Transport for NSW

Koala protection on Heathcote Road near Deadmans Creek

Review of Environmental Factors

November 2024

NSW GOVERNMENT

transport.nsw.gov.au

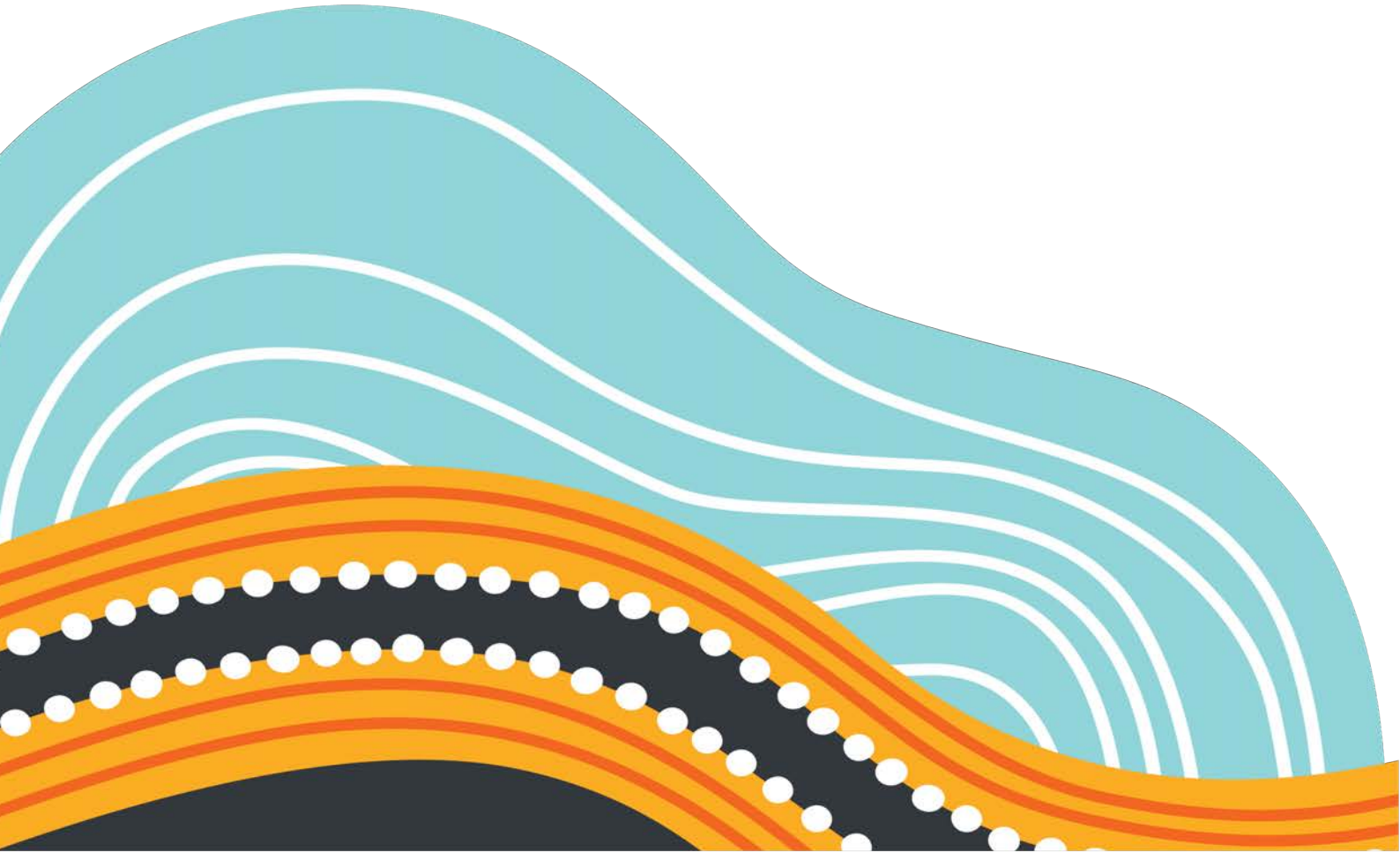
Acknowledgement of Country

Transport for NSW acknowledges the Tharawal People, the traditional custodians of the land where koala protection measures are proposed near Deadmans Creek.

We pay our respects to their Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.



Executive Summary

The proposal

Transport for NSW (Transport) is proposing a number of koala protection measures along Heathcote Road at Deadmans Creek (the proposal). Transport proposes to construct about 1,153 metres of fencing along Heathcote Road, which aims to prevent koalas accessing the road where they are susceptible to vehicle strike and guide them towards safe crossing points under the road. A high number of koala fatalities have been recorded along Heathcote Road near Deadmans Creek, where the road separates large areas of habitat within Georges River National Park to the east and Holsworthy Barracks military base to the west.

The proposal comprises several sections of fencing that will be constructed on both sides of Heathcote Road near Deadmans Creek, between St George Crescent in Menai and Pleasure Point Road in Pleasure Point. The proposal also involves the installation of structures and ground treatments to further improve the safe passage of animals under Heathcote Road. In combination with existing fencing located on the boundary of Holsworthy Barracks military base (on both sides of Heathcote Road), the proposal would provide a 1,495 metre-long continuous barrier to fauna attempting to access Heathcote Road, from 380 metres south of Deadmans Creek to 1,200 metres north of Deadmans Creek.

The proposal is located about 24 kilometres south-west of the Sydney Central Business District (CBD) and about 8.5 kilometres south-east of the Liverpool CBD. The proposal falls within both the Liverpool City and Sutherland Shire Local Government Areas. The location of the proposal is shown in Figure 1-1.

Key features of the proposal include:

- About 1,153 metres of new koala fencing that is 1.5 metres high, with galvanised steel sheeting along the top, comprising of:
  - About 360 metres (excluding the 170 metres of koala fence to be assessed by separate EIS) of continuous fencing on the eastern side of Heathcote Road, between existing Defence fencing to the north and Deadmans Creek Bridge to the south.
  - About 350 metres of fencing on the eastern side of Heathcote Road, south of Deadmans Creek Bridge. This fencing would be installed in three sections to tie into existing rock slopes and St George Crescent, to create a continuous barrier to Heathcote Road.
  - About 143 metres on the western side of Heathcote Road north of Deadmans Creek Bridge to direct fauna to cross under the road via two existing culverts and Deadmans Creek Bridge, and into the fauna access pipes installed in the Defence fencing.
  - About 300 metres on the western side of Heathcote Road, south of Deadmans Creek Bridge.
- A koala grid with a pedestrian gate across St George Crescent about 80 metres from the intersection with Heathcote Road, which aims to prevent koalas from accessing Heathcote Road.
- About six fauna escape structures, located near fence ends or other weak points, to allow any koalas or other fauna to move from roadside to the habitat side of the fence.
- Up to three metres of selective vegetation clearing on either side of koala fencing, including:
  - Trimming of overhanging trunks or branches (that may allow koalas to climb over the fence into the road corridor)
  - Removal of vegetation on existing rock slopes along the proposed fence alignment to deter animals from using the slopes to access the road.
- Fauna access improvements around Deadmans Creek Bridge including:
  - Koala refuge poles to offer refuge from predators where trees are absent.
  - Surface treatments (shotcrete/concrete) in drains around existing fauna crossing structures under Deadmans Creek bridge to assist fauna movements.
- Gates in the fencing for emergency and maintenance access.

Construction is expected to commence in 2025 and would take around four months to complete.

Need for the proposal

The koala is listed as an endangered species under both the *Biodiversity Conservation Act 2016 (NSW)* and *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*. In NSW, vehicle strike is regarded as a key threat to koalas (Department of Planning, Industry and Environment, 2020), and is one of the most frequently reported causes of injury and death for koalas brought into care by wildlife rehabilitation groups (Environment and Heritage, 2024).

BioNet shows 16 records of koala vehicle strike Heathcote Road near Deadmans Creek between 2018 and 6 November 2024 (Environment and Heritage, 2024). Koalas are particularly susceptible to vehicle strike along this section of Heathcote Road because the road separates large areas of koala habitat within Georges River National Park to the east and within Holsworthy Barracks military base to the west. Koala vehicle strike on Heathcote Road is likely to be concentrated around Deadmans Creek as animals may be traveling along the riparian corridors.

In 2018, the NSW Government launched the NSW Koala Strategy (Office of Environment and Heritage, 2018)and one of the actions prescribed by the strategy is to fix priority koala vehicle strike hotspots. Heathcote Road at Deadmans Creek was prioritised for funding under the NSW Koala Strategy 2022 (Department of Planning and Environment, 2022). Accordingly, Transport is delivering work for koala protection at this location. Work to address koala vehicle strike is divided in two stages. Stage 1 was completed in early 2023 to improve access for koalas travelling under the bridge. This proposal is Stage 2 of works.

Proposal objectives

The objectives of the proposal are:

- Reduce koala vehicle-strike along Heathcote Road near Deadmans Creek.
- Reduce the barrier effects of Heathcote Road and enhance regional connectivity for fauna movement, by promoting safe passage of animals under the road.

Options considered

Five options were considered for the proposal:

- Option 1: Fencing the road reserve of Heathcote Road along both sides of the entire road reserve (including fencing above the rock cutting near St George Crescent), improving the conditions of the Deadmans Creek bridge underpass and installing a koala grid on St George Crescent.
- Option 2 (the proposal): Install shorter lengths of fauna fence along the road reserve of Heathcote Road (north-west of the bridge) and utilising existing Defence fence (some of which may need to be modified), improving the conditions of the Deadmans Creek bridge underpass and installing a koala grid on St George Crescent.
- Option 3: Install shorter lengths of fauna fence along the road reserve of Heathcote Road to avoid impacts to land mapped as coastal wetlands under the State Environmental Planning Policy (Resilience and Hazards) 2021
- Option 4: Extension of fencing along Heathcote Road from St George Crescent to the entrance to Bendict Sands Quarry (about 1.5 kilometres south Deadmans Creek). This option can also be applied to Option 1, 2 and 3 and where appropriate, existing Defence fencing would be incorporated (some of which may need to be modified).
- Option 5: “Do nothing”. Under a “Do nothing” option, no measures would be taken to mitigate koala vehicle strike along Heathcote Road at Deadmans Creek.

Options 3 and 5 would not have resulted in any impact on mapped coastal wetlands, and therefore would not have required an EIS.

Option 2 was selected as the preferred option as it met all of the proposal objectives and all of the three development criteria prescribed for the proposal.

Statutory and planning framework

The proposal is for road infrastructure facilities and is to be carried out by Transport for NSW and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979 (NSW)*. Development consent from council is not required. The areas of the proposal which are subject to Coastal Wetlands mapping under the State Environmental Planning Policy (Resilience and Hazards) 2021 are being assessed under a separate Environmental Impact Statement.

Community and stakeholder consultation

Development of the proposal has involved extensive consultation with government agencies and community groups, including:

- Department of Defence
- Sutherland Shire Council
- Liverpool Council
- National Parks and Wildlife Service
- Department of Planning, Housing and Infrastructure
- Sutherland Shire Environment Centre
- National Parks Association
- Sandy Point Residents Association
- Georges River Environmental Alliance.

Transport also consulted with Gandangara Local Aboriginal Land Council about the proposal in March 2021, who were supportive of the proposal.

Environmental impacts

A number of potential environmental impacts from the proposal have been avoided or reduced though the selection of a preferred proposal option and subsequent design refinements of that option. The main environmental impacts of the proposal are:

Biodiversity

The proposal has been designed to avoid and minimise the removal of native vegetation and threatened ecological communities (TECs) wherever practical. The proposal would result in impacts on biodiversity due to the removal of 0.74 hectares of native vegetation, of which 0.02 hectares is commensurate with Threatened Ecological Communities listed under the *Biodiversity Conservation Act 2016* and the *Environment Protection Biodiversity Conservation Act 1999*. Vegetation clearing would also result in the loss of 0.74 hectares of potential habitat for a number of threatened species that may occur in the REF proposal area, and 376 trees, of which three are hollow-bearing.

The Biodiversity Assessment Report concluded the proposal is unlikely to result in a significant impact on threatened species, populations, ecological communities or their habitats. A number of environmental safeguards are proposed to minimise and mitigate impacts on biodiversity, including further minimising vegetation clearing through detailed design, undertaking pre-clearing surveys and clearly identifying native vegetation, ecological communities and notable habitat features to be retained. Biodiversity impacts would be managed by the implementation of safeguards, including the preparation of a Flora and Fauna Management Plan as part of the Construction Environment Management Plan.

Although efforts have been made to avoid, minimise and mitigate potential impacts on biodiversity, some residual impacts would occur. As a result, the proposal would trigger one threshold set out by No Net Loss Guidelines (Transport for NSW, 2022); clearing of hollows and/or trees ≥5cm Diameter at Breast Height. Up to 376 individual trees (including three hollow-bearing trees) would be removed for construction of the proposal, which will be required to be replaced in accordance with Tree and hollow replacement guidelines (Transport for NSW, 2023). Consistent with Transport's Biodiversity Policy, trees may either be replaced on nearby land with the consent of the landowner or, where this is not feasible, payment may be made to Transport's Conservation Fund.

Noise and vibration

Temporary noise and vibration impacts would occur during construction of the proposal. Construction of the proposal would generally be undertaken outside of standard construction hours (i.e. outside of the hours of 7am to 6pm) to ensure safe working conditions and minimise disruptions to traffic on Heathcote Road and St George Crescent. As a result, a number of residences in Sandy Point are predicted to experience noise levels above the noise management levels (NMLs) during the evening and at night.

Temporary construction noise impacts would affect a number of residences at Sandy Point during construction of all elements of the proposal, including establishment an ancillary facilities, vegetation clearing, installation of koala fencing, installation of the koala grid and fauna access improvements around Deadmans Creek Bridge. Construction noise impacts of the proposal include:

- The noisiest construction activity is vegetation clearing, to be carried out along the entire alignment of the koala fence. Vegetation clearing would result in noise levels above the NMLs for residential receivers at Sandy Point during all work periods, including standard working hours, out-of-hours work (OOHW) Day, Evening and Night periods.
- All other construction activities will result in noise levels that exceed NMLs for residential receivers at Sandy Point during the OOHW Day, Evening and Night periods
- No construction activities are predicted to result in the maximum noise trigger levels (sleep disturbance) criterion of 65dB L_{Amax} being exceeded at any residential receiver locations.
- Assessment of construction noise levels for non-residential receivers indicated that exceedance of the relevant NMLs is predicted at Georges River National Park (active recreation) during installation of the koala grid only. Given that there are no recreational facilities such as marked tracks or picnic areas within Georges River National Park in proximity to the REF proposal area, construction noise impacts on national park users are unlikely.
- Construction noise impacts would be managed by the implementation of safeguards that would be prescribed by the CEMP. Following the implementation of standard mitigation measures, it is expected that some residential receivers would experience noise impacts during the OOHW day, evening and night periods.
- Construction noise is not likely to be noticeable at residential receivers during standard hours. Construction noise impacts would be greatest during the OOHW night period when vegetation clearing is being undertaken, when it is anticipated that up to 180 receivers would experience noise levels within the 'noticeable' perception category, up to 51 receivers would experience noise levels within the 'clearly audible' perception category, and up to 12 receivers would experience noise levels within the 'moderately intrusive' perception category.
- No construction vibration impacts are anticipated to occur, as construction activities would be located outside of the minimum working distances for the potential for vibration levels to cause human annoyance or cosmetic damage to structures to residential receivers

Operation of the proposal is not anticipated to result in noise impacts.

Landscape character and visual impact

The proposal would result in changes to the existing landscape character, and visual impacts during construction and operation of the proposal.

Temporary visual impacts during construction of the proposal would include a reduction in visual amenity associated with vegetation clearing, construction vehicles entering and exiting the REF proposal area and ancillary facility, machinery and equipment moving about the REF proposal area and ancillary facility, construction security/exclusion fencing and stockpiling and storage of construction materials. These visual impacts would occur for the duration of construction, anticipated to be about four months.

Permanent changes to the operational landscape character would arise where areas with bushland character would be subjected to vegetation clearing for installation of the koala fence and fauna escape structures. However, the sense of place, identity and functioning of this area would remain mostly unchanged by the proposal. Given that the proposal would aim to improve wildlife movements and reduce mortality, this improvement in biodiversity conservation positively contributes to the character of these area.

The proposal would result in permanent visual impacts, although these impacts would only affect road users travelling along Heathcote Road and entering St George Crescent. As such, visual impacts are temporary and

transient. The proposal is not visible from anywhere outside of the road corridor that is designated for public or private use. The koala fence is most prominent where it is located close to the road verge (and therefore passing road users) and where there is absence of screening features between the fence and the road verge. Elsewhere, the surrounding dense native vegetation reduces the visual presence of the fence in most places.

Mitigation measures to reduce the magnitude of the visual impact of the proposal have been proposed, to improve the appearance of the koala fence and help integrate the proposal into its setting.

Traffic and transport

Temporary traffic and transport impacts would occur during construction of the proposal, including:

- Travel times along Heathcote Road and St George Crescent may be temporarily increased during construction, due to a reduction in the existing speed limit of 80 kilometres per hour to 40 kilometres per hour, where construction activities occur in close proximity to the road verge.
- Partial road closures on Heathcote Road and St George Crescent would be required for some construction activities. These closures are expected to be undertaken at night to minimise disruption to traffic. Access along St George Crescent to Sandy Point would be maintained.

Construction traffic and transport impacts would be managed by the implementation of safeguards prescribed by the CEMP. Operation of the proposal is expected to benefit the local community, as there would be a reduction in koala (and other fauna) vehicle strikes, thereby increasing road user safety along Heathcote Road.

Justification and conclusion

While the proposal would result in some environmental impacts, including impacts on biodiversity, traffic, construction noise and visual impacts, these impacts have been minimised through the selection of a preferred proposal option and subsequent design refinements of that option. In addition, site-specific mitigation measures and safeguards will be implemented to further minimize and mitigate impacts of the proposal,

Once operational, the proposal is expected to have positive impacts on biodiversity. The provision of koala fencing along the Heathcote Road at Deadmans Creek, a known koala vehicle-strike hotspot, would improve the safety and health of koalas in the area, by keeping them off Heathcote Road and guiding them under the road at safe crossing points. Ultimately, the proposal would contribute to the long-term conservation of the local koala population and indeed, the wider koala population of NSW. The proposal would also reduce the barrier effects of Heathcote Road and enhance regional connectivity for the safe movement of koalas and other fauna species that inhabit the expanse of habitat contained within the adjoining Holsworthy Barracks and Georges River National Park. The proposal would be unlikely to cause a significant impact on the environment, including any threatened entities listed under the *Biodiversity Conservation Act 2016*, and it is not likely to have a significant impact on matters of national environmental significance listed under the *Environment Protection and Biodiversity Conservation Act 1999*. On balance, the proposal is considered justified.

Display of the review of environmental factors

This REF is on display for comment between Monday 25 November 2024 and Friday 13 December 2024. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Transport for NSW website at transport.nsw.gov.au/projects/current-projects/deadmans-creek-koala-fencing-on-heathcote-road and the Have Your Say webpage.

Printed copies

The documents can be viewed at the following locations:

- Liverpool City Council
  - CBD Customer Service Hub, Yellamundie, Lower Ground Floor, 52 Scott Street, Liverpool NSW 2170
  - Carnes Hill Customer Service Hub, 600 Kurrajong Road, Carnes Hill NSW 2171
  - Moorebank Customer Service Hub, Corner Nuwarra Road and Maddecks Avenue, Moorebank NSW 2170

- Sutherland Shire Council
  - 4-20 Eton Street, Sutherland NSW 2232

Staffed display

Sandy Point Community Centre, 200 St George Crescent, Sandy Point NSW 2172, Saturday 7 December, 2024 between 11.00am – 1.30pm.

How can I make a submission?

To make a submission about this proposal, please send your written comments to:

- Mail:
  Heathcote Road Koala Protection Project, Transport for NSW, 4 Parramatta Square, 12 Darcy Street, Parramatta, NSW, 2150
- Email: koalaprotectionheathcoteroad@transport.nsw.gov.au
- Phone: 1800 684 490

Submissions must be received by Friday 13 December 2024. Submissions will be managed in accordance with the *Transport for NSW Privacy Statement*. A copy can be made available upon request.

What happens next?

Transport will collate and consider the submissions received during public display of the REF.

After this consideration, Transport will determine whether or not the proposal should proceed as proposed and will inform the community and stakeholders of this decision.

If the proposal is determined to proceed, Transport will continue to consult with the community and stakeholders prior to and during construction.

Table of contents

Tables

Figures

1. Introduction

This chapter introduces the proposal and provides context for the environmental assessment. In introducing the proposal, the objectives and project development history are detailed and the purpose of the report provided.

1.1 Proposal identification

The koala (*Phascolarctos cinereus*) is listed as an endangered species under both the *Biodiversity Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In NSW, vehicle strike is regarded as a key threat to koalas (Department of Planning, Industry and Environment, 2020). An increasing number of koala fatalities have been recorded the low-lying section of Heathcote Road around Deadmans Creek, where Heathcote Road separates large areas of habitat within Georges River National Park to the east and Holsworthy Barracks military base to the west.

Transport for NSW (Transport) is delivering two stages of works which aim to prevent koalas accessing this road section where they are susceptible to vehicle strike, and to guide them towards safe crossing points under the road. Stage 1 was completed in 2023 and comprised construction of a raised ledge attached to the northern abutment of Deadmans Creek bridge and a concrete pathway by the southern abutment. The Stage 1 works and the two existing culverts north of the bridge facilitate safe crossing under Heathcote Road.

Transport now proposes to deliver Stage 2 (the overall proposal), which would involve the construction of koala fencing along both sides of Heathcote Road, from 50 metres south of St George Crescent in Menai to Pleasure Point Road in Pleasure Point. Together with existing Department of Defence (Defence) fencing along the boundary of Holsworthy Barracks military base and existing rock cuttings, this koala fencing would form a continuous barrier to koalas attempting to access and cross Heathcote Road. Fencing would instead direct koalas to the safe crossing locations.

The proposal is located about 24 kilometres south-west of the Sydney Central Business District (CBD) and about 8.5 kilometres south-east of the Liverpool CBD. The proposal falls within both the Liverpool City and Sutherland Shire Local Government Areas. The location of the proposal is shown in Figure 1-1.

The key features of the proposal include:

- About 1,153 metres of new koala fencing that is 1.5 metres high, with galvanised steel sheeting along the top, comprising of:
  - About 360 metres of continuous fencing on the eastern side of Heathcote Road, between existing Defence fencing to the north and Deadmans Creek Bridge to the south.
  - About 350 metres of fencing on the eastern side of Heathcote Road, south of Deadmans Creek Bridge. This fencing would be installed in three sections to tie into existing rock slopes and St George Crescent, to create a continuous barrier to Heathcote Road.
  - About 143 metres on the western side of Heathcote Road north of Deadmans Creek Bridge to direct fauna to cross under the road via two existing culverts and Deadmans Creek Bridge, and into the fauna access pipes installed in the Defence fencing.
  - About 300 metres on the western side of Heathcote Road, south of Deadmans Creek Bridge.
- A koala grid with a pedestrian gate across St George Crescent about 80 metres from the intersection with Heathcote Road, which aims to prevent koalas from accessing Heathcote Road.
- About six fauna escape structures, located near fence ends or other potentially accessible locations, to allow any koalas or other fauna to move from within the road corridor to habitat on the other side of the koala fence.
- Up to three metres of selective vegetation clearing on either side of koala fencing, including
  - trimming of overhanging trunks or branches (that may otherwise allow koalas to climb over the fence into the road corridor)
  - Removal of vegetation on existing rock slopes along the proposed fence alignment to deter animals from using the slopes to access the road

- Fauna access improvements around Deadmans Creek Bridge including:
  - Koala refuge poles to offer refuge from predators where trees are absent.
  - Surface treatments (shotcrete/concrete) in drains around existing fauna crossing structures under Deadmans Creek bridge to assist fauna movements.
- Gates in the fencing for emergency and maintenance access.

Key features of the proposal are shown in Figure 1-2 and are all contained within the Review of Environmental Factors (REF) proposal area, shown in Figure 1-3. The proposal is described in more detail in section 3.

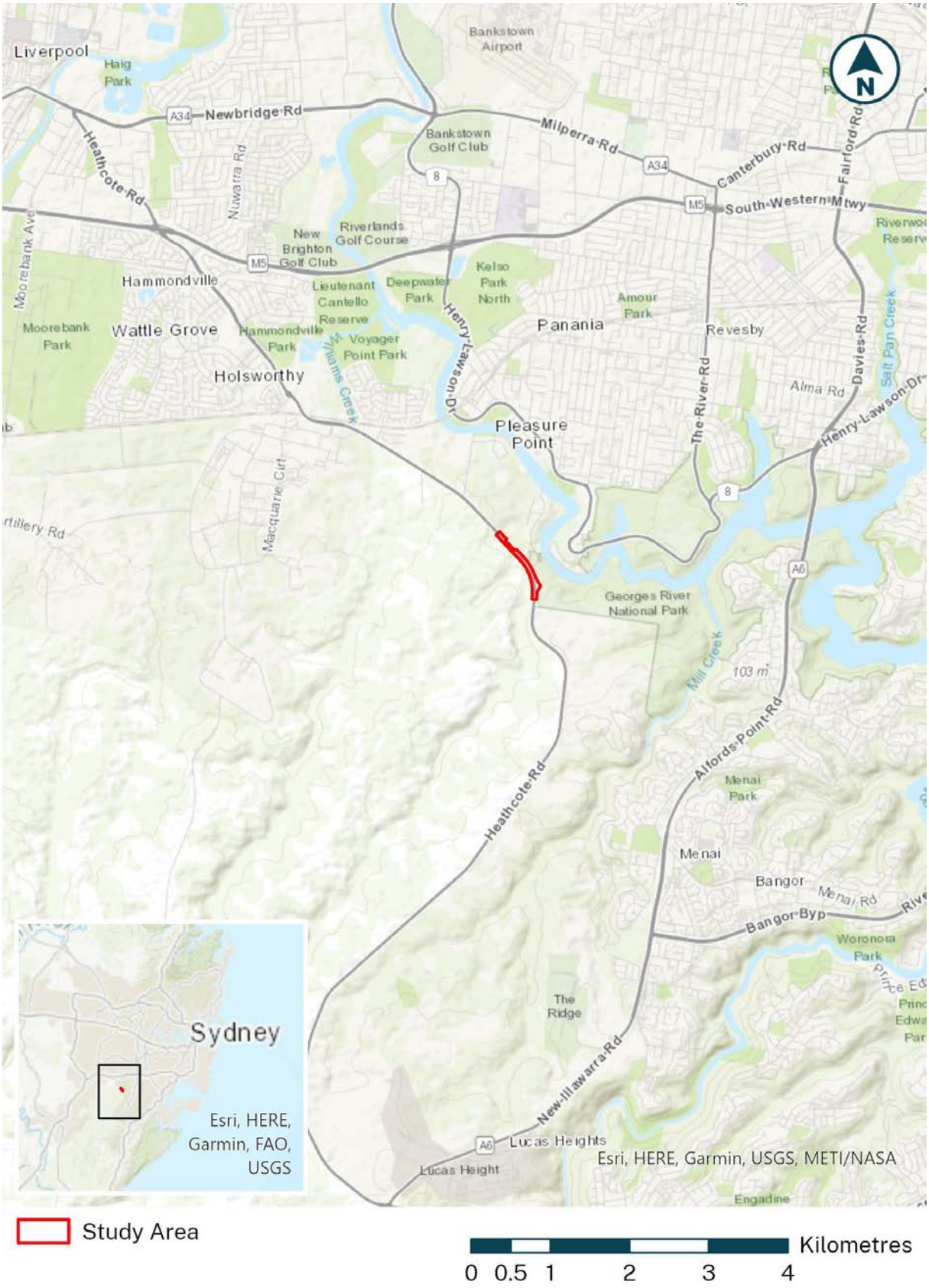


Figure 1-1: Location of the REF proposal area

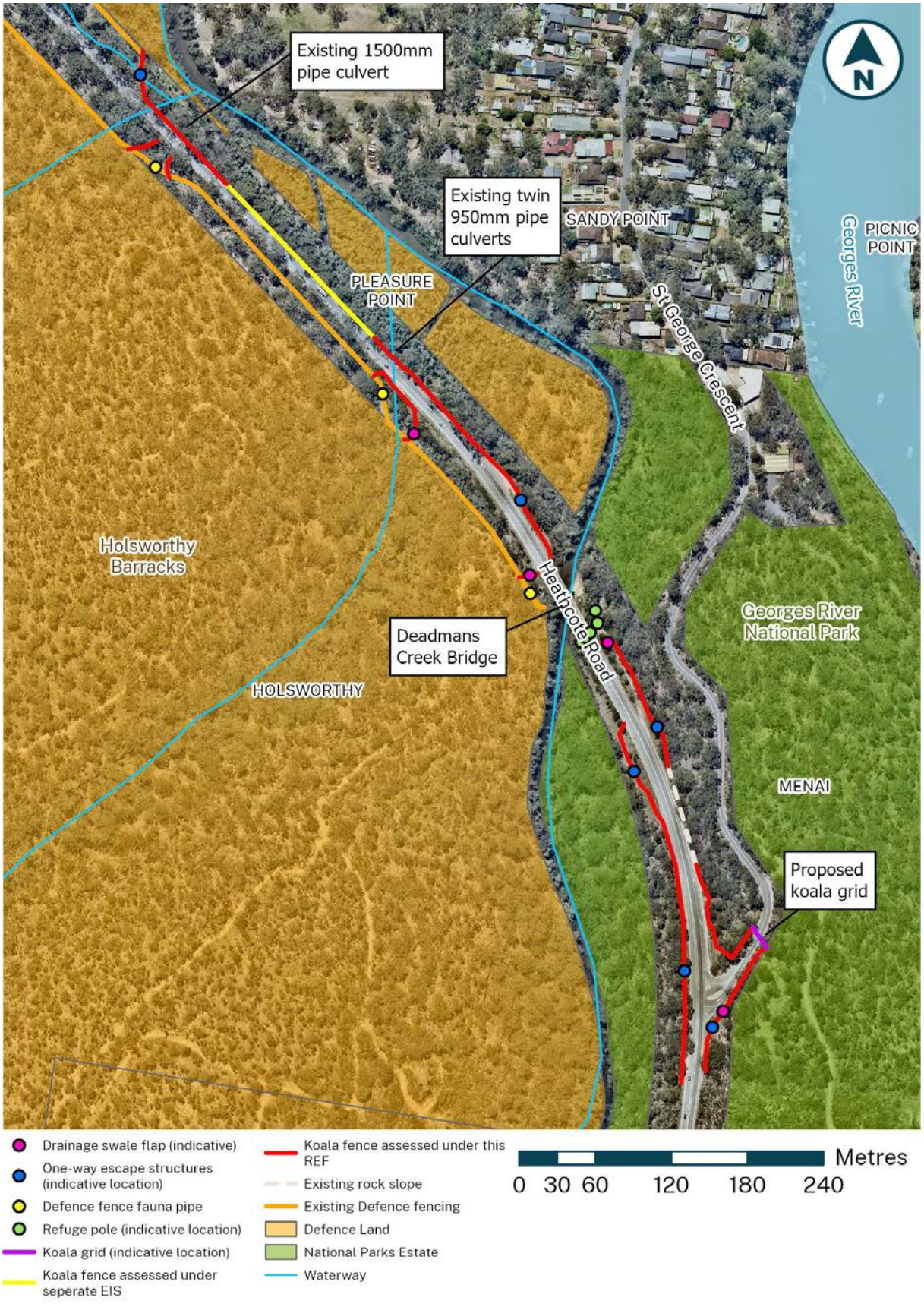


Figure 1-2: Key features of the proposal

1.1.1 Relationship between REF proposal and EIS proposal

In addition to the 1,153 metres of koala fencing to be installed along Heathcote Road as part of this REF proposal, 170 metres of fencing is proposed within land mapped as 'coastal wetland' under State Environment Planning Policy (Resilience and Hazards) 2021.

Works within a mapped coastal wetland are considered designated development under clause 2.7(2) of SEPP (Resilience and Hazards) and trigger the need for an Environmental Impact Statement (EIS). The extent of fencing located within the mapped coastal wetland, that will be assessed by a separate EIS, is shown in Figure 1-2. The EIS will be prepared by Transport and will support a development application for the koala fence to Liverpool City Council.

The location of the REF proposal area and EIS proposal area is shown in Figure 1-3. While coastal wetlands are also mapped along Deadmans Creek under Heathcote Road, no other proposal features are located within these mapped extents of coastal wetland. The REF proposal and the EIS proposal together are referred to as the 'overall proposal'. The overall proposal has a total length of 1,323 metres.

In combination with the fencing proposed under the EIS, and the existing fencing located on the boundary of Holsworthy Barracks military base (on both sides of Heathcote Road), the overall proposal would provide a continuous barrier to fauna attempting to access Heathcote Road, from 380 metres south of Deadmans Creek to 1,200 metres north of Deadmans Creek.

As such, the overall proposal is subject to assessment under two planning pathways, an EIS under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and a REF under Division 5.1 of the EP&A Act. Together this REF and the separate EIS assess the potential environmental impacts of the overall proposal, and it is intended that these documents be read in conjunction with each other.

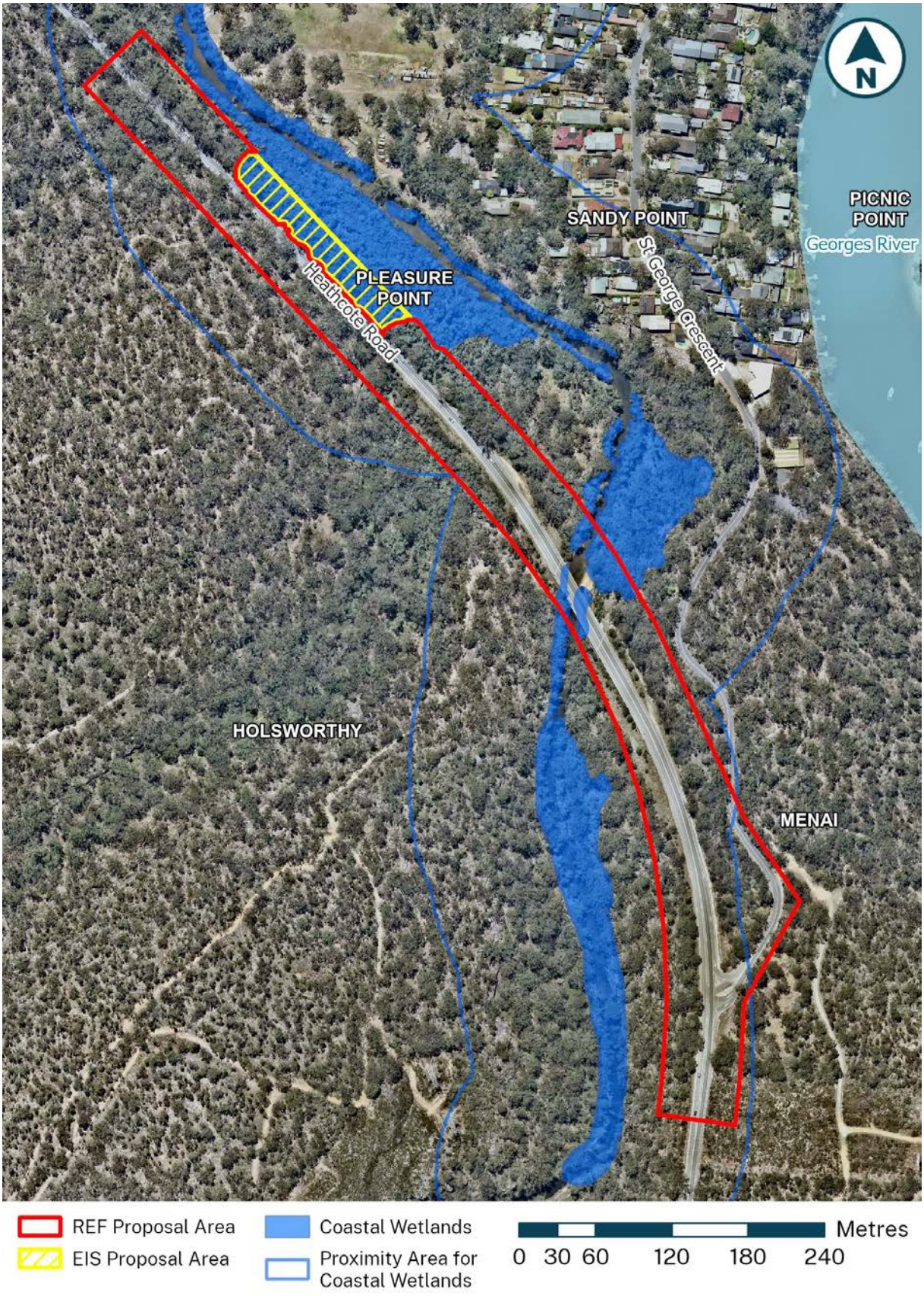


Figure 1-3: Relationship between the REF proposal area and EIS proposal area (assessed by separate EIS)

1.2 Purpose of the report

This REF has been prepared by bd infrastructure on behalf of Transport. For the purposes of these works, Transport is the proponent and determining authority under Division 5.1 of the EP&A Act.

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of Section 171 of the Environmental Planning and Assessment Regulation 2021, the factors in *Guidelines for Division 5.1 assessments* (Department of Planning and Environment, 2022), *Roads and Related Facilities EIS Guideline* (Department of Urban Affairs and Planning, 1996), the BC Act, the *Fisheries Management Act 1994* (FM Act), and the EPBC Act.

In doing so, the REF helps to fulfil the requirements of:

- Section 5.5 of the EP&A Act including that Transport examine and take into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.
- The strategic assessment approval granted by the Federal Government under the EPBC Act in September 2015, with respect to the impacts of Transport's road activities on nationally-listed threatened species, ecological communities and migratory species.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval sought from the Minister for Planning under Division 5.2 of the EP&A Act.
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The significance of any impact on nationally-listed biodiversity matters under the EPBC Act (https://www.dcceew.gov.au/environment/epbc), including whether there is a real possibility that the activity may threaten the long-term survival of these matters, and if offsets are required and able to be secured.

The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW) for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2. Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

The koala is listed as an endangered species under both the BC Act and EPBC Act. In NSW, vehicle strike is regarded as a key threat to koalas (Department of Planning, Industry and Environment, 2020), and is one of the most frequently reported causes of injury and death for koalas brought into care by wildlife rehabilitation groups (Environment and Heritage, 2024). Between 2011 and 2021, at least 249 koalas were struck by vehicles across the Sydney region (Biolink, 2023).

BioNet species sighting data shows a cluster of koala vehicle strike records on Heathcote Road near Deadmans Creek (Environment and Heritage, 2024). As of 6 November 2024, there are 16 records of koala vehicle strike within the REF proposal area since 2018 (refer to Figure 2-3).

The Holsworthy Defence land is likely to be an important dispersal route for the Campbelltown population as it facilitates north-south movement of koalas between large areas of habitat. Koalas are therefore particularly susceptible to vehicle strike along this section of Heathcote Road because the road separates large areas of koala habitat within Georges River National Park to the east and within Holsworthy Barracks military base to the west. Koala vehicle strike on Heathcote Road is likely to be concentrated around Deadmans Creek as animals may be traveling along the riparian corridors. Wildlife cameras have been deployed in various locations around Heathcote Road and Deadmans Creek since May 2021. So far, 16 koalas have been recorded in vegetation within the road corridor. This includes individual koalas around Deadmans Creek and five instances of koalas crossing under Heathcote Road via an existing 1500 millimetres concrete pipe culvert north of Deadmans Creek (Transport for NSW, 2024).

Figure 2-1: Koala crossing under Heathcote Road via pipe culvert

Figure 2-2: Koala and joey approaching pipe culvert under Heathcote Road

Koalas moving between these areas of habitat, particularly during the breeding season, must cross Heathcote Road, which has a signposted speed limit of 80 kilometres per hour and is not lit at night. Studies demonstrate that the likelihood of koala vehicle strike increases when vehicles travel at speeds over 60 kilometres an hour, while low-light conditions also make it harder for drivers to see koalas crossing the road (Environment and Heritage, 2024).

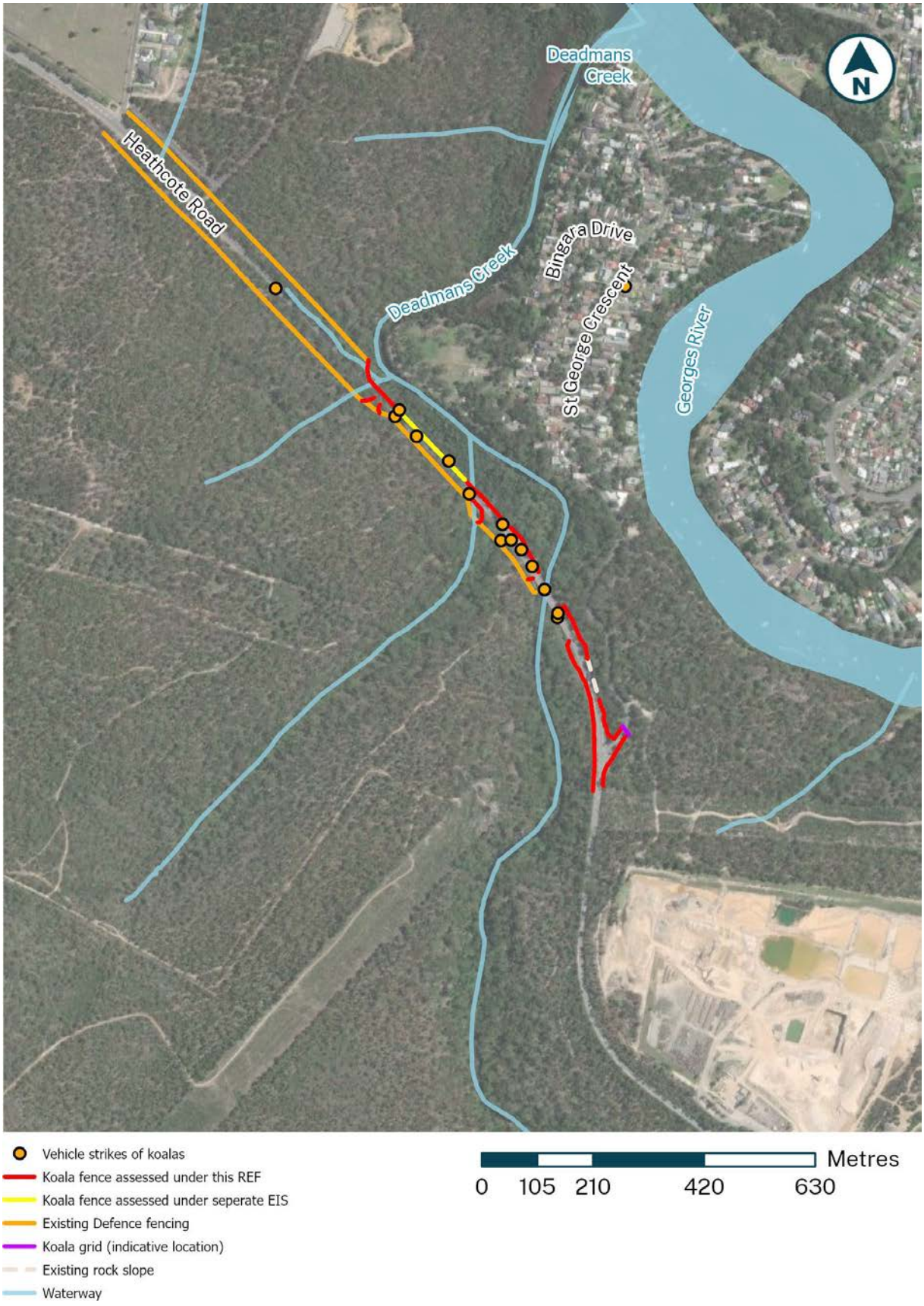


Figure 2-3: BioNet records of koala vehicle strikes along Heathcote Road at Deadmans Creek as of 18 November 2024

In 2018, the NSW Government launched the NSW Koala Strategy 2018-21 (Office of Environment and Heritage, 2018), which outlined a number of actions under four overarching pillars to stabilise and increase koala populations across the state. One of the actions prescribed by the strategy is to fix priority koala vehicle strike hotspots and this action is maintained in the NSW Koala Strategy 2021-26 (Department of Planning and Environment, 2022).

While Heathcote Road at Deadmans Creek was not specifically identified in the NSW Koala Strategy 2018-21 as a vehicle strike hotspot, it has been prioritised for funding under the NSW Koala Strategy 2021-26. This recognition followed extensive consultation between Transport, the NSW Department of Planning, Housing and Infrastructure (DPHI), NSW National Parks and Wildlife Service, Sutherland Shire Council, Liverpool City Council, Defence, the southern Sydney branch of the National Parks Association, local environmental community groups and Gandangara Local Aboriginal Lands Council.

In 2021, a report was commissioned by Transport to identify options to reduce koala vehicle strike at this hotspot (WSP, 2021). Based on the recommendations of this report, Transport is delivering two stages of works to address koala vehicle strike on Heathcote Road around Deadmans Creek. Stage 1 was completed in early 2023 to improve access for koalas travelling under the bridge. This proposal is Stage 2 of works.

2.1.1 NSW Koala Strategy 2022

The NSW Koala Strategy 2021-26 (Department of Planning and Environment, 2022) builds on the NSW Koala Strategy 2018-21 (Office of Environment and Heritage, 2018), and provides for the continuation of the actions outlined in the 2018-21 strategy to double the numbers of koalas in NSW by 2050. The four pillars of the strategy are:

- Pillar 1: Koala habitat conservation
- Pillar 2: Supporting local communities to conserve koalas
- Pillar 3: Improving the safety and health of koalas
- Pillar 4: Building our knowledge of koalas

The proposal is consistent with a key action of Pillar 3, specifically the key action “Fixing priority koala vehicle strike hotspots”, which is under this pillar. Heathcote Road at Deadmans Creek bridge is specifically recognised as a priority koala vehicle strike hotspot by the strategy, and implementation of the proposal would improve the safety and health of koalas in the area, by keeping them off Heathcote Road (where they are susceptible to death or injury from vehicle strike) and guiding them under the road at safe crossing points.

2.1.2 NSW Koala Strategy 2018

The NSW Koala Strategy 2018–21 comprised a $44.7-million investment over three years to stabilise NSW koala populations. The proposal is consistent with a key action of Pillar 3 (improving the safety and health of koalas), specifically, “Fixing priority koala vehicle strike hotspots”.

Implementation of the proposal would improve the safety and health of koalas in the area, by keeping them off Heathcote Road (where they are susceptible to death or injury from vehicle strike) and guiding them under the road at safe crossing points.

2.1.3 Liverpool Biodiversity Management Plan 2012

The koala is listed as a state and nationally threatened species that has been recorded in the Liverpool Local Government Area (LGA). The aims of the Liverpool Biodiversity Management Plan 2012 (Liverpool City Council, 2012) are to:

- Provide for the conservation of native plants, animals, habitat and ecological processes within the Liverpool LGA
- Prioritise actions and guide LCC in making decisions relevant to managing the biodiversity in the LGA
- Provide guidance for the use, conservation and enhancement of natural resources in the Liverpool LGA according to the principles of Ecologically Sustainable Development
- Build on existing, and develop new, community partnerships to manage biodiversity on private and public lands
- Ensure Council planning and operational activities integrate with other agencies to achieve the most effective biodiversity outcomes

- Develop an effective monitoring and reporting framework to measure progress of the plan and the status of biodiversity resources within the LGA

The proposal is consistent with the aims of Liverpool Biodiversity Management Plan as reducing koala injury and mortality from vehicle strike will facilitate the conservation of the local koala population. The proposal also contributes to the conservation of other locally occurring fauna species that may otherwise be susceptible to vehicle strike.

2.1.4 Sutherland Shire Council Environment Strategy 2013

The Sutherland Shire Council Environment Strategy outlines Council's commitment to regulating development and land use to deliver sound environmental outcomes for the LGA. The key objectives of the strategy are:

1. To protect and enhance local biodiversity.
2. To protect and enhance the water quality of creeks, rivers, bays and beaches.
3. To facilitate the use of public transport and the utilisation of existing and future infrastructure.
4. To encourage energy and water efficiency.

The proposal is aligned with Objective 1 of the strategy, as reducing koala injury and mortality from vehicle strike will protect and enhance local the local koala population. The proposal would contribute to the protection and enhancement of other locally occurring fauna species that may otherwise be susceptible to vehicle strike.

2.2 Limitations of existing infrastructure

There is currently some fencing along both sides of Heathcote Road, mostly along the boundary of the Defence land north of Deadmans Creek. The extent of existing Defence fencing is shown in Figure 1-2. This fencing typically comprises of chain-mesh fencing to 1.5 metres high, with galvanised steel sheeting affixed to the top of the fence. Typically, galvanised sheeting affixed to the top of fencing aims to prevent koalas (and other arboreal mammals) from being able to climb over the fence.

About 200 metres north of Deadmans Creek bridge is a twin-cell 950 millimetre diameter concrete pipe culvert under Heathcote Road. This culvert usually contains water, as it conveys a tributary to Deadmans Creek which is tidally influenced and forms part of the coastal wetland located to the east of Heathcote Road. Being inundated most of the time, this culvert likely offers limited opportunities for fauna to pass through from one side of Heathcote Road to the other.

About 470 metres north of Deadmans Creek bridge is a reinforced single-cell 1500 millimetre diameter concrete pipe culvert under Heathcote Road. It conveys an ephemeral tributary to Deadmans Creek and its higher elevation means it is often dry. It therefore offers dry passage for small and medium-sized fauna species to cross from one side of Heathcote Road to the other.

The only fencing currently on the eastern side of Heathcote Road is located between Pleasure Point Road and approximately 60 metres north of the single-cell 1500 mm diameter concrete pipe culvert. There is no fencing of any type along the eastern side of Heathcote Road, between the northernmost culvert and St George Crescent in the south (refer to Figure 3-1).

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are:

- Reduce koala vehicle-strike along Heathcote Road near Deadmans Creek.
- Reduce the barrier effects of Heathcote Road and enhance regional connectivity for fauna movement, by promoting safe passage of animals under the road.

2.3.2 Development criteria

The development criteria for the proposal include:

- Minimise environmental impacts
- Minimise community impacts
- Minimise constructability and maintenance impacts

2.3.3 Urban design objectives

The urban design objectives prescribed by Beyond the Pavement (Transport for NSW, 2023) have been considered in the development of the proposal. The urban design objectives relevant to the proposal are:

- Fitting with the built fabric.
- Fitting with the landform.
- Contributing to green infrastructure and responding to natural systems.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

In 2021, Transport commissioned the Options to reduce koala vehicle strike along Heathcote Road, near Deadmans Creek report to develop a number of mitigation options that could be implemented to reduce koala vehicle-strike (WSP, 2021). This report has informed the development of options for reducing koala vehicle-strike along Heathcote Road.

The development of each option considered local topography, landscape characteristics, the location of existing and potential fauna crossing structures (i.e. Deadmans Creek bridge and drainage culverts), known koala roadkill hotspots, predicted koala movement corridors, location of core koala habitat and engineering and environmental considerations. A survey of Heathcote Road was also undertaken to verify the ground conditions and identify constraints at and near Deadmans Creek.

The options report was developed prior to the installation of the Defence fence on the southern side of Heathcote Road between the northernmost culvert and Deadmans Creek bridge.

To identify the preferred option, Transport evaluated each option against the proposal objectives (listed in section 2.3.1) and development criteria (listed in section 2.3.2).

2.4.2 Identified options

A key finding of the options assessment report was that the existing Deadmans Creek Bridge provides some fauna connectivity under Heathcote Road, though scour protection may limit access for koalas. As such, five options for mitigating koala vehicle strike along Heathcote Road were developed, which are shown in Figure 2-4. Except for a “do nothing” approach, all options were based on improving Deadmans Creek Bridge as an underpass for koalas and the use of fencing to both exclude koalas from the road and direct them underneath the bridge. The options assessed include:

- Option 1: Fencing the road reserve of Heathcote Road along both sides of the entire road reserve (including fencing above the rock cutting near St George Crescent), improving the conditions of the Deadmans Creek bridge underpass and installing a koala grid on St George Crescent.
- Option 2 (the proposal): Install shorter lengths of fauna fence along the road reserve of Heathcote Road (north-west of the bridge) and utilising existing Defence fence (some of which may need to be modified), improving the conditions of the Deadmans Creek bridge underpass and installing a koala grid on St George Crescent.
- Option 3: Install shorter lengths of fauna fence along the road reserve of Heathcote Road to avoid impacts to land mapped as coastal wetlands under the State Environmental Planning Policy (Resilience and Hazards) 2021
- Option 4: Extension of fencing along Heathcote Road from St George Crescent to the entrance to Bendict Sands Quarry (about 1.5 kilometres south Deadmans Creek). This option can also be applied to Option 1, 2 and 3 and where appropriate, existing Defence fencing would be incorporated (some of which may need to be modified).

- Option 5: “Do nothing”. Under a “Do nothing” option, no measures would be taken to mitigate koala vehicle strike along Heathcote Road at Deadmans Creek.

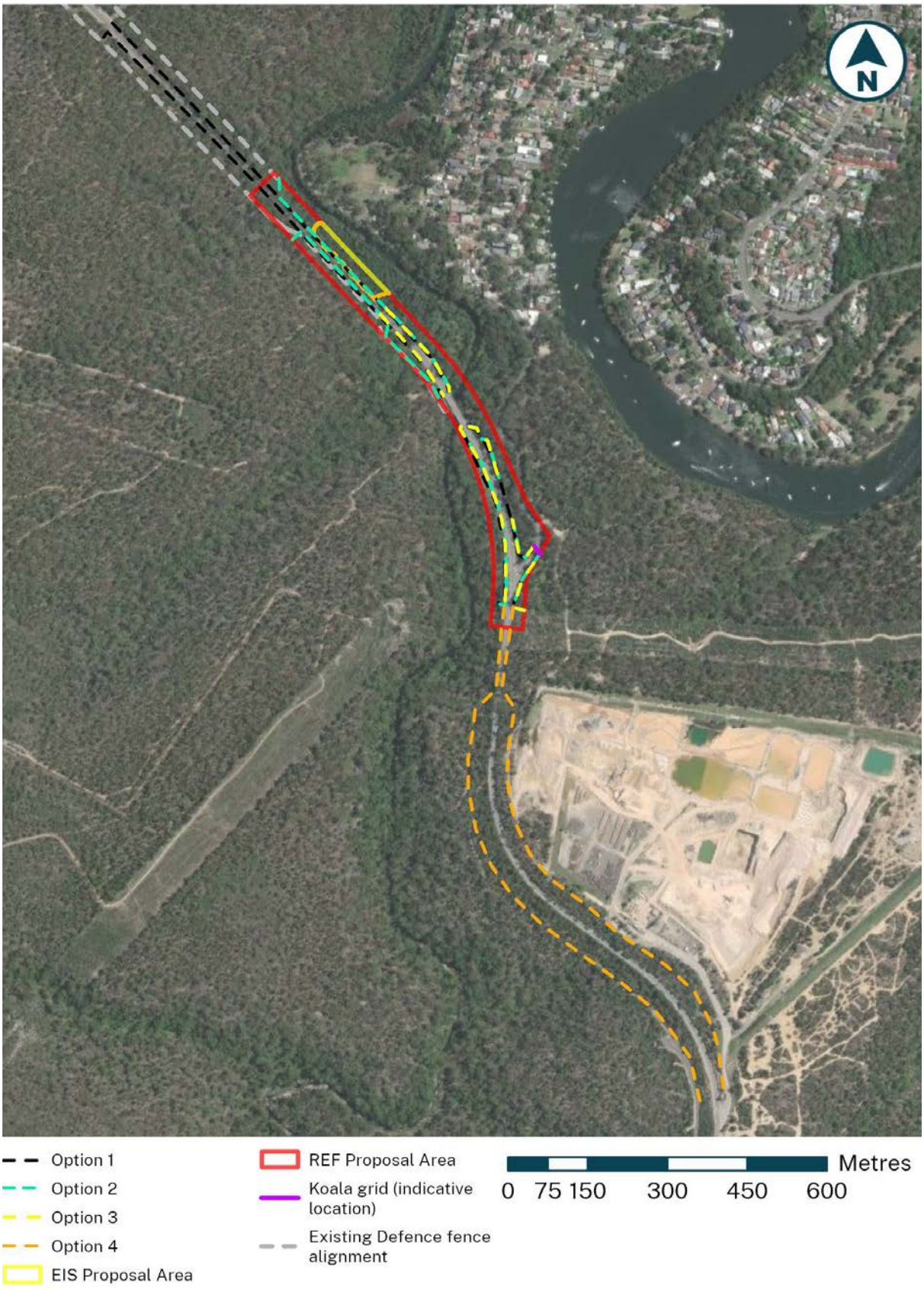


Figure 2-4: Options identified to reduce koala strike on Heathcote Road (WSP, 2021)

2.4.3 Analysis of options

A qualitative analysis of each of the five options against the proposal objectives is provided in Table 2-2. An evaluation of all options against the design criteria is provided in Table 2-3. The evaluation of each option has been categorised as "Good", "Moderate" or "Poor" (refer to Table 2-1).

Table 2-1: Evaluation categories

Evaluation	Description
Good	Meets proposal objective or development criteria
Moderate	Partially meets proposal objective or development criteria
Poor	Does not meet proposal objective or development criteria

Table 2-2: Evaluation of options against proposal objectives

Option	Proposal objective 1 Reduce koala vehicle-strike along Heathcote Road near Deadmans Creek	Proposal objective 2 Reduce the barrier effects of Heathcote Road and enhance regional connectivity for fauna movement, by promoting safe passage of animals under the road
1	Would reduce koala vehicle-strike along Heathcote Road near Deadmans Creek.	Would reduce the barrier effects of Heathcote Road and enhance regional connectivity for fauna movement, by promoting safe passage of animals under the road. Installation of new fencing parallel to existing Defence fencing (on the boundary of Holsworthy Barracks) would create isolated patches of habitat between two fences, that may result in the entrapment of fauna. This would not promote the safe passage of fauna under the road.
2	Would reduce koala vehicle-strike along Heathcote Road near Deadmans Creek.	Would reduce the barrier effects of Heathcote Road and enhance regional connectivity for fauna movement, by promoting safe passage of animals under the road.
3	With no fencing installed in the mapped coastal wetland, this option would result in a gap in the fencing which would allow fauna to access Heathcote Road just 200 metres north of Deadmans Creek. Koala vehicle-strike has occurred here in the past (refer to Figure 2-3) and would likely continue to occur in the future. This option would result in a funnelling effect, concentrating vehicle strike in this location, limiting the effectiveness of the proposal.	With no fencing installed in the mapped coastal wetland, the koala fencing is not tied into the existing culvert and this gap in fencing would not promote safe passage of animals under the road. The barrier effect of Heathcote Road would persist in this location, as koala vehicle-strike would likely continue to occur in this location in the future.
4	Would reduce koala vehicle-strike along a much longer stretch of Heathcote Road near Deadmans Creek.	Would reduce the barrier effects of Heathcote Road and enhance regional connectivity for fauna movement, by promoting safe passage of animals under the road, making this the better option.
5	The "Do nothing" option does not reduce koala vehicle-strike along Heathcote Road near Deadmans Creek	The "Do nothing" option does not promote safe passage of animals under Heathcote Road

Table 2-3: Evaluation of options against development criteria

Option	Development criteria 1 Minimise environmental impacts	Development criteria 2 Minimise community impacts	Development criteria 3 Minimise constructability and maintenance impacts
1	Would result in greater environmental impacts (native vegetation clearing, ground disturbance and visual impacts) than Option 2 and Option 3, but less than Option 4. Fencing up to and along the rock slope north of Deadmans Creek bridge, on the western side of Heathcote Road, would require more vegetation clearing for the access of plant and equipment during construction. Would create isolated patches of habitat between two fences, that may result in the fauna being trapped.	Greater extent of new fencing is required for this option when compared to Option 2, Option 3 and Option 4. This would result in greater community impacts when compared to Option 1 and Option 4, such as partial temporary road closures along Heathcote Road, traffic delays and construction noise impacts. The construction of this option would be of a shorter duration (with shorter community impacts) than Option 4, but a longer duration than Option 2 and 3.	Would be more difficult to construct and maintain than other options.
2	Reduces the extent of vegetation clearing required for the proposal compared to Option 1. The reduced extent of new fencing required for this option would also minimise other environmental impacts such as construction noise, erosion and sedimentation risks, and visual impacts.	Reduced new fencing extents compared to Option 1 and Option 4. Would minimise community impacts such as partial temporary road closures along Heathcote Road, traffic delays and construction noise impacts. Shorter construction duration (with shorter community impacts) than Option 4.	Reduced new fencing extents compared to Option 1 and Option 4, resulting in reduced construction and maintenance impacts.
3	Would have fewer environmental impacts (such as vegetation clearing and construction noise and a smaller area at risk of sedimentation and erosion) than Option 1, Option 2 and Option 4. Absence of fencing from the mapped coastal wetland would result in a gap in the fencing which would allow fauna to access Heathcote Road just 200 metres north of Deadmans Creek. Koala vehicle-strike has occurred here in the past (refer to Figure 2-3) and would likely continue to occur in the future. This option would result in a funnelling effect, concentrating vehicle strike in this location, resulting in adverse impacts on biodiversity.	Reduced new fencing extents compared to Option 1, Option 2 and Option 4. Would minimise community impacts such as partial temporary road closures along Heathcote Road, traffic delays and construction noise impacts. Shorter construction duration (with shorter community impacts) compared to Option 1, Option 2 and Option 4.	Reduced new fencing extents compared to Option 1, Option 2 and Option 4, resulting in reduced construction and maintenance impacts.
4	This option involves the construction of the longest	This option involves the construction of the longest	This option involves the construction and maintenance

Option	Development criteria 1 Minimise environmental impacts	Development criteria 2 Minimise community impacts	Development criteria 3 Minimise constructability and maintenance impacts
	length of fencing. Therefore, this option has the greatest environmental impact, including the largest area of vegetation clearing, the widest spread of construction noise impacts, the greatest area at risk of sediment and erosion risks. Furthermore, records of koala vehicle-strike (refer to Figure 2-3) are generally located in proximity to Deadmans Creek and the extent of Heathcote Road north of Deadmans Creek. There are no records of koala vehicle-strike further than 50 metres south of Deadmans Creek. As such, installing fencing for 1.5 kilometres south from Deadmans Creek is deemed unnecessary.	extent of new fencing. Therefore, this option has the greatest community impacts, including the longest extent of partial temporary road closures along Heathcote Road (including potential traffic and access impacts on Benedict Sands Quarry), traffic delays and the widest spread of construction noise impacts. This option would take the longest time to construct, therefore impacting the local community for the longest period of time, compared to the other options.	of the longest extent of new fencing, requiring the largest buffer (three metres either side of the fence). This option would require ongoing trimming and lopping of branches from the longest extent of fencing (i.e. from the three-metre buffer either side of the fence), which aims to prevent arboreal animals climbing over the fence via overhanging branches. The longest extent of fencing under this option would require the longest inspections to ensure no breaches and effectiveness of the fence.
5	Provides no reduction in koala (and other fauna) vehicle strikes. Would not have any other environmental impacts such a construction noise, potential sedimentation and erosion, visual impacts and changes to landscape character.	No community impacts, such as construction noise or partial temporary road closures and traffic delays.	No new infrastructure to construct and maintain.

Each of the five options' consistency with the proposal objectives and development criteria are considered in Table 2-4.

Table 2-4: Summary of options analysis for each proposal option

Option	Proposal objective		Development criteria		
	1	2	1	2	3
1	Good	Moderate	Moderate	Moderate	Poor
2	Good	Good	Good	Good	Good
3	Poor	Poor	Moderate	Good	Good
4	Good	Good	Poor	Poor	Poor
5	Moderate	Poor	Moderate	Good	Good

2.5 Preferred option

As demonstrated in Table 2-2, only Option 2 and Option 4 met both proposal objectives.

While Option 1 met one of the two proposal objectives, it did not meet any of the design criteria. This is mainly due to new fencing parallel to existing Defence fencing (on the boundary of Holsworthy Barracks) resulting in adverse environment and community impacts, potential entrapment of fauna and a fencing alignment that would be more difficult to construct and maintain than other options. Option 1 was therefore discounted.

Option 2 meets both proposal objectives while also having reduced environmental and community impacts when compared to other options, particularly Option 4.

Option 3 did not meet either proposal objective, as the substantial gap in koala fencing (within the mapped coastal wetland) would allow fauna to access Heathcote Road (rather than guiding fauna towards safe crossing points under the road), where koala vehicle-strike would likely continue to occur in the future. Option 3 was therefore discounted.

Option 4 meets both proposal objectives, however, has the greatest environmental and community impacts, and would result in the longest extent of new fencing to be constructed and maintained of all options. While the benefits of Options 2 and 4 are similar, Option 4 was discounted as greater potential impacts were expected.

Option 5, the "Do nothing" option, was discounted as it does not achieve the proposal objectives or fulfil the strategic need for the proposal.

Following this analysis of options, Option 2 was selected as the preferred option.

2.6 Design refinements

Since the selection of Option 2 as the preferred option, design refinements have been made to further minimise koala access to Heathcote Road and facilitate their movement under the road. The length of fencing proposed under Option 2 has been reduced as a result of recent extensions of Defence fencing, which was installed following the commission of the options report.

Additional fencing on the west side of Heathcote Road tying into two existing drainage culverts to create additional koala crossing opportunities. Motion-sensor camera monitoring undertaken by Transport for NSW since 2021 has identified koalas utilising the single-cell 1500 millimetre diameter concrete pipe culvert located around 470m north of Deadmans Creek Bridge to cross underneath the road. Fencing will therefore capture this as a secondary koala crossing location, which is supported by the presence of a fauna access pipe on the Defence fence. The twin-cell 950 millimetre diameter concrete pipe culvert around 200m north of Deadmans Creek Bridge will also be captured by the proposed fencing. While this culvert was found in the options assessment report (WSP, 2021) to provide limited connectivity due to tidal inundation, the culvert is unable to be blocked by fencing on the eastern side of the road. The associated unnamed creek also creates a gap under the Defence fence. As such, proposed fencing will tie into the culvert to both safeguard this potential weak point and provide an incidental crossing location should conditions allow fauna passage in the future.

No improvements to the suitability of the culverts are proposed as the bridge underpass will remain the primary crossing point under Heathcote Road. In addition to the installation of koala fencing, the following features are also now included in the proposal:

- Installation of a koala grid on St George Crescent.
- Improvement of the ground conditions of the Deadmans Creek bridge underpass
- Provision of up to six fauna escape structures, located near fence ends or other weak points, to allow any koalas or other fauna to move from roadside to the habitat side of the fence.
- Installation of Koala refuge poles under and near Deadmans Creek bridge to offer refuge from predators where trees are absent.
- Gates in the fencing for emergency and maintenance access.

3. Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

Transport proposes to construct about 1,153 metres of fencing along Heathcote Road (the proposal), which aims to prevent koalas accessing the road where they are susceptible to vehicle strike and guide them towards safe crossing points under the road. A high number of koala fatalities have been recorded along Heathcote Road near Deadmans Creek, where the road separates large areas of habitat within Georges River National Park to the east and Holsworthy Barracks military base to the west.

The proposal comprises several sections of fencing that will be constructed on both sides of Heathcote Road near Deadmans Creek, between St George Crescent in Menai and Pleasure Point Road in Pleasure Point. The proposal also involves the installation of structures and ground treatments to further improve the safe passage of animals under Heathcote Road.

The proposal is located about 24 kilometres south-west of the Sydney CBD and about 8.5 kilometres south-east of the Liverpool CBD. The proposal falls within both the Liverpool City and Sutherland Shire Local Government Areas. The location of the proposal is shown in Figure 1-1.

Key features of the proposal include:

- About 1,153 metres of new koala fencing that is 1.5 metres high, with galvanised steel sheeting along the top, comprising of:
  - About 360 metres (excluding the 170 metres of koala fence to be assessed by separate EIS) of continuous fencing on the eastern side of Heathcote Road, between existing Defence fencing to the north and Deadmans Creek Bridge to the south.
  - About 350 metres of fencing on the eastern side of Heathcote Road, south of Deadmans Creek Bridge. This fencing would be installed in three sections to tie into existing rock slopes and St George Crescent, to create a continuous barrier to Heathcote Road.
  - About 143 metres on the western side of Heathcote Road north of Deadmans Creek Bridge to direct fauna to cross under the road via two existing culverts and Deadmans Creek Bridge, and into the fauna access pipes installed in the Defence fencing.
  - About 300 metres on the western side of Heathcote Road, south of Deadmans Creek Bridge.
- A koala grid with a pedestrian gate across St George Crescent about 80 metres from the intersection with Heathcote Road, which aims to prevent koalas from accessing Heathcote Road.
- About six fauna escape structures, located near fence ends or other weak points, to allow any koalas or other fauna to move from roadside to the habitat side of the fence.
- Up to three metres of selective vegetation clearing on either side of koala fencing, including
  - Trimming of overhanging trunks or branches (that may allow koalas to climb over the fence into the road corridor).
  - Removal of vegetation on existing rock slopes along the proposed fence alignment to deter animals from using the slopes to access the road
- Fauna access improvements around Deadmans Creek Bridge including:
  - Koala refuge poles to offer refuge from predators where trees are absent.
  - Surface treatments (shotcrete/concrete) in drains around existing fauna crossing structures under Deadmans Creek bridge to assist fauna movements.
- Gates in the fencing for emergency and maintenance access.

Key features of the proposal are shown in Figure 3-1.

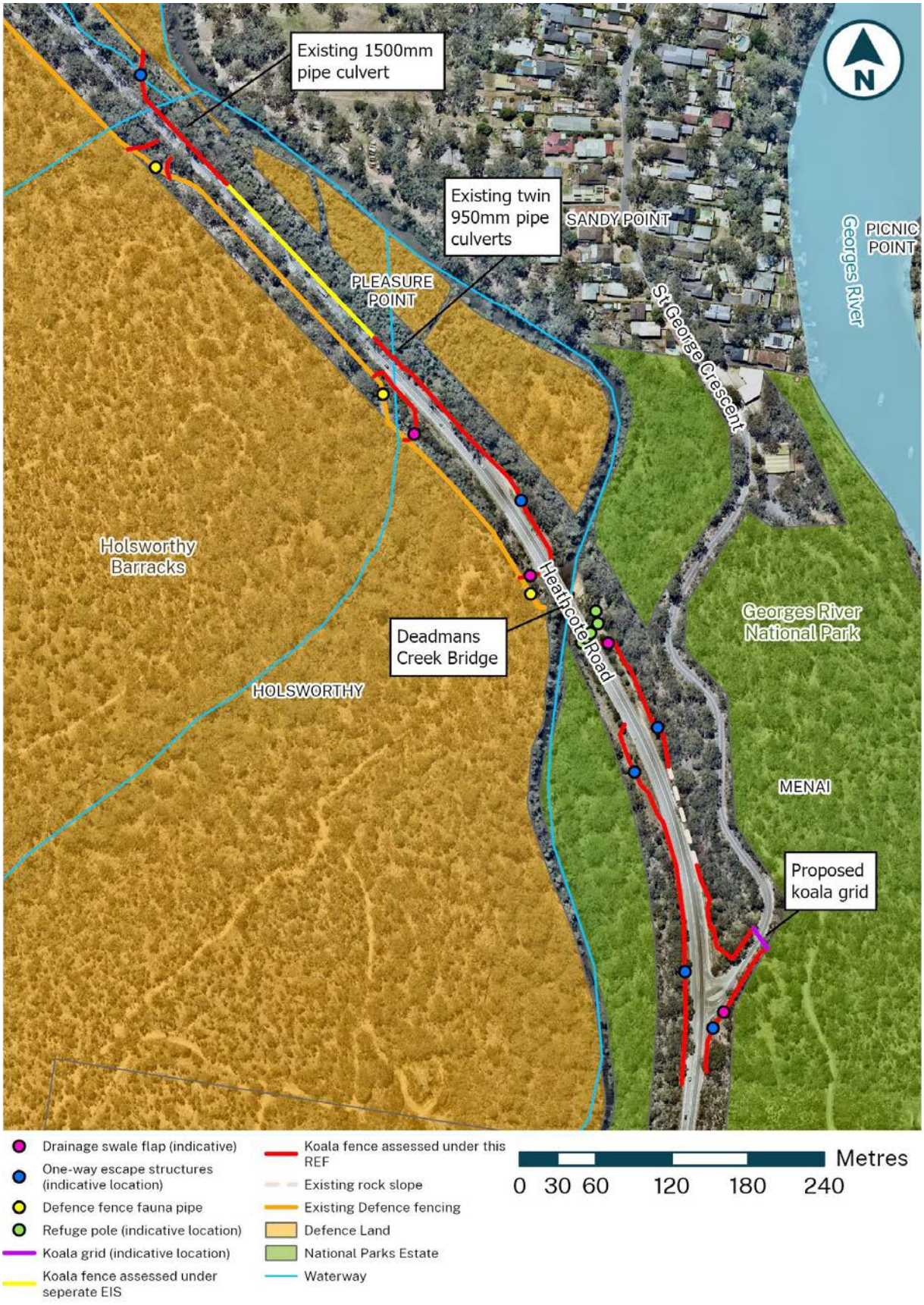


Figure 3-1: Key features of the proposal

3.2 Design

The following sections provide a description of the design criteria, design features and engineering constraints of the proposal.

3.2.1 Design criteria

The design of the proposal has been carried out in accordance with the following guidelines and standards:

- Austroads Guide to Traffic Management (Austroads, 2021).
- Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers (Austroads, 2021).
- Austroads Guide to Road Design Part 6B: Roadside Environment (Austroads, 2021).
- Lessons Learned - Environmental Design and Fauna Connectivity (Transport for NSW, 2021).
- How to keep koalas off the road: Koala Vehicle Strike Fact sheet 2 (Department of Planning, Industry and Environment, 2020).

3.2.2 Engineering constraints

Key engineering constraints considered in the design of the proposal include:

- Topography: the alignment of the fence accounts for localised variations in elevation, low lying areas of swamp and Deadmans Creek, rocky cliffs and roadside cuts with shotcrete treatments. Refer to section 6.4 for further detail.
- Drainage and road infrastructure: the alignment of fence crosses a number of small drainage channels north of Deadmans Creek, which are subject to flooding.
- Property: the REF proposal area is constrained by boundary of Holsworthy Barracks military base to the east, the boundary of George River National Park to the west and mapped Coastal Wetlands in the north-west of the REF proposal area. Refer to section 6.9 for further detail.
- Operational traffic: the operation of Heathcote Road needs to be maintained during construction, as there are no detour options. Access to St George Cresent, which provides the only road into and out of Sandy Point, also needs to be maintained during construction. Refer to section for further detail.
- Water quality: the proposal is within the Georges River Catchment area and consideration must be given to whether the proposal will have a neutral or beneficial effect on water quality in receiving waters. Refer to section 6.5 for further detail.
- Aboriginal heritage: the alignment of the fence avoids a recently recorded Potential Archaeological Deposit (PAD), that was identified in 2023 near Deadmans Creek, on the eastern side of Heathcote Road. Refer to section 6.7 for further detail.

3.2.3 Major design features

The design features of the proposal aim to reduce vehicle strike of koalas (and other animals) on Heathcote Road, guide animals towards safe crossing points below the road to facilitate their safe passage between areas of habitat on either side of the road. The design of the proposal has been informed by all recent installations of koala fencing and other mitigations measures that have been implemented by Transport to reduce animal-vehicle collisions.

Koala fencing

About 1,153 metres of koala fencing installed along Heathcote Road, extending about 600 metres north of Deadmans Creek Bridge and 380 metres south of Deadmans Creek Bridge. All koala fencing would be installed within the road corridor. To reduce vegetation clearing and avoid low-lying swamp areas, most of the koala fence would be installed about 1.5 metres behind the existing steel safety barriers.

Koala fencing will also tie into existing boundary fencing around Department of Defence land north of the bridge on the western side of Heathcote Road. In consultation with Transport, Department of Defence modified a section of their boundary fence in mid-2024 to align with the objectives of this proposal. This included installation of smooth metal panels on the habitat side of the fence to stop koalas climbing into the road corridor.

Koala fencing will also guide koalas (and other small animals) to small pipes that have been strategically installed at the base of the existing Defence fence on the western side of Heathcote Road at three locations; one near Deadmans Creek bridge and one near each of the two existing culverts north of Deadmans Creek. These pipes allow animals to access large areas of habitat contained within Holsworthy barracks military base.

The koala fence design would be consistent with recent Transport koala fencing projects that use the 'slippery top' design. Key design features of this fence design include:

- Chain-mesh about 1.5 metres high from the ground and extending about 30 centimetres along the ground on the habitat side of the fence, to stop animals digging and passing underneath.
- Galvanised steel sheeting, about 60 centimetres wide, affixed to the top of the fence, which aims to prevent koalas (and other arboreal mammals) from being able to climb over the fence.
- The chain-mesh and steel sheeting would be affixed to vertical steel posts that are buried to a depth of about 90 centimetres and a horizontal post along the top edge.
- Bracing posts may also be required for some panels.

Where fencing crosses existing drainage swales, the fence would include a flap at the base conformed to a concrete drain lining that is self-cleaning of debris and prevents blockages from vegetation growth. The indicative location of drainage swale flaps is shown in Figure 3-2 while an example of this design detail is shown in Figure 3-3. Therefore, part of this proposal would include replacing existing riprap drains with concrete lining up to two metres either side of the fence where drain crossings are required.

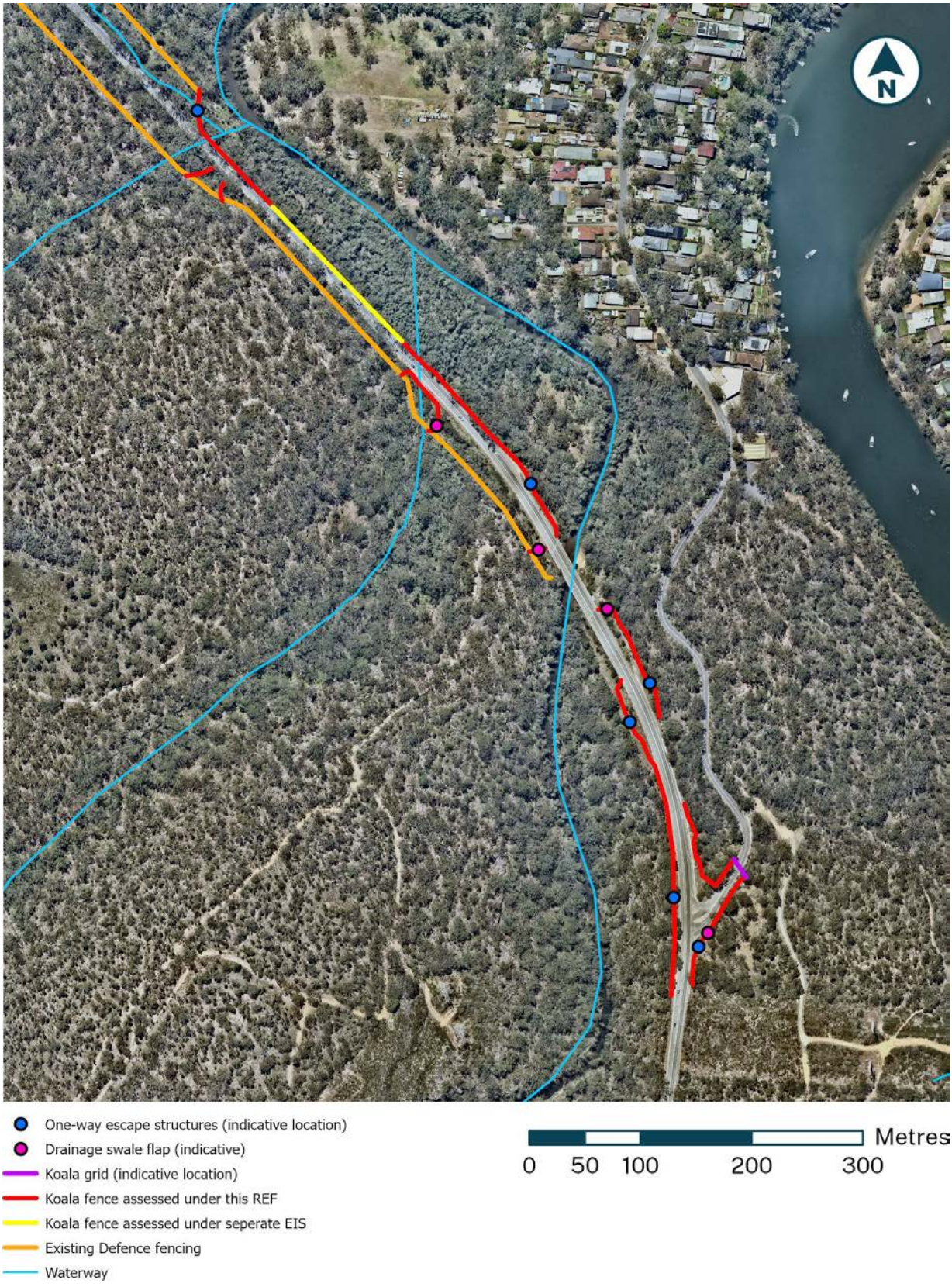


Figure 3-2: Indicative drainage swale flap locations

Figure 3-3: Example drainage flap where koala fence traverses a drainage swale

Up to three metres of vegetation clearing on both sides of the proposed fence would be required, for installation and maintenance of the fence. Overhanging branches may also be trimmed in this area that may otherwise allow koalas to climb over the fence into the road. Clearing impacts and mitigation measures are discussed further in Section 6.1.4.

An example of koala fencing, similar to the koala fencing to be installed along Heathcote Road, is shown in Figure 3-4. The design of this koala fencing is shown in Figure 3-5.

Figure 3-4: Example of koala fencing installed alongside the M1 to Raymond Terrace project in the Hunter Region

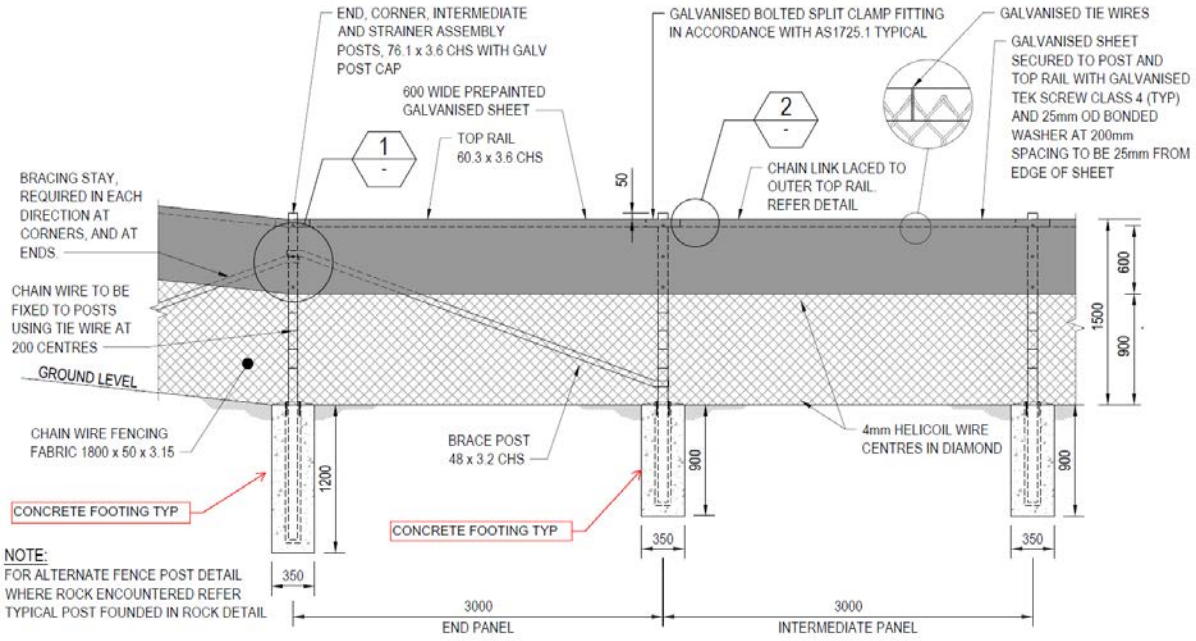


Figure 3-5: Typical koala fence 'slippery top' design, indicative of the fence design to be installed along Heathcote Road

Koala grid

Koala grids are a modified cattle grid that allows vehicle passage but deters koala passage. Grids are required where exclusion fence alignments are disrupted by roads, creating a gap in the fence. Koala grids may not stop every animal that interacts with them. However, these structures are currently considered the best exclusion measure for fauna at road crossings

One koala grid would be installed on St George Crescent, about 60-80 metres from the intersection with Heathcote Road. The koala grid would extend across both lanes of St George Crescent. Key design features of the koala grid include:

- About 9 metres long (across the entire road) and about 1.5 metres wide.
- A drainage trough beneath the grid that is about 0.6 metres deep.
- A pedestrian gate on the north side of the grid to facilitate passage for pedestrians and cyclists.
- Koala fencing would tie in the grid and gate to create a continuous barrier to Heathcote Road.

An example of a koala grid with two pedestrian gates is shown in Figure 3-6.

Figure 3-6: Koala grid installed on Gulgan Road, Brunswick Heads, with koala fencing alongside the road

Koala refuge poles

Koala refuge poles are vertical timber poles with a fork at the top that offer koalas and other climbing animals refuge from threats such as predators. Refuge poles are needed where animals are expected to be moving through an environment otherwise devoid of natural shelter (i.e. trees). About six koala refuge poles would be installed under and near Deadmans Creek Bridge, where native vegetation is absent. Key design features of koala refuge poles include:

- Set about one metre deep in a concrete footing.
- Constructed of salvaged hardwood timber, where possible.
- About three metres tall and about 200 millimetres in diameter.

The typical design of a koala refuge pole is shown in Figure 3-7.

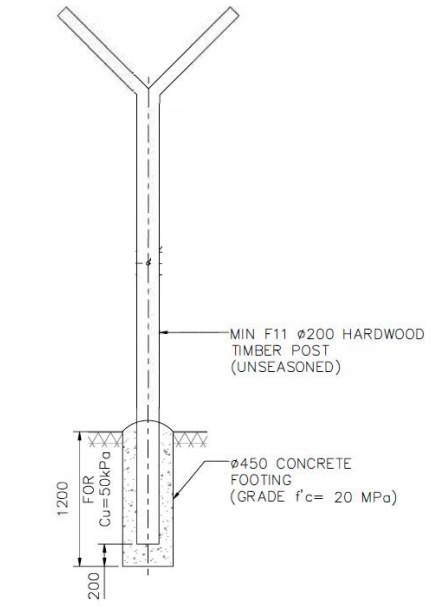


Figure 3-7: Typical design of koala refuge pole

Underbridge access improvements

To further improve upon Stage 1 works that were completed in early 2023, ground treatments are required under and near Deadmans Creek Bridge, to improve fauna access to the fauna ledge installed at the northern bridge abutment, and the concrete path installed at the southern bridge abutment. Currently, fauna must travel across riprap, which is the rocky material that has been placed at the bridge abutments to protect against scour an erosion.

Ground treatments on top of riprap may include installation of ramps, vertical logs and shotcrete to create a more favourable surfaces for koalas and other animals to walk across and access the raised ledge and concrete path.

Figure 3-8: Raised ledge installed at northern abutment of Deadmans Creek bridge. Ground treatments would be applied to each end of this ledge to improve fauna access across the riprap

Figure 3-9: Concrete pathway installed at the southern bridge abutment

One-way escape structures

One-way escape structures would be installed near fence ends and other weak points to allow any koalas that may become trapped in the road corridor a means to escape. One option for a one-way escape structure includes a timber pole design that allows koalas to climb over a fence from the roadside, though is not accessible from the ground on the habitat side. This may be achieved by a hovering pole or pole wrapped in smooth material on the habitat side that cannot be climbed. Other one-way structures with a similar construction footprint, including escape hatches, may be considered for installation.

Figure 3-10: Example of one-way koala escape pole on Heathcote Bridge

Figure 3-11: Example of one-way koala escape hatch

Photo credit: Endeavour Veterinary Ecology

3.3 Construction activities

3.3.1 Work methodology

There are six stages expected for construction of the proposal:

- Establishment of ancillary facilities, involving:
  - Installation of temporary fencing, lighting and signage.
  - Installation of temporary amenities.
  - Installation of erosion and sediment controls.
  - Installation of temporary traffic controls.

- Vegetation clearing and minor earthworks, involving:
  - Removal of trees and shrubs.
  - Site leveling along fence alignment (where required).
- Installation of fencing, involving:
  - Concrete lining of drains which intersect the proposed fence alignment.
  - Installation of fence posts.
  - Installation of chain-mesh wire fencing and galvanised steel sheeting.
- Installation of supplementary fauna crossing measures (koala refuge poles and ground treatments), involving:
  - Installation of koala poles.
  - Installation of ground treatments under and near Deadmans Creek.
  - Installation of one-way escape structures.
- Installation of the koala grid, involving:
  - Excavation of koala grid footprint.
  - Construction of koala grid foundation and drainage infrastructure.
  - Installation of koala grid and pedestrian fence.
  - Installation of signage and line-marking on the road.

Some activities within these six stages may be carried out concurrently, or the stages may be carried out in a different order than listed.

Construction of the overall proposal, including both the REF and EIS proposals, is anticipated to begin in 2025, with construction expected to take four months, weather permitting and subject to approval.

3.3.2 Construction workforce

The construction workforce would fluctuate, depending on the stage of construction and associated activities. Between eight and 15 construction personnel are anticipated to be on site for each day of construction, including traffic control crew, depending specific work arrangement on the day.

3.3.3 Construction hours and duration

Construction of the proposal would generally be carried out during standard working hours:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 7:00am to 1:00pm
- Sunday and Public holidays: no planned work.

Some construction activities would be required to be undertaken outside of these standard working hours, to ensure safe working conditions and minimise disruptions to traffic on Heathcote Road and St George Crescent. Noisier activities such as jackhammering and concrete cutting would be completed by midnight. These hours would be in accordance with Road Occupancy Licences (ROLs) issued by the Transport Management Centre and up to five consecutive nights a week as follows:

- Evening / night work– Sunday to Thursday
- No works on public holidays

Approval from Transport would be required for out of hours works and the affected community would be engaged regarding the proposed construction hours at least five working days prior to works commencing in accordance with the *Construction Noise and Vibration Guideline* (Transport for NSW, 2023) and Environmental Planning Authority (EPA)'s *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change, 2009). The community would be kept informed of proposed upcoming work and contact information.

3.3.4 Plant and equipment

Plant and equipment expected to be used to construct the proposal includes:

- Truck (medium rigid)
- Road truck
- Franna crane
- Five tonne excavator
- Concrete saw
- Jackhammer
- Chainsaw
- Plate compactor
- Tub grinder
- Mulch truck
- Elevated work platform
- Light vehicles
- Truck mounted auger
- Side tipper
- Concrete truck
- Truck with lifting boom
- Hand tools
- Skid steer

3.3.5 Source and quantity of materials

Materials to be used to construct the proposal would be sourced from local quarries and appropriately licensed commercial suppliers in nearby areas. About 1,153 metres of fencing material is required to construction the proposal. Other materials required include hardwood timbers (for koala refuge poles and one-way escape structures), shotcrete and steel for the koala grid. The quantity of materials required for the proposal would be negligible and therefore would not have any significant impact on demand for materials.

3.3.6 Traffic management and access

The proposal is expected to generate light and heavy vehicle traffic movements during construction. Vehicle movements would mainly be associated with:

- Delivery of construction materials including chain-mesh fencing, timber poles and shotcrete.
- Removal of cleared vegetation.
- Delivery and removal of construction equipment and machinery.
- Workers (including traffic management crews) travelling to and from the REF proposal area.

Construction traffic

It is anticipated that construction of the proposal would generate between three and six light vehicle movements to and from the proposal each day, as the workforce travels to and from the site.

It is anticipated that construction of the proposal would generate up to five heavy vehicle movements to and from the proposal each day, although heavy vehicle movements would be sporadic.

Temporary road closures

Partial road closures on Heathcote Road and St George Crescent would be required for construction of the proposal. These closures are expected to be undertaken at night to minimise disruption to traffic. Access along St George Crescent would be maintained.

Potential construction traffic impacts are discussed further in Section 6.4.

3.4 Ancillary facilities

To support construction of the proposal, ancillary facilities would be required. Three ancillary facility sites have been identified for use during construction. These sites have been selected as they have been previously disturbed and do not contain trees and therefore require only minimal clearing or trimming of shrubs. They do not comprise of formal access roads or formalised roadside facilities. The locations of proposed ancillary sites are shown in Figure 3-12.

Two proposed ancillary sites would be located on the southern side of Deadmans Creek. Ancillary site #1 would be located on the western side of Heathcote Road, while Ancillary site #2 would be located on the eastern side. These ancillary sites would also support stockpile and laydown areas and construction staff parking. Some removal of shrubs and small trees would be required.

Ancillary site #3 would be located on the northern side of Deadmans Creek, on the eastern side of Heathcote Road. This ancillary site would support stockpile and laydown areas and construction staff parking. No tree removal or earthworks are anticipated to be required for the establishment of this ancillary facility.

Access to the two ancillary facilities on the eastern side of Heathcote Road (Ancillary sites #2 and #3) would be from the southbound lane of Heathcote Road, with traffic control to be implemented as required for heavy vehicle movements. Access to Ancillary site #1 on the western site of Heathcote Road would be from the northbound lane of Heathcote Road, with traffic control to be implemented as required for heavy vehicle movements. No new access roads are required to be constructed for heavy or light vehicles to access the ancillary sites.

Ancillary facilities would be secured with temporary fencing and signage would be erected advising the general public of access restrictions. Temporary lighting would be installed to support construction activities carried out at night. Upon completion of construction, any plant, equipment and stockpiled material would be removed and the area restored to pre-construction condition.

Operational hours of the ancillary facilities would generally align with the construction hours for the proposal.

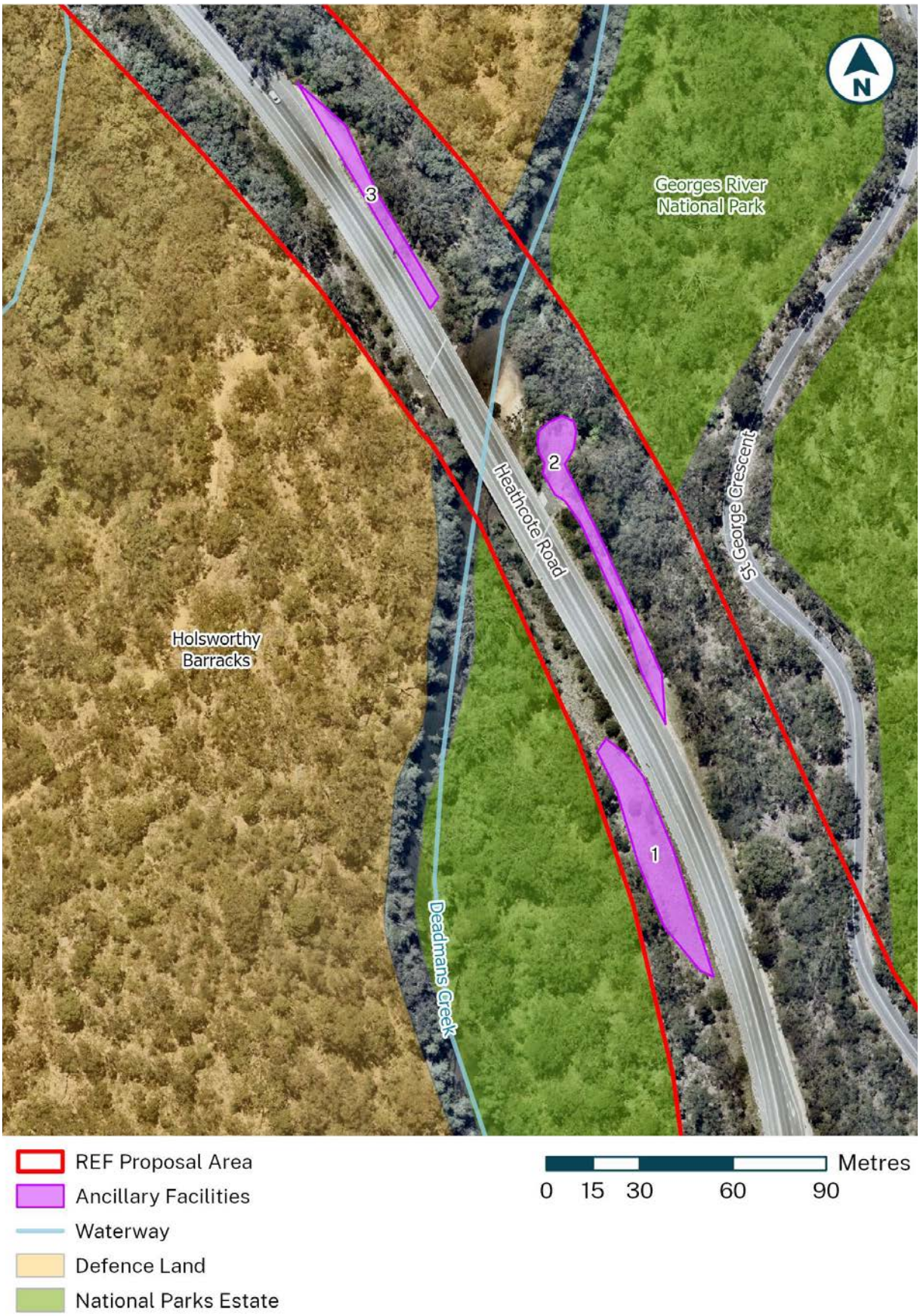


Figure 3-12: Ancillary facilities required to support construction of the proposal

3.5 Public utility adjustment

No relocations of public utilities are anticipated for the proposal.

3.6 Property acquisition

The proposal would be entirely constructed within the road corridor which is zoned SP2 Infrastructure (Classified Road) under both the Liverpool Local Environmental Plan 2008 (LLEP 2008) and Sutherland Shire Local Environmental Plan 2015 (SSLEP 2015). No property acquisition is proposed as part of the proposal.

4. Statutory and planning framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies (SEPP), local environmental plans (LEP) and other legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Transport and Infrastructure) 2021

State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP (Transport and Infrastructure)) aims to facilitate the effective delivery of infrastructure across the State.

Section 2.109 of SEPP (Transport and Infrastructure) permits development on any land for the purpose of a road or road infrastructure facilities, or environmental management works if the works are in or adjacent to a road corridor, to be carried out by or on behalf of a public authority without consent.

As the proposal is for koala fencing, which can be characterised as road infrastructure facilities and environmental management works, and is to be carried out by Transport, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* (NP&W Act) and does not require development consent or approval under:

- State Environmental Planning Policy (Resilience and Hazards) 2021
- State Environmental Planning Policy (Planning Systems) 2021
- State Environmental Planning Policy (Precincts – Central River City)
- State Environmental Planning Policy (Precincts – Eastern Harbour City)
- State Environmental Planning Policy (Precincts – Regional) 2021
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021.

Section 2.10 to 2.15 of SEPP (Transport and Infrastructure) contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by SEPP (Transport and Infrastructure) (where applicable), is discussed in chapter 5 of this REF.

State Environmental Planning Policy (Resilience and Hazards) 2021

SEPP (Resilience and Hazards) aims to promote an integrated and coordinated approach to land use planning in the coastal zone, which includes land mapped as coastal wetlands, littoral rainforests, coastal vulnerability areas, coastal environment areas and coastal use areas.

Coastal wetlands are mapped adjacent to and within the REF proposal area. About 170 metres of koala fencing is located within a mapped coastal wetland mapped on the eastern side of Heathcote Road, north of Deadmans Creek. This section of koala fencing is being assessed by a separate EIS, and falls within the EIS proposal area, as shown in Figure 1-3. While coastal wetlands are also mapped along Deadmans Creek under Heathcote Road, no other REF proposal features are located within these mapped extents of coastal wetland, as shown in Figure 4-1.

Much of the REF proposal area falls within land mapped as “proximity area for coastal wetlands”. Clause 2.8(1) of SEPP (Resilience and Hazards) states that development consent must not be granted to development on land identified as “proximity area for coastal wetlands” on the *Coastal Wetlands and Littoral Rainforests Area Map* unless the consent authority is satisfied that the proposed development will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, or; the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland.

Potential impacts on nearby wetlands, and safeguards to avoid, minimise and mitigate potential impacts, are assessed in Section 6.5.

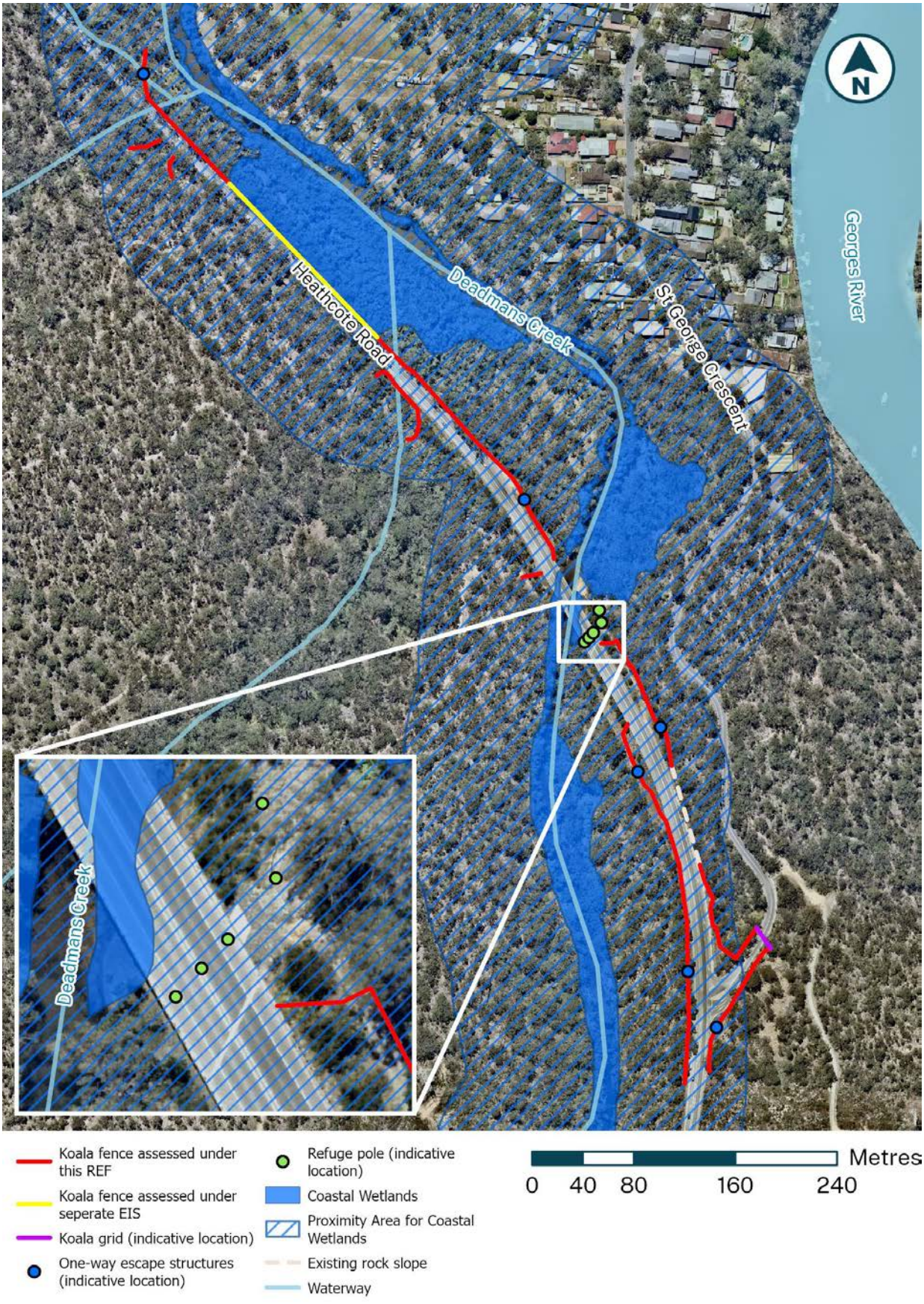


Figure 4-1: Key features of the REF proposal area that are located outside of mapped coastal wetlands

State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapter 6 (Water Catchments) of State Environmental Planning Policy (Biodiversity and Conservation) 2021 (SEPP (Biodiversity and Conservation)) relates to the use of land within regulated water catchments. Part 6.5 of the SEPP requires consideration of whether an activity to which Division 5.1 of the EP&A Act applies will have a neutral or beneficial effect on water quality before carrying out the activity. The REF proposal area is not located within the Sydney drinking water catchment and therefore a neutral or beneficial effect assessment is not required.

Part 6.2 of the SEPP relates to development in regulated catchments and pursuant to section 171A (1) of the EP&A Regulation, in considering the likely impact on the environment of an activity proposed to be carried out in a regulated catchment, a determining authority must take into account:

a) the matters a consent authority must consider under State Environmental Planning Policy (Biodiversity and Conservation) 2021, sections 6.6(1), 6.7(1), 6.8(1) and 6.9(1), and

b) the matters of which a consent authority must be satisfied under State Environmental Planning Policy (Biodiversity and Conservation) 2021, sections 6.6(2), 6.7(2), 6.8(2) and 6.9(2).

The REF proposal area is located within the Georges River Catchment. Therefore, the provisions listed above relevant to Chapter 6 of SEPP (Biodiversity and Conservation) are considered in Appendix C.

4.1.2 Local Environmental Plans

Liverpool Local Environmental Plan 2008

Liverpool Local Environmental Plan 2008 (LLEP 2008) applies to land to the west of Deadmans Creek. The proposal is located entirely within the road corridor which is zoned SP2 Infrastructure (Classified Road). The objectives of the SP2 zone under the LLEP 2008 are as follows:

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.
- To reserve land for the provision of infrastructure.

As stated in Section 4.1.1, Section 2.109 of SEPP (Transport and Infrastructure) permits the proposal to be carried out without consent.

Sutherland Shire Local Environmental Plan 2015

Sutherland Shire Local Environmental Plan 2015 (SSLEP 2015) applies to land to the east of Deadmans Creek. The proposal is located entirely within the road corridor which is zoned SP2 Infrastructure (Classified Road). The objectives of the SP2 zone under the SSLEP 2015 are as follows:

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.

As stated in Section 4.1.1, Section 2.109 of SEPP (Transport and Infrastructure) permits the proposal to be carried out without consent.

4.2 Other relevant NSW legislation

4.2.1 Roads Act 1993

The objects of the *Roads Act 1993* (Roads Act) include classifying roads, declaring Transport and other public authorities as roads authorities, and regulation of various activities on public roads.

Heathcote Road is a classified Main Road (512) under the Roads Act. Under section 143 of the Roads Act, a roads authority can use a public road in the exercise of a function conferred by the Roads Act, so long as the function is exercised in a way that will not unduly interfere with the rights of passage and access that exist with respect to the public road.

4.2.2 Crown Lands Management Act 2016

The *Crown Land Management Act 2016* sets out the framework for the management of Crown Land in NSW. The land in the Deadmans Creek corridor is mapped as Crown Land. None of the works proposed encroach on this Crown Land.

4.2.3 Biodiversity Conservation Act 2016

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community consistent with the principles of ecologically sustainable development.

Under Part 2 of the BC Act it is an offence to harm animals and plants; damage areas of outstanding biodiversity value; damage habitat of threatened species or ecological communities. Under Part 2, Division 2 of the BC Act it is a defence to a prosecution if the harm or damage was necessary for the carrying out of a Division 5.1 EP&A Act activity undertaken in compliance with the determination.

Section 7.3 of the BC Act establishes a test to determine whether a proposed development or activity is 'likely to significantly affect threatened species'. If an activity under Division 5.1 of the EP&A Act is likely to significantly affect threatened species then a Species Impact Statement or a Biodiversity Development Assessment Report is required to be prepared.

Further details regarding potential impacts of the proposal on biodiversity are provided in Section 6.16.1.

4.2.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the protection of threatened fish and marine vegetation and for the management of associated threatening processes. Part 7A Division 4 of the FM Act prohibits, without a licence or permit, activities that damage habitats or harm threatened species, populations or ecological communities.

Under section 205 of the FM Act, works that harm marine vegetation, such as mangroves, require a permit from the Minister. The proposal does not involve the harming of marine vegetation, including mangroves that occur along the banks of Deadmans Creek.

Section 219 of the FM Act makes it an offence to obstruct fish passage without a permit issued under Part 7 of the FM Act. Any requirement for a permit to block fish passage would be determined in consultation with DPI Fisheries. As no works within Deadmans Creek are proposed, the proposal would not block fish passage, temporary or permanent. Therefore, a permit is not required under section 219 of the FM Act.

Biodiversity impacts in relation to the proposal, and safeguards to manage and mitigate potential impacts, are considered in Section 6.1.

4.2.5 National Parks and Wildlife Act 1974

The NP&W Act aims to conserve nature; conserve objects, places or features; foster public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation (including biological diversity) of cultural value within the landscape; and provide for the management of land reserved under this Act.

Georges River National Park is reserved under this Act, and directly adjoins the REF proposal area on the western side of Heathcote Road, south of Deadmans Creek. The REF proposal does not encroach Georges River National Park. Safeguards will be implemented to avoid indirect impacts of the proposal on Georges River National Park (refer to section 6).

The harming or desecrating of Aboriginal objects or places is an offence under Section 86 of the NP&W Act. Under section 90, an Aboriginal Heritage Impact Permit (AHIP) may be issued in relation to a specified Aboriginal object, Aboriginal place, land, activity or person or specified types or classes of Aboriginal objects, Aboriginal places, land, activities or persons.

Further details regarding potential impacts of the proposal on Aboriginal cultural heritage are provided in Section 6.7.

4.2.6 Coastal Management Act 2016

The *Coastal Management Act 2016* (Coastal Management Act) promotes strategic and integrated management, use and development of the coast for the social, cultural and economic wellbeing of the people of NSW.

The Coastal Management Act defines the coastal zone as comprising of the four coastal management areas. The Coastal Management Act establishes management objectives specific to each of the management areas, reflecting their different values to coastal communities and the priorities for those areas.

The REF proposal area is subject to the provisions of the Coastal Management Act, as it is partially located in the coastal use zone, coastal environment zone and proximity area for coastal wetlands.

The Coastal Management Act outlines the following management objectives for the coastal environment area:

A. to protect and enhance the coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes and coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity

B. to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change

C. to maintain and improve water quality and estuary health

D. to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons

E. to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place

F. to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms.

The Coastal Management Act outlines the following management objectives for the coastal use area:

A. to protect and enhance the scenic, social and cultural values of the coast by ensuring that—

   i. the type, bulk, scale and size of development is appropriate for the location and natural scenic quality of the coast, and

   ii. adverse impacts of development on cultural and built environment heritage are avoided or mitigated, and

   iii. urban design, including water sensitive urban design, is supported and incorporated into development activities, and

   iv. adequate public open space is provided, including for recreational activities and associated infrastructure, and

   v. the use of the surf zone is considered.

B. to accommodate both urbanised and natural stretches of coastline.

Potential impacts on the mapped proximity area for coastal wetlands and safeguards to avoid, minimise and mitigate these potential impacts are described in section 6.1 (Biodiversity), section 6.5 (water, hydrology and flooding) and section 6.4 (soils, topography and contamination). An assessment of potential impacts of the 170-metres section of koala fencing to be constructed within the mapped coastal wetland is assessed by the separate EIS prepared by Transport.

4.2.7 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates land, air, noise and water pollution in NSW. It also aims to provide opportunity for increased public involvement and access to information regarding environmental protection.

An environment protection licence (EPL) is required for scheduled activities or scheduled development work outlined in Schedule 1 of the POEO Act. The REF proposal does not include any works detailed in Schedule 1 of the POEO Act, therefore an EPL would not be required for the proposal.

4.2.8 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, work, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the state. Matters protected under the Heritage Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under Section 170 of the Heritage Act by NSW state government agencies

(Section 170 Registers). The Heritage Act also provides for the protection of archaeological 'relics', being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.

The Heritage Act concerned with all aspects of heritage conservation ranging from basic protection against indiscriminate damage and demolition of buildings and sites, through to restoration and enhancement.

There are no non-Aboriginal heritage items within the REF proposal area. One locally listed heritage item is located adjacent to the REF proposal area. The 'Holsworthy Group' (Item 32) corresponds with the LEP curtilage of the Holsworthy Military Reserve, which adjoins the REF proposal area to the east and west, north of Deadmans Creek. Neither the construction or operation of the proposal is anticipated to impact the heritage value or conservation of the adjacent 'Holsworthy Group' heritage item. Impacts on non-Aboriginal heritage are assessed in section 6.8.3.

4.2.9 Water Management Act 2000

The *Water Management Act 2000* (WM Act) aims to provide for the sustainable and integrated management of the water sources of NSW for the benefit of both present and future generation, and in particular, to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality.

Under Section 91 of the WM Act, approval is required to carry out a controlled activity on or under waterfront land. While the proposal is a controlled activity and would partly occur on waterfront land, public authorities including Transport are exempt from this approval requirement under Clause 41 of the Water Management (General) Regulation 2018.

4.2.10 Biosecurity Act 2015

Under the *Biosecurity Act 2015*, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Section 22 requires that 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.

Plants and animals identified as prohibited matters throughout or in parts of NSW are listed under Schedule 2 of the Act. No prohibited matters were identified within the REF proposal area (refer to Section 6.1).

4.2.11 Contaminated Land Management Act 1997

Part 3 of the *Contaminated Land Management Act 1997* empowers the Environment Protection Authority to regulate contaminated sites that pose a significant risk of harm to human health and/or the environment. While there are no registered contaminated sites in the REF proposal area, the Act would require Transport to immediately notify the Environment Protection Authority if it suspected that the work has resulted in ground contamination or encountered/remobilised existing ground contamination. The proposal is unlikely to result in ground contamination.

Further details regarding potential impacts of the proposal on contamination are provided in Section 6.4.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act, a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and Chapter 6 of the REF.

A referral is not required for proposed road activities that may affect nationally-listed threatened species, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these biodiversity matters are also considered in section 6.1.

Findings - matters of national environmental significance

The assessment of the proposal's impact, on matters of national environmental significance and the environment of Commonwealth land, found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to DCCEEW (Commonwealth) under the EPBC Act.

Findings - nationally-listed biodiversity matters (where the strategic assessment applies)

The assessment of the proposal's impact on nationally-listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Chapter 6 of the REF describes the safeguards and management measures to be applied.

4.3.2 Native Title Act 1993

The *Native Title Act 1993* recognises and protects native title. The Act covers actions affecting native title and the processes for determining whether native title exists and compensation for actions affective native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register. Under the Act, a future act includes proposed public infrastructure on land or waters that affects native title rights or interest.

A search of the Native Title Tribunal Native Title Vision website was undertaken on 12 July 2024, which identifies NC2017/03 South Coast People as an active Native Title application. NC2017/03 applies to land on the south coast of NSW, including the entirety of the REF proposal area. The northern boundary is defined by Harris Creek and the Georges River before cutting across the Sutherland Shire to Port Hacking. The area extends as far south as Eden, with its western boundary defined by the Great Dividing Range.

In accordance with Division 2B of the Act, native title has been extinguished in relation to the land and waters on which a public work constructed or established on or before 23 December 1996 is situated. The definition of public work in line with Section 253 includes a road constructed by a local government body or other statutory authority. Road reserve meets the definition of land, which is necessary for, or incidental to, the construction, establishment or operation of a public work (i.e. a road.

Heathcote Road and St George Crescent are a State Road and local road respectively, constructed prior to 23 December 1996. The proposal is located within the road or road reserve of Heathcote Road and St George Crescent, a State Road and local road respectively, constructed prior to 23 December 1996. As such, native title has been extinguished within the proposal area and notification to the Native Title claimant is not required.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of road infrastructure facilities, and as environmental management works, and is being carried out by or on behalf of a public authority. Under section 2.109 of SEPP (Transport and Infrastructure) the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

Transport is the determining authority for the proposal. This REF addresses Transport's obligation under section 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

5. Consultation

5.1 Consultation strategy

Targeted consultation with key stakeholders including relevant community groups has been undertaken during proposal development.

The REF is to be displayed for a minimum two week period. The REF will be made publicly available, and stakeholders and the wider community would be encouraged to participate, provide feedback and make a submission on the REF.

Transport would endeavour to keep the community and stakeholders informed and proactively consulted throughout the development and construction of the proposal. The purpose of consultation is:

- To keep the local community informed and increase understanding of the proposal
- To gain local knowledge and consider comments and issues relating to the proposal
- To ensure stakeholders potentially impacted by the proposal are provided clear information about possible impacts, such as partial road closures
- To provide clear and timely information and advise the community on how they may obtain information and communicate concerns, complaints and suggestions.

The consultation strategy for the proposal would involve several engagement tools which have and would continue to be used to consult with the community and identified stakeholders. These include:

- Social media / media announcements
- Website updates
- Community updates.

5.2 Community involvement

The following community groups have been consulted to date:

- Sutherland Shire Environment Centre
- National Parks Association
- Sandy Point Residents Association
- Georges River Environmental Alliance
- Sydney Basin Koala Network

Two consultation sessions were held at the Deadmans Creek bridge in March and April 2021. Representatives from these groups and other stakeholders that attended were given the opportunity to ask questions and comment on the issue of koala vehicle strike in the vicinity of the bridge. The sessions included:

- 29 March 2021 – inspection of the bridge and surrounds to determine if it would be a suitable location for a koala underpass.
- 27 April 2021 – second inspection also attended by specialist engaged by Transport to prepare the options assessment report.

After issue of the options report in December 2021, ongoing consultation has been undertaken with Sutherland Shire Environment Centre to discuss the report outcomes and discuss potential work by Defence on their fencing.

Consultation was carried out with various government agencies and other stakeholders including community groups as part of preparation of the EIS (refer section 1.1.1) from 27 September 2024 to 22 October 2024.

A summary of the key issues raised regarding the proposal is summarised in Table 5-1.

Table 5-1: Summary of issues raised by community groups regarding the proposal

Category	Issue raised	Response / where addressed in REF
Need for proposal	Fencing is required to address existing koala vehicle strike	Noted. The overall proposal (this REF proposal with the EIS proposal) aims to install fencing and subsequently reduce vehicle strike.
Need for proposal	It is important that the measures proposed are effective to allow safe crossing of koalas and other wildlife and prevent fatalities which over recent years have been increasing and concerning to the community.	Transport acknowledges the increasing frequency of koala vehicle strike at this location in recent years. The measures proposed are based on expert advice and aim to allow safe fauna crossing and prevent access to the road corridor.
Options selection	Why has Transport selected an option that will impact mapped coastal wetlands rather than Option 2, the highest scoring option from the 2021 options report	The overall proposal reflects Option 2 of the 2021 options report (refer section 2.4), which indicated impacts to mapped coastal wetlands.
Options selection	Why has Option 4 (extending the fence to the quarry entrance) from the 2021 Transport study, which scored highly for ecological effectiveness, not been implemented in this proposal?	Options 2 and 4 of the 2021 options report scored the same for ecological effectiveness as they both involved continuous fencing that captures the concentration of vehicle strike records around Deadmans Creek. However, Option 4 was deemed to offer minimal additional benefits for the increased cost and ecological impacts of extending proposed fencing south to the quarry entrance. The proposal constitutes the recommended Option 2 of the 2021 options report, which scored highest against proposal objectives and development criteria (refer sections 2.4 and 2.5).
Proposal design	Concern that the southern extent of proposed fencing ends at a fire break and will not ensure koalas turn back to use the safe crossing point under the bridge at Deadmans Creek rather than crossing the road. Fence ends should be placed in unsuitable habitat to encourage koalas to turn around. The proposed fence ends at a fire break, however in a previous study (Transport for NSW, 2021) this has been classified as in moderate condition, and is mapped on the Sharing and Enabling Environmental Data in NSW website as koala habitat, see Figure 3. Therefore, we are concerned that koalas will not turn back here.	Options for locations to terminate the proposed fencing south of Deadmans Creek are limited. The powerline easement was chosen by the expert (refer 2021 options report) in consultation with Transport as the location to terminate the proposed fencing as it represents the first clear break in intact koala habitat south of the bridge. Furthermore, the southern extent of proposed fencing on the western side of Heathcote Road terminates at the northern extent of a steep rocky escarpment which would act as a natural barrier to koala movement from the west. This is expected to limit road access for koalas moving south along the inside of the proposed fence, causing them to either head west or turn around. Fence ends on both sides of Heathcote Road would also be constructed with angled “returns” that aim to direct animal movement away from the road.

Category	Issue raised	Response / where addressed in REF
Proposal design	Concern that koalas could access the road under emergency gates installed in the proposed fencing. Are there plans to install koala grids underneath the gates to prevent access?	Koala grids are not proposed underneath gates. Installed gates are proposed to incorporate the same design features as proposed fencing including height, non-climbable sheeting and extension of chain-mesh 30 centimetres along the ground on the habitat/property side, to prevent animals digging and passing underneath.
Proposal design	How will Transport ensure that gates are secured and not left open?	Transport is investigating additional design features for the gates to ensure they would not become weak points in installed fencing.
Proposal design	Transport's proposal and Defence's fauna access pipes must complement each other to keep koalas from escaping onto Heathcote Road	Transport has consulted with Defence regarding recommended modifications to their fencing to support the proposal objectives. As a result, Defence has installed non-climbable sheeting and fauna access pipes at strategic locations on their fencing within the proposal footprint. Transport will continue to monitor the effectiveness of these measures and work with Defence to make further recommendations if required. The culverts north of Deadmans Creek Bridge facilitate flow from two unnamed creeks, both of which are crossed by the Defence fence. These are known weak points and are captured by fencing as part of this proposal. Transport have inspected the remainder of the Defence fence within the hotspot area and are not concerned about any other potential weak points.
Proposal design	Transport's proposal does not address the potential for gaps forming under fencing due to water run off leading to potential escape of koalas onto the road	No gaps are anticipated in proposed fencing. The fence design includes an extension of chain-mesh 30 centimetres along the ground on the habitat/property side of the fence. This feature aims to prevent animals from digging under the fence and captures small gaps that form due to localised runoff erosion. The design also includes a drainage flap (refer section 3.2.3) for sections of fence across small drainage lines, which allows water and debris to move underneath a self-closing flap.
Proposal design	The proposed refuge poles are important to enable koalas to be safe from predators and must be implemented. How many are to be considered and what will they look like?	About six koala refuge poles are proposed under and near Deadmans Creek Bridge, where native vegetation is absent, and refuge opportunities are limited. Key design features of koala refuge poles are described and depicted in section 3.2.3).
Proposal design	The current surface treatment under the Deadman's Creek is a problem as the sharp rocks are not surfaces that koalas will walk over. Sharp surfaces do not encourage koalas and other wildlife to walk over them. Long term maintenance of the surface is important as evident with the current break down of the surface over time under the bridge.	Transport recognises that the rocks for scour protection currently around the new ledge and pathway under the Deadmans Creek bridge are not ideal for koalas to traverse. Access improvements were made in Stage 1, and Stage 2 proposes additional ground surface treatments to these areas. The proposed ground treatments are expected to facilitate koala access under the bridge.

Category	Issue raised	Response / where addressed in REF
Proposal design	Fencing is only effective when combined with well-designed wildlife crossing structures, as it helps guide animals into these safe passageways. There is a lack of evidence that the current structure is used by koalas. What evidence is there that any proposed modifications at that location will improve its suitability for koalas?	Transport has over 15 years of connectivity monitoring data that demonstrates koala use of a range of bridge and culvert underpasses, which is available on the Transport website (https://www.transport.nsw.gov.au/operations/roads-and-waterways/environment-and-heritage/biodiversity). The proposed fencing would tie into three existing structures – two pipe culverts and two crossing points under Deadmans Creek Bridge. The primary crossing structure would be Deadmans Creek Bridge. Stage 1 included design features to improve access under the bridge, which will be further improved by the Stage 2 proposal. While the bridge has been difficult to monitor, Transport have recorded koalas with motion-senor cameras using the existing 1500 millimetre pipe culvert around 500 metres north of the bridge to cross under Heathcote Road. While less likely to be used due to water accumulation at the eastern culvert outlet, the smaller twin-cell pipe culvert around 300 metres north of the bridge has been included to safeguard a weak point in the Defence fence along the small creek and facilitate potential future passage at this location. Broader monitoring data demonstrates koalas can use a range of underpass sizes, with the smallest recorded structure used being a 1050 millimetre diameter pipe culvert 15 metres in length. While koalas have been recorded traversing structures on raised concrete ledges and raised timber poles, most koalas have been recorded walking on the ground. There is little doubt that the existing structures would be accessible.
Proposal design	The overall proposal should be matched to koala kill records and should cover at least 95 per cent of the road length along which koalas have been killed on Heathcote Road near Deadmans Creek.	Transport has worked with an expert to develop the most effective length of fencing to address the koala vehicle strike hotspot at Deadmans Creek (refer 2021 options report). Transport biodiversity specialists have continued to monitor vehicle strike records along Heathcote Road since development of the 2021 options report, including recent records shared by NSW DCCEEW before they are in BioNet. As of November 2024, all but one of the vehicle strike records around Deadmans Creek are located along an approximate 600 metre section of Heathcote Road, which includes Deadmans Creek Bridge. Option 2 in the 2021 options report (the proposal) will enclose a length of Heathcote Road about one kilometre long with fencing, safely capturing the road length along which the BioNet records are concentrated. As such, the proposal is still considered the most effective solution to address vehicle strike at this location.

Category	Issue raised	Response / where addressed in REF
Proposal design	Transport should install fencing as close to the road as is safe to do so to minimise clearing required for construction and to minimise opportunities to climb the fence	Transport has selected a fence alignment for the proposal which includes use of existing cleared areas and elsewhere, runs as close to Heathcote Road as is safe to do so to minimise vegetation clearing. Proposed fencing must maintain a minimum clearance from safety barriers and trafficable lanes to meet safety requirements. Some clearing of vegetation around the fencing is necessary to facilitate construction, minimise maintenance risks of falling branches and minimise opportunities for animals to breach the fence. Transport has assessed the impact of clearing of up to three metres on either side of the fencing alignment to allow flexibility for micro-siting of the fence during construction. In practice this clearing would be selective and limited to removal of the vegetation required to achieve these objectives.
Proposal design	Concern that this proposal seems to be based on a report from 2021, meaning the last 3 years of data has not been considered. At a minimum, solutions should be based on community records, current Bionet records and koala occupancy information.	Transport engaged an expert in 2021 (refer 2021 options report) to assess all aspects of the location, including BioNet records, to develop the most effective length of fencing to address the koala vehicle strike hotspot at Deadmans Creek. Transport biodiversity specialists have continued to monitor vehicle strike records along Heathcote Road since development of the 2021 options report, including recent records shared by NSW DCCEEW before they are in BioNet. As of November 2024, all but one of the vehicle strike records around Deadmans Creek are located along an approximate 600 metre section of Heathcote Road, which includes Deadmans Creek Bridge. Option 2 the of the 2021 options report (the proposal) will enclose a length of Heathcote Road about one kilometre long with fencing, safely capturing the road length along which the BioNet records are concentrated. As such the proposal is still considered the most effective solution to address vehicle strike in this location.
Proposal design	Does the proposal include rock face treatment at steep areas to prevent koalas coming down tracks between rocks as was included in Option 2 of the 2021 options report?	The rock slopes along the proposed fence alignment will be cleared of vegetation to deter animals from using the slopes to access the road (refer section 3.1).
Proposal design	Seeking assurance that escape devices installed as part of the proposal work for koalas.	Both escape hatches and escape poles are being considered for the proposal. During construction, the proposal would install whichever escape device is best supported by available information. Evidence of koalas using escape hatches can be viewed on the Endeavour Veterinary Ecology (EVE) website.
Proposal design	Has the movement of other species been considered in this design? All animals need to move to access resources and mates. Wildlife crossings should be designed to serve as many species as possible to enable animals to move and to keep roads safe for wildlife and for people.	Transport have been monitoring the area with motion sensor cameras since 2021 and have recorded a range of native species that have been considered in the design. The proposed mitigation is suitable for all native ground-dwelling and semi-arboreal species that have been recorded by monitoring. Due to security requirements, the fauna access pipes in the Defence fence can only accommodate animals of similar or smaller size than koalas.

Category	Issue raised	Response / where addressed in REF
Monitoring of proposal effectiveness	Has Transport conducted baseline studies of koala populations and movement across Heathcote Road?	Transport has not conducted baseline studies of koala populations but has been monitoring the location with motion-sensor cameras since 2021.
Monitoring of proposal effectiveness	Will there be ongoing monitoring, and how will the success of this project be measured?	Camera monitoring will continue to be undertaken for the foreseeable future at the crossing locations to assess their effectiveness. Monitoring would continue after construction of this proposal and be adaptable as required.
Monitoring of proposal effectiveness	Simply relying on recorded vehicle strikes is insufficient, as vehicle strikes are often underreported. More importantly, strike rates may decrease as koala populations decline, potentially creating a false sense of success, even if the situation has not improved for koalas. Likewise relying solely on counting koalas using the crossing, gives no indication of the impact on population movement without a scientifically robust control.	Transport acknowledges the inherent limitations of wildlife records, such as BioNet data. However, they are a useful tool to indicate where further investigation may be required. Transport continually monitors koala vehicle strike data across NSW as it becomes available in BioNet in collaboration with the NSW Koala Strategy. Transport recognises there are many factors that affect koala population dynamics. We are not aware of a broader population monitoring program that could be referenced as part of monitoring this location. However, monitoring has been undertaken at this location using motion-sensor cameras since 2021. Transport will continue to monitor both vehicle strike data and koala activity around Deadmans Creek.
Monitoring of proposal effectiveness	Requests a clear commitment to adaptive management strategies, in particular if the overall design does not mitigate vehicle strike adequately during operation. There should be a “nature positive” approach to address this koala vehicle strike issue.	Transport plans to monitor the effectiveness of the Stage 2 works (the proposal) and will respond with an adaptive approach if required.
Other issues	Fauna fencing was implemented poorly on Appin Road. Transport must learn from these mistakes and ensure that the Deadmans Creek fencing is designed to funnel koalas toward safe crossing points.	Transport strives to continually improve our approach to mitigating the impacts of transport infrastructure on biodiversity and is committed to learning from previous projects.
Other issues	Long term maintenance of the proposed infrastructure must be implemented and budgeted for	Maintenance of the proposal would be undertaken by Transport’s maintenance contractors. Transport would appropriately budget for long-term maintenance of this proposal.

Category	Issue raised	Response / where addressed in REF
Broader mitigation	Road strikes is Sutherland Shire's number one loss of local koalas along the 24 kilometre stretch of Heathcote Road and Deadman's Creek and is the number one vehicle strike hot spot. The issue requires much more than just Deadman's Creek or Woronora Bridge being fenced. Action needs to be undertaken on the whole of Heathcote Road. It is not practical to fence all of Heathcote Road to safeguard koalas but Transport must consider broader measures to reduce the number of vehicle strikes on the road.	As Deadmans Creek is a hotspot for koala vehicle strike, this section of Heathcote Road was prioritised for mitigation. However, Transport will continue to work with the NSW Koala Strategy to monitor vehicle strike data throughout the south-west Sydney area and develop strategies for mitigation on existing roads as required. Fencing was determined to be the most effective course of action for this proposal; however, Transport recognises that fencing is not suitable for all stretches of road. Furthermore, Transport is currently working on plans to improve the Heathcote Road corridor, which will include investigating options for koala connectivity design along the rest of the corridor.
Other mitigation measures	Can the speed limit be reduced? Speed is an issue on the road and there is the need to consider lowering speed limits, and the placement of speed cameras especially near the hot spots. Heathcote Road is notorious for speeding as many motorists do not adhere to the speed zones.	Speed limits are set in accordance with NSW speed zoning standards. Motor vehicle crashes involving animal strikes with the potential for road user casualties are considered when assessing the appropriate speed limit of a particular road. Heathcote Road at Deadmans Creek has not been assessed as eligible for speed limit reduction to date. Feedback about speed limits and speed signs in NSW may be lodged online via the NSW Centre for Road Safety website (https://www.transport.nsw.gov.au/roadsafety).
Other mitigation measures	Can Transport install more signs warning drivers of koalas	Five permanent static yellow warning signs were installed on Heathcote Road in 2023. Two variable message signs (VMS) were deployed from September 2023 to February 2024 to encompass the koala breeding season. Transport is working with local councils and the NSW Koala Strategy to continue using VMS at this location during the koala breeding season until fencing is completed.
Other mitigation measures	Can virtual fencing be installed in this location?	Virtual fencing is one type of emerging technology addressing wildlife vehicle strike. Transport held a symposium in May 2024 that brought together researchers from across the globe to discuss emerging technologies for wildlife vehicle strike. Currently, there is no research that demonstrates virtual fencing technology is effective for Australian fauna. Stimuli used by the technology has not been tested to understand its immediate and long-term effects on different species. The technology is also observed to be less effective on busy roads with speed limits greater than 80 kilometres per hour. Virtual fencing is therefore not considered a suitable option for Heathcote Road. Transport continues to examine all emerging technology options for potential application on state roads, including the use of artificial intelligence to warn drivers of fauna on the road in real time.

5.3 Aboriginal community involvement

Transport consulted with Gandangara Local Aboriginal Land Council about the proposal in March 2021, who were supportive of the proposal.

The proposal has been considered against the requirements of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011). This procedure is generally consistent with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (Department of Environment, Climate Change and Water, 2010). An outline of the procedure is presented in Table 5-2.

Table 5-2: Summary of Transport's Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	The PACHCI Stage 1 assessment was completed 30 September 2024 by Transport and determined that the proposal is unlikely to harm known Aboriginal objects or places, as: • The Aboriginal Heritage Information Management System (AHIMS) search did not indicate moderate to high concentrations of Aboriginal objects or places in the study area. • The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Environment and Heritage Due diligence Code of Practice for the Protection of Aboriginal objects in NSW and the Transport for NSW procedure. • The cultural heritage potential of the study area appears to be reduced due to past disturbance. • There is an absence of sandstone rock outcrops likely to contain Aboriginal art. Mitigation measures were recommended to ensure nearby Aboriginal sites are avoided (refer to Section 6.7), but no further stages of the PACHCI were required to be completed.
Stage 2	Site survey and further assessment.
Stage 3	Formal consultation and preparation of a cultural heritage assessment report.
Stage 4	Implement environmental impact assessment recommendations.

5.4 SEPP (Transport and Infrastructure) consultation

Sutherland Shire Council has been consulted under SEPP (Transport and Infrastructure) about the proposal as per the requirements of Section 2.10. Appendix B contains a SEPP (Transport and Infrastructure) consultation checklist that documents how SEPP (Transport and Infrastructure) consultation requirements have been considered.

Correspondence was sent to Sutherland Shire Council on 11 September 2024 and a response was received on 4 October 2024. A second response was received on 9 October 2024. Issues raised from this consultation are outlined in Table 5-3 below.

Table 5-3: Issues raised through SEPP (Transport and Infrastructure) consultation

Issue raised	Response / where addressed in REF
The ecological Assessment to be provided to council and all recommendations are to be adopted.	The Biodiversity Assessment Report for this proposal is provided in Appendix E and discussed in Section 6.1 of this REF.
Confirm that no clearing of threatened ecological communities is to occur.	The proposal would not involve the clearing of threatened ecological communities. Biodiversity impacts are detailed further in Section 6.1.

Issue raised	Response / where addressed in REF
Recommendation to deploy VMS during breeding season until the completion of the fence	Four VMS have been deployed for the 2024-2025 koala breeding season. Transport is working with local councils and the NSW Koala Strategy to continue using VMS at this location during the koala breeding seasons until fencing is completed.
Details and effectiveness of the fauna escape structures should be included in the REF, including the use of shotcrete in drains.	Both escape hatches and escape poles are being considered for the proposal. During construction, the proposal would install whichever escape device is best supported by available information. Evidence of koalas using escape hatches can be viewed on the Endeavour Veterinary Ecology (EVE) website. The proposal may employ shotcrete to concrete line up to two metres along existing swale drains on either side of proposed fence drainage flaps (refer section 3.2.3). Concrete is commonly used to line swale drains and shotcrete has been employed on previous projects as a concrete application. The swale drains are expected to maintain their existing performance due to the small extents of shotcrete proposed and the retention of vegetation along the rest of the swales.
Warning advisory signs shall be put in place on approaches to the koala grid with recommended speeds on St George Crescent.	Transport will undertake a road safety audit as the detailed design progresses to identify any additional safety measures which may be required for the proposal including speed limits and additional signage on approach to the proposed koala grid on St George Crescent.
Transport shall be responsible for the monitoring and maintenance of their assets including signage, fencing, koala grids etc. They will also be responsible for pavement defects cause by the koala grid.	Transport will monitor the effectiveness of new fencing and other structures and carry our maintenance / repair where required.

The proposal is located adjacent to Georges River National Park (refer to Figure 3-1). The National Parks and Wildlife Service (part of the Department of Climate Change, Energy, the Environment and Water) will be consulted about the proposal during the public display period and any comments will be considered. Relevant matters outlined in Developments adjacent to National Parks and Wildlife Service lands Guidelines for consent and planning authorities (NSW National Parks and Wildlife Service, 2020) are considered in Appendix D.

5.5 Government agency and stakeholder involvement

Sutherland Shire Council was consulted about the proposal per SEPP (Transport and Infrastructure) requirements. Various other government agencies and stakeholders have been consulted about the proposal, including:

- Department of Defence
- Liverpool City Council
- National Parks and Wildlife Service
- Department of Planning, Housing and Infrastructure
- Department of Climate Change, Energy, the Environment and Water – Biodiversity Conservation Division
- Department of Climate Change, Energy, the Environment and Water – Environment and Heritage (for Aboriginal cultural heritage)
- Department of Primary Industries and Regional Development (DPIRD)
- Department of Climate Change, Energy, the Environment and Water – Water

- NSW Crown Lands
- Rural Fire Service.

Consultation was carried out with various government agencies and other stakeholders including community groups as part of preparation of the EIS (refer section 1.1.1) from 27 September 2024 to 22 October 2024.

Issues raised from consultation, relevant to the REF proposal are outlined in Table 5-4. Consideration of the response from DPIRD is included in the EIS.

Table 5-4 Issues raised through government agency and stakeholder involvement

Stakeholder	Issue raised	Response / where addressed in REF
Department of Defence	Requested that koala fencing at the points of intersection with existing Defence fencing, should be installed at the same height when within three metres of the Defence fencing to minimise footholds.	This guidance around fence height near to Defence fencing will be implemented into the proposal.
Crown Lands	Waterway beneath Deadmans Creek Bridge is a Crown waterway and is near the proposal. If any part of the proposal requires the use and/or occupation of this section of waterway for construction of the proposal, Transport will need to contact Crown Lands to discuss relevant requirements.	Noted. Construction of the proposal is not expected to require the use or occupation of the water underneath Deadmans Creek Bridge.
Rural Fire Service	The proposal raises no concerns in relation to bush fire protection.	Noted.
	The proposal, specified to be construction of non-combustible materials, is not expected to play a significant role in the vulnerability of nearby structures in a bush fire event.	Noted.
	The proposal is not anticipated to impede operational access for firefighting operations.	Noted.

5.6 Ongoing or future consultation

Following the public display of the REF, Transport will prepare a submissions report which summarises and provides responses to submissions received on the proposal. The submissions report will include a summary of any changes to the proposal in response to the submissions and other feedback during the display period.

Transport will undertake ongoing consultation with key stakeholders and the affected community including relevant community groups, nearby landholders, businesses and road users during construction. Ongoing communications and notifications may include:

- Community/construction updates.
- Media announcements.
- NSW LiveTraffic updates and social media updates.
- Stakeholder meetings as required.
- Web page updates.
- Work notification letters (as required).

6. Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the REF proposal. All aspects of the environment, potentially impacted upon by the REF proposal, are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act.
- The factors specified in the Guideline for Division 5.1 assessments (Department of Planning and Environment, 2022) and as required under section 171 of the Environmental Planning and Assessment Regulation 2021 and the Roads and Related Facilities EIS Guideline (Department of Urban Affairs and Planning, 1996). The factors specified in section 171 of the Environmental Planning and Assessment Regulation 2021 are also considered in Appendix A.
- Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Biodiversity

Potential biodiversity impacts of the REF proposal have been assessed by Heathcote Road Koala Fencing at Deadmans Creek Biodiversity Assessment Report (BAR) (East Coast Ecology, 2024), provided in Appendix E.

6.1.1 Methodology

The methodology for the BAR included the following:

- A desktop review of databases and previous studies to identify Commonwealth and State listed threatened species, populations and ecological communities or other biodiversity values predicted to occur in the locality of the area of investigation
- A field survey of the REF proposal area carried out during July and August 2024, involving:
  - Plot-based vegetation surveys to identify plant community types (PCTs)
  - Targeted threatened species surveys based on the results of the desktop review and the characteristics of the REF proposal area
  - Opportunistic observations of fauna species
  - Assessing habitat suitability of the REF proposal area and the likelihood of occurrence of threatened species or community identified in database searches
- Targeted flora surveys based on threatened species identified in the habitat suitability assessment as having a moderate or high likelihood of occurring in the REF proposal area
- Aquatic surveys to characterise the habitat value of the three waterways in the REF proposal area
- Assessing the potential impacts of construction and operation of the proposal on biodiversity values, including assessments of significance where required
- Identification of construction and operational safeguards and management measures, as well as the need for biodiversity offsets.

BAR assessment areas

The following key terms are used in the BAR and in this section of the REF:

- Construction footprint: Equivalent to the limit of construction works, and the 'Subject land' assessed in the BAR. It assumes a three-metre buffer around the koala fence and encompasses all areas required to construct all elements of the REF proposal, including ancillary facilities. It is assumed the construction footprint would be completely cleared of all vegetation for construction of the proposal.
- Study Area: The construction footprint plus a buffer to capture land which may be indirectly impacted. For this assessment, the study area is consistent with the REF proposal area.
- Locality: the area covered by a 10 kilometre buffer of the study area.

- Assessment Area: The study area plus a 500 metre buffer to capture landscape attributes within the broader context.

6.1.2 Existing environment

Landscape context

The REF proposal area extends from Pleasure Point within Liverpool LGA to Menai in the Sutherland Shire LGA. The extent of the REF proposal area corresponds with the Liverpool LEP curtilage for the SP2 road corridor and contains Heathcote Road, a short section of St George Crescent and dense bushland on both side of these roads. This dense bushland is continuous with an expanse of relatively undisturbed native vegetation contained and conserved within the adjacent Holsworthy Barracks and Georges River National Park.

The REF proposal area occurs within the 'Sydney Cataract' Interim Biogeographic Regionalisation for Australia (IBRA) Subregion, which is part of the 'Sydney Basin' IBRA Bioregion. The REF proposal area contains areas of geological significance including exposed sandstone, small overhangs and crevices. The REF proposal area also occurs within the Woronora Plateau Mitchell Landscape. Woronora Plateau is characterised by Triassic quartz sandstone with benched low angle slopes and a marked break to steep sided deep valleys controlled by joint patterns.

Native vegetation

Vegetation zones (which capture vegetation condition) and PCTs (and equivalent threatened ecological communities (TECs)) identified within the REF proposal area have been aligned with the BioNet Vegetation Classification PCT listed in Table 6-1 and depicted in Figure 6-1. Profiles for the mapped PCT and associated vegetation zones are provided as subsections below.

Table 6-1: PCTs and vegetation zones including patch size and vegetation integrity (VI) score

Vegetation zone	PCT	Equivalent TEC	Area		Patch size class	VI Score
			Construction footprint	Proposal area		
Zone 1 – Moderate	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Not associated with a TEC	0.15	0.65	>100ha	56.1
Zone 3 – Low	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Not associated with a TEC	0.26	0.43	>100ha	21.9
Zone 4 – Good	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Not associated with a TEC	0.28	2.71	>100ha	65.2
Zone 5 – Moderate (easement)	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Not associated with a TEC	0.01	0.22	>100ha	43.4
Zone 6 – Good	PCT 4091: Grey Mangrove-River Mangrove Forest	Not associated with a TEC	0.002	0.05	>100ha	67.8

Vegetation zone	PCT	Equivalent TEC	Area		Patch size class	VI Score
			Construction footprint	Proposal area		
Zone 2 – Good	PCT 4028: Estuarine Swamp Oak Twig-rush Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – BC Act listed Endangered Ecological Community (EEC) Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – EPBC Act listed EEC	0.02	0.43	>100ha	28.5
Zone 7 – Moderate	PCT 4059: Sydney Hinterland Sandy Creekflat Shrub Forest	Not associated with a TEC	0.03	0.17	>100ha	53.9

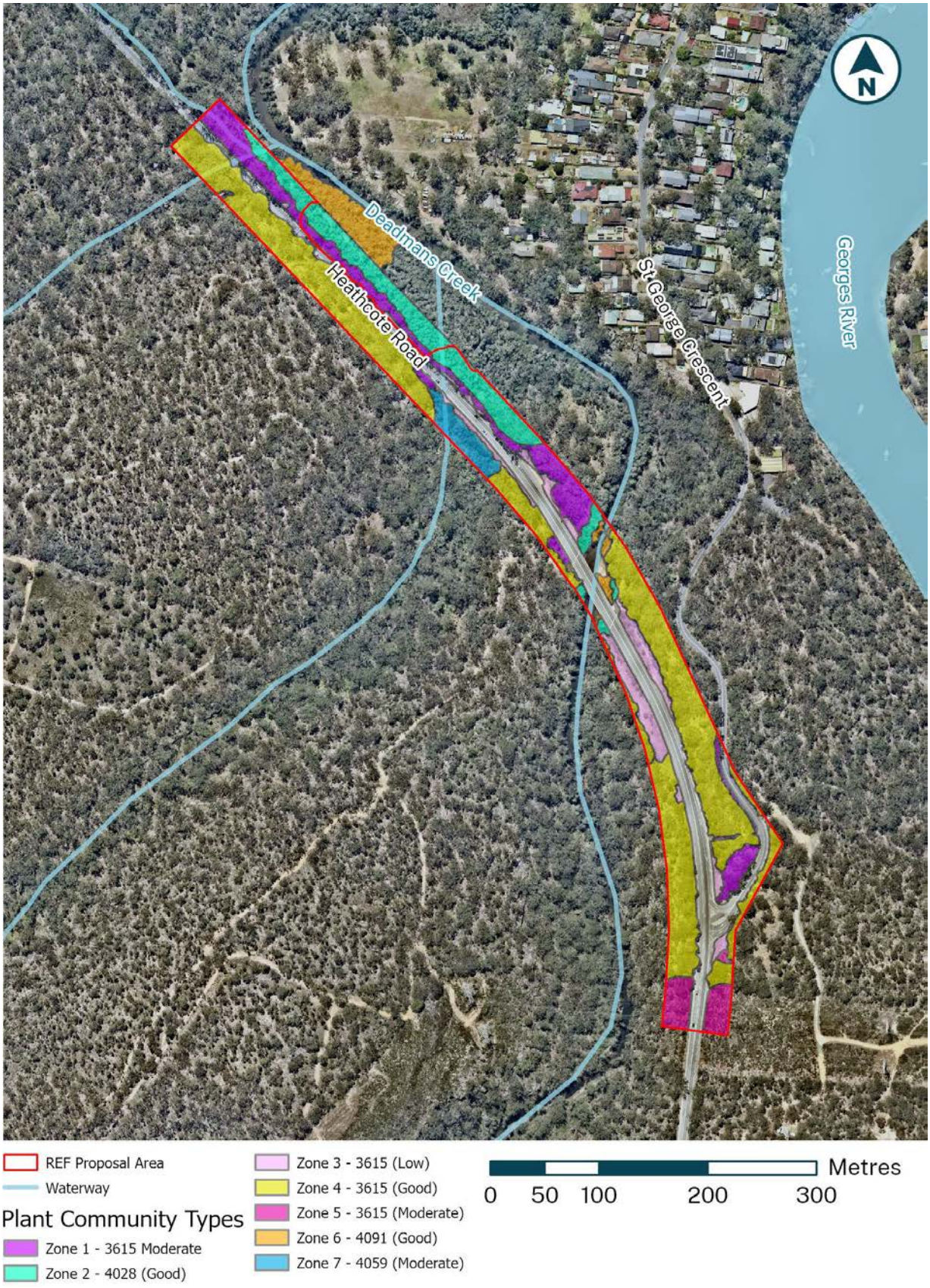


Figure 6-1: PCTs and vegetation zones

Threatened Ecological Communities

One PCT within the REF proposal area is associated with a TEC listed under both the BC Act and EPBC Act.

PCT 4028 Estuarine Swamp Oak Twig-rush Forest is associated with Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC is listed under the BC Act. The Final Determination for this community outlines that it is associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains and it generally occurs below 20 metres (rarely above 10 metres) elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee, 2011). Vegetation Zone 2 (PCT 4028 – Good) occurs on clay loams and sands adjacent to Deadmans Creek and has an elevation of less than 10 metres above sea level Characteristic species detailed in the Final Determination were also recorded within this vegetation zone.

PCT 4028 Estuarine Swamp Oak Twig-rush Forest is also associated Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland EEC, is listed under the EPBC Act. The Approved Conservation Advice for this community lists key diagnostic attributes and condition thresholds to determine whether the federal listing applies to an ecological community, both of which must be met for listing under the EPBC Act. Vegetation within vegetation zone 2 meets the key diagnostics and minimum condition thresholds. Vegetation zone 2 meets the relevant condition threshold as the patch is at least 0.5 hectares and less than two hectares and non-native species comprise less than 20 per cent of total understorey vegetation cover. Areas of PCT 4028 in the REF proposal area are shown in Figure 6-2.

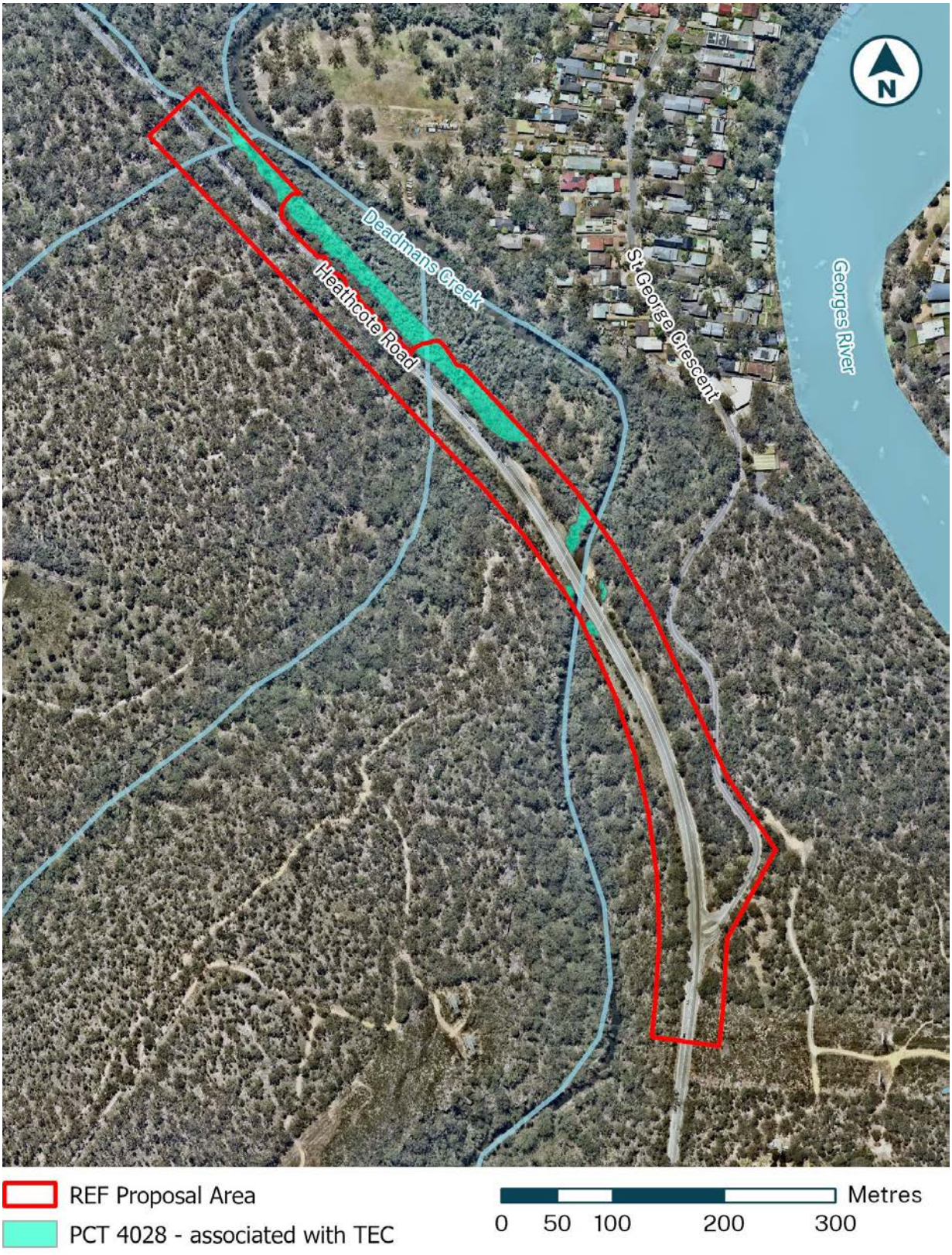


Figure 6-2: TECs in the REF proposal area

Threatened species

The preliminary habitat assessment identified 39 threatened species as having a moderate or higher likelihood of occurrence within the REF proposal area.

Following the targeted flora surveys and field-based habitat assessment of the REF proposal area, 17 threatened species were still considered to have a moderate or higher likelihood of occurrence based on habitat constraints and recent/ nearby records.

One threatened fauna species, White-bellied Sea-Eagle (*Haliaeetus leucogaster)*, was seen flying over the REF proposal area during field surveys, however no stick nests were identified. White-bellied Sea-Eagle is listed as a Migratory species under the EPBC Act and Vulnerable under the BC Act.

No other threatened or migratory species were identified in the REF proposal area. The presence of some species were assumed, and previous credible records of koalas in the area have been considered.

A summary of the threatened species considered to have a moderate or higher likelihood of occurrence within the REF proposal area and therefore subject to further assessment is provided in Table 6-2.

Table 6-2: Threatened species survey results

Species name	EPBC Act	BC Act	Identification method	Survey effort compliant?[1]	Results
Threatened flora species					
Callistemon linearifolius	-	V	Not recorded	No. Field surveys were undertaken outside of the NSW DCCEEW endorsed survey period.	Species credit species. This species is associated with PCT 3615 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Grevillea parviflora subsp. parviflora	V	V	Not recorded	Yes	Species credit species. This species is associated with PCT 3615, however was not detected during targeted surveys.
Hibbertia puberula	-	E	Assumed	No. Field surveys were undertaken outside of the NSW DCCEEW endorsed survey period.	Species credit species. This species is associated with PCT 3615 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Hibbertia stricta subsp. furcatula	-	E	Assumed	No. Field surveys were undertaken outside of the NSW DCCEEW endorsed survey period.	Species credit species. This species is associated with PCT 3615 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.

Species name	EPBC Act	BC Act	Identification method	Survey effort compliant?[1]	Results
Melaleuca biconvexa	V	V	Not recorded	Yes	Species credit species. This species is associated with PCT 3615 and PCT 4028, however was not detected during targeted surveys.
Persicaria elatior	V	V	Assumed	No. Field surveys were undertaken outside of the NSW DCCEEW endorsed survey period.	Species credit species. This species is associated with PCT 4028 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Persoonia bargoensis	E	E	Not recorded	Yes	Species credit species. This species is associated with PCT 3615, however was not detected during targeted surveys.
Persoonia hirsuta	E	E	Not recorded	Yes	Species credit species. This species is associated with PCT 3615, however was not detected during targeted surveys.
Threatened fauna species					
Burhinus grallarius (Bush Stone-curlew)	-	E	Assumed	No	Species credit species. Assumed present (not recorded). This species is associated with PCT 3615 and PCT 4059 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Glossopsitta pusilla (Little Lorikeet)	-	V	Assumed	No	Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615 and PCT 4059 and potential breeding habitat (hollow-bearing trees) identified within the REF proposal area and large areas surrounding the proposal. No species polygon prepared for ecosystem credit species.
Haliaeetus leucogaster (White-bellied Sea-Eagle)	-	V	Recorded	No	Species/Ecosystem credit species. One recorded flying over the during site assessment. Associated with PCT 4028, PCT 4059 and PCT 4091 but habitat similar to that within the REF proposal area is distributed in the locality. No stick nests were identified within the proposal area. No species polygon prepared for ecosystem credit species.
Ninox strenua (Powerful Owl)	-	V	Assumed	No	Species/Ecosystem credit species. Assumed present (not recorded).

Species name	EPBC Act	BC Act	Identification method	Survey effort compliant?[1]	Results
					This species is associated with PCT 3615, PCT 4059 and PCT 4028 and potential breeding habitat (hollow-bearing trees) identified within the REF proposal area and large areas surrounding the proposal.
Pandion cristatus (Eastern Osprey)	-	V	Assumed	No	Species/Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT 4059, PCT 4028 and PCT 4091 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Tyto tenebricosa (Sooty Owl)	-	V	Assumed	No	Species/Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615 and potential breeding habitat (hollow-bearing trees) identified within the REF proposal area and large areas surrounding the proposal.
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	-	V	Assumed	No	Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT4059 and PCT4028 and potential habitat identified within the REF proposal area and large areas surrounding the proposal. No species polygon prepared for ecosystem credit species.
Isoodon obesulus obesulus (Southern Brown Bandicoot)	E	E	Assumed	No	Species credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT4059 and PCT4028 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Miniopterus orianae oceanensis (Large Bent-winged Bat)	-	V	Assumed	No	Species/Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT 4059, PCT 4028 and PCT 4091 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Myotis macropus (Southern Myotis)	-	V	Assumed	No	Species/Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT 4059, PCT 4028 and PCT 4091 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Phascolarctos cinereus (Koala)	E	E	Recorded	No	Species credit species. Previous credible records on BioNet.

Species name	EPBC Act	BC Act	Identification method	Survey effort compliant?[1]	Results
					This species is associated with PCT 3615, PCT 4059 and PCT 4028 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	Assumed	No	Species/Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT 4059, PCT 4028 and PCT 4091 and potential habitat identified within the REF proposal area and large areas surrounding the proposal.
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	-	V	Assumed	No	Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT 4028 and PCT 4091 and potential habitat identified within the REF proposal area and large areas surrounding the proposal. No species polygon prepared for ecosystem credit species.
Scoteanax rueppellii (Greater Broad-nosed Bat)	-	V	Assumed	No	Ecosystem credit species. Assumed present (not recorded). This species is associated with PCT 3615, PCT 4059, PCT 4028 and PCT 4091 and potential habitat identified within the REF proposal area and large areas surrounding the proposal. No species polygon prepared for ecosystem credit species.

Threatened species habitat and wildlife connectivity corridors

A number of habitat features relevant to threatened species were identified in the REF proposal area, including features important for roosting, nesting, sheltering and foraging. These include caves associated with sandstone rock outcrops and cliffs, culverts under Heathcote Road, dense shrub vegetation, hollow logs, hollow-bearing trees and stags. The location of these features is shown in Figure 6-3.

There are no mapped wildlife corridors within or encompassing any portion of the REF proposal area. However, vegetation within the REF proposal area is continuous with the expanse of relatively undisturbed native vegetation contained and conserved within Holsworthy Barracks and Georges River National Park. Georges River National Park adjoins the REF proposal area south of Deadmans Creek, on both side of the Heathcote Road corridor. It includes several large and small discrete riverfront areas along Georges River with a total of 320 hectares (NSW National Parks and Wildlife Service, 1994). Holsworthy Barracks adjoins the REF proposal area north of Deadmans creek, on both sides of the Heathcote Road corridor. Covering an area of 20,000 hectares, it maintains connectivity with Heathcote National Park and Dharawal State Recreation Area to the south. This large area of fauna habitat is likely to provide important movement corridors and habitat linkages for a wide range of fauna species, including aquatic species.

Roads can act as barriers to animal movement through mortality during crossing attempts or behavioural avoidance. Koala vehicle-strike records (refer to Figure 2-3) demonstrate that Heathcote Road in the REF proposal area acts as a barrier to fauna movements. Other commonly occurring terrestrial fauna such as macropods and reptiles are also likely to be susceptible to vehicle strike.

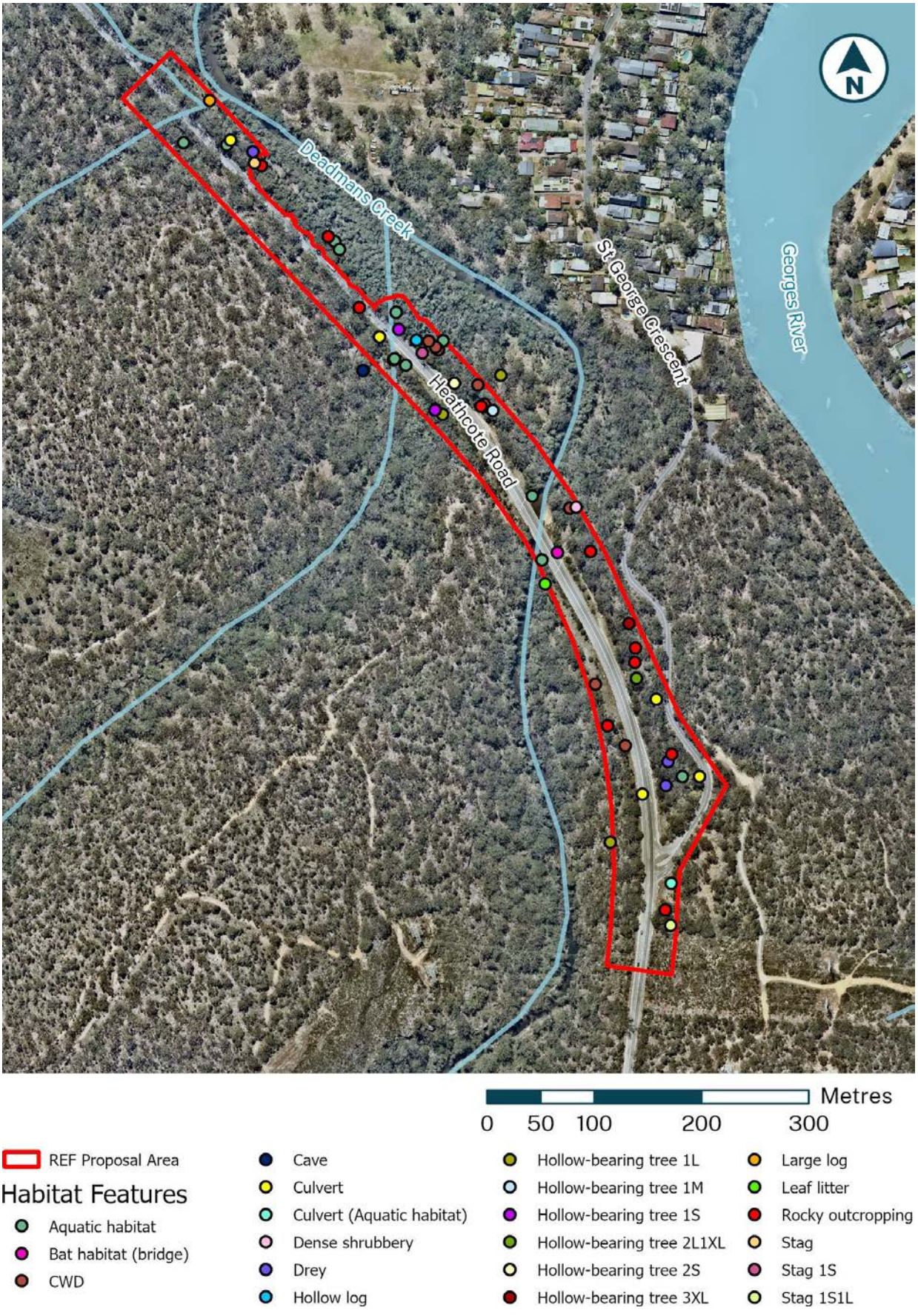


Figure 6-3: Habitat features identified in the REF proposal area

Aquatic habitats

Three watercourses traverse the REF proposal area. Deadmans Creek is a permanent, tidally influenced third-order watercourse, while two unnamed non-perennial watercourses flow under Heathcote Road north of Deadmans Creek.

Deadmans Creek is mapped as Key Fish Habitat under the FM Act (Figure 6-4). No threatened species, populations or ecological communities under the FM Act are mapped as occurring within the REF proposal area from review of the DPIRD Fisheries Spatial Data Portal.

Results of the waterway habitat assessment for each watercourse is provided in Table 6-3.

Table 6-3: Aquatic habitat assessment

Indicator	Deadmans Creek	Unnamed watercourse (Creek 2)	Unnamed watercourse (Creek 3)
Width	Approximately 10m at high tide	Approximately 3m wide – northern side of Heathcote Road Shallow pools <1m wide - through the culvert on the southern side of Heathcote Road	Approximately 2m
Depth	Deepest point approximately 1m (10cm at lower tide)	50cm – northern side of Heathcote Road <30cm – southern side of Heathcote Road	Approximately 40cm
Flow Characteristics	Tidal	Non-perennial	Non-perennial
Bed Substrate	Mud/sand with some rocks	Mud	Mud with rock
Habitat features	No habitat features recorded	Fallen trees	No habitat features recorded
Existing infrastructure and barriers to fish movement	Deadmans creek bridge, sand bar	Culvert under Heathcote Road	Culvert under Heathcote Road
Riparian vegetation	Mangroves present on the bank of the creek. Surrounding riparian vegetation consists of *Casuarina glauca* and exotic species including *Arundo donax, Cestrum parqui* and E*ragrostis curvula*.	Riparian vegetation is in moderate condition and includes a canopy of *Casuarina glauca* and *Melaleuca styphelioides*. Weed species include *Ehrharta erecta, Rubus fruticosus species aggregate* and *Asparagus aethiopicus*.	Riparian vegetation is in moderate condition and includes a canopy of *Casuarina glauca* and *Melaleuca styphelioides*. Weed species include *Ehrharta erecta, Rubus fruticosus species aggregate* and *Asparagus aethiopicus*.
Water quality	Low turbidity	High turbidity, thick layer of rusty brown algae present	Low turbidity, water is brown in colour
Key fish habitat classification	Mapped as Class 1 Major key fish habitat: Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	Not Key Fish Habitat	Not Key Fish Habitat
Sensitivity classification scheme	Type 2 – Moderately sensitive key fish habitat	Not Key Fish Habitat	Not Key Fish Habitat

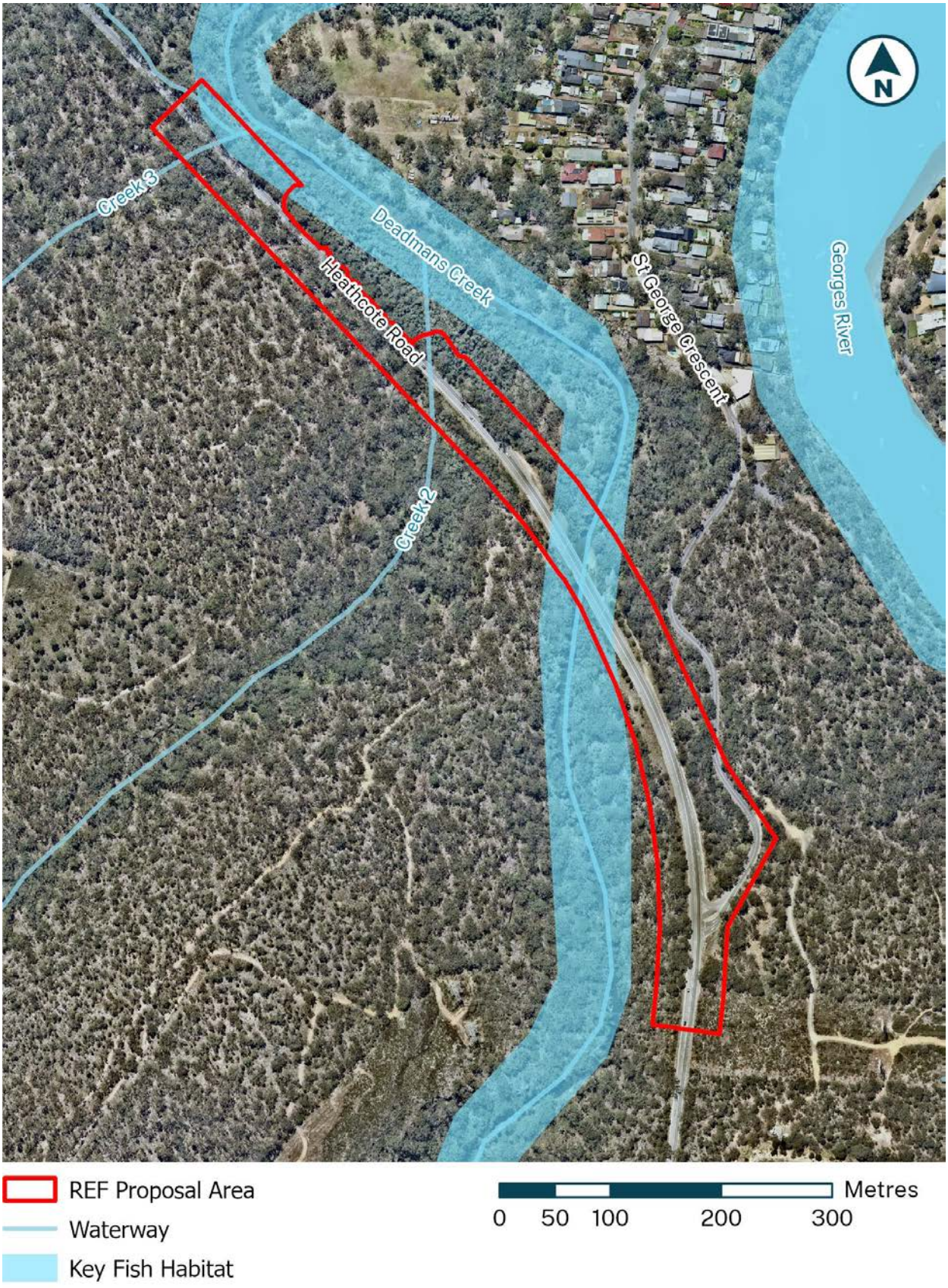


Figure 6-4: Aquatic habitat within the REF proposal area

Groundwater dependent ecosystems

The likely degree of groundwater dependence of the PCTs within the proposal area has been assessed using the Atlas of GDEs (Bureau of Meteorology, 2024). The Atlas of Groundwater Dependent Ecosystems (GDEs) identifies most of the REF proposal area as supporting high potential terrestrial GDEs. There are no mapped aquatic GDEs within the REF proposal area (refer to Figure 6-5).

While vegetation communities considered to have a high potential to comprise terrestrial GDEs, such vegetation communities are unlikely to be entirely dependent on groundwater. These vegetation communities are not restricted to locations of groundwater discharge and are not located within aquifers.

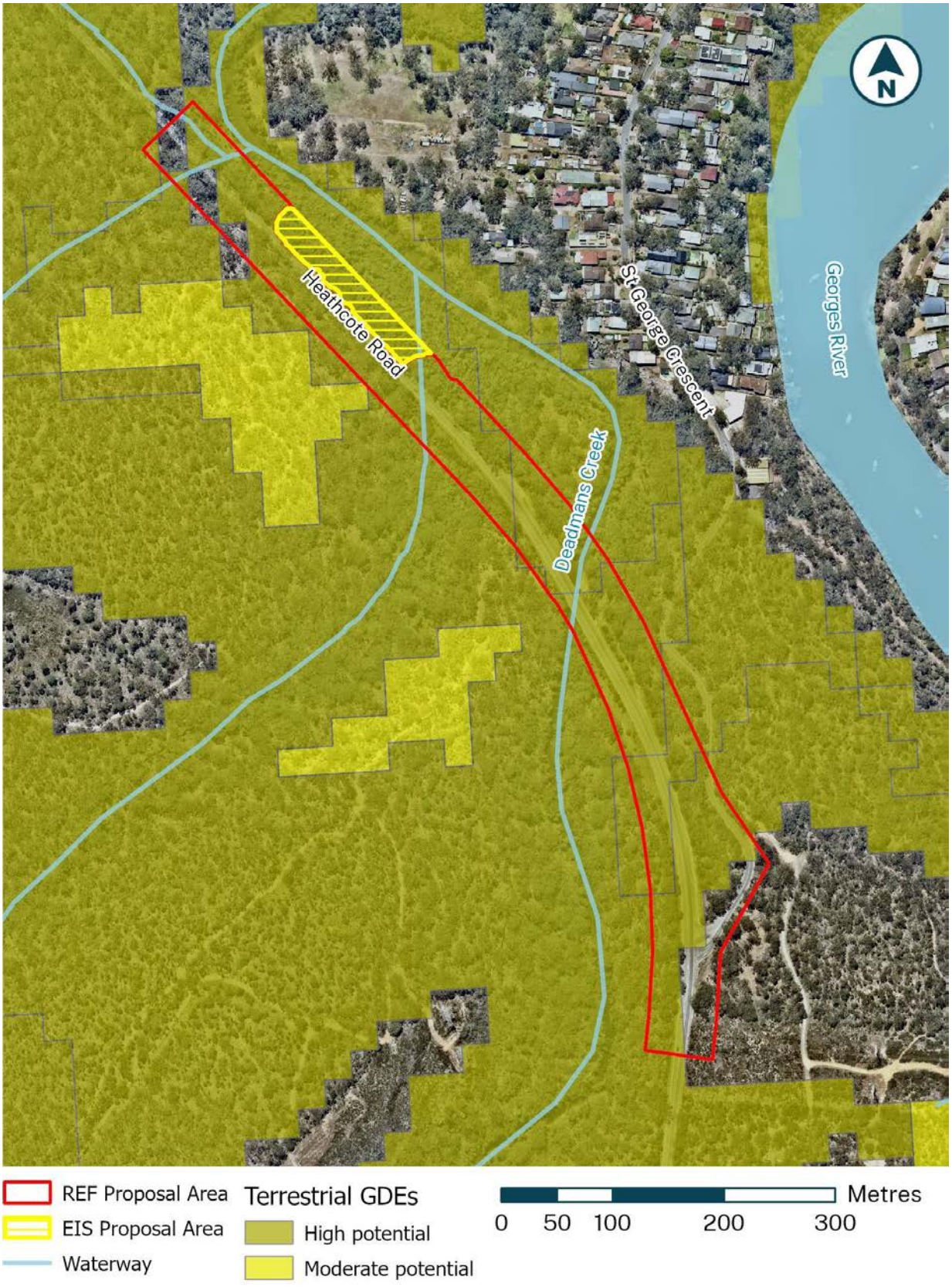


Figure 6-5: Groundwater dependent ecosystems

Weeds and exotic species

Eight priority weeds for the Greater Sydney region have been recorded in the REF proposal area:

- Bridal Creeper (*Asparagus asparagoides*)
- Ground Asparagus (*Asparagus aethiopicus*)
- Fireweed (*Senecio madagascariensis*)
- Blackberry (*Rubus fruticosus* species aggregate)
- Green Cestrum (*Cestrum parqui*)
- Giant Reed (*Arundo donax*)
- Common Pear (*Opuntia stricta*)
- Pampas Grass (*Cortaderia species*)

Pest animals such as *Felis catus* (feral Cat), *Vulpes vulpes* (Red Fox), *Oryctolagus cuniculus* (European Rabbit) and feral deer are widely spread within the region and are known or likely to occur across the locality and the REF proposal area.

Areas of Outstanding Biodiversity Value

No areas of outstanding biodiversity value occur within the REF proposal area.

Matters of National Environmental Significance

Under the EPBC Act, a proponent must not take an action if that action will have, or is likely to have, a significant impact on matters protected under the EPBC Act, referred to as Matters of National Environmental Significance (MNES), without approval. The EPBC Act identifies nine MNES:

1. World Heritage properties
2. National Heritage places
3. Wetlands of international importance (those listed under the Ramsar Convention)
4. Listed threatened species and communities
5. Migratory species listed under international agreements
6. Great Barrier Reef Marine Park
7. Commonwealth marine areas
8. Nuclear actions
9. Water resources (that relate to coal seam gas development and large coal mining development).

The Protected Matters Search Tool identified the following as potentially occurring within the REF proposal area:

- 13 Threatened Ecological Communities
- 81 Threatened Species
- 45 Migratory Species

Through a habitat suitability assessment, the following EPBC Act listed threatened species were considered to have a moderate or higher likelihood of occurring within the REF proposal area:

- *Persicaria elatior*
- *Isoodon obesulus obesulus* (Southern Brown Bandicoot)
- *Phascolarctos cinereus* (Koala)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

As described previously, one EPBC Act listed TEC, Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland EEC, occurs within the REF proposal area.

6.1.3 Avoidance and minimisation

A key component of Transport's Biodiversity Policy commitment to no net loss of biodiversity requires the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

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

Table 6-4 outlines how the proposal will avoid and minimise direct impacts to native vegetation and habitat in accordance with Transport policies.

Table 6-4: Design considerations that have avoided and/or minimised impacts

Avoidance and/or minimisation measure	Proposal
Location of the proposal	
Locating the proposal in areas where there are no biodiversity values.	The REF proposal is limited in its scope to be positioned in a way that would avoid all biodiversity values within the construction footprint. To reduce impacts, the REF proposal has used the existing Defence fencing and natural barriers (i.e. rock cuttings). Efforts have also been made to position the alignment in previously cleared areas and avoid specialist breeding habitat (e.g. hollow-bearing trees), where possible. The fence alignment was walked and pegged to ensure the lowest impact route was taken.
Locating the proposal in areas where the native vegetation or threatened species habitat is in the lowest condition.	
Locating the proposal in areas that avoid habitat for threatened species that may be at risk of a significant impact or native vegetation that is part of a critically endangered ecological community (CEEC) or an endangered ecological community (EEC).	PCT 4028 within the construction footprint is consistent with the Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions - BC Act listed EEC and Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – EPBC Act listed EEC. Measures to minimise direct impacts to this community have been implemented, however cannot be totally avoided as part of the proposal. A small area of approximately 0.02 hectares will be impacted as part of the proposal.
Design refinement of the proposal	
Reducing the clearing footprint of the proposal.	The clearing footprint has been reduced as far as practicable and most of the impacts are to vegetation with a moderate-high level of disturbance. To allow flexibility in the final placement of the fencing, a buffer of 3 metres was assessed. Clearing would be reduced to that necessary to prevent fauna climbing installed fencing and would occur no more than three metres from the installed fence alignment.
Locating ancillary facilities in areas where there are no biodiversity values.	Ancillary facilities for the proposal have been located in previously cleared areas which primarily contain heavily disturbed vegetation devoid of trees and shrubs. No notable threatened species habitat (e.g. hollow-bearing trees) would be removed for establishment and use of the ancillary facilities.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the lowest condition.	
Locating ancillary facilities in areas that avoid habitat for threatened species and vegetation in high threat status categories (e.g. endangered or critically endangered)	

Avoidance and/or minimisation measure	Proposal
Alternatives	
An analysis of alternative routes, technologies, locations and sites that would avoid or minimise impacts on biodiversity values and justification for selecting the location and methods of the proposal	Four alternative options were assessed in 2021 (WSP, 2021). The effective options for reducing Koala vehicle strike along Heathcote Road were limited to the installation of fauna fencing and improving the conditions of the existing bridge over Deadmans Creek. The main differences in the various options related to the length of fauna fencing and how the fence ends are treated. Based on outcomes of the qualitative options assessment, Option 2 was selected. Option 2 was consistent with 'How to keep Koalas off the road – Koala vehicle strike factsheet 2' (Department of Planning, Industry and Environment, 2020), as long, uninterrupted sections of fauna fencing used in conjunction with crossing structures such as bridges are proven to be effective for mitigating Koala vehicle strike. Option 2 was chosen as it minimises impacts on biodiversity values by utilising the existing Defence fence and rock cuttings when compared to alternative options of equivalent fence length.

6.1.4 Potential impacts

Construction or direct impacts

Removal of native vegetation

The proposal would result in the direct loss of native vegetation as summarised in Table 6-5, noting that areas of primarily non-native vegetation have been mapped as degraded PCTs (refer to Figure 6-6 and Figure 6-7). Direct impacts on TECs are summarised in Table 6-6.

Table 6-5: Summary of direct impacts on native vegetation

Veg. zone	PCT	Broad condition class	TEC	Area to be impacted (ha)
Zone 1 - Moderate	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Moderate	Not associated with a TEC	0.15
Zone 3 - Low	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Low	Not associated with a TEC	0.26
Zone 4 - Good	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Good	Not associated with a TEC	0.28
Zone 5 – Moderate (easement)	PCT 3615: Sydney Hinterland Apple-Blackbutt Gully Forest	Moderate	Not associated with a TEC	0.01
Zone 6 - Good	PCT 4091: Grey Mangrove-River Mangrove Forest	Good	Not associated with a TEC	0.002

Veg. zone	PCT	Broad condition class	TEC	Area to be impacted (ha)
Zone 2 - Good	PCT 4028: Estuarine Swamp Oak Twig-rush Forest	Good	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – EEC under the BC Act Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – EEC under the EPBC Act	0.02
Zone 7 - Moderate	PCT 4059: Sydney Hinterland Sandy Creekflat Shrub Forest	Moderate	Not associated with a TEC	0.03
Total				**0.74**

Table 6-6: Summary of direct impacts on TECs

TEC	Listing	Veg zone	Area of veg zone consistent with TEC	Total area to be impacted (ha)
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	BC Act	Zone 2 – Good	0.02	0.02
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	EPBC Act	Zone 2 – Good	0.02	0.02

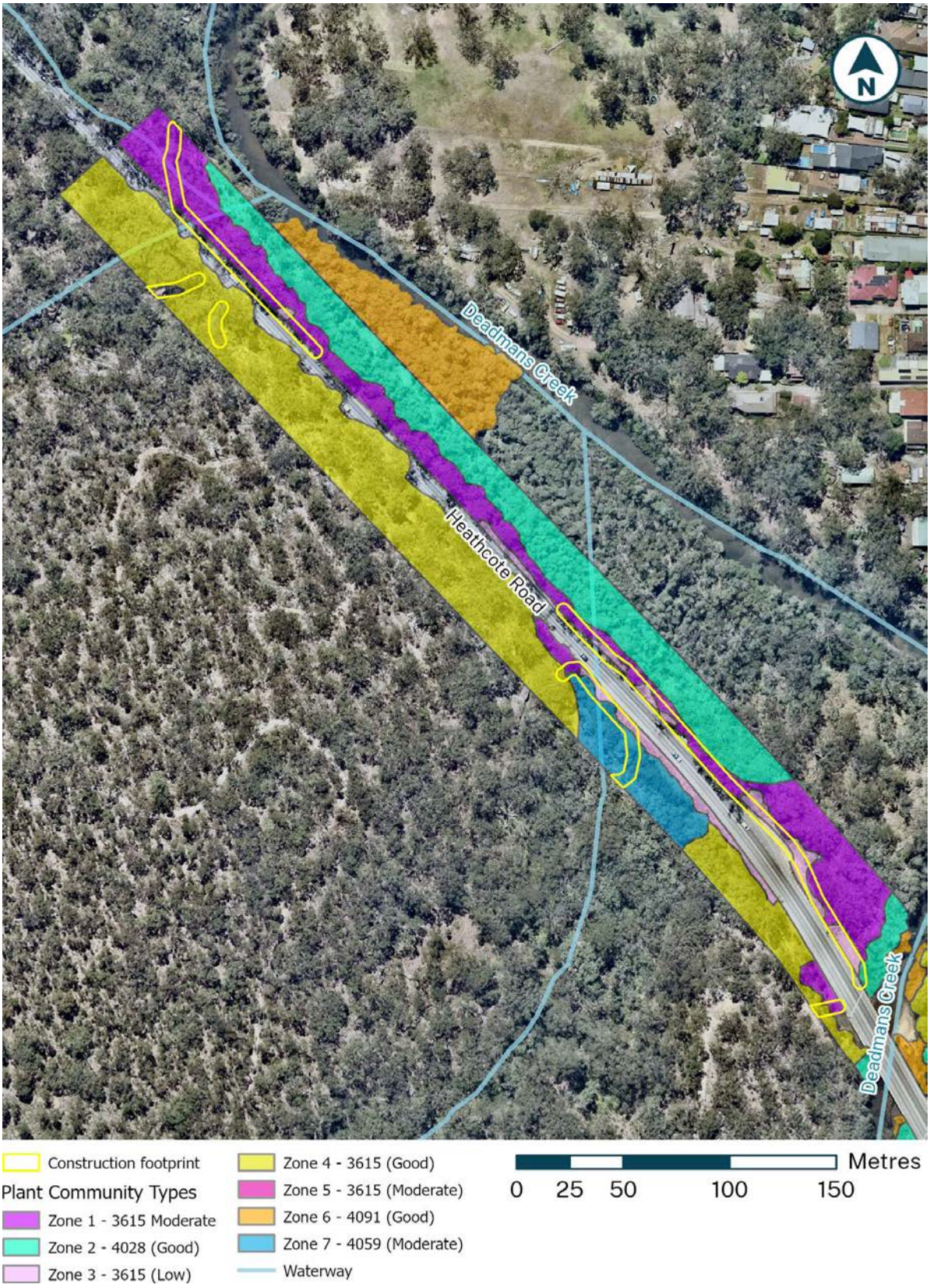


Figure 6-6: PCT clearing areas – north

Figure 6-7: PCT clearing areas – south

Impacts on Swamp Oak Floodplain Forest and Coastal Swamp Oak (*Casuarina glauca*) Forest were assessed against BC Act criteria and EPBC Act Significant Impact Guidelines and were found to not be significant. The assessment noted that these communities are already fragmented by Heathcote Road and that there would be only a minor reduction in the extent of these TECs as a result of the REF proposal. The local occurrence of these communities is not likely to be placed at risk of extinction.

Removal of threated fauna habitat

The proposal would result in impacts to about 0.74 hectares of native vegetation in varying condition classes. The removal of 0.74 hectares of vegetation would also result in the loss of 0.74 hectares of foraging resources for several threatened fauna considered to have a moderate or higher likelihood of occurring within the REF proposal area.

Native vegetation to be removed from the REF proposal area includes the loss of three hollow-bearing trees, containing four hollows that offer potential habitat for hollow-dependent birds, mammals and small insectivorous bats (microbats). The loss of hollow-bearing trees is a Key Threatening process listed under Schedule 2 of the BC Act.

A summary of impacts to potential habitat for those species assessed as having a moderate or higher likelihood of occurrence within the REF proposal area are presented in Table 6-7. PCTs in the REF proposal area and the area of vegetation clearing are shown in Figure 6-6**Error! Reference source not found.** and Figure 6-7.

Table 6-7: Summary of direct impacts on threatened fauna and habitat

Species name	EPBC Act	BC Act	Credit type	Potential occurrence (Moderate, High, Recorded)	Associated habitat in construction footprint	Impact (ha)
Hibbertia puberula	-	E	Species	Moderate	PCT 3615 (Zones 1, 4, 5)	0.43
Hibbertia stricta subsp. furcatula	-	E	Species	Moderate	PCT 3615 (Zones 1, 4, 5)	0.43
Persicaria elatior	V	V	Species	Moderate	PCT 4028	0.02
Burhinus grallarius (Bush Stone-curlew)	-	E	Species	Moderate	PCT 3615 (All zones), PCT4059	0.72
Glossopsitta pusilla (Little Lorikeet)	-	V	Ecosystem	Moderate	PCT 3615 (All zones), PCT4059	0.72
Haliaeetus leucogaster (White-bellied Sea-Eagle)	-	V	Species/Ecosystem	Recorded	PCT 4059, PCT4028, PCT 4091	0.05
Ninox strenua (Powerful Owl)	-	V	Species	Moderate	PCT 3615 (All zones), PCT4059, PCT 4028	0.74
Pandion cristatus (Eastern Osprey)	-	V	Species/Ecosystem	Moderate	PCT 3615 (All zones), PCT4059, PCT 4028, PCT 4091	0.74
Tyto tenebricosa (Sooty Owl)	-	V	Species	Moderate	PCT 3615 (All zones)	0.70
Falsistrellus tasmaniensis	-	V	Ecosystem	Moderate	PCT 3615 (All zones), PCT4059, PCT 4028	0.74

Species name	EPBC Act	BC Act	Credit type	Potential occurrence (Moderate, High, Recorded)	Associated habitat in construction footprint	Impact (ha)
(Eastern False Pipistrelle)						
Isoodon obesulus obesulus (Southern Brown Bandicoot)	E	E	Species	Moderate	PCT 3615 (Zone 1, 4, 5), PCT4059	0.46
Miniopterus orianae oceanensis (Large Bent-winged Bat)	-	V	Species/Ecosystem	Moderate	PCT 3615 (All zones), PCT4059, PCT 4028, PCT 4091	0.74
Myotis macropus (Southern Myotis)	-	V	Species	Moderate	PCT 3615 (All zones), PCT4059, PCT 4028, PCT 4091	0.74
Phascolarctos cinereus (Koala)	E	E	Species	Recorded	PCT 3615 (1, 4, 5), PCT4059, PCT 4028	0.48
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	Species/Ecosystem	Moderate	PCT 3615 (1, 4, 5), PCT4059, PCT 4028	0.48
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	-	V	Ecosystem	Moderate	PCT 3615 (All zones), PCT 4028, PCT 4091	0.72
Scoteanax rueppellii (Greater Broad-nosed Bat)	-	V	Ecosystem	Moderate	PCT 3615 (All zones), PCT4059, PCT 4028, PCT 4091	0.74

Aquatic impacts

Construction of the proposal may result in the sedimentation of downstream environments (including Deadmans Creek and the two unnamed watercourses), potential erosion of stream banks from physical disturbance (relating to construction activities located near watercourses, such as the installation of koala refuge poles) and potential stream bed erosion.

Key Fish Habitat is mapped at Deadmans Creek. The proposal would not block fish passage or result in disturbance to the creek flow or the aquatic habitat (such as in stream woody debris).

No threatened aquatic species, populations and communities have been identified within the REF proposal area or are considered likely to occur and are therefore unlikely to be impacted.

Injury and mortality

Construction of the proposal may result in injury and mortality to fauna. Risks to fauna are associated with vegetation clearing and the mobilisation of plant. It is expected that mobile fauna would relocate to undisturbed areas during construction activities, however less mobile fauna may be directly impacted during these activities. Fauna injury and mortality impacts would be managed through the implementation of mitigation measures, outlined in Section 7.2.

Groundwater dependent ecosystems

Direct impacts to GDEs mapped within the REF proposal area include the clearing of native vegetation and the construction footprint required for construction of the proposal. It is unlikely that vegetation removal to facilitate the REF proposal, including fence installation, would impact on any GDEs. (refer to section 6.5 for further detail). These GDEs are unlikely to be entirely groundwater dependent and are likely to be more reliant on the collection of rainwater into associated waterways.

Generally, groundwater interference would be temporary and deep excavations are not expected, groundwater would be managed by a Construction Environmental Management Plan (CEMP), and as such substantial impacts to GDEs are not expected.

Operation or indirect impacts

Wildlife connectivity and habitat fragmentation

The REF proposal area is widely recognised as being part of a highly used Koala movement corridor. Heathcote Road and the existing Defence fence already presents a barrier to movement for fauna, particularly ground-dwelling fauna, in a northeast-southwest direction. The proposal would deliberately introduce an additional barrier to wildlife movement across Heathcote Road. This may result in fewer koalas dispersing north of Heathcote Road, however safe crossing points under Heathcote Road would aim to reduce the incidence of vehicle-strike and mortality in the locality and facilitate the movement of fauna through more suitable corridors by channelling fauna to existing crossings under the road. Therefore, the impact on koala habitat connectivity is considered negligible

Clearing of roadside vegetation for the installation of koala fencing would slightly increase the existing gap between tree canopies on either side Heathcote Road. The slight increase in canopy gap resulting from the REF proposal is minimal (by approximately three metres) may increase habitat fragmentation for arboreal mammals, particularly gliders. Safeguards provided in section 6.1.5 aim to reduce any potential operational impacts by maintaining the present level of connectivity.

Injury and mortality

Operation of the proposal would seek to reduce the rate of fauna injury and mortality along Heathcote Road by aiming to prevent fauna access to this high-speed traffic environment. Koala fencing would also direct fauna to existing safe crossing opportunities (such as under Deadmans Creek bridge). In rare instances, koala fencing may contribute to mortality of fauna as they attempt to escape sporadic threats, such as bushfires or predators. These potential negative impacts would be mitigated through the fence design including koala refuge poles and fauna escape structures.

Invasion and spread of weeds

Construction of the proposal has the potential to introduce or spread weeds within the REF proposal area. The spread of weeds is most likely to be associated with earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery.

Conclusion on significance of impacts

BC Act significance assessments and EPBC Act Significant Impact Criteria assessments were carried for all relevant threatened entities recorded or considered to have a moderate or higher likelihood of occurrence within the REF proposal area.

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* (refer to Appendix D of the BAR) and therefore a Biodiversity Development Assessment Report (or Species Impact Statement) is not required. A separate Biodiversity Development Assessment Report has been prepared for the part of the overall proposal within land mapped as 'coastal wetland' under State Environment Planning Policy (Resilience and Hazards) 2021 which is addressed in a separate EIS (refer Section 1.1.1). A summary of the BC Act significance assessments findings is provided in Table 6-8.

Table 6-8: Summary of BC Act significance assessments findings

Significance assessment question *(per Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines* (Office of Environment and Heritage, 2018)*)*						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
Hibbertia puberula	N	N	N	N	N	N
Hibbertia stricta subsp. furcatula	N	N	N	N	N	N
Persicaria elatior	N	N	N	N	N	N
Burhinus grallarius (Bush Stone-curlew)	N	N	N	N	N	N
Glossopsitta pusilla (Little Lorikeet)	N	N	N	N	N	N
Haliaeetus leucogaster (White-bellied Sea-Eagle)	N	N	N	N	N	N
Ninox strenua (Powerful Owl)	N	N	N	N	N	N
Pandion cristatus (Eastern Osprey)	N	N	N	N	N	N
Tyto tenebricosa (Sooty Owl)	N	N	N	N	N	N
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	N	N	N	N	N	N
Isoodon obesulus obesulus (Southern Brown Bandicoot)	N	N	N	N	N	N
Miniopterus orianae oceanensis (Large Bent-winged Bat)	N	N	N	N	N	N
Myotis macropus (Southern Myotis)	N	N	N	N	N	N
Phascolarctos cinereus (Koala)	N	N	N	N	N	N
Pteropus poliocephalus (Grey-headed Flying-fox)	N	N	N	N	N	N
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	N	N	N	N	N	N
Scoteanax rueppellii (Greater Broad-nosed Bat)	N	N	N	N	N	N
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	N	N	N	N	N	N

Y *= Yes (negative impact),* ***N*** *= No (no or positive impact),* ***X*** *= Yes/No answer not applicable,* ***?*** *= unknown impact.*

The Significant Impact Guidelines prepared under the EPBC Act were used to determine whether the proposal would have a significant impact on MNES known or likely to occur in the REF proposal area (refer to Appendix C of the BAR). The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act. Therefore, the proposal does not require referral to the Federal Minister for the Environment. A summary of the BC Act significance assessments findings is provided in Table 6-9.

Table 6-9: Summary of EPBC Act significance assessments findings

Threatened species, or communities	Important population *(per Significant Impact Guidelines 1.1 (DoE 2013))*	Likely significant impact?
Persicaria elatior	N	N
Isoodon obesulus obesulus (Southern Brown Bandicoot)	N	N
Phascolarctos cinereus (Koala)	N	N
Pteropus poliocephalus (Grey-headed Flying-fox)	N	N
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland	N	N

Y *= Yes (negative impact),* ***N*** *= No (no or positive impact),* ***X*** *= Yes/No answer not applicable,* ***?*** *= unknown impact.*

6.1.5 Safeguards and management measures

Table 6-10: Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	A Flora and Fauna Management Plan will be prepared in accordance with Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects (Transport for NSW, 2024) 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, protected habitat features and revegetation areas • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling. • Procedures addressing relevant matters specified in the DPI Policy and guidelines for fish habitat conservation and management (2013). • Protocols to manage weeds, pathogens and pest species	Transport/ Contractor	During construction	Section 4.8 of QA G36 Environment Protection
Removal of native vegetation	Native vegetation removal will be minimised during detailed design and construction. Clearing would be reduced to that necessary to prevent fauna climbing installed fencing and would occur no more than three metres from the installed fence alignment.	Transport/ Contractor	Detailed design During construction	Project specific control

Impact	Environmental safeguards	Responsibility	Timing	Reference
Native vegetation, threatened flora and TECs	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).	Contractor	Pre-construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
Removal of native vegetation	Pre-clearing surveys and final pre-clearing checks 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 2024).	Transport/ Contractor	Prior to construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
Removal of native vegetation	Vegetation and 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).	Transport/ Contractor	During construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
Fauna injury and mortality	Fauna will be managed in accordance with Guide 9: Fauna handling of the Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)	Contractor	Construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)

Impact	Environmental safeguards	Responsibility	Timing	Reference
Invasion and spread of weeds	Weed species will be managed in accordance with Guide 6: Weed management of the Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024).	Contractor	Construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)	Contractor	Construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
Aquatic habitats	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 ((Department of Primary Industries, 2013).	Transport/ Contractor	During construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
Removal of native vegetation	An unexpected threatened species finds procedure is to be developed as part of the FFMP using the template in *Guide 1: Pre-clearing process* of the Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects (Transport for NSW, 2024). The procedure is to be followed if threatened ecological communities, either new TECs or new occurrences of known TECs, not assessed in the biodiversity assessment, are identified in the REF proposal area.	Transport/ Contractor	During construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)

6.1.6 Biodiversity offsets

Transport's Biodiversity Policy (Transport for NSW, 2022) sets out the approach to avoid, minimise, mitigate and offset impacts of Transport projects and includes a commitment to replace native and amenity trees unavoidably lost through development.

Although efforts have been made to avoid, minimise and mitigate potential impacts on biodiversity, some residual impacts would occur. However, the proposal would trigger the policy's tree and hollow replacement requirements.

Up to 376 individual trees with a ≥5cm Diameter at Breast Height (DBH) (including three hollow-bearing trees which support four hollows) may be removed for construction of the proposal (refer to Table 6-11), which will be required to be replaced in accordance with Tree and hollow replacement guidelines (Transport for NSW, 2023). Per the guidelines, trees may either be replaced on nearby land with the consent of the landowner or, where this is not feasible, payment may be made to Transport's Conservation Fund.

Table 6-11: Preliminary estimates of trees and hollow replacement requirements

Category	Estimated No. impacted		Replacement requirement per tree/hollow removed[1]		Estimated 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)	0	0	Plant minimum 16 trees	$2,500	0	0	$0
Large tree (DBH ≥50 to <100cm)	16	0	Plant minimum 8 trees	$1,000	128	0	$16,000
Medium tree (DBH ≥20 to <50 cm)	70	0	Plant minimum 4 trees	$500	280	0	$35,000
Small tree (DBH ≥ 5cm to <20 cm)	290	0	Plant minimum 2 trees	$125	580	0	$36,250
Hollows	4		Provide 3 artificial hollows for every occupied hollow removed*	$500	3		$2,000
Total					**988 (trees) 3 (hollows)**		**$89,250**

* For every five hollows identified (or where less than five hollows will be impacted), it is assumed one hollow will be occupied and requires replacement. Where hollows are inspected during the clearing process, actual occupation can used as the basis for the replacement requirement.

6.2 Noise and vibration

Potential noise and vibration impacts of the overall proposal have been assessed by Heathcote Road Koala Fencing at Deadmans Creek Noise and Vibration Assessment (Muller Acoustic Consulting, 2024), provided in Appendix F. This Noise and Vibration Assessment informs both this REF and the separate EIS.

6.2.1 Methodology

The Noise and Vibration Assessment has been prepared in accordance with the following guidelines:

- Construction Noise:
  - Transport for NSW, Noise and Vibration Assessment Procedure (for road traffic and construction) (Transport for NSW, 2023).
  - Transport for NSW, Construction Noise and Vibration Guideline (Roads) (Transport for NSW, 2023).
  - Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009).
  - Standards Australia – AS 2436-2010 (R2016) Guide to Noise Control on Construction, Maintenance and Demolition Sites.

- Construction Vibration:

  Assessing Vibration: A Technical Guideline (NSW Department of Environment and Conservation, 2006).

  - British Standard BS 7385: Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2”.
  - German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – Structural Vibration - Effects of Vibration on Structures.

In summary, the methodology for the noise and vibration assessment included the following:

- Identifying and classifying noise and vibration sensitive receivers and defining the REF proposal area. Receivers were classified using a combination of recent aerial and ground photography, web-based information sources and cadastral data
- Establishing proposal specific construction noise management levels (NML) with reference to the representative noise environment. The representative noise environment was identified using the Transport Construction and Maintenance Noise Estimator Tool
- Modelling predicted construction to predict noise levels at the nearest potentially affected receivers.
- Assessing construction noise levels against the representative noise environment to determine potential impacts.
- Reviewing vibration intensive activities against minimum working distances for vibration intensive plant in the Construction Noise and Vibration Guideline (CNVG) (Transport for NSW, 2023).

Noise modelling

A computer model was developed to quantify proposal noise emissions to neighbouring receivers using DGMR (iNoise, Version 2024) noise modelling software. The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. The model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

6.2.2 Existing environment

Sensitive Receivers

The REF proposal area is near the suburbs of Pleasure Point, Sandy Point, Menai and Picnic Point, where residential receivers are typical of dwellings on suburban lots. Other nearby land uses include the Georges River National Park, the Holsworthy Barracks, and the Sandy Point Quarry. Sensitive receivers identified near the proposal are listed in Table 6-12 and are shown in Figure 6-8.

Table 6-12: Sensitive Receivers

Receiver Type	Description	Number of Receivers
Residential	Pleasure Point, Sandy Point and Picnic Point	~420
Active Recreation	Georges River NP, Sandy Point Reserve and Community Centre	2
Commercial Premises	Sandy Point RFS	1
Industrial Premises	Sandy Point Quarry	1

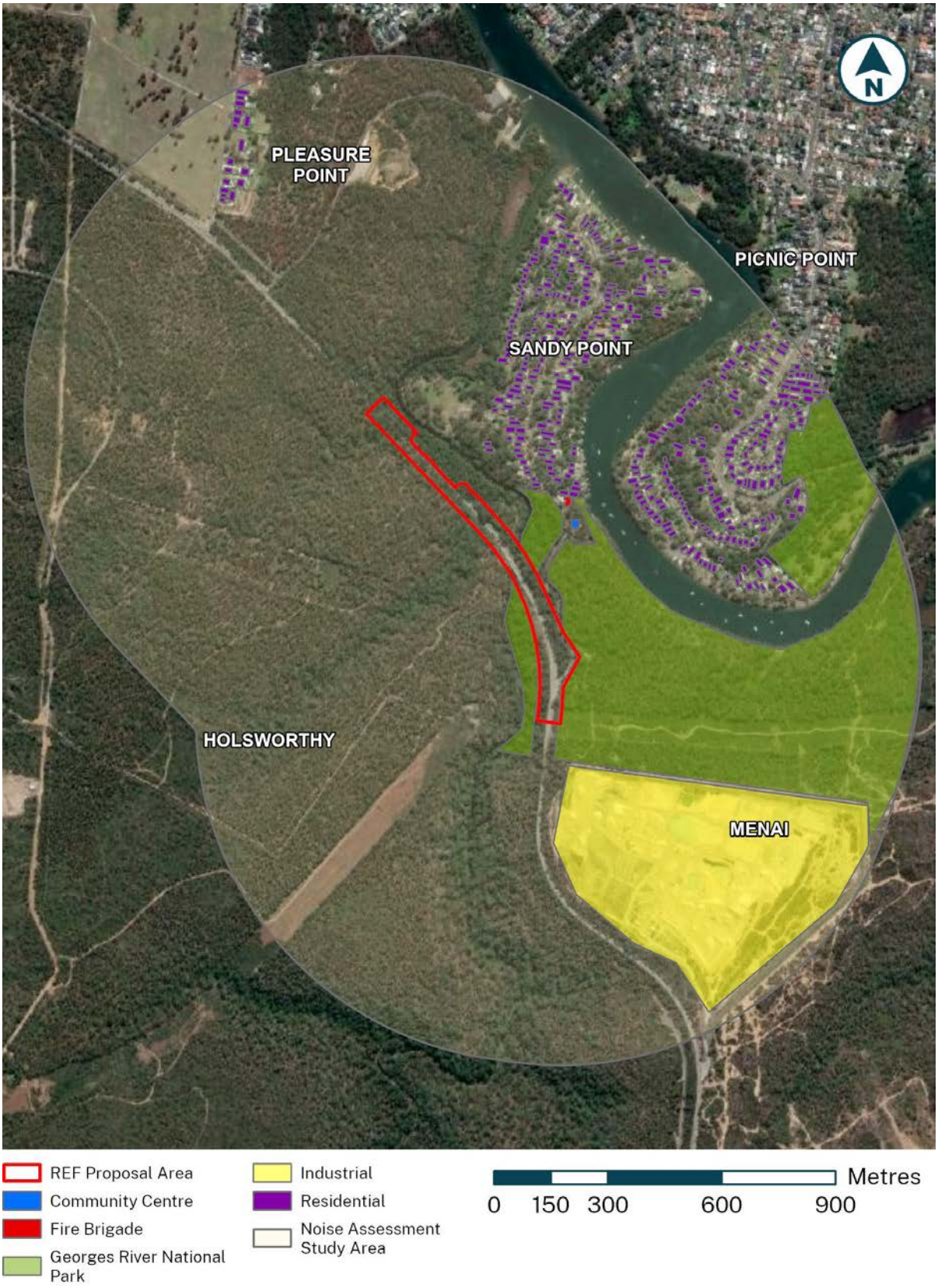


Figure 6-8: Sensitive receivers in the noise assessment proposal area

Representative Noise Environment

The main sources of noise in the REF proposal area include road traffic on Heathcote Road and operation of the Sandy Point Quarry. Based on an Annual Average Daily Traffic volume of approximately 25,000 vehicles per day travelling on Heathcote Road (80 kilometres per hour sign posted speed limit), and a minimum offset distance of approximately 130 metres to the nearest residential receiver, the Construction and Maintenance Noise Estimator Tool Category R1 representative noise environment has been used to derive Rating Background Levels (RBLs).

A summary of the existing background noise levels is included in Table 6-13.

Table 6-13: Summary of existing background noise levels

Receivers	Noise Area Category	Time Period	RBL, dBA
All Residential	R1	Day	40
		Evening	35
		Night	30

6.2.3 Criteria

Construction noise criteria

Construction noise criteria have been established for the proposal in accordance with the ICNG, in the form of construction NMLs. The NMLs for residential receivers are derived from the existing background noise levels, or rating background levels RBL, as defined in Table 6-13. Relevant criteria are applied in accordance with the ICNG for work during recommended standard hours and work outside these hours. Table 6-14 identifies the NMLs for residential receivers.

Table 6-14: Noise management levels for residential receivers

Time of day	Noise Management Level $LA_{eq(15min)}$	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10dB.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	Noise Management Level $L_{Aeq(15min)}$	How to apply
Outside recommended standard hours.	Noise affected RBL +5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community.

Construction noise management levels

The NMLs for standard and out of hours works (OOHW) periods are summarised in Table 6-15 for residential receivers and for applicable non-residential receivers.

Table 6-15: Construction NMLs for residential receivers

Assessment period	RBL,dBA	NML dB LAeq(15min)	Highly noise affected NML dB LAeq(15min)
Standard Hours Monday to Friday – 7am to 6pm Saturday – 8am to 1pm	40	50	75
OOHW – Day Saturdays – 7am to 8am & 1pm to 6pm Sundays/Public Holidays – 8am to 6pm	40	45	75
OOHW – Evening Monday to Friday – 6pm to 10pm	35	40	75
OOHW – Night Monday to Friday – 10pm to 7am Saturdays – 6pm to 7am Sunday mornings Public Holidays 6pm to 8am	30	35	75

Table 6-16: Noise management levels for other noise sensitive receivers

Receiver	Assessment Period	Where NML applies	NML, dB LAeq(15min)
Active recreation	When in use	Internal noise level	65dB
Commercial premises	When in use	External noise level	70dB
Industrial premises	When in use	External noise level	75dB

Sleep disturbance

The CNVG nominates a sleep disturbance screening level of 65dB L_{Amax} (external) for the operation of individual items of plant and equipment during the night period.

Vibration assessment criteria

Residential and non-residential buildings

British Standard BS7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2", gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage. The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in Table 6-17.

Table 6-17: Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak Component Particle Velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note: Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in should be reduced by 50 per cent.

Heritage items

BS7385 indicates that heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. If a heritage building or structure is structurally unsound (following inspection) a more conservative cosmetic damage objective as per DIN4150 would be applicable. The DIN4150 values are summarised in Table 6-18.

Table 6-18: Structural damage guideline – heritage structures

Type of structure	Vibration velocity in mm/s			
	Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	... at horizontal plane of highest floor (all frequencies)
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that because of their particular sensitivity to vibration do not correspond to those above and have intrinsic value (e.g. heritage buildings)	3	3 to 8	8 to 10	8

Human comfort

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline (Department of Environment and Climate Change, 2006) w is based on guidelines contained in BS6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

Criteria for human exposure to continuous vibration (1-80 Hz) are provided in Table 6-19.

Table 6-19: Criteria for exposure to continuous vibration

Place	Time[1]	Peak velocity in mm/s	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note: velocity (mm/s) and vibration velocity value (dB re 10 -9 mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.
Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

Impulsive vibration is generally associated with infrequent activities that create up to three distinct vibration events in an assessment period (e.g. occasional dropping of heavy equipment, occasional loading and unloading). Criteria for human exposure to impulsive vibration are provided in Table 6-20.

Table 6-20: Criteria for exposure to impulsive vibration

Place	Time[1]	Peak velocity in mm/s	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	8.6	17.0
	Night	2.8	5.6
Offices	Day or Night	18.0	36.0
Workshops	Day or Night	18.0	36.0

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking). Criteria for human exposure to intermittent vibration are provided in Table 6-21.

Table 6-21: Criteria for exposure to intermittent vibration

Place	Daytime		Night-time	
	Preferred value $m/s^{1.75}$	Maximum value $m/s^{1.75}$	Preferred value $m/s^{1.75}$	Maximum value $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.
Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comments or complaints may be expected if vibration values approach the maximum values.

6.2.4 Potential impacts

Construction

Construction noise

Construction noise impacts consider the sound power levels of construction plant and equipment involved in each stage, or scenario, of construction. The construction scenarios for the proposal are listed in Table 6-22. The sound power levels of plant and equipment involved in each construction scenario are listed in the noise and vibration assessment (Appendix F).

Table 6-22: Proposed construction scenarios

Scenario	Description	Plant	Sound Power Levels, dB(A)
S1: Establishment of site facilities	• Installation of temporary fencing, lighting and storage • Installation of temporary amenities • Installation of erosion and sediment controls • Installation of temporary traffic controls	Light vehicles	88
		Medium truck	103
		Road truck	108
		Franna	98
S2: Vegetation clearing and minor earthworks	• Removal of vegetation from the fence alignment • Site levelling along fence alignment	Light vehicles	88
		5t excavator	100
		Chainsaw	114
		Tubgrinder	116
		Mulch blower	104
		Elevated work platform	87
		Side tipper	104
S3: Installation of fencing	• Concrete lining of drains which interest the proposed fence alignment • Installation of fence posts using a truck-mounted auger or rock-drilling where posts would be located on rock • Installation of chain-wire fencing and galvanised steel sheeting	Light vehicles	88
		Truck-mounted auger	103
		Micro-drill rig	105
		Concrete Truck	103
		Truck with lifting boom	105
		Hand tools	105
S4: Supplementary fauna crossing measures	• Installation of koala poles • Installation of ground treatments under and near Deadmans Creek • Installation of one-way escape structures	Light vehicles	88
		Franna	98
		Truck-mounted auger	103
		Concrete Truck	103
S5: Installation of koala grid	• Excavation of koala grid footprint • Construction of koala grid foundation and drainage infrastructure • Installation of koala grid and pedestrian fence • Installation of signage and line marking on the road	Light vehicles	88
		Truck with lifting boom	105
		Hand tools	105
		Concrete saw	118
		Jackhammer	108
		Plate compactor	104

Construction noise levels at sensitive receivers

Construction noise levels have been predicted for sensitive receiver locations for each of the construction scenarios described in Table 6-22. A summary of the predicted L_{Aeq}(15min) noise emissions is presented for the most affected receiver location for each receiver type in Table 6-23.

Table 6-23: Summary of construction works and predicted construction noise levels

Receiver type	Period	NML, dBA	Typical offset	S1 Site facilities	S2 Clearing	S3 Fencing	S4 Fauna crossing	S5 Koala grid
Residential	Standard Hours	50	50 – 230m	<30 – 44dBA	**<30 – 54dBA**	<30 – 49dBA	<30 – 47dBA	<30 – 45dBA
	OOHW - Day	45	75 – 285m	<30 – 44dBA	**<30 – 54dBA**	**<30 – 49dBA**	**<30 – 47dBA**	**<30 – 45dBA**
	OOHW – Evening	40	115 – 350m	**<30 – 44dBA**	**<30 – 54dBA**	**<30 – 49dBA**	**<30 – 47dBA**	**<30 – 45dBA**
	OOHW - Night	35	185 – 670m	**<30 – 44dBA**	**<30 – 54dBA**	**<30 – 49dBA**	**<30 – 47dBA**	**<30 – 45dBA**
	Sleep disturbance	65	50 – 75m	<30 – 50dBA	<30 – 59dBA	<30 – 54dBA	<30 – 54dBA	<30 – 45dBA
Active Recreation	When in use	65	15 – 35m	40 – 41dBA	48 – 62dBA	43 – 55dBA	38 – 53dBA	40 – 66dBA
Commercial	When in use	70	10 – 20m	40dBA	48dBA	43dBA	43dBA	42dBA
Industrial	When in use	75	5 – 10m	36dBA	49dBA	44dBA	44dBA	47dBA

Note 1: Not recommended as OOHW, as per the Construction and maintenance noise estimator tool.

Table 6-24: Number of sensitive receivers predicted to experience noise exceedances during each construction scenario

Receivers	Period	NML, dBA	S1 Site facilities	S2 Clearing	S3 Fencing	S4 Faina crossing	S5 Koala grid
Residential	Standard Hours	50	--	12	--	--	--
	OOHW - Day	45	--	29	10	6	--
	OOHW – Evening	40	11	51	26	22	15
	OOHW - Night	35	22	180**	51	54	48
	Sleep disturbance	65	--	--	--	--	--
Active Recreation	When in use	65	--	--	--	--	1
Commercial	When in use	70	--	--	--	--	--
Industrial	When in use	75	--	--	--	--	--

The only construction activity predicted to result in noise levels above the NMLs during standard construction hours is vegetation clearing (construction scenario 2). Up to 12 residences at Sandy Point are predicted to experience noise levels above the NMLs during this activity.

Construction of the proposal would generally be undertaken outside of standard construction hours to ensure safe working conditions and minimise disruptions to traffic on Heathcote Road and St George Crescent (refer to section 3.3.3 for further detail). With most construction activities occurring during the OOHW Day, Evening

and Night periods, a number of residences in Sandy Point are predicted to experience noise levels above the NMLs, for each construction activity.

The highest number of residences are anticipated to experience noise levels above the NMLs during vegetation clearing and minor earthworks (construction scenario 2). No construction activities are predicted to result in the maximum noise trigger levels (sleep disturbance) criterion of 65dB LAmax being exceeded at any residential receiver locations.

Implementing standard mitigation measures during construction of the proposal (such as turning off or throttling down construction plant when not in use) is expected to further reduce construction noise. However, following the implementation of standard mitigation measures, it is expected that some residential receivers would still experience noise impacts during the OOHW day, evening and night periods. Construction noise impacts are not expected during the day.

Perception categories (noticeable, clearly audible, moderately intrusive and highly intrusive) are used to describe the extent to which noise would be above background levels. Construction noise impacts would be greatest during the OOHW night period when vegetation clearing is being undertaken, when it is anticipated that up to 180 receivers would experience noise levels within the 'noticeable' perception category, up to 51 receivers would experience noise levels within the 'clearly audible' perception category, and up to 12 receivers would experience noise levels within the 'moderately intrusive' perception category. A summary of residential receivers above noise perception categories for each construction activity is provided in Table 6-25 and is illustrated in Figure 6-9 to Figure 6-13. The predictions presented do not include reductions in noise due to the implementation of standard mitigation measures and are therefore conservative.

Table 6-25: Residential receivers above noise perception categories for each construction activity

Perception category[1]	Recommended mitigation[2]	Number of receivers impacted				
		S1	S2	S3	S4	S5
Standard hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Holidays (Nil)						
Noticeable	--	0	12	0	0	0
Clearly audible	--	0	12	0	0	0
Moderately intrusive	N, V	0	0	0	0	0
Highly intrusive	N, V	0	0	0	0	0
OOHW day: Sat (7am – 8am & 1pm – 6pm), Sun/Pub Hol (8am – 6pm)						
Noticeable	--	0	29	10	6	0
Clearly audible	N, R1, DR	0	12	0	0	0
Moderately intrusive	V, N, R1, DR	0	0	0	0	0
Highly intrusive	V, IB, N, R1, DR, PC, SN	0	0	0	0	0
OOHW evening: Mon – Sat (6pm – 10pm)						
Noticeable	--	11	51	26	22	15
Clearly audible	N, R1, DR	0	29	10	6	0
Moderately intrusive	V, N, R1, DR	0	0	0	0	0
Highly intrusive	V, IB, N, R1, DR, PC, SN	0	0	0	0	0
OOHW night: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Holidays (6pm – 7am)						

Perception category[1]	Recommended mitigation[2]	Number of receivers impacted				
		S1	S2	S3	S4	S5
Noticeable	N	22	180	51	54	48
Clearly audible	V, N, R2, DR	11	51	26	22	15
Moderately intrusive	V, IB, N, PC, SN, R2, DR	0	12	0	0	0
Highly intrusive	AA, V, IB, N, PC, SN, R2, DR	0	0	0	0	0

Note 1: Perception = relates to level above RBL. Noticeable (5-10 dBA above RBL, clearly audible (10-20 dBA above RBL), moderately intrusive (20-30 dBA above RBL, highly intrusive > 30 dBA above RBL)

Note 2: AA = Alternative accommodation, R1 = Respite Period 1, V = Validation of predicted noise levels (not required for projects less than 3 weeks), PC = Phone calls, IB = Individual briefings (not required for projects less than 3 weeks), SN = Specific notifications, N = Notification, R2 = Respite Period 2, DR = Duration Respite,

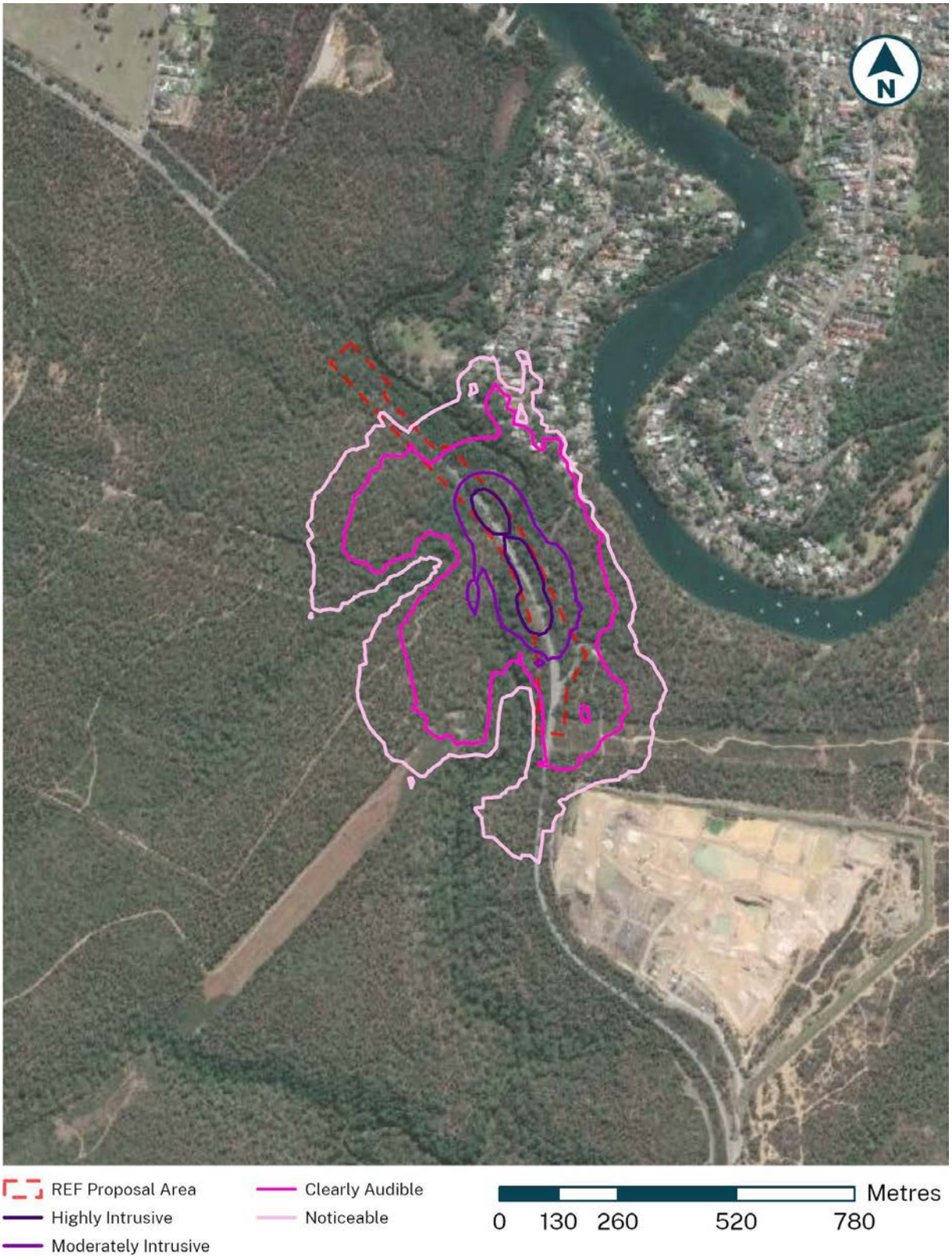


Figure 6-9: Noise perception categories – site establishment (night)

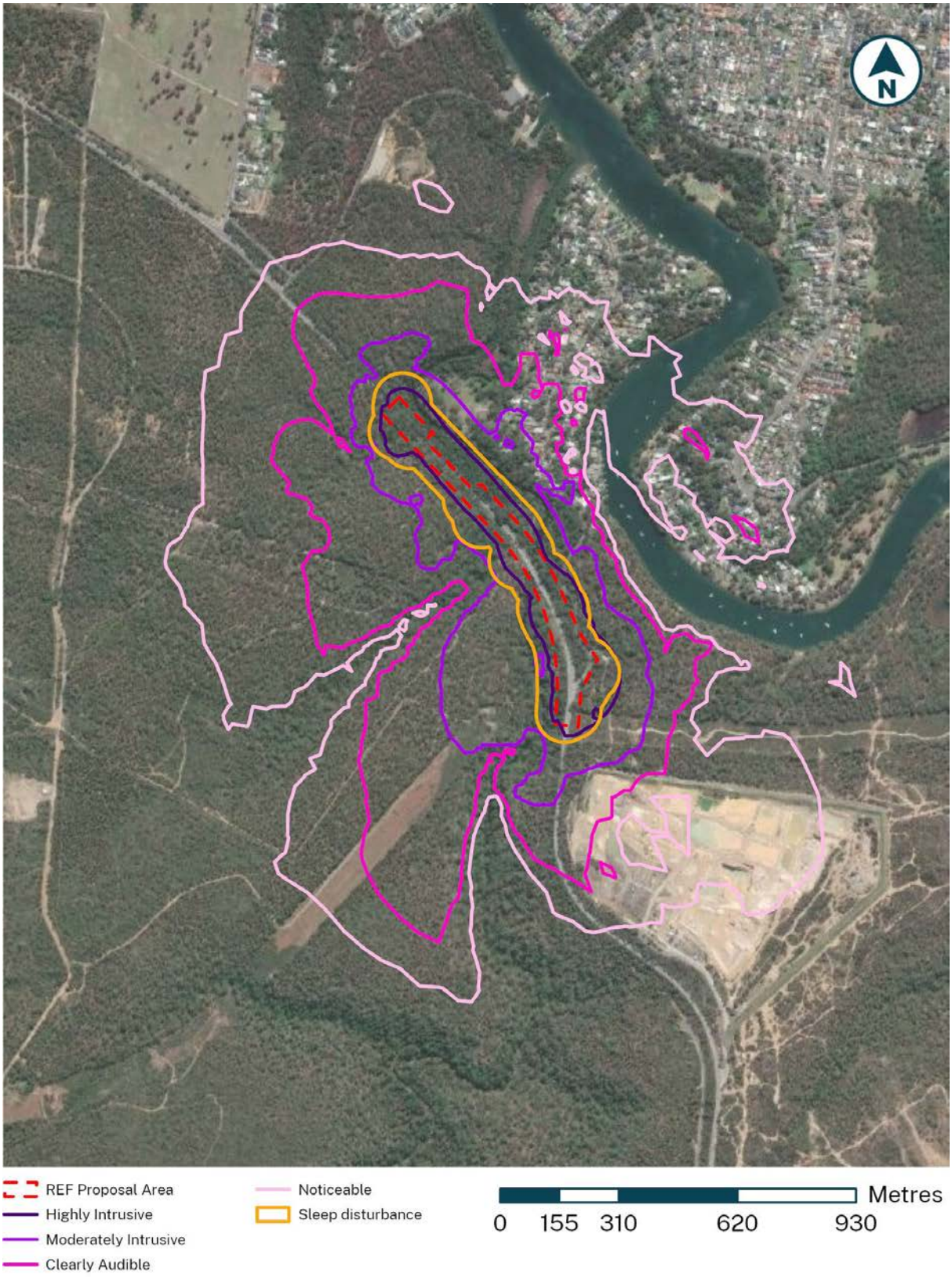


Figure 6-10: Noise perception categories – vegetation clearing (night)

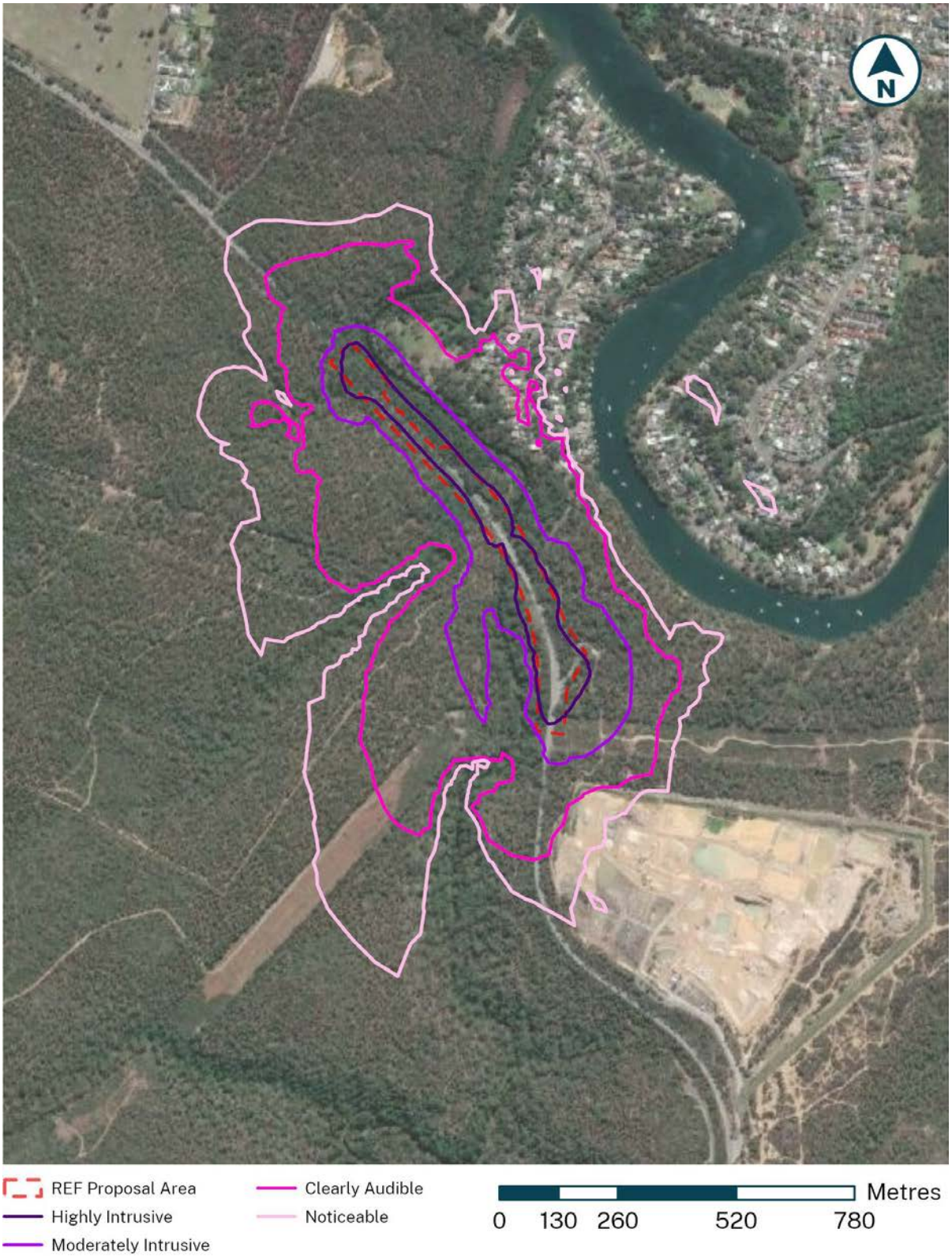


Figure 6-11: Noise perception categories – fencing (night)

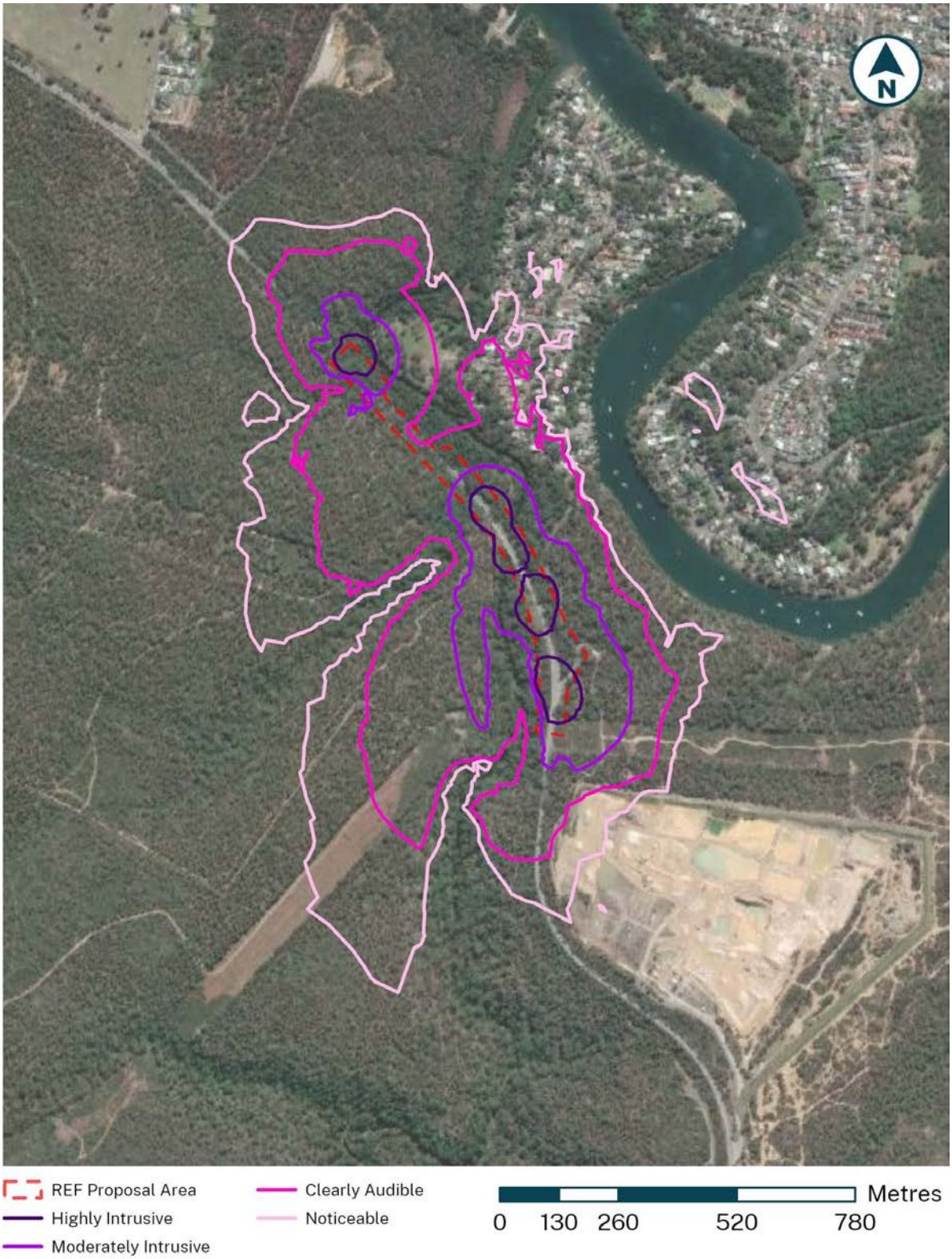


Figure 6-12: Noise perception categories – fauna crossing measures (night)

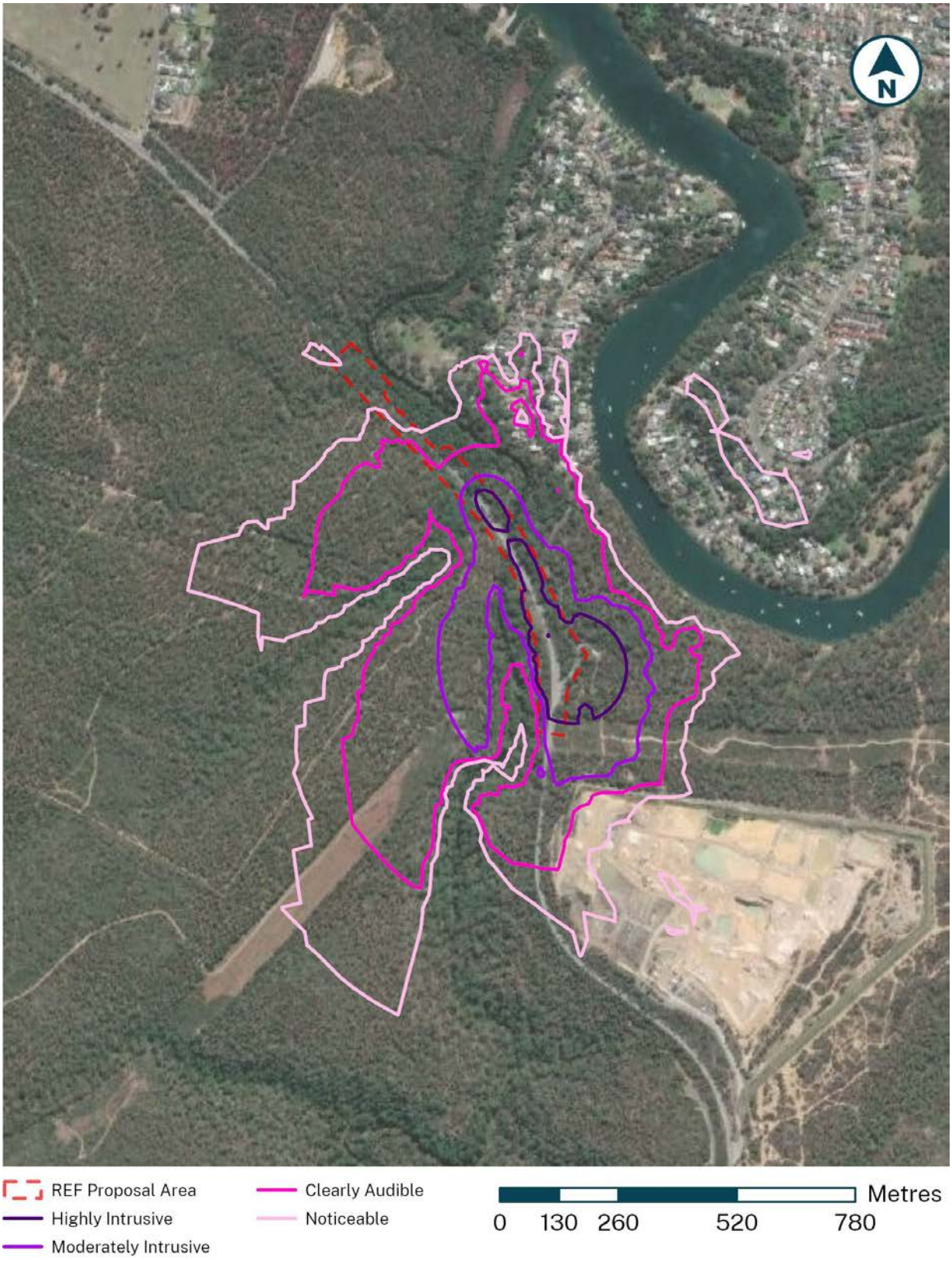


Figure 6-13: Noise perception categories – koala grid (night)

The assessment of construction noise levels for non-residential receivers indicated that exceedance of the relevant NMLs is predicted at Georges River National Park (passive recreation) during installation of the koala grid only. Given that there are no recreational facilities such as marked tracks or picnic areas within Georges River National Park near the REF proposal area, construction noise impacts on national park users are unlikely.

Construction traffic noise levels

Construction traffic would generate noise over a relatively wide area and beyond the REF proposal area. Traffic noise would be greatest where there is a concentration of vehicle movements, such as the main construction area. Due to existing road traffic noise levels in the locality (associated with the 25,000 vehicles per day using Heathcote Road), additional construction related road traffic noise (associated with up to six light vehicle and five heavy vehicle movements per day) would be negligible. Increases in noise levels are anticipated to remain well below the 2dB $L_{Aeq(period)}$ increase criterion.

Construction vibration

A review of construction equipment for the proposal indicates that the installation of the fauna fencing, and ancillary works would not require the use of vibration intensive plant and equipment. As the nearest sensitive receivers are located about 120 metres from the REF proposal area, the no potential for vibration levels to cause human annoyance or cosmetic damage to structures to residential receivers.

Operation

Operation of the proposal would not generate noise, except for traffic travelling across the koala grid on St George Crescent. St George Crescent is a no through road, providing access to about 200 residential properties within the suburb of Sandy Point. The koala grid, similar to a cattle grid with a metal grate spanning both the entire road, would be located about 60–80 metres from the intersection with Heathcote Road, which carries greater than 25,000 vehicles per day (Transport for NSW *Traffic Volume Viewer* – Station Id: 63109, Heathcote Road 80 metres east of Margate Avenue). The nearest residential receivers are located about 420 metres to the northeast of the koala grid, and about 410 metres from the nearest point of Heathcote Road.

The passage of vehicles across the koala grid would be similar to typical traffic calming devices, with noise levels generated by the interactions between the vehicle tires and the koala grid. These interactions would typically occur for a duration of less than five seconds for each vehicle passby event, with maximum noise levels in the order of 109dB L_{Amax} directly at the grid location. This level is consistent with monitoring of koala grid passby events for the Pacific Highway upgrade Woolgoolga to Ballina project (where an 81 L_{Amax} was recorded at 10 metres from the koala grid, which is equivalent to about 109 L_{Amax} when the reduction in noise over distance is considered).

Based on the separation distance to the nearest residential receivers, low existing traffic volumes on St George Crescent, the short duration of noise generation from vehicles passing over the koala grid, and the high existing traffic volumes on Heathcote Road, which are the dominant noise source in the locality, the passage of vehicles across the koala grid would not result in a discernible change to road traffic noise levels at the nearest residential receivers. Similarly, the maximum noise levels from vehicles passing over the koala grid would be significantly lower than the sleep disturbance criterion of 65dB L_{Amax} at the nearest receivers.

6.2.5 Safeguards and management measures

Table 6-26: Noise and vibration safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	Noise and vibration safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • All potential significant noise and vibration generating activities associated with the activity. • Feasible and reasonable mitigation measures to be implemented • Additional mitigation measures required, in accordance with CNVG (Transport for NSW, 2023).	Contractor	Detailed design / Pre-construction	Section 4.6 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Reference
Out of hours work	As part of the CEMP, an out-of-hours work protocol will be developed, which defines all scheduled and planned out-of-hours activities. Very noisy activities should, where practicable, be programmed for normal working hours. If the work cannot be undertaken during the day, it should be completed during the OOHW Evening period.	Contractor	Construction	Section 4.6 of QA G36 Environment Protection
Noise and vibration	All sensitive receivers (e.g. local residents) likely to be affected will be notified prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • the project • the construction period and construction hours • contact information for project management staff • complaint and incident reporting • how to obtain further information.	Contractor	Pre-construction/ construction	Construction Noise and Vibration Guideline (Transport for NSW, 2023)
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures.	Contractor	Construction	Project specific measure

6.3 Landscape character and visual impacts

Potential impacts of the overall proposal on landscape character and visual amenity have been assessed by Heathcote Road: Koala Fencing at Deadmans Creek Landscape Character and Visual Impact Assessment (KI Studio, 2024), provided in Appendix G. This Landscape Character and Visual Impact Assessment (LCVIA) informs both this REF and the separate EIS.

6.3.1 Methodology

The LCVIA was prepared in accordance with the Environmental Impact Assessment Practice Note: Guidelines for Landscape Character and Visual Impact Assessment (EIA-N04) (Transport for NSW, 2023). The principles outlined in Beyond the Pavement: Urban design policy, procedures and principles for roads and waterways projects (Transport for NSW, 2023) have also been considered.

As prescribed by the practice note, the LCVIA differentiates between:

- Landscape character assessment – the overall impact of a proposal on an area's character and sense of place; and
- Visual impact assessment – the proposal's impacts on views.

Landscape character assessment

Landscape character is defined as "the combined quality of built, natural and cultural aspects which make up an area and provide its unique sense of place" (Transport for NSW, 2023). The REF proposal area was divided into several unique Landscape Character Zones (LCZs), with each LCZ having a distinct and consistent character; a combination of landform, hydrology, vegetation, views and vistas, land use patterns, and the scale and form of built structures. The landscape character assessment determined the impact of the proposal on each LCZ of the REF proposal area, as each LCZ would have a variable sensitivity to change (refer to Figure 6-16).

Visual impact assessment

The visual impact of the proposal was assessed by considering the sensitivity of the view and the magnitude of change to the view as a result of the proposal. Four viewpoints were selected, that are representative of locations likely to be visually impacted by the REF proposal, as shown in Figure 6-14.

- Viewpoint 3: From Heathcote Road (north of Deadmans Creek), looking south-east towards the adjacent bushland
- Viewpoint 4: From Heathcote Road (south of Deadmans Creek), looking north towards the adjacent bushland
- Viewpoint 5: From Heathcote Road (south of Deadmans Creek), looking south towards the adjacent bushland
- Viewpoint 6: From the intersection of Heathcote Road and St George Crescent, looking north towards Heathcote Road and adjacent bushland

Viewpoints 1 and 2, shown in Figure 4.1 of the LCVIA in Appendix G, are relevant to the 170-metre extent of fencing being assessed by the separate EIS.

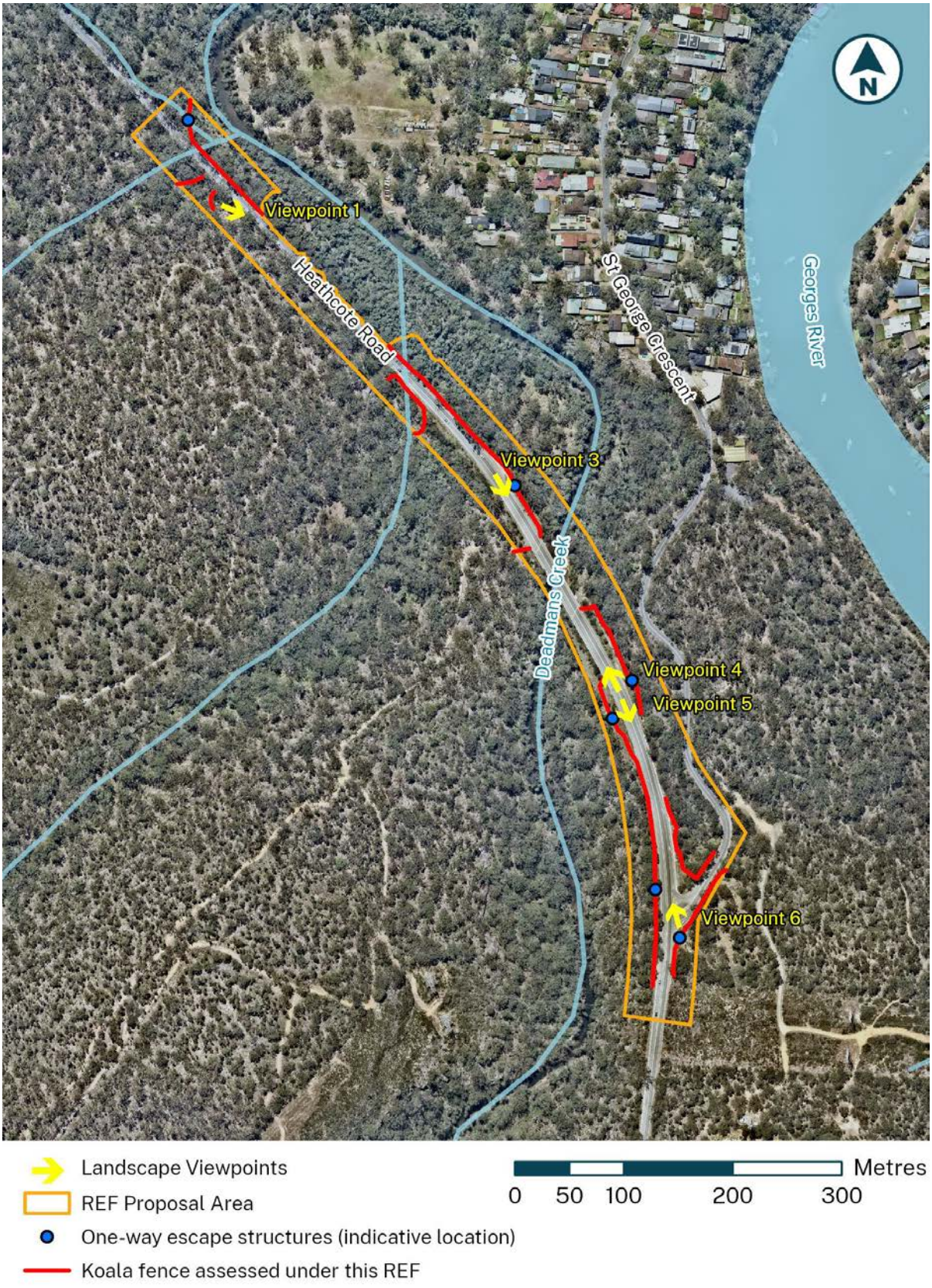


Figure 6-14: Viewpoints assessed by the LCVIA

Landscape character and visual impacts assessment matrix

The landscape character and visual impacts of the proposal were determined by a combination of the sensitivity of the existing area (or view of the area) to change, and the magnitude (scale, contrast, quality, distance) of the proposal on that area or view. Both the landscape character and visual impact assessments used the matrix in Figure 6-15 to evaluate the overall impact.

Sensitivity	Magnitude: High	Magnitude: Moderate	Magnitude: Low	Magnitude: Negligible
High	High	High-Moderate	Moderate	Negligible
Moderate	High-Moderate	Moderate	Moderate-low	Negligible
Low	Moderate	Moderate-low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Figure 6-15: Landscape character and visual impact rating matrix

6.3.2 Existing environment

Landscape context

The proposal is situated in a dense bushland setting, that extends from Heathcote Road to the banks of the Georges River and Georges River National Park in the east and the Holsworthy Barracks military base to the west. Most of the vegetation is classified as Sydney Hinterland Apple-Blackbutt Gully Forest (refer to section 6.1.2 for more detail), with small areas of estuarine swamp and mangroves occurring along Deadmans Creek.

The undulating topography surrounding the REF proposal area is characterised by rock outcrops, surface boulders and cobbles, typical of the underlying Hawkesbury Sandstone geology.

The proposal interfaces with four suburbs: Holsworthy, Pleasure Point, Sandy Point and Menai. The small residential suburb of Sandy Point, with a population of about five hundred people, is only accessible via St George Crescent from Heathcote Road, about 350 metres south of Deadmans Creek.

Heathcote Road within the REF proposal area comprises a single lane in either direction, with a picturesque character and dramatic sandstone cuttings that expose the local sandstone geology of the area.

Landscape character zones

Six LCZs have been identified within and around the REF proposal area, as shown in Figure 6-16. Each landscape character zone is an area of distinct and consistent character, usually a combination of landform, hydrology, vegetation, views and vistas, land use patterns, and the scale and form of built development, including structures. Table 6-27 provides a description of each LCZ within the REF proposal area.

Table 6-27: Description of landscape character zones of the REF proposal area and surrounds

LCZ	Description	Sensitivity	Photographic example
LCZ 1: Sandy Point	A residential zone within the Sutherland Shire, with a mix of well-established endemic and non-endemic vegetation. Predominantly single and double storey detached residences of various architectural styles.	**High**: established residential area with a green outlook and filtered panoramic vistas to areas beyond.	

LCZ	Description	Sensitivity	Photographic example
LCZ 2: Coastal Wetlands	Associated with the low lying areas of Deadmans Creek and minor tributaries of Deadmans Creek. Comprises undisturbed pristine natural environment in the form of waterways, wetlands and rock outcrops. This zone is of high visual quality.	**High:** sensitive environmental area that is highly susceptible to change due to its natural qualities and sensitive ecosystems	
LCZ 3: Holsworthy Barracks	Located west of Heathcote Road, this rugged setting encompasses both low and high grounds in a bushland setting, that comprises a military training facility. Supports stands of mature Eucalypts with a grassed and shrub understorey that provides a strong natural setting.	**Moderate:** the lower rating is driven by the partially modified pristine natural setting with several primary and secondary paths used for military training purposes	
LCZ 4: Low Lying Bushland	A low-lying zone located east of Heathcote Road, between Deadmans Creek and Heathcote Road. Comprises an undisturbed natural environment in the form of dense wetland vegetation, mature trees in a bushland setting.	**High:** sensitive area adjacent to wetlands with high environmental value.	
LCZ 5: Bushland South	Occupying the southern end of the REF proposal area, this zone includes mid slopes set in a rugged landscape. The natural environment is dominated by dense bushland with mature trees and a vegetated understorey and includes sandstone outcrops.	**High:** the pristine environment combined with heritage items, result in a high sensitivity rating.	

LCZ	Description	Sensitivity	Photographic example
LCZ 6: Road Corridor	Heathcote Road and parts of St George Crescent, that comprise roadways framed by a pristine bushland setting	**Moderate**: the scenic quality of the general setting strongly contributes to the identity and sense of place of Heathcote Road in this location. While this zone is experienced from vehicles at speed it has still been given moderate rating.	

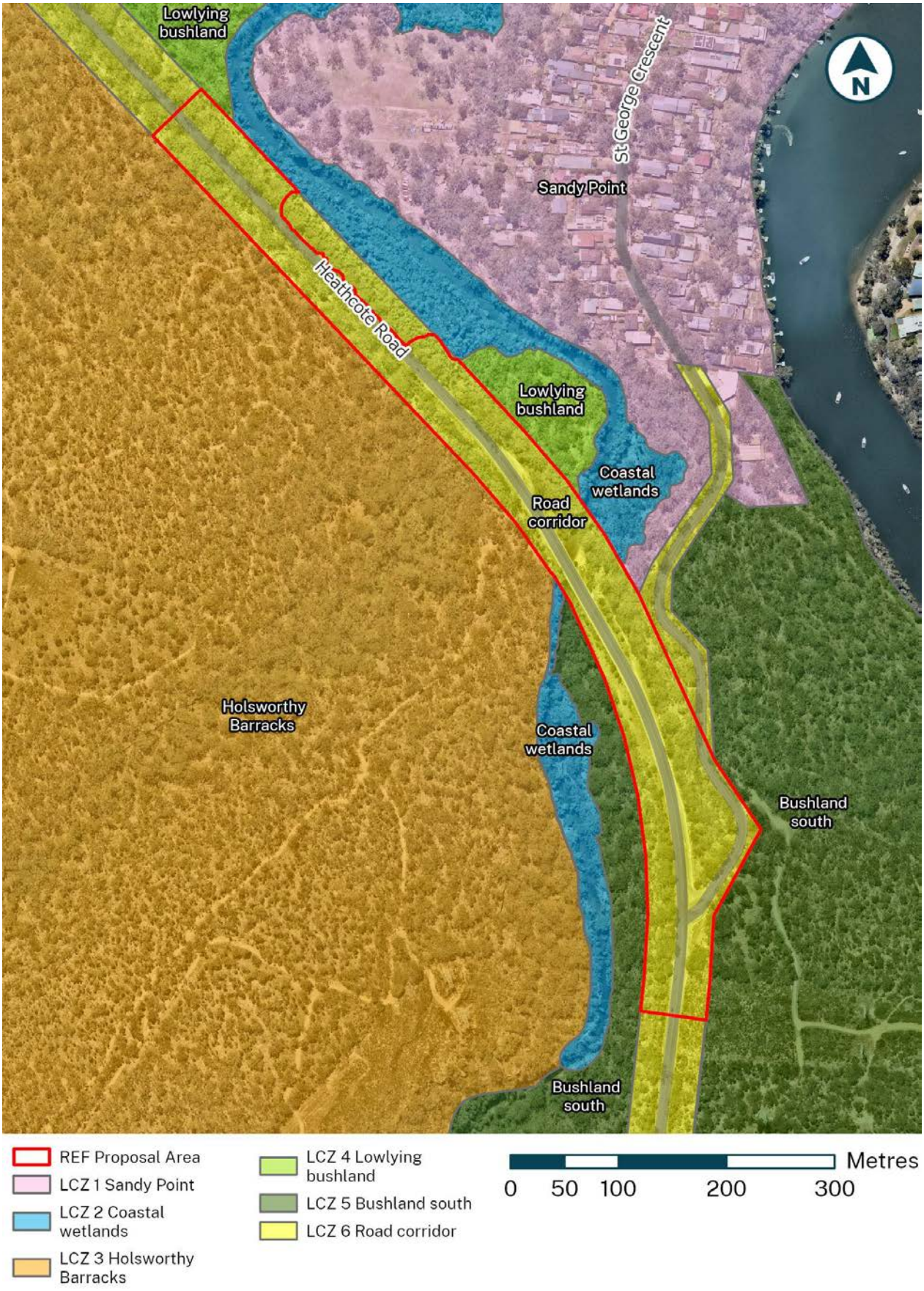


Figure 6-16: Landscape character zones of the REF proposal area and surrounds

Viewpoints

The existing views of the REF proposal area, from the four viewpoints shown in Figure 6-14, are described in Table 6-28.

Table 6-28: Description of viewpoints and their sensitivity

Viewpoint	Description	Sensitivity	Photograph
Viewpoint 1	Rural road set in undisturbed bushland with mature vegetation within a wetland setting.	**Moderate.** The scenic quality of this section of road results in a high sensitivity, yet the transient nature of the viewer (road user) diminishes the sensitivity to an overall moderate rating.	
Viewpoint 3	Rural road set in undisturbed bushland flanked by mature vegetation along both verges	**Moderate.** The scenic quality of this section of road results in a high sensitivity, yet the transient nature of the viewer (road user) diminishes the sensitivity to an overall moderate rating.	
Viewpoint 4	Rural road set in undisturbed bushland surrounded by mature vegetation, rock outcrops and a dense shrub understorey.	**Moderate.** The scenic quality of this section of road results in a high sensitivity, yet the transient nature of the viewer (road user) diminishes the sensitivity to an overall moderate rating.	
Viewpoint 5	Rural road set in undisturbed bushland surrounded by mature vegetation, rock outcrops and a dense shrub understorey.	**Moderate.** The scenic quality of this section of road results in a high sensitivity, yet the transient nature of the viewer (road user) diminishes the sensitivity to an overall moderate rating.	
Viewpoint 6	Rural road set in undisturbed bushland surrounded by mature vegetation, rock outcrops and a dense shrub understorey.	**Moderate.** The scenic quality of this section of road results in a high sensitivity, yet the transient nature of the viewer (road user) diminishes the sensitivity to an overall moderate rating.	

6.3.3 Potential impacts

Construction

The construction phase of the proposal would result in a combination of temporary and permanent visual impacts to the existing landscape, and would include:

- Construction vehicles entering and existing the REF proposal area
- Machinery and equipment moving about the REF proposal area

- Construction security/exclusion fencing surrounding the ancillary facilities
- Signage
- Stockpiling and storage of construction materials
- Vegetation removal (permanent impact).

The construction stage changes would not be seen from any residential receivers but would be visible at a close distance to the high number of Heathcote Road users who would see the works, primarily in their peripheral vision and at moderate speed. Visual clutter associated with construction (such as construction equipment and activity) would be prominent but limited to the construction phase. Areas of ground disturbance would be visible beyond the construction stage but would become less prominent over time. The visibility of vegetation removal would persist over a longer period.

Operation

Permanent changes to the landscape character and permanent visual impacts would occur once the proposal has been constructed. These are described in further detail below.

Landscape character
The proposal has been assessed as having variable impacts on each LCZ. Moderate to high impacts are anticipated for LCZ 2, 3 and 5, which are currently characterised by bushland that would be subjected to vegetation clearing for installation of man-made structures, including the koala fence and fauna escape structures. The impact of the proposal on landscape character, once operational, is summarised in Table 6-29.

Table 6-29: Impacts of the proposal on landscape character

LCZ	Sensitivity	Magnitude of impact	Landscape Character Impact
LCZ 1: Sandy Point	**High**	**Negligible** The proposal would not affect the amenity and sense of place of Sandy Point.	**Negligible.** The proposal would have a negligible amenity and sense of place of Sandy Point.
LCZ 2: Coastal Wetlands	**High**	**Moderate** The proposal would contribute in a positive way to the functioning of this LCZ, supporting safe wildlife movements under Heathcote Road and the protection of fauna within the coastal wetlands. Some vegetative clearing would be required, yet the sense of place, integrity and identity of this zone would not greatly change.	**Moderate to high** The proposal would contribute to the robustness of fauna movements, enhancing the overall vitality of the ecosystem. Minor vegetative clearing would have a limited impact to the overall zone.
LCZ 3: Holsworthy Barracks	**Moderate**	**Low** The proposal would contribute in a positive way to the functioning of this LCZ, supporting safe wildlife movements under Heathcote Road and the protection of fauna within Holsworthy Barracks. The proposal would not impact the adjacent 'Holsworthy Group' local heritage item (refer to section 6.8.2).	**Low to moderate.** The overall sense of place would not dramatically change, yet the proposal would enhance safe fauna movements. This is considered a positive impact of the proposal.

LCZ	Sensitivity	Magnitude of impact	Landscape Character Impact
LCZ 4: Low Lying Bushland	**High**	**Moderate** The introduction of a fauna fence would contribute to the functioning of this ecosystem.	**Moderate to high** The sense of place, identity and functioning of this area would greatly be unchanged, the proposal would improve wildlife movements. Minor vegetative clearing would have a limited impact to the overall zone.
LCZ 5: Bushland South	**High**	**Moderate** The proposal would contribute in a positive way to the functioning of the area, supporting safe wildlife movements and the protection of fauna within this area of bushland . Aboriginal heritage sites near the proposal (refer to section 6.7.2) would remain unchanged.	**Moderate to high** The fauna fence proposal would contribute to the robustness of fauna movements, enhancing the overall vitality of the ecosystem whilst restricting people access to the bushland.
LCZ 6: Road Corridor	**Moderate**	**Moderate** The scale of the proposal in context with the road setting limits the magnitude of impact. Any reductions in vegetation clearing that could be made would mitigate the overall magnitude of change. The Koala grid would be installed within this zone but would have a negligible magnitude.	**Moderate** The proposal would somewhat affect the sense of place and identity for the road user. The fence would introduce a man-made element into the setting, slightly reinforcing its urbanity and create a sense of separation between the bushland and the roadway.

Visual impacts
The proposal would mostly have a low to moderate visual impact, only affecting road users travelling along Heathcote Road and entering St George Crescent. The visual impact has been assessed as moderate to high from Viewpoint 3 only, given the proximity of the fence to the road verge (and passing road users) and absence of screening features between the fence and the road verge.

The proposal is not visible from anywhere outside of the road corridor that is designated for public or private use. The dense native vegetation reduces the visual presence of the fence. The visual impact of the proposal, once operational, is summarised in Table 6-30.

Table 6-30: Visual impacts of the proposal

Viewpoint	Sensitivity	Visible elements of the proposal	Magnitude	Visual impact
Viewpoint 3	Moderate	The koala fence would be clearly visible along the verge of Heathcote Road. Some vegetation clearing would be required and due to the necessary clear zone, the fence would contrast in its setting, making it a prominent man-made element within the viewscape.	**High** The fauna fence would create a visual separation from the bushland setting, visually detracting from the pristine character of the surrounding environment.	**Moderate to high** The visual presence of the proposal would somewhat contrast with the existing setting, detracting from the visual experience of the road user creating a separation between bushland and road.

Viewpoint	Sensitivity	Visible elements of the proposal	Magnitude	Visual impact
Viewpoint 4	Moderate	The koala fence would only be partially visible from Heathcote Road. The extent of fencing (and its exposure to the road) would be reduced by the existing rock cutting acting as a barrier to fauna. Minor vegetation clearing would be required. The ancillary sites would also be visible from this viewpoint.	**Low** With existing rock cutting acting as a barrier to fauna, shorter sections of fence would be visible. Therefore, the magnitude of change is limited. This is further underpinned by the limited vegetation clearing required in this area.	**Low to moderate** The visual presence of the proposal would have a limited contrast and visual presence resulting in a low to moderate impact.
Viewpoint 5	Moderate	The koala fence would only be partially visible from Heathcote Road. The extent of fencing (and its exposure to the road) would be reduced by existing rock cutting acting as a barrier to fauna. Along the western verge of Heathcote Road, the fence would be located within an existing cleared area (which will support ancillary facility #1), limiting the extent of vegetation clearing and setting the fence back from the road.	**Low** With existing rock cutting acting as a barrier to fauna, shorter sections of fence would be visible. Along the western verge of Heathcote Road, the ground slopes away from the road. This, combined with the setback of the fence, would limit its presence. The magnitude of change is therefore low, supported by the limited vegetation clearing required in this area.	**Low to moderate** The visual presence of the proposal would have a limited contrast and visual presence resulting in a low to moderate impact.
Viewpoint 6	Moderate	The koala fence would be clearly visible adjacent to the road and behind the steel safety barrier. Hence, the fence would be partially screened by the safety barrier slightly reducing its prominence. Some vegetation clearing would be required.	**Low** The limited vegetation removal and the backdrop of dense vegetation would limit the visual effect of vegetative clearing. While the fauna fence would introduce a new element within the setting, its limited scale would limit the magnitude of visual effect.	**Low to moderate** Although the fauna fence would detract from the viewscape, the visual impact is considered limited as its contrast and scale in the setting would be modest.

6.3.4 Safeguards and management measures

Table 6-31: Landscape character and visual safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Visual amenity	Construction areas and the ancillary facility will be maintained during construction, kept tidy and well-presented including sorting regular	Contractor	Construction	Project specific control

Impact	Environmental safeguards	Responsibility	Timing	Reference
	removal of excess materials to reduce visual impact.			
Visual amenity	The ancillary facility and construction areas (outside of the REF proposal area) will be progressively restored to at least its pre-construction condition.	Contractor	Construction, post-construction	Project specific control
Koala fence design	The koala fence will be a black PVC coated chain-link fence with black pre-painted galvanised sheeting.	Transport	Prior to construction (procurement)	Project specific control

6.4 Traffic and transport

6.4.1 Methodology

A desktop review of the impacts of the proposal on traffic and transport was carried out by accessing the following sources:

- Google Maps and Streetview (accessed 3 June 2024)
- Transport for NSW Traffic Volume Viewer (accessed 3 June 2024)
- Transport for NSW Cycleway Finder (accessed 3 June 2024)

6.4.2 Existing environment

Road network

The REF proposal area encompasses a 980 metre section of Heathcote Road and its intersection with St George Crecent. This intersection is does not have traffic lights but provides for all movements into and out of St George Crescent.

Heathcote Road is classified as a State Road, which connects south-west Sydney with the Princes Highway and the Illawarra area. The road is an undivided road with one lane each direction and a posted speed limit of 80 kilometres per hour. St George Crescent is also an undivided road with one lane each direction and provides the only vehicular access to Sandy Point. It has a posted speed limit of 50 kilometres per hour.

Traffic volumes

The nearest traffic volume classifier to the REF proposal area is located about 80 metres east of Margate Avenue at Holsworthy, about three kilometres north of the proposal (Station I.D 63109). The most recent traffic count for this volume classifier was in 2009, when it counted a daily average of 12,716 vehicles heading northbound and 12,419 vehicles heading southbound on Heathcote Road.

Public and active transport

The 902X bus route travels along Heathcote Road, connecting Sandy Point and Voyager Point with Holsworthy. The bus route operates seven services per day, on weekdays. School bus services also use this section of Heathcote Road. There are no bus stops within the REF proposal area.

There is no pedestrian path or cycle lane along Heathcote Road or St George Crescent within the REF proposal area.

There is no train line or train station within or near the REF proposal area. Holsworthy Station is about three kilometres to the north-east.

Parking and access

There is no provision for parking along Heathcote Road or St George Crescent within the REF proposal area. There are no property accesses within the REF proposal area, given that adjoining land uses are not publicly accessible areas.

6.4.3 Potential impacts

Construction

Construction of the proposal is anticipated to generate between three and six light vehicle movements and up to five heavy vehicle movements to and from the REF proposal area each day, although heavy vehicle movements would be sporadic. The number of vehicle movements associated with construction of the proposal would be within the range of daily variations in existing traffic volumes on the road network. The overall impact of construction traffic on road network performance is therefore anticipated to be minor.

Travel times along Heathcote Road and St George Crescent may be temporarily increased during construction, due to a reduction in the existing speed limit of 80 kilometres per hour to 40 kilometres per hour, where construction activities occur near the road verge.

Partial road closures on Heathcote Road and St George Crescent would be required for some construction activities. These closures are expected to be carried out at night to minimise disruption to traffic. Access along St George Crescent to Sandy Point would be maintained.

Construction workforce parking would primarily be accommodated by the ancillary facilities.

Operation

Operation of the proposal would not adversely impact existing traffic volumes, travel times or road network performance of Heathcote Road or St George Crescent. The proposal would likely improve road user safety and traffic conditions of Heathcote Road, as the installation of koala fencing would aim to prevent future vehicle strikes within the proposal area.

6.4.4 Safeguards and management measures

Table 6-32: Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	Where possible, current traffic movements and property accesses will be maintained during the works. Any disturbance will be minimised to prevent unnecessary traffic delays.	Contractor	Detailed design / Pre-construction	Section 4.8 of QA *G36 Environment Protection*
Traffic and transport	A traffic guidance scheme will be prepared in accordance with Transport Traffic control at work sites manual (version 6.1, 2022) and Australian Standard 1742.3 Manual of uniform control devices.	Contractor	Pre-construction	Project specific control

6.5 Water, Hydrology and flooding

6.5.1 Methodology

A desktop review of the impacts of the proposal on water was carried out by accessing the following sources:

- Aerial imagery from Nearmap (accessed 3 June 2024)
- Watercourse data from the NSW Digital Topographic Database
- Data for Holsworthy Aerodrome meteorological station from the Bureau of Meteorology (accessed 3 June 2024)
- Liverpool Flood Planning Map
- Sutherland Shire Flood Planning Map
- Australian Groundwater Explorer database from the Bureau of Meteorology (accessed 3 June 2024)

- Replacement of the bridge over Deadmans Creek along Heathcote Road, Sandy Point: Review of Environmental Factors (Transport for NSW, 2013)

6.5.2 Existing environment

Surface water

The REF proposal area is located adjacent to and crosses Deadman's Creek, a third-order stream which drains in a northerly direction from its headwaters approximately 10 kilometres south of the REF proposal area, to its confluence with the Georges River, about one kilometre north of Deadmans Creek bridge. The Georges River flows through south-west Sydney before draining to Botany Bay and ultimately the Pacific Ocean. Deadmans Creek is tidally influenced within the REF proposal area, with low tides ranging from about 0.2-0.6 metres and high tide ranging from about 1.5-1.7 metres (Willy Weather, 2024).

Waterfront land includes the bed and bank of any river, lake or estuary and all land within a certain distance of the highest bank of the river, lake or estuary. For a third order stream such as Deadmans Creek, the vegetated riparian zone extends 30 metres from the highest bank on both side of the creek.

About 200 metres north of Deadmans Creek bridge is a twin-cell 950 mm diameter concrete pipe culvert under Heathcote Road. This culvert usually contains water, as it conveys a tributary to Deadmans Creek which is tidally influenced and forms part of the coastal wetland located to the east of Heathcote Road.

About 470 metres north of Deadmans Creek bridge is a reinforced single-cell 1500 mm diameter concrete pipe culvert under Heathcote Road. It conveys an ephemeral tributary to Deadmans Creek and its higher elevation means it is often dry.

Surface water features of the REF proposal area and surrounds are shown in Figure 6-17.

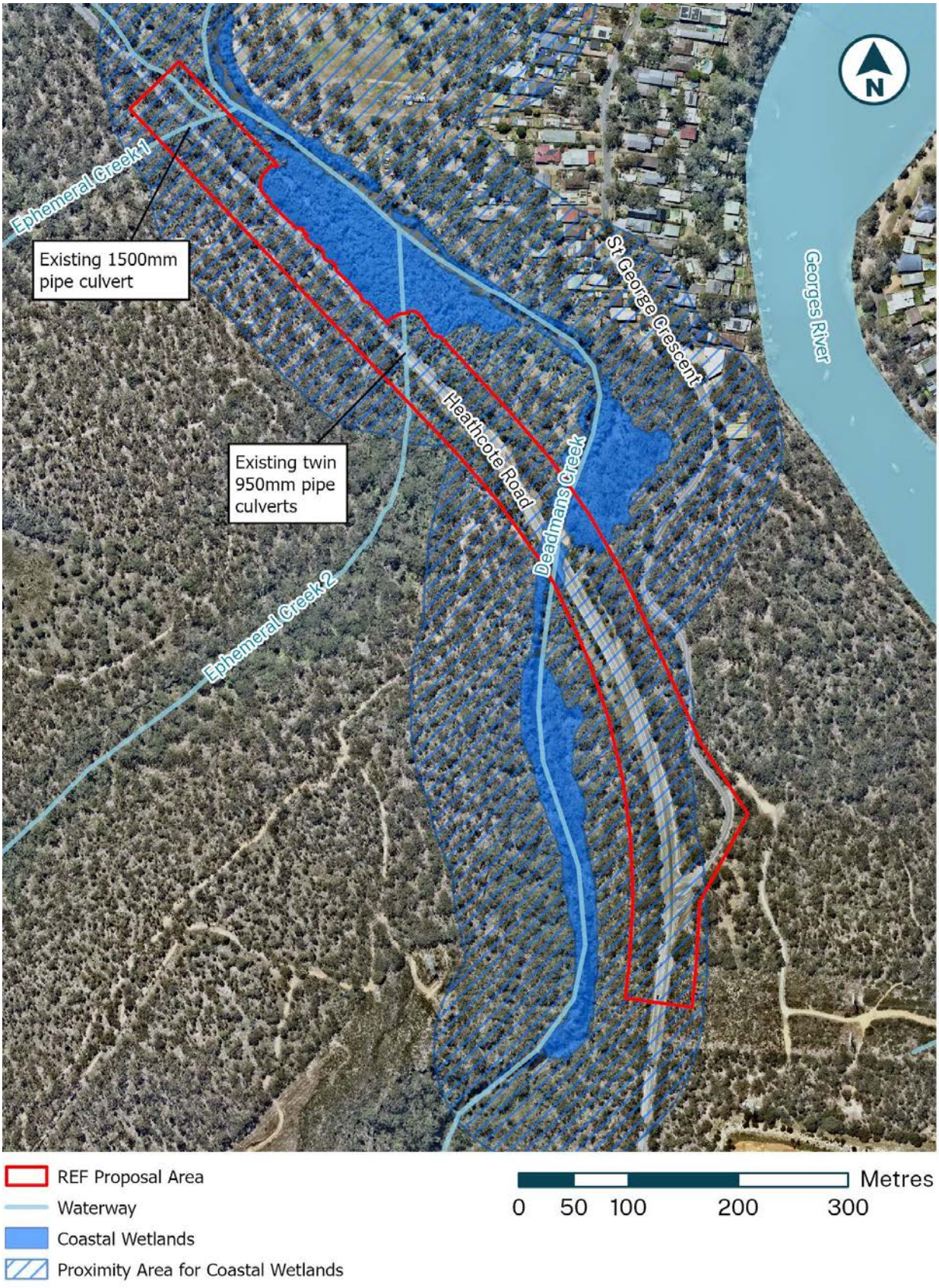


Figure 6-17: Surface water features of the REF proposal area

Water quality

The water quality of Deadmans Creek was measured in 2013 to inform the Review of Environmental Factors for the replacement of Deadmans Creek bridge (Transport for NSW, 2013). It was determined that pH, dissolved oxygen and alkalinity values were all within the range recommended by Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines (Australian and New Zealand Environment and Conservation Council, 2000). The conductivity values obtained were typical for brackish water and reflect the tidal influence of the creek, while turbidity values were also within the acceptable range recommended by the ANZECC Guidelines. Heavy metals and metalloids, including vanadium, lead, antimony, cadmium, arsenic, manganese, barium, strontium, uranium, thorium, zinc, copper, nickel and chromium levels were below the screening levels adopted from the ANZECC Guidelines.

These results indicate minimal anthropogenic impacts on the water quality of Deadmans Creek, which is to be expected as upstream of Heathcote Road (i.e. west of Heathcote Road), Deadmans Creek flows through relatively undisturbed bushland contained within Holsworthy Barracks. While water quality has not been measured at Deadmans Creek to inform this REF, there has been no development or land use changes along the upstream reaches of Deadmans Creek that would otherwise adversely influence water quality in Deadmans Creek.

There is no formal drainage infrastructure to capture stormwater from Heathcote Road. As a result, stormwater runoff from Heathcote Road discharges from the road pavement into the adjacent bushland, and may ultimately reach Deadmans Creek and its two tributaries. Stormwater may carry common road runoff pollutants include gross pollutants and litter, sediment and suspended solids, toxic organics, nutrients, heavy metals and hydrocarbons.

Flooding

Part of the REF proposal area, predominantly north of Deadmans Creek bridge, is mapped as having a high flood risk on the SES Georges River Flood Extent map (NSW State Emergency Service, 2024). The Probable Maximum Flood (PMF) level is shown in Figure 6-18 which indicates the highest possible flood that could occur on the Georges River. Smaller floods on the Georges River would occur more frequently. Flood behaviour on the Georges River is strongly influenced by the local topography, with the lower reaches of the river (i.e. downstream from East Hills) confined to a narrow gorge which constricts flows and prevents water from dispersing quickly. The only outlet for floodwater on the Georges River is through Botany Bay (SES, 2024).

The flood investigation carried out for the replacement of Deadmans Creek (Lyall and Associates, 2013) identified the following flood conditions within and near the REF proposal area:

- Peak 20 Average Recurrence Interval (ARI) Georges River flood levels along Deadmans Creek of RL 3.1 m AHD
- Peak 100 ARI Georges River flood levels along Deadmans Creek of RL 3.9 m AHD
- The twin concrete pipe culverts about 200 metres north of Deadmans Creek can convey flows generated by local catchment storms with ARIs up to about five years without overtopping Heathcote Road
- The sag which is present in Heathcote Road adjacent to the REF proposal area would be inundated to a maximum depth of about 300 mm during a 100 year ARI local catchment storm event.

Water levels in Deadmans Creek in the REF proposal area are also influenced by backwater flooding from the Georges River and local catchment flooding, following heavy rain across the Deadmans Creek catchment upstream of Heathcote Road.

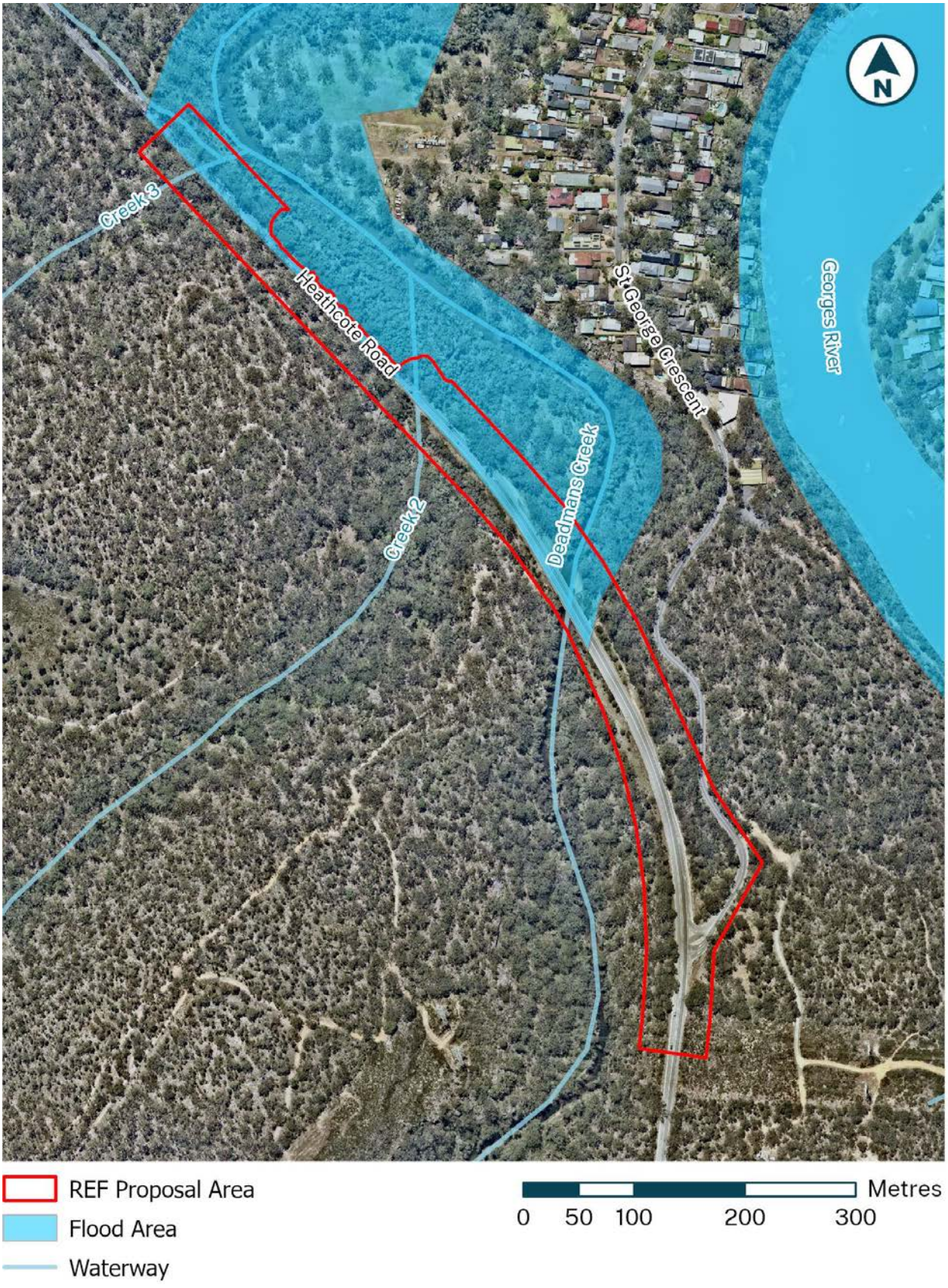


Figure 6-18: Flood mapping of the Georges River showing highest riverine flood risk (SES, 2024)

Groundwater

During the geotechnical investigations undertaken for the replacement of Deadmans Creek bridge (SMEC, 2012), groundwater was encountered at depths ranging from 0.4 metres on the southern side of Deadmans Creek) to 2.7 metres (to the north of the Deadmans Creek) below ground level. Groundwater flows downhill from both the north and south towards Deadmans Creek.

There are no groundwater bores located within the REF proposal area (Bureau of Meteorology, 2024).

6.5.3 Potential impacts

Construction

Impacts on surface water

Construction of the proposal is anticipated to have negligible impacts on the direction and velocity of existing surface water flows, including stormwater runoff from Heathcote Road.

Impacts on water quality

Construction of the proposal may have adverse impacts on water quality if construction activities are not appropriately managed. Construction activities that have potential for temporary impacts on surface water include:

- Vegetation clearing and localised earthworks (site leveling for fencing) may increase the risk of erosion and sedimentation resulting in the mobilisation of soils into stormwater runoff and nearby watercourses (including Deadmans Creek)
- Potential change in pH affecting water quality of nearby watercourses and the coastal wetland, as a result of concrete dust or concrete slurry mix used for installation of the koala fence posts and koala refuge poles alongside Deadmans Creek
- Potential for contaminants being transported to nearby watercourses and the coastal wetland as a result of accidental spills or leaks from construction plant and equipment machinery, or from vehicle/truck incidents travelling to and from the REF proposal area.

Deadmans Creek would be most susceptible to potential impacts on water quality during installation of the koala refuge poles and ground treatments, due to the proximity of these construction activities to the creek. Safeguards have been proposed to ensure adequate erosion and sediment control measures are in place and the risk of water pollution is adequately managed.

Following completion of construction, ground layer and small shrub species would be permitted to naturally regenerate the disturbance footprint (that was cleared of vegetation for the installation of the koala fence). This would contribute to the stabilisation of soils and reduction of erosion and sedimentation from disturbed soils.

The proposal is located within the Georges River Catchment (as defined by SEPP (Resilience and Hazards)) and therefore the water quality provisions of this SEPP apply to the proposal. An assessment of the impacts of the proposal on the Georges River Catchment is included in Appendix C. It concluded that the proposal would not have any impacts on water quality in the Georges River Catchment.

Impacts on groundwater

The installation of koala refuge poles on the southern bank of Deadmans Creek, which are set about one metre deep in a concrete footing, may intercept groundwater, which may be as shallow as 0.4 metres below ground level. Groundwater inflows into the koala refuge pole footing holes would likely be small, given the diameter of the koala refuge poles. In addition, the limited extent, small volume and short duration of dewatering would be at a very localised scale in a groundwater system that operates and recharges regionally. A dewatering procedure would be implemented for the management of infiltrated groundwater during construction.

Impacts on flooding

Construction activities within the REF proposal area and ancillary facilities are not anticipated to affect flood behaviour. No construction activities would temporarily or permanently obstruct Deadmans Creek. There would be no change in the capacity or velocity of flows in Deadmans Creek as a result of the proposal.

A significant flood event during construction could impact the proposal, ancillary site and/or cause damage to construction plant and equipment.

Operation

Impacts on surface water flows

The proposal includes the installation of 1,153 metres of koala fencing, a koala grid, refuge poles and access pipes in the existing defence fencing. The existing surface water flow patterns would be maintained, as these structures would not modify existing surface flow volumes or velocity.

Impacts on water quality

The proposal would not alter the existing influences on water quality in the REF proposal area and would not introduce new influences that may degrade water quality. Operation of the proposal is therefore not anticipated to affect water quality in Deadmans Creek, its two tributaries that flow through the REF proposal area or the coastal wetland located on the eastern side of Heathcote Road.

Impacts on groundwater

Operation of the proposal would not have further impacts on groundwater, as there would be no ongoing groundwater drawdown.

Impacts on flooding

Operation of the proposal would not affect flood behaviour. The proposal would not modify or obstruct Deadmans Creek. There would be no change in the capacity or velocity of flows of Deadmans Creek as a result of the proposal.

6.5.4 Safeguards and management measures

Table 6-33: Hydrology safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	A site-specific Erosion and Sediment Control Plan will be prepared and implemented as part of the CEMP. The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / pre-construction	Section 2.2 of QA G38 Soil and Water Management
Groundwater	A dewatering procedure will be prepared and implemented as part of the CEMP, for the management of infiltrated groundwater during construction.	Contractor	Construction	Project specific control
Sediment run-off	The extent of ground disturbance and exposed soil will be minimised to the greatest extent practicable to minimise the potential for erosion.	Contractor	Construction	Section 2.2 of QA G38 Soil and Water Management
Flooding	A flood management procedure will be prepared to detail procedures to be implemented where extreme weather is predicted and where there is a risk of flooding affecting the work site and compound, including removal and storage of plant and equipment and securing of site.	Contractor	Construction	Project specific control

6.6 Soils, topography and contamination

6.6.1 Methodology

Potential impacts of the proposal on soils, geology and topography were identified by completing a desktop review of the following sources:

- eSpade Spatial Viewer (accessed 13 June 2024)
- Soil Landscapes of the Penrith 1:100,000 Sheet (Bannerman, 2010)
- Penrith 1:100,000 Geological Map (Clark, 1991)
- Contaminated land record (EPA, 2024) (accessed 27 June 2024)
- List of notified and regulated contaminated land (EPA, 2024) (accessed 27 June 2024)

6.6.2 Existing environment

Topography

The REF proposal area is generally located within an area of undulating topography (refer to Figure 6-19). The REF proposal area slopes down from an elevation of about 26 metres Above Sea Level (ASL) at its northern boundary, to Deadmans Creek which is between 0-2m ASL. The REF proposal area then rises towards its southern boundary at about 38m ASL. Much of the REF proposal area between Heathcote Road and Deadmans Creek is low-lying land below 4m ASL that is tidally inundated,

Geology

A review of the Penrith 1:100,000 Geological Map indicates that geology in the REF proposal area includes:

- Land around Deadmans Creek: Muddy sand and sandy mud
- Other land in the REF proposal area: Medium to very coarse grained quartz sandstone, minor laminated mudstone and siltstone lenses.

Soils

Three soil landscapes are mapped in the REF proposal area; Richmond, Hawkesbury and Gymea (Bannerman, 2010), as shown in Figure 6-19.

The Hawkesbury soil landscape is a colluvial landscape which occurs extensively throughout the Hornsby Plateau, Blue Mountains Plateau and Woronora Plateau in the south east. The dominant soil materials include loose, coarse quartz sand; earthy yellowish brown sandy clay loam; and pale strongly pedal light clay. Its limitations include steep slopes, mass movement hazard, rockfall hazard, water erosion hazard, shallow soils, rock outcrop, non-cohesive soils (localised), stony, highly permeable soils of low fertility. The topsoil in this landscape has low erodibility and consists of highly permeable, loose, coarse sands and organic matter. Topsoil is however highly susceptible to concentrated flow erosion, especially when the organic matter is removed by hot bushfires. Subsoils have moderate erodibility.

The Gymea soil landscape is an erosional landscape which occurs extensively throughout the Blue Mountains Plateau and the Woronora Plateau. The dominant soil materials include loose, coarse sandy loam; earthy yellowish brown clayey sand; earthy yellowish sandy clay; and strongly pedal, yellowish brown clay. Its limitations include steep slopes, water erosion hazard, rock outcrop, localised rockfall hazard, localised non-cohesive soils, shallow highly permeable soil, very low soil fertility. Topsoils have very low erodibilities as they are freely drained and are held together by high organic matter, while subsoils can have moderate to high erodibility.

The Richmond soil landscape is an alluvial landscape which occurs around the Hawkesbury, Nepean and Georges Rivers. The dominant soil materials include loose reddish brown loamy sand, loose reddish brown loamy sand, Brown mottled light day, and brown mottled stiff medium-heavy clay. Limitations include localised flood hazard, localised seasonal waterlogging, localised water erosion hazard on terrace edges. Topsoils are moderately erodible, while subsoils have very high erodibility due to very low organic matter and a high fine sand and silt content.

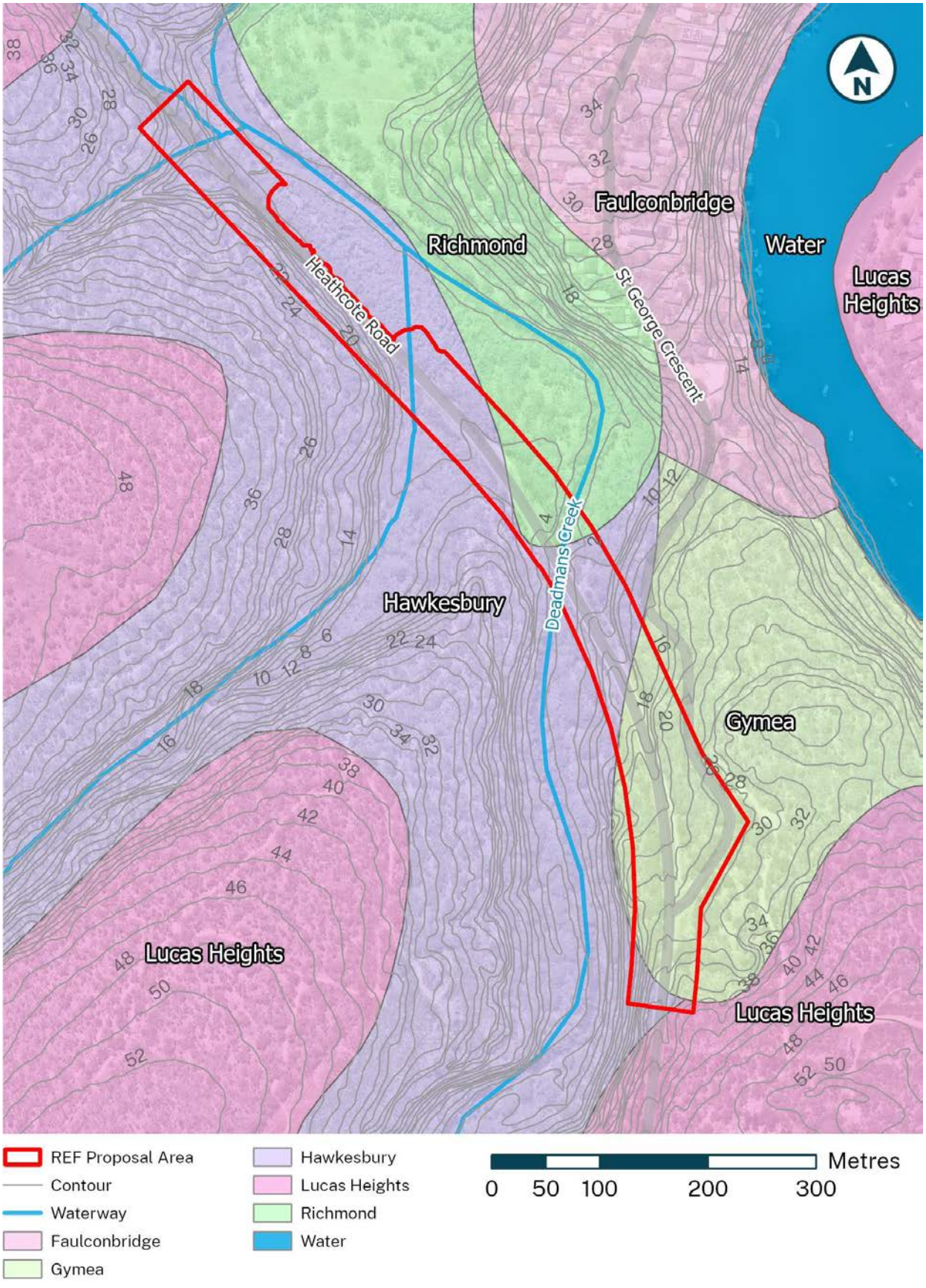


Figure 6-19: Soils and topography of the REF proposal area

Acid sulfate soil

Acid sulfate soil probability mapping on the eSpade Spatial Viewer (searched 27 June 2024) indicates that the area around the crossing of Heathcote Road over Deadmans Creek has a high probability of acid sulfate soils 1-3 metres below the ground level.

The ePlanning Spatial Viewer (searched 27 June 2024) shows the LEP mapping for acid sulfate soils, which as classified into five different classes based on the likelihood of the acid sulfate soils being present in particular areas and at certain depths (Department of Planning, Housing and Infrastructure, 2018). The area around Deadmans Creek under the Liverpool LEP is classed as 'Class 4' acid sulfate soils, whereas the area around Deadmans Creek under the Sutherland Shire LEP is classed as 'Class 3' acid sulfate soils. A 500 metre buffer zone which is classed as 'Class 5' acid sulfate soils is located around the Class 3 and 4 acid sulfate soils (refer to Figure 6-20). The definition of each class identified in the REF proposal area are as follows:

- Class 3: Acid sulfate soils in a class 3 area are likely to be found beyond 1 metre below the natural ground surface.
- Class 4: Acid sulfate soils in a class 4 area are likely to be found beyond 2 metres below the natural ground surface.
- Class 5: Acid sulfate soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres on adjacent class 1,2,3 or 4 land.

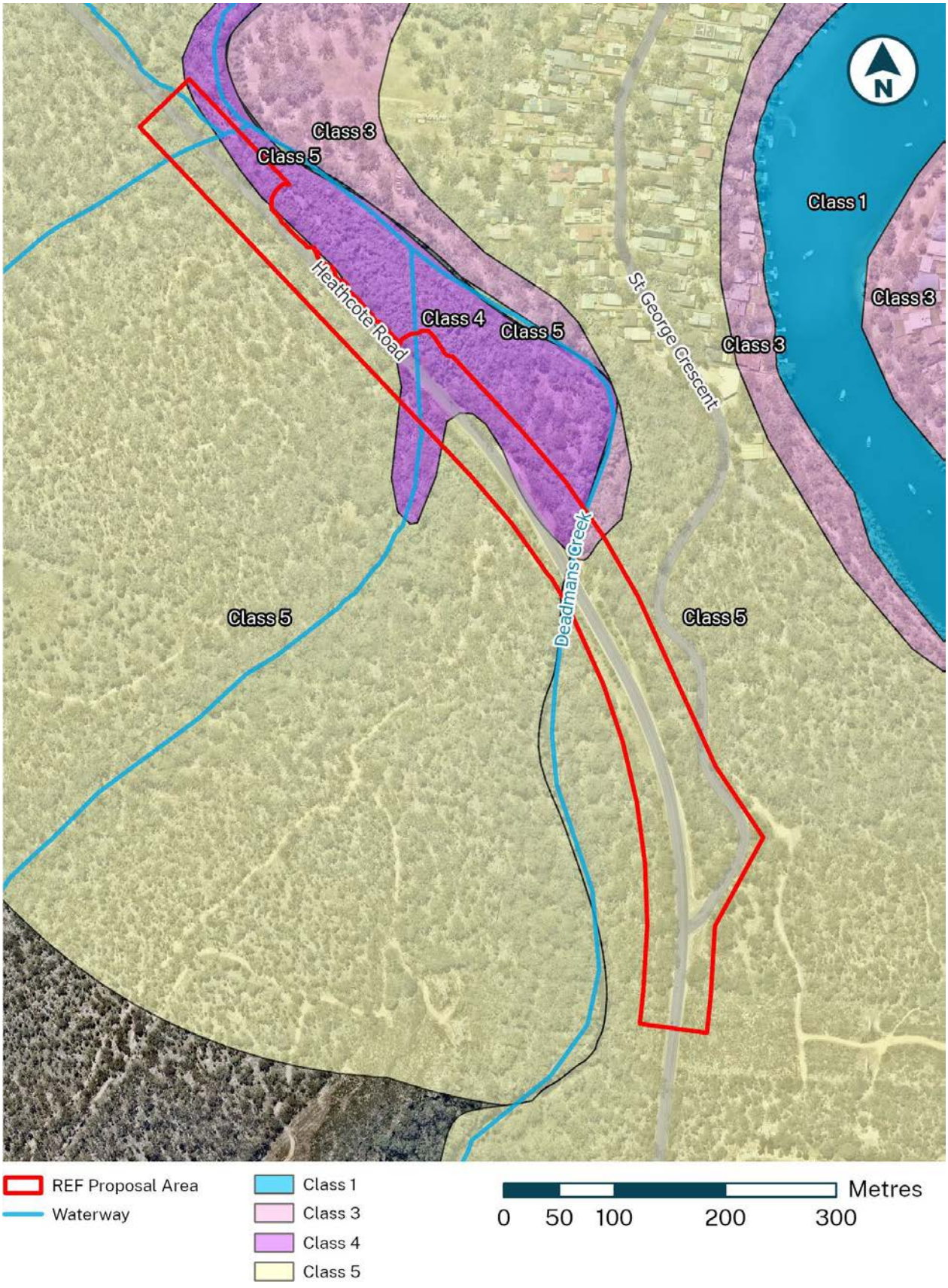


Figure 6-20: Acid sulfate soil classifications of the REF proposal area and surrounds

Contamination

A search of the NSW EPA's contaminated land record of notices was carried out for the Liverpool and Sutherland LGAs on 27 June 2024. The search did not identify any sites of contamination within or near the REF proposal area (NSW Environmental Protection Authority, 2024). A similar search of the list of contaminated sites reported to the EPA (as at 8 August 2024 for the suburbs of Sandy Point and Pleasure Point), also did not identify any records near the REF proposal area.

Soil Salinity

Salinity mapping sourced from the eSpade Spatial viewer on 27 June 2024 indicates that the area around the crossing of Heathcote Road over Deadmans Creek has a moderate probability of salinity, while the rest of the site has a low probability of salinity (refer to Figure 6-21).

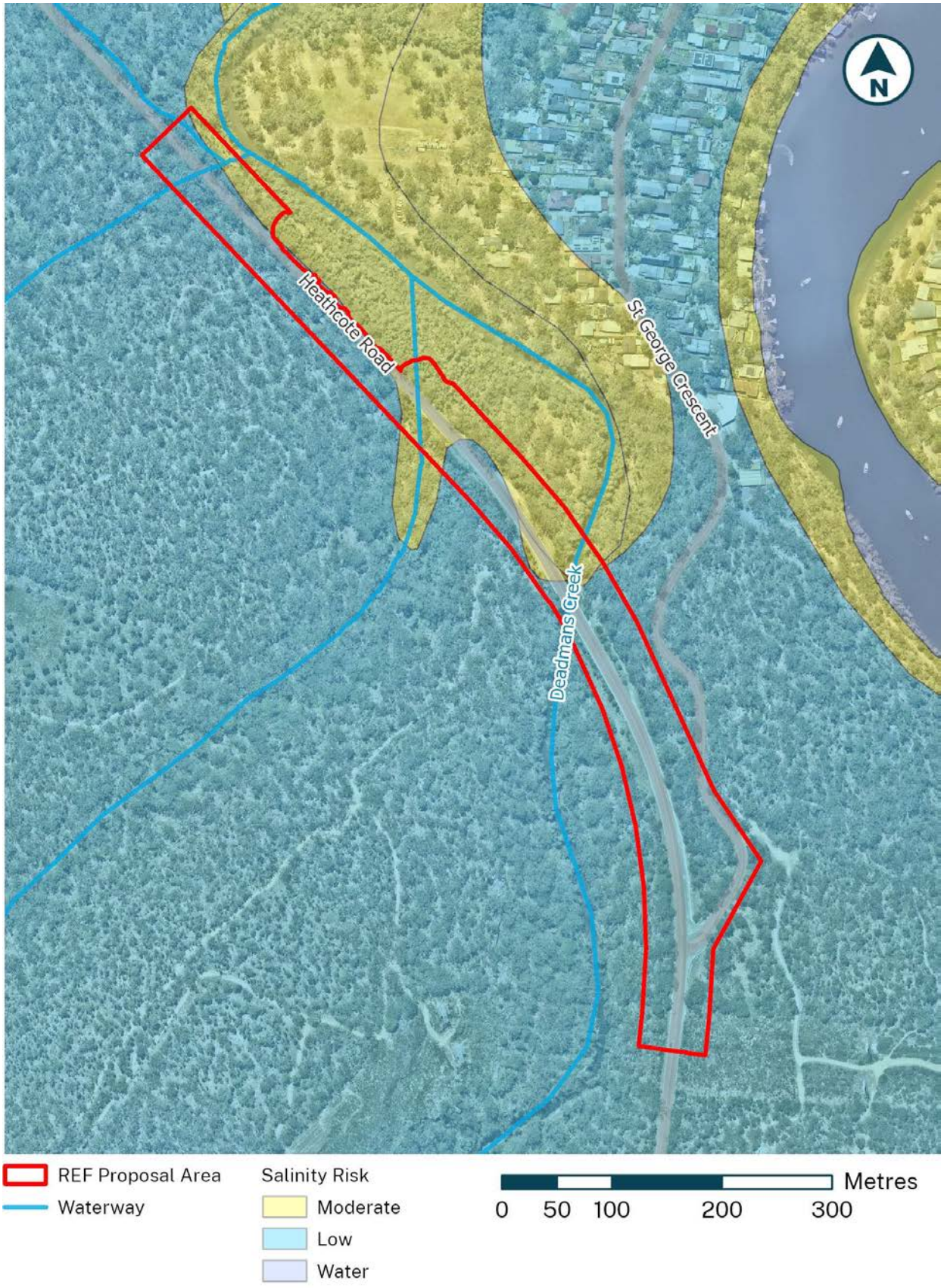


Figure 6-21: Soil salinity risk of the REF proposal area and surrounds

6.6.3 Potential impacts

Construction

Soil erosion
Potential impacts on soil from construction activities would be primarily associated with minor earthworks and potential sedimentation of surrounding land and waterways, including Deadmans Creek. Construction activities with the potential to expose soils and lead to erosion and sedimentation include vegetation clearing, localised site levelling for the installation of the fauna fence, and augering for koala fence posts and koala refuge pole installation. With the implementation of erosion and sediment control and other mitigation measures, the risks to degradation of surface water quality during construction would be low.

Following completion of construction, ground layer and small shrub species would be permitted to naturally regenerate the disturbance footprint (that was cleared of vegetation for the installation of the koala fence). This would contribute to the stabilisation of soils and reduction of erosion and sedimentation from disturbed soils.

Saline soils
Minor earthworks during construction of the proposal (mainly related to auguring for koala fence posts) if not managed appropriately, may cause salinity impacts where there is disturbance of saline soils. Any potential salinity impacts would be managed in accordance with Book 4 Dryland Salinity: Productive Use of Saline Land and Water (NSW DECC, 2008).

Acid sulfate soils
Potential acid sulfate soils may be intercepted during installation of fence posts and koala refuge poles (near Deadmans Creek), which require footings up to one metre deep.

An acid sulfate soil management plan would be prepared if construction of the proposal was to trigger the criteria (relating to the net acidity of any soil material tested in the REF proposal area) prescribed by Table 1.1 of National Acid Sulfate Soils Identification and Laboratory Methods Manual (Sullivan, L, Ward, N, Toppler, N and Lancaster, G, 2018).

Contamination
During construction, there would be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials. Given that large volumes of fuels, chemicals and other potentially hazardous materials are unlikely to be needed to be stored within the ancillary sites, the potential for accidental spills is limited.

Operation

After completion of construction, any disturbed areas would be stabilised. Operation of the proposal would not have any ongoing impacts on soils or contamination.

6.6.4 Safeguards and management measures

Table 6-34: Soils safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Impacts on soils	The site-specific Erosion and Sediment Control Plan to be prepared and implemented as part of the CEMP will include measures to manage saline soils	Contractor	Detailed design / pre-construction	Section 2.2 of QA G38 Soil and Water Management
Impacts on acid sulfate soils	An acid sulfate soil management plan would be required to be prepared if construction of the proposal was to trigger the criteria (relating to the net acidity of any soil material tested in the REF proposal area) prescribed by Table 1.1 of National Acid Sulfate Soils Identification and	Contractor	Pre-construction/ construction	National Acid Sulfate Soils Identification and Laboratory Methods Manual (Sullivan, L, Ward, N, Toppler, N and Lancaster, G, 2018).

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Laboratory Methods Manual (Sullivan, L, Ward, N, Toppler, N and Lancaster, G, 2018).			
Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Senior Manager Environment and Sustainability and/or EPA.	Contractor	Detailed design / Pre-construction	Section 4.2 of QA G36 Environment Protection
Accidental spill	A site-specific emergency spill plan will be developed and include spill-management measures in accordance with the Transport Code of Practice for Water Management (Roads and Traffic Authority, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport EPA officers).	Contractor	Detailed design / Pre-construction	Section 4.3 of QA G36 Environment Protection

6.7 Aboriginal cultural heritage

6.7.1 Methodology

A desktop review of the impacts of the proposal on Aboriginal heritage was carried out by accessing the following sources:

- Heathcote Road Corridor Aboriginal Archaeological Survey Report: Stage 2 PACHCI (Kelleher Nightingale Consulting, 2024).
- Aboriginal Heritage Information Management System (AHIMS) (NSW Environment and Heritage, 2024)
- Australian Heritage Database (Department of Climate Change, Energy, the Environment and Water, 2024)
- Heathcote Road corridor between Voyager Point and Lucas Heights: Aboriginal Archaeological Survey Report Stage 2 PACHCI (Kelleher Nightingale Consulting, 2024)

6.7.2 Existing environment

The proposal is located on the land of the Tharawal people and is within the Tharawal Local Aboriginal Land Council Area.

Cubbitch Barta National Estate Area

The REF proposal area borders the Cubbitch Barta National Estate Area (also referred to as the Holsworthy Military Training Area) which is a listed place on the Commonwealth Heritage List (Place ID 105405). As a listed place on the Commonwealth Heritage List, the area is protected under the EPBC Act.

Disturbance within the Holsworthy Military Training area is considered relatively low due to the historic land use of the site as a military training area and the rugged nature of the landscape. Much of the surrounding urban development has not encroached on the military training area at Holsworthy, leading to the protection of over 500 Aboriginal archaeological sites.

Aboriginal Heritage Sites

There is one Aboriginal Heritage site within the REF proposal area and one adjacent to the REF proposal area, both located around Deadmans Creek. The location of these sites is shown in Figure 6-22.

One newly recorded Aboriginal archaeological site was identified in the REF proposal area, during the archaeological survey carried out in September 2023 to inform the Heathcote Road Corridor Aboriginal Archaeological Survey Report: Stage 2 PACHCI (Kelleher Nightingale Consulting, 2024). Deadmans Creek PAD 1 was recorded on a small rise on the eastern side of Deadmans Creek and was considered to contain archaeological potential based on its proximity to Deadmans Creek and low levels of visible disturbance.

An AHIMS Search conducted on 27 June 2024 identified the Deadmans Creek Artefact Scatter adjoining the REF proposal area Deadmans Creek). Deadmans Creek Artefact Scatter 1 (DCAS1) consists of a surface artefact scatter located across a low-lying crest landform about 25 metres south of Heathcote Road, within the Holsworthy Barracks property boundary. Artefacts recorded consisted of silcrete complete flakes and flake fragments, one silcrete core, one indurated mudstone/tuff flake fragment and one quartz flake. The artefacts were predominantly exposed on an unsealed vehicle track that ran north across the crest landform before turning east towards Deadmans Creek.

Details of the Aboriginal heritage sites in the REF proposal area are included in Table 6-35.

Table 6-35: Aboriginal heritage sites in the REF proposal area

Site ID	Name	Context	Status	Features
45-5-4155	DCAS 1	Open site	Valid	Artefact: 13
N/A	Deadmans Creek PAD 1	Open site	Valid	PAD: 1

FIGURE REDACTED FROM PUBLIC DISPLAY VERSION DUE TO SENSITIVITY

Figure 6-22: AHIMS site identified near the REF proposal area

6.7.3 Potential impacts

Construction

The proposal has been located to avoid the known Aboriginal site (Deadmans Creek PAD 1) within the REF proposal area. The proposal similarly avoids the Aboriginal site located adjacent to the REF proposal area (Deadmans Creek Artefact Scatter 1). The Stage 1 PACHCI assessment notes that the proposal is unlikely to have an impact on Aboriginal cultural heritage provided that the mitigation measures in section 6.7.4 are implemented. The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Due diligence Code of Practice for the Protection of Aboriginal objects in NSW and the PACHCI.

In the event of an unexpected find of an Aboriginal heritage item (or suspected item), the safeguards specified in section 6.7.4 of this REF would be implemented to avoid or minimise any potential impact on Aboriginal heritage items uncovered during the proposed works.

Operation

The proposal is not expected to have any operational impacts to Aboriginal cultural heritage.

6.7.4 Safeguards and management measures

Table 6-36: Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	Exclusion zones will be established around Aboriginal heritage items before works commence in their vicinity. All site-personnel will be toolboxed on the items and exclusion zones.	Contractor	Construction	Section 4.9 of QA G36 Environment Protection
Aboriginal heritage	The Unexpected heritage items procedures (Transport for NSW, 2022) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction.	Contractor	Construction	Section 4.9 of QA G36 Environment Protection

6.8 Non-Aboriginal heritage

6.8.1 Methodology

A desktop review of the impacts of the proposal on non-Aboriginal heritage was carried out by accessing the following sources:

- State Heritage Inventory (NSW Environment and Heritage, 2024)
- Liverpool Local Environmental Plan 2008
- Section 170 Heritage and Conservation Register (Transport for NSW, 2023)

6.8.2 Existing environment

No non-Aboriginal heritage items have been identified within the REF proposal area. A review of the Liverpool LEP on 27 June 2024 identified one locally listed heritage item adjacent to the REF proposal area. The 'Holsworthy Group' (Item 32) corresponds with the LEP curtilage of the Holsworthy Military Reserve, which adjoins the REF proposal area to the east and west, north of Deadmans Creek. The Holsworthy Group is comprised of the following components:

- Collection of early 20th century structures and building remains scattered round the edge of a former parade ground
- Parade ground encircled by macadam paved road
- Tree plantings, both natives and exotics

- Remains of the former Officer's Mess
- Remains of the (former) Corporal's Club
- Powder magazine
- Remains of a former railway bridge
- Parts of the railway line, the ruins of the railway terminus, the railway siding and part of Military Road
- Group of weatherboard buildings directly north of the remains of the Officer's Mess.

6.8.3 Potential impacts

The works would not encroach on the adjacent Holsworthy Group' heritage item. Neither the construction or operation of the proposal is anticipated to impact the heritage value or conservation of the adjacent 'Holsworthy Group' heritage item.

6.8.4 Safeguards and management measures

Table 6-37: Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	The Unexpected heritage items procedures (Transport for NSW, 2022) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Pre-construction, Construction	Section 4.9 of QA G36 Environment Protection

6.9 Property and land use

6.9.1 Methodology

Potential impacts of the proposal on property and land use were identified by completing a desktop review of the following sources:

- Google Maps (accessed 12 June 2024)
- ePlanning Spatial Viewer Zoning Map (accessed 12 June 2024)

6.9.2 Existing environment

Land use

Land uses in and around the REF proposal area includes the road corridor that contains Heathcote Road and St George Crescent, Georges River National Park, Holsworthy Barracks, and residential and community land uses in Sandy Point. The land around Deadmans Creek is Crown Land. Land uses are shown in Figure 6-23.

The proposal is located entirely within the road corridor and would not encroach on Crown Land, National Parks or Defence Land.

The Georges River National Park adjoins the REF proposal area south of Deadmans Creek, on both side of the Heathcote Road corridor. It includes several large and small discrete riverfront areas along Georges River with a total of 320 hectares (NSW National Parks and Wildlife Service, 1994).

Holsworthy Barracks adjoins the REF proposal area north of Deadmans Creek, on both sides of the Heathcote Road corridor. Covering an area of 20,000 hectares, it includes headquarters, training areas, an airport, artillery ranges, Defence accommodation and Army reserve units. Holsworthy Barracks supports extensive areas of intact native vegetation.

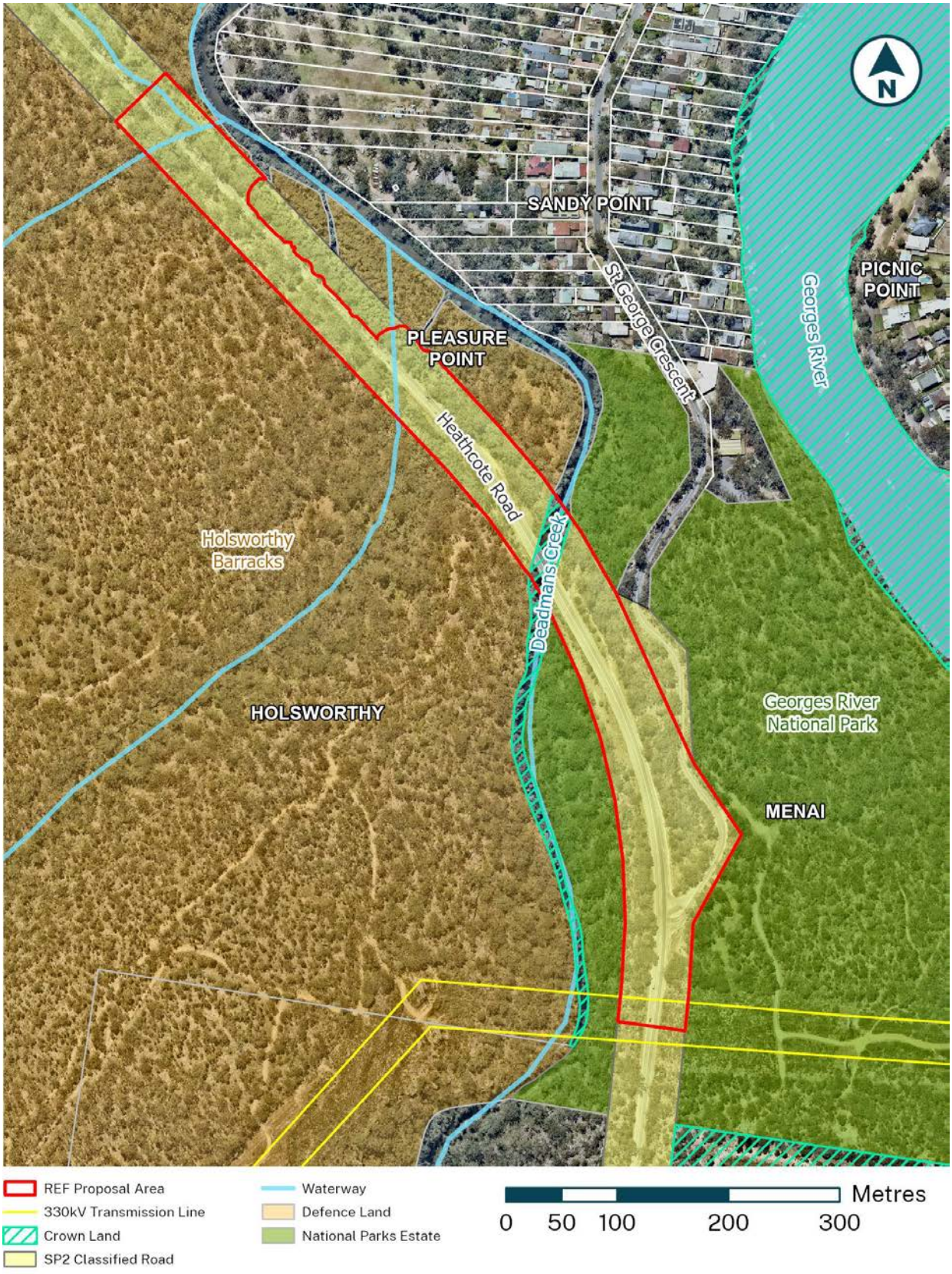


Figure 6-23: Land use within and near the REF proposal area

Utilities

An electrical transmission easement containing a pair of high-voltage (330kV) electricity transmissions lines crosses the southern end of the REF proposal area (refer to Figure 6-23). The electricity transmissions lines do not intersect with the proposed koala fencing alignment. An electrical substation is located on the other side of the Georges River, in Picnic Point.

6.9.3 Potential impacts

No property acquisition is required for the proposal as it will be located entirely within the Heathcote Road corridor, which is zoned SP2 Infrastructure. There would be no changes to access as a result of the proposal. No utilities will be impacted by the proposal.

6.9.4 Safeguards and management measures

Table 6-38: Property and land use safeguards and land use

Impact	Environmental safeguards	Responsibility	Timing	Reference
Property access	Existing access for nearby properties is to be maintained at all times during the works unless otherwise agreed to by the affected property owner	Contractor	Construction	Project specific control

6.10 Socio-economic

6.10.1 Methodology

The socio-economic assessment was prepared in accordance with the Environmental Impact Assessment Practice Note: Socio-economic assessment (Transport for NSW, 2020). The proposal is anticipated to have some short-term localised impacts (and longer-term benefits) to the communities surrounding the proposal and therefore a basic level of socio-economic assessment was carried out.

The socio-economic assessment:

- Identified the existing socio-economic characteristics of the locality through desktop research including reference to Australian Bureau of Statistics 2021 Census of Population and Housing data
- Identified the types and locations of social infrastructure that could be affected by the proposal
- Identified the location of businesses that could be affected by the proposal.

Consistent with the practice note, the socio-economic assessment has evaluated the significance of impacts by reference to sensitivity (vulnerability to change and capacity to adapt) and magnitude (scale, duration, intensity and scope of the proposal).

6.10.2 Existing environment

Population and demography

Key population and demographic information for the Holsworthy – Wattle Grove and Menai – Lucas Heights – Woronora SA2s is summarised in Table 6-39.

Table 6-39: Population and demographics in the Holsworthy – Wattle Grove and Menai – Lucas Heights – Woronora SA2s

Indicator	Holsworthy – Wattle Grove	Menai – Lucas Heights – Woronora	NSW
Population	21,129	20,927	8,072,161
Median Age	35 years	40	39 years
Age 0-14 years	21.5%	19.2%	18.2%

Indicator	Holsworthy – Wattle Grove	Menai – Lucas Heights – Woronora	NSW
Age 15 – 64 years	66.8%	64.6%	64.2%
Age 65 and over	11.7%	16.2%	17.7%
Aboriginal and Torres Strait Islander	2.2%	1.4%	3.4%
Unemployment	3.6%	3.0%	4.9%
Median household income	$2,463	$2,692	$1,829

Travel to work

Travel to work data for the Holsworthy – Wattle Grove and Menai – Lucas Heights – Woronora SA2s is summarised in Table 6-40. It is noted that the 2021 Census was undertaken during the 2021 COVID-19 lockdowns which would have likely influenced the high rate of workers who working from home. As such, the 2016 travel to work data is also included below.

Table 6-40: Travel to work data

Mode	Holsworthy – Wattle Grove 2016	Holsworthy – Wattle Grove 2021	Menai – Lucas Heights – Woronora 2016	Menai – Lucas Heights – Woronora 2021
Car, as driver	59.8	34.5	65.1	41.2
Car, as passenger	3.5	2.3	3.3	2.3
Walked only	-	2.7	-	0.9
Train	11.9	1.8	5.4	0.7
Train, car as driver	2.9	-	4.8	-
Did not go to work	-	16.7	-	13.2
Worked from Home	3.3	38.2	4.1	37.1

Income and employment

The top industries of employment in the Holsworthy – Wattle Grove SA2 are:

- Defence
- Hospitals (except psychiatric hospitals)
- Primary education
- Banking
- Secondary education

The top industries of employment in the Menai – Lucas Heights – Woronora SA2 are:

- Primary Education
- Hospitals (except psychiatric hospitals)
- Banking
- Secondary education
- Combined Primary and Secondary Education

The percentage of people in the Holsworthy – Wattle Grove SA2 who are currently serving in the Australian Defence Force is 5.9 per cent, which is significantly higher than the state and national average of 0.4 per cent. This SA2 includes the Holsworthy Barracks Defence land.

Social Infrastructure

Social infrastructure near the proposal includes:

- Sandy Point Community Centre – 200 St George Crescent, Sandy Point
- Sandy Point Rural Fire Brigade – 198 St George Crescent, Sandy Point

Business and Industry

The only business nearby the proposal is Benedict Sands Sandy Point located at 14309 Heathcote Road, Menai.

6.10.3 Potential impacts

Construction

Construction activities associated with the proposal would be localised and occur for a period of four months (weather permitting). Impacts on community values or changes to way of life or health and wellbeing are not expected during construction given the short-term nature of the works and the considerable distance to any receivers. As there are no residents located near the works, the main potential impacts anticipated to occur during construction are related to traffic and noise.

Operation

The proposal is located adjacent to Heathcote Road, however it will have no impacts on the operation of the road or any pedestrian paths. It is unlikely to have any socio-economic impacts on the surrounding area and community.

6.10.4 Safeguards and management measures

Table 6-41: Socio economic safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic impacts	Local residents and affected businesses will be notified before work starts regarding the timing, duration and likely impact of construction activities.	Transport	Pre-construction	Project specific control

6.11 Climate Resilience

6.11.1 Methodology

Potential impacts of climate change on the proposal and mitigation measures have been identified in accordance with the Transport for NSW Climate Risk Assessment Guidelines DMS-SD-081/4.1 (Transport for NSW, 2021). Information was obtained from the following sources:

- Liverpool and Sutherland Shire Council Flood Maps
- RFS Bushfire Prone Land Map on ePlanning Spatial Viewer
- AdaptNSW Climate Change Projections Map (accessed 8 August 2024)

6.11.2 Existing environment

Flood Risk

The closest meteorological station is the Holsworthy Aerodrome Automatic Weather Station No. 66161. The Holsworthy Automatic Weather Station has recorded an average rainfall of 888mm annually (between 2013 and 2023). The AdaptNSW Climate Change Projections map indicates that the area around Menai and Holsworthy is predicted to experience an increase in rainfall of 1.11 per cent in the short term (2020-2039) and of 7.04 per cent in the long term (2060-2079).

The land around Deadman's Creek and the Georges River is mapped as having a high flood risk on the SES Georges River Flood Extent map (refer to Section 6.5). The risk of flooding is likely to increase as a result of the projected increases in rainfall.

Bushfire Risk

The entire REF proposal area is mapped as Vegetation Category 1 Bushfire Prone Land (refer to Figure 6-24), as is the densely vegetated land adjoining the REF proposal area. Vegetation Category 1 Bushfire Prone Land is the highest risk of bushfire prone land; it has the highest combustibility and likelihood of forming fully developed fires including heavy ember production (NSW Rural Fire Service, 2015).

AdaptNSW Interactive Climate Change Projections map (AdaptNSW, 2024) for the Sydney Metropolitan Region identified that the region, which includes the REF proposal area, is predicred to experience an increase in the number of severe fire weather days (i.e. where the fire danger index is over 50). The number of severe fire weather days is predicted to increase by 0.4 days between 2020 and 2039, by 1.2 days between 2040-2059 and 2.5 days between 2080 and 2099.

Figure 6-24: Bushfire risk of the REF proposal area and surrounds

6.11.3 Potential impacts

The potential impacts of climate change on the proposal are an increase in risk in bushfire or flooding frequency and severity. The impacts of these events are detailed in Sections 6.5.3 and 6.12.1.

6.11.4 Safeguards and management measures

Safeguards and management measures for flooding and bushfire are detailed in Sections 6.5.4 and 6.12.2.

6.12 Other impacts

6.12.1 Existing environment and potential impacts

Table 6-42: Other potential impacts

Environmental factor	Existing environment	Potential impacts
Air Quality	The closest air quality monitoring station to the proposal is located in Liverpool. The NSW Annual Compliance Report 2021 states that the Liverpool station was compliant with all National Environment Protection (Ambient Air Quality) Measure goals for particles and gases other than Ozone 8-hour rolling average standard and PM10 1-day standard. The location of the proposal is located further from many sources of pollutants than Liverpool CBD and therefore is likely to experience a higher level of air quality. The main influence on existing air quality would be road traffic.	The proposal would have potential to generate dust from minor earthworks and ground disturbance for the installation of the koala grid. Levels of airborne dust would be expected to be low provided the mitigation measures outlined in Chapter 7.2 are implemented. Construction equipment and plant would emit exhaust fumes. However, given the high level of existing vehicular movements within the REF proposal area and given the duration of the construction period, this is negligible. Operation of the proposal would not affect air quality.
Waste and Resource Use	Transport is committed to ensuring responsible management of unavoidable waste and promoting the reuse of such waste though appropriate measures in accordance with the resource management hierarchy principles in the *Waste Avoidance and Resource Recovery Act 2001*. The resource management hierarchy principles in order of priority as outlined in the *Waste Avoidance and Resource Recovery Act 2001* are: • Avoidance of unnecessary resource consumption; • Resource recovery (including reuse, reprocessing, recycling and energy recovery); and • Disposal.	**Waste** The proposal is not expected to generate large quantities of waste materials. The following waste streams have been identified during construction of the proposal: • Surplus fencing materials (including galvanised sheeting, posts and straining posts) • Roadside materials • Oil, grease and other liquid wastes from the maintenance of construction plant and equipment • Sewage from the potable ablutions and first aid facilities • Waste from maintaining plant and equipment, including liquid wastes • Packaging materials from items delivered to the site, such as pallets, crates, cartons, plastics and wrapping materials Vegetation to be removed from the REF proposal area would be mulched and reused on site or for landscaping purposes on other Transport-managed projects.

Environmental factor	Existing environment	Potential impacts
	By adopting the above principles, Transport encourages the most efficient use of resources, reduces cost and environmental harm in accordance with the principles of ecologically sustainable development. During operation, the proposal will create no waste. This generally consists of some green waste associated with the maintenance of roadside vegetation, roadside litter from motorists and other road users and, possibly, material from clearing roadside drainage. Transport is committed to managing construction water within sustainable limits of the area and catchment.	All waste would be managed in accordance with Transport guidelines and disposed of by a licensed contractor to an appropriately licensed facility. Operation of the proposal would not generate waste.
Hazards and Risk Management	Hazards in the REF proposal area include: • Constant road traffic associated with Heathcote Road, including light and heavy vehicles • Risk of flooding in Deadmans Creek and the broader Georges River catchment • Risk of bushfires due to the dense native vegetation in the Georges River National Park and Holsworthy Barracks • St George Crescent providing the only vehicular access to the residents of Sandy Point • Operation of utilities including high-voltage electricity transmission lines at the southern end of the REF proposal area.	Potential hazards and risks associated with the construction include: • Spills or leakage of contaminants such as fuels, chemicals and hazardous substances • Encountering unexpected utilities or contaminated material during construction • Changed traffic conditions leading to incidents on Heathcote Road and/ or St George Crescent (including the temporary closure of St George Crescent) • Hazards associated with bushfire risk. Construction hazards and risks are manageable through the application of standard mitigation measures, which have been summarised in section 7.2 of this REF and/or which would be developed by the construction contractor prior to construction. Hazards or risks associated with the operation of the proposal would not represent any substantial change from the existing road environment.

6.12.2 Safeguards and management measures

Table 6-43: Other impacts Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	Air quality safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • Potential sources of air pollution. • Air quality management objectives consistent with any relevant published EPA and/or DPHI guidelines.	Contractor	Detailed design / Pre-construction	Section 4.4 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Mitigation and suppression measures to be implemented. • Methods to manage work during strong winds or other adverse weather conditions.			
Waste	Waste management safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • Measures to avoid and minimise waste associated with the project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing on- and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal monitoring, record keeping and reporting.	Contractor	Detailed design / Pre-construction	Section 4.2 of QA G36 Environment Protection
Bushfire Risk	Bushfire management safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • Monitoring of weather and local bushfire ratings • Consultation requirements for community notifications in the event of a bushfire • Maintaining equipment in good working order • Ensuring plant and equipment are fitted with appropriate spark arrestors, where practicable • Ensuring site workers are informed of the site rules including designated smoking areas and putting rubbish in designated bins. • Obtaining hot work permits and implementing total fire bans as required • Implementing adequate storage and handling requirements for potentially flammable substances in accordance with the relevant guidelines.	Contractor	Pre-construction / during construction	Proposal specific control

6.13 Cumulative impacts

6.13.1 Methodology

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal as well as interaction with other projects that may be occurring or planned within the locality or the broader region.

Other locally occurring or planned projects that could interact with the proposal were identified by completing a desktop review of the following sources:

- Planning Portal for Major Projects (Department of Planning and Environment, 2024) (accessed 20 August 2024).
- Liverpool City Council Development ePlanning portal (Liverpool City Council, 2024)
- Sutherland Shire Council Development Applications Online DA Tracker (Sutherland Shire Council , 2024)
- Relevant council online development assessment tracking tools (accessed 20 August 2024).

6.13.2 Study area

The cumulative impact assessment has considered proposals in the suburbs of Sandy Point, Pleasure Point, Holsworthy, and Menai.

6.13.3 Broader program of work

The need for the proposal has arisen in response to the NSW Koala Strategy 2018 – 2021, which has since been replaced by the NSW Koala Strategy (2022). One of the commitments in the 2018 strategy was to improve the safety and health of koala population by 'fixing priority koala roadkill hotspots across NSW'. The carrying out of fixing several koala roadkill hotspots aims to cumulatively reduce the number of koala fatalities as a result of vehicle strike.

6.13.4 Other projects and developments

Other projects relevant to construction and operation of the proposal are listed in Table 6-44. Given that the REF proposal area is surrounded by land not typically subject to development (i.e. Georges River National Park and Holsworthy Barracks), there are few other projects in the surrounding locality that are relevant for consideration of cumulative impacts.

Table 6-44: Past, present and future projects that may contribute to cumulative impacts

Project	Construction impacts	Operational impacts
Heathcote Road Upgrade A 2.2 kilometre upgrade of Heathcote Road between Infantry Parade, Holsworthy and The Avenue, Voyager Point. Currently under construction and due to open to traffic in 2025	Biodiversity The loss of 6.24 hectares of native vegetation (including 2.4 hectares of TECs), the loss of threatened flora species (including 46 individuals of the *Grevillea parviflora subsp. Parviflora* and 75 individuals of the species *Hibbertia puberula*) Traffic and transport Temporary increase in travel times and extension of the peak periods of congestion and queuing, due to lowering of the speed limit through sections of the proposal site under construction Noise Residents would be highly affected by noise during construction with levels exceeding between 30 to 50 dB(A) above day and night time NMLs, and	Traffic and transport The proposed upgrade would improve traffic congestion and safety conditions for general traffic, and also introduces benefits for freight movement. Some adverse impacts on queuing and intersection performances are predicted in the future. Noise Exceedances of operation noise level for non-residential criteria at two non-residential receivers. Noise impacts at 24 acute residential receivers

Project	Construction impacts	Operational impacts
	noise levels would be 35 dB(A) above the non-residential criteria.	
Lucas Heights Resource Recovery Facility SSD-6835-Mod 2 Little Forest Road, Lucas Heights Increase landfill capacity, relocate and expand the garden organics facility and construct and operate a new resource recovery facility Development consent granted November 2023	Traffic and transport The impacts during construction were minimal and mitigation measures were used to reduce any potential impacts on the community. Noise No impacts are expected to arise from construction noise as a result of the distance between the facility and sensitive receivers.	Traffic and transport No additional traffic impacts as a result of the proposed modification Noise The predicted operational noise levels at all surrounding residential sensitive receivers are predicted to comply with all noise criteria. The road traffic noise levels from the proposal are also predicted to comply with the noise criteria at sensitive receivers along the traffic routes. Air quality Composting operations would be fully enclosed as part of the modification. Predicted odour results would comply with the adopted performance standard of 2 OU at all identified receptor Water A reduction in leachate being generated from maturing compost. New buildings would increase rainwater capture to be used for on-site process
Heathcote Road bridge widening Construction of a new six- metre wide bridge built upstream of the existing Heathcote Road Bridge over the Woronora River in Engadine, and widening of bridge approaches. Opened to traffic in late 2023	Biodiversity Loss of up to 3.08 hectares of native vegetation, including 0.05 hectares of TECs and potential microbat roosting habitat. Traffic and transport Construction required the full closure of Heathcote Road between New Illawarra Road and the Princes Highway for up to six months. An increase in traffic volumes on the proposed detour route and increase travel times between New Illawarra Road and the Princes Highway by an average of 29 minutes. Noise and vibration During night time scenarios, the proposal may exceed noise management levels for surrounding residential receivers. Larger vibration intensive construction equipment may exceed the adopted vibration criteria for heritage structures at distances of less than 10 metres as well as the maximum night-time levels for residences within 390 metres of construction activities. Water Risk of water quality and soil impacts from the establishment of the new temporary access track, crane pads and waterway crossing across the Woronora River	Traffic and transport Increased road safety on the Heathcote Road bridge and its approaches, and improved reliability along the A6 section of Heathcote Road due to the increased lane and shoulder width.

6.13.5 Potential impacts

There is potential for cumulative traffic impacts to occur during the construction phase of the proposal. The increase in vehicular traffic during the operation of the Lucas Heights Resource Recovery Facility and the construction of the koala fence is expected to be minimal and therefore unlikely to result in any significant impacts.

There are no cumulative impacts anticipated following the construction of the fence.

6.13.6 Safeguards and management measures

Table 6-45: Cumulative impact management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative construction impacts	Current and upcoming projects with the potential to interact with the proposal will be monitored. Where potential cumulative impacts are identified, the scheduling of works will be coordinated with interacting projects to minimise potential impacts. This will include: • Scheduling works to allow suitable respite periods for construction noise. • Scheduling of works to minimise consecutive construction noise impacts, where feasible. • Coordinating lane closures and pedestrian/cyclist diversions to minimise the overall number of occasions where disruption occurs.	Transport	Pre-construction Construction	Project specific control

7. Environmental management

7.1 Environmental management plans (or system)

Safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A CEMP will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment and Sustainability Officer, Sydney region, prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the QA Specification G36 - Environmental Protection (Management System), QA Specification G38 - Soil and Water Management (Soil and Water Plan), QA Specification G40 - Clearing and Grubbing, QA Specification G10 - Traffic Management.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7 1.

Table 7-1: Summary of safeguards and management measures

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
B1	Biodiversity	A Flora and Fauna Management Plan will be prepared in accordance with Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects (Transport for NSW, 2024) 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, protected habitat features and revegetation areas • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling. • Procedures addressing relevant matters specified in the DPI Policy and guidelines for fish habitat conservation and management (2013). • Protocols to manage weeds, pathogens and pest species	Transport/ Contractor	During construction	Section 4.8 of QA G36 Environment Protection
B2	Removal of native vegetation	Native vegetation removal will be minimised during detailed design and construction. Clearing would be reduced to that necessary to prevent fauna climbing installed fencing and would occur no more than three metres from the installed fence alignment.	Transport/ Contractor	Detailed design During construction	Project specific control
B3	Native vegetation, threatened flora and TECs	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).	Contractor	Pre-construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
B4	Removal of native vegetation	Pre-clearing surveys and final pre-clearing checks will be undertaken in accordance with Guide 1: Pre-clearing process of	Transport/ Contractor	Prior to construction	Biodiversity Management Guideline: Protection and managing biodiversity on

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
		the Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects (Transport 2024).			Transport for NSW project (Transport for NSW, 2024)
B5	Removal of native vegetation	Vegetation and 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).	Transport/ Contractor	During construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
B6	Fauna injury and mortality	Fauna will be managed in accordance with Guide 9: Fauna handling of the Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)	Contractor	Construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
B7	Invasion and spread of weeds	Weed species will be managed in accordance with Guide 6: Weed management of the Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024).	Contractor	Construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
B8	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)	Contractor	Construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
B9	Aquatic habitats	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* ((Department of Primary Industries, 2013).	Transport/ Contractor	During construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)
B10	Removal of native vegetation	An unexpected threatened species finds procedure is to be developed as part of the FFMP using the template in *Guide 1: Pre-clearing process* of the Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects (Transport for NSW, 2024). The procedure is to be followed if threatened ecological communities, either new TECs or	Transport/ Contractor	During construction	Biodiversity Management Guideline: Protection and managing biodiversity on Transport for NSW project (Transport for NSW, 2024)

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
		new occurrences of known TECs, not assessed in the biodiversity assessment, are identified in the REF proposal area.			
NV1	Noise and vibration	Noise and vibration safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • All potential significant noise and vibration generating activities associated with the activity. • Feasible and reasonable mitigation measures to be implemented • Additional mitigation measures required, in accordance with CNVG (Transport for NSW, 2023).	Contractor	Detailed design / Pre-construction	Section 4.6 of QA G36 Environment Protection
NV2	Out of hours work	As part of the CEMP, an out-of-hours work protocol will be developed, which defines all scheduled and planned out-of-hours activities. Very noisy activities should, where practicable, be programmed for normal working hours. If the work cannot be undertaken during the day, it should be completed during the OOHW Evening period.	Contractor	Construction	Section 4.6 of QA G36 Environment Protection
NV3	Noise and vibration	All sensitive receivers (e.g. local residents) likely to be affected will be notified prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • the project • the construction period and construction hours • contact information for project management staff • complaint and incident reporting • how to obtain further information.	Contractor	Pre-construction/ construction	Construction Noise and Vibration Guideline (Transport for NSW, 2023)
NV4	Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas	Contractor	Construction	Project specific measure

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
		• Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures.			
LCVI1	Visual amenity	Construction areas and the ancillary facility will be maintained during construction, kept tidy and well-presented including sorting regular removal of excess materials to reduce visual impact.	Contractor	Construction	Project specific control
LCVI2	Visual amenity	The ancillary facility and construction areas (outside of the REF proposal area) will be progressively restored to at least its pre-construction condition.	Contractor	Construction, post-construction	Project specific control
LCVI3	Koala fence design	The koala fence will be a black PVC coated chain-link fence with black pre-painted galvanised sheeting.	Transport	Prior to construction (procurement)	Project specific control
TT1	Traffic and transport	Where possible, current traffic movements and property accesses will be maintained during the works. Any disturbance will be minimised to prevent unnecessary traffic delays	Contractor	Detailed design / Pre-construction	Section 4.8 of QA *G36 Environment Protection*
TT2	Traffic and transport	A traffic guidance scheme will be prepared in accordance with Transport Traffic control at work sites manual (version 6.1, 2022) and Australian Standard 1742.3 Manual of uniform control devices.	Contractor	Pre-construction	Project specific control
W1	Soil and water	A site-specific Erosion and Sediment Control Plan will be prepared and implemented as part of the CEMP. The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / pre-construction	Section 2.2 of QA G38 Soil and Water Management
W2	Groundwater	A dewatering procedure will be prepared and implemented as part of the CEMP, for the management of infiltrated groundwater during construction.	Contractor	Construction	Project specific control
W3	Sediment run-off	The extent of ground disturbance and exposed soil will be minimised to the greatest extent practicable to minimise the potential for erosion.	Contractor	Construction	Section 2.2 of QA G38 Soil and Water Management

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
W4	Flooding	A flood management procedure will be prepared to detail procedures to be implemented where extreme weather is predicted and where there is a risk of flooding affecting the work site and compound, including removal and storage of plant and equipment and securing of site.	Contractor	Construction	Project specific control
SC1	Impacts on soils	The site-specific Erosion and Sediment Control Plan to be prepared and implemented as part of the CEMP will include measures to manage saline soils	Contractor	Detailed design / pre-construction	Section 2.2 of QA G38 Soil and Water Management
SC2	Impacts on acid sulfate soils	An acid sulfate soil management plan would be required to be prepared if construction of the proposal was to trigger the criteria (relating to the net acidity of any soil material tested in the REF proposal area) prescribed by Table 1.1 of National Acid Sulfate Soils Identification and Laboratory Methods Manual (Sullivan, L, Ward, N, Toppler, N and Lancaster, G, 2018).	Contractor	Pre-construction/ construction	National Acid Sulfate Soils Identification and Laboratory Methods Manual (Sullivan, L, Ward, N, Toppler, N and Lancaster, G, 2018).
SC3	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Senior Manager Environment and Sustainability and/or EPA.	Contractor	Detailed design / Pre-construction	Section 4.2 of QA G36 Environment Protection
SC4	Accidental spill	A site-specific emergency spill plan will be developed and include spill-management measures in accordance with the Transport Code of Practice for Water Management (Roads and Traffic Authority, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport EPA officers).	Contractor	Detailed design / Pre-construction	Section 4.3 of QA G36 Environment Protection
AH1	Aboriginal heritage	Exclusion zones will be established around Aboriginal heritage items before works commence in their vicinity. All site-personnel will be toolboxed on the items and exclusion zones.	Contractor	Construction	Section 4.9 of QA G36 Environment Protection
AH2	Aboriginal heritage	The Unexpected heritage items procedures (Transport for NSW, 2022) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction.	Contractor	Construction	Section 4.9 of QA G36 Environment Protection

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
NAH1	Non-Aboriginal heritage	The Unexpected heritage items procedures (Transport for NSW, 2022) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Pre-construction, Construction	Section 4.9 of QA G36 Environment Protection
PL1	Property access	Existing access for nearby properties is to be maintained at all times during the works unless otherwise agreed to by the affected property owner	Contractor	Construction	Project specific control
SE1	Socio-economic impacts	Local residents and affected businesses will be notified before work starts regarding the timing, duration and likely impact of construction activities.	Transport	Pre-construction	Project specific control
AQ1	Air quality	Air quality safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • Potential sources of air pollution. • Air quality management objectives consistent with any relevant published EPA and/or DPHI guidelines. • Mitigation and suppression measures to be implemented. • Methods to manage work during strong winds or other adverse weather conditions.	Contractor	Detailed design / Pre-construction	Section 4.4 of QA G36 Environment Protection
WA1	Waste	Waste management safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • Measures to avoid and minimise waste associated with the project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing on- and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal monitoring, record keeping and reporting.	Contractor	Detailed design / Pre-construction	Section 4.2 of QA G36 Environment Protection
HR1	Bushfire risk	Bushfire management safeguards will be incorporated and implemented as part of the CEMP, including but not be limited to: • Monitoring of weather and local bushfire ratings	Contractor	Pre-construction / during construction	Proposal specific control

Ref.	Impact	Environmental safeguard	Responsibility	Timing	Reference
		• Consultation requirements for community notifications in the event of a bushfire • Maintaining equipment in good working order • Ensuring plant and equipment are fitted with appropriate spark arrestors, where practicable • Ensuring site workers are informed of the site rules including designated smoking areas and putting rubbish in designated bins. • Obtaining hot work permits and implementing total fire bans as required • Implementing adequate storage and handling requirements for potentially flammable substances in accordance with the relevant guidelines.			
CI1	Cumulative construction impacts	Current and upcoming projects with the potential to interact with the proposal will be monitored. Where potential cumulative impacts are identified, the scheduling of works will be coordinated with interacting projects to minimise potential impacts. This will include: • Scheduling works to allow suitable respite periods for construction noise. • Scheduling of works to minimise consecutive construction noise impacts, where feasible. • Coordinating lane closures and pedestrian/cyclist diversions to minimise the overall number of occasions where disruption occurs.	Transport	Pre-construction Construction	Project specific control

7.3 Licensing and approvals

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Road occupancy Licence	Approval to temporarily close lanes on Heathcote Road and St George Crescent during construction of the proposal.	Prior to the start of construction

8. Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Section 193 of the Environmental Planning and Assessment Regulation 2021.

8.1 Justification

8.1.1 Social factors

Construction of the proposal would result in some minor negative social impacts. However, potential construction impacts such as construction noise, traffic delays, partial road closures and visual impacts would be temporary, and would only be experienced by road users of Heathcote Road and St George Crescent.

Once operational, the proposal would provide improved safety for motorists and koalas, by reducing the vehicle strikes on Heathcote Road at Deadmans Creek. The proposal is therefore expected to have a positive impact for the local communities.

8.1.2 Biophysical factors

Construction of the proposal would require the removal of 0.73 hectares of native vegetation, including 0.02 hecatres of PCT 4028: Estuarine Swamp Oak Twig-rush Forest, which is associated with Swamp Oak Floodplain Forest EEC listed under the BC Act, and Coastal Swamp Oak (*Casuarina glauca*) Forest EEC listed under the EPBC Act. The removal of vegetation would also involve the loss of 381 trees, including three hollow-bearing trees.

Assessments of significance concluded that the proposal is unlikely to have a significant impact on threatened species or ecological communities or their habitats listed under the BC Act, nor MNES listed under the EPBC Act. Safeguards would be implemented to minimize and mitigate potential impacts on biodiversity.

Once operational, the proposal is expected to have positive impacts on biodiversity. The provision of koala fencing along the Heathcote Road at Deadmans Creek, a known koala vehicle-strike hotspot, would improve the safety and health of koalas in the area, by keeping them off Heathcote Road and guiding them under the road at safe crossing points. Minimising koala mortality along Heathcote Road would contribute to the conservation of the local koala population. Operation of the proposal would similarly benefit other locally occurring terrestrial fauna species, by reducing the incidence of death or injury from vehicle strike.

8.1.3 Economic factors

The proposal would be entirely constructed within the existing road corridor. No property acquisition would be required for the proposal. Construction of the proposal is anticipated to generate work for up to 15 employees.

Locally, the proposal would improve road safety, by reducing koala vehicle-strikes on Heathcote Road at Deadmans Creek. This would have a positive impact on road users travelling along this busy arterial road.

8.1.4 Public interest

There is substantial public interest in the proposal, with a shared desire to reduce koala vehicle strike on Heathcote Road at Deadmans Creek. A number of community groups have been consulted during development of the proposal, including Sutherland Shire Environment Centre, National Parks Association, Sandy Point Residents Association and Georges River Environmental Alliance.

Heathcote Road at Deadmans Creek has been prioritised for funding under the NSW Koala Strategy 2022. This recognition followed extensive consultation between Transport, DPHI, NSW National Parks and Wildlife Service, Sutherland Shire Council, Liverpool City Council, Defence and Gandangara Local Aboriginal Lands Council. The proposal is consistent with a key action of Pillar 3, specifically the key action “Fixing priority koala vehicle strike hotspots”, which is under this pillar. Heathcote Road at Deadmans Creek bridge is specifically recognised as a priority koala vehicle strike hotspot by the strategy, and implementation of the proposal would improve the safety and health of koalas in the area, by keeping them off Heathcote Road (where they are susceptible to death or injury from vehicle strike) and guiding them under the road at safe crossing points.

8.2 Objects of the EP&A Act

Table 8-1: Objects of the Environmental Planning and Assessment Act 1979

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposed development aims to conserve the NSW koala population by reducing koala vehicle-strikes (often resulting in koala mortality) on Heathcote Road at Deadmans Creek. As detailed in section 2.1, the proposal is consistent with a key action of Pillar 3 of the NSW Koala Strategy 2022, specifically the key action "Fixing priority koala vehicle strike hotspots",
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in Section 8.2.1 below and Chapter 6 of this REF has considered relevant economic, environment and social considerations in decision making about environmental planning and assessment.
1.3(c) To promote the orderly and economic use and development of land.	As described in section 3.6, the proposal would be entirely constructed within the existing road corridor and is consistent with the current use. No property acquisition would be required for the proposal.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the project.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The provision of koala fencing along the Heathcote Road at Deadmans Creek, a known koala vehicle-strike hotspot, would improve the safety and health of koalas in the area, by keeping them off Heathcote Road and guiding them under the road at safe crossing points. Minimising koala mortality along Heathcote Road would contribute to the conservation of the local koala population. Operation of the proposal would similarly benefit other locally occurring terrestrial fauna species, by reducing the incidence of death or injury from vehicle strike.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	No impacts to built and cultural heritage (including Aboriginal cultural heritage) are anticipated as a result of the proposal.
1.3(g) To promote good design and amenity of the built environment.	Permanent changes to the landscape character would occur once the proposal has been constructed, mainly due to the removal of native vegetation for the installation of man-made structures, including the koala fence and fauna escape structures. The proposal would only be visible to road users travelling along Heathcote Road and St George Crescent. The dense native vegetation reduces the visual presence of the fence. The implementation of safeguards would soften the appearance of the fence to passing road users and help integrate the proposal into its setting.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the project.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the project.

Object	Comment
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Extensive community consultation has occurred in the development of the proposal to date, as detailed in section 5. This REF will be made publicly available, and stakeholders and the wider community would be encouraged to participate, provide feedback and make a submission on the REF.

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during the development of proposal options (refer to section 2.4). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of safeguards. The best available technical information, environmental standards and measures have been used to minimise environmental risks. Specialist studies (including a Biodiversity Assessment Report (East Coast Ecology, 2024), a Noise and Vibration Assessment (Muller Acoustic Consulting, 2024) and a Landscape Character and Visual Impact Assessment (KI Studio, 2024)) were incorporated to gain a detailed understanding of the existing environment.

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. While the proposal would have some temporary adverse impacts, such as construction noise, traffic delays and partial road closures, they are not considered to be of a nature or extent that would result in disadvantage to any specific section of the community or to future generations.

The proposal will facilitate the conservation of the local koala population, which would provide social and environmental benefits to the community and future generations.

Conservation of biological diversity and ecological integrity

Preserving biological diversity and ecological integrity requires that ecosystems, species and genetic diversity within species are maintained. The objectives of the proposal aim to preserve koalas (and other terrestrial fauna species) and thereby their genetic diversity, by reducing koala vehicle-strike and promoting safe passage of animals under Heathcote Road.

Other measures to conserve biological diversity and ecological integrity of the REF proposal area and immediate surrounds include:

- The design features of the proposal (such as fauna access improvements around Deadmans Creek Bridge) aim to improve connectivity for koalas and other fauna species likely to occur in the area.
- The design of the proposal has been informed by all recent installations of koala fencing and other mitigations measures that have been implemented by Transport to reduce animal-vehicle collisions.
- The locations of ancillary facilities were selected to minimise native vegetation clearance.

Trees to be removed from the REF proposal area will be offset in accordance with Tree and hollow replacement guidelines (Transport for NSW, 2023). Consistent with Transport's Biodiversity Policy, trees may either be replaced on nearby land with the consent of the landowner or, where this is not feasible, payment may be made to Transport's Conservation Fund.

Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources that may be affected by the carrying out of a project, including air, water, land and living things.

This REF has assessed potential impacts on environmental resources and has outlined safeguards to avoid, minimise or mitigate such impacts. Where impacts cannot be avoided (such as the removal of native vegetation and trees), some residual impacts would occur. Consistent with Transport's Biodiversity Policy, trees may either be replaced on nearby land with the consent of the landowner or, where this is not feasible, payment may be made to Transport's Conservation Fund. This demonstrates that that environmental resources have been given appropriate valuation.

8.3 Conclusion

The proposal is subject to assessment under Division 5.1 of the EP&A Act. This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration of impacts on threatened species and ecological communities and their habitats, and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced though the selection of a preferred proposal option and subsequent design refinements of that option. The proposal, as described in the REF, best meets the project objectives and design criteria, but would result in impacts on biodiversity, landscape character, construction noise impacts, and temporary traffic impacts. Safeguards and management measures as detailed in this REF would minimise or mitigate these impacts.

The proposal would improve the safety and health of koalas in the area, by keeping them off Heathcote Road (where they are susceptible to death or injury from vehicle strike) and guiding them under the road at safe crossing points. Ultimately, the proposal would contribute to the long-term conservation of the local koala population and indeed, the wider koala population of NSW. The proposal would also reduce the barrier effects of Heathcote Road and enhance regional connectivity for the safe movement of koalas and other fauna species that inhabit the expanse of habitat contained within the adjoining Holsworthy Barracks and Georges River National Park. On balance, the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared nor approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance nor the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Department of Climate Change, Energy, the Environment and Water is not required.

9. EP&A Regulation publication requirement

Table 9-1: EP&A Regulation publication requirement

Requirement	Yes/No
Does this REF need to be published under section 171(4) of the EP&A Regulation?	Yes

10. References

AdaptNSW. (2024). *Interactive climate change projections map*. Retrieved from AdaptNSW: https://adaptnsw.prod.acquia-sites.com/projections-map?region=illawarra&climateprojection=tasmean&range=0

Australian and New Zealand Environment and Conservation Council. (2000). *Australian and New Zealand guidelines for fresh and marine water quality.*

Austroads. (2021). *Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers .*

Austroads. (2021). *Guide to Road Design Part 6B: Roadside Environment.*

Austroads. (2021). *Guide to Temporary Traffic Management.*

Bannerman, S. H. (2010). *Soil Landscapes of the Penrith 1:100,000 Sheet map.* Sydney: Department of Environment, Climate Change, and Water.

Biolink. (2023). *Sydney Basin Koala Assessment.*

Bureau of Meteorology. (2024). *Australian Groundwater Explorer*. Retrieved from http://www.bom.gov.au/water/groundwater/explorer/

Bureau of Meteorology. (2024). *Groundwater Dependent Ecosystems Atlas.*

Clark, N. J. (1991). *Penrith 1:100,000 Geological Sheet 9030.* Sydney: New South Wales Geological Survey.

Department of Climate Change, Energy, the Environment and Water. (2024). *Australian Heritage Database*. Retrieved from https://www.dcceew.gov.au/parks-heritage/heritage/publications/australian-heritage-database

Department of Environment and Climate Change. (2006). *Assessing vibration: a technical guideline.* Sydney: Department of Environment and Climate Change.

Department of Environment and Climate Change. (2009). *Interim Construction Noise Guideline.* Sydney: NSW Government.

Department of Environment, Climate Change and Water. (2010). *Aboriginal Cultural Heritage Consultation Requirements for Proponents.* Sydney: NSW Government.

Department of Planning and Environment. (2022). *Guidelines for Division 5.1 Assessment.* Sydney: NSW Government.

Department of Planning and Environment. (2022). *NSW Koala Strategy.* Sydney: Environment and Heritage Group.

Department of Planning and Environment. (2024). *Planning Portal for Major Projects* . Retrieved from https://www.planningportal.nsw.gov.au/major-projects

Department of Planning, Housing and Infrastructure. (2018). *Acid Sulfate Soils spatial dataset.*

Department of Planning, Industry and Environment. (2020). *How to keep koalas off the road - Koala vehicle strike fact sheet 2.* Sydney: NSW Government.

Department of Primary Industries. (2013). *Policy and guidelines for fish habitat conservation and management.* Sydney: NSW Government.

Department of Urban Affairs and Planning. (1996). *Road and Related Facilities EIS Guideline.*

East Coast Ecology. (2024). *Heathcote Road Koala Fencing at Deadmans Creek Biodiversity Assessment Report .*

Environment and Heritage. (2024). Retrieved from NSW Bionet.

Environment and Heritage. (2024). *Drive Responsibly*. Retrieved from https://www2.environment.nsw.gov.au/topics/animals-and-plants/nsw-koala-country/help-koalas/drive-responsibly

EPA. (2024). *contaminated land record*. Retrieved from https://app.epa.nsw.gov.au/prclmapp/searchregister.aspx

EPA. (2024). *List of notified sites*.

Kelleher Nightingale Consulting. (2024). *Heathcote Road corridor between Voyager Point and Lucas Heights: Aboriginal Archaeological Survey Report Stage 2 PACHCI* .

KI Studio. (2024). *Heathcote Road: Koala Fencing at Deadmans Creek Landscape Character and Visual Impact Assessment* .

Liverpool City Council. (2012). *Liverpool Biodiversity Management Plan 2012* .

Liverpool City Council. (2024). *Liverpool City Council ePlanning portal*. Retrieved from https://eplanning.liverpool.nsw.gov.au/Pages/XC.Home/LCC_PublicTrackHome.aspx

Lyall and Associates. (2013). *Flooding and Drainage Investigation for Replacement of Bridge B153 over Sandy Point.*

Muller Acoustic Consulting. (2024). *Heathcote Road Koala Fencing at Deadmans Creek* .

NSW Department of Environment and Conservation. (2006). *Assessing Vibration: A Technical Guideline.* Sydney: NSW Government.

NSW Environment and Heritage. (2024). *Aboriginal Heritage Information Management System (AHIMS) Web Services*. Retrieved from https://www.environment.nsw.gov.au/awssapp/Login.aspx?ReturnUrl=%2fawssapp

NSW Environment and Heritage. (2024). *State Heritage Inventory*. Retrieved from https://www2.environment.nsw.gov.au/topics/heritage/search-heritage-databases/state-heritage-inventory

NSW Environmental Protection Authority. (2024). *Record of notices*. Retrieved from https://www.epa.nsw.gov.au/your-environment/contaminated-land/notified-and-regulated-contaminated-land/record-of-notices

NSW National Parks and Wildlife Service. (1994). *Georges River National Park Plan of Management* .

NSW National Parks and Wildlife Service. (2020). *Developments adjacent to National Parks and Wildlife Service lands Guidelines for consent and planning authorities.* Sydney: NPWS.

NSW Rural Fire Service. (2015). *Guide for Bushfire Prone Land.*

NSW Scientific Committee. (2011). *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions Final Determination.*

NSW State Emergency Service. (2024). *Georges River Flood Information*. Retrieved from NSW State Emergency Service: https://www.ses.nsw.gov.au/flood-awareness-nsw/sydney-rivers/georges-river/

Office of Environment and Heritage. (2018). *BC Act and Threatened Species Test of Significance Guidelines.*

Office of Environment and Heritage. (2018). *NSW Koala Strategy 2018.*

Roads and Maritime Services. (2011). *Procedure for Aboriginal cultural heritage consultation and investigation.* Sydney: NSW Government.

Roads and Traffic Authority. (1999). *Code of Practice for Water Management.*

SES. (2024). *Georges River Flood Information*. Retrieved from https://www.ses.nsw.gov.au/flood-awareness-nsw/sydney-rivers/georges-river/

SMEC. (2012). *Geotechnical Investigations Report.*

Sullivan, L, Ward, N, Toppler, N and Lancaster, G. (2018). *National Acid Sulfate Soils Identification and Laboratory Methods Manual* .

Sutherland Shire Council . (2024). *Sutherland Shire Council Development Applications* . Retrieved from https://www.sutherlandshire.nsw.gov.au/plan-and-build/track-a-da

Transport for NSW. (2013). *Replacement of the bridge over Deadmans Creek along Heathcote Road, Sandy Point: Review of Environmental Factors* .

Transport for NSW. (2020). *Environmental Impact Assessment Practice Note: Socio-economic Assessment.*

Transport for NSW. (2021). *Environmental Design and Fauna Connectivity .*

Transport for NSW. (2021). *TfNSW Climate Risk Assessment Guidelines.* Sydney: NSW Government.

Transport for NSW. (2022). *Biodiversity Policy.*

Transport for NSW. (2022). *No Net Loss Guidelines.*

Transport for NSW. (2022). *Unexpected heritage items procedure .* Sydney: NSW Government.

Transport for NSW. (2023). *Beyond the Pavenemt: Urban design policy, procedures and principles for roads and waterways projects.*

Transport for NSW. (2023). *Construction Noise and Vibration Guideline.*

Transport for NSW. (2023). *Noise and Vibration Assessment Procedure.* Sydney.

Transport for NSW. (2023). *Section 170 Heritage and Conservation Register.*

Transport for NSW. (2023). *Stakeholder and community engagement guidelines.* NSW Government.

Transport for NSW. (2023). *Tree and hollow replacement guidelines.*

Transport for NSW. (2024). *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects.* Sydney: NSW Government.

Transport for NSW. (2024). *TfNSW fauna camera monitoring – Deadmans Creek Heathcote Road.*

Willy Weather. (2024). *Georges River - Deadmans Creek Entrance Tide Times*. Retrieved from https://tides.willyweather.com.au/nsw/sydney/georges-river--deadmans-creek-entrance.html

WSP. (2021). *Options to reduce koala vehicle strike along Heathcote Road, near Deadmans Creek.* Sydney: wsp.

Terms and acronyms used in this REF

Table 10-1: Terms and acronyms used in this REF

Term / Acronym	Description
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ANCECC	Australian and New Zealand Environment and Conservation Council
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act 2016 (NSW)*
CEMP	Construction environmental management plan
CNVG	Construction Noise and Vibration Guideline
DBH	Diameter at Breast Height – a measure of tree size
DCCEEW (Commonwealth)	Commonwealth Department of Climate Change, Energy, the Environment and Water
DCCEEW (NSW)	NSW Department of Climate Change, Energy, the Environment and Water
Defence	Department of Defence (owners of land adjacent to REF proposal area).
DPHI	Department of Planning, Housing and Infrastructure. Formerly known as Department of Planning and Environment (DPE) and Department of Planning, Industry and Environment (DPIE).
DPIRD	Department of Primary Industries and Regional Development
EEC	Endangered Ecological Community
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW).* Provides the legislative framework for land use planning and development assessment in NSW
EPA	Environmental Protection Authority
EPL	Environment protection licence
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).* Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	*Fisheries Management Act 1994 (NSW)*
GDE	Groundwater Dependent Ecosystems
IBRA	Interim Biogeographic Regionalisation for Australia
ICNG	Interim Construction Noise Guideline
LCVIA	Landscape Character and Visual Impact Assessment
LCZ	Landscape Character Zones
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
LLEP 2008	Liverpool Local Environmental Plan 2008
MNES	Matter of National Environmental Significance

NML	Noise Management Level
NP&W Act	*National Parks and Wildlife Act 1974 (NSW)*
OOHW	Out of hours works
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential Archaeological Deposit
PCT	Plant Community Type
PMF	Probable Maximum Flood
POEO Act	Protection of the Environment Operations Act 1997
QA Specifications	Specifications developed by Transport for use with road work and bridge work contracts let by Transport.
RBL	Rating Background Levels
REF	Review of Environmental Factors
Roads Act	*Roads Act 1993 (NSW)*
ROL	Road Occupancy Licence
SA2	Statistical Area 2
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP (Biodiversity and Conservation)	State Environmental Planning Policy (Biodiversity and Conservation) 2021
SEPP (Resilience and Hazards)	State Environmental Planning Policy (Resilience and Hazards) 2021
SEPP (Transport and Infrastructure)	State Environmental Planning Policy (Transport and Infrastructure) 2021
SSLEP 2015	Sutherland Shire Local Environmental Plan 2015
TEC	Threatened Ecological Community
Transport	Transport for NSW
VI	Vegetation integrity
VMS	Variable Message Signs
WM Act	*Water Management Act 2000*

Appendix A - Consideration of section 171 factors and matters of national environmental significance and Commonwealth land

Section 171 Factors

In addition to the requirements of the Guideline for Division 5.1 assessments (Department of Planning and Environment, 2022) and the Roads and Related Facilities EIS Guideline (Department of Urban Affairs and Planning, 1996) as detailed in the REF, the following factors, listed in section 171 of the Environmental Planning and Assessment Regulation 2021, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor		Impact
a	Any environmental impact on a community? The proposal would have the potential for short-term noise and traffic impacts on nearby community and road users during construction. Safeguards have been proposed to minimise the extent and duration of these potential impacts.	Minor short term negative Long term positive
b	Any transformation of a locality? There would be no transformation of a locality as a result of the proposal.	Nil
c	Any environmental impact on the ecosystems of the locality? The proposal has been designed to avoid and minimise the removal of native vegetation and TECs wherever practical. The proposal would result in impacts on biodiversity due to the removal of 0.74 hectares of native vegetation, of which 0.02 hectares is commensurate with TECs listed under the BC Act and the EPBC Act. Impacts on TECs were assessed as not significant. Refer to Section 6.1. Operation of the proposal would seek to reduce the rate of fauna injury and mortality along Heathcote Road by aiming to prevent fauna access to this high-speed traffic environment.	Short term negative Long term positive
d	Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? There would be a short term negative impact on the aesthetic value of the locality. Long term impacts are expected to be negligible.	Short term negative
e	Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? No effects expected.	Nil
f	Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)? The proposal would have some impact on the habitats of protected fauna due to the clearing of native vegetation required for fence construction. Operation of the proposal would seek to reduce the rate of fauna injury and mortality along Heathcote Road by aiming to prevent fauna access to this high-speed traffic environment.	Minor short term negative Long term positive
g	Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? No impacts expected. Refer to Section	Nil
h	Any long-term effects on the environment? Operation of the proposal would seek to reduce the rate of fauna injury and mortality along Heathcote Road by aiming to prevent fauna access to this high-speed traffic environment.	Long-term positive
i	Any degradation of the quality of the environment? There is some potential for degradation of the quality of the environment during the construction phase. Safeguards have been proposed to minimise these impacts.	Minor short term negative
j	Any risk to the safety of the environment? The proposal will improve safety for motorists by reducing opportunities for koalas to access the road corridor.	Long term positive

Factor		Impact
k	Any reduction in the range of beneficial uses of the environment? No reduction expected.	Nil
l	Any pollution of the environment? Mitigation measures in Section 7.2 will be put in place to ensure no pollution to the environment during construction.	Nil
m	Any environmental problems associated with the disposal of waste? Mitigation measures in Section 7.2 will be put in place to ensure waste is disposed of appropriately.	Nil
n	Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? None expected.	Nil
o	Any cumulative environmental effect with other existing or likely future activities? None expected.	Nil
p	Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? No impacts expected.	Nil
q	Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1, The proposal is consistent with the values of relevant strategic planning documents. Refer to Section 2.1.	Nil
r	Other relevant environmental factors.	In considering the potential impacts of this proposal all relevant environmental factors have been considered, refer to Chapter 6 of this assessment.

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Department of Climate Change, Energy, the Environment and Water.

A referral is not required for proposed actions that may affect nationally-listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor		Impact
a	Any impact on a World Heritage property? There are no World Heritage properties near the proposal.	Nil
b	Any impact on a National Heritage place? There are no National Heritage places near the proposal.	Nil
c	Any impact on a wetland of international importance? There are no wetlands of international importance near the proposal.	Nil
d	Any impact on a listed threatened species or communities?	Positive long term
e	Any impacts on listed migratory species? No impacts are anticipated on any migratory species.	Nil
f	Any impact on a Commonwealth marine area? There are no Commonwealth marine areas near the proposal.	Nil
g	Does the proposal involve a nuclear action (including uranium mining)? Not relevant to proposal.	Nil
h	Additionally, any impact (direct or indirect) on the environment of Commonwealth land? Land adjacent to the REF proposal area is listed as a Commonwealth Heritage Place 'Cubbitch Barta National Estate Area'. The proposal will not have any impacts on the heritage value of the area.	Nil

Appendix B - Statutory consultation checklists

Transport and Infrastructure SEPP

Certain development types

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	Liverpool City Council, Sutherland Shire Council and the occupiers of adjoining land	Section 2.110
Bus Depots	Does the project propose a bus depot?	No	Liverpool City Council, Sutherland Shire Council and the occupiers of adjoining land	Section 2.110
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	Liverpool City Council, Sutherland Shire Council and the occupiers of adjoining land	Section 2.110

Development within the Coastal Zone

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No	Liverpool City Council and Sutherland Shire Council	Section 2.14

Note: See interactive map at ***Planning Portal NSW spatial viewer - find a property***. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program.

Council related infrastructure or services

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Stormwater	Are the works likely to have a *substantial* impact on the stormwater management services which are provided by council?	No	Liverpool City Council and Sutherland Shire Council	Section 2.10

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Traffic	Are the works likely to generate traffic to an extent that will *strain* the capacity of the existing road system in a local government area?	No	Liverpool City Council and Sutherland Shire Council	Section 2.10
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No	Liverpool City Council and Sutherland Shire Council	Section 2.10
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a *substantial* volume of water?	No	Liverpool City Council and Sutherland Shire Council	Section 2.10
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	Liverpool City Council and Sutherland Shire Council	Section 2.10
Road & footpath excavation	Will the works involve more than *minor* or inconsequential excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	Sutherland Shire Council	Section 2.10

Local heritage items

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the REF proposal area for the works? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than minor or inconsequential?	No	Liverpool City Council and Sutherland Shire Council	Section 2.11

Flood liable land

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and

				Infrastructure) Section
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a *minor* extent?	No	Liverpool City Council and Sutherland Shire Council	Section 2.12
Flood liable land	Are the works located on flood liable land? (to any extent). If so, do the works comprise more than minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance?	No	State Emergency Service	Section 2.13

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled Floodplain Development Manual: the management of flood liable land published by the New South Wales Government.

Public authorities other than councils

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	Yes	Environment and Heritage Group, DPE	Section 2.15
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	Environment and Heritage Group, DPE	Section 2.15
Navigable waters	Do the works include a fixed or floating structure in or over navigable waters?	No	Transport for NSW - Maritime	Section 2.15
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service (RFS) [Refer to the NSW RFS publication: *Planning for Bush Fire Protection (2006)*]	Section 2.15
Artificial light	Would the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	Director of the Siding Spring Observatory	Section 2.15
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in section	No	Secretary of the Commonwealth Department of Defence	Section 2.15

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
	5.15 of Lockhart LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.			
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	Section 2.15

Appendix C: Biodiversity SEPP Requirements

Clauses 6.6, 6.7, 6.8 and 6.9 of the Biodiversity SEPP are required to be considered under Clause 171A of the EP&A Regulation. These clauses are considered below.

Control	Comment
Clause 6.6 water quality and quantity	
(1) In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider the following —	
(a) whether the development will have a neutral or beneficial effect on the quality of water entering a waterway,	Potential water quality impacts during construction mas arise if construction activities are not appropriately managed. Potential impacts include: • Vegetation clearing and localised earthworks (site leveling for fencing) may increase the risk of erosion and sedimentation resulting in the mobilisation of soils into stormwater runoff and nearby watercourses (including Deadmans Creek) • Potential change in pH affecting water quality of nearby watercourses and the coastal wetland, as a result of concrete dust or concrete slurry mix used for installation of the koala fence posts and koala refuge poles alongside Deadmans Creek • Potential for contaminants being transported to nearby watercourses and the coastal wetland as a result of accidental spills or leaks from construction plant and equipment machinery, or from vehicle/truck incidents travelling to and from the REF proposal area. Mitigation measures relating to water quality during construction include: • A site-specific Erosion and Sediment Control Plan will be prepared and implemented as part of the CEMP. The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather. • The extent of ground disturbance and exposed soil will be minimised to the greatest extent practicable to minimise the potential for erosion. No impacts on water quality would arise during operation. The implementation of construction mitigation measures mean that the proposal is expected to have a neutral impact on the quality of water entering Deadmans Creek and the wider Georges River Catchment.
(b) whether the development will have an adverse impact on water flow in a natural waterbody,	The proposal includes the installation of 1,153 metres of koala fencing, a koala grid, refuge poles and access pipes in the existing defence fencing. The existing surface water flow patterns would be maintained, as

Control	Comment
	these structures would not modify existing surface flow volumes or velocity.
(c) whether the development will increase the amount of stormwater run-off from a site,	The proposal would not increase the amount of stormwater runoff.
(d) whether the development will incorporate on-site stormwater retention, infiltration or reuse,	No stormwater retention, infiltration or reuse is proposed.
(e) the impact of the development on the level and quality of the water table,	The installation of koala refuge poles on the southern bank of Deadmans Creek, which are set about one metre deep in a concrete footing, may intercept groundwater, which may be as shallow as 0.4 metres below ground level. Groundwater inflows into the koala refuge pole footing holes during construction would likely be small, given the diameter of the koala refuge poles. In addition, the limited extent, small volume and short duration of dewatering would be at a very localised scale in a groundwater system that operates and recharges regionally. A dewatering procedure would be implemented for the management of infiltrated groundwater during construction. Operation of the proposal would not have further impacts on groundwater, as there would be no ongoing groundwater drawdown.
(f) the cumulative environmental impact of the development on the regulated catchment,	The proposal would have negligible impacts on the catchment and therefore the potential for cumulative impacts is limited.
(g) whether the development makes adequate provision to protect the quality and quantity of ground water.	A dewatering procedure will be prepared and implemented as part of the CEMP, for the management of infiltrated groundwater during construction.
(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied the development ensures —	
(a) the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial, and	The proposal is expected to have a neutral impact on water quality the Georges River and its tributaries.
(b) the impact on water flow in a natural waterbody will be minimised.	The proposal is expected to have a neutral impact on water flow the Georges River and its tributaries.
6.7 Aquatic ecology	
(1) In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider the following —	
(a) whether the development will have a direct, indirect or cumulative adverse impact on terrestrial, aquatic or migratory animals or vegetation,	Key Fish Habitat is mapped at Deadmans Creek. No threatened aquatic species, populations and communities have been identified within the REF proposal area or are considered likely to occur and are therefore unlikely to be impacted.
(b) whether the development involves the clearing of riparian vegetation and, if so, whether the development will require — (i) a controlled activity approval under the Water Management Act 2000, or (ii) a permit under the Fisheries Management Act 1994,	The proposal does not require any permits under the WM Act or the FM Act.

Control	Comment
(c) whether the development will minimise or avoid — (i) the erosion of land abutting a natural waterbody, or (ii) the sedimentation of a natural waterbody,	Erosion and sedimentation would be managed through a site-specific erosion and sediment control plan which will be prepared and implemented as part of the CEMP.
(d) whether the development will have an adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area,	Minimal impacts on wetlands are expected to arise as a result of the proposal.
(e) whether the development includes adequate safeguards and rehabilitation measures to protect aquatic ecology,	Mitigation measures are included in Section 7.2.
(f) if the development site adjoins a natural waterbody — whether additional measures are required to ensure a neutral or beneficial effect on the water quality of the waterbody. Example — Additional measures may include the incorporation of a vegetated buffer between the waterbody and the site.	The proposal is located near Deadmans Creek. Mitigation measures are listed in Section 7.2.
(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following —	
(a) the direct, indirect or cumulative adverse impact on terrestrial, aquatic or migratory animals or vegetation will be kept to the minimum necessary for the carrying out of the development,	Impacts of the proposal on flora and fauna is expected to be minimal with the implementation of mitigation measures listed in Section 7.2.
(b) the development will not have a direct, indirect or cumulative adverse impact on aquatic reserves,	The proposal will not impact upon any aquatic reserves.
(c) if a controlled activity approval under the Water Management Act 2000 or a permit under the Fisheries Management Act 1994 is required in relation to the clearing of riparian vegetation — the approval or permit has been obtained,	No permits are required under the FM Act or the WM Act.
(d) the erosion of land abutting a natural waterbody or the sedimentation of a natural waterbody will be minimised,	Erosion and sedimentation is proposed to be managed through a site-specific erosion and sediment control plan which will be prepared and implemented as part of the CEMP.
(e) the adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area will be minimised.	Minimal impacts on wetlands are expected to arise as a result of the proposal.
6.8 Flooding	
(1) In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider the likely impact of the development on periodic flooding that benefits wetlands and other riverine ecosystems.	Construction activities within the REF proposal area and ancillary facilities are not anticipated to affect flood behaviour. No construction activities would temporarily or permanently obstruct Deadmans Creek. There would be no change in the capacity or velocity of flows in Deadmans Creek as a result of the proposal. Operation of the proposal would not affect flood behaviour. The proposal would not modify or obstruct

Control	Comment
	Deadmans Creek. There would be no change in the capacity or velocity of flows of Deadmans Creek as a result of the proposal.
(2) Development consent must not be granted to development on flood liable land in a regulated catchment unless the consent authority is satisfied the development will not —	
(a) if there is a flood, result in a release of pollutants that may have an adverse impact on the water quality of a natural waterbody, or	A flood management procedure will be prepared to detail procedures to be implemented where extreme weather is predicted and where there is a risk of flooding affecting the work site and compound, including removal and storage of plant and equipment and securing of site.
(b) have an adverse impact on the natural recession of floodwaters into wetlands and other riverine ecosystems.	The proposal will not have any impact on the recession of floodwaters into wetlands and riverine ecosystems.
6.9 Recreation and public access	
(1) In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider —	
(a) the likely impact of the development on recreational land uses in the regulated catchment, and	The proposal is not anticipated to have any impacts on recreational land uses in the regulated catchment.
(b) whether the development will maintain or improve public access to and around foreshores without adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation.	The proposal will have no impacts on public access to and around foreshores in the Georges River Catchment.
(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following —	
(a) the development will maintain or improve public access to and from natural waterbodies for recreational purposes, including fishing, swimming and boating, without adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation,	The proposal will have no impacts on public access to and around foreshores in the Georges River Catchment.
(b) new or existing points of public access between natural waterbodies and the site of the development will be stable and safe,	No new points of public access are proposed.
(c) if land forming part of the foreshore of a natural waterbody will be made available for public access as a result of the development but is not in public ownership — public access to and use of the land will be safeguarded.	No new points of public access are proposed.

Appendix D: NPWS Guidelines review

The recommendations in Developments adjacent to NPWS lands: Guidelines for consent and planning authorities (as relevant to the proposal) are considered in the table below.

Category	Recommended approach	Response
Erosion and sediment control	Appropriate erosion and sedimentation control measures should be implemented before works commence, and maintained for the duration of construction and until soil is stabilised. As general erosion and sediment control measures, NPWS recommends that: • Clearance of native vegetation is kept to a minimum • Areas of retained vegetation are fenced off during construction • Areas of bare soil and stockpiles are managed to prevent erosion during the construction process • Disturbed areas are rehabilitated and appropriately stabilised as soon as possible following construction (this includes removal of control measures, such as sediment fences, when they are no longer required). To prevent sediment moving from an adjacent property onto NPWS land, and to avoid and minimise erosion risks, NPWS also recommends that appropriate controls should be applied in accordance with the following guidance documents: • Erosion and sediment control on unsealed roads (OEH 2012) • Managing Urban Stormwater – Soils and Construction, Volume I (Landcom 2004) • Managing Urban Stormwater – Soils and Construction, Volume II (DECC 2008) • A Resource Guide for Local Councils: Erosion and Sediment Control (DEC 2006)	Measures to address soil and water quality impacts have been included in Sections 6.5 and 6.6.
Stormwater runoff	Development proposals for areas adjacent to NPWS land should incorporate stormwater detention and water quality systems (with appropriately managed buffer areas) within the development site. Water sensitive urban design (WSUD) principles should be applied to developments in catchments upstream from wetlands. Stormwater should be diverted to council stormwater systems or to infiltration and	Following the completion of works the quality of stormwater flows is expected to be the same as the existing situation. The adjacent NPWS land is largely upslope of the nearest works (the fauna grid on St George Crescent) and would receive minimal stormwater from the construction footprint. No changes to the volume and velocity of road related runoff are

	subsurface discharge systems within the development site. The discharge of stormwater to NPWS land, where the quantity and quality of stormwater differs from natural levels, must be avoided.	anticipated (as there would be no changes to the impermeable surfaces within the catchment). Refer to Section 6.5 for further discussion of hydrology and water quality.
Wastewater	Requirements relating to wastewater infrastructure and discharge.	Not relevant to the proposal.
Pests, weeds and edge effects	During construction works adjoining parks, the boundary of the NPWS park and any buffer will require demarcation using a visually obvious barrier such as temporary fencing or flicker tape to reduce the risk of accidental encroachments.	The construction footprint would not encroach on NPWS estate. Areas outside the proposal footprint would be an exclusion zone and would be demarcated where required as per Guide 2: Exclusion zones of the Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects (Transport for NSW, 2024).
Fire and the location of asset protection zones	Relates to bush fire hazard reduction works, including the establishment of asset protection zones.	Not relevant to the proposal.
Boundary encroachments and access through **NPWS land**	NPWS land is not to be used: • To access development sites • To store materials, equipment, workers' vehicles or machinery • For maintenance access after development. Measures, such as temporary fencing of 'no-go' areas during construction or installation of permanent, wildlife-compatible fencing should be considered, and will require NPWS approval if they are proposed to be located along the site boundary.	Access to the construction footprint would be directly from Heathcote Road and St George Crescent. Access through Georges River National Park is not required.
Visual, odour, noise, vibration, air quality and amenity impacts	Visual (including lighting), noise, odour and air quality impacts of development adjacent to NPWS land to ensure that they do not affect the amenity or public enjoyment of the land.	Visual impacts are considered in Section 6.3. Temporary site lighting would be required for night works. This lighting would be directed so as to minimise impacts on Georges River National Park. Noise impacts are considered in Section 6.2. Air quality impacts are considered in Section 6.12.
Threats to ecological connectivity and **groundwater-dependent ecosystems**	Vegetation, waterways and water bodies close to NPWS land that exhibit ecological connectivity should be retained, protected and, where necessary, rehabilitated. For proposals involving the extraction of groundwater, NPWS recommends that consent authorities obtain and consider a comprehensive assessment of any potential impacts that may occur to	Potential biodiversity impacts and suitable safeguards are discussed in Section 6.1. Groundwater inflows into the koala refuge pole footing holes would likely be small, given the diameter of the koala refuge poles. In addition, the limited extent, small volume and short duration of dewatering would be at a very

	groundwater-dependent ecosystems in NPWS lands.	localised scale in a groundwater system that operates and recharges regionally. Nearby groundwater dependent ecosystems are not likely to be entirely groundwater dependent and are likely to be more reliant on the collection of rainwater into associated waterways.
Cultural heritage	Adequate consideration should be given to potential impacts of nearby development on the heritage values of NPWS land.	No impacts on Aboriginal heritage or non-Aboriginal heritage are expected. Refer to Section 6.7 and 6.8 respectively.
Access to parks	Any potential impacts on the accessibility to NPWS parks. Works should not block or in any way impede access to tactical fire trails.	The proposal would not affect access to Georges River National Park. The proposal would not affect tactical fire trails.

Appendix E: Biodiversity Assessment Report

Appendix F: Construction Noise and Vibration Assessment

Appendix G: Landscape Character and Visual Impact Assessment

NSW GOVERNMENT