6.3 Biodiversity

The potential impacts on biodiversity during construction and operation of the proposal have been assessed as part of the *Great Western Highway Upgrade East Biodiversity Assessment Report* (BAR) (Transport, 2022), provided in Appendix E.

6.3.1 Methodology

The methodology for the BAR included:

- identification of the biodiversity study area as the area that would be subject to direct impacts (proposal area) and some areas of potential habitat beyond that boundary (refer to Figure 6-2)
- a review of relevant literature, databases and existing vegetation mapping to identify vegetation, threatened flora and fauna and Threatened Ecological Communities (TECs) that are listed under both NSW and Commonwealth legislation, with potential to occur within a 10 kilometre radius of the study area, including:
  - Department of Planning and Environment (DPE) BioNet, Atlas of NSW Wildlife
  - Department of Agriculture, Water and Environment (DAWE) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool
  - Threatened Biodiversity Data Collection
  - Directory of Important Wetlands of Australia published by Environment Australia
  - Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (GDE)
  - Species Profile and Threats database for EPBC listed threatened species and communities
  - Biodiversity Assessment Method Calculator (BAM-C) for prescribed and candidate threatened biodiversity
- field surveys of the study area to identify and assess biodiversity values in accordance with the Biodiversity Assessment Methodology (BAM) and relevant threatened biodiversity survey guidelines
- an assessment of 'likelihood of occurrence' following the collation of database records and species and community profiles
- assessing the potential impacts to flora, fauna and migratory species within the proposal area including assessments of significance where required
- identification of construction and operational management measures as well as the need for biodiversity offsets.

Biodiversity field surveys for the proposal were carried out for the following seasons:

- Spring/Summer 2020 (14 October – 17 December 2020)
- Winter 2021 (15 – 20 June 2021)
- Spring 2021 (13 – 18 September 2021)
- Summer 2021 (6 December 2021 – 11 January 2022)
- Autumn 2022 (11 March 2022).

These surveys were carried out in accordance with the BAM and included:

- floristic and BAM plots to determine Plant Community Type (PCT) and condition
- habitat mapping (hollow-bearing tree survey, watercourses, rocky outcrops, fallen woody debris and ground refugia, feed trees, nests)
- spotlighting for nocturnal mammals and birds (Winter 2021 and Spring 2021 survey)
- stagwatching (hollow watching) for nesting Glossy Black-Cockatoos (Spring 2021 survey)
- stagwatching (hollow watching) for nesting Gang-gang Cockatoos (Summer 2021 survey)
- terrestrial and arboreal baited camera trapping (Spring 2020 and Summer 2021 survey)

- anabat deployment and analysis (Spring 2020 and Summer 2021 survey)
- opportunistic fauna observations
- targeted threatened flora surveys
- dry pitfall trapping for Blue Mountains Water Skink (*Eulamprus leuraensis*) in Blue Mountains Swamp habitat (Summer 2021 survey)
- targeted survey for Giant Dragonfly (*Petalura gigantea*) in Blue Mountains Swamp habitat (Summer 2021 survey).

The field survey methodology for the proposal is explained further in Section 2 of the BAR, attached to the REF as Appendix E.

6.3.2 Existing environment

The proposal is located in the Wollemi subregion of the Sydney Basin bioregion. The existing environment of topography, geology and soils, surface water and hydrogeology related to the assessment of biodiversity is discussed in Section 6.1.2.

The study area is surrounded by native vegetation to the north, north-east, west and south-west and is moderately to well-connected to the adjoining Blue Mountains National Park. However, parts of the study area have been previously impacted by historical land clearing, residential and commercial development and existing infrastructure. This has slightly reduced the vegetation connectivity in parts of the study area.

Native vegetation

There is 68.80 hectares of native vegetation and 15.11 hectares of non-native vegetation within the study area. Three PCTs were recorded within the study area:

- PCT 1248 – *Sydney Peppermint – Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion*
- PCT 967 – *Narrow-leaved Peppermint – Silvertop Ash – Mountain Grey Gum shrubby open forest of the upper Blue Mountains, Sydney Basin Bioregion*
- PCT 1078 – *Prickly Tea-tree – sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion.*

Different vegetation condition classes were identified where obvious differences in structure and quality occurred, resulting in three PCTs and six vegetation conditions. A summary of PCTs and associated vegetation conditions is presented in Table 6-12.

PCT 1078 was recorded in one location on intermittently waterlogged soils in a moderate condition with a variety of common wet ferns, sedges and shrubs. This PCT was the only PCT recorded which corresponded to a TEC listed under the *Biodiversity Conservation Act 2016* (BC Act) (Blue Mountains Swamps in the Sydney Basin Bioregion vulnerable ecological community) and EPBC Act (Temperate Highland Peat Swamps on Sandstone endangered ecological community), referred to collectively as Blue Mountains Swamp TEC.

Areas of PCT 967 were mostly aligned with creeks or depressions and had a greater diversity and abundance of more mesic understorey species compared to surrounding vegetation communities. PCT 1248 is widely distributed and variable across much of the study area. Areas highly disturbed by development, powerlines and maintenance access were of lower condition and had less canopy cover, lower species diversity and typically higher abundance of exotic species.

All six vegetation zones reflected the edge effects from the existing road, including weed occurrence, sedimentation, erosion and some debris. Historical and current clearing is evident across the site.

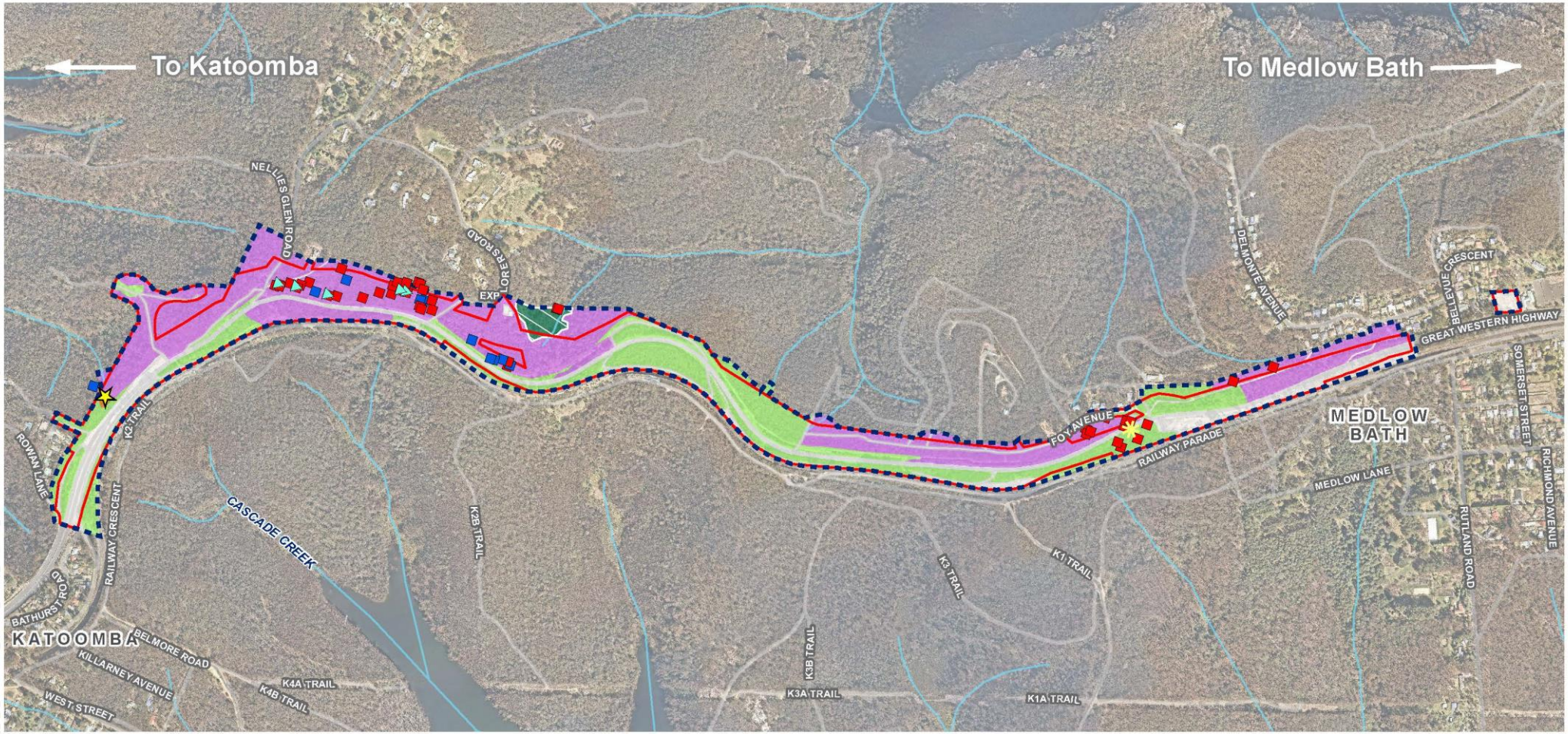
No potential GDEs were identified within the study area that are listed in the Bureau of Meteorology Atlas of GDEs. However, it is known that PCT 1078 is reliant on a combination of surface and groundwater flows. PCT 1078 are formed via groundwater that seeps through permeable sandstone layer and are reliant on groundwater discharge.

The extent of vegetation within the study area is shown in Figure 6-2.

Table 6-12: Plant community types

Vegetation Zone	Vegetation Condition (BAM-C)	Threatened Ecological Community	PCT Cleared Extent	Area within the study area (ha)
PCT 1248	Moderate	Does not align to any TEC	20	43.33
PCT 1248	Low			23.50
PCT 1248	Degraded			0.30
PCT 967	Moderate	Does not align to any TEC	5	0.90
PCT 967	Low			0.06
PCT 1078	Moderate	• Blue Mountains Swamps in the Sydney Basin Bioregion listed as Vulnerable under the BC Act. • Forms part of the TEC Temperate Highland Peat Swamps on Sandstone listed as Endangered under the EPBC Act.	-	0.71
Total native vegetation				68.80
Total non-native vegetation / cleared areas*				15.11
Total area				83.91

* Non-native vegetation / cleared areas comprise areas of planted vegetation or cleared areas including: the existing Great Western Highway, services, footpaths.



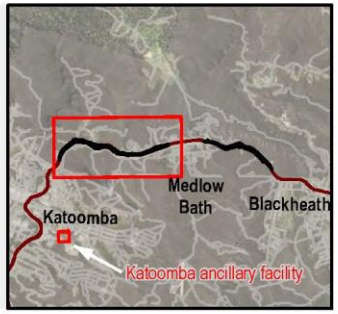
Proposal area
Study area
Culvert
Hollow-bearing stag
Hollow-bearing tree
Fallen timber
Potential cockatoo nest trees (as defined by the BAM)

TEC

1078, Moderate

Validated vegetation and condition (PCT)

0, Non-native / cleared areas
967, Low
1078, Moderate
1248, Moderate
1248, Low



P:\GIS\Project-4\project511168_GWH\GWHE_REF_Fig_6_4_Threatened_species_survey_locations_K2M.mxd\JOB No.\14-04-22\Virgil.Robinson\Rev 0

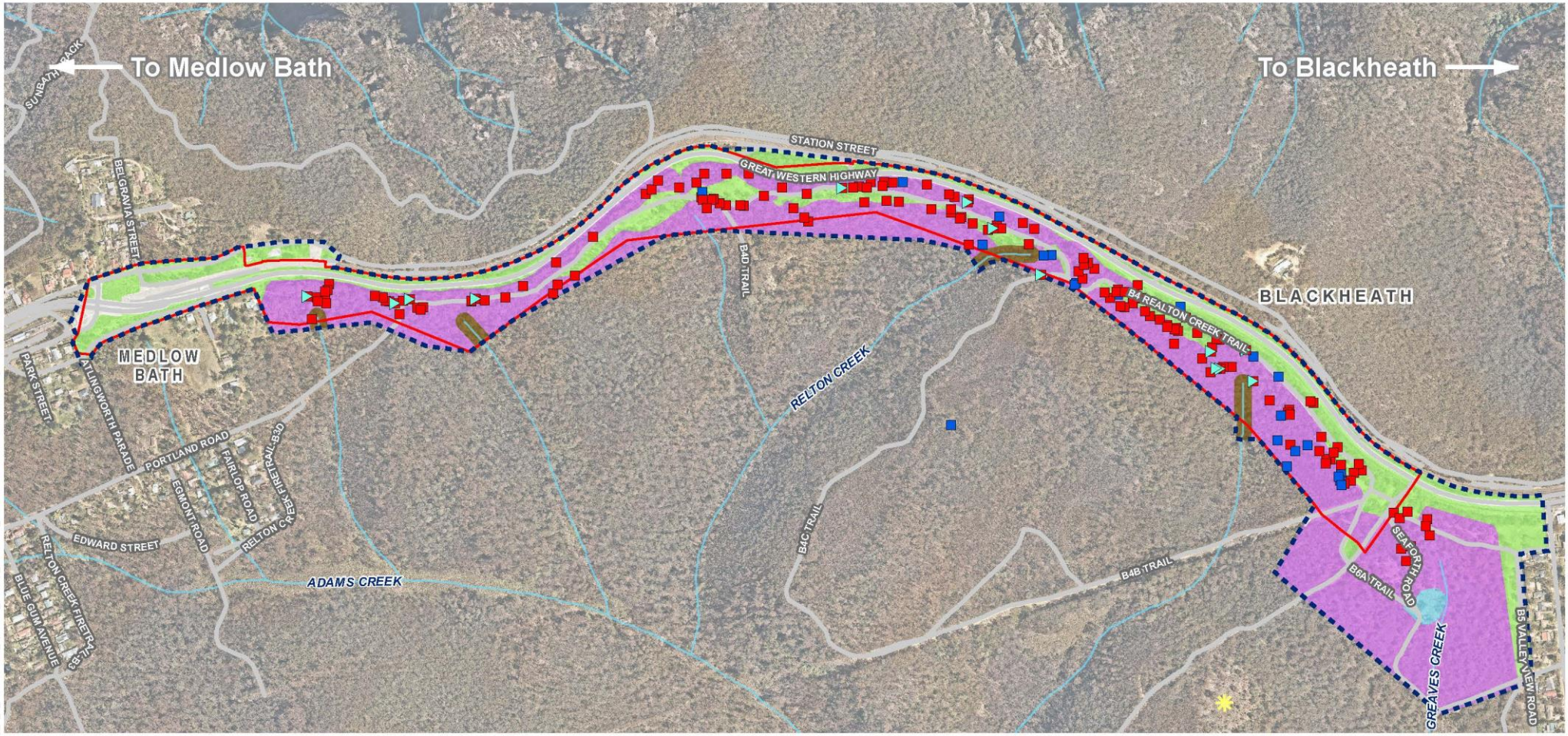
Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:13,500@A4
0 150 300m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

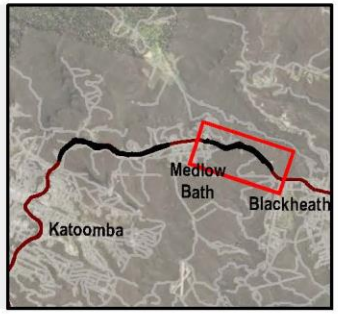
FIGURE 6-2a: Threatened species survey locations



Proposal area
Study area
Culvert
Hollow-bearing stag
Hollow-bearing tree
Fallen timber
Potential cockatoo nest trees (as defined by the BAM)

Validated vegetation and condition (PCT)

0, Non-native / cleared areas
967, Moderate
1248, Moderate
1248, Low
1248, Degraded



P:\GIS\Project-4\project511168_GWH\GWHE_REF_Fig_6_4_Threatened_species_survey_locations_M2B.mxd\JOB No.\21-10-21\Virgil.RobinsonRev 0

Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:10,000@A4
0 100 200m

Projection: GDA2020 MGA Zone 56

Great Western Highway East **Review of Environmental Factors**

FIGURE 6-2b: Threatened species survey locations

Threatened fauna species and habitat

The desktop searches carried out for the proposal identified 67 threatened fauna species as occurring or having potential habitat within the study area or generated by the BAM-C. Forty four threatened fauna species were considered in the biodiversity assessment due to there being a moderate to high likelihood of occurrence of the species within the study area or the species being identified by the BAM-C. This includes:

- 31 species listed under the BC Act only
- one species listed under the EPBC Act only
- 12 species listed under both the BC Act and EPBC Act.

A total of 66 fauna species were recorded during field surveys, comprising three reptiles, 29 birds, 33 mammals and one frog. Eight threatened fauna species were recorded during the field surveys including:

- Eastern Pygmy-possum (*Cercartetus nanus*)
- Large Bentwing-bat (*Miniopterus orianae oceanensis*)
- Little Bentwing-bat (*Miniopterus australis*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Freetail Bat (*Micronomous norfolkensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*).

The locations where the threated species were recorded during the field surveys are shown in Figure 6-3.

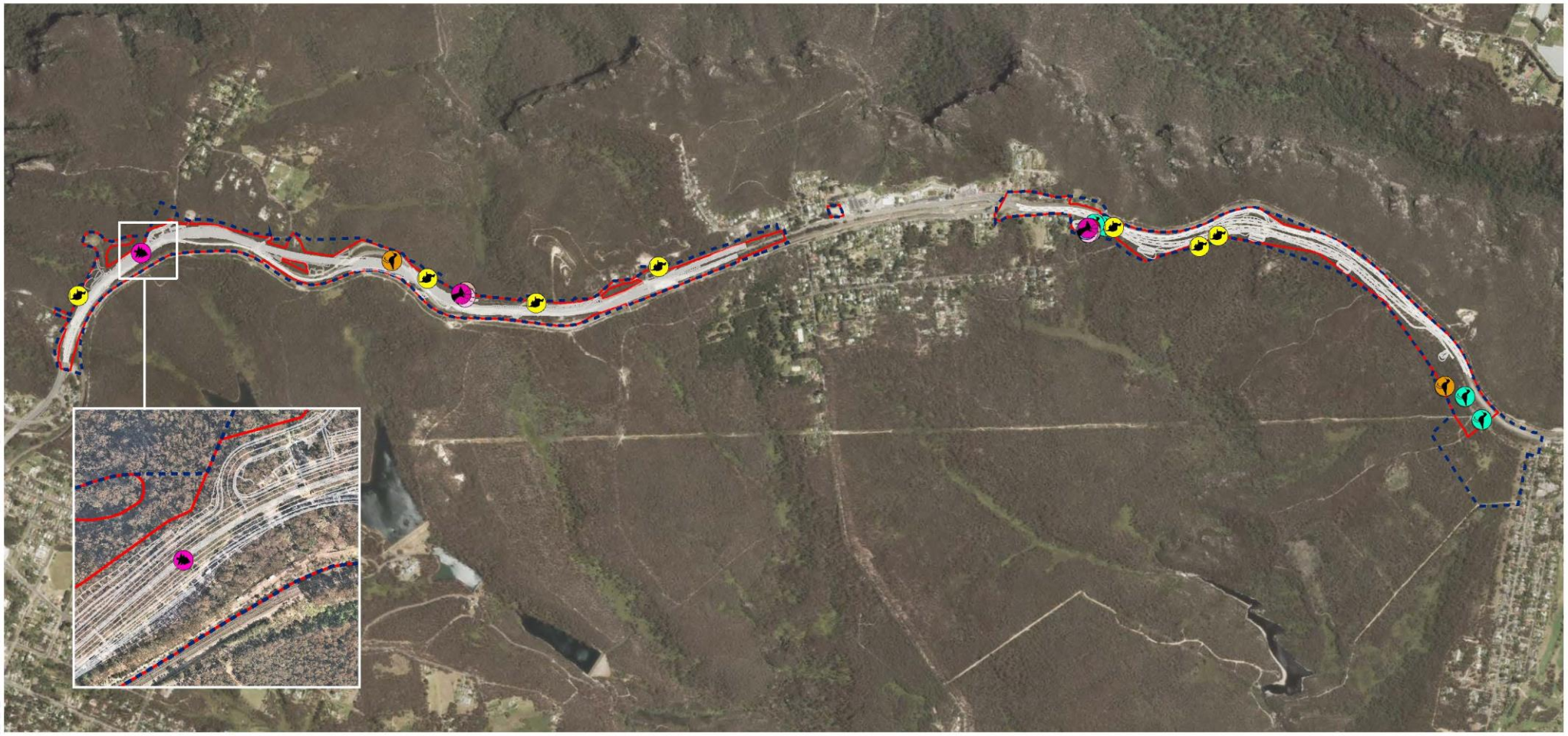
The habitats that occur within the study area consist of moderately to highly connected woody/forest habitat types comprising the PCTs discussed in the previous section. These occupy about 90 per cent of the study area. Some of these areas are mildly disturbed by edge-effects and fragmentation from existing and previous urban encroachment. However, forest habitats within the study area have moderate to high connectivity with large patches of native vegetation especially within the Blue Mountains National Park in the Medlow Bath to Blackheath section. They are considered likely to support a high diversity of both sedentary and transient native fauna species, including birds, reptiles, mammals and frogs.

The fauna habitats that occur within the study area consist of woodland habitat types comprising of the PCTs discussed in the previous section. Mid-storey vegetation across native vegetation ranged from moderately dense to patchy and consisted primarily of native species. The study area generally supports a good amount of ground cover for small mammals and reptiles, fallen woody debris, thick to patchy leaf litter cover and an abundance of feed trees. The habitats facilitate fauna movement throughout the region. The study area is included within a recognised ‘fauna corridor’ under the *Blue Mountains Local Environment Plan 2015*. However, the existing Great Western Highway road corridor is likely to prevent most terrestrial and arboreal species reaching connected habitat in surrounding areas.

There were also 231 hollow-bearing trees identified within the study area. The diameter at breast height (DBH) of hollow-bearing trees was observed to be between 15 and 250 centimetres. The hollow-bearing trees were predominantly *Eucalyptus sieberi* and *Eucalyptus oreades*, with the size of the hollows ranging from less than 5 to 30 centimetres. The only fauna species observed leaving any hollows during the survey were Rainbow Lorikeets (*Trichoglossus haematodus*) and Sulphur-crested Cockatoo (*Cacatua galerita*). There are 18 hollow-bearing trees that have potential to be Gang-gang Cockatoo nest trees.

One culvert (500-millimetre pipe) that could provide fauna habitat was identified in the Katoomba to Medlow Bath section and was considered to provide marginal habitat for roosting bats.

Threatened species habitats are shown on Figure 6-2. Areas of habitat close to the road edges, are likely to be subject to a high level of noise and light pollution. These factors likely limit these areas to only being suitable for highly urban tolerant species.



Design
Proposal area
Study area

Threatened species recorded

Brown Treecreeper (eastern subspecies)
Eastern Freetail Bat
Eastern Pygmy-possum
Gang-gang Cockatoo (foraging only)
Greater Broad-nosed Bat
Large Bentwing-bat
Little Bentwing-bat
Yellow-bellied Sheathtail Bat
Persoonia acerosa

P:\GIS\Project-4\project\511168_GWH\GWHE_REF_Fig_6_5_ThreatenedSpeciesRecorded.mxd\JOB No.\14-04-22\Virgil Robinson\Rev 0

Source: Aurecon, Mott MacDonald, LPI, Nearmap, Niche

1:25,000@A4
0 300 600m

Projection: GDA2020 MGA Zone 56

FIGURE 6-3: Threatened species recorded

Threatened flora species

The desktop searches carried out for the proposal identified that 37 threatened flora species have the potential to occur or have habitat within the locality. This includes:

- 14 species listed under the BC Act only
- 23 species listed under both the BC Act and EPBC Act.

Of the 37 subject species, one threatened flora species was recorded within the proposal area. Needle Geebung (*Persoonia acerosa*) was recorded within the proposal area during pre-clearing surveys for geotechnical investigations as part of the proposal. Needle Geebung is listed as Vulnerable under the BC Act and EPBC Act.

The remaining species were either surveyed (and not detected) or have been excluded due to lack of suitable habitat within the proposal area.

Weeds

Weeds that were recorded throughout the field investigations collected that are regarded as 'High Threat Weeds', include the following: *Ligustrum sinense* (Small-leaved privet), *Rubus fruticosus* sp. *agg.* (Blackberry), *Bidens pilosa* (Cobblers pegs), and *Juncus acutus*.

6.3.3 Potential impacts

Construction

Impacts to vegetation

The proposal would result in direct impacts on biodiversity from the removal of up to 47.56 hectares of native vegetation (refer to Table 6-13). The largest area of impact would be PCT 1248, with up to 46.8 hectares of this PCT subject to direct impacts due to the proposal. A small area of PCT 967 near waterways on the eastern side of the Medlow Bath to Blackheath section (up to 0.76 hectares) would also be directly impacted by the proposal. While the proposal design has avoided direct impact to the Blue Mountains Swamp TEC (PCT 1078) near the twin bridges in the Katoomba to Medlow Bath section, there may be indirect impacts to 0.12 hectares of the swamp located within the proposal area.

Up to 207 hollow-bearing trees have the potential to be directly impacted. These values are upper limits and would be reduced wherever possible and practical during detailed design.

The proposal would result in indirect impacts to parts of the Blue Mountains National Park and Water NSW Blackheath Special Catchment Area to the east of the Medlow Bath to Blackheath section. Indirect impacts may include:

- increased noise, dust and light from the construction and operational activities
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of native vegetation within the proposal area
- erosion or sedimentation in areas adjoining construction and operational activities
- increased spreading of weed propagules
- increased edge-effects for surrounding vegetated areas.

While there would be no direct impacts to the Blue Mountains Swamp TEC, there may be indirect impacts to the swamp from the construction of the twin bridges. This may include indirect impacts to 0.12 hectares of the swamp within the proposal area due to its proximity to the area required for construction of the

proposed twin bridges. These impacts would be managed through the implementation of targeted mitigation measures. A buffer area of at least five metres between the proposal area and boundary of the Blue Mountains Swamp TEC would be established and lined with sediment fencing to minimise indirect impacts to the swamp near the twin bridges. Other construction erosion and sedimentation controls have been designed to minimise the potential for impacts to the swamp (refer to Section 6.1.4). As such, it is unlikely that run-off from the detention basin would negatively impact the swamp habitat. During construction, dirty water from the bridge deck would also be drained away from the swamp to avoid water flowing into the swamp.

Indirect impacts from construction would generally have a short to medium timeframe and would be minimised through implementation of safeguards and management measures in accordance with the CEMP (refer to Section 7.2).

Table 6-13: Summary of potential impacts to native vegetation during construction of the proposal

Vegetation Zone	Vegetation Condition (BAM-C)	Status (BC Act)	Area within proposal area (ha)	Area subject to direct impacts (ha)	Number of hollow bearing trees directly impacted
PCT 1248	Moderate	Not listed	27.74	27.74	165
PCT 1248	Low	Not listed	19.06	19.06	41
PCT 967	Moderate	Not listed	0.70	0.70	1
PCT 967	Low	Not listed	0.06	0.06	0
PCT 1078	Moderate	• Blue Mountains Swamps in the Sydney Basin Bioregion listed as Vulnerable under the BC Act. • Forms part of the TEC Temperate Highland Peat Swamps on Sandstone listed as Endangered under the EPBC Act.	0.12	0	0
Total			**47.68**	**47.56**	**207**

Impacts to threatened species

The removal of native vegetation would result in impacts to threatened species, including a loss of fauna habitat (refer to Table 6-14). This would impact one threatened flora species and 25 threatened species of fauna.

Table 6-14: Potential impacts to threatened species

Threatened species	Status (BC Act)	Status (EPBC Act)	Habitat or individuals to be impacted
Flora			
Needle Geebung (*Persoonia acerosa*)	Vulnerable	Vulnerable	1 individual identified within the proposal area, which would be impacted by loss of habitat through vegetation clearing, weed incursion, and indirect habitat disturbance
Fauna			
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Vulnerable	Vulnerable	Up to 47.56 ha potential foraging habitat
Koala (*Phascolarctos cinereus*)	Vulnerable	Endangered	Up to 47.56 ha potential foraging habitat

Threatened species	Status (BC Act)	Status (EPBC Act)	Habitat or individuals to be impacted
Grey-headed Flying fox (*Pteropus poliocephalus*)	Vulnerable	Vulnerable	Up to 47.56 ha potential foraging habitat
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	Vulnerable	Endangered	Up to 47.56 ha confirmed foraging habitat
Spotted-tailed Quoll (*Dasyurus maculatus*)	Vulnerable	Endangered	Up to 47.56 ha potential foraging habitat and impacts to connectivity across the widened road corridor
Rosenberg's Goanna (*Varanus rosenbergi*)	Vulnerable	-	Up to 47.56 ha potential habitat (foraging, sheltering, breeding)
Eastern Pygmy Possum (*Cercartetus nanus*)	Vulnerable	-	Up to 47.56 ha confirmed foraging habitat and up to 207 hollow-bearing trees (which provide potential nesting/breeding resources)
Greater Glider (*Petauroides volans*)	-	Vulnerable	Up to 47.56 ha of potential foraging habitat, and up to 207 hollow-bearing trees (which may provide potential nesting/breeding resources)
Squirrel Glider (*Petaurus norfolcensis*)	Vulnerable	-	Up to 47.56 ha of potential foraging habitat, and up to 207 hollow-bearing trees (which may provide potential nesting/breeding resources)
Threatened hollow-dependant bats • **Eastern Coastal Free-tailed Bat (*Micronomous norfolkensis*)** • **Greater Broad-nosed Bat (*Scoteanax rueppellii*)** • **Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*)** • **Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)**	Vulnerable	-	Up to 47.56 ha confirmed foraging habitat and 63 hollow-bearing trees that are considered suitable as potential roosting habitat for these species.
Threatened cave-dependant bats • **Little Bent-winged Bat (*Miniopterus australis*)** • **Large Bent-winged Bat (*Miniopterus orianae oceanensis*)** • **Eastern Cave Bat (*Vespadelus troughtoni*)**	Vulnerable	-	Up to 47.56 ha of confirmed foraging habitat
Threatened woodland birds • **Brown Treecreeper (eastern subspecies) (*Climacteris picumnus*)** • **Varied Sittella (*Daphoenositta chrysoptera*)** • **Diamond Firetail (*Stagonopleura guttata*)** • **Gilbert's Whistler (*Pachycephala inornate*)**	Vulnerable	-	Up to 47.56 ha of confirmed foraging habitat and removal of potential nesting habitat (including up to 207 hollow-bearing trees to be removed and cup nests)

Threatened species	Status (BC Act)	Status (EPBC Act)	Habitat or individuals to be impacted
• **Black-chinned Honeyeater (*Melithreptus glumaris gularis*)** • **Little Lorikeet (*Glossopsitta pusilla*)**			
Threatened woodland robins • **Flame Robin (Petroica phoenicea)** • **Scarlet Robin (Petroica boodang)** • **Hooded Robin (Melanodryas cucullate)**	Vulnerable	-	Up to 47.56 ha of potential foraging habitat and indirect removal of potential nesting habitat (e.g., cup-nests, sheltered sites and shallow tree cavities)

Operation

Direct impacts

Operation of the proposal has the potential to result in fauna injury and death. Threatened fauna most at risk include terrestrial species such as the Koala, Eastern Pygmy-possum, Spotted-tailed Quoll and the Greater Glider. Spotted-tailed Quolls and Eastern Pygmy-possums have been identified close to the road corridor. One recent Koala record (from 2020) has also been identified as road kill near the existing highway about nine kilometres west of the study area.

While fauna are currently at risk of vehicle strikes along the existing highway, the proposal would result in an increased road crossing distance (from about 30 metres to about 100 metres in some locations) and increased volume of traffic. Despite existing obstruction to fauna movement, the ability for gliding and terrestrial fauna to safely cross the Great Western Highway may become constrained due to this increased separation of habitats.

These changes would increase the risk of injury and mortality to local fauna. Fauna mitigation measures to provide safe passage across the road, such as glider poles for the Greater Glider, would be investigated and included as part of a Fauna Connectivity Strategy during detailed design of the proposal. This would also consider the use of fauna fencing to deter fauna from accessing the road corridor and reduce the potential for injury or mortality. Monitoring of road kill during construction and operation of the proposal would also allow any indirect impacts to threatened species to be identified and mitigated where required.

Indirect impacts

Edge effects (such as erosion, dust, intensive light spill and sedimentation) and weed incursion would be likely to occur during operation of the proposal. This impact area would include parts of the Blue Mountains National Park and the Water NSW Blackheath Special Catchment Area to the east of the Medlow Bath to Blackheath section. This area is not currently adjacent to a road corridor and so would experience edge effects for the first time. Parts of the Blue Mountains National Park have tested positive to *Phytophthora cinnamomi* (Phytophthora), which may also spread due to the proposal. Measures to minimise the likelihood of indirect impacts to sensitive receiving environments as a result of the proposal are outlined in Section 6.3.4. Streetlighting would only be installed at the three intersections within the Katoomba to Medlow Bath section and would include ecologically sensitive lighting design. This would minimise indirect impact to surrounding sensitive receiving environments.

Shading from the bridge may result in indirect impacts to the Blue Mountains Swamp TEC due to floristic responses to changes in light and temperature. The greatest shading impact is likely to occur on the

eastern side of the swamp during the morning. However, any shading impacts would be temporal in nature as the area in shadow would shift with the sun during the day as it moves from east to west. There would not be any section of the swamp permanently in shadow and most of the swamp would remain unaffected by shadow.

Altered hydrology may affect sensitive receiving environments near the proposal. This may lead to extended periods of drying or waterlogging, weed incursion or increase in weed abundance and changes in floristics and habitat suitability for dependant flora and fauna at the Blue Mountains Swamp TEC. The proposed water quality and drainage network would result in a beneficial impact on water quality due to the proposal (refer to Section 3.2.3 and Section 6.1.3). This would minimise hydrologic impacts to surrounding sensitive environments, including the Blue Mountains Swamp TEC habitat.

Significance of impacts

Assessments of significance have been carried out for threatened species which were identified with potential to occur within the proposal area. These assessments found that the proposal would not have a significant impact on threatened biota. Significant impacts would be avoided through the implementation of mitigation measures, including the implementation of a Flora and Fauna Management Plan.

As such, the proposal is not likely to significantly impact threatened species or ecological communities or their habitats:

- within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.
- within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

The proposal's response to Transport's checklist for significance of impacts is outlined in Table 6-15.

Table 6-15: Significance of impacts assessment checklist

Item	Proposal response
Is there a real chance that the activity threatens the long-term survival of nationally listed biodiversity matters?	No
Has the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government been considered?	Yes
Can suitable offsets be secured?	Yes

Eastern Pygmy-possums have been identified at seven camera trap locations within the study area during targeted surveys in 2021. While no survey data exists to demonstrate the extent of the local population, a local population is likely to be widespread due to the extent of high-quality habitat around the proposal (K Madden DPE 2021, personal communication). On this assumption, the proposal is not considered likely to significantly impact a local population of the Eastern Pygmy-possum. To support this conclusion, further surveys for the Eastern Pygmy-possum are proposed to better understand the size and extent of the population within the surrounding area. Following the completion of the monitoring program, a final assessment of significance for the Eastern Pygmy-possum would be generated and mitigation measures further refined.

6.3.4 Safeguards and management measures

Safeguards and management measures for biodiversity are outlined in Table 6-16.

Table 6-16: Safeguards and management measures – biodiversity

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	A Flora and Fauna Management Plan will be prepared in accordance with Transport's *Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects* (Roads and Traffic Authority, 2011a) and implemented as part of the CEMP. It will include, but not be limited to: • plans showing areas to be cleared and areas to be protected, including exclusion zones around the proposal (including a five-metre exclusion zone around the Blue Mountains Swamp TEC), protected habitat features and revegetation areas • requirements set out in the *Landscape Guideline* (Roads and Maritime, 2008) • pre-clearing survey requirements, vegetation removal and habitat removal in line with Transport's vegetation clearance protocol • directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the proposal • development of a habitat replacement or nest box strategy • procedures for re-establishment of native vegetation • procedures for unexpected threatened species finds and fauna handling • procedures addressing relevant matters specified in the *Policy and guidelines for fish habitat conservation and management* (DPI Fisheries, 2013) • commitments relating to threatened species management, pest and weed management, and site hygiene practices.	Transport / Contractor	Detailed design / pre-construction / construction	Section 4.8 of QA *G36 Environment Protection*
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	Transport / Contractor	Detailed design / pre-construction	Additional safeguard
Biodiversity	Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposed construction boundary. A buffer area of at least five metres will be established between the proposal area and boundary of the swamp.	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Signposting will be used to inform project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.			
Biodiversity	The Needle Geebung (*Persoonia acerosa*) individual identified during field surveys will be translocated prior to construction.	Contractor	Pre-construction	Additional safeguard
Biodiversity	For flora species such as Needle Geebung (*Persoonia acerosa*), seed collection will be carried out in an effort to minimise impacts to the species and aid in re-establishment of individuals within protected areas in the vicinity of the study area. This would form part of the seed collection planned by Transport to occur across the Great Western Highway Upgrade Program.	Contractor	Construction / pre-construction	Additional safeguard
Vehicle strike	Transport will monitor road kills along Great Western Highway before, during and after commencement of the proposal.	Transport / Contractor	Pre-construction / construction / operation	Additional safeguard
Indirect impacts on native vegetation and habitat	Measures to further avoid and minimise the area of direct impact on all native vegetation will be investigated during detailed design and implemented where practicable and feasible, especially in sensitive environments and near the Blue Mountains National Park.	Transport	Detailed design	Additional safeguard
Indirect impacts on native vegetation and habitat	Installation of stormwater/sediment and erosion control mechanisms to prevent sediment or dirty water discharging into the Blue Mountain Swamp TEC.	Contractor	Construction	Additional safeguard
Wildlife connectivity, habitat fragmentation and fauna injury and mortality	A Fauna Connectivity Strategy will be developed for the proposal during detailed design to minimise the impacts of the proposal on connectivity. This will include consideration of: • fauna mitigation measures to provide safe passage across the road • fauna fencing.	Transport	Detailed design	Additional safeguard
Changes to hydrology	Changes to existing surface water flows will be minimised during detailed design and mitigated via preparation and implementation of the following: • preparation of progressive Erosion and Sediment Control Plans (ESCPs) and their continual revision and update • preparation of a Storm Water Management Plan and other aspects of the Construction Environment Management Plan to manage water quality impacts during construction of the proposal • preparation of Water Quality Management Plan (surface and groundwater) to describe water quality monitoring before and during construction • design of scour protection at new stormwater outlets and culverts and drainage basins	Transport	Detailed design	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• stormwater drainage design which incorporated a treatment trains and drainage basing to achieve a neutral or beneficial effect on the surrounding waterways.			
Fragmentation of identified habitat corridors	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (Roads and Traffic Authority, 2011c). Any connectivity measures implemented will be installed under the supervision of an experienced ecologist.	Transport / Contractor	Detailed design / pre-construction / construction	Additional safeguard
Invasion and spread of pathogens and disease	• Any excavated earth will be either disposed or reused appropriately with care taken to avoid spreading propagules of weeds or infested soil or plant material. • Correct plant hygiene will be minimised to minimise spread of weeds, Phytophthora and other contaminants, including wash down when moving between weedy and non-weedy parts of the proposal. • All weed material removed during the construction works will be disposed of in a suitable waste facility and not mulched onsite to avoid the reintroduction and further spread of weeds and pathogens in the area.	Contractor	Construction	Additional safeguard
Noise, light and vibration	Shading and artificial light impacts on sensitive areas or areas adjacent to the Blue Mountains National Park will be minimised during detailed design.	Transport	Detailed design	Additional safeguard
Threatened ecological community (TEC)	• During construction, dirty water from the bridge deck would be drained away from the Blue Mountains Swamp TEC and not flow over into the swamp. • pH levels of water in the nearby water quality basins will be monitored near the Blue Mountains Swamp TEC during construction.	Contractor	Construction	Additional safeguard
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems (e.g. Upland Swamp) will be minimised through detailed design.	Transport	Detailed design	Additional safeguard
Biodiversity offsets	Where required, Transport would offset vegetation removal in accordance with the Transport 'Guideline for Biodiversity Offsets' (Roads and Maritime, 2016b). Offsets would be sought for both this proposal and any other projects within the Great Western Highway Upgrade Program for which biodiversity impacts have not separately been offset.	Transport	Detailed design	Additional safeguard

Other safeguards and management measures that would address biodiversity impacts are identified in Section 6.1.4.

6.3.5 Biodiversity offsets

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts associated with the proposal, some residual impacts would occur. Transport would provide biodiversity offsets or, where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds listed under Transport's *Guideline for Biodiversity Offsets* (Transport, 2016b).

The *Guideline for Biodiversity Offsets* refers to BioBanking and the Framework for Biodiversity Assessment. These have been replaced by the Biodiversity Offset Scheme and use of the Biodiversity Assessment Method (BAM) Calculator (BAM-C) to determine offset requirements for unavoidable impacts to biodiversity under the BC Act. As such, the BAM-C has been used to determine the offset requirement for this proposal.

Biodiversity offset thresholds relevant to the proposal and the resulting credit requirements are summarised in Table 6-17. Based on impact to 47.56 hectares of native vegetation, as per the BAM-C, the proposal requires:

- 924 ecosystem credits for impact to known habitat of seven NSW listed threatened ecosystem credit species (Gang-gang Cockatoo, Brown Treecreeper, Large Bentwing-bat, Little Bentwing-bat, Greater Broad-nosed Bat, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat).
- 1233 species credits for impacts to known habitat for the Eastern Pygmy-possum (species credit species under the BAM).

Table 6-17: Transport offset thresholds

Description of activity or impact	Consider offsets or supplementary measures	Relevant to the proposal?	Offsets required
Activities in accordance with Roads and Maritime Services Environmental assessment procedure: Routine and Minor Works (Roads and Traffic Authority, 2011b)	No	No	Not applicable
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	No	Not applicable
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	No	Not applicable
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of an CEEC in moderate to good condition	No	Not applicable
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Yes. Clearing of 1 individual of *Persoonia acerosa.*	Area of occupation less than 1 ha. No offsets required.

Description of activity or impact	Consider offsets or supplementary measures	Relevant to the proposal?	Offsets required
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	No	Not applicable
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database	Where clearing > 1ha or where the species is the subject of an SIS	Yes. Clearing of 47.56 ha of known habitat for the Eastern Pygmy-possum.	1233 Eastern Pygmy-possum species credits
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database	Where clearing > 5ha or where the species is the subject of an SIS	Yes. Clearing of 47.56 ha of known habitat for 7 NSW listed threatened ecosystem credit species: • Gang-gang Cockatoo • Brown Treecreeper • Large Bentwing-bat • Little Bentwing-bat • Greater Broad-nosed Bat • Eastern Coastal Free-tailed Bat • Yellow-bellied Sheathtail-bat.	924 ecosystem credits
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	Not applicable	Not applicable

A Biodiversity Offset Strategy (BOS) would be developed by Transport and identify how the offset obligations would be met. The BOS would be updated, and the offset calculations finalised, once detailed design is complete. This would include consideration of offset requirements for both this proposal and any other projects within the Great Western Highway Upgrade Program for which biodiversity impacts have not separately been offset.