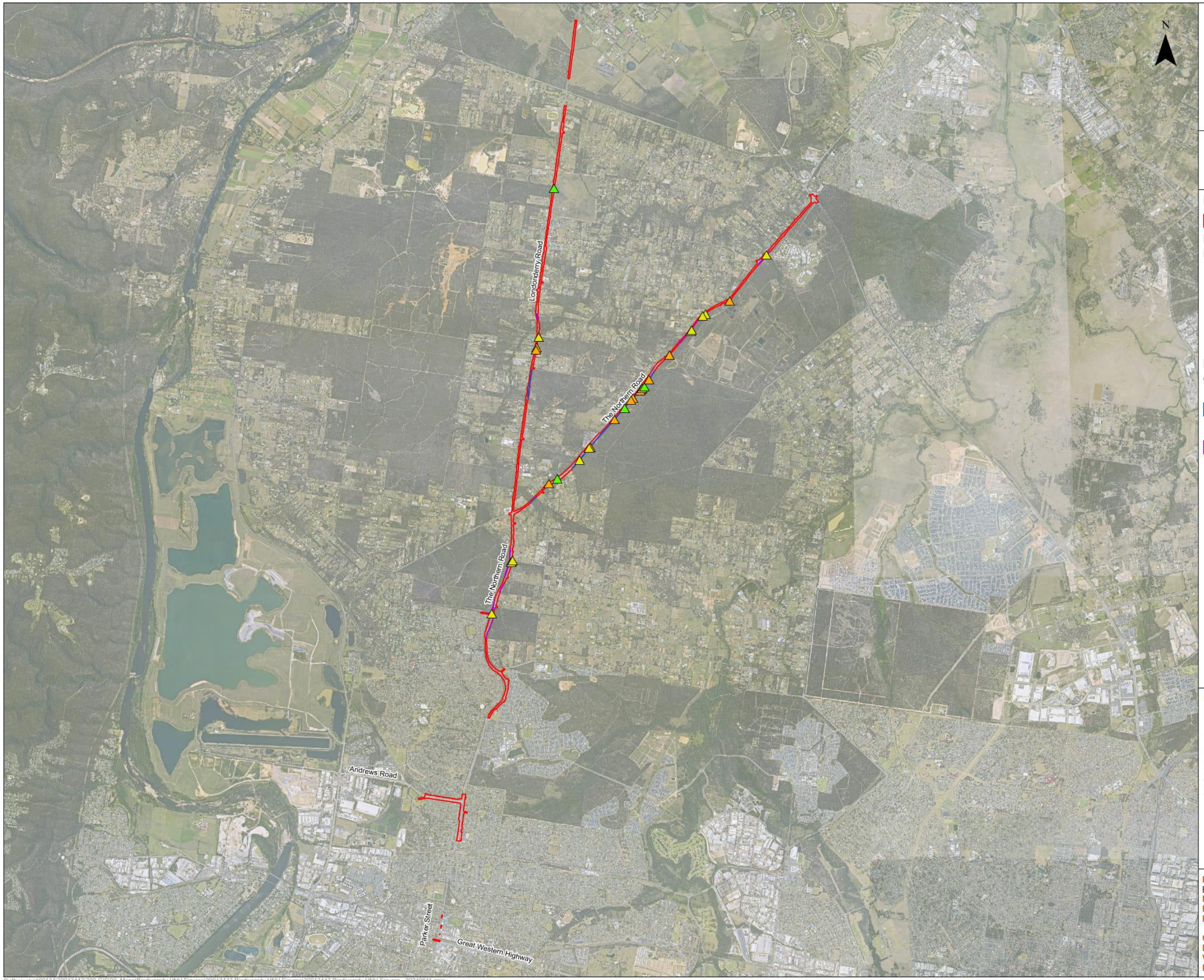
No other threatened flora species are considered likely to occur.

Four EPBC Act listed threatened fauna species (two birds and two mammals) are considered likely to occur in the study area based on the availability of suitable habitat (Appendix B):

- Regent Honeyeater (*Anthochaera phrygia*)
- Swift Parrot (*Lathamus discolor*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*).

Database searches identified 13 species listed as migratory under the EPBC Act (Appendix B). None are considered likely to occur in the study area.

MNES recorded in the study area are shown in Figure 3–8.



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LEGEND

- Subject land

EPBC listed flora species identified in surveys

- Micromyrtus minutiflora
- Persoonia nutans (Nodding Geebung)
- Pultenaea parviflora

EPBC listed vegetation communities

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Cooks River/ Castlereagh Ironbark Forest

SOURCES:
1. Roads © Roadnet MDS 2020
2. Basemap: MetroMap Imagery © Aerometrex Pty Ltd

PROJECT:	Hawkesbury Nepean Valley Flood Evacuation Road Resilience Improvement Project
PROJECT NO:	30013443
FIGURE NO:	3 - 8
FIGURE TITLE:	Matters of national environmental significance recorded
CREATED BY:	LL16284
DATE:	12/06/2024
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3.11.1 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

This critically endangered ecological community was named under the EPBC Act because it reflects the key location, substrate and vegetation structure, as well as reflecting its relationship with two threatened ecological communities listed under the then NSW *Threatened Species Conservation Act 1995*; 'Cumberland Plain Woodland in the Sydney Basin Bioregion' and 'Shale Gravel Transition Forest in the Sydney Basin' (DEWHA 2009). Key diagnostic criteria are accordingly largely the same as for the NSW listings described in Section 3.2, however the community listed under the Australian EPBC Act is restricted to larger patches and better condition states. The thresholds for minimum condition criteria are listed in Table 3–10.

Table 3–10: EPBC listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest minimum condition criteria

Category and rationale	Thresholds
A. Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW.	Minimum patch size is ≥0.5ha; AND ≥50% of the perennial understorey vegetation cover is made up of native species.
B. Larger patches which are inherently valuable due to their rarity.	The patch size is ≥5ha; AND ≥30% of the perennial understorey vegetation cover is made up of native species.
C. Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is ≥0.5 ha; AND ≥30% of the perennial understorey vegetation cover is made up of native species;
D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥0.5 ha in size; AND ≥30% of the perennial understorey vegetation cover is made up of native species; AND The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A.

Within the subject land even moderate quality PCT 3320 had less than 30% native vegetation cover (Plot 6). No zones of PCT 3320 within the subject land meet the criteria for the EPBC listed community. Some areas of the TEC are likely to be present in the study area outside properties available for survey.

3.11.2 Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion

The EPBC Act conservation advice for the critically endangered TEC uses the same name as the BC Act listing which reflects that the structure and limited range of distribution are essentially the same (DoE 2015). The condition of the vegetation eligible for listing under the EPBC Act differs from the BC Act, and the thresholds which provide minimum condition criteria are listed in Table 3–11.

Table 3–11: Listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion minimum condition thresholds

Category and rationale	Thresholds
A. Moderate condition class Represented by medium to large-size patch as part of a larger native vegetation remnant and/or with mature trees	Patch size >0.5 ha (Patch size >0.1 ha in areas east of Riverstone (150°51' 38"E)) and >30% of the perennial understorey vegetation cover is made up of native species. and The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) >1ha in area. or The patch has at least one tree with hollows or at least one large locally indigenous tree (>80 cm dbh)
B. Moderate condition class Represented by medium to large size patch with high quality native understorey	Patch size >0.5 ha (Patch size >0.1 ha in areas east of Riverstone (150°51' 38"E)) and >50% of the perennial understorey vegetation cover is made up of native species.

Most patches of PCT 3448 in good condition, and a small subset of moderate condition, meet the criteria of the EPBC listed TEC. Low condition PCT 3448 does not meet the condition criteria and is therefore not part of the TEC.

The total area of Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion in the subject land is 2.90 hectares.

3.11.3 Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion

The Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion, listed as endangered under the EPBC Act, combines two of the equivalent communities listed separately under the BC Act. Because of the highly localised range, the distribution and diagnostic characteristics are strongly based on the NSW descriptions of the community (DoE 2015a). Minimum condition thresholds for this community are provide in Table 3–12.

Table 3–12: Castlereagh Scribbly Gum and Agnes Banks Woodlands minimum condition thresholds

Category and rationale	Thresholds
A. Moderate condition class Represented by medium to large-size patch as part of a larger native vegetation remnant and/or with mature trees	Patch size >0.5 ha and >30% of the perennial understorey vegetation cover* is made up of native species and The patch is contiguous^ with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) >1 ha in area.
B. Moderate condition class Represented by medium to large size patch with high quality native understorey	Patch size >0.5 ha and >50% of the perennial understorey vegetation cover is made up of native species

PCT 3629 in low condition had less than 30% perennial native cover and ineligible for being considered the listed community. Good condition PCT 3629 typically contained patches of at least 0.5 hectares with more than 30% perennial understory native

cover and were adjacent to large tracts of native vegetation greater than one hectare in area. A subset of moderate condition PCT 3629 in better connected patches continuous with larger bushland remnant also meet Class A Moderate thresholds.

The total area of Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion in the subject land is 6.00 hectares.

3.11.4 River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria

This critically endangered TEC was only represented by a small area of low condition within accessible areas within the subject land. This vegetation described in Section 3.3.5 is not representative of the listed community for two reasons:

- Structurally, crown cover must be over 20% cover whereas the vegetation contained limited juvenile regrowth. Even the lowest condition class described in the approved Conservation Advice (DAWE 2020) requires an understorey cover comprised of greater than 30% native species.
- A native ground cover of less than 5% was recorded at RMP 4.

3.11.5 Location summary

The locations of each of the EPBC Act listed communities is provided in Table 3–13.

Table 3–13: Locations of EPBC listed TECs in the study area

EPBC listed TEC	Locations
Cumberland Plain Shale Woodlands	Not in subject land. Likely in some unsurveyed portions of PCT 3320 outside the study area.
Cooks River/Castlereagh Ironbark Forest	Zones 3448_Good, some of 3448_Moderate
Castlereagh Scribbly Gum and Agnes Banks Woodlands	Zone 3629_Good
River-flat eucalypt forest	Not in subject land. May be present outside surveyed areas.

4. Avoidance and minimisation

A key part of Transport's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

1. Avoid and minimise impacts
2. Mitigate impacts
3. Offset impacts in accordance with Transport guidelines.

This section of the BAR demonstrates the efforts taken to avoid and minimise impacts on biodiversity values.

Direct impacts on native vegetation and habitat have been avoided and minimised by:

- Using an existing road corridor to provide the flood evacuation route rather than creating a new route through greenfield areas
- Locating the proposal in areas where the native vegetation or threatened species habitat is in the lowest condition (i.e. on the edge of an existing major road).

The location of temporary ancillary construction and maintenance facilities, has avoided and minimised clearing of native vegetation and habitat by:

- Reducing the clearing footprint of the proposal
- Locating ancillary facilities in areas:
  - Where there are no biodiversity values (e.g. gravel area of Site Compound 1), or
  - Where the native vegetation or threatened species habitat is in the lowest condition (e.g. isolated canopy trees above mown grass at Site Compound 2), or
  - That avoid habitat for threatened species and vegetation in high threat status categories (e.g., endangered or critically endangered).

Construction will take place in stages, potentially minimising impacts to mobile fauna species that can relocate to other parts of their home range to avoid high levels of disturbance.

5. Impact assessment

Anticipated impacts during the construction and operational phases of the proposal as well as indirect impacts are:

- Construction impacts:
  - Removal of native vegetation
  - Removal of threatened fauna species habitat and habitat features
  - Removal of threatened flora species
  - Aquatic impacts
  - Injury and mortality of fauna
  - Groundwater dependent ecosystems
- Operation/indirect impacts:
  - Wildlife connectivity and habitat fragmentation
  - Edge effects on adjacent native vegetation and habitat
  - Invasion and spread of weeds
  - Invasion and spread of pests
  - Invasion and spread of pathogens and disease
  - Changes to hydrology
  - Noise, light, dust and vibration.

These potential impacts are discussed in Sections 5.1 and 5.2.

5.1 Construction direct impacts

5.1.1 Removal of native vegetation

The proposal would result in the removal of 20.93 hectares of native vegetation for construction. An additional 0.26 hectares of 'planted (non-native)' and 1.42 hectares of 'planted native' vegetation would also be removed. The area to be impacted was determined by calculating the area of each vegetation zone (from Figure 3–2) within the construction boundary, not including the site compound areas because work in these areas will not impact any native vegetation. The construction buffer was set at 10 metres in most areas and reduced to six metres in areas where vegetation was mapped in 'moderate' or 'good' condition.

A summary of the direct impacts of the proposal on native vegetation is provided in Table 5–1.

Table 5–1: Summary of direct impacts on native vegetation

Vegetation zone	Plant community type (PCT)	Broad condition class	TEC	Area to be impacted (ha or m^2)[1]
3320_Moderate	3320: Cumberland Shale Plains Woodland	Moderate	Critically Endangered (BC Act)	0.58 ha
3320_Low		Low	Critically Endangered (BC Act)	2.24 ha
3448_Good	PCT 3448: Castlereagh Ironbark Forest	Good	Endangered (BC Act) Critically Endangered (EPBC Act)	0.96 ha
3448_Moderate		Moderate	Endangered (BC Act) Critically Endangered (EPBC Act)[2]	3.02 ha
3448_Low		Low	Does not meet TEC condition criteria	2.82 ha

Vegetation zone	Plant community type (PCT)	Broad condition class	TEC	Area to be impacted (ha or m²)[1]
3628_Moderate	PCT 3628: Castlereagh Shrubby Swamp Woodland	Moderate	Endangered (BC Act)	0.29 ha
3628_Low		Low	Endangered (BC Act)	0.21 ha
3629_Good	PCT 3629: Castlereagh Scribbly Gum Woodland	Good	Vulnerable (BC Act) Endangered (EPBC Act)	3.01 ha
3629_Moderate		Moderate	Vulnerable (BC Act) Endangered (EPBC Act)[2]	4.40 ha
3629_Low		Low	Does not meet TEC condition criteria	3.30 ha
4025_Low	PCT 4025: Cumberland Red Gum Riverflat Forest	Low	Endangered (BC Act)	0.10 ha
Planted native	N/A	N/A	N/A	1.42 ha
Total impact on native vegetation[3]				**22.35 ha**

NOTE:

[1] Area to be cleared based on ground-truthed vegetation mapping within the subject land.

[2] Not all 3448_Moderate and 3629_Moderate meets the condition criteria of the EPBC listed Community.

[3] 0.26 ha of planted (non-native) vegetation would also be removed as part of the Proposal.

Removal of native vegetation is listed as a key threatening process under the BC Act and EPBC Act and contributes to the loss of suitable habitat for threatened flora and fauna species. It also has flow-on indirect impacts including edge effects, loss of connectivity and fragmentation, spread of invasive species, changes to hydrology and increases to noise, light, dust and vibration (discussed in Section 5.2).

5.1.2 Removal of threatened fauna habitat

Surveys and habitat suitability assessment identified 17 fauna species (seven birds, nine mammals, one gastropod) that have a moderate or higher likelihood of occurring in the study area and therefore would have potential habitat removed by the project. These species and the impacted PCTs are listed in Table 5–2. The total area of habitat to be removed is also included in Table 5–2, however, areas of 'planted' or 'planted native' vegetation are not included in offsetting calculations (see Section 7).

Where a species credit species is not likely to occur in all areas of habitat due to the absence of connectivity to other areas of suitable habitat or nearby records, individual polygons of a PCT have been removed from the species polygon.

Breeding habitat for the dual credit species was not identified in the study area; caves and cliff lines do not occur. The study area is not mapped as Important Habitat for the Regent Honeyeater or Swift Parrot. No Grey-headed Flying-fox camps occur. The presence of these features is identified in Appendix B.

Table 5–2: Summary of direct impacts on threatened fauna and habitat

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha)
Regent Honeyeater (*Anthochaera phrygia*)	CE	E	Ecosystem	Moderate	All PCTs (all zones) plus planted and planted native zones	22.61

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha)
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	-	V	Ecosystem	Moderate	All PCTs (only moderate or good condition)	12.26
Varied Sittella (*Daphoenositta chrysoptera*)	-	V	Ecosystem	Moderate	All PCTs (only good condition)	3.98
Little Lorikeet (*Glossopsitta pusilla*)	-	V	Ecosystem	Moderate	All PCTs (all zones) plus planted and planted native zones	22.61
Swift Parrot (*Lathamus discolor*)	CE	V	Ecosystem	Moderate	All PCTs (all zones) plus planted and planted native zones	22.61
Square-tailed Kite (*Lophoictinia isura*)	-	V	Ecosystem	Recorded	All PCTs (all zones)	20.93
Powerful Owl (*Ninox strenua*)	-	V	Species	Moderate	All PCTs (all zones) plus planted and planted native zones	22.61
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	-	V	Ecosystem	Moderate	All PCTs (all zones) except 3628	20.43
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	-	V	Ecosystem	High	All PCTs (all zones) except 3628	20.43
Little Bent-winged Bat (*Miniopterus australis*)	-	V	Ecosystem	High	All PCTs (all zones) except 3628	20.43
Large Bent-winged Bat (*Miniopterus orianae oceanensis*)	-	V	Ecosystem	High	All PCTs (all zones) except 3628	20.43
Southern Myotis (*Myotis macropus*)	-	V	Species	Recorded	All PCTs (all zones) except 3628 within 200m of waterways	12.54
Koala (*Phascolarctos cinereus*)	E	E	Species	Moderate	All PCTs (all zones)	15.73
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	Ecosystem	High	All PCTs (all zones) plus planted and planted native zones	22.61
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	-	V	Ecosystem	Moderate	All PCTs (all zones) except 3628	20.43

Species name	EPBC Act	BC Act	Credit type[1]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha)
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	-	V	Ecosystem	Moderate	All PCTs (all zones) except 3628	20.43
Cumberland Plain Land Snail (*Meridolum corneovirens*)	E	-	Species	High	All PCTs (moderate and good condition zones)	12.26
Note: 1. For dual-credit species, identify the credit type being assessed (i.e. where there is no breeding habitat present the credit type would be 'ecosystem').						

Culvert LNR04 where the Southern Myotis roost was observed is to be extended rather than removed and replaced. Thirteen culverts of various sizes that may provide suitable microbat habitat are to be upgraded or extended as listed in Section 3.2.16 of the REF. Other culverts may be increased to a size that may accommodation microbats, however, the design specifications and suitability are unknown. Culverts that a subject to flooding are considered unsuitable as habitat, which is possible for the majority of the culverts in the study area.

Clearing of vegetation is likely to result in the loss of hollow-bearing trees that provide habitat for many fauna species, not just those listed as threatened. Mitigation measures have been proposed to minimise the loss of hollow-bearing trees.

Removal of native vegetation and loss of hollow-bearing trees are listed as key threatening processes under the BC Act and EPBC Act and contribute to the loss of suitable habitat for threatened fauna species.

5.1.3 Removal of threatened flora

Five threatened flora species and one threatened flora population will be directly impacted by the proposal. The species and area of impact are provided in Table 5–3. The vegetation zones are known habitat in which each species may occur based on NSW TBDC data. The species polygons include patches of these zones in which the species were found in or connected to the patch, during survey. In addition, because of the very narrow survey paths relative to the surrounding body of vegetation, likely habitat was also identified using proximity to local BioNet records. Areas were considered habitat if within a reasonable distance to BioNet records and well connected to those records by intact vegetation. For example, vegetation zones north of the Londonderry Road and The Northern Road intersection were removed as potential *Marsdenia viridiflora* subsp. *viridiflora* habitat as they are not near any known records of the species.

Table 5–3: Summary of direct impacts on threatened flora

Species name	EPBC Act	BC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha or individuals)
Dillwynia tenuifolia	-	V	Recorded	3320, 3448, 3629 (moderate and good condition zones)	10.68ha
Grevillea juniperina subsp. *juniperina* (Juniper-leaved Grevillea)	-	V	Recorded	All PCTs (moderate and good condition zones)	7.04 ha
Marsdenia viridiflora subsp. *viridiflora*	-	EP	Recorded	All PCTs (moderate and good condition zones) south of Londonderry Road and The Northern Road intersection	1.12 ha

Species name	EPBC Act	BC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha or individuals)
Micromyrtus minutiflora	V	E	Recorded	3320, 3448, **3629** (moderate and good condition zones)	7.64 ha
Persoonia nutans (Nodding Geebung)	E	E	Recorded	3320, 3448, 3628, **3629** (moderate and good condition zones)	6.68 ha
Pultenaea parviflora	V	E	Recorded	3320, **3448**, 3628, 3629 (moderate and good condition zones)	5.44 ha

5.1.4 Aquatic impacts

Works would be required to be carried out in ephemeral and perennial waterways that flow through the culvert locations that are being extended. Scour protection would also be installed at these locations. These works would temporarily impact the key fish habitat at Rickabys Creek during construction.

Culvert works would be carried out in dry periods to minimise the need for dewatering and obstruction of fish passage in Rickabys Creek. Where required, temporary diversions would be installed to allow any waterway flow to continue while works are being carried out. Transport would notify DPI (Fisheries) of the proposed works at Rickabys Creek prior to construction and respond to any requirements during detailed design.

The Proposal is unlikely to result in any impacts to any threatened aquatic species or populations as none are known to occur in the study area.

5.1.5 Injury and mortality

There is a potential for fauna injury and mortality in relation to removal of vegetation, particularly hollow-bearing trees where animals may be roosting or nesting. An increase in movement of heavy vehicles around construction area and site compounds also poses a risk to fauna with slow-moving reptiles and mammals particularly susceptible.

Mitigation measures have been included in Section 6 to reduce the potential for fauna Injury and mortality.

5.1.6 Groundwater dependent ecosystems

Potential impacts to GDEs are addressed in the *Soils, Surface and Groundwater Assessment Working Paper* (SMEC 2023). It is acknowledged that some excavation activities will occur close to high potential GDEs and there is potential risk to groundwater levels during the construction phase through the interception of groundwater. However, the majority of excavations required for culverts are less than one metre deep. A reduction in rainfall infiltration during operation is likely to have a negligible effect in flows available to high potential GDEs in the study area (SMEC 2023). The working paper also includes recommendations to minimise the impacts of construction and operation on groundwater.

5.1.7 Register of the National Estate

No direct impacts to items listed on the Register of the National Estate are anticipated.

5.2 Indirect and operational impacts

5.2.1 Edge effects on adjacent native vegetation and habitat

The proposal would result in the removal of vegetation (including areas of items listed on the Register of the National Estate) along the side of a major road, which is currently subject to edge effects. The incursion of weeds is most obvious in areas where the ground is level with or below the surface of the road. In these areas a dense cover of African Love Grass (*Eragrostis curvula*) often persists several metres into the adjacent vegetation before thinning out and returning to a predominately native groundcover layer.

No new edges will be created, and much of the vegetation to be removed will be roadside invasive species, but this is likely to result in the current edge effects extending further into the existing native vegetation. Around drainage lines a variety of introduced species occur and there is unlikely to be any additional impacts from edge effects in these areas.

5.2.2 Wildlife connectivity and habitat fragmentation

The study area occurs in a disturbed landscape in which vegetation has historically been cleared for farming, industry and residential developments. Further habitat fragmentation is unlikely to occur as a result of the proposal as the work would involve removing vegetation from the edge of a major road rather than fragmenting remaining large areas of vegetation.

Isolation of habitats is likely to slightly increase by vegetation clearing resulting in the distance between patches of vegetation on opposite sides of the road increasing. However, in many cases no large trees will be removed so the canopy connectivity will remain. The increased fragmentation is unlikely to affect breeding and dispersal of plant propagules, including those of the threatened species known to occur in the study area.

Specific mitigation measures to manage wildlife connectivity and habitat fragmentation are not required due to the low expected impact. Minimal clearing of native vegetation and retention of canopy trees has been recommended to minimise the effects of fragmentation, particularly where Priority Conservation Lands occur on opposite sides of the road.

5.2.3 Injury and mortality

Fauna occupying the study area are currently at risk of injury and mortality as a result of vehicle strikes. The nature of the proposal means that the operational traffic levels will not differ from the current levels, except when the evacuation route is in use. During this time, it would be expected that animal movements are changed as a result of landscape flooding and this is more likely to impact them than the risk of vehicle strike amongst potentially slow-moving traffic. More individuals may be drawn to the roadside as an escape from flooded areas and would be required to negotiate two lanes of traffic instead of the current one. This may temporality increase the rate of vehicle strike triggered by the environmental conditions.

5.2.4 Invasion and spread of weeds

Surveys identified the following high threat weed species in the study area:

- Lantana (*Lantana camara*)*
- African Lovegrass (*Eragrostis curvula*) along most of the study area within a few metres of the road
- *Ludwigia peruviana* near Rickabys Creek*
- *Opuntia* species along The Northern Road near Londonderry Road*
- Blackberry (*Rubus fruticosus* species aggregate)*
- Small-leaf Privet (*Ligustrum sinense*).

Species marked with an asterisk are identified on the Priority Weeds List for the Hawkesbury River County Council, which includes Hawkesbury and Penrith LGAs.

Relevant biosecurity duties in Greater Sydney for each species are listed in Table 5–4.

Table 5–4: Significant weeds identified in the study area and their biosecurity duty

Species	Duty
All weed species	**General Biosecurity Duty** All pest plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.
Lantana camara Lantana WoNS	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.

Species	Duty
Ludwigia peruviana Water primrose	**Regional Recommended Measure** (for Regional Priority - Asset Protection) Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Notify local control authority if found.
Opuntia species Prickly pears WoNS	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale. For all Opuntia species except for Opuntia ficus-indica (Indian fig).
Rubus fruticosus species aggregate Blackberry WoNS	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale. All species in the *Rubus fruticosus* species aggregate have this requirement, except for the varietals Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smooth Stem, and Thornfree.

None of these significant weed species were present in high numbers at any location, but mitigation measures (Section 6) should be followed to remove them where they occur within the construction area and ensure they are not spread further at this site or transferred to any other site in fill, waste or on machinery.

5.2.5 Invasion and spread of pests

Three species of exotic bird and one mammal were observed opportunistically in the study area during recent surveys (Appendix A). As the study area occurs in a semi-rural area, other vertebrate mammal pest species such as cats (*Felis catus*), foxes (*Vulpes vulpes*) and rats (*Rattus rattus*) are expected to occur and move freely throughout the study area. These species are likely to have contributed to the decline of native bird and small mammal species in the Sydney Basin. The proposal is unlikely to introduce any new pest species or facilitate their movement into previously unoccupied areas.

5.2.6 Invasion and spread of pathogens and disease

Pathogens which may be introduced by contaminated soils or unwashed machinery or construction equipment include:

- Phytophthora (*Phytophthora cinnamomi*)
- Myrtle Rust (*Austropuccinia psidii*)
- Chytrid Fungus (*Batrachochytrium dendrobatidis*).

Risks to threatened amphibians from Chytrid fungus is not considered high as it is unlikely they are present in the study area and the risk generated by frequent flooding events is likely much higher. The threatened species *Micromyrtus minutiflora* may be susceptible to Myrtle Rust. Mitigation measures to reduce the likelihood of invasion or spread of disease are included in Section 6.

5.2.7 Changes to hydrology

Significant changes to catchments and run-off are not proposed due to the nature of the proposed construction activities (REF Section 3.2.15).

Localised changes as a result of scour protection are possible, however these will not result in changes to the overall hydrology of the study area.

5.2.8 Noise, light, dust and vibration

Construction activities would result in an increase in noise, light, dust and vibration in the study area during the construction period. Construction is to be completed in stages over about two and half years.

Operational impacts are expected to be minimal due to as there will be no increase to current traffic volumes. Traffic increases will only be observed when the evacuation route is active and is working to clear traffic from at-risk areas more quickly. There are no plans to install additional street lighting at any locations.

Specific measures to reduce impacts relating to noise, light, dust and vibration are included in Section 6.

5.3 Cumulative impacts

A nearby Transport project is the upgrade of The Driftway between Londonderry Road Blacktown/Racecourse Road (TfNSW 2021). The project will include the clearing of native vegetation identified as:

- Shale Gravel Transition Forest in the Sydney Basin Bioregion (Endangered BC Act) (PCT 724) – 0.51 hectares
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered) (PCT 725) – 0.20 hectares
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) (PCT 835) – 0.37 hectares
- Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered) (PCT 849) – 3.41 hectares
- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (Vulnerable) (PCT 883) – 1.17 hectares.

A total of 0.08 hectares of PCT 883 – Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion Community that meets the condition criteria for the EPBC Act listed Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion EEC would be removed. *Dillwynia tenuifolia* was recorded in the construction footprint during targeted surveys and evidence of the Cumberland Plain Land Snail was also observed.

Offsets are required for the critically endangered Cumberland Plain Woodland in the Sydney Basin Bioregion and habitat for *Dillwynia tenuifolia* and the Cumberland Plain Land Snail.

Combined areas of PCTs for this proposal and The Driftway project do not exceed offset thresholds for any communities that are not already offset by either project, noting that The Driftway surveys were undertaken using previous PCT names and classification where there is not a single replacement new PCT. The most frequently inherited PCT numbers have been used.

Other nearby projects with available information about proposed biodiversity impacts are outlined in Section 5.3 of the *New Richmond Bridge and traffic improvements – Stage 1 The Driftway: Biodiversity Assessment* (TfNSW 2021).

Geotechnical investigations for Stage 2 of the New Richmond Bridge and traffic improvements project (TfNSW 2023) have identified the following vegetation communities that also occur in the study area:

- PCT 3629 Castlereagh Scribbly Gum Woodland
- PCT 3320 Cumberland Shale Plains Woodland
- PCT 4025 Cumberland Red Gum Riverflat Forest.

Impacts to these communities and the threatened species that occupy them are unknown at present as the project details are yet to be finalised.

Projects being undertaken on the Hawkesbury-Nepean floodplain continue to remove vegetation communities that have already been extensively cleared for farming, industry, transport routes and residential developments. Some areas remain protected in national parks and nature reserves that occur in the region, however connectivity between these areas is limited.

5.4 Assessments of significance

Assessments of significance were prepared for each threatened species, population or ecological community that have been recorded in the study area or are assumed present as they have a moderate to high likelihood of occurrence based on the habitat suitability assessment in Appendix B. Results of the assessments of significance are summarised in Table 5–5 (BC Act) and Table 5–6 (EPBC Act). Assessments of significance are provided in Appendix D and E.

Table 5–5: Summary of BC Act significance assessments findings

Significance assessment question *(in accordance with Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH 2018))*						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
Cumberland Plain Woodland in the Sydney Basin Bioregion	X	N	N	N	Y	N

Significance assessment question *(in accordance with Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH 2018))*						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	X	N	N	N	Y	N
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	X	N	N	N	Y	N
Castlereagh Swamp Woodland	X	N	N	N	Y	N
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	X	N	N	N	Y	N
Dillwynia tenuifolia	N	X	N	N	Y	N
Grevillea juniperina subsp. *juniperina* (Juniper-leaved Grevillea)	N	X	N	N	Y	N
Marsdenia viridiflora subsp. *viridiflora*	N	X	N	N	Y	N
Micromyrtus minutiflora	N	X	N	N	Y	N
Persoonia nutans (Nodding Geebung)	N	X	N	N	Y	N
Pultenaea parviflora	N	X	N	N	Y	N
Regent Honeyeater (*Anthochaera phrygia*)	N	X	N	N	Y	N
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	N	X	N	N	Y	N
Varied Sittella (*Daphoenositta chrysoptera*)	N	X	N	N	Y	N
Little Lorikeet (*Glossopsitta pusilla*)	N	X	N	N	Y	N
Swift Parrot (*Lathamus discolor*)	N	X	N	N	Y	N
Square-tailed Kite (*Lophoictinia isura*)	N	X	N	N	Y	N
Powerful Owl (*Ninox strenua*)	N	X	N	N	Y	N
Koala (*Phascolarctos cinereus*)	N	X	N	N	Y	N
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	N	X	N	N	Y	N
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	N	X	N	N	Y	N
Little Bent-winged Bat (*Miniopterus australis*)	N	X	N	N	Y	N
Large Bent-winged Bat (*Miniopterus orianae oceanensis*)	N	X	N	N	Y	N
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	N	X	N	N	Y	N
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	N	X	N	N	Y	N
Southern Myotis (*Myotis macropus*)	N	X	N	N	Y	N
Grey-headed Flying-fox (*Pteropus poliocephalus*)	N	X	N	N	Y	N
Cumberland Plain Land Snail (*Meridolum corneovirens*)	N	X	N	N	Y	N

Significance assessment question *(in accordance with Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH 2018))*						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
***Y** = Yes (negative impact), **N** = No (no or positive impact), **X** = Yes/No answer not applicable, **?** = unknown impact.*						

Table 5–6: Summary of EPBC Act significance assessments findings

Threatened species, or communities	Important population *(per Significant Impact Guidelines 1.1 (DoE 2013))*	Likely significant impact?
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	N	N
Cooks River Castlereagh Ironbark Forest	Y (Critical habitat)	N
Castlereagh Scribbly Gum and Agnes Banks Woodlands	Y (Critical habitat)	N
Micromyrtus minutiflora	Y	N
Nodding Geebung (*Persoonia nutans*)	N	N
Pultenaea parviflora	N	N
Regent Honeyeater (*Anthochaera phrygia*)	Y	N
Swift Parrot (*Lathamus discolor*)	Y	N
Koala (*Phascolarctos cinereus*)	N	N
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Y	N
***Y** = Yes (negative impact), **N** = No (no or positive impact), **X** = Yes/No answer not applicable, **?** = unknown impact.*		

6. Mitigation

Measures to minimise impacts on particular threatened species, populations or TECs, or for a particular phase of the proposal have been considered. Best practice management measures have been included in Transport's *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (2011), and these have been used as a base for the development of mitigation measures for this proposal.

Mitigation measures also satisfy the Transport for NSW Biodiversity Sustainability Requirements (BSRs) referred to in the Project Sustainability Plan (SMEC 2024) to protect and enhance biodiversity by:

- Avoid, minimise and mitigate the impacts of the project on native fauna and flora including the use of mitigation techniques
- Avoid, minimise and mitigate any biosecurity risks arising from the project; within 3 months from the end of construction or as agreed.

Impacts identified in Section 5 have corresponding mitigation measures. Measures to be implemented before, during and after construction to avoid, minimise or mitigate the potential impacts of the proposal are included in Table 6–1.

Table 6–1: Mitigation measures

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B01	Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Detailed design	Effective	The proposal will result in the removal of up to 20.93 hectares of native vegetation	Designer Contractor
B02		Construction activities should prioritise use of areas where no native vegetation has been mapped	During construction	Effective	The proposal will result in the removal of up to 20.93 hectares of native vegetation	Contractor
B03		Exclusion fencing should be established in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024) where existing fencing does not adequately distinguish the clearing boundary.	During construction	Effective	None expected	Contractor
B04		Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	Prior to construction	Effective	None expected	Contractor
B05		Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Effective	The proposal will result in the removal of up to 20.93 hectares of native vegetation	Contractor
B06		Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	Post construction	Effective	None expected	Contractor
B07		The unexpected species find procedure is to be followed under *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	None expected	Contractor
B08		Do not impact any National Park estate or Nature Reserves. Avoid impacts to Biodiversity Offset sites.	Detailed design During construction	Effective	None expected	Designer Contractor

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B09		A Biodiversity Offset Strategy should be prepared to determine the required offsets for the clearing of threatened ecological communities. A Tree and Hollow Replacement Plan will be prepared to determine the required offsets for low condition vegetation and trees.	During construction Post-construction	Effective	Offset loss of threatened ecological communities and trees	Transport for NSW
B10	Removal of threatened fauna habitat	Threatened fauna habitat removal will be minimised through detailed design. The retention of large hollow-bearing trees should be prioritised.	Detailed design	Effective	Identify the loss of threatened fauna habitat	Designer
B11		Further assessment of the location of hollow-bearing trees should be undertaken to inform the detailed design. Hollow-bearing trees to be retained or removed within the construction footprint should be clearly marked.	Detailed design	Effective	Potential loss of hollow-bearing trees	Designer Transport for NSW
B12		Exclusion fencing established in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024) should be used to identify hollow-bearing trees to be retained that may lie within the general construction area.	During construction	Effective	None expected	Contractor
B13		Disturbance of known Southern Myotis roosting habitat will be undertaken outside the breeding season (October to February). Further advice from a microbat specialist and a Microbat Management Plan are likely to be required if works are to be undertaken while microbats are present in any culverts.	During construction	Effective	Temporary disturbance to a known Southern Myotis roost	Contractor
B14		Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Effective	None expected	Contractor
B15		Habitat removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024). If removal of hollow-bearing trees is required, a staged removal should be used – felling hollow-bearing trees at least 24 hours after removal of other vegetation and non-habitat trees. A licensed wildlife handler or ecologist should be present during removal of any potential fauna habitat.	During construction	Effective	None expected	Contractor Ecologist
B16		Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Artificial hollows* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Proven	None expected	Contractor

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B17		The unexpected species find procedure is to be followed under *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	None expected	Contractor
B18		Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Proven	None expected	Contractor
B19	Removal of threatened flora	Threatened flora removal will be minimised through detailed design. Construction boundary should be kept as close as possible to edge of design where threatened species are known to occur. Ecologist should be consulted to determine clearing boundaries where threatened species are known to occur.	Detailed design	Effective	Threatened flora species and their habitat will be removed	Designer Contractor Ecologist
B20		Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Proven	None expected	Contractor
B21		The unexpected species find procedure is to be followed under *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	None expected	Contractor
B22	Aquatic impacts	Impacts to aquatic habitat will be minimised through detailed design.	Detailed design	Effective	None expected	Designer Contractor
B23		Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	During construction	Effective	None expected	Contractor
B24		Undertake culvert works in drier periods to minimise the need for dewatering and obstruction of fish passage in Rickabys Creek. The Construction Environmental Management Plan (CEMP) should include methods to managing waterway impacts during construction Notify NSW DPI Fisheries (the Minister), as required, of works within Key Fish Habitat	During construction	Effective	None expected	Contractor

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated?	Responsibility
B25	Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Detailed design	Effective	None likely	Designer Contractor
B26		Minimise excavations below groundwater table and duration of time that excavations below the water table are open.	During construction	Effective	None likely	Contractor
B27	Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective	None likely	Designer Contractor
B28	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Effective	None likely	Contractor
B29	Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna* handling of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Effective	None likely	Contractor
B30	Invasion and spread of weeds	Weed species will be managed in accordance *with Guide 6: Weed management* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Effective	None likely	Contractor
B31	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW 2024).	During construction	Effective	None likely	Contractor
B32	Noise, light, dust and vibration	Shading and artificial light impacts will be minimised through detailed design. Lighting required during construction with be designed to minimise light spill.	Detailed design During construction	Effective	Minor temporary disturbance to local fauna	Designer Contractor
B33		Construction will be undertaken in stages to minimise extent of noise and vibration.	During construction	Likely to be effective	Minor temporary disturbance to local fauna	Designer Contractor

7. Offsets and other measures

Proposal impacts require the provision of biodiversity offsets, conservation measures or tree and hollow replacement in accordance with:

- *No Net Loss Guidelines* and supporting resources (Transport 2022b)
- *Tree and Hollow Replacement Guidelines* and supporting resources (Transport 2023).

7.1 Thresholds

Table 7–1 is used to calculate the threshold at which works involving a vegetation community, fauna habitat or threatened flora or their habitats require offsetting as set out by the *No Net Loss Guidelines* (Transport 2022b).

Table 7–1: Offset thresholds (Transport No Net Loss Guidelines)

Impact	Threshold
Works involving clearing of a CEEC	Where there is any clearing of an CEEC in 'moderate to good' condition
Works involving clearing of an EEC	Where clearing of a EEC ≥ 2 ha in 'moderate to good' condition
Works involving clearing of VEC	Where clearing of VEC ≥ 5 ha in 'moderate to good' condition
Works involving clearing of any habitat for a known species credit fauna species or clearing of breeding habitat (as defined by the TBDC) for dual-credit fauna species (excluding exotic and planted vegetation that cannot be assigned to a plant community type)	Where clearing ≥ 1 ha in 'moderate to good' condition
Works involving removal of known threatened flora species and their habitat	Where loss of individuals is ≥10 or where clearing of habitat is ≥ 1 ha
Type 1 or Type 2 key fish habitats	Where there is a net loss of habitat
Any residual biodiversity impact that doesn't require offsets in accordance with the No Net Loss Guideline is to be assessed against the requirements of the Tree and Hollow Replacement Guideline.	**Any clearing of hollows and/or trees ≥5cm DBH**

The area of each vegetation zone in the impact area was calculated and the outcome of considering the thresholds are provided in Table 7–2.

Table 7–2: Assessment of vegetation impacts against thresholds

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha or m^2)[1]	Threshold triggered?
3320_Moderate	PCT 3320: Cumberland Shale Plains Woodland	Moderate	Critically Endangered (BC Act)	0.58	Yes (>0ha CEEC)
3320_Low		Low	Critically Endangered (BC Act)	2.24	No – tree and hollow replacement required
3448_Good	PCT 3448: Castlereagh Ironbark Forest	Good	Endangered (BC Act) and Critically Endangered (EPBC Act)	0.96 – 0.17 (BC Act) only	Yes (>0ha CEEC)

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha or m²)[1]	Threshold triggered?
				and 0.79 (both)	
3448_Moderate		Moderate	Endangered (BC Act) and Critically Endangered (EPBC Act)	3.02 – 0.91 (BC Act only) and 2.11 (both)	Yes (>0ha CEEC)
3448_Low		Low	Does not meet TEC condition criteria	2.82	No – tree and hollow replacement required
3628_Moderate	PCT 3628: Castlereagh Shrubby Swamp Woodland	Moderate	Endangered (BC Act)	0.29	No – tree and hollow replacement required
3628_Low		Low	Endangered (BC Act)	0.21	No – tree and hollow replacement required
3629_Good	PCT 3629: Castlereagh Scribbly Gum Woodland	Good	Vulnerable (BC Act) and Endangered (EPBC Act)	3.01	Yes (>2ha EEC)
3629_Moderate		Moderate	Vulnerable (BC Act) and Endangered (EPBC Act)	4.40 - 1.36 (BC Act only) and 2.99 (both)	Yes (>5ha VEC when combined with 3629_Good)
3629_Low		Low	Does not meet TEC condition criteria	3.30	No – tree and hollow replacement required
4025_Low	PCT 4025: Cumberland Red Gum Riverflat Forest	Low	Endangered (BC Act)	0.10	No – tree and hollow replacement required
Planted	N/A	Planted	Not a TEC	0.26	No – tree and hollow replacement required
Planted native	N/A	Planted native	Not a TEC	1.42	No – tree and hollow replacement required
Exotic	N/A	Exotic	Not a TEC	0.18	No

7.2 Preliminary offset and tree/hollow replacement calculations

7.2.1 Preliminary offset calculations

This section provides a preliminary calculation of offsets for each impact triggering a threshold identified in Section 7.1. Offsets for ecological communities listed under the BC Act and EPBC Act were preliminarily calculated as credits using the BAM-C (Table 7–3). A copy of the BAM-C credit report is provided in Appendix F.

Table 7–3: Preliminary ecosystem credit calculations for impacts to threatened ecological communities

Plant community type	EPBC Act	BC Act	VI score	BRW	HBT	Impact (ha)	Ecosystem credits
PCT 3320: Cumberland Shale Plains Woodland	Does not meet TEC condition criteria	Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered	25	2.50	Yes	0.58	9
PCT 3448: Castlereagh Ironbark Forest	Cooks River/ Castlereagh Ironbark Forest – Critically Endangered	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – Endangered	79.3 (Good) 48.4 (Moderate)	2.00	Yes	3.98	111
PCT 3629: Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion – Endangered	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion –Vulnerable	49.2 (Good) 42.1 (Moderate)	1.75	Yes	7.41	146
Total ecosystem credits							266

Offsets for threatened species listed under the BC Act and EPBC Act were calculated as credits using the BAM-C (Table 7–4).

Transport's Biodiversity Policy establishes impact thresholds which trigger the requirement to provide biodiversity offsets or conservation measures. For fauna species, habitat to be cleared that is also a TEC is considered sufficiently covered by the offsetting requirements for the relevant community. Within the study area, all habitat for threatened fauna that is in 'moderate' to 'good' condition is a TEC and therefore not subject to species specific offsets in accordance with the *No Net Loss Guidelines* (Transport 2022b).

Areas of threatened flora habitat consisting only of vegetation in 'moderate' and 'good' condition was included in the BAM-C and used for offset calculations.

Table 7–4: Preliminary credit calculations for impacts to species-credit species

Species name	EPBC Act	BC Act	Impact area to be offset (ha)[1]	Species credits
Dillwynia tenuifolia	-	V	10.7	262
Grevillea juniperina subsp. *juniperina* (Juniper-leaved Grevillea)	-	V	7.0	133
Marsdenia viridiflora subsp. *viridiflora*	-	EP	1.1	26
Micromyrtus minutiflora	V	E	7.6	284
Persoonia nutans (Nodding Geebung)	E	E	6.7	168
Pultenaea parviflora	V	E	5.4	144
Total species credits				1,017
NOTE 1: Impact area based on rounded totals from the BAM-C. Species habitat that is not vegetation eligible for offset, (e.g areas of low quality or planted vegetation) is not included.				

7.2.2 Preliminary tree and hollow replacement estimates

Areas of vegetation to be cleared that did not trigger an offset threshold require tree and hollow replacement. To provide an estimate of trees and hollows to be replaced, the average number of trees in each size class per hectare were calculated. The plots used in each vegetation zone and the number of trees or hollows in each class are provided in Table 7–5.

Even though no hollows were recorded in the plots, numerous tree hollows were observed throughout the study area and it is likely that a more detailed survey of the trees to be removed would identify some hollow-bearing trees that would require offsetting.

Table 7–5: Average counts of trees and hollows and estimates per hectare

Veg. zone	Impact (ha)	Plots	Average number of trees in stem size classes (cm) and hollows per ha[1]					Average count of tree and hollows in impact area[2]				
			5-19	20-49	50-99	>100	Hollows	5-19	20-49	50-99	>100	Hollows
3628_Moderate	0.29	TP03	625	150	0	0	0	181	42	0	0	0
3320_Low	2.24	TP05 TP10	10	70	45	5	0	22	157	101	11	0
3448_Low	2.82	TP01 TP08	0	80	20	0	0	0	226	56	0	0
3628_Low	0.21	TP06	80	220	0	0	0	17	46	0	0	0
3629_Low	3.30	TP02 TP04	20	30	15	5	0	66	99	50	17	0
4025_Low	0.10	TP07	80	80	0	0	0	8	8	0	0	0
Planted	0.26	TP09	0	30	30	0	0	0	8	8	0	0
Planted native	1.42	TP11	220	420	0	0	0	312	596	0	0	0

NOTE 1: Calculated by the average from the plot data (assuming standard 0.1 ha plot) multiplied by a factor of 10
NOTE 2: Calculated by the average/ha multiplied by the impact

Using the average counts of trees in Table 7–5, estimates of the preliminary tree and hollow replacement requirements for all tree removal that does not require offsetting was calculated (Table 7–6).

Table 7–6: Preliminary estimates of trees and hollow replacement requirements

Category	Estimated No. impacted		Replacement requirement per tree/hollow removed[1]		Estimates number to be replaced[2]		Estimated equivalent payment to Transport conservation Fund[2]
	Native trees	Amenity trees	Planting required	Contribution required	Native trees	Amenity trees	
Very large tree (DBH ≥100cm)	28	0	Plant minimum 16 trees	$2,500	448	0	$70,000
Large tree (DBH ≥50 to <100cm)	215	0	Plant minimum 8 trees	$1,000	1,720	0	$215,000
Medium tree (DBH ≥20 to <50 cm)	1,183	0	Plant minimum 4 trees	$500	4,732	0	$591,500
Small tree (DBH ≥ 5cm to <20 cm)	607	0	Plant minimum 2 trees	$125	1,214	0	$75,875

Category	Estimated No. impacted		Replacement requirement per tree/hollow removed[1]		Estimates number to be replaced[2]		Estimated equivalent payment to Transport conservation Fund[2]
	Native trees	Amenity trees	Planting required	Contribution required	Native trees	Amenity trees	
Hollow	0		Provide 3 artificial hollows for every occupied hollow removed*	$500	0		$0
Totals					8,114		$952,375

NOTE 1: As per the Transport Tree and Hollow Replacement Guidelines

NOTE 2: An equivalent payment to the Transport Conservation Fund can be used where replanting is not feasible or fully achievable within the project boundary or adjacent land.

7.3 Biodiversity offset strategy/tree and hollow replacement plan

Clearing of vegetation in 'moderate' and 'good' condition triggers the Transport biodiversity offsetting thresholds. Therefore, a Biodiversity Offset Strategy (BOS) should be prepared to:

- Confirm which offsetting thresholds have been exceeded based on the final clearing boundary
- Calculate the offset and/or conservation requirement in accordance with Transport's *No Net Loss Guidelines* (2022b)
- Establish what feasible and reasonable steps can be taken to meet this requirement including timing and delivery partners.

The appropriate guideline to preparing the BOS is Resource 2 under the No Net Loss Guidelines (EMF-BD-GD-0011). There are three types of impacts triggered by the proposal under the Transport Policy, with offset obligations to be documented within the BOS. These include:

- Terrestrial biodiversity offset, which can be met by either:
  - Making payment into the NSW Biodiversity Conservation Fund (BCF)
  - Purchasing and retiring biodiversity credits including purchasing from the Transport Biobank
  - Arranging for Biodiversity Conservation Actions to be undertaken
- Offsets for the loss of trees not covered by the terrestrial biodiversity triggers to be covered by a proposal specific Tree and Hollow Replacement Plan prepared in accordance with the Tree and Hollow Replacement Guideline.

Tree and hollow replacement can also be offset by payment into the TfNSW Conservation Fund where a tree and hollow replacement plan is not feasible. Local tree replacement is likely to be a reasonable option given the large extent of the infrastructure corridor proximal to the proposal that could be improved by supplemental tree planting.

8. Conclusion

The findings of the report are summarised below:

- Five PCTs were identified, all threatened communities in NSW and two that met the criteria for listing under the EPBC Act
- Five threatened flora species and one threatened flora population were identified in the study area
- Two threatened fauna species were opportunistically observed and several others are assumed present based on the availability of suitable habitat within the study area
- Up to 22.35 hectares of native vegetation would be cleared for construction and operation:
  - 2.82 hectares of 3320: Cumberland Shale Plains Woodland
  - 6.8 hectares of PCT 3448: Castlereagh Ironbark Forest
  - 0.5 hectares of PCT 3628: Castlereagh Shrubby Swamp Woodland
  - 10.71 hectares of PCT 3629: Castlereagh Scribbly Gum Woodland
  - 0.10 hectares of PCT 4025: Cumberland Red Gum Riverflat Forest
  - 1.42 hectares of 'Planted native' vegetation
- No significant impacts are expected to threatened entities under either the EPBC or BC Acts
- Transport biodiversity offset thresholds or tree and hollow replacement requirements have been triggered under the No Net Loss Guidelines and Tree and Hollow Replacement Guidelines and therefore a Biodiversity Offset Strategy and Tree and Hollow Replacement Plan (or payment into the Transport Conservation Fund) are required. The following offsets are required:
  - 266 credits for the loss of:
    - 0.58 hectares of PCT 3320: Cumberland Shale Plains Woodland
    - 3.98 hectares of PCT 3448: Castlereagh Ironbark Forest
    - 7.40 hectares of PCT 3629: Castlereagh Scribbly Gum Woodland
  - 1,017 credits for the loss of habitat for:
    - *Dillwynia tenuifolia*
    - *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea)
    - *Marsdenia viridiflora* subsp. *viridiflora*
    - *Micromyrtus minutiflora*
    - *Persoonia nutans* (Nodding Geebung)
    - *Pultenaea parviflora*
    - Koala (*Phascolarctos cinereus*)
    - Southern Myotis (*Myotis macropus*)
    - Powerful Owl (*Ninox strenua*)
    - Cumberland Plain Land Snail (*Meridolum corneovirens*)
  - Tree replacement requires planting 8,114 trees or a $952,375 contribution into the Transport Conservation Fund.

The report has been prepared to address the requirements of the September 2015 strategic assessment approval granted by the Australian Minister for the Environment in accordance with the EPBC Act. The approval applies to Transport road proposals assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. The report addresses and considers potential impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species, including application of the "avoid, minimise, mitigate and offset" hierarchy.

9. Glossary

Term	Definition
Accredited person or assessor	Means as person accredited under section 6.10 (of the BC Act) to prepare reports in accordance with the BAM.
Biodiversity Assessment Method	The Biodiversity Assessment Method is established under section 6.7 of the BC Act. The BAM is established for the purpose of assessing certain impacts on threatened species and threatened ecological communities (TECs), and their habitats, and the impact on biodiversity values.
Biodiversity Assessment Method Calculator	Biodiversity Assessment Method Calculator (BAM-C) – the online computer program that provides decision support to assessors and proponents by applying the BAM and referred to as the BAM-C. The BAM-C contains biodiversity data from the BioNet Vegetation Classification and the Threatened Biodiversity Data Collection that the assessor is required to use in a BAM assessment. The BAM-C applies the equations used in the BAM, including those to determine the number and class of biodiversity credits required to offset the impacts of a development, or created at a biodiversity stewardship site. It is published by the Department (DPIE 2020a).
Biodiversity credit report	The report produced by the BAM-C that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (DPIE 2020a).
Biodiversity offsets	The gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development (DPIE 2020a).
Biodiversity Offsets and Agreement Management System	The online system used to administer the Biodiversity Offsets Scheme. The BOAMS is used by accredited assessors (to carry out specific BAM-related tasks involving access to the BAM-C to perform assessments, submit data, generate credits and calculate a credit price), by landholders (to apply for a Biodiversity Stewardship Agreement and manage ongoing reporting obligations for their agreement) and by proponents of developments (to view their credit obligation or the payment required to the Biodiversity Conservation Fund).
Biodiversity risk weighting	A factor of the formulas used by the BAM to calculate credits. The biodiversity risk weighting (BRW) is a score given to each vegetation zone and species based on the 'sensitivity to loss' versus the 'sensitivity to gain'. The value is set for threatened species and listed in the TBDC. The BRW for vegetation is calculated for each vegetation zone by the BAM-C using a factor of the 'sensitivity to loss' of the PCT or TEC (located in the BioNet vegetation classification) and the 'sensitivity to gain' of the ecosystem credit species (in the TBDC) that are predicted to occur.
Biodiversity Stewardship site	Refers to land which is the subject to a Biodiversity Stewardship Agreement under the BC Act.
BioNet Atlas	The DPIE database of flora and fauna records (formerly known as the NSW Wildlife Atlas). The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails listed under the BC Act) and some fish (DPIE 2020a).
BioNet Vegetation classification	Refers to the vegetation community-level classification for use in vegetation mapping programs and regulatory biodiversity impact assessment frameworks in NSW. Refer *About BioNet Vegetation Classification* (DPE 2020a).
Construction footprint	The area to be directly impacted by the proposal during construction activities. See also definition for subject land.

Term	Definition
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (the BC Regulation) (DPIE 2020a).
Ecosystem credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for ecosystem credits. This is analogous with the definition of 'predicted species'.
Ecosystem credits	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity certification site and the gain in biodiversity values at a biodiversity stewardship site (DPIE 2020a).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (DPIE 2020a).
Indirect impact	Impacts that occur when the proposal affects native vegetation and threatened species habitat beyond the development footprint or within retained areas (e.g. transporting weeds or pathogens, dumping rubbish). This includes impacts from activities related to the construction or operational phase of the proposal and prescribed impacts (DPIE 2020a).
Landscape assessment area	The area which includes the subject land and a 1500 m buffer surrounding the outside edge of the boundary of the subject land or 500 m along each side of the centre line of a linear-shaped proposal
Local population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions: • *The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.* • *The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.* • *The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time or return year to year (OEH 2018).*
Matter of national environmental significance	A matter of national environmental significance (MNES) is any of the nine defined components protected by a provision of Part 3 of the EPBC Act (Commonwealth).
Mitigation	Action to reduce the severity of an impact.
Native vegetation	Has the same meaning as in section 1.6 of the BC Act and section 60B of the LLS Act. In summary, a) trees (including any sapling or shrub or any scrub)

Term	Definition
	b) understorey plants c) groundcover (being any type of herbaceous vegetation) d) plants occurring in a wetland. A plant is native to New South Wales if it was established in New South Wales before European settlement (BC Act). Native vegetation does not extend to marine vegetation (being mangroves, seagrasses or any other species of plant that at any time in its life cycle must inhabit water other than fresh water). Marine vegetation is covered by the provisions of the FM Act.
NSW (Mitchell) landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (DPIE 2020a).
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Patch size	An area of native vegetation that: • *occurs on the development site or biodiversity stewardship site* • *includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems).* Patch size may extend onto adjoining land that is not part of the development site or biodiversity stewardship site (DPIE 2020a).
PlantNET	An online database of the flora of New South Wales which contains currently accepted taxonomy for plants found in the State, both native and exotic.
Population	A group of organisms, all of the same species, occupying a particular area (DPIE 2020a).
Spatial datasets	Spatial databases required to prepare a BAR • *BioNet NSW (Mitchell) Landscapes – Version 3.1* • *NSW Interim Biogeographic Regions of Australia (IBRA region and sub-regions) – Version 7* • *NSW soil profiles* • *hydrogeological landscapes* • *acid sulfate soils risk* • *digital cadastral database* • *Vegetation Information Systems maps* • *Geological sites of NSW.*
Species credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits (DPIE 2020a). This is analogous with the definition of 'candidate species'.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection (DPE 2024).
Species polygon	An area of land identified in Chapter 5 (of the BAM) that contains habitat or is occupied by a threatened species (DPIE 2020a).
Study area	The area directly affected by the proposal (subject land or construction footprint) and any additional areas likely to be affected by the proposal, either directly or indirectly.
Subject land	Land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal. It excludes the landscape assessment area which surrounds the subject

Term	Definition
	land (i.e., the area of land in the 1500 m buffer zone around the subject land or 500m buffer zone for linear proposals). In the case of a biodiversity certification proposal, subject land includes the biodiversity certification assessment area (DPIE 2020a). See also definition for construction footprint.
Threatened Biodiversity Profiles Data Collection	A publicly assessable online database (registration required) which contains information for listed threatened species, populations and ecological communities (DPIE 2020a). Part of the BioNet database, published by the EHG and accessible from the Bionet website at www.bionet.nsw.gov.au.
Vegetation integrity (score)	The condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT. The vegetation integrity score is the quantitative measure of vegetation condition calculated by the BAM-C (DPIE 2020a).
Vegetation zone	A relatively homogeneous area of native vegetation on a development site, clearing site, land to be biodiversity certified or biodiversity stewardship site that is the same PCT and has the same broad condition state (DPIE 2020a).

10. Abbreviations

Term	Definition
AOBV	Area of Outstanding Biodiversity Value
Australian DCCEEW	Australian Department of Climate Change, Energy, the Environment and Water
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method calculator
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BRW	Biodiversity risk weighting
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DIWA	Directory of Important Wetlands in Australia
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EHG	NSW Environment and Heritage Group within the Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	*Environment Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
Fisheries NSW Policy and guidelines	Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of national environmental significance
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
PCT	Plant community type
PMST	Protected Matters Search Tool
RDP	Rapid Data Point
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Profile Data Collection
TECs	Threatened ecological communities (VECs, EECs and CEECs)
Transport	Transport for NSW

Term	Definition
VEC	Vulnerable Ecological Community

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Appendix A: Species recorded

Recorded flora

Family	Scientific name	Common name	Exotic	Status		Cover (%) in each plot*					
				BC Act	EPBC Act	1	2	3	4	5	6
Anthericaceae	*Caesia* spp.			-	-						0.05
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily		-	-		0.1	1	0.5		
Apocynaceae	*Araujia sericifolia*	Moth Vine	*	-	-	0.2				0.1	
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	*	-	-			0.1			
Asparagaceae	*Asparagus virgatus*	Asparagus Fern	*	-	-						0.1
Asteraceae	*Cirsium vulgare*	Spear Thistle	*	-	-						0.2
Asteraceae	*Euryops* spp.		*	-	-					0.1	
Asteraceae	*Hypochaeris radicata*	Catsear	*	-	-			0.01			
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood		-	-			0.1	2		
Asteraceae	*Senecio madagascariensis*	Fireweed	*	-	-						0.5
Asteraceae	*Vittadinia* spp.	Fuzzweed		-	-					0.01	
Campanulaceae	*Pratia purpurascens*	Whiteroot		-	-	0.05		1			
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		-	-		1		3		
Chenopodiaceae	*Einadia hastata*	Berry Saltbush		-	-					0.1	1
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush		-	-						0.01
Convolvulaceae	*Convolvulus erubescens*	Pink Bindweed		-	-					0.1	1
Convolvulaceae	*Dichondra repens*	Kidney Weed		-	-	0.1				0.1	

Family	Scientific name	Common name	Exotic	Status		Cover (%) in each plot*					
				BC Act	EPBC Act	1	2	3	4	5	6
Cyperaceae	*Cyathochaeta diandra*			-	-		1	5	0.5		
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	*	-	-					0.1	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		-	-	0.2	1	5	1	0.1	
Ericaceae	*Brachyloma daphnoides*	Daphne Heath		-	-			0.1			
Ericaceae	*Lissanthe strigosa* subsp. *strigosa*			-	-		0.1	0.2	0.2		
Ericaceae	*Styphelia laeta* subsp. *laeta*			-	-		0.1				
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea		-	-		5				
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea		-	-		2	5			
Fabaceae (Faboideae)	*Dillwynia retorta*			-	-	0.2					
Fabaceae (Faboideae)	*Dillwynia sieberi*			-	-					0.2	
Fabaceae (Faboideae)	*Dillwynia tenuifolia*			Vulnerable	-		0.5	1	0.2		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine		-	-					0.01	0.2
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla		-	-			0.2			
Fabaceae (Faboideae)	*Hovea linearis*			-	-		0.05				
Fabaceae (Faboideae)	*Indigofera australis*	Australian Indigo		-	-	0.1					
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood		-	-		0.5	0.2	0.5		
Fabaceae (Faboideae)	*Pultenaea parviflora*			Endangered	Vulnerable	0.1				0.25	
Fabaceae (Mimosoideae)	*Acacia elongata*	Swamp Wattle		-	-		0.2				
Fabaceae (Mimosoideae)	*Acacia falcata*			-	-		0.1				
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		-	-			0.1			

Family	Scientific name	Common name	Exotic	Status		Cover (%) in each plot*					
				BC Act	EPBC Act	1	2	3	4	5	6
Fabaceae (Mimosoideae)	*Acacia howittii*	Sticky Wattle		-	-					0.1	
Fabaceae (Mimosoideae)	*Acacia longifolia*	Coastal Wattle		-	-	0.5			0.2		
Fabaceae (Mimosoideae)	*Acacia parramattensis*	Parramatta Wattle		-	-		0.5		1		
Fabaceae (Mimosoideae)	*Acacia parvipinnula*	Silver-stemmed Wattle		-	-					1	
Goodeniaceae	*Brunonia australis*	Blue Pincushion		-	-						0.1
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia		-	-			0.5			
Lauraceae	*Cassytha glabella*			-	-	0.3		0.2			
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*			-	-	5		10			
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		-	-			0.1	0.1	0.5	
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush		-	-		0.5	1			
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*	-	-					0.5	1
Meliaceae	*Melia azedarach*	White Cedar		-	-						2
Myrtaceae	*Angophora bakeri*	Narrow-leaved Apple		-	-		5	10	2		
Myrtaceae	*Angophora floribunda*	Rough-barked Apple		-	-				8		
Myrtaceae	*Corymbia gummifera*	Red Bloodwood		-	-		0.5				
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark		-	-		3		5		
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark		-	-			3			
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark		-	-	15		20		20	
Myrtaceae	*Eucalyptus moluccana*	Grey Box		-	-						15
Myrtaceae	*Eucalyptus sclerophylla*	Hard-leaved Scribbly Gum		-	-		20		15		

Family	Scientific name	Common name	Exotic	Status		Cover (%) in each plot*					
				BC Act	EPBC Act	1	2	3	4	5	6
Myrtaceae	*Leptospermum parvifolium*			-	-			0.1			
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree		-	-		0.5	0.1			
Myrtaceae	*Melaleuca decora*			-	-	20				5	
Myrtaceae	*Melaleuca nodosa*			-	-					1	
Phormiaceae	*Dianella longifolia*	Blueberry Lily		-	-				0.1	0.1	0.1
Phormiaceae	*Dianella revoluta*	Blueberry Lily		-	-	0.1	0.5	1	1		
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge		-	-		0.01				
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn		-	-	0.5		0.5			
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*	-	-						0.5
Poaceae	*Anisopogon avenaceus*	Oat Speargrass		-	-			5			
Poaceae	*Aristida ramosa*	Purple Wiregrass		-	-			5	0.1		
Poaceae	*Aristida vagans*	Threeawn Speargrass		-	-	0.1	2	5	0.5	0.5	
Poaceae	*Bromus catharticus*	Praire Grass	*	-	-					0.1	
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	*	-	-					2	10
Poaceae	*Chloris gayana*	Rhodes Grass	*	-	-				0.2	1	10
Poaceae	*Cortaderia spp.*		*	-	-						
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass		-	-				0.2		
Poaceae	*Cynodon dactylon*	Common Couch		-	-					5	
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass		-	-			0.1	0.05		
Poaceae	*Entolasia stricta*	Wiry Panic		-	-	10	0.5	1	1	0.2v	

Family	Scientific name	Common name	Exotic	Status		Cover (%) in each plot*					
				BC Act	EPBC Act	1	2	3	4	5	6
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		-	-		0.1	0.1			
Poaceae	*Eragrostis curvula*	African Lovegrass	*	-	-	60	30	15	80	70	70
Poaceae	*Lachnagrostis* spp.			-	-						
Poaceae	*Microlaena stipoides*	Weeping Grass		-	-	1	1	1	0.1		
Poaceae	*Panicum simile*	Two-colour Panic		-	-	0.1	0.5				
Poaceae	*Paspalidium distans*			-	-					0.1	
Poaceae	*Setaria parviflora*		*	-	-					0.5	
Poaceae	*Sporobolus africanus*	Parramatta Grass	*	-	-	0.1					
Poaceae	*Themeda triandra*			-	-	0.3		10		2	
Poaceae	*Vulpia myuros*	Rat's Tail Fescue	*	-	-						0.2
Proteaceae	*Grevillea juniperina*			-	-			1		0.1	
Proteaceae	*Hakea sericea*	Needlebush		-	-		1				

*Note: *Cover determined in accordance with the BAM.*

Recorded fauna

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Amphibian	*Crinia signifera*	Common Eastern Froglet	-	-
Amphibian	*Limnodynastes peronii*	Striped Marsh Frog	-	-
Amphibian	*Litoria fallax*	Eastern Dwarf Tree Frog	-	-
Bird	*Acanthiza nana*	Yellow Thornbill	-	-

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Bird	*Acanthiza reguloides*	Buff-rumped Thornbill	-	-
Bird	*Acridotheres tristis**	Common Myna	-	-
Bird	*Anas platyrhynchos**	Mallard	-	-
Bird	*Anas superciliosa*	Pacific Black Duck	-	-
Bird	*Anthochaera carunculata*	Red Wattlebird	-	-
Bird	*Cacatua galerita*	Sulphur-crested Cockatoo	-	-
Bird	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	-	-
Bird	*Caligavis chrysops*	Yellow-faced Honeyeater	-	-
Bird	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	-	-
Bird	*Chenonetta jubata*	Australian Wood Duck	-	-
Bird	*Corcorax melanorhamphos*	White-winged Chough	-	-
Bird	*Corvus coronoides*	Australian Raven	-	-
Bird	*Dacelo novaeguineae*	Laughing Kookaburra	-	-
Bird	*Egretta novaehollandiae*	White-faced Heron	-	-
Bird	*Elanus axillaris*	Black-shouldered Kite	-	-
Bird	*Eolophus roseicapilla*	Galah	-	-
Bird	*Eudynamys orientalis*	Eastern Koel	-	-
Bird	*Gallinula tenebrosa*	Dusky Moorhen	-	-
Bird	*Gerygone olivacea*	White-throated Gerygone	-	-
Bird	*Grallina cyanoleuca*	Magpie-lark	-	-

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Bird	*Gymnorhina tibicen*	Australian Magpie	-	-
Bird	*Hirundo neoxena*	Welcome Swallow	-	-
Bird	*Lophoictinia isura*	Square-tailed Kite	Vulnerable	-
Bird	*Malurus cyaneus*	Superb Fairy-wren	-	-
Bird	*Manorina melanocephala*	Noisy Miner	-	-
Bird	*Meliphaga lewinii*	Lewin's Honeyeater	-	-
Bird	*Microeca fascinans*	Jacky Winter	-	-
Bird	*Neochmia temporalis*	Red-browed Finch	-	-
Bird	*Pardalotus punctatus*	Spotted Pardalote	-	-
Bird	*Philemon corniculatus*	Noisy Friarbird	-	-
Bird	*Pycnonotus jocosus**	Red-whiskered Bulbul	-	-
Bird	*Rhipidura albiscapa*	Grey Fantail	-	-
Bird	*Rhipidura leucophrys*	Willie Wagtail	-	-
Bird	*Spilopelia chinensis*	Spotted Turtle-Dove	-	-
Bird	*Stizoptera bichenovii*	Double-barred Finch	-	-
Bird	*Strepera graculina*	Pied Currawong	-	-
Bird	*Threskiornis moluccus*	Australian White Ibis	-	-
Bird	*Trichoglossus haematodus*	Rainbow Lorikeet	-	-
Bird	*Vanellus miles*	Masked Lapwing	-	-
Bird	*Zanda funereus*	Yellow-tailed Black-Cockatoo	-	-

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Mammal	*Macropus giganteus*	Eastern Grey Kangaroo	-	-
Mammal	*Myotis macropus*	Southern Myotis	Vulnerable	-
Mammal	*Oryctolagus cuniculus**	Rabbit	-	-
Reptile	*Eulamprus quoyii*	Eastern Water-skink	-	-
Reptile	*Lampropholis delicata*	Dark-flecked Garden Sunskink	-	-
Reptile	*Pseudechis porphyriacus*	Red-bellied Black Snake	-	-
Reptile	*Varanus varius*	Lace Monitor	-	-
Invertebrate	*Cornu aspersum**	Garden Snail	-	-

* introduced species

Appendix B: Habitat suitability assessment

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey or has been recorded within the past five years (known from a reputable source).
High	A species is considered highly likely to occur in the study area if: • *There are previous credible records on BioNet within the study area from the last 10 years and suitable habitat is present.* **OR** • *The species is highly mobile, is dependent on identified suitable habitat within the study area (i.e., for breeding or important life cycle periods such as winter flowering resources) and has been recorded recently (within five years) on BioNet in the locality. This also includes species known or likely to visit the study area during regular seasonal movements or migration.*
Moderate	A species is considered moderately likely to occur in the study area if: • *Any suitable habitat (e.g., foraging) is present in the study area, the species is highly mobile and has been recorded in the locality in the last 10 years on BioNet. The species may be unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area.* **OR** • *The species is not highly mobile, is dependent on identified suitable habitat features (e.g., hollows, rocky outcrops) within the study area and has been recorded in the locality in the last 10 years on BioNet.* **OR** • *For flora species that are associated with PCTs in the study area (see TBDC) or have been recorded in the locality in the last 10 years on BioNet – the associated PCT/habitat present in the study area is not degraded and the species was not targeted by surveys in accordance with the BAM and relevant survey guidelines. In addition, for flora species known to occur in disturbed areas (e.g., orchids), records from any time within the locality may warrant inclusion in this category.*
Low	A species is considered to have a low likelihood of occurring in the study area if: • *For highly mobile species, the species may be an occasional visitor, but habitat similar to the study area is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on habitats in the study area and the species has not been recorded in the locality in the last 10 years on BioNet.* **OR** • *The species is not highly mobile, is dependent on identified suitable habitat features (e.g., hollows, rocky outcrops) within the study area and has not been recorded in the locality in the last 10 years on BioNet.* **OR** • *For flora species that are associated with PCTs in the study area (see TBDC) and the species was not identified following targeted surveys in accordance with the BAM and relevant survey guidelines. Flora species that have been recorded in the locality on BioNet at any time, associated suitable habitat (see the TBDC) is not present in the study area, though similar habitats of the same vegetation formation is present in the study area.*
Unlikely	Suitable habitat for the species is absent from the study area.

Habitat suitability assessment table

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Plants							
Acacia bynoeana Bynoe's Wattle	Endangered	Vulnerable	Species	N/A	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	219 (BioNet)	Low - Not recorded in targeted surveys
Acacia gordonii	Endangered	Endangered	Species	Rocky areas (Sandstone outcrops, ridgetops, spurs or within 200 m)	Restricted to the north-west of Sydney, it has a disjunct distribution occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east. This species is known from only a few locations and current information suggests the total number of individuals may be less than 2000, with only one population supporting greater than 400 individuals. A relatively large proportion of individuals (approximately 850) occur on conservation reserve within Blue Mountains National Park. This species is found within the Hawkesbury, Blue Mountains and Baulkham Hills LGAs.	-	Unlikely - no suitable habitat
Acacia pubescens Downy Wattle	Vulnerable	Vulnerable	Species	N/A	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 Cumberland Plain Woodland. Longevity is unknown, but clonal species have been known to survive for many decades.	– (BioNet)	Low - Not recorded in targeted surveys
Acrophyllum australe	Vulnerable	Vulnerable	Species	Cliffs (Drip zones of rock overhangs/cliff faces and within 50m)	Restricted, from Faulconbridge to Lawson, South of Bilpin and near Kings Tableland, in the Blue Mountains area, all within the Central Coast Botanical Subdivision, currently known from 27 sites. Grows in sheltered gullies beneath waterfalls and drip zones of rock overhangs and cliff faces, usually with a south-east to south-west aspect. Typically found in areas where there is a more or less constant supply of water. Usually grows in shale interbeds at the base of small	-	Unlikely - no suitable habitat

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					cliffs, in crevices on the sandstone rock face or on talus slopes. The rock overhangs are of Hawkesbury or Narrabeen Sandstone.		
Allocasuarina glareicola	Endangered	Endangered	Species	N/A	Grows in Castlereagh woodland on lateritic soil. Found in open woodland with Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora. Common associated understorey species include Melaleuca nodosa, Hakea dactyloides, Hakea sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, Acacia brownei, Themeda australis and Xanthorrhoea minor.	131 (BioNet)	Low - Not recorded in targeted surveys
Asterolasia elegans	Endangered	Endangered	Species	N/A	Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (Syncarpia glomulifera subsp. glomulifera), Smooth-barked Apple (Angophora costata), Sydney Peppermint (Eucalyptus piperita), Forest Oak (Allocasuarina torulosa) and Christmas Bush (Ceratopetalum gummiferum). Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. Also likely to occur in the western part of Gosford LGA. Known from only seven populations, only one of which is wholly within a conservation reserve.	-	Unlikely - no suitable habitat
Callistemon linearifolius Netted Bottle Brush	Vulnerable	Not listed	Species	N/A	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Grows in dry sclerophyll forest on the coast and adjacent ranges.	-	Low - no local records
Cryptostylis hunteriana Leafless Tongue-orchid	Vulnerable	Vulnerable	Species	N/A	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. Larger populations typically occur in woodland dominated by Scribbly Gum (E. sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta). Recorded from as far north as Gibraltar Range NP	-	Low - no local populations known

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					south into Victoria around the coast as far as Orbost. Known historically from NSW south coast and has been recently at sites between Batemans Bay and Nowra. Also recorded at Munmorah State Conservation Area, Nelson Bay, Wyee, Washpool NP, Nowendoc State Forest, Ku-Ring-Gai Chase NP and Ben Boyd NP.		
Cynanchum elegans White-flowered Wax Plant	Endangered	Endangered	Species	N/A	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub. Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley.	-	Low - no associated PCTs and no nearby sightings
Deyeuxia appressa	Endangered	Endangered	Species	N/A	Given that D. appressa hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology.	-	Low - probably extinct
Dillwynia tenuifolia	Vulnerable	Not listed	Species	N/A	In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. Eucalyptus fibrosa is usually the dominant canopy species. Eucalyptus globoidea, E. longifolia, E. parramattensis, E. sclerophylla and E. sideroxylon may also be present or codominant, with Melaleuca decora frequently forming a secondary canopy layer. Associated species may include Allocasuarina littoralis, Angophora bakeri, Aristida spp. Banksia spinulosa, Cryptandra spp. Daviesia ulicifolia, Entolasia stricta, Hakea sericea, Lissanthe strigosa, Melaleuca nodosa, Ozothamnus diosmifolius and Themeda australis. D. tenuifolia is often found in association with other threatened species such as Dodonaea falcata, Grevillea juniperina,	3170 (BioNet)	Recorded

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					Micromyrtus minutiflora, Pultenaea parviflora and Styphelia laeta.		
Epacris purpurascens var. purpurascens	Vulnerable	Not listed	Species	N/A	Found in a range of habitat types, most of which have a strong shale soil influence. Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild. Killed by fire and re-establishes from soil-stored seed.	-	Low - not recorded in locality.
Epacris sparsa	Vulnerable	Vulnerable	Species	N/A	Grows in Riparian Sandstone Scrub, where it is found on the base of cliffs or rock faces, on rock ledges or among rocks in the riparian flood zone. Grows in small pockets of damp clay soil, chiefly on south-west facing slopes. In rocky sites the scrub vegetation is dominated by Tristaniopsis laurina, Leptospermum trinervium, Allocasuarina littoralis, Acacia longifolia, Grevillea sericea and Lomandra fluviatilis. In wetter, more sheltered sites typical species include Callicoma serratifolia, Backhousia myrtifolia, Austromyrtus tenuifolia, Leucopogon lanceolatus, Lomandra montana, Todea barbara, Sticherus flabellatus and Dracophyllum secundum. Restricted to the lower Grose River, within the Hawkesbury and Blue Mountains LGAs.	-	Unlikely - no suitable habitat
Eucalyptus aggregate Black Gum	Vulnerable	Vulnerable	Species	N/A	Grows in the lowest parts of the landscape. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (Eucalyptus pauciflora), Manna or Ribbon Gum (E. viminalis), Candlebark (E. rubida), Black Sallee (E. stellulata) and Swamp Gum (E. ovata). Usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (Poa labillardierei) or Kangaroo Grass (Themeda australis), but with few shrubs. Also occurs as isolated paddock trees in modified native or exotic pastures. Found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. In NSW it occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion. Has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands, for example in the Blayney, Crookwell, Goulburn, Braidwood and Bungendore districts.	-	Low - no suitable habitat in the study area

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Eucalyptus benthamii Camden White Gum	Vulnerable	Vulnerable	Species	N/A	Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Recruitment of juveniles appears to be most successful on bare silt deposits in rivers and streams. The recorded elevation range for the species is from 30m ASL at Bents Basin to 750m ASL in the Kedumba population. Most of the individuals are around 60 to 300m ASL. Occurs in open forest. Associated species at the Bents Basin site include Eucalyptus elata, E. bauerina, E. amplifolia, E. deanei and Angophora subvelutina. Understorey species include Bursaria spinosa, Pteridium esculentum and a wide variety of agricultural weeds. The Kedumba Valley site lists E. crebra, E. deanei, E. punctata, Leptospermum flavescens, Acacia filicifolia and Pteridium esculentum among its associated species.	-	Low - not known to occur in the locality
Eucalyptus glaucina Slaty Red Gum	Vulnerable	Vulnerable	Species	N/A	Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.	-	Low - no local records
Eucalyptus sp. Cattai (Gregson s.n., 28 Aug 1954)	Critically Endangered	Critically Endangered	Species	N/A	Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small clustered groups. The sites at which it occurs are generally flat and on ridge tops. Associated soils are laterised clays overlying sandstone. Occurs in The Hills LGA, with known populations occurring within the area bounded by Kellyville - Maraylya - Glenorie.	-	Low - no associated PCTs and no nearby sightings
Genoplesium baueri Yellow Gnat-orchid	Endangered	Endangered	Species	N/A	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	-	Low - no associated PCTs and no nearby sightings

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Grevillea juniperina subsp. *juniperina* Juniper-leaved Grevillea	Vulnerable	Not listed	Species	N/A	Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest. Associated canopy species within Cumberland Plain Woodland and Shale/Gravel Transition Forest include Eucalyptus tereticornis, E. moluccana, E. crebra, E. fibrosa and E. eugenioides. Understorey species include Bursaria spinosa, Dillwynia sieberi, Ozothamnus diosmifolius, Daviesia ulicifolia, Acacia falcata, Acacia parramattensis, Themeda australis, Aristida ramosa, Cymbopogon refractus, Eragrostis brownii, Cheilanthes sieberi, Dianella revoluta and Goodenia hederacea. In Castlereagh Woodland on more sandy soils the dominant canopy species are Eucalyptus fibrosa, E. sclerophylla, Angophora bakeri and Melaleuca decora. Understorey species include Melaleuca nodosa, Hakea sericea, Cryptandra spinescens, Acacia elongata, Gonocarpus teucrioides, Lomandra longifolia and the threatened species Dillwynia tenuifolia, Pultenaea parviflora, Micromyrtus minutiflora and Allocasuarina glareicola.	2431 (BioNet)	Recorded
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	Vulnerable	Vulnerable	Species	N/A	Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. In Sydney it has been recorded from Shale Sandstone Transition Forest and in the Hunter in Kurri Sand Swamp Woodland. However, other communities occupied include Corymbia maculata - Angophora costata open forest in the Dooralong area, in Sydney Sandstone Ridgetop Woodland at Wedderburn and in Cooks River / Castlereagh Ironbark Forest at Kemps Creek. In the Shale Sandstone Transition Forest associated species include Eucalyptus fibrosa, E. punctata, Corymbia gummifera, Pultenaea scabra var. biloba, Kunzea ambigua, Allocasuarina littoralis and Themeda australis. At sites with a stronger	6 (BioNet)	Low - Not recorded in targeted surveys

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					sandstone influence Eucalytpus sclerophylla, E. piperita, E. oblonga, Grevillea diffusa, G. mucronulata, Acacia suaveolens and Persoonia pinifolia are found. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Hunter occurrences are usually 30-70m ASL, while the southern Sydney occurrences are typically at 100-300m ASL. Often occurs in open, slightly disturbed sites such as along tracks.		
Hakea dohertyi Kowmung Hakea	E	CE	Species	N/A	Grows in dry sclerophyll forest, usually dominated by grey gum or silvertop ash, with a sparse groundcover and midstorey. Confined to a small area in the Kowmung Valley in Kanangra Boyd National Park.	-	Low – not known to occur in the study area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort	Vulnerable	Vulnerable	Species	Waterbodies (Edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100m)	Appears to require protected and shaded damp situations in riparian habitats. Occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW.	-	Low - no associated PCTs and no nearby sightings
Haloragodendron lucasii Hal	Endangered	Endangered	Species	Other (Seepage zone or within 100 m)	Associated with dry sclerophyll forest. Reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Associated with high soil moisture and relatively high soil-phosphorus levels. The known locations of this species are confined to a very narrow distribution on the north shore of Sydney.	-	Unlikely – no suitable habitat
Hibbertia fumana	Critically Endangered	Not listed	Species	N/A	Species is known to occur in a long intergrade between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest. Also recently found associated with aeolian sand deposits. Species has been found to occur in a variety of structural habitats including open areas, disturbed sites and also within thick ground cover dominated by a heavy cover of sedges, rushes and grasses. Has the potential to occur in similar intergrade alluvial habitats rich in sands and laterite in	20 (BioNet)	Low – unlikely to occur in disturbed roadside habitat

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					other parts of western Sydney. Habitat of an 1802 Caley collection 'near South Head' are uncertain, with potential communities in that area including coastal shale sandstone communities and open forest or forest communities on lateritised shale lenses. No similar alluvial sand deposits are identified in that area. Soil texture and character described as fine sandy clay loam, grey brown in colour. Community composition is noted to include Eucalyptus sideroxylon, E. fibrosa, E. parramattensis and E. sclerophylla, with Melaleuca decora. Shrub layer with Hakea sericea, Callistemon linearis, Bursaria spinosa, Grevillea parviflora, Acacia brownii, Acacia bynoeana, Pultenaea retusa, P. villosa, a diverse groundcover of Goodenia, Dianella, Poa, Stylidium, Themeda and Gonocarpus.		
Hibbertia puberula	Endangered	Not listed	Species	N/A	Flowering time is October to December, sometimes into January. Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. One of the recently (2012) described subspecies also favours upland swamps.	4 (BioNet)	Low – Not recorded in targeted surveys
Hibbertia sp. Bankstown	Critically Endangered	Critically Endangered	Species	N/A	The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content. The remnant at the site and soil type are consistent with an inferred pre-settlement cover of Castlereagh Ironbark Forest although some remnant vegetation at and near the site (along the channel in particular) suggests Castlereagh Scribbly Gum Woodland is equally valid. Hibbertia sp. Bankstown has been observed to flower from October to December, with seed setting from October to January. Most Hibbertia species are primarily pollinated by bees, but many have specialised mechanisms requiring particular bee species, beetles or syrphid flies.	118 (BioNet)	Low – Not recorded in targeted surveys
Isotoma fluviatilis subsp. fluviatilis	Not listed	Extinct	Species	N/A	Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early	-	Low – no PCT associations and no recent records

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					successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as Cyndon dactylon.Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks.		
Lasiopetalum joyceae	Vulnerable	Vulnerable	Species	N/A	Grows in heath on sandstone. Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. It is currently known from 34 sites between Berrilee and Duffys Forest. Seventeen of these are reserved.	-	Low – not known to occur in the locality
Leucopogon exolasius Woronora Beard-heath	Vulnerable	Vulnerable	Species	N/A	Occurs in woodland on sandstone. Found along the upper Georges River area and in Heathcote National Park.	-	Low - no local records
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs	Endangered population	Not listed	Species	N/A	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.	462 (BioNet)	Recorded
Melaleuca deanei Deane's Melaleuca	Vulnerable	Vulnerable	Species	N/A	Occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. 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.	-	Low - no PCT associations and no recent records
Micromyrtus minutiflora	Endangered	Vulnerable	Species	N/A	Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	675 (BioNet)	Recorded
Olearia cordata	Vulnerable	Vulnerable	Species	N/A	Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges. A NSW endemic with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Most known populations occur within conservation reserves	-	Low - no associated PCTs and no nearby sightings

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					(Wollemi National Park, Yengo National Park and Wisemans Ferry Historic Site).		
Persicaria elatior Knotweed, Tall Knotweed	Vulnerable	Vulnerable	Species	Semi-permanent/ephemeral wet areas (or within 50 m) Swamps (or within 50 m) Waterbodies (including Wetlands, or within 50 m)	Normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests).	-	Low - no associated PCTs and no nearby sightings
Persoonia acerosa Needle Geebung	Vulnerable	Vulnerable	Species	N/A	Occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils. Has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba/ Wentworth Falls/ Springwood area.	-	Low - no associated PCTs and no nearby sightings
Persoonia bargoensis Bargo Geebung	Endangered	Vulnerable	Species	N/A	Occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils of the Wianamatta Shale and Hawkesbury Sandstone. Favours interface soil landscapes such as between the Blacktown Soil Landscape and the complex Mittagong Formation soils (Lucas Heights Soil Landscape) with the underlying sandstone (Hawkesbury Soil Landscape and Gymea Soil Landscape). Some of the vegetation the species occurs within would be recognised as the Shale/Sandstone Transition Forest, a listed community.	-	Low - no local records
Persoonia hirsute Hairy Geebung	Endangered	Endangered	Species	N/A	The Hairy Geebung is found in clayey and sandy soils in dry sclerophyll open forest, woodland and heath, primarily on the Mittagong Formation and on the upper Hawkesbury Sandstone. It is usually present as isolated individuals or very small populations. Plants are generally killed by all but the lowest intensity fire or partial burning. Fire may promote germination of soil-stored seed, although it may also kill some of the seedbank if it is of high severity. Extreme wet-dry weather cycles may also promote germination of soil-stored seed.	-	Low - no local records

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Persoonia nutans Nodding Geebung	Endangered	Endangered	Species	N/A	Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Southern populations also occupy tertiary alluvium, but extend onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest. Abundance at a site appears to be related to disturbance history. Sites with higher abundance also appear to be more disturbed.	1232 (BioNet)	Recorded
Pimelea curviflora var. curviflora	Vulnerable	Vulnerable	Species	N/A	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowalnd Grassy Woodland habitat at Albion Park on the Illawaraa coastal plain. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots.	16 (BioNet)	Low - no local records and habitat is not typical of landform description
Pimelea spicata Spiked Rice-flower	Endangered	Endangered	Species	N/A	In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the Cumberland Plain sites it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark. The co-occurring species in the Cumberland Plain sites are grey box (Eucalyptus moluccana), forest red gum (E. tereticornis) and narrow-leaved ironbark (E. crebra). Blackthorn (Bursaria spinosa) is often present at sites (and may be important in protection from grazing) and kangaroo grass (Themeda australis) is usually present in the groundcover (also indicative of a less intense grazing history). In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey. Coastal headlands and hilltops are the favoured sites. the IIllawarra populations usually occur in one of two communities - a woodland or a coastal grassland. Woodland sites are dominated by forest red gum (E. tereticornis) and	443 (BioNet)	Low - Not recorded in targeted surveys

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	BC Act	EPBC Act					
					stringybark (E. eugenioides), with a groundcover dominated by kangaroo grass (Themeda australis) and matrush (Lomandra longifolia). The grassland sites are dominated by kangaroo grass (Themeda australis) and matrush (Lomandra longifolia), with blady grass (Imperata cylindrica). A shrubby layer, where present, is dominated by coastal wattle (Acacia sophorae) and coast rosemary (Westringia fruticosa) with coast banksia (Banksia integrifolia). Mature plants spread over short distances through underground rhizomes, and this can assist them to recover from disturbances like fire and irregular grazing.		
Pomaderris brunnea Brown Pomaderris	Endangered	Vulnerable	Species	N/A	Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. The species has been found in association with Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa and Kunzea ambigua.	-	Low - no local records
Pterostylis gibbose Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	Endangered	Endangered	Species	N/A	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum Eucalyptus tereticornis, Woollybutt E. longifolia and White Feather Honey-myrtle Melaleuca decora. Near Nowra, the species grows in an open forest of Spotted Gum Corymbia maculata, Forest Red Gum and Grey Ironbark E. paniculata. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark E. crebra, Forest Red Gum and Black Cypress Pine Callitris endlicheri.Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803).	-	Low - no associated PCTs and no nearby sightings
Pterostylis saxicola Sydney Plains Greenhood	Endangered	Endangered	Species	N/A	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.	-	Unlikely - no suitable habitat

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Pultenaea parviflora	Endangered	Vulnerable	Species	N/A	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. Associated species may include Allocasuarina littoralis, Angophora bakeri, Aristida spp. Banksia spinulosa, Cryptandra spp., Daviesia ulicifolia, Dodonaea falcata, Entolasia stricta, Hakea sericea, Lissanthe strigosa, Melaleuca nodosa, Ozothamnus diosmifolius, Styphelia laeta and Themeda australis. Often found in association with other threatened species such as Dillwynia tenuifolia, Grevillea juniperina, Micromyrtus minutiflora and Persoonia nutans.	860 (BioNet)	Recorded
Pultenaea pedunculata Matted Bush-pea	Endangered	Not listed	Species	N/A	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. Largely confined to loamy soils in dry gullies in populations in the Windellama area. The ability of stems to creep and root from the nodes has made this species a very good coloniser of bare ground in many parts of its range. In the Cumberland Plain the species favours sites in clay or sandy-clay soils (Blacktown Soil Landscape) on Wianamatta Shale-derived soils, usually close to patches of Tertiary Alluvium (Liverpool area) or at or near the Shale-Sandstone interface (Appin). All sites have a lateritic influence with ironstone gravel (nodules) present. On the Cumberland Plain the species is recorded from Cumberland Plain Woodlands, the shale-soil form of Shale Sandstone Transition Forests and Cooks River/Castlereagh Ironbark Forest. Associated species in the Sydney area include include Eucalyptus moluccana, E. fibrosa, E. crebra, E. longifolia and Melaleuca decora. Understorey species include Bursaria spinosa, Ozothamnus diosmifolius, Acacia parramattensis, A. falcata, Indigofera australis, Dillwynia sieberi, Olearia viscidula, Kunzea ambigua, Opercularia	-	Low - no local records

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					diphylla, Astroloma humifusum, Glycine tabacina, Hardenbergia violacea, Wahlenbergia gracilis, Aristida vagans, Gahnia aspera, Lomandra filiformis, Cheilanthes sieberi and Themeda australis.		
Rhizanthella slateri Eastern Australian Underground Orchid	Vulnerable	Endangered	Species	N/A	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	-	Low - no local records and unlikely to occur in disturbed roadside
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood	Critically Endangered	Critically Endangered	Species	N/A	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm.	-	Low - no associated PCTs and no nearby sightings
Syzygium paniculatum Magenta Lilly Pilly	Endangered	Vulnerable	Species	N/A	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.	-	Low - no local records
Thelymitra kangaloonica Kangaloon Sun Orchid	Critically Endangered	Critically Endangered	Species	Swamps (Or within 200 m of swamp)	It is found in swamps in sedgelands over grey silty grey loam soils. Only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level.	-	Low - no associated PCTs and no nearby sightings
Thesium australe Austral Toadflax, Toadflax	Vulnerable	Vulnerable	Species	N/A	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis). Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region.	-	Low - no associated PCTs and no nearby sightings

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Zieria involucrata	Endangered	Vulnerable	Species	N/A	Occurs primarily on Hawkesbury sandstone. Also occurs on Narrabeen Group sandstone and on Quaternary alluvium. Found primarily in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest, although some populations extend upslope into drier vegetation. Also known from at least two atypical ridgetop locations. The canopy typically includes Syncarpia glomulifera subsp. glomulifera (Turpentine), Angophora costata (Smooth-barked Apple), Eucalyptus agglomerata (Blue-leaved Stringybark) and Allocasuarina torulosa (Forest Oak). Has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains LGAs. Recent records for the species come from 22 populations in the catchments of the Macdonald, Colo and Hawkesbury Rivers between Melon Creek and Mogo Creek in the north to Little Cattai Creek (Hillside) and Wheeny Creek (Colo) in the south and from a single population in the upper Blue Mountains north of Katoomba.	-	Low - no associated PCTs and no nearby sightings
Birds							
Anthochaera phrygia Regent Honeyeater	Endangered	Critically Endangered	Species/Ecosystem	Habitat species: Other (As per Important Habitat Map) Habitat ecosystem: N/A	Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	20 (BioNet)	Moderate - rare sightings and some potential foraging habitat in the study area
Aphelocephala leucopsis Southern Whiteface	Not listed	Vulnerable	N/A	N/A	Occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Ranges live in a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are	-	Low - not known to occur in the locality

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					usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains.		
Apus pacificus Fork-tailed Swift	Not listed	Migratory	N/A	N/A	In NSW, the Fork-tailed Swift is recorded in all regions. They are almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher. They mostly occur over inland plains but sometimes above foothills or in coastal areas.	-	Low - may fly above, but unlikely to interact with any aspect of the study area
Artamus cyanopterus cyanopterus Dusky Woodswallow	Vulnerable	Not listed	Ecosystem	N/A	Widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris.	22 (BioNet)	Moderate - suitable habitat present in the study area
Botaurus poiciloptilus Australasian Bittern	Endangered	Endangered	Ecosystem	Waterbodies (Brackish or freshwater wetlands)	Widespread but uncommon over south-eastern Australia. In NSW may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleocharis spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.	-	Low - no suitable habitat in the study area
Calidris ferruginea Curlew Sandpiper	Endangered	Critically Endangered, Migratory	Species/Ecosystem	Habitat species: Other (As per important habitat map) Habitat ecosystem: N/A	Distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Breeds in Siberia and migrates to Australia for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April. Generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts.	1 (BioNet)	Low - no suitable habitat in the study area
Calidris melanotos Pectoral Sandpiper	Not listed	Migratory	N/A	N/A	In NSW, the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. Prefers shallow fresh to saline	-	Low - no suitable habitat

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					wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.		in the study area
Callocephalon fimbriatum Gang-gang Cockatoo	Endangered	Endangered	Species/Ecosystem	Habitat species: Hollow bearing trees (Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger) Habitat ecosystem: N/A	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 7 cm in diameter or larger in eucalypts and 3 metres or more above the ground. Distributed from southern Victoria through south- and central-eastern NSW. In NSW, it is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes.	-	Low - no suitable habitat in the study aera
Calyptorhynchus lathami (lathami) Glossy Black-Cockatoo	Vulnerable	Vulnerable	Species/Ecosystem	Habitat species: Hollow bearing trees (Living or dead tree with hollows greater than 15cm diameter and greater than 8m above ground.) Habitat ecosystem: Other (Presence of Allocasuarina and casuarina species)	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (Allocasuarina littoralis) and Forest Sheoak (A. torulosa) are important foods.	8 (BioNet)	Low - no suitable habitat in the study area
Chthonicola sagittata Speckled Warbler	Vulnerable	Not listed	Ecosystem	N/A	Has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	18 (BioNet)	Low - unlikely to occur in disturbed areas

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Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	Vulnerable	Not listed	Ecosystem	N/A	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	2 (BioNet)	Low - unlikely to occur in the Sydney Basin
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo	Not listed	Migratory	N/A	N/A	Inhabits forest and woodland in dense foliage. A rare summer non-breeding migrant species.	-	Low - no suitable habitat in the study area
Daphoenositta chrysoptera Varied Sittella	Vulnerable	Not listed	Ecosystem	N/A	Sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	47 (BioNet)	Moderate - suitable habitat present in the study area
Ephippiorhynchus asiaticus Black-necked Stork	Endangered	Not listed	Ecosystem	Swamps (Shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands within 300m of these swamps.) Waterbodies (Shallow lakes, lake margins and estuaries within 300m of these waterbodies)	Comprises two subspecies, E. a. asiaticus in India and south-east Asia, and E. a. australis in Australia and New Guinea. In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW. In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	1 (BioNet)	Low - no suitable habitat in the study aera

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Erythrotriorchis radiatus Red Goshawk	Critically Endangered	Vulnerable	Species	N/A	Inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers.	-	Low - not known to occur in the Sydney Basin
Falco hypoleucos Grey Falcon	Vulnerable	Vulnerable	Ecosystem	N/A	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range.	-	Low - not known to occur in the Sydney Basin
Falco subniger Black Falcon	Vulnerable	Not listed	Species	N/A	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres. Occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	2 (BioNet)	Low - no suitable habitat in the study area
Gallinago hardwickii Latham's Snipe	Not listed	Migratory	N/A	N/A	Non-breeding visitor to south-eastern Australia. Has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation.	-	Low - no suitable habitat in the study area

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Glossopsitta pusilla Little Lorikeet	Vulnerable	Not listed	Ecosystem	N/A	Distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	25 (BioNet)	Moderate - suitable habitat present in the study area
Grantiella picta Painted Honeyeater	Vulnerable	Vulnerable	Ecosystem	If mistletoes are present at a density of greater than five mistletoes per hectare	Is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests.	1 (BioNet)	Low - no suitable habitat in the study area
Haliaeetus leucogaster White-bellied Sea-Eagle	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Other (Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines) Habitat ecosystem: Waterbodies (Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines)	Distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.	4 (BioNet)	Low - known to use Hawkesbury River for hunting and may fly over the study area but unlikely to use any resources within it. Large water bodies >1km from the study area.
Hieraaetus morphnoides Little Eagle	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Nest trees - live (occasionally dead) large	Found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range	13 (BioNet)	Low - home range may

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				old trees within vegetation. Habitat ecosystem: N/A	escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.		include study area, but more likely to use better quality habitat nearby. No suitable nest trees observed in study area
Hirundapus caudacutus White-throated Needletail	Vulnerable	Vulnerable, Migratory	Ecosystem	N/A	Migratory and usually seen in eastern Australia from October to April. Breeds in forests in south-eastern Siberia, Mongolia, the Korean Peninsula and northern Japan. Most often seen in eastern Australia before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. More common in coastal areas, less so inland.	5 (BioNet)	Low - may fly above, but unlikely to interact with any aspect of the study area
Ixobrychus flavicollis Black Bittern	Vulnerable	Not listed	Ecosystem	Waterbodies (Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation)	Has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	1 (BioNet)	Low - no suitable habitat in the study aera
Lathamus discolor Swift Parrot	Vulnerable	Critically Endangered	Species/Ecosystem	Habitat species: Other (As per Important Habitat Map) Habitat ecosystem: N/A	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.	27 (BioNet)	Moderate - some records and suitable foraging habitat in the non-breeding season
Lophoictinia isura Square-tailed Kite	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Other (Nest trees) Habitat ecosystem: N/A	Ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east,	14 (BioNet)	Recorded - home range likely to include study area and better quality habitat nearby.

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	BC Act	EPBC Act					
					including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.		No suitable nest trees observed in study area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern)	Endangered	Endangered	Ecosystem	N/A	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form (subspecies cucullata) is found from Brisbane to Adelaide and throughout much of inland NSW.	-	Low - no suitable habitat in the study area
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subspecies)	Vulnerable	Not listed	Ecosystem	N/A	Has two subspecies, with only the nominate (gularis) occurring in NSW. The eastern subspecies extends south from central Queensland, through NSW, Victoria into south eastern South Australia. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (Eucalyptus sideroxylon), White Box (E. albens), Inland Grey Box (E. microcarpa), Yellow Box (E. melliodora), Blakely's Red Gum (E. blakelyi) and Forest Red Gum (E. tereticornis). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	4 (BioNet)	Low - rarely recorded east of the Great Dividing Range
Monarcha melanopsis Black-faced Monarch	Not listed	Migratory	N/A	N/A	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical rainforest, subtropical rainforest, mesophyll thicket/shrubland, warm temperate rainforest, dry rainforest and cool temperate rainforest.	-	Low - no suitable habitat in the study area

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Motacilla flava Yellow Wagtail	Not listed	Migratory	N/A	N/A	Distributed throughout mainland Australia within global range. Occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra.	-	Low - no suitable habitat in the study area
Myiagra cyanoleuca Satin Flycatcher	Not listed	Migratory	N/A	N/A	Widespread in eastern Australia. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	-	Low - no suitable habitat in the study area, unlikely to occur during migration
Neophema chrysostoma Blue-winged Parrot	Vulnerable	Vulnerable	TBD - listed in August 2023	TBD - listed in August 2023	Occurs in the south-east of Australia. Inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones. Breed in Tasmania and far southern mainland.	-	Low - no suitable foraging habitat and doesn't breed in Sydney Region
Neophema pulchella Turquoise Parrot	Vulnerable	Not listed	Ecosystem	N/A	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	1 (BioNet)	Low - unlikely to occur in disturbed roadside habitat
Ninox connivens Barking Owl	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Hollow bearing trees (Living or dead tree with hollows greater than 20cm diameter and greater than 4m above ground.) Habitat ecosystem: N/A	Found throughout continental Australia except for the central arid regions. Although still common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. Roost in shaded portions	3 (BioNet)	Low - may use nearby vegetation for hunting

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.		
Ninox strenua Powerful Owl	Vulnerable	Not listed	Species/Ecosystem	Hollow bearing trees (A living or dead tree with a hollow >20cm diameter that occurs >4 metres above the ground)	Endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine Syncarpia glomulifera, Black She-oak Allocasuarina littoralis, Blackwood Acacia melanoxylon, Rough-barked Apple Angophora floribunda, Cherry Ballart Exocarpus cupressiformis and a number of eucalypt species.	8 (BioNet)	Moderate - may use the study area as part of its foraging habitat. Some suitable breeding hollows present in the study area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew	Not listed	Critically Endangered, Migratory	Species/Ecosystem	Habitat species: Other (As per important habitat map) Habitat ecosystem: N/A	Within Australia, has a primarily coastal distribution. In NSW the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast. Breeds in Russia and China. Generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. Roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves.	-	Low - no suitable habitat in the study area
Pandion haliaetus Osprey	Vulnerable	Migratory	N/A	N/A	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Found right around the Australian coast line, except for Victoria and Tasmania. The species is	-	Low - unlikely to occur in the Sydney Basin

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
					uncommon to rare or absent from closely settled parts of south-eastern Australia.		away from the coast
Petroica boodang Scarlet Robin	Vulnerable	Not listed	Ecosystem	N/A	Found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Habitat usually contains abundant logs and fallen timber.	14 (BioNet)	Low - some suitable foraging habitat in non-breeding season occurs nearby but unlikely to occur in study area due to disturbance and absence of logs that are used for foraging
Petroica phoenicea Flame Robin	Vulnerable	Not listed	Ecosystem	N/A	Endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense.	22 (BioNet)	Low - some suitable foraging habitat in non-breeding season occurs nearby but unlikely to occur in study area due to disturbance and absence of logs that are used for foraging
Pycnoptilus floccosus Pilotbird	Not listed	Vulnerable	N/A	N/A	Pilotbirds are strictly terrestrial, living on the ground in dense forests with heavy undergrowth. Largely sedentary, they are typically seen hopping briskly over the forest floor and foraging on damp ground or among leaf-litter. Pilotbirds are endemic to south-east Australia. Upland Pilotbirds occur above 600 m in the Brindabella Ranges in the ACT, and in the Snowy Mountains in NSW and north-east Victoria. Lowland Pilotbirds occur in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia, to Dandenong near Melbourne.	-	Unlikely - no suitable habitat

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Rhipidura rufifrons Rufous Fantail	Not listed	Migratory	N/A	N/A	Occurs in coastal and near coastal districts of northern and eastern Australia. Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.	-	Low - no suitable habitat in the study area
Rostratula australis Australian Painted Snipe	Endangered	Endangered	Ecosystem	N/A	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. Restricted to Australia. Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.	-	Low - no suitable wetland habitat
Stagonopleura guttata Diamond Firetail	Vulnerable	Not listed	Ecosystem	N/A	Endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River.	1 (BioNet)	Low - not known to occur in the Sydney Basin
Symposiachrus/Monarcha trivirgatus Spectacled Monarch	Not listed	Migratory	N/A	N/A	Occurs along the east coast of Australia. Occupy dense vegetation, mainly in rainforest but also in moist or wet sclerophyll forest and occasionally in other densely vegetated habitats such as mangroves, drier forest, woodlands, parks and gardens.	-	Low - no suitable habitat in the study area

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
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Tyto tenebricosa Sooty Owl	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Caves (Caves or clifflines/ledges) Hollow bearing trees (Living or dead trees with hollows greater than 20cm diameter.) Habitat ecosystem: N/A	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	1 (BioNet)	Low - no suitable habitat in the study area
Mammals							
Chalinolobus dwyeri Large-eared Pied Bat	Vulnerable	Vulnerable	Species	Habitat constraint: Cliffs (Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.)	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.	-	Low - no nearby rocky areas providing suitable roosting habitat
Dasyurus maculatus Spotted-tailed Quoll	Vulnerable	Endangered	Ecosystem	N/A	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites.	2 (BioNet)	Low - rare records on the floodplain. Study area unlikely to support any individuals. Few suitable den sites.
Falsistrellus tasmaniensis Eastern False Pipistrelle	Vulnerable	Not listed	Ecosystem	N/A	Found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	9 (BioNet)	Moderate - some potential foraging habitat in the study area

Scientific name Common name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
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Micronomus norfolkensis Eastern Coastal Free-tailed Bat	Vulnerable	Not listed	Ecosystem	N/A	Found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	30 (BioNet)	High - suitable foraging habitat in the study area
Miniopterus australis Little Bent-winged Bat	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Caves (Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.) Habitat ecosystem: N/A	Occur along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Occupy moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	2 (BioNet)	High - suitable foraging habitat in the study area
Miniopterus orianae oceanensis Large Bent-winged Bat	Vulnerable	Not listed	Species/Ecosystem	Habitat species: Caves (Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500) Habitat ecosystem: N/A	Occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops.	29 (BioNet)	High - suitable foraging habitat in the study area
Myotis macropus Southern Myotis	Vulnerable	Not listed	Species	Waterbodies (Waterbodies with permanent pools/stretches 3m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies, on or within 200m of the site.)	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. Forage over streams and pools.	23 (BioNet)	Recorded - some suitable foraging habitat within and nearby the study area. One roost identified and other potential roost habitat present

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Notamacropus parma Parma Wallaby	Vulnerable	Vulnerable	Species	N/A	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. Once occurred in north-eastern NSW from the Queensland boarder to the Bega area in the southeast. Their range is now confined to the coast and ranges of central and northern NSW from the Gosford district to south of the Bruxner Highway between Tenterfield and Casino.	-	Low - not known to occur in the locality
Petauroides volans Greater Glider (southern and central)	Endangered	Endangered	Species	N/A	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occurs in eastern Australia, in eucalypt forests and woodlands, where it has a broad distribution from around Proserpine in Queensland, south through NSW and the Australian Capital Territory into Victoria.	-	Unlikely - no suitable habitat
Petaurus australis Yellow-bellied Glider	Vulnerable	Vulnerable	Ecosystem	N/A	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	2 (BioNet)	Low - no suitable habitat
Petaurus norfolcensis Squirrel Glider	Vulnerable	Not listed	Species	N/A	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria.	5 (BioNet)	Low - no suitable habitat present
Petrogale penicillata Brush-tailed Rock-wallaby	Endangered	Vulnerable	Species	Other (Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines)	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Range extends from south-east Queensland to the Grampians in western Victoria, roughly	-	Unlikely - no suitable habitat

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					following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit.		
Phascolarctos cinereus Koala	Endangered	Endangered	Species	Other (Presence of koala use trees - refer to Survey Comments field in TBDC)	Has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	7 (BioNet)	Moderate - few records in the region, unlikely to persist close to a major road but may move through the study area on occasion
Pseudomys novaehollandiae New Holland Mouse, Pookila	Not listed	Vulnerable	Ecosystem	N/A	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. Has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland.	-	Low - no suitable habitat in the study area
Pteropus poliocephalus Grey-headed Flying-fox	Vulnerable	Vulnerable	Species/Ecosystem	Habitat species: Other (Breeding camps) Habitat ecosystem: N/A	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	85 (BioNet)	High - suitable foraging habitat in the study area. Nearby camps at Yarramundi, Emu Plains and Windsor.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	Vulnerable	Not listed	Ecosystem	N/A	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. There are scattered records of this species across the New England Tablelands and North West Slopes. Forages in most habitats across its very wide range, with and without trees; appears to	2 (BioNet)	Moderate - may use parts of the study area for foraging and roosting

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	BC Act	EPBC Act					
					defend an aerial territory. Roosts singly or in groups of up to six, in tree hollows and buildings.		
Scoteanax rueppellii Greater Broad-nosed Bat	Vulnerable	Not listed	Ecosystem	N/A	The 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. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	21 (BioNet)	Moderate - may use parts of the study area for foraging and roosting
Amphibians							
Heleioporus australiacus Giant Burrowing Frog	Vulnerable	Vulnerable	Species	N/A	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. Distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria.	-	Low - no suitable habitat present
Litoria aurea Green and Golden Bell Frog	Endangered	Vulnerable	Species	Semi-permanent/ephemeral wet areas (within 1km of wet areas). Swamps (within 1km of swamps). Waterbodies (within 1km of waterbody)	Formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland. Records from west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population).	3 (BioNet)	Low - poor quality habitat and few recent records in the study area

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Mixophyes balbus Stuttering Frog	Endangered	Vulnerable	Species	N/A	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only Mixophyes species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species.	-	Low - no suitable habitat present
Reptiles							
Delma impar Striped Legless Lizard, Striped Snake-lizard	Vulnerable	Vulnerable	Species	N/A	Occurs in the Southern Tablelands, the South West Slopes, the Upper Hunter and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma, Muswellbrook and Tumut areas. Also occurs in the ACT, Victoria and south-eastern South Australia. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa* spp. and poa tussocks *Poa* spp., and occasionally wallaby grasses *Austrodanthonia* spp. Sometimes present in modified grasslands with a significant content of exotic grasses. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.	-	Unlikely - no suitable habitat
Hoplocephalus bungaroides Broad-headed Snake	Endangered	Vulnerable	Species/Ecosystem	Habitat species: Rocky areas (Including escarpments, outcrops and pogodas within the Sydney Sandstone geologies) Habitat ecosystem: N/A	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer. Largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the	-	Unlikely - no suitable habitat

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	BC Act	EPBC Act					
					coast and ranges in an area within approximately 250 km of Sydney.		
Invertebrates							
Meridolum corneovirens Cumberland Plain Land Snail	Endangered	Not listed	Species	N/A	Lives in small areas 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. Known from over 100 different locations, but not all are currently occupied, and they are usually isolated from each other as a result of land use patterns. Primarily inhabits Cumberland Plain Woodland. This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	214 (BioNet)	High - suitable habitat with varying condition in the study area. Suitable sheltering habitat under logs and roadside rubbish
Pommerhelix duralensis Dural Land Snail	Endangered	Endangered	Species	N/A	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. *P. duralensis* in the strict sense is found in an area of north-western Sydney between Rouse Hill - Cattai and Wiseman's Ferry, west from Berowra Creek. North of the Hawkesbury and Wiseman's Ferry there is an entity with morphologically similar shells but which have not had the DNA sequenced. The Blue Mountains records have been assigned to Pommerhelix 'Elizabeth', a genetically distinct species which has been sampled at Elizabeth Lookout in Glenbrook, and which extends along the eastern escarpment of the Blue Mountains. In the northern side of Sydney, between Parramatta and Port Jackson and east of Berowra Creek is identified as *Meridolum middenense*. The species is definitely found within the LGAs of The Hills Shire, Hawkesbury Shire and Hornsby Shire. Records from the Blue Mountains City, Penrith City and Parramatta City may represent this species.	2 (BioNet)	Low - study area outside the known range of the species

Appendix C: Plot-based field data sheets

Site sheet #	1 of	**Date**	12/09/2023	**Survey name**	HNV			**Plot identifier**	Plot1
Recorders	GG RC			**IBRA region**				**Veg zone ID**	3448_Moderate
[1]**Datum**	GDA2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	[1]**X coordinate**	'292486	[1]**Y coordinate**	6273049
Location description	descriptive notes to locate site without grid reference								
[1] **Plot dimensions**	10x100m For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m					[1] **Orientation of midline from 0 m point**	Magnetic ° 36	**Photo #**	104611

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count **2**
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	**Yes - count on excel** If [8] large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. **Yes** If [8] large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. **Yes** If [8] large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick **Yes**
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick **Yes**
						[4]Tree regeneration <5 cm	Tick **Yes**
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space **5** Total 5 m
						[6] Hollow bearing trees	Tick **None**

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
Subplot score (% in each)	100	100	90	100	100	a	b	c	d	e	a	b	c	d	e	a	b	10	d	e
Average of the 5 subplots	98																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code	Brief site description or other notes
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (id. native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date _ _ / _ _ / _ _			

GF code	**Species name** Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	Eragrostis curvula		60.0	1,000	
	Melaleuca decora		20.0	55	
	Eucalyptus fibrosa		15.0	16	
	Entolasia stricta		10.0	400	
	Lomandra filiformis subsp. filiformis		5.0	2,000	
	Microlaena stipoides		1.0	50	
	Bursaria spinosa		0.5	10	
	Acacia longifolia		0.5	1	
	Cassytha glabella		0.3	3	
	Themeda triandra		0.3	10	
	Lepidosperma laterale		0.2	10	
	Dillwynia retorta		0.2	6	
	Araujia sericiflora		0.2	2	
	Dianella revoluta		0.1	15	
	Aristida vagans		0.1	10	
	Dichondra repens		0.1	5	
	Solanum sisymbriifolium		0.1	2	
	Sporobolus africanus		0.1	10	
	Indigofera australis		0.1	1	
	Pultenaea parviflora		0.1	4	
	Panicum simile		0.1	10	
	Pratia purpurascens		0.1	3	
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33				
	34				
	35				

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Site sheet #	1 of	**Date**	12 /09 /2023	**Survey name**	HNV			**Plot identifier**	Plot 2
Recorders	GG RC			**IBRA region**				**Veg zone ID**	
[1]**Datum**	GDA2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**		[1]**X coordinate**	291679	[1]**Y coordinate**	6272116
Location description	descriptive notes to locate site without grid reference								
[1] **Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m					[1] **Orientation of midline from 0 m point**	Magnetic ° 225	**Photo #**	124131

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 5
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If large tree benchmark size ≥50 cm, count yes
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If large tree benchmark size ≥ 30 cm, count yes
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If large tree benchmark size ≥ 20 cm, count yes
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick yes
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick yes
						[4]Tree regeneration <5 cm	Tick yes
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space 2m / Total 2m m
						[6] Hollow bearing trees	Tick 2

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
Subplot score (% in each)	100	95	95	100	100	a	5 b	c	d	e	a	b	5 c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date __ / __ / __			

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Eragrostis curvula		30.00	500	
2		Eucalyptus sclerophylla		20.00	4	
3		Angophora bakeri		5.00	9	
4		Bossiaea obcordata		5.00	50	
5		Eucalyptus crebra		3.00	3	
6		Aristida vagans		2.00	100	
7		Daviesia ulicifolia		2.00	30	
8		Microlaena stipoides		1.00	100	
9		Lepidosperma laterale		1.00	200	
10		Allocasuarina littoralis		1.00	2	
11		Hakea sericea		1.00	15	
12		Cyathochaeta diandra		1.00	100	
13		Entolasia stricta		0.50	40	
14		Dianella revoluta		0.50	50	
15		Panicum simile		0.50	50	
16		Leptospermum trinervium		0.50	5	
17		Acacia parramattensis		0.50	10	
18		Dillwynia tenuifolia		0.50	20	
19		Corymbia gummifera		0.50	2	
20		Jacksonia scoparia		0.50	5	
21		Lomandra multiflora		0.50	10	
22		Acacia elongata		0.20	5	
23		Dodonaea falcata		0.20	5	
24		Xanthorrhoea spp.		0.20	5	
25		Persoonia nutans		0.20	1	
26		Pimelea linifolia		0.10	3	
27		Laxmannia gracilis		0.10	10	
28		Styphelia laeta subsp. laeta		0.10	2	
29		Opercularia spp.		0.10	5	
30		Eragrostis brownii		0.10	20	
31		Acacia falcata		0.10	3	
32		Lissanthe strigosa subsp. strigosa		0.10	1	
33		Hovea linearis		0.05	2	
34		Petrophile pulchella		0.01	1	
35		Phyllanthus hirtellus		0.01	2	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Site sheet #	1 of	**Date**	12/ 09/ 2023	**Survey name**	HNV			**Plot identifier**	Plot 3
Recorders	GG RC			**IBRA region**				**Veg zone ID**	
[1]**Datum**	GDA 2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	[1]**X coordinate**	289840	[1]**Y coordinate**	6273331
Location description	descriptive notes to locate site without grid reference								
[1] **Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m 20x50			[1] **Orientation of midline from 0 m point**	Magnetic ° 353			**Photo #**	141357

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 3
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥50 cm, count Yes- counts in excel
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 30 cm, count Yes
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 20 cm, count Yes
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick Yes
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick Yes
						[4]Tree regeneration <5 cm	Tick Yes
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space / Total 17 m
						[6] Hollow bearing trees	Tick 1

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
	98	100	100	100	100											2				
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date _ _ / _ _ / _ _		Plot 3	GG

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	² Foliage cover	Abund -ance	Voucher
1		Eucalyptus fibrosa		20.0	11	
2		Eragrostis curvula		15.0	200	
3		Lomandra filiformis subsp. filiformis		10.0	500	
4		Angophora bakeri		10.0	12	
5		Themeda triandra		10.0	400	
6		Aristida vagans		5.0	200	
7		Daviesia ulicifolia		5.0	40	
8		Lepidosperma laterale		5.0	300	
9		Cyathochaeta diandra		5.0	50	
10		Aristida ramosa		5.0	100	
11		Anisopogon avenaceus		5.0	15	
12		Eucalyptus eugenioides		3.0	3	
13		Pratia purpurascens		1.0	20	
14		Microlaena stipoides		1.0	100	
15		Entolasia stricta		1.0	50	
16		Dianella revoluta		1.0	50	
17		Dillwynia tenuifolia		1.0	20	
18		Lomandra multiflora		1.0	20	
19		Laxmannia gracilis		1.0	50	
20		Grevillea juniperina		1.0	15	
21		Bursaria spinosa		0.5	5	
22		Pomax umbellata		0.5	50	
23		Goodenia hederacea		0.5	20	
24		Cassytha glabella		0.2	5	
25		Jacksonia scoparia		0.2	3	
26		Lissanthe strigosa subsp. strigosa		0.2	20	
27		Hardenbergia violacea		0.2	5	
28		Xanthorrhoea minor		0.2	5	
29		Leptospermum trinervium		0.1	2	
30		Eragrostis brownii		0.1	5	
31		Ozothamnus diosmifolius		0.1	5	
32		Acacia floribunda		0.1	2	
33		Cheilanthes spp.		0.1	10	
34		Asparagus aethiopicus		0.1	5	
35		Leptospermum parvifolium		0.1	3	
		Lomandra longifolia		0.1	2	
		Echinopogon caespitosus		0.1	3	
		Brachyloma daphnoides		0.1	2	
		Hypochoeris radicata		0.0	2	

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	26/ 09/ 2023	**Survey name**	HNV			**Plot identifier**	Plot 4
Recorders	RC GG			**IBRA region**				**Veg zone ID**	
[1]**Datum**	GDA2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	[1]**X coordinate**	292120	[1]**Y coordinate**	6272642
Location description	descriptive notes to locate site without grid reference								
[1] **Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 10x100 20 m x 50 m					[1] **Orientation of midline from 0 m point**	Magnetic ° 226	**Photo #**	085752

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 4
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥50 cm, count Yes - count in excel
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 30 cm, count Yes
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 20 cm, count Yes
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick Yes
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick Yes
						[4]Tree regeneration <5 cm	Tick Yes
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space / Total 13 m
						[6] Hollow bearing trees	Tick 3

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
Subplot score (% in each)	100	100	100	100	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	100																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date _ _ / _ _ / _ _			

		GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	1		Eragrostis curvula		80.0	4,000	
	2		Dianella revoluta		1.0	100	
	3		Entolasia stricta		1.0	50	
	4		Lepidosperma laterale		1.0	40	
	5		Laxmannia gracilis		0.5	40	
			Ozothamnus diosmifolius		2.0	40	
	6		Aristida vagans		0.5	20	
	7		Cheilanthes spp.		0.1	20	
	8		Chloris gayana		0.2	20	
	9		Aristida ramosa		0.1	10	
	10		Microlaena stipoides		0.1	10	
	11		Dianella longifolia		0.1	10	
	12		Angophora floribunda		8.0	10	
	13		Eucalyptus crebra		5.0	5	
	14		Cyathochaeta diandra		0.5	5	
	15		Dillwynia tenuifolia		0.2	5	
	16		Lissanthe strigosa subsp. strigosa		0.2	5	
	17		Cymbopogon refractus		0.2	5	
	18		Allocasuarina littoralis		3.0	4	
	19		Jacksonia scoparia		0.5	4	
	20		Eucalyptus sclerophylla		15.0	3	
	21		Acacia longifolia		0.2	3	
	22		Persoonia linearis		1.0	3	
	23		Angophora bakeri		2.0	2	
	24		Lomandra longifolia		0.1	2	
	25		Echinopogon caespitosus		0.1	2	
	26		Verbena bonariensis		0.1	2	
	27		Acacia parramattensis		1.0	1	
	28		Persoonia nutans		0.1	1	
	29						
	30						
	31						
	32						
	33						
	34						
	35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Site sheet #	1 of	Date	26/09/2023	Survey name	HNV	Plot identifier	Plot 5
Recorders	GG RC	IBRA region		Veg zone ID			
[1]Datum	GDA2020	Coordinate system	□ Projected □ Geographic	MGA zone	56	[1]X coordinate	289041	[1]Y coordinate	6268165
Location description	descriptive notes to locate site without grid reference						
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m 20 x 50	[1] Orientation of midline from 0 m point	Magnetic ° 15	Photo #	20230926_143835		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 3
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If large tree benchmark size ≥50 cm, count Yes - count in excel
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If large tree benchmark size ≥ 30 cm, count Yes
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If large tree benchmark size ≥ 20 cm, count Yes
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick Yes
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick Yes
						[4]Tree regeneration <5 cm	Tick Yes
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space / Total 4 m
						[6] Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Subplot score (% in each)	100	50	100	80	100		50											20		
Average of the 5 subplots	86																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Adjacent reserve has many Grevillea juniperina, Micromyrtus minutiflora

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date __ / __ / __			

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Eragrostis curvula		70.0	1,000	
2		Eucalyptus fibrosa		20.0	17	
3		Melaleuca decora		5.0	11	
4		Cynodon dactylon		5.0	500	
5		Themeda triandra		2.0	30	
6		Cenchrus clandestinus		2.0	20	
7		Chloris gayana		1.0	40	
8		Verbena bonariensis		1.0	20	
9		Acacia parvipinnula		1.0	5	
10		Melaleuca nodosa		1.0	2	
11		Aristida vagans		0.5	20	
12		Lomandra longifolia		0.5	8	
13		Sida rhombifolia		0.5	50	
14		Setaria parviflora		0.5	50	
15		Pultenaea parviflora		0.3	10	
16		Entolasia stricta		0.2	10	
17		Dillwynia sieberi		0.2	3	
18		Lepidosperma laterale		0.1	5	
19		Araujia sericiflora		0.1	1	
20		Dichondra repens		0.1	1	
21		Solanum sisymbriifolium		0.1	2	
22		Dianella longifolia		0.1	2	
23		Grevillea juniperina		0.1	1	
24		Opercularia spp.		0.1	5	
25		Convolvulus erubescens		0.1	5	
26		Euryops spp.		0.1	1	
27		Einadia hastata		0.1	1	
28		Acacia howittii		0.1	1	
29		Cyperus eragrostis		0.1	10	
30		Bromus catharticus		0.1	10	
31		Paspalidium distans		0.1	10	
32		Glycine clandestina		0.0	1	
33		Vittadinia spp.		0.0	1	
34						
35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	26 / 09/2023	**Survey n ame**	HNV		**Plot identifier**	Plot 6	
Recorders	GG RC			**IBRA region**			**Veg zone ID**	3320_Moderate	
[1]**Datum**	GDA2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	[1]**X coordinate**	289292	[1]**Y coordinate**	6267024
Location description	descriptive notes to locate site without grid reference								
[1] **Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m 20x50m			[1] **Orientation of midline from 0 m point**	Magnetic ° 330		**Photo #**	20230926_160616	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count Yes
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count Yes
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count Yes
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count Yes
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick Yes
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick Yes
						[4]Tree regeneration <5 cm	Tick Yes
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space / Total 0 m
						[6] Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					**Bare ground cover (%)**					**Cryptogam cover (%)**					**Rock cover (%)**				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	100																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code	Brief site description or other notes
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (id. native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date _ _ / _ _ / _ _			

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Eragrostis curvula		70.0		
2		Eucalyptus moluccana		15.0	12	
3		Cenchrus clandestinus		10.0	5	
4		Chloris gayana		10.0	50	
5		Verbena bonariensis		5.0	100	
6		Melia azedarach		2.0	4	
7		Sida rhombifolia		1.0	100	
8		Convolvulus erubescens		1.0	5	
9		Einadia hastata		1.0	5	
10		Senecio madagascariensis		0.5	20	
11		Plantago lanceolata		0.5	50	
12		Glycine clandestina		0.2	5	
13		Cirsium vulgare		0.2	10	
14		Vulpia myuros		0.2	20	
15		Dianella longifolia		0.1	1	
16		Asparagus virgatus		0.1	1	
17		Brunonia australis		0.1	3	
18		Caesia spp.		0.1	1	
19		Cheilanthes spp.		0.0	2	
20		Lycium ferocissimum		0.0	3	
21		Einadia nutans		0.0	1	
22						
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35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Appendix D: Tests of Significance (BC Act)

Cumberland Plain Woodland in the Sydney Basin Bioregion

Cumberland Plain Woodland (CPW) occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. The local occurrence of an ecological community is defined in the Threatened Species Test of Significance Guidelines (OEH 2018) as:

"the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated."

The extent of CPW in construction footprint which may be impacted by the proposal totals 2.74 hectares. These stands of CPW however are contiguous with extents occurring outside the study area. These extents form part of the local occurrence. Because of the long linear nature of the proposal there are two main separate local occurrences of the community (Figure 3–2). Most of the community to impacted is near Jordan Springs where the local community includes over 200 hectares to the north and west of the residential areas. Other small low-quality remnants of CPW on Londonderry Road near The Driftway are part of a northern occurrence of over 30 hectares.

The area of CPW within the proposal's construction footprint includes 0.58 hectares of moderate condition vegetation and 2.24 hectares of vegetation in low condition.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to a threatened ecological community
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
Up to 2.94 hectares of CPW may be removed or disturbed by the proposal. The areas to be remove constitute no more than 2% of a local occurrence (far less near Jodan Springs). The condition of vegetation to be removed is low to moderate and of lower quality than most of the local occurrences which extend further away from the disturbed road edges. This level of impact is unlikely to place a local occurrence at risk of extinction.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Disturbances to composition are limited to the 2.94 hectares within the construction footprint. There are no processes from the proposal likely to modify composition of the local populations more broadly place them at risk or extinction.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
Habitat to be modified includes the permanent operational area, and areas disturbed during construction to a total of 2.94 hectares. No other areas are likely to be removed or modified.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal involves widening an existing road and does not introduce additional breaks that could fragment or isolate areas of habitat significantly.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality

The habitat to be removed contains a low diversity of canopy tree species, a limited number of shrubs and ground cover in the moderate condition zones and negligible shrubs or ground covers in the low-quality zones. The habitat to removed is within disturbed areas of the community. The habitat to be removed is not indicated in the NSW Cumberland Plain Recovery plan's priority conservation lands, which indicates areas critical to the survival of the community. Low quality habitat can provide a buffer for more important habitat, but on the balance of factors the habitat to be removed is of low importance to the long-term survival of CPW in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The Proposal constitutes, and/or is part of, and/or is likely to result in the operation of, and/or increases the impact of, a number of key threatening process that particularly relate to CPW: – Clearing of native vegetation – Invasion of native plant communities by exotic perennial grasses – Invasion and establishment of exotic vines and – Infection of native plants by Phytophthora cinnamomi – Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae Clearing of native vegetation is the primary process already discussed in this assessment. The other processes are able to be mitigated through standard construction environmental management activities.
Conclusion
The Proposal will directly clear up to 2.94 hectares of CPW and its habitat. This represents approximately 2% decrease in the local extent in the northern part of the site and less than 2% in the vicinity of Jordan Springs. While detrimental to the future of this community, the proposal cannot be attributed to causing a local extinction. The proposal has therefore not been assessed as having a significant impact on CPW.

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (CIF) is listed as endangered under the BC Act. According to the NSW profile, the extent of intact remnants is now reduced to 1,011 hectares, 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.

The local occurrence of an ecological community is defined in the Threatened Species Test of Significance Guidelines (OEH 2018) as:

the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated. Along the construction footprint there are three local populations of the CIW identified where polygons of the community are mapped within reasonable proximity to be considered to allow species interactions (Figure 3–2). These local populations are:

- The mid Londonderry Road group (Mid occurrence) – Scattered remnants of the community north of the Londonderry/Northern Road intersection centred approximately around Whitegates Rd intersection. Approximately 25ha of CIF is mapped in this locality on the State Vegetation Type Map.
- Northern end of The Northern Road (Northern occurrence) found along approximately the upper third of the Northern Rd past the intersection with Londonderry Rd. More than 200 hectares of CIF is mapped in this locality.
- South of the Londonderry/Northern Road intersection (Southern occurrence), in the area proximal to Wianamatta Reserve. At least 200 hectares of CIF is mapped in this locality.

Within the proposed construction footprint there are 0.96 hectares of CIF in good condition and 3.02 hectares in moderate condition, which could be permanently cleared or impacted during construction.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to a threatened ecological community.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
Adverse effects from clearing will impact up to 3.98 hectares of the community. Within all populations the areas of clearing represent a narrow impact along the road edge and a small percentage of the total area of the local population. The local populations are represented largely by vegetation in reserves. Adverse effects on the extent of the ecological community is not likely to place a local occurrence at risk of extinction.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Modification of the composition of the ecological community is unlikely except for the areas directly impacted as discussed above and is not likely to place a local occurrence at risk of extinction.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
Of the 3.98 hectares of the community within the construction zone a proportion will be permanently removed under the operational footprint. The remainder of the area consisting of the six metre buffer around the operational footprint will be cleared of vegetation during construction but may be retained as future habitat for regeneration.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal involves widening an existing road and does not introduce additional breaks that could fragment or isolate areas of habitat significantly.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Most habitat to be removed is peripheral to areas within reserves, with the exception of the Mid occurrence. Most of the area for removal is withing the areas to be impacted are within the priority conservation land indicated in the NSW Cumberland Plain Recovery Plan (DECCW 2011), which indicates areas critical to the survival of the community under EPBC criteria. The habitat to be removed is on the periphery of these areas and has some importance in providing a buffer to core areas.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The Proposal constitutes, and/or is part of, and/or is likely to result in the operation of, and/or increases the impact of, a number of key threatening process that particularly relate to CIF: – Clearing of native vegetation – Invasion of native plant communities by exotic perennial grasses – Invasion and establishment of exotic vines and – Infection of native plants by *Phytophthora cinnamomi*

– Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae
Clearing of native vegetation is the primary process already discussed in this assessment. The other processes are able to be mitigated through standard construction environmental management activities.
Conclusion
The proposal will impact up to 3.98 hectares of the community distributed across three local occurrences of CIF. Although detrimental the level of impact is unlikely to result in the extinction of a local occurrence of the threatened ecological community.

Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion

Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (CSGW) is listed as vulnerable under the BC Act. Within the construction footprint there is 7.36 hectares of the community that may be impacted by the proposal. Castlereagh Scribbly Gum Woodland (PCT 3269) is mapped as the most common vegetation type within the assessment area (Figure 3–2). There is good connectivity between the patches of CSGW found in the construction area across the locality via this vegetation. CSGW found within the construction footprint is therefore all considered to be part of the same local occurrence of community. Withing the 500 metre buffered assessment areas surrounding the project 4,632 hectares of PCT 3269 is mapped on the STVM, although not all would meet the condition criteria of the threatened ecological community. The local occurrence of CSGW would also include connected patches outside the assessment area, however this total area has not been quantified.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to a threatened ecological community
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
CSGW is vulnerable under the BC Act and therefore question is not applicable.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Up to 7.36 hectares of the community could be impacted by permanent or temporary clearing under the proposal. Other that the directly impacted areas, there are no processes likely to change to composition of the ecological community more broadly.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
Up to 7.36 hectares of the community would be cleared permanently in the operational footprint area or modified by clearing during construction.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal involves widening an existing road and does not introduce additional breaks that could fragment or isolate areas of habitat significantly.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Many of the areas to be modified are within the Priority Conservation Lands indicated in the NSW Cumberland Plain Recovery Plan (DECCW 2011), which indicates areas critical to the survival of threatened communities on the Cumberland Plain. CSGW was not yet listed as TEC at the time of writing of the Cumberland Plain Recovery Plan but does mention that there was a made a preliminary determination. The habitat to be impacted is on the periphery of the Priority Conservation

Lands which contains some large remnants of CSGW including within Castlereagh Nature Reserve. The areas impacted, although generally edge effected provide some importance as a buffer to some of the larger core areas. The community is well represented in Castlereagh Nature Reserve and biodiversity offset sites in Berkshire Park and therefore the habitat to be impacted has a relatively low importance to the long-term survival of the ecological community in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The Proposal constitutes, and/or is part of, and/or is likely to result in the operation of, and/or increases the impact of, a number of key threatening process that particularly relate to CIW: – Clearing of native vegetation – Invasion of native plant communities by exotic perennial grasses – Invasion and establishment of exotic vines and – Infection of native plants by *Phytophthora cinnamomi* – Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae Clearing of native vegetation is the primary process already discussed in this assessment. The other processes are able to be mitigated through standard construction environmental management activities.
Conclusion
The proposal was not found likely to have a significant impact on vulnerable Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion under the BC Act.

Castlereagh Swamp Woodland

Castlereagh Swamp Woodland is found along some creek lines that intersect the road though culverts. The area of the community within the construction boundary is 0.50 hectares. The condition of the community is highly disturbed. 0.21 hectares is “low” quality with occasional scattered local trees and exotic shrubs and ground covers. Even the “moderate” quality zone is dominated by an exotic understorey but includes a more complete native canopy layer. The community’s location withing drainage lines makes it vulnerable to ongoing disturbance from floodwater scouring and nutrient and weed deposition.

The local occurrence of the community is not shown adequately in the most up-to date vegetation mapping. No Castlereagh Swamp woodland is mapped within the study area in the latest Statewide vegetation mapping (Release C2.0M2.0), even in areas where it was identified during survey. The presence of the community is shown in older vegetation layers including the Threatened Ecological Communities of Sydney mapping DCCEEW 2021) represented in Figure 3–3. The occurrences of the community are located at three separate creek lines, two on Londonderry Rd and one on The Northern Road adjacent to Castlereagh Nature Reserve. The total area of the TEC mapped as directly connected to the proposal area is 20.51 hectares.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to a threatened ecological community
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
The proposal will impact up to 0.50 hectares of the community. This extent represents 2.4% of the local occurrence of the community inferred from mapping. Much of the work within the creek lines where the community is located involves

culvert upgrades including improved scour protection. Once operational these creek modifications are expected to improve conditions for the community by reducing impacts from high flow events.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
The composition of the ecological community is largely in common with surrounding woodland, consisting of a canopy of *Eucalyptus parramattensis*, and a mid-storey of Paperbark (*Melaleuca*) trees and shrubs. It is primarily the land landform position within periodically inundated areas that has helped to define the community. Ground covers indicative of the wetter soils are common sedges and forbs tolerant of disturbance. Modification of the composition of the community is limited to the localised clearing area and represent common species. Alteration to the composition of the community through indirect impacts are unlikely with standard controls to prevent run-off during construction.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
Of the 0.50 hectares that may be modified, approximately half would be removed within the permanent operational footprint consisting of road and embankment. The remaining riparian land within the construction buffer will not be permanently removed and may be regenerated post construction following temporary disturbance and clearing.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The widening of the road will not introduce new breaks in habitat but does increase the gap created by hard surfaces. Culverts at all instances of the community assist in maintaining connectivity and overall, the proposal does not significantly fragment or isolate habitat of the ecological community.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The habitat to be removed represents degraded areas of the ecological community close to the disturbed margin of the original construction of the road and culverts. The 0.50 hectares to be modified does not represent an important proportion of the habitat for the long-term survival of the community.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The Proposal constitutes, and/or is part of, and/or is likely to result in the operation of, and/or increases the impact of number of key threatening process that relate to Castlereagh Swamp Woodland: • Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. • Clearing of native vegetation. • Invasion of native plant communities by exotic perennial grasses. • Invasion and establishment of exotic vines and. • Infection of native plants by Phytophthora cinnamomic. • Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. Clearing of native vegetation is the primary process already discussed in this assessment. Alterations to flow regimes had already occurred during the historic construction of the culverts. Proposed upgrades to the culverts are likely to improve natural flow regimes by dissipating energy and adding scour protection. The other processes are able to be mitigated through standard construction environmental management activities.
Conclusion

The proposal was not found likely to have a significant impact on endangered Castlereagh Swamp Woodland in the Sydney Basin Bioregion under the BC Act.

River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

River-flat eucalypt forest is an endangered ecological community and represented by a single location in the study area. Found along Rickaby's Creek, the community is mapped as occurring both upstream and downstream of the Londonderry Road crossing. Downstream (east) of Londonderry Road, the community extends continuously along the river flat for over six kilometres, past Blacktown Road to the east. A local occurrence of the community, as defined as patches directly connected to the study area, includes over 200 hectares.

The community identified with the project boundary is within a highly disturbed zone adjacent to the roadway. The condition of the vegetation is poor, consisting of juvenile canopy trees regrowing in a drainage line, with an exotic dominant ground layer. On-going disturbance occurs during drainage maintenance by slashing and possibly dredging. The ground layer within the area to be removed is heavily infested with the garden plant escapee – Watsonia (*Watsonia meriana*).

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to a threatened ecological community
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
The extent of the community would be reduced by 0.1 hectares. Removal of this small area subject to on-going disturbance is unlikely to place the over 200 hectares of the local occurrence of the community as risk of extinction.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Species composition will only be substantially modified within the 0.1 hectares to be cleared under the proposal. Alteration to species composition by indirect impacts is unlikely in the remainder of local recurrence found over 200 hectares, and therefore the risk of extinction of this local occurrence is unlikely.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
All habitat in the terms of access to suitable river-flat soils will be removed within the 0.1 hectare area of the community modified by the proposal. This extent represents approximately 0.05% of the local occurrence.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The widening of the road will not introduce new breaks in habitat but does increase the gap created by hard surfaces. The culvert under Londonderry Road will assist in maintaining connectivity and overall, the proposal does not significantly fragment or isolate habitat of the ecological community.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The habitat to be removed represents a highly degraded example of the ecological community located close to the disturbed margin of the existing road and culverts. Disturbance is on-going through maintenance of the drainage line running parallel to the road embankment. The 0.1 hectares to be modified does not represent an important proportion of the habitat for the long-term survival of the community in terms of area or quality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The Proposal constitutes, and/or is part of, and/or is likely to result in the operation of, and/or increases the impact of number of key threatening process that relate to River-flat eucalypt forest. • Clearing of native vegetation • Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants • Invasion of native plant communities by exotic perennial grasses • Invasion and establishment of exotic vines. • Infection of native plants by *Phytophthora cinnamomi* • Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. Clearing of native vegetation is the primary process already discussed in this assessment. Alterations to flow regimes has already occurred during the construction of the existing culverts and the road embankment. Proposed upgrades to the culverts are likely to improve natural flow regimes by dissipating energy and adding scour protection. The other processes can be mitigated through standard construction environmental management activities.
Conclusion
The proposal was not found likely to have a significant impact on endangered River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions under the BC Act.

Dillwynia tenuifolia

Dillwynia tenuifolia is listed as Vulnerable under the BC Act. It was identified in the study area during recent surveys and there are numerous records of the species distributed widely across the locality. At least 35 populations totalling several million individuals are known across its range.

The species responds well to fire, which stimulates the seedbank and often generates dense populations. These plants reduce in frequency as other vegetation recover from the fire.

D. tenuifolia is associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3629 – Castlereagh Scribbly Gum Woodland.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
D. tenuifolia was recorded during recent surveys and is known from at least 35 populations across its range. Most individuals recorded in the recent surveys were located nearby existing records of the species, which often occur adjacent to large areas of intact vegetation including nature reserves. The proposal would require the removal of 10.42 hectares of suitable habitat for *D. tenuifolia* along the edge of a road. In many areas the existing habitat has been invaded by exotic grasses. Some individuals were found within this disturbed habitat; however, numbers are higher in better quality vegetation further away from the road. Given the widespread occurrence of the species in adjacent habitat, and the relatively low quality of habitat to be removed, the proposal is unlikely to place a local population of *D. tenuifolia* at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would require the removal of 10.42 hectares of suitable habitat for *D. tenuifolia*.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal would clear along the existing disturbed edges of habitat. The widening of the existing roads does not significantly increase the existing barriers to pollination or seed dispersal.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
D. tenuifolia is widespread throughout the study area and is known to occur in nearby conservation reserves including Wianamatta Nature Reserve, Castlereagh Nature Reserve and Windsor Downs Nature Reserve. Individual numbers of the species are expected to be in the millions based on surveys of local populations. The habitat to be removed occurs along the edge of a major road which, in many areas, has been subject to invasion by exotic grasses. *D. tenuifolia* responds well to disturbance and fire and is capable of storing a viable soil seedbank. The habitat within the proposal area is of lower importance than core areas of habitat within the reserves because it supports less individuals and seed dispersal is limited by the location along the roadway. Habitat along the road can provide a buffer against edge effects. Because of the ability of *D. tenuifolia* to persist along disturbed edges the population is expected to persist along the newly created road margins and therefore the proposal is likely to result in a reduction in habitat equal the area of occupancy directly removed. Given the limited opportunities for seed dispersal and small proportion of the local occurrence in the proposal area close to the road, it is unlikely the 10.42 hectares of habitat to be removed is important to the long-term survival of *D. tenuifolia* in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and *D. tenuifolia*: • Clearing of native vegetation • Infection of native plants by *Phytophthora cinnamomic* • Invasion of native plant communities by exotic perennial grasses • Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. Mitigation measures have been proposed to minimise the impact of KTPs.

Conclusion
The proposal would result in the clearing of 10.42 hectares of habitat for *D. tenuifolia* adjacent to an existing major road. Given the occurrence of the species in neighbouring nature reserves and the relatively small number of individuals to be removed, the proposal is unlikely to have a significant impact on *D. tenuifolia*.

Grevillea juniperia subsp. *juniperina*

Grevillea juniperia subsp. *juniperina* (Juniper-leaved Grevillea) is listed as Vulnerable under the BC Act. It was identified in the study area during recent surveys and there are numerous records for the locality, mostly towards the southern end of the study area. Londonderry is considered the western limit of the species. *G. juniperina* subsp. *juniperina* was locally abundant in the locations where it was identified during survey.

Pollination of flowers is reported to be done by birds although bees have also been observed visiting flowers. Fire kills plants, which then regenerate from soil-stored seed, resulting in a sudden increase in seedling recruitment. Frequent fires may not allow for a suitable build up of stored seed to continue replenishment of the population. Physical disturbance of the soil also appears to result in an increase in seedling recruitment. Good numbers of plants seen along the road edges may also be helped by better light levels found at the edge of the forest canopy. As a result, populations often occur at roadsides so road widening is identified as a threat to the species.

The ability of *G. juniperia* subsp. *juniperina* to spread can be limited by dense growth of Bursaria and African lovegrass is also identified as a threat to the species. Both of these species were identified in the study area.

G. juniperia subsp. *juniperina* is associated with all PCTs found in the study area. Where found it tended to be locally common. Conditions may have been favourable for growth in recent year, and numbers were higher than suggested by sighting records.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
G. juniperia subsp. *juniperina* was recorded during recent surveys from populations within its known range. Most individuals recorded in the recent surveys were located nearby existing records of the species, which often occur adjacent to large areas of intact vegetation including Castlereagh and Wianamatta Nature reserves. The number of records within these reserves on BioNet is low and it is suggested that the species is not adequately conserved in the NSW impact assessment guidelines for the species (NPWS 2002). The proposal would require the removal of 7.04 hectares of suitable habitat for *G. juniperia* subsp. *juniperina* along the edge of a road. In many areas the existing habitat has been invaded by exotic grasses. *G. juniperia* subsp. *juniperina* responds well to mechanical disturbance and depending on the nature of the construction activities, it may recolonise disturbed areas post-construction. Given the widespread occurrence of the species in adjacent habitat, the proposal is unlikely to place a local population of *G. juniperia* subsp. *juniperina* at risk of extinction.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would require the removal of up to 7.04 hectares of suitable habitat for *G. juniperia* subsp. *juniperina*, including patches of vegetation in which the species was recorded during recent survey.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

The proposal would clear along the existing disturbed edges of habitat. The widening of the existing roads does not significantly increase the existing barriers to pollen or seed dispersal.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
G. juniperia subsp. *juniperina* is widespread throughout the study area, mostly in the south, and is known to occur in nearby conservation reserves including Wianamatta Nature Reserve and Castlereagh Nature Reserve. The habitat to be removed occurs along the edge of a major road which, in many areas, has been subject to invasion by exotic grasses that are known to be a threat to the species although the species still appeared able to grow in good numbers close to the road. *G. juniperia* subsp. *juniperina* responds well to mechanical disturbance of the soil and fire, capable of storing a viable seedbank. Disturbance and tree clearing for the proposal is likely to create more favourable growth along the revised road edges. Habitat along the road edges is already fragmented, and the chance of seed dispersal across the road is low. Given the limited opportunities for seed dispersal and small proportion of local individuals occurring close to the road, it is unlikely the 7.04 hectares of habitat to be removed is important to the long-term survival of *G. juniperia* subsp. *juniperina* in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and *G. juniperia* subsp. *juniperina*: • Clearing of native vegetation • Infection of native plants by *Phytophthora cinnamomic* • Invasion of native plant communities by exotic perennial grasses • Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 7.04 hectares of habitat for *G. juniperia* subsp. *juniperina* adjacent to an existing major road. Given the occurrence of the species in neighbouring nature reserves and the relatively small number of individuals to be removed, the proposal is unlikely to have a significant impact on *G. juniperia* subsp. *juniperina*.

Marsdenia viridiflora subsp. *viridiflora*

Marsdenia viridiflora subsp. *viridiflora* is listed as an Endangered Population under the BC Act in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs. There are records for the locality, mostly centred around two clusters opposite Wianamatta Nature Reserve south of Seventh Avenue and at Kanangra Reserve. *M. viridiflora* subsp. *viridiflora* was identified at one location in the study area during recent surveys close to the Seventh Avenue population.

Seed dispersal of *M. viridiflora* subsp. *viridiflora* is via wind. Due to its small population size, the species is threatened by habitat clearing and stochastic events.

M. viridiflora subsp. *viridiflora* is associated with all PCTs found in the study area. Although associated vegetation occurs throughout the study area, only vegetation nearby to existing populations is considered be potential habitat for the species.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

One *M. viridiflora* subsp. *viridiflora* plant was identified in the study area during recent surveys. It is expected to be part of a known population that occurs adjacent to the study area. The proposal will require the removal of a small area of disturbed habitat along the edge of a major road. The removal of one individual and a small area of habitat is unlikely to disrupt the life cycle of the species and place any local population at risk of extinction.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would require the removal of 1.12 hectares of habitat for *M. viridiflora* subsp. *viridiflora*, including a patch of vegetation where one individual was identified during recent surveys.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal would clear along the existing disturbed edges of habitat. Occurrences of *M. viridiflora* subsp. *viridiflora* in the locality are already isolated and fragmented therefore and the proposal would not contribute further to these factors. The proposal would not result in the erection of any barriers to the wind dispersal of this species.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Only two populations of *M. viridiflora* subsp. *viridiflora* are known to occur near the study area. Most of the populations of this species on the Cumberland Plain are protected in Priority Conservation Lands. The habitat to be removed occurs along the edge of a major road and the nearby population does not persist on the opposite side of the road. Given the small area of habitat on the edge of a major road, it is unlikely the 1.12 hectares of habitat to be removed is important to the long-term survival of *M. viridiflora* subsp. *viridiflora* in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and *M. viridiflora* subsp. *viridiflora*: • Clearing of native vegetation • Infection of native plants by *Phytophthora cinnamomic* • Invasion of native plant communities by exotic perennial grasses • Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. Mitigation measures have been proposed to minimise the impact of KTPs.

Conclusion
The proposal would result in the clearing of 1.12 hectares of habitat for *M. viridiflora* subsp. *viridiflora* adjacent to an existing major road. Only one individual was identified in this habitat. Given the proximity of the habitat to be removed to a major road and the small number of individuals to be removed, the proposal is unlikely to have a significant impact on *M. viridiflora* subsp. *viridiflora*.

Micromyrtus minutiflora

Micromyrtus minutiflora is listed as Endangered under the BC Act. It was identified in the study area during recent surveys and there are numerous records of the species distributed widely across the locality.

M. minutiflora is associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3629 – Castlereagh Scribbly Gum Woodland.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Approximately 23 individuals and 7.64 hectares of potential habitat would be permanently removed. Some of the habitat removed is vegetation adjacent to the Castlereagh Nature Reserve, which contains a population specifically mentioned in the Conservation Advice for *M. minutiflora*, and the habitat impacted could reasonably be considered to be belonging to that population. All but one of the plants recorded during survey were in vegetation with connectivity to Castlereagh Nature Reserve. The removal of up to 23 individual plants effectively removes them from the breeding cycle. Using the most current estimate of the Castlereagh Nature Reserve Population of 1,105,254, the proposal would result in removal of less than a 0.002% of the existing population. No other disturbance events are expected to influence the breeding cycle of the species. The proposal is not likely to place any local populations at risk of extinction.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal permanently removes 7.64 hectares of habitat representing potential and known habitat for the species of an important population.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal would widen an existing break in the population associated with Castlereagh Nature Reserve by approximately 10 metres. The species was found on both sides of the road adjacent to reserve. The existing gap in habitat may still allow for dispersal and interaction by pollination and the proposed widening does not significantly increase the existing barriers.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality

Most of the 7.64 hectares of habitat likely to be removed or disturbed in the construction zone occur within the Priority Conservation Lands identified in the Cumberland Plain Recovery Plan, which is considered habitat critical to the survival of the species.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and *M. minutiflora*: • Clearing of native vegetation • Infection of native plants by *Phytophthora cinnamomic* • Invasion of native plant communities by exotic perennial grasses • Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants • Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 7.64 hectares of habitat for *M. minutiflora* adjacent to an existing major road. Given the occurrence of the species in neighbouring nature reserves and the relatively small number of individuals to be removed, the proposal is unlikely to have a significant impact on *M. minutiflora*.

Persoonia nutans

Persoonia nutans (Nodding Geebung) is listed as Endangered under the BC Act. It was identified in the study area during recent surveys and there are numerous records of the species distributed widely across the locality, mostly towards the northern end of the study area. Large populations of the species occur in Agnes Banks Nature Reserve, Castlereagh Nature Reserve and Wianamatta Nature Reserve.

P. nutans is associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3628 – Castlereagh Shrubby Swamp Woodland
- PCT 3629 – Castlereagh Scribbly Gum Woodland.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal will reduce the population size by the removal of up to 18 individuals and up to 6.68 hectares of known and potential habitat. Those few mature individuals or those in the soil seedbank that may be disturbed by the construction would be taken out of the breeding cycle, however a population-wide disruption of the breeding cycle is unlikely to be caused by the proposal. The local population of *P. nutans* occurs in nearby conservation reserves, which are likely to maintain the population.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of up to 6.68 hectares of suitable habitat for *P. nutans*, including patches of vegetation where the species was identified during recent surveys.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal would clear along the existing disturbed edges of habitat. The widening of the existing roads does not introduce a new break, however it will increase the width by approximately 10 metres. The existing roads would allow for cross pollination, which in Persoonia species is primarily by native bees. The proposal is unlikely to significantly alter genetic exchange across road and would therefore not fragment or isolate areas of habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
All habitat in the construction area that will either be removed or disturbed is within the areas of preferred soils, vegetation communities and known geographic distribution described in the Recovery Plan. *P. nutans* also occurs in nearby conservation reserves. The disturbed habitat along the edge of a major road is unlikely to be important to the long-term survival of the species.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and *P. nutans*: • Clearing of native vegetation • Infection of native plants by *Phytophthora cinnamomic* • Invasion of native plant communities by exotic perennial grasses • Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat) • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 6.68 hectares of habitat for *P. nutans* adjacent to an existing major road. Given the local occurrence of the species in neighbouring nature reserves and the relatively small number of individuals to be removed, the proposal is unlikely to have a significant impact on *P. nutans* such that a local population would become extinct.

Pultenaea parviflora

Pultenaea parviflora is listed as Endangered under the BC Act. It was identified in the study area during recent surveys and there are numerous records of the species in the locality, mostly towards the central and eastern portions of the study area. Local populations are known to occur in Castlereagh Nature Reserve and Wianamatta Nature Reserve.

P. parviflora is associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3628 – Castlereagh Shrubby Swamp Woodland
- PCT 3629 – Castlereagh Scribbly Gum Woodland.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The removal of up to 61 individual plants effectively removes them from the breeding cycle. No other disturbance events are expected to influence the breeding cycle of the species within the study area. Many of the individuals recorded during recent survey will be retained. Removal of individual plants and up to 5.44 hectares of suitable habitat is unlikely to place a local population at risk of extinction due to the remaining populations in neighbouring habitat within nature reserves.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of up to 5.44 hectares of suitable habitat for *P. parviflora*, including patches of vegetation where the species was identified during recent surveys.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The proposal would clear along the existing disturbed edges of habitat. The widening of the existing roads does not introduce a new break of significantly greater width in relation to dispersal or pollination. The proposal is unlikely to fragment or isolate areas of potential habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Much of the habitat likely to be cleared or disturbed in the construction footprint is within the Priority Conservation Lands and therefore considered important habitat for the species. Better quality, more suitable habitat occurs in nearby conservation reserves.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and *P. parviflora*:

- Clearing of native vegetation
- Infection of native plants by *Phytophthora cinnamomic*
- Invasion of native plant communities by exotic perennial grasses
- Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat)
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

Mitigation measures have been proposed to minimise the impact of KTPs.

Conclusion

The proposal would result in the clearing of 5.44 hectares of habitat for *P. parviflora* adjacent to an existing major road. Given the occurrence of local populations of the species in nearby nature reserves and the relatively small number of individuals to be removed, the proposal is unlikely to have a significant impact on *P. parviflora*.

Woodland birds: Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet and Swift Parrot

The Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), Varied Sittella (*Daphoenositta chrysoptera*), Little Lorikeet (*Glossopsitta pusilla*) and Swift Parrot (*Lathamus discolor*) are listed as Vulnerable under the BC Act. The Regent Honeyeater (*Anthochaera phrygia*) is listed as Endangered under the BC Act. No targeted surveys were undertaken however all species have been recently recorded within 10 kilometres of the study area.

Each of these species are known to utilise open woodlands for foraging. The Dusky Woodswallow, Varied Sittella and Little Lorikeet use hollows for nesting. Habitat within the study area would be only occupied by the Regent Honeyeater and Swift Parrot outside their respective breeding seasons.

The Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet and Swift Parrot are associated with all PCTs found in the study area. The Dusky Woodswallow and Varied Sittella are likely to only be found in areas of moderate or good quality vegetation.

The proposal would result in the removal of up to 22.61 hectares of potential foraging habitat for these species. Nesting is unlikely to occur in the study area due to the high level of disturbance. The study area does not occur within the known breeding range of the Regent Honeyeater or Swift Parrot.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Each of these species occupy open woodlands and forests. The proposal would result in the removal of 22.61 hectares of vegetation that may provide foraging habitat for the Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet and Swift Parrot. The known breeding range of the Regent Honeyeater or Swift Parrot does not include the study area.

The proposal is unlikely to result in the extinction of a viable local population of any of these woodland birds due to the availability of other suitable habitat outside the study area.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable to a threatened species

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal would result in the removal of 22.61 hectares of native vegetation that may provide foraging habitat for these species. It is unlikely any nesting habitat would be removed.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. The Dusky Woodswallow, Varied Sittella, Little Lorikeet are likely to utilise the more intact areas of vegetation and occasionally move through and use the study area for foraging. The Regent Honeyeater and Swift Parrot are known to travel long distances from breeding sites to access suitable foraging habitat. The proposal would require the removal of 22.61 hectares of vegetation along a major road and is unlikely to isolate or fragment any potential habitat of these woodland birds.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The habitat to be removed is along the edge of a major road and unlikely to be important habitat for these woodland bird species. This vegetation would not provide sufficient foraging, nesting and sheltering habitat to support the entire life cycle of these species.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet and Swift Parrot: • Clearing of native vegetation • Loss of Hollow-bearing Trees • Removal of dead wood and dead trees • Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala*. These KTPs may result in the loss of foraging and/or nesting habitat for the Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet and Swift Parrot. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 22.61 hectares of vegetation that may provide suitable foraging habitat for the Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet or Swift Parrot. Nesting is unlikely to occur in the study area. The proposal is unlikely to have a significant impact on the Regent Honeyeater, Dusky Woodswallow, Varied Sittella, Little Lorikeet or Swift Parrot.

Square-tailed Kite

The Square-tailed Kite (*Lophoictinia isura*) listed as Vulnerable under the BC Act. No targeted surveys were undertaken however the Square-tailed Kite was observed flying near the study area on The Northern Road near Carrington Road.

This species occurs in various timbered habitats including woodlands and forests, preferencing watercourses. It hunts for birds and insects in the tree canopy over large home ranges that appear to be over 100 square kilometres.

The Square-tailed Kite is associated with all PCTs found in the study area.

The proposal would result in the removal of 20.93 hectares of potential hunting habitat for the Square-tailed Kite. This habitat could also be used by prey species of the kite. No potential nest sites were observed in the study area.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The proposal would result in the removal of 20.93 hectares of suitable habitat for the Square-tailed Kite. This habitat consists of vegetation that may be used for hunting, but is unlikely to include any suitable nesting sites. Given the large home range of this species, the proposal is unlikely to result in the extinction of a viable local population of the Square-tailed Kite due to the availability of other suitable habitat outside the study area and temporary nature of the construction disturbance.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of 20.93 hectares of native vegetation that may be used by the Square-tailed Kite and its prey species. No likely nesting sites would be removed.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
Square-tailed Kites occupy very large home ranges and are capable of negotiating fragmented habitats within that range to hunt. The proposal would require the removal of 20.93 hectares of vegetation along a major road. There would be no significant alterations to existing drainage lines and waterbodies that would be used for foraging. Given the ability of this species to negotiate the fragmented landscape, the proposal unlikely to result in fragmentation or isolation of any Square-tailed Kite habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Square-tailed Kites occupy very large home ranges. Within the locality there any many large areas of intact vegetation that would provide suitable hunting habitat. The study area does not contain any suitable nesting habitat. Considering the availability of suitable habitat in the locality and the proximity of the habitat to be removed to a major road, it is unlikely that the proposed habitat to be removed would be important to the long-term survival of the Square-tailed Kite in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Square-tailed Kite: • Clearing of native vegetation • Loss of Hollow-bearing Trees. These KTPs may result in the loss of hunting habitat for the Square-tailed Kite and habitat for its prey species. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 20.93 hectares of native vegetation that may provide suitable hunting habitat for the Square-tailed Kite. No potential nesting sites were observed in the study area. The proposal is unlikely to have a significant impact on the Square-tailed Kite.

Powerful Owl

The Powerful Owl (*Ninox strenua*) listed as Vulnerable under the BC Act. No targeted surveys were undertaken however the Powerful Owl has been recorded recently within 10 kilometres of the study area and suitable habitat has been identified.

A range of vegetation types are used by Powerful Owls for hunting including woodland and open forest. They use large home ranges up to 4,000 hectares in size in fragmented landscapes where there are few hollows and a lower density of prey species. They nest in very large tree hollows in eucalypts with a DBH of greater than 80 centimetres.

The Powerful Owl is associated with all PCTs found in the study area.

The proposal would result in the removal of 22.61 hectares of potential hunting and roosting habitat for the Powerful Owl. This habitat could also be used by prey species of the owl. Several large tree hollows were observed in the study area that may provide suitable nesting sites, although no known nests occur in the study area (Birdlife Australia 2024).

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal would result in the removal of 22.61 hectares of potential habitat for the Powerful Owl. This habitat consists of vegetation that may be used for hunting and roosting, as well as provide suitable habitat for preferred prey species of the Powerful Owl. The proposal may also result in the removal of trees containing hollows, although most of the largest hollows identified in the study area lie outside the construction boundary. It is unlikely that a nest site would be removed as none are known to occur in the study area. Disturbance to any nearby nest site as a result of construction would be temporary and would occur in addition to ongoing disturbance generated by the existing roads. The proposal is unlikely to result in the extinction of a viable local population of Powerful Owl due to the availability of other suitable habitat outside the study area and temporary nature of the construction disturbance.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species.
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of 22.61 hectares of vegetation that may be used by the Powerful Owl and its prey species. An unidentified number of suitable nesting hollows may also be removed.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. The proposal would require the removal of 22.61 hectares of vegetation along a major road and the Powerful Owl is known to occupy urban areas that have fragmented vegetation. Given the ability of this species to occupy the fragmented landscapes, clearing of vegetation along a major road is unlikely to result in fragmentation or isolation of any Powerful Owl habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Powerful Owls occupy and defend large home ranges depending on the availability of adequate prey species. The study area is located in a semi-rural landscape, with many large areas of native vegetation that provides suitable habitat for the Powerful Owl. The proposal will result in the removal of 22.61 hectares of potential habitat along a major road.

Nesting sites are established in large hollows in trees that are at least 150 years old. These are important to determining the persistence of the Powerful Owl in an area. Large hollows occur, but those observed in the study area will be prioritised for retention. Considering the availability of suitable habitat in the locality and the ability of this species to occupy partially disturbed landscape, it is unlikely that the proposed habitat to be removed would be important to the long-term survival of the Powerful Owl in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Powerful Owl: • Clearing of native vegetation • Loss of Hollow-bearing Trees. These KTPs may result in the loss of roosting habitat for the Powerful Owl and habitat for its prey species. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of up to 22.61 hectares of vegetation that provides potential habitat for the Powerful Owl and its prey species. Potential nest hollows occur in the study area but are not known to be in use and are unlikely to be removed by the proposed works. The proposal is unlikely to have a significant impact on the Powerful Owl.

Koala

The Koala (*Phascolarctos cinereus*) is listed as Endangered under the BC Act. No targeted surveys were undertaken however there are recent sightings of the species within 10 kilometres of the study area.

Records of Koalas in the region are rare but indicate the species is present in low numbers. Although koalas are unlikely to be found in the study area, individuals may move through the locality to forage and disperse. Koala will spend most of their time in trees but will descend and traverse open ground to move between trees.

The Koala is associated with all PCTs found in the study area, as each PCT contains at least one species that has been identified as a preferred tree species for feeding or sheltering. Koala habitat in the study area includes only areas that have connectivity to other areas of suitable habitat.

The proposal would result in the removal of up to 15.73 hectares of potential habitat for the Koala.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal would result in the removal of 15.73 hectares of potential habitat for the Koala. The proposal is unlikely to result in the extinction of a viable local population of Koalas due to the availability of other more suitable habitat outside the study area.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
The proposal would result in the removal of up to 15.73 hectares of native vegetation that could provide foraging and resting habitat for the Koala.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The Koala generally has a solitary existence, yet still has complex social hierarchies based on a dominant male with a territory overlapping several females with sub-ordinate males existing on the periphery. They are capable of moving through fragmented landscapes but are at risk of vehicle strikes and dog attacks as they move along the ground. The proposal would require the removal of 15.73 hectares of vegetation along a major road in a landscape that has large patches of native vegetation but also has been subject to long-term clearing. Given the willingness of this species to negotiate fragmented landscapes and the limited likely change to connectivity of suitable habitat, it is unlikely the proposal would result in fragmentation or isolation of any Koala habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The proposal would result in the removal of 15.73 hectares of native vegetation along the edge of a major road. Koalas are expected to occur in low density and more suitable habitat is available in the locality. The vegetation to be removed along a major road is unlikely to be important habitat for the Koala.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening process is considered relevant to the proposal and the Koala: • Clearing of native vegetation. This KTP may result in the loss of potential habitat for the Koala. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the removal of 15.73 hectares of native vegetation along the edge of a major road. Koalas are expected to occur in low density and more suitable habitat is available in the locality. The proposal is therefore unlikely to have a significant impact on the Koala.

Hollow-roosting bats: Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*) are listed as Vulnerable under the BC Act. No targeted surveys were undertaken however all species have been recorded within 10 kilometres of the study area.

Although preferred habitat varies between species, each of these species forage in woodland or forest. They mostly roost in tree hollows but are also known to occur in man-made structures.

The Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat are associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3629 – Castlereagh Scribbly Gum Woodland

- PCT 4025 – Cumberland Red Gum Riverflat Forest.

The proposal would result in the removal of up to 20.43 hectares of potential foraging and roosting habitat for these species, including an unidentified number of hollow-bearing trees.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal would result in the removal of up to 20.43 hectares of potential habitat for the Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat. This habitat consists of vegetation that may be used for foraging habitat includes hollow-bearing trees that may be used for roosting. The proposal is unlikely to result in the extinction of a viable local population of these species due to the availability of other suitable habitat outside the study area and temporary nature of the construction disturbance.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of up to 20.43 hectares of native vegetation that may provide foraging habitat for the Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat. Some potential roosting sites in tree hollows may also be removed.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. Given the ability of these species to negotiate the fragmented habitats and the location of the habitat to be removed along an existing major road, the proposal is unlikely to result in fragmentation or isolation of any microbat habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The habitat to be removed is located along the edge of a major road and unlikely to be important habitat for these microbat species. This vegetation would not provide sufficient foraging or roosting habitat to support the entire life cycle of these species and frequent use would increase the risk of vehicle strike.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat: • Clearing of native vegetation • Loss of Hollow-bearing Trees. These KTPs may result in the loss of foraging and roosting habitat for the Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat. Mitigation measures have been proposed to minimise the impact of KTPs.

Conclusion
The proposal would result in the clearing of up to 20.43 hectares of native vegetation that may provide suitable foraging and roosting habitat for these microbat species. The proposal is unlikely to have a significant impact on the Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat or Greater Broad-nosed Bat.

Cave-roosting bats: Little Bent-winged Bat and Large Bent-winged Bat

The Little Bent-winged Bat (*Miniopterus australis*) and Large Bent-winged Bat (*Miniopterus orianae oceanensis*) are listed as Vulnerable under the BC Act. No targeted surveys were undertaken however all species have been recorded within 10 kilometres of the study area.

The Little Bent-winged Bat occurs along the east coast and ranges from Cape York in QLD to Wollongong in NSW. It can be found roosting in caves, tunnels, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. The Large Bent-winged Bat occurs along the east and north-western coasts of Australia. Caves are the primary roosting habitat for the Large Bent-winged Bat, but it also uses derelict mines, storm-water tunnels, buildings and other man-made structures.

The Little Bent-winged Bat and Large Bent-winged Bat are associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3629 – Castlereagh Scribbly Gum Woodland
- PCT 4025 – Cumberland Red Gum Riverflat Forest.

The proposal would result in the removal of up to 20.43 hectares of potential foraging habitat for these species. There would also be disturbance to culverts that may provide occasional roosting habitat for individuals. No maternity caves occur in the region.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal would result in the removal of up to 20.43 hectares of potential foraging habitat for the Little Bent-winged Bat and Large Bent-winged Bat. Extensive areas of more suitable foraging habitat that is subject to less light and noise generated by the major roads is available in the locality. Both species breed in maternity colonies, none of which occur in the Sydney region. The proposal is unlikely to result in the extinction of a viable local population of Little Bent-winged Bat or Large Bent-winged Bat due to the availability of other suitable habitat outside the study area and temporary nature of the construction disturbance.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of up to 20.43 hectares of potential foraging habitat and disturbance to six culverts that may provide suitable roosting habitat.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. Bent-winged bats are highly mobile and are capable of travelling large distances from maternity colonies outside the breeding season. The proposal would require the removal of 20.43 hectares of vegetation along a major road. Given the ability of these species to negotiate the fragmented landscape and occupy man-made structures for roosting, it is unlikely to result in fragmentation or isolation of any Little Bent-winged Bat or Large Bent-winged Bat habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
Both species of bent-winged bats should be able to tolerate minor removal of foraging habitat. They have large foraging ranges and there is other foraging habitat (often more suitable) within these ranges. No maternity caves would be impacted as they occur outside the Sydney region.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Little Bent-winged Bat and Large Bent-winged Bat: • Clearing of native vegetation. This KTPs may result in the loss of foraging habitat for the Little Bent-winged Bat and Large Bent-winged Bat. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 20.43 hectares of native vegetation that provides potential foraging habitat for the Little Bent-winged Bat and Large Bent-winged Bat. Extensive areas of other suitable habitat are available in the locality and no maternity caves would be impacted. The proposal is unlikely to have a significant impact on the Little Bent-winged Bat or Large Bent-winged Bat.

Southern Myotis

The Southern Myotis is listed as Vulnerable under the BC Act. A small colony was opportunistically found roosting in a culvert over a drainage line under Londonderry Road south of Wilshire Road. It appeared some of the individuals were juveniles, making this a likely maternity colony.

They forage over bodies of water and are known to use hollows, caves and man-made structures near waterways for roosting.

The Southern Myotis is associated with the following PCTs found in the study area:

- PCT 3320 – Cumberland Shale Plains Woodland
- PCT 3448 – Castlereagh Ironbark Forest
- PCT 3629 – Castlereagh Scribbly Gum Woodland
- PCT 4025 – Cumberland Red Gum Riverflat Forest.

The species polygon for the Southern Myotis is shown in Figure 3–6. This includes 12.54 hectares of vegetation that would be removed by the proposal. The study area also includes 13 culverts that may provide suitable roosting habitat, six of which will be upgraded. The current and potential future suitability of these culverts as microbat habitat is unknown.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal would result in the removal of up to 12.54 hectares of suitable habitat for the Southern Myotis. This habitat consists of vegetation that may be used for roosting as it is located within 200 metres of waterway.

The study area also includes drainage culverts, of which one was observed to provide a suitable roost site. The proposal is unlikely to result in the extinction of a viable local population of Southern Myotis due to the availability of other suitable habitat outside the study area and temporary nature of the construction disturbance.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of 12.54 hectares of native vegetation and disturbance to 13 culverts that may provide suitable roosting habitat.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. The continuity of vegetation along waterways varies across the site, with some farm dams isolated from riparian corridors and drainage lines. The Southern Myotis was detected in a culvert with very low water levels and limited vegetated connectivity to other waterbodies that would be suitable for foraging. It is likely the microbats negotiate open space and very narrow drainage lines within their home range. The proposal would require the removal of 12.54 hectares of vegetation along a major road. There would be no significant alterations to existing drainage lines and waterbodies that would be used for foraging. Given the ability of this species to negotiate the fragmented landscape and occupy man-made structures for roosting, it is unlikely to result in fragmentation or isolation of any Southern Myotis habitat.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The study area is located in a semi-rural landscape, with many unnamed drainage lines and farm dams that would provide suitable foraging habitat for the Southern Myotis. Surrounding these water bodies is farms, residential properties and nature reserves in varying condition. The study area occurs along two major roads and associated road reserves. Considering the availability of suitable habitat in the locality and the ability of this species to occupy partially disturbed landscape, it is unlikely that the proposed habitat to be removed would be important to the long-term survival of the Southern Myotis in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Southern Myotis: • Clearing of native vegetation • Loss of Hollow-bearing Trees • Invasion, establishment and spread of Lantana • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

These KTPs may result in the loss of roosting habitat for the Southern Myotis. Mitigation measures have been proposed to minimise the impact of these KTPs.
Conclusion
The proposal would result in the clearing of 12.54 hectares of native vegetation and disturbance of 13 culverts that may provide suitable roosting habitat for the Southern Myotis. One colony of roosting Southern Myotis were observed in the study area. The proposal is unlikely to have a significant impact on the Southern Myotis.

Grey-headed Flying-fox

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under the BC Act. No targeted surveys were undertaken however the species is known to occur within 10 kilometres of the study area. They are distributed from Ingham in Queensland to Adelaide in South Australia, occupying the coastal lowlands and slopes (DAWE 2021).

Grey-headed Flying-foxes feed on flowering trees and fleshy-fruited trees and assist seed and pollen dispersal these species. They migrate in response to the seasonal availability of food resources and are capable of using fragmented and degraded habitat. They socialise, roost and breed in camps that are generally used repeatedly although occupation varies between some that are occupied continuously and some that are rarely used. Numbers at important camps often exceed 10,000 individuals (DAWE 2021).

The Grey-headed Flying-fox is associated with all PCTs found in the study area.

The proposal would require the removal of up to 22.61 hectares of potential foraging habitat for the Grey-headed Flying-fox. No camps would be impacted.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Grey-headed Flying-foxes are known to occur in the locality but would only use the study area for foraging. The proposal would result in the removal of up to 22.61 hectares of vegetation that may provide foraging habitat for the Grey-headed Flying-fox. The proposal is unlikely to result in the extinction of a viable local population of Grey-headed Flying-fox due to the availability of other suitable foraging habitat outside the study area and the lack of disturbance to any camps.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the removal of up to 22.61 hectares of vegetation that may provide foraging habitat for the Grey-headed Flying-fox. No camps occur near the study area.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The Grey-headed Flying-fox can undertake long-distance movements in response to the availability of feeding resources. The removal of vegetation along the edge of an existing major road is unlikely to fragment the Grey-headed Flying-fox population.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality

Grey-headed Flying-foxes breed in large numbers in camps that are used repeatably over the years. No flying-fox camps were identified in the study area. The nearest camps occur at Yarramundi, Emu Plains and Windsor. The vegetation to be removed includes potential foraging habitat for the Gyre-headed Flying-fox when suitable species are in flower. The locality contains large areas of suitable foraging habitat that are more suitable as they are located away from a major road. The habitat to be removed is unlikely to be important to the long-term survival of the Grey-headed Flying-fox.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening process is considered relevant to the proposal and the Grey-headed Flying-fox: • Clearing of native vegetation. This KTP may result in the loss of foraging habitat for the Grey-headed Flying-fox. Mitigation measures have been proposed to minimise the impact of KTPs.
Conclusion
The proposal would result in the clearing of 22.61 hectares of vegetation that may provide suitable foraging habitat for the Grey-headed Flying-fox. No camps would be impacted. The proposal is unlikely to have a significant impact on the Grey-headed Flying-fox.

Cumberland Plain Land Snail

The Cumberland Plain Land Snail (*Meridolum corneovirens*) is listed as Endangered under the BC Act. The species occurs in grassy open woodland on the Cumberland Plain. They are generally active at night, feeding on fungus and sheltering under bark, leaves, fallen logs and around grass clumps. They also use rubbish for shelter.

Suitable habitat in the study area includes vegetation in moderate and good condition that is not subject to regular roadside maintenance. Leaf litter, tree stumps, fall logs and rubbish occur to provide sheltering sites. African Lovegrass is prevalent throughout the study area, particularly along the roadside where the gradient is level or slopes down from the road.

The Cumberland Plain Land Snail is associated with all PCTs found in the study area.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
The proposal would result in the removal of 12.26 hectares of potential habitat for the Cumberland Plain Land Snail. All populations of Cumberland Plain Land Snail are considered viable. The habitat to be removed is along a major road and is unlikely to support a local population of the species.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or** **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
Not applicable to a threatened species
(c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
The proposal would result in the clearing of 12.26 hectares of potential habitat for the Cumberland Plain Land Snail.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
The Cumberland Plain Land Snail occupies a very small home range and its habitat is already fragmented by land clearing on the Cumberland Plain, although large areas of intact vegetation remain. Removal of vegetation along the edge of a major road would not result in further isolation or fragmentation of potential habitat for this species.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
The habitat to be removed occurs along the edge of a major road. The condition of the vegetation varies and is subject to maintenance and edge effects. This marginal quality habitat is unlikely to be important to the long-term survival of the Cumberland Plain Land Snail in the locality.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
No areas of outstanding biodiversity value have been identified in the locality.
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The following key threatening processes are considered relevant to the proposal and the Cumberland Plain Land Snail: • Clearing of native vegetation • Removal of dead wood and dead trees • Invasion of native plant communities by exotic perennial grasses. Mitigation measures have been proposed to minimise the impact of these KTPs.
Conclusion
The proposal would result in the clearing of 12.26 hectares of native vegetation that may provide suitable habitat for the Cumberland Plain Land Snail. The proposal is unlikely to have a significant impact on the Cumberland Plain Land Snail.

Appendix E: Assessments of significance (EPBC Act)

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

Cumberland Plain Woodland (CPW) is listed as Critically Endangered under the EPBC Act. The proposal does not directly impact any areas of CPW that meets the EPBC Act condition criteria. Low quality areas below EPBC Act quality thresholds that may be directly impacted consist of remnant trees with a non-native understorey (Zone 3320_low), or an understory containing some native ground covers (Zone 3320_moderate) although still dominated by exotic perennial grasses. Areas within the Priority Conservation Lands within the Cumberland Plain Recovery Plan are assumed to be of EPBC quality, and these are noted near the intersection with The Driftway, Kanangra Reserve and areas to the west of Jordan Springs. The Proposal boundary avoids these areas. This assessment is therefore relevant to potential indirect impacts to CPW.

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 is unlikely to reduce the extent of the community. Some low integrity vegetation below the condition threshold to be EPBC Act listed will be removed.
• **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**
The proposal does not introduce any breaks within or between EPBC listed patches of the community. The existing roadway presents breaks of approximately 20 metres between low quality examples of the community near Jordan Springs. This vegetation does not form part of connectivity between high quality areas or remnants likely to be part of the EPBC listed community.
• **adversely affect habitat critical to the survival of an ecological community**
There is no critical habitat listed under the EPBC Act for CPW. Within the Cumberland Plain Recovery Plan (DECCW 2011), Priority Conservation Lands are considered to contain habitat critical to the survival of CPW under the meaning with the EPBC Act. No areas of CPW within the Priority Conservation Lands are to be cleared or likely to be indirectly impacted.
• **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**
There are no significant alterations to soils and hydrology by the proposal expected to be relevant to the community. Significant changes to catchments and run-off are not proposed due to the nature of the proposed construction activities (REF Section 3.2.15).
• **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**
No substantial changes to species composition within the community is likely within areas of the EPBC listed community.
• **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** – **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**
Land use (roadway) adjacent to remnants of the community will not change and is unlikely to increase the mobilisation of the harmful agents listed. Weed species are already common along the road edges and standard construction protocols can mitigate risk of introducing or spreading invasive species.

• **interfere with the recovery of an ecological community**
No recovery plan has been prepared for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. The Conservation Advice for the community identifies priority actions to assist the recovery of the community in relation to: • Habitat loss, disturbance and modification • Invasive weeds • Trampling, browsing and grazing • Fire • Conservation information • Enabling recovery of additional sites and/or populations The following actions are considered relevant to the proposal: • Manage any changes to hydrology that may result in changes to water table levels. In addition, develop and implement urban stormwater management guidelines that address risks of urban run-off to the ecological community • Manage sites to prevent introduction or further spread of invasive weeds, which become a threat to the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community, using appropriate methods. Mitigation measures have been proposed to minimise the impact of proposal on these recovery actions. The proposal would not interfere with any other recovery actions.
Conclusion
The proposal avoids direct impacts to this community and indirect impacts are unlikely to be significant under the EPBC Act to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin ecological community (CIF) is listed as Critically Endangered under the EPBC Act.

CIF is endemic to NSW, within the Cumberland subregion of the Sydney Basin Bioregion. The majority of the community is found in the north-west section of the Cumberland Subregion in the Castlereagh area between Penrith and Richmond. It 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.

The NSW profile data (TPDC) states that extent of intact remnants is now reduced to 1,011 hectares, with the most extensive stands occurring in the Castlereagh and Holsworthy areas. About 7% of the original distribution is estimated to remain. Smaller remnants occur in the Kemps Creek area and in the eastern section of the Cumberland Plain. Good examples are to be seen at the Castlereagh and Windsor Downs Nature Reserves, according to the profile.

The National Conservation Advice gives guidance on the “area critical to the survival of the ecological community”. Given the reduced extent of the already limited distribution of CIF, areas that meet the minimum (moderate class) condition thresholds are considered critical to the survival of the ecological community. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community, for example, as buffers for higher condition areas, and should be considered in the surrounding environment and landscape context.

The Conservation Advice considers the ecological importance of a patch being assessed for ‘significant impact’ is also influenced by its surrounding landscape, for example, if connected or nearby to other native vegetation it may contribute substantially to landscape connectivity and function.

There is no national recover plan for the community however there is an NSW Cumberland Plain Recovery Plan (DECCW 2011) which includes CIF. The Cumberland Plain Recovery Plan includes mapping of priority conservation lands which are considered to contain “habitat critical to the survival” of CIF within the meaning of EPBC Act’s definition of the term.

Patches of CIF within the study area are well connected by bushland, which has links between Castlereagh Nature Reserve, Wianamatta Nature Reserve, Windsor Down Nature Reserve and biobanking stewardship sites within Berkshire Park. For this

assessment all CIF within the study area which meet the EPBC criteria has been considered part of the same local "occurrence".

The total occurrence of the local community could not practically be determined by survey and a desk-top approach was used. The total area of remnants representing intact vegetation in the locality will be less than the 1,011 hectares of remaining intact CIF indicated in the State profile as more southern examples of the community around Holsworthy would be considered a separate occurrence. The mapping of PCT 3448 does not differentiate areas of the community eligible for listing as EPBC quality from those of lower quality than the listing threshold. A means of estimating the local occurrence of EPBC quality vegetation was to analyse the area of PCT 3448 connected to the proposal's assessment area (500m buffer) and also falling within Priority Conservation Areas, thereby selecting only better-quality vegetation. A total figure of 488 ha of CIF of EPBC quality was calculated. Therefore clearing of 2.90 hectares of CIF for the proposal represent a direct impact of 0.60% of the local occurrence or 0.29% of the remaining 1,011 hectares in NSW.

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**
Approximately 2.90 hectares of the community is found in the proposal's construction footprint. Much of this is to be permanently removed. This constitutes a 0.60% reduction in the local extent of the ecological community or a 0.29% extent of the remaining intact patches within NSW totalling 1,011 hectares.
• **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**
The existing roadway presents breaks through the community of approximately 20 metres width in most locations. In four locations the mapping of the Priority Conservation Lands cross the road alignment at points where CIF is present. The proposal will widen some of the existing breaks by approximately 10 metres. The enlarged breaks are unlikely to present significant additional barriers to pollination or flora distribution however some fauna, which is considered part of the ecological community, may have reduced connectivity – for example sugar gliders. One moderate condition patch of CIW separated by the roadway from larger remnants is found south of Vincent Road on the western side of the road is already relatively fragmented by the road and housing. This approximately 1.2 hectare patch will be further reduced in dimensions by approximately 0.86 hectares. The proposal therefore presents an incremental increase in the fragmentation of the ecological community although does not introduce significant new breaks.
• **adversely affect habitat critical to the survival of an ecological community**
There is no critical habitat listed under the EPBC Act for CIF. The approved Conservation Advice states in the section on habitat critical to survival: "Given reduced extent of the already limited distribution of the Cooks River/Castlereagh Ironbark Forest, areas that meet the minimum (moderate class) condition thresholds are considered critical to the survival of the ecological community. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community, for example, as buffers for higher condition areas, and should be considered in the surrounding environment and landscape context as outlined in the other considerations." The 2.90 hectares of CIF eligible for EPBC listing within the study area is by de facto habitat critical to the survival on the grounds that it meets the listing criteria. Other guidance on habitat critical for survival comes from the Cumberland Plain Recovery Plan through mapping of the Priority Conservation Lands. 2.05 hectares on the subject land are found within the Priority Conservation Lands. The CIF likely to be impacted within the Priority Conservation Lands is adjacent to larger intact remnants and therefore have both their intrinsic value as habitat and importance in providing buffer to the core areas of larger intact remnants. The proposal reduces the width of road verge vegetation fringing approximately 1.97 kilometres of CIF within Priority Conservation Lands. Low quality remnants of CIF in the study area were rarely found bordering intact remnants and have not been considered as contributing habitat critical to survival of the species. In total the area of adversely affected habitat critical to the survival of CIF is 2.90 hectares. Within the local context, habitat critical to survival includes at least the local occurrence of the community plus areas of lower quality which may provide importance by offering connectivity or buffering. The removal of 2.90 of habitat is unlikely to lead to the extinction of the community.

- **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**

No large-scale modifications to abiotic factors are expected to risk the local occurrence of the community's survival. Areas cleared and paved will be permanently removed as habitat. Areas subject to construction disturbance but not permanently modified retain the abiotic factors necessary for regeneration if facilitated. Therefore, less than 2.90 hectares of direct impact will be subject to permanent removal.

- **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**

No substantial changes to species composition are likely in the community generally, other than within the areas cleared where most species are removed.

- **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**
  - **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**

Invasion of perennial exotic grasses is already reducing the integrity of the community within the study area. This threatening process may be exacerbated along clearing boundaries. There is no change to the proposed land use (roadway) adjacent to remnants of the community and this is unlikely to substantially increase the mobilisation of harmful agents including fertilizers, herbicides or other chemicals. The operational objectives of the proposal as an emergency transport lane does not facilitate substantial changes to traffic type or volumes and therefore does not significantly alter the risk of harmful agents entering the community.

- **interfere with the recovery of an ecological community**

No national recovery plan has been prepared for Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion. The Conservation Advice for this vegetation community identifies the following high priority actions that are considered relevant to the proposal:

- Protect and conserve patches of this ecological community to avoid further clearance and fragmentation of remnants that meet the condition thresholds. Identify high conservation value sites for conservation management (formal reserve and off-reserve protection), on private and public lands. These may include the 'priority conservation lands' identified in the New South Wales Cumberland Plain Recovery Plan (DECCW, 2010), as well as other remnants of Cooks River/Castlereagh Ironbark Forest that meet the high-quality condition thresholds.
- Avoid planting potential weeds in roadworks, landscaping and other development near the ecological community (plant local species). Implement appropriate measures to prevent introduction and dispersal of weeds (e.g. during mowing, roadworks, adjacent development)
- Control storm-water and other urban run-off to prevent:
  - The further alteration of hydrological regimes in the ecological community;
  - The infiltration of litter;
  - The dispersal of weeds; and
  - The introduction of unnaturally high nutrient levels to the ecological community
- Buffer zones with native species should be utilised to minimise 'edge effects' such as increased run-off, weed invasion, rubbish dumping and other disturbances. Buffers should be as large as possible, at a minimum 30 metres from the outer edge of the patch.

The action of the proposal is contrary the recommended recovery priorities by:

- Clearance of remnants that meet the condition thresholds and are within the priority conservation lands identified in the New South Wales Cumberland Plain Recovery Plan.

- Reducing vegetation which acts as buffer zones for some of the largest remnants of the community in NSW, some of which are within conservation reserves.
- Mitigation measures and design considerations for stormwater handling, landscape and remediation work are not to be contrary to priority conservation actions.

Conclusion

In summary the proposal will:

- reduce the extent of the community by 2.90 hectares, representing 0.29% of the 1,011 hectares of the remaining intact area in NSW, and approximately 0.60% of the calculated local occurrence of the community.
- result in a small increase in fragmentation of the community by widening existing corridor breaks created by roads.
- adversely affect 2.90 hectares of habitat critical to the survival of the community.
- result in actions contrary to the recovery of the community by clearing within the Priority Conservation Lands and reducing the buffer zone widths along approximately 1.9 km of roadway.

The criteria in the significant impact guidelines used in this assessment are intended to provide general guidance on the types of actions that will require approval. The general test for significance is whether an impact is 'important, notable or of consequence'. If there is any uncertainty referral is recommended.
The total significance of the impacts of the proposal are inherently difficult to quantify because of the widely distributed and linear nature of the impacts, which represent narrow incursions along existing boundaries. The proposal's location adjacent to several of the best examples of the remaining community within conservation reserves presents a contradiction in the assessment process. On one hand the protection offered by reserves provides some degree of security for the local occurrence of the community as the proposal does not directly impact within reserves. However, reducing the width of vegetation fringing the reserves may shift edge effects such as weed invasion closer to or within the reserve boundary. Management actions with reserves tend to prevent such impacts. The proposal is still considered very unlikely to risk the ongoing viability of the community within any of the reserves.
The concluding comment within the NSW Final Determination provides some context and is as follows:
"In view of the originally restricted distribution of this community, its inadequate representation within conservation reserves, the extensive disturbance and fragmentation and weed invasion that has occurred and the ongoing development and use threats, the Scientific Committee is of the opinion that Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that the community is eligible for listing as an endangered ecological community."
In conclusion the proposal is detrimental to the CEEC but is unlikely to result in the complete extinction of the local occurrence of the community. The scale of the impact is not concluded as significant within a national context under the EPBC Act.

Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion

Background

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is listed as endangered under the EPBC Act. The ecological community occurs mostly in the Cumberland IBRA sub-region, with small occurrences just outside the Cumberland sub-region in the Sydney Cataract (SYB10), Wollemi and Burragorang sub-regions. Within the study area the community is found within good condition zones of PCT 3269, with an area of 6.01 hectares.

Castlereagh Scribbly Gum and Agnes Banks Woodlands has been subjected to substantial clearing, fragmentation and degradation. Since European settlement, the Castlereagh Scribbly Gum (CSGW) sub community, (not including the rarer Agnes Banks sub community) has undergone a reduction of at least 51% to estimated extent of 3,100 hectares. Of this 12.6% is estimated to be within reserves, equating to 390 hectares.

According to the National conservation advice, areas that meet the minimum (moderate class) condition thresholds are considered critical to the survival of the ecological community. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community, for example, as buffers for higher condition areas, and should be considered in the surrounding environment and landscape context.

The total occurrence of the local community could not practically be determined by survey and a desk-top approach was used. The State mapping of PCT 3629 does not differentiate areas of the community eligible for listing as EPBC from those of lower quality than the listing threshold. A means of estimating the local occurrence of the EPBC community was to analyse the area

of PCT 3629 connected to the proposal's assessment area (500m buffer) and falling within Priority Conservation Areas, thereby selecting only better-quality vegetation. A total figure of 749 hectatres of CSGW of EPBC quality was calculated. This is almost certainly an underestimate as other intact remnant of the PCT are seen in the assessment area outside the Priority Conservation Lands.

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 may reduce the extent of the community by up 6.01 hectares. Areas under the operational footprint would be removed permanently, areas disturbed during construction have the possibly to regenerate but should be assumed cleared. This represents 0.80% of the occurrence of the community in the locality discussed in the background section.

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

The existing roadway presents breaks through the community of approximately 20m width. The proposal will widen some of the existing breaks by approximately 10m. The enlarged breaks are unlikely to present significant additional barriers to pollination or flora distribution however some fauna, particularly arboreal species are likely to have reduced connectivity. Fauna is a component of the ecological community and therefore the proposal is likely to increase in existing fragmentation of the ecological community. There are at least three locations where areas of CSGW mapped as Priority Conservation Lands in the NSW Cumberland Plain Recovery Plan cross the road alignment. This vegetation represents relatively intact and connected vegetation.

- **adversely affect habitat critical to the survival of an ecological community**

There is no critical habitat listed under the EPBC Act for CSGW. All areas of CSGW meeting the minimum criteria to be considered the EPBC listed community is to be considered habitat critical to the survival of the community according to the approved Conservation Advice. Therefore at least 6.01 hectares of habitat critical to the survival of the ecological community would be adversely affected through permanent clearing and construction disturbance. All listed CSGW in the local occurrence is also part of the habitat critical to survival.

- **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**

Other than the direct impact to soils described above there are no significant modifications to abiotic factors likely to occur. Significant changes to catchments and run-off are not proposed due to the nature of the proposed construction activities (REF Section 3.2.15).

- **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**

No processes that would cause substantial changes to species composition are likely in the community generally, other than the direct loss of all species within areas subject to clearing.

- **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**
  - **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**

Invasion of perennial exotic grasses is already reducing the integrity of the community within the study area. This threatening process may be exacerbated along clearing boundaries. There is no change to the proposed land use (roadway) adjacent to remnants of the community and this is unlikely to substantially increase the mobilisation of harmful agents including fertilizers, herbicides or other chemicals. The operational objectives of the proposal as an emergency transport lane does not facilitate substantial changes to traffic type or volumes.

• **interfere with the recovery of an ecological community**
The Conservation Advice recommends development of a recovery plan, although no National or State plan is available yet. High priorities in the conservation advice include: • Protect and conserve remnants that meet the condition thresholds for this ecological community to avoid further clearance and fragmentation. • Identify high conservation value sites for conservation management (formal reserve and off-reserve protection), on private and public lands. These may include the 'priority conservation lands' identified in the Cumberland Plain recovery plan), as well as other remnants of Castlereagh Scribbly Gum and Agnes Banks Woodlands that meet the high-quality condition thresholds. • Promote formal conservation arrangements, management agreements and covenants on private land. For crown and private land, promote inclusion in reserve tenure. Areas of CSGW proposed to be impacted are part of large high conservation value patches including remnants bordering with and extending into Castlereagh Nature Reserve. 5.07 hectares of CSGW potentially impacted is within the priority conservation lands from the Cumberland Plains Recovery Plan.
Conclusion
In summary the proposal will: • Reduce the extent of the community by 6.01 hectares, which is between 0.80% of the occurrence of the community. This is considered minor. • Result in a small increase in fragmentation of the community by widening existing breaks created by the road. • Adversely affect 6.01 hectares of habitat critical to the survival of the community as defined by the National conservation advice. This represents a 0.80% decrease in the estimated 749 hectares of the local occurrence, also considered habitat critical to survival of the community. • Constitute actions contrary to the recovery of the community by introducing additional clearing and fragmentation including on the edge of intact remnants in Castlereagh Nature Reserve. The criteria within the significant assessment guidelines are intended to provide general guidance on the types of actions that will require approval. The general test for significance is whether an impact is 'important, notable or of consequence'. If there is any uncertainty referral is recommended. Although detrimental to the occurrence community, the proposal is unlikely to threaten the ongoing viability of the community. In conclusion the proposed action is not considered significant under the EPBC Act.

Micromyrtus minutiflora

Micromyrtus minutiflora is listed as vulnerable under the EPBC Act and Endangered under the BC Act.

M. minutiflora, Family Myrtaceae, is a slender spreading shrub to 2 m high. Leaves are 1–4 mm long and 0.5–1 mm wide with ciliate margins. The flowers are solitary on a peduncle (stalk) 0.5 mm long and sometimes forming small terminal clusters. The petals are white and fruit are non-opening nuts that are only slightly enlarged from the flower (Approved Conservation Advice).

The Conservation Advice (DEWHA 2008) describes the distribution of the species as follows:

Micromyrtus minutiflora is endemic to the western parts of the Cumberland Plain in the Richmond-Castlereagh area of the Sydney Region, NSW. There are 11 sites with a total of 1800 individuals across the Blacktown, Hawkesbury and Penrith Local Government Areas. Only one population of fewer than 50 plants is conserved within the Castlereagh Nature Reserve (DECC, 2002). There are over 1160 individuals in the Australian Defence Industries site and 500 individuals in Marsden Park

Under the EPBC significant impact guidelines an 'important population' is 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 was not possible within the confines of this assessment process to survey and quantify all populations of *M. minutiflora* in or near the study area for size, extent, or genetic diversity. Guidance in this case comes from the Conservation advice and information on known populations, which makes mention of the population in Castlereagh Nature Reserve relevant to this proposal. Over twenty specimens were found near the reserve, but outside its boundary.

The largest cluster of specimens found was on the opposite side of the road to the Castlereagh Nature Reserve. Little is known about the pollination of *M. minutiflora* (Bangel *et al.* 2023) and therefore it is difficult to comment on the degree of interaction across the road.

'Habitat critical to the survival of a species or ecological community' in the assessment process refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

There is no National Recovery Plan for the species however the NSW Cumberland Plain Recovery Plan (DECCW 2011) addresses *M. minutiflora* and maps Priority Conservation Lands which are considered to contain the habitats critical to survival of the species. A relatively recent study on the distribution of *M. minutiflora* by Bangel *et al*., 2023, included investigation into the distribution of the species in Castlereagh Nature Reserve estimated the area of occupancy to be 99.8 hectares, and numbers found were significantly higher than those within the conservation advice mentioned above. The total number of plants within Castlereagh Nature Reserve is calculated at 1,105,254 with a 95% confidence interval. The presence of the species was associated with areas with lower percentage of canopy cover, but with a high cover of native understorey species. The description of habitat in which it was found in Castlereagh nature reserve was "Along edges of roads, walking tracks, creek lines and drainage lines. Found also within revegetated open areas with little tree canopy." Within the study area the highest density of the species was found under power lines where canopy trees had been removed.

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**
Approximately 23 individuals and 7.64 hectares of potential habitat would be permanently removed. Some of the habitat removed is vegetation adjacent to the Castlereagh Nature Reserve, which contains a population specifically mentioned in the Conservation Advice, and most habitat impacted can be considered to belong to that population. All but one of the plants recorded during survey were in vegetation with connectivity to Castlereagh Nature reserve. The Castlereagh Nature Reserve population would meet the requirements to be considered important to the long-term survival of the species, being within a conservation area, as the species has a very localized range between Richmond and Penrith. By permanently removing a small quantity of vegetation which forms a buffer around Castlereagh Nature Reserve, and part of the species known habitat a small decrease in an important population is likely to occur. Using the most current estimate of the Castlereagh Nature Reserve population of 1,105,254, this represents less than a 0.002% decline.
• **reduce the area of occupancy of an important population**
The proposal permanently removes 7.64 hectares of habitat representing potential and known habitat for the species of an important population.
• **fragment an existing important population into two or more populations**
The proposal would widen an existing break in the population associated with Castlereagh Nature Reserve by approximately 10 metres. The species was found on both sides of the road adjacent to Castlereagh Nature reserve. The existing gap in habitat may still allow for dispersal and interaction by pollination and the proposed widening does not significantly increase the existing barriers.

• **adversely affect habitat critical to the survival of a species**
Most of the 7.64 hectares of habitat likely to be removed or disturbed in the construction zone is within the priority conservation lands under the Cumberland Plain Recovery Plan, which is considered habitat critical to the survival of the species. Within the context of the local occurrence of the species, this area supports a very low proportion of the estimated population (0.002%)
• **disrupt the breeding cycle of an important population**
The removal of approximately 23 individual plants effectively removes them from the breeding cycle. No other disturbance events are expected to influence the breeding cycle of any important population more broadly outside of areas directly impacted.
• **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
The proposal removes approximately 7.64 hectares of habitat including a small number of known individuals and therefore a small decline in the species is expected. *M. minutiflora* was described as having has preferred habitat within Castlereagh Nature reserve in areas where the tree canopy has been thinned from previous clearing or along trails (Bagnal 2023). This finding is backed up by the current survey sightings which found specimens along the relatively disturbed edges of the roadway. Habitat within the reserve near the proposal boundary is expected to be improved by reduced canopy cover.
• **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**
New invasive weeds have the potential to be introduce and existing weeds established more deeply into core habitat. Dense stands of invasive African lovegrass are found extensively along the disturbed road edges. Widening the road is likely to shift the weed impacted margins further into areas of habitat.
• **introduce disease that may cause the species to decline, or**
All Australian species in the Myrtaceae family have the potential to be impacted by Myrtle rust. Most areas in the study area are already at risk of exposure to plant pathogens or soil borne disease from urban run-off and illegal dumping. Standard hygiene protocols during the proposal's construction should mitigate additional risks of introducing diseases.
• **interfere substantially with the recovery of the species**
The Proposal will interfere with the recovery of the species by reducing the extent of its potential habitat and impacting habitat critical to the survival of the species as mapped in the Cumberland Plain Recovery Plan. This interference is expected to be minor however, and unlikely to lead to be "substantial" and result in the extinction of a local population.
Conclusion
The proposal is likely to lead to a very minor long-term decrease in at least one important population associated with the Castlereagh Nature Reserve through the removal of approximately 23 individuals and 7.64 hectares of habitat. Although detrimental to the species the level of impact is not considered significant under the EPBC Act.

Persoonia nutans

Persoonia nutans (Nodding Geebung) is listed as Endangered under the EPBC Act. There is no EPBC listing advice for this species. The NSW recovery plan (DEC 2005) has been adopted to act as the National Recovery Plan and therefore is the primary source of information in the following summary, unless otherwise specified.

P. nutans is restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. The specie's core northern distribution (99% of recorded individuals) occurs within the Penrith, and to a lesser extent, Hawkesbury, Local Government Areas (LGA), with isolated and relatively small southern populations occurring in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs. The species current known distribution equates to a linear range of approximately 45 kilometres across the species entire range and only 14 kilometres excluding the southern relatively small and disjunct populations.

In the north of the species' range (where the proposal area is located), *P. nutans* does not typically appear in discrete populations, but rather, occurs as scattered individuals throughout suitable habitat. Survey within the north of the species range is likely to reveal additional occurrences. It is therefore difficult to place precise limits on the boundaries of known populations. However, based on available information in the Recovery Plan, there are 27 known extant local populations of *P. nutans*, supporting greater than 5,500 individuals in total. Current known estimates of population size were obtained largely from survey work undertaken in 1996. Given that *P. nutans* is a fire sensitive obligate seeder, the species will exhibit considerable fluctuations in the number of mature individuals over time, depending upon time since fire.

To date, critical habitat to the survival of the species has not been declared for *P. nutans* however, the recovery plan identifies the habitat features and general locations that would contain habitat that is critical to the survival of the species. Although most known individuals are found in conservation reserves, representation of habitat in reserves is considered inadequate by the Recovery Plan and constitutes only 17.8% of potential habitat. Persoonia nutans is confined to aeolian and alluvial sediments and is found primarily on the Agnes Banks and Berkshire Park soil landscapes, particularly in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland (99% of individuals are found within these vegetation communities).

For impact assessment of an endangered species, the EPBC impact guidelines uses a 'population of a species' which is defined as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

Under both of these definitions all specimens in the study area could be considered part of the same 'population of a species'. All specimens found within the study area were found in vegetation near or connected to the Castlereagh Nature Reserve.

The recovery plan further categorises "local populations". Castlereagh Nature Reserve and adjacent bushland is tabled as containing eight distinct populations however their location is not disclosed. Without knowing the distribution of *P. nutans* more broadly outside of the study area it is not possible to confirm the boundaries of local populations and for this assessment all specimens of Persoonia nutans are part of one 'occurrence'. Four specimens were recorded in the construction footprint and may be directly impacted.

Up to 6.68 hectares of potential habitat is within the construction footprint and may be impacted.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will: • **lead to a long-term decrease in the size of a population**
Removal of up to 18 mature individuals and up to 6.68 hectares of potential habitat will decrease the known area of occupancy of the species, leading to a small decrease in the size of the population of *P. nutans*.
• **reduce the area of occupancy of the species**
The NSW Recovery Plan states that the species' area of occupancy is unknown but an estimated area of potential habitat (i.e. suitable vegetation community and suitable soil type) is currently 5,300 hectares within the northern range of the species. The area of habitat proposed to be removed of up to 6.68 hectares results in reduction in the likely area of occupancy by approximately 0.13%.
• **fragment an existing population into two or more populations**
The proposal would clear along the existing disturbed edges of habitat. The widening of the existing roads does not introduce a new break, however it will increase the width by approximately 10 metres. The existing roads would allow for cross pollination, which in Persoonia species is primarily by native bees. The proposal is unlikely to significantly alter genetic exchange across the road.
• **adversely affect habitat critical to the survival of a species**
All habitat in the construction area that will either be removed or disturbed is within the areas of preferred soils, vegetation communities and known geographic distribution described in the Recovery Plan. No habitat critical to survival has been declared for the species and there is not objective means of making a critical declaration of this habitat with the information gained from this study.

• **disrupt the breeding cycle of a population**
The 18 mature individuals and the soil seedbank that may be disturbed by the construction would be taken out of the breeding cycle, however a population-wide disruption of the breeding cycle is unlikely to be caused by the proposal.
• **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
The 6.68 hectares of habitat to be permanently removed or disturbed may result in small decline in the species.
• **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**
New invasive weeds have the potential to be introduce and existing weeds established more deeply into core habitat. Dense stands of invasive African lovegrass is found extensively along the disturbed road edges. Widening the road is likely to shift the weed impacted margins further into areas of habitat. These existing species are already established, and new species are unlikely to be introduced if standard construction hygiene protocols are used.
• **introduce disease that may cause the species to decline, or**
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*) is identified as a Key Threatening Process in the recovery plan. Most areas in the study area are already at risk of exposure to plant pathogens or soil borne disease from urban run-off and illegal dumping. Standard hygiene protocols during the proposal's construction should be able to mitigate additional risks of introducing the disease.
• **interfere with the recovery of the species**
The possible removal of 18 mature individuals and removal or disturbance of up to 6.68 hectares is contrary to recovery efforts for the species.
Conclusion
The proposal is likely to: • Lead to a small long-term decrease in the size of a population by impacting up to 18 individual plants and 6.68 hectares of potential habitat. • Reduce the area of occupancy of the species by 6.68 hectares, representing approximately 0.2% of the population occurrence. • Be contrary to recovery of the species but does not represent a significant interference. Although detrimental to the species, the level of impact is not considered significant under the EPBC Act.

Pultenaea parviflora

Pultenaea parviflora is listed as vulnerable under the EPBC Act and Endangered under the BC Act.

P. parviflora, also known as the Prickly Bush-pea, is a small erect, branching shrub growing to less than two metres. It has sharp-tipped leaves which are narrow and concave, 22 mm long and 2 mm wide. Flowers are yellow with red markings and a red keel (the pair of petals under the flower). Each flower is attached to a pair of enlarged stipules (leaf-like structures found at the base of the leaves) and is covered with long white hairs. Seed pods are egg-shaped, generally produced in December

P. parviflora inhabits scrubby or dry heath areas within the Castlereagh Ironbark Forest. It is known chiefly from Penrith, Windsor and Blacktown and there are outlier populations in Liverpool (James *et al.*, 1999). Within these areas it may be locally abundant and it may also be common in transitional areas where the Castlereagh Ironbark Forest adjoins Castlereagh Scribbly Gum Woodland (NPWS, 2000). This species re-establishes from soil-stored seed and there is no evidence of vegetative spread (NPWS, 2000). *P. parviflora* occurs within the Hawkesbury-Nepean (NSW) Natural Resource.

Under the EPBC significant impact guidelines an 'important population' is 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.

There is no National Recovery Plan for the species. The NSW Cumberland Plain Recovery Plan addresses *P. parviflora* and maps Priority Conservation Lands, which are considered to contain the habitats critical to survival of the species. The count of individuals likely to be impacted was approximate because of uncertainly in the exact clearing extent using had-held GPS. Up to 61 individuals are estimated to be cleared under the proposal. 5.44 hectares of potential habitat for the species is within the construction footprint. A large proportion of this is within the Priority Conservation Lands.

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**
The proposal removes or disturbs approximately 5.44 hectares of vegetation with is potential habitat for the species, some of which borders Castlereagh Nature Reserve and Wianamatta Nature Reserve. The species is locally common within the reserves. Both populations within the reserve would constitute important populations as the species is geographically confined to a relatively small area within the Sydney Basin and the reserves are specified as priority management sites in NSW. In contrast to a similar situation for *Micromyrtus minutiflora*, populations numbers are more robust. The number of individuals potentially removed outside the reserve has not been considered to represent a significant part of the conserved population.
• **reduce the area of occupancy of an important population**
The proposed 5.44 hectares of habitat for removal represents less than 1% of the combined area of Castlereagh and Wianamatta Nature reserve, and significantly less of the total population within the Sydney Basin. The reduction in the area of occupancy is minor.
• **fragment an existing important population into two or more populations**
The proposal would clear along the existing disturbed edges of habitat. The widening of the existing roads does not introduce a new break of significantly greater width in relation to dispersal or pollination.
• **adversely affect habitat critical to the survival of a species**
Much of the habitat likely to be cleared or disturbed in the construction footprint is within the Priority Conservation Lands and therefore considered habitat critical to the survival of the species.
• **disrupt the breeding cycle of an important population**
The removal of some individual plants effectively removes them from the breeding cycle. No other disturbance events are expected to influence the breeding cycle of the majority 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**
The proposal removes approximately 5.44 hectares of habitat including habitat occupied by 10 to 20 individuals but is not expected to result in a significant decline in the species.
• **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**
New invasive weeds have the potential to be introduce and existing weeds established more deeply into core habitat. Dense stands of invasive African lovegrass is found extensively along the disturbed road edges. Widening the road is likely to shift the weed impacted margins further into areas of habitat. These existing species are already established and new species are unlikely to be introduced if standard construction hygiene protocols are used.
• **introduce disease that may cause the species to decline, or**

Most areas in the study area are already at risk of exposure to plant pathogens or soil borne disease from urban run-off and illegal dumping. Standard hygiene protocols during the proposal's construction is able to mitigate additional risks of introducing diseases.
• **interfere substantially with the recovery of the species**
Removal of habitat and not just that which is mapped as Priority Conservation Lands is contrary to the Cumberland Plain Recover Plan. This interference is no considered "substantial" such that it might lead to the extinction of a local population.
Conclusion
The Proposal is expected to modify the habitat of the local population causing a decline of less than 1% in its extent. Within this extent, breeding cycle processes will be completely lost. The Proposal is however unlikely to cause an extinction in the local population. The Proposal will not have a significant impact.

Regent Honeyeater

The Regent Honeyeater (*Anthochaera phrygia*) is listed as Critically Endangered under the EPBC Act.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that **it will:** • **lead to a long-term decrease in the size of a population**
The Regent Honeyeater occupies open woodlands and forests, moving through the landscape to opportunistically feed on flowering plants outside the breeding season. The proposal would result in the removal of 22.61 hectares of vegetation that may provide rarely used foraging habitat for the Regent Honeyeater, although larger areas of suitable habitat occur in the locality. Specific nesting locations are used by the Regent Honeyeater, none of which occur in the locality. The proposal is unlikely to result in a long-term decrease in the size of a population due to the availability of other better quality feeding habitat in the study area and the lack of impact to any breeding habitat.
• **reduce the area of occupancy of the species**
The Regent Honeyeater occurs from southern coast Queensland through to Victoria. From the coast of Sydney its range extends west past Parkes and Dubbo. The removal of a small area of habitat in the middle of its range is unlikely to reduce the area of occupancy of the Regent Honeyeater.
• **fragment an existing population into two or more populations**
The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. The Regent Honeyeater is known to travel long distances from breeding sites to access suitable foraging habitat. The proposal would require the removal of 22.61 hectares of vegetation along a major road and is unlikely to isolate or fragment any potential habitat for the Regent Honeyeater.
• **adversely affect habitat critical to the survival of a species**
Habitat critical to the survival of the Regent Honeyeater is identified by DAWE 2016 as: – Any breeding or foraging habitat in areas where the species is likely to occur; and – Any newly discovered breeding or foraging locations. Western Sydney is identified as an area where the Regent Honeyeater is likely to occur, but is not a regularly used area. The proposal would result in the removal of 22.61 hectares of potential foraging habitat along a major road in an area where more suitable foraging habitat is available immediately adjacent to parts of the study area.
• **disrupt the breeding cycle of a population**

The Regent Honeyeater breeds in only a few locations in NSW, none of which occur in the study area.

The proposal would not create any barriers that may prevent individuals moving between foraging habitat in the locality to breeding sites.

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

The proposal would result in the removal of 22.61 hectares of potential foraging habitat along a major road in an area where more suitable foraging habitat is available immediately adjacent to parts of the study area. The low density of the species across its range mean habitat in the study area would be rarely used. No breeding habitat would be modified or isolated.

Loss of potential foraging habitat that would be rarely used is unlikely to result in the decline of the Regent Honeyeater.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**

Invasive fauna species that pose a threat to the Regent Honeyeater, such as cats and foxes, are already present in the study area.

The proposal would not result in the introduction of any new invasive species to the study area.

- **introduce disease that may cause the species to decline, or**

No diseases that effect the Regent Honeyeater have been identified.

- **interfere with the recovery of the species**

A National Recovery Plan has been prepared for the Regent Honeyeater (DoE 2016). The strategies to achieve the objectives of the recovery plan are:

  - Improve the extent and quality of regent honeyeater habitat.
  - Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining.
  - Increase understanding of the size, structure, trajectory and viability of the wild population.
  - Maintain and increase community awareness, understanding and involvement in the recovery program.

The proposal would not interfere with any recovery plan objectives.

Conclusion

The proposal would require the removal of 22.61 hectares of potential foraging habitat for the Regent Honeyeater. Given the extremely low numbers of the species, this habitat would be rarely used and more suitable habitat is available in the locality. No known breeding sites occur in the region.

Given the availability of more suitable foraging habitat and absence of impact on breeding habitat, the proposal is unlikely to have a significant impact on the Regent Honeyeater.

Swift Parrot

The Swift Parrot (*Lathamus discolor*) is listed as Critically Endangered under the EPBC Act.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that

it will:

- **lead to a long-term decrease in the size of a population**

The Swift Parrot forages in woodlands and forests of the south-eastern mainland outside the breeding season. The proposal would result in the removal of up to 22.61 hectares of vegetation that includes some key tree foraging species – Forest Red Gum (*Eucalyptus tereticornis*) and Spotted Gum (*Corymbia maculata*). The vegetation may provide rarely used foraging habitat for the Swift Parrot, although larger areas of suitable habitat occur in the locality.

The Swift Parrot breeds exclusively in Tasmania.

The proposal is unlikely to result in a long-term decrease in the size of a population due to the availability of other better quality feeding habitat in the study area and the lack of impact to any breeding habitat.

- **reduce the area of occupancy of the species**

During the non-breeding season, the Swift Parrot occurs in the south-east of the mainland in parts of Victoria, NSW, ACT and Queensland.

The removal of a small area of potential foraging habitat in the middle of its range is unlikely to reduce the area of occupancy of the Swift Parrot.

- **fragment an existing population into two or more populations**

The study area occurs in a landscape that has already been fragmented by historical land uses including transport routes, farming, industry and residential areas, although many large areas of intact vegetation remain. The Swift Parrot is known to travel long distances from breeding sites to opportunistically forage on flowering eucalypts.

The proposal would require the removal of 22.61 hectares of vegetation along a major road and is unlikely to isolate or fragment any potential habitat for the Swift Parrot.

- **adversely affect habitat critical to the survival of a species**

The National Recovery Plan identifies habitat critical to the survival of the Swift Parrot as "areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team".

There are currently no priority sites identified in the study area. The proposal would result in the removal of up to 22.61 hectares of potential foraging habitat along a major road in an area where more suitable foraging habitat is available immediately adjacent to parts of the study area.

- **disrupt the breeding cycle of a population**

The Swift Parrot breeds exclusively in Tasmania.

The proposal would not create any barriers that may prevent individuals moving between foraging habitat in the locality and breeding sites.

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

The proposal would result in the removal of up to 22.61 hectares of potential foraging habitat along a major road in an area where more suitable foraging habitat is available immediately adjacent to parts of the study area. The low numbers of the species across its range mean habitat in the study area would be rarely used as a prolific flowering event would occur over a large area. No breeding habitat would be modified or isolated.

Loss of potential foraging habitat that would be rarely used is unlikely to result in the decline of the Swift Parrot.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**

Invasive fauna species that pose a threat to the Swift Parrot, such as cats and foxes, are already present in the study area.

The proposal would not result in the introduction of any new invasive species to the study area.

- **introduce disease that may cause the species to decline, or**

Psittacine beak and feather disease has been identified as a threat to the Swift Parrot. The disease is transmitted by infected birds and the proposal is unlikely to influence its prevalence or spread.

- **interfere with the recovery of the species**

A National Recovery Plan has been prepared for the Swift Parrot (Saunders and Tzaros 2011). The strategies to achieve the objectives of the recovery plan are:

  - Identify the extent and quality of habitat

- Manage and protect Swift Parrot habitat at the landscape scale
- Monitor and manage the impact of collisions, competition and disease
- Monitor population and habitat.

The proposal would not interfere with any recovery plan objectives.

Conclusion

The proposal would require the removal of up to 22.61 hectares of potential foraging habitat for the Swift Parrot. Given the extremely low numbers of the species, this habitat would be rarely used and more suitable habitat is available in the locality. No known breeding sites occur in NSW.

Given the availability of more suitable foraging habitat and absence of impact on breeding habitat, the proposal is unlikely to have a significant impact on the Swift Parrot.

Koala

The Koala (*Phascolarctos cinereus*) is listed as Endangered under the EPBC Act.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that

it will:

- **lead to a long-term decrease in the size of a population**

The proposal would result in the clearing of 15.73 hectares of vegetation that may provide potential foraging habitat for the Koala. This vegetation occurs along a major road and is unlikely to be used regularly given the availability of more suitable areas of vegetation in nearby nature reserves.

There are few records of the Koala in the region, suggesting that they are present in very low numbers. The Koala is currently at risk from vehicle strike and dog attacks, but of which are likely to be the main risk factors present.

Given the current risk and available habitat in the locality, the removal of a small area of vegetation adjacent to a major road is unlikely to reduce the size of a Koala population.

- **reduce the area of occupancy of the species**

The range of the Koala extends from Queensland through NSW and the ACT into Victoria.

Clearing of a small area of roadside habitat in western Sydney would not reduce the area of occupancy of this species.

- **fragment an existing population into two or more populations**

The Koala generally has a solitary existence, yet still has complex social hierarchies based on a dominant male with a territory overlapping several females with sub-ordinate males existing on the periphery. They are capable of moving through fragmented landscapes but are at risk of vehicle strikes and dog attacks as they move along the ground.

- **adversely affect habitat critical to the survival of a species**

Critical habitat for the Koala has been identified as areas that are relied on to halt decline and promote the recovery of the species. For koalas these are areas used in times of stress, to meet essential life cycle requirements, connect populations and habitat and ensure the long-term future through re-colonisation and reintroduction.

The following activities should be avoided to reduce impact of habitat critical to the survival of the Koala:

- Clearing of habitat used by Koalas for feeding and resting
- Reducing connectivity between patches of habitat used by Koalas for feeding, resting, commuting and dispersing (either by clearing of vegetation or by the erection of barriers to passage)
- Clearing of habitat used by Koalas during extreme events (heat waves, drought/fire refuge)
- Avoiding activities that will expose Koalas to additional threats (e.g. dogs, cars) in places where Koalas must use the ground to move between resting and feeding trees.

Although the proposal would result in the clearing of some vegetation, it is unlikely to be used often by the koala due to its proximity to a major road and the density of koalas in the locality is likely to be very low.

• **disrupt the breeding cycle of a population**
Females generally produce one offspring per year, with breeding influenced by the availability of food, climate and population density. The proposal is unlikely to significantly influence the availability of food resources that would result in changes to the breeding activity of a koala population. It would also not influence the ability of any koalas to disperse from their natal home range.
• **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**
The proposal would result in the removal of 15.73 hectares of native vegetation along the edge of a major road. Koalas are expected to occur in low density and more suitable habitat is available in the locality. Any increase in risk associated with vehicle strike during construction will be very minor and temporary. The removal of vegetation along a major road is unlikely to result in a decline of the Koala population.
• **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**
Invasive fauna species that pose a threat to the Koala, such as dogs, are already present in the study area. Invasive flora species may reduce the quality of the habitat available and inhibit the movement of koala amongst and between trees, however many of these species are already abundant in the study area. Mitigation measures have been proposed to reduce the spread of weed species. The proposal is unlikely to result in the introduction of any new invasive species to the study area.
• **introduce disease that may cause the species to decline, or**
Infections by the bacterium *Chlamydia pecorum* is a concern to Koala populations. It is not expected that the proposal would influence the prevalence of this disease in the study area or introduce any other disease that may affect Koalas.
• **interfere with the recovery of the species**
The Department of Agriculture, Water and the Environment has prepared the *National Recovery Plan for the Koala Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (DAWE 2022). Objectives of the plan are: – The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased – The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased – Metapopulation processes are maintained or improved – Partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation and management. The proposal is unlikely to interfere with any of these recovery objectives.
Conclusion
The proposal would result in the removal of 15.73 hectares of native vegetation along the edge of a major road. Koalas are expected to occur in low density and more suitable habitat is available in the locality. The proposal is therefore unlikely to have a significant impact on the Koala.

Grey-headed Flying-fox

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under the EPBC Act.

According to the National Recovery Plan for the Grey-headed Flying-fox (DAWE 2021), the species is a single, mobile population across its range. Therefore, this population is considered an important population.

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**

Grey-headed Flying-foxes forage opportunistically on fruits and flowers across a large range. They roost and breed in camps that are used repeatedly between years.

The proposal would result in the removal of 22.61 hectares of potential foraging habitat for the Grey-headed Flying-fox in vegetation that occurs along a major road. No camps would be affected although many occur within foraging range of the study area.

Due to the absence of nearby camps and availability of food resources in the region, the proposal is unlikely to lead to a long-term decrease in the Grey-headed Flying-fox population.

- **reduce the area of occupancy of an important population**

The area of occupancy of the Grey-headed Flying-fox extends along the east coast of Australia from Queensland to South Australia. The proposed removal of potential Grey-headed Flying-fox foraging habitat in a linear strip along the edge of a major road would not reduce the area of occupancy of the species.

- **fragment an existing important population into two or more populations**

The Grey-headed Flying-fox can undertake long-distance movements in response to the availability of feeding resources. The removal of vegetation along the edge of an existing major road is unlikely to fragment the Grey-headed Flying-fox population.

- **adversely affect habitat critical to the survival of a species**

Habitat critical to the survival of the Grey-headed Flying-fox is identified as important winter and spring flowering vegetation. 22.61 hectares of vegetation containing some of these species would be removed. *Eucalyptus crebra* and *E. fibrosa* were recorded in the study area and are important species for foraging. Clearing would occur along a disturbed roadside edge and mitigation measures have been proposed to prioritise retention of large trees that could be used for foraging. Within the locality, there are large areas of better quality vegetation with the same PCT as those identified in the study area.

The proposal is unlikely to have an adverse effect on habitat critical to the survival of the Grey-headed Flying-fox due to their wide foraging range and availability of large areas of suitable habitat in the locality that are not immediately adjacent to a major road.

- **disrupt the breeding cycle of an important population**

Grey-headed Flying-foxes breed in large numbers in camps that are used repeatably over the years. No flying-fox camps were identified in the study area. The nearest camps occur at Yarramundi, Emu Plains and Windsor.

The proposal is unlikely to disrupt the breeding cycle of any Grey-headed Flying-foxes.

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

The proposed would result in the removal of 22.61 hectares of suitable foraging habitat for the Grey-headed Flying-fox. No roost camps would be affected.

The removal of potential foraging habitat along a major road in an area with extensive areas of more suitable habitat is unlikely to result in the decline of the Grey-headed Flying-fox.

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

No invasive species are considered relevant to the Grey-headed Flying-fox in the study area and none would be introduced by the proposal.

- **introduce disease that may cause the species to decline, or**

No diseases are considered relevant to the Grey-headed Flying-fox in the study area and none would be introduced by the proposal.
• **interfere substantially with the recovery of the species**
A National Recovery Plan has been prepared for the Grey-headed Flying-fox (DAWE 2021). The proposal will not interfere with any of the recovery objectives or priority actions outlined in the plan.
Conclusion
The proposal would result in the removal of up to 22.61 hectares of vegetation along the edge of a major road. No camps would be affected, and more suitable foraging habitat occurs in the locality. The proposal is therefore unlikely to have a significant impact on the Grey-headed Flying-fox.

Appendix F: Biodiversity credit reports

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00040680/BAAS18170/24/00048206	Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Improvements	14/03/2024
Assessor Name	Report Created	BAM Data version *
Gregg Z Goldin	23/05/2024	67
Assessor Number	BAM Case Status	Date Finalised
BAAS18170	Open	To be finalised
Assessment Revision	Assessment Type	
0	Part 5 Activities	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Castlereagh Ironbark Forest												
1	3448_Moderate	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	48.4	48.4	3	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	73
2	3448_Good	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	79.3	79.3	0.96	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	38
											Subtotal	**111**
Castlereagh Scribbly Gum Woodland												
3	3629_Moderate	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	42.1	42.1	4.4	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Vulnerable Ecological Community	Not Listed	1.75		81
4	3629_Good	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	49.2	49.2	3	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Vulnerable Ecological Community	Not Listed	1.75		65
											Subtotal	**146**

Castlereagh Shrubby Swamp Woodland											
6	3628_Moderate	Castlereagh Swamp Woodland Community	100	100.0	0.29	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	15
										Subtotal	**15**
Cumberland Shale Plains Woodland											
5	3320_Moderate	Cumberland Plain Woodland in the Sydney Basin Bioregion	25	25.0	0.58	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Critically Endangered Ecological Community	Not Listed	2.50	True	9
										Subtotal	**9**
										Total	**281**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Dillwynia tenuifolia / Dillwynia tenuifolia (Flora)									
3448_Moderate	48.4	48.4	2.8	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	67

3448_Good	79.3	79.3	0.95	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	38
3629_Moderate	42.1	42.1	3.9	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	83
3629_Good	49.2	49.2	3	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	74
								Subtotal	**262**
Grevillea juniperina subsp. juniperina / Juniper-leaved Grevillea (Flora)									
3448_Moderate	48.4	48.4	1.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	33
3448_Good	79.3	79.3	0.95	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	28

3629_Moderate	42.1	42.1	1.9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	30
3629_Good	49.2	49.2	2.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	40
3320_Moderate	25.0	25.0	0.21	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	2
								Subtotal	**133**
Marsdenia viridiflora subsp. viridiflora - endangered population / Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas (Flora)									
3448_Moderate	48.4	48.4	0.84	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered Population	Not Listed	False	20
3448_Good	79.3	79.3	0.09	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered Population	Not Listed	False	4

3320_Moderate	25.0	25.0	0.19	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered Population	Not Listed	False	2
								Subtotal	**26**
Meridolum corneovirens / Cumberland Plain Land Snail (Fauna)									
3448_Moderate	48.4	48.4	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Not Listed	False	73
3448_Good	79.3	79.3	0.96	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Not Listed	False	38
3629_Moderate	42.1	42.1	4.4	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Not Listed	False	93
3629_Good	49.2	49.2	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Not Listed	False	74

3320_Moderate	25.0	25.0	0.58	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Not Listed	False	7
3628_Moderate	100.0	100.0	0.29	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Not Listed	False	15
								Subtotal	**300**
Micromyrtus minutiflora / Micromyrtus minutiflora (Flora)									
3448_Moderate	48.4	48.4	1.6	Rate of decline	Ecology or response to management is poorly known	Endangered	Vulnerable	True	58
3448_Good	79.3	79.3	0.7	Rate of decline	Ecology or response to management is poorly known	Endangered	Vulnerable	True	42
3629_Moderate	42.1	42.1	2.3	Rate of decline	Ecology or response to management is poorly known	Endangered	Vulnerable	True	73

3629_Good	49.2	49.2	3	Rate of decline	Ecology or response to management is poorly known	Endangered	Vulnerable	True	111
								Subtotal	**284**
Myotis macropus / Southern Myotis (Fauna)									
3448_Moderate	48.4	48.4	2.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	54
3448_Good	79.3	79.3	0.92	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	36
3629_Moderate	42.1	42.1	3.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	67
3629_Good	49.2	49.2	1.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	32
3320_Moderate	25.0	25.0	0.38	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	5
								Subtotal	**194**

Ninox strenua / Powerful Owl (Fauna)									
3448_Moderate	48.4	48.4	3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	73
3448_Good	79.3	79.3	0.96	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	38
3629_Moderate	42.1	42.1	4.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	93
3629_Good	49.2	49.2	3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	74
3320_Moderate	25.0	25.0	0.58	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	7
3628_Moderate	100.0	100.0	0.29	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	15
								Subtotal	**300**

Persoonia nutans / Nodding Geebung (Flora)									
3448_Moderate	48.4	48.4	1.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	26
3448_Good	79.3	79.3	0.7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	28
3629_Moderate	42.1	42.1	1.9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	40
3629_Good	49.2	49.2	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	74
								Subtotal	**168**
Phascolarctos cinereus / Koala (Fauna)									
3448_Moderate	48.4	48.4	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	73

3448_Good	79.3	79.3	0.96	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	38
3629_Moderate	42.1	42.1	3.7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	77
3629_Good	49.2	49.2	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	74
3628_Moderate	100.0	100.0	0.19	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	10
								Subtotal	**272**
Pultenaea parviflora / Pultenaea parviflora (Flora)									
3448_Moderate	48.4	48.4	2.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	51

3448_Good	79.3	79.3	0.78	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	31
3629_Moderate	42.1	42.1	0.24	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	5
3629_Good	49.2	49.2	2.3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	57
								Subtotal	**144**

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00040680/BAAS18170/24/00048206

Proposal Name
Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Improvements

BAM data last updated *
14/03/2024

Assessor Name
Gregg Z Goldin

Assessor Number
BAAS18170

BAM Data version *
67

Proponent Names

Report Created
23/05/2024

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Part 5 Activities

Date Finalised
To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered Ecological Community	3448-Castlereagh Ironbark Forest
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	3320-Cumberland Shale Plains Woodland

Species
Micromyrtus minutiflora / Micromyrtus minutiflora

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Ephippiorhynchus asiaticus / Black-necked Stork
Grantiella picta / Painted Honeyeater
Ixobrychus flavicollis / Black Bittern
Haliaeetus leucogaster / White-bellied Sea-Eagle

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3448-Castlereagh Ironbark Forest	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	4.0	38	73	111
3629-Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	7.4	146	0	146
3320-Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.6	9	0	9
3628-Castlereagh Shrubby Swamp Woodland	Castlereagh Swamp Woodland Community	0.3	0	15	15

3320-Cumberland Shale Plains Woodland

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 3319, 3320	-	3320_Moderate	Yes	9	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3448-Castlereagh Ironbark Forest

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion This includes PCT's: 3448	-	3448_Moderate	No	73	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion This includes PCT's: 3448	-	3448_Good	Yes	38	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
3628-Castlereagh Shrubby Swamp Woodland	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Castlereagh Swamp Woodland Community This includes PCT's: 3628, 3958	-	3628_Moderate	No	15	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3628-Castlereagh Shrubby Swamp Woodland

3629-Castlereagh Scribbly Gum Woodland

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 3629	-	3629_Moderate	Yes	81	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 3629	-	3629_Good	Yes	65	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Vegetation Zone/s	Area / Count	Credits
Dillwynia tenuifolia / Dillwynia tenuifolia	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good**	10.7	262.00
Grevillea juniperina subsp. juniperina / Juniper-leaved Grevillea	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good, 3320_Moderate**	7.0	133.00
Marsdenia viridiflora subsp. viridiflora - endangered population / Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	**3448_Moderate, 3448_Good, 3320_Moderate**	1.1	26.00
Meridolum corneovirens / Cumberland Plain Land Snail	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good, 3320_Moderate, 3628_Moderate**	12.3	300.00
Micromyrtus minutiflora / Micromyrtus minutiflora	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good**	7.6	284.00
Myotis macropus / Southern Myotis	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good, 3320_Moderate**	8.0	194.00
Ninox strenua / Powerful Owl	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good, 3320_Moderate, 3628_Moderate**	12.3	300.00
Persoonia nutans / Nodding Geebung	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good**	6.7	168.00

Phascolarctos cinereus / Koala	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good, 3628_Moderate**	10.8	272.00
Pultenaea parviflora / Pultenaea parviflora	**3448_Moderate, 3448_Good, 3629_Moderate, 3629_Good**	5.4	144.00

Credit Retirement Options

Like-for-like credit retirement options

Dillwynia tenuifolia / Dillwynia tenuifolia	Spp	IBRA subregion
	Dillwynia tenuifolia / Dillwynia tenuifolia	Any in NSW
Grevillea juniperina subsp. juniperina / Juniper-leaved Grevillea	Spp	IBRA subregion
	Grevillea juniperina subsp. juniperina / Juniper-leaved Grevillea	Any in NSW
Marsdenia viridiflora subsp. viridiflora - endangered population / Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Spp	IBRA subregion
	Marsdenia viridiflora subsp. viridiflora - endangered population / Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Any in NSW
Meridolum corneovirens / Cumberland Plain Land Snail	Spp	IBRA subregion
	Meridolum corneovirens / Cumberland Plain Land Snail	Any in NSW

Micromyrtus minutiflora / Micromyrtus minutiflora	Spp	IBRA subregion
	Micromyrtus minutiflora / Micromyrtus minutiflora	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Ninox strenua / Powerful Owl	Spp	IBRA subregion
	Ninox strenua / Powerful Owl	Any in NSW
Persoonia nutans / Nodding Geebung	Spp	IBRA subregion
	Persoonia nutans / Nodding Geebung	Any in NSW
Phascolarctos cinereus / Koala	Spp	IBRA subregion
	Phascolarctos cinereus / Koala	Any in NSW
Pultenaea parviflora / Pultenaea parviflora	Spp	IBRA subregion
	Pultenaea parviflora / Pultenaea parviflora	Any in NSW

BAM Candidate Species Report

Proposal Details

Assessment Id 00040680/BAAS18170/24/00048206	Proposal Name Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Improvements	BAM data last updated * 14/03/2024
Assessor Name Gregg Z Goldin	Report Created 23/05/2024	BAM Data version * 67
Assessor Number BAAS18170	Assessment Type Part 5 Activities	BAM Case Status Open
Assessment Revision 0	Date Finalised To be finalised	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

List of Species Requiring Survey

Name	Presence	Survey Months
Dillwynia tenuifolia Dillwynia tenuifolia	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Grevillea juniperina subsp. juniperina Juniper-leaved Grevillea	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Marsdenia viridiflora subsp. viridiflora - endangered population Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Meridolum corneovirens Cumberland Plain Land Snail	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Micromyrtus minutiflora Micromyrtus minutiflora	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Myotis macropus Southern Myotis	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Ninox strenua Powerful Owl	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Persoonia nutans Nodding Geebung	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus Koala	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Pultenaea parviflora Pultenaea parviflora	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Allocasuarina glareicola	Allocasuarina glareicola	Refer to BAR
Bargo Geebung	Persoonia bargoensis	Refer to BAR
Barking Owl	Ninox connivens	Refer to BAR
Broad-billed Sandpiper	Limicola falcinellus	Habitat constraints
Brown Pomaderris	Pomaderris brunnea	Refer to BAR
Bush Stone-curlew	Burhinus grallarius	Refer to BAR
Bynoe's Wattle	Acacia bynoeana	Refer to BAR
Camden White Gum	Eucalyptus benthamii	Refer to BAR
Deyeuxia appressa	Deyeuxia appressa	Refer to BAR

Dillwynia tenuifolia, Kemps Creek	Dillwynia tenuifolia - endangered population	Refer to BAR
Downy Wattle	Acacia pubescens	Refer to BAR
Dural Land Snail	Pommerhelix duralensis	Refer to BAR
Eastern Australian Underground Orchid	Rhizanthella slateri	Refer to BAR
Eastern Osprey	Pandion cristatus	Habitat constraints
Eastern Pygmy-possum	Cercartetus nanus	Refer to BAR
Epacris purpurascens var. purpurascens	Epacris purpurascens var. purpurascens	Refer to BAR
Gang-gang Cockatoo	Callocephalon fimbriatum	Refer to BAR
Giant Burrowing Frog	Heleioporus australiacus	Refer to BAR
Gosford Wattle, Hurstville and Kogarah Local Government Areas	Acacia prominens - endangered population	Refer to BAR
Green and Golden Bell Frog	Litoria aurea	Refer to BAR
Grey-headed Flying-fox	Pteropus poliocephalus	Refer to BAR
Hairy Geebung	Persoonia hirsuta	Refer to BAR
Hibbertia fumana	Hibbertia fumana	Refer to BAR
Hibbertia puberula	Hibbertia puberula	Refer to BAR
Hibbertia sp. Bankstown	Hibbertia sp. Bankstown	Refer to BAR
Large Bent-winged Bat	Miniopterus orianae oceanensis	Refer to BAR
Large-eared Pied Bat	Chalinolobus dwyeri	Habitat constraints
Little Bent-winged Bat	Miniopterus australis	Refer to BAR
Little Eagle	Hieraaetus morphnoides	Refer to BAR
Long-nosed Bandicoot population in inner western Sydney	Perameles nasuta - endangered population	Geographic limitations
Masked Owl	Tyto novaehollandiae	Refer to BAR
Matted Bush-pea	Pultenaea pedunculata	Refer to BAR
Netted Bottle Brush	Callistemon linearifolius	Refer to BAR
P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	Pomaderris prunifolia - endangered population	Refer to BAR

Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	Refer to BAR
Regent Honeyeater	Anthochaera phrygia	Habitat constraints
Slaty Red Gum	Eucalyptus glaucina	Refer to BAR
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	Refer to BAR
South-eastern Glossy Black-Cockatoo	Calyptorhynchus lathami lathami	Refer to BAR
Southern Greater Glider	Petauroides volans	Refer to BAR
Spiked Rice-flower	Pimelea spicata	Refer to BAR
Square-tailed Kite	Lophoictinia isura	Refer to BAR
Squirrel Glider	Petaurus norfolcensis	Refer to BAR
Swift Parrot	Lathamus discolor	Habitat constraints
Sydney Plains Greenhood	Pterostylis saxicola	Refer to BAR
Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	Wahlenbergia multicaulis - endangered population	Geographic limitations
White-bellied Sea-Eagle	Haliaeetus leucogaster	Habitat constraints
Woronora Beard-heath	Leucopogon exolasius	Refer to BAR

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00040680/BAAS18170/24/00048206	Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Improvements	14/03/2024
Assessor Name	**Report Created**	**BAM Data version ***
Gregg Z Goldin	23/05/2024	67
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS18170	Part 5 Activities	Open
Assessment Revision		**Date Finalised**
0		To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Black Falcon	Falco subniger	3448-Castlereagh Ironbark Forest
		3320-Cumberland Shale Plains Woodland
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Broad-billed Sandpiper	Limicola falcinellus	3629-Castlereagh Scribbly Gum Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Diamond Firetail	Stagonopleura guttata	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland

Dusky Woodswallow	Artamus cyanopterus cyanopterus	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
Eastern False Pipistrelle	Falsistrellus tasmaniensis	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
Eastern Osprey	Pandion cristatus	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Flame Robin	Petroica phoenicea	3448-Castlereagh Ironbark Forest
		3320-Cumberland Shale Plains Woodland
Gang-gang Cockatoo	Callocephalon fimbriatum	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Greater Broad-nosed Bat	Scoteanax rueppellii	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
Grey-headed Flying-fox	Pteropus poliocephalus	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Large Bent-winged Bat	Miniopterus orianae oceanensis	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
Little Bent-winged Bat	Miniopterus australis	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
Little Eagle	Hieraaetus morphnoides	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland

Little Eagle	Hieraaetus morphnoides	3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Little Lorikeet	Glossopsitta pusilla	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Regent Honeyeater	Anthochaera phrygia	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Rosenberg's Goanna	Varanus rosenbergi	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Scarlet Robin	Petroica boodang	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
South-eastern Glossy Black-Cockatoo	Calyptorhynchus lathami lathami	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
South-eastern Hooded Robin	Melanodryas cucullata cucullata	3629-Castlereagh Scribbly Gum Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Speckled Warbler	Chthonicola sagittata	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Spotted Harrier	Circus assimilis	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Spotted-tailed Quoll	Dasyurus maculatus	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland

Square-tailed Kite	Lophoictinia isura	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Swift Parrot	Lathamus discolor	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Turquoise Parrot	Neophema pulchella	3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
Varied Sittella	Daphoenositta chrysoptera	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
White-throated Needletail	Hirundapus caudacutus	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Common Name	Scientific Name	Plant Community Type(s)
Black Bittern	Ixobrychus flavicollis	3448-Castlereagh Ironbark Forest
Black-necked Stork	Ephippiorhynchus asiaticus	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
Painted Honeyeater	Grantiella picta	3629-Castlereagh Scribbly Gum Woodland
		3628-Castlereagh Shrubby Swamp Woodland

South-eastern Glossy Black-Cockatoo	Calyptorhynchus lathami lathami	3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland
White-bellied Sea-Eagle	Haliaeetus leucogaster	3448-Castlereagh Ironbark Forest
		3629-Castlereagh Scribbly Gum Woodland
		3320-Cumberland Shale Plains Woodland
		3628-Castlereagh Shrubby Swamp Woodland

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Black Bittern	Ixobrychus flavicollis	Habitat constraints
Black-necked Stork	Ephippiorhynchus asiaticus	Habitat constraints
Painted Honeyeater	Grantiella picta	Habitat constraints
White-bellied Sea-Eagle	Haliaeetus leucogaster	Habitat constraints

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