M1 PACIFIC MOTORWAY REPLACEMENT AND WIDENING: TUGGERAH TO DOYALSON

Review of environmental factors

AUGUST 2014

RMS 14.167
ISBN: 978-1-925093-53-7

(blank page)

Roads and Maritime Services

M1 Pacific Motorway replacement and widening: Tuggerah to Doyalson

Review of environmental factors
August 2014

Prepared by SMEC Australia

Document tracking

Revision	Details	Date	Amended by
0	Draft REF	30/09/13	Peter Fawcett
1	Draft REF - revision 1	28/03/14	Peter Fawcett
2	Draft REF - revision 2	18/06/14	Peter Fawcett
3	Draft REF - revision 3	11/07/14	Simon Cusack
4	Final REF	25/07/2014	Peter Fawcett

Executive summary

The proposal

Roads and Maritime Services (Roads and Maritime) proposes to replace the existing pavement and widen around 12.3 kilometres of the M1 Pacific Motorway (formerly known as the F3 Freeway) from two lanes in each direction to three lanes in each direction between Wyong Road, Tuggerah, and Doyalson Link Road, Kiar.

The proposal would generally involve the following:

- Provision of two additional lanes (one each northbound and southbound) on 12.3 kilometres of the M1 Pacific Motorway by techniques including pavement widening and new line-marking.
- Provision of an additional lane by new line-marking on five northbound and six southbound motorway bridges.
- Provision of an additional lane by bridge widening and new line-marking on the northbound motorway bridge over St Johns Road.
- Provision of an additional lane in each direction south of the Wyong River between Wyong Road and Wyong River (about three kilometres) by constructing a widened flexible (asphalt) pavement section in the existing central median, placing an asphalt overlay over the existing traffic lanes, and then implementing new line-marking to achieve three lanes on each carriageway.
- Replacement of the existing pavement and stabilisation of the subgrade through full removal and reconstruction of around 9.3 kilometres of rigid concrete pavement (north of the Wyong River).
- Upgrades to the existing Warnervale Interchange (Sparks Road) including a new separated northbound G-loop entry ramp that connects with the motorway north of the Doyalson Link Road off ramp, reconfiguration of intersections and approaches, and provision of a new pedestrian overbridge at Sparks Road.
- Provision of new signalised intersections at the Warnervale Interchange where Sparks Road joins the southbound motorway off ramp and where Sparks Road joins the northbound motorway on ramp.
- Upgrades to the Doyalson Link Road Interchange including reconstruction of the Doyalson Link Road northbound off ramp to extend over the proposed Sparks Road northbound extended on ramp.
- Provision for a future southbound motorway off ramp on to Doyalson Link Road and a new motorway northbound on ramp from Doyalson Link Road including a new bridge over the motorway (subject to further investigation including traffic modelling).
- Lengthening of the northbound and southbound motorway on ramps from both motorway service centres.
- Minor reconfiguration of the northbound and southbound motorway off ramps to both service centres to accommodate the widening.
- Provision of a commuter car park on the south-west corner of the Warnervale Interchange.
- Ancillary facilities to support construction activities including stockpiling, storage, concrete batching and crushing.

Need for the proposal

The M1 Pacific Motorway is a primary freight route, forming a critical part of the National Transport Network connecting Sydney, the Central Coast and Newcastle. It links with the New England Highway and Pacific Highway connecting northern NSW regional centres and Queensland. Some of the highest traffic volumes in Australia are recorded on the motorway between Sydney and Newcastle and the motorway is predicted to experience increasing congestion in the future particularly during peak periods.

The proposal has been developed in response to the need to replace the existing pavement which has severe cracking along much of its length. The existing pavement has a residual life of about five years. The work activities for the replacement of the existing asset are consistent with similar pavement replacement and maintenance activities routinely undertaken by Roads and Maritime across its road network, albeit on a much larger scale.

The proposal is one of a series of upgrades to sections of the M1 Pacific Motorway which aim to provide a six lane divided motorway between Sydney and the Doyalson interchange. The proposal provides for the upgrade of critical infrastructure consistent with Government strategic planning at the National, State and subregional levels. It would provide for reduced travel times, improved road safety and improved freight efficiency.

Options considered

The following alternatives were addressed:

- Do nothing option.
- Design options, including:
    - Proposal alignment options for the main carriageway.
    - Pavement replacement options.
    - Bridge widening options.
    - Warnervale Interchange options.
    - Doyalson Link Road Interchange options.
- Construction ancillary site options.
- Construction working hour options.

Do nothing option

The do nothing option was determined not to be feasible. The proposal would improve road safety and efficiency and replace the road pavement which is at the end of its design life.

Design options

A range of design options were assessed for each element of the proposal. These included a range of vertical and horizontal alignment options, a range of options for providing changed road network configurations at interchanges, options to use or augment the existing infrastructure and a range of options for replacing the deteriorated road pavements. The proposal was selected from a combination of these assessed options on the basis of best meeting the project objectives while providing a value for money outcome.

The preferred option includes removal and replacement of the existing pavements north of Wyong River and widening into the median south of Wyong River. It includes the provision of a third lane in each direction between Wyong Road and Doyalson Link Road. The Warnervale Interchange and the Doyalson Link Road Interchange would be upgraded.

Construction ancillary site options

A number of potential sites were considered for use as construction ancillary sites. Three sites were ultimately selected as preferred option and these have been considered as part of the proposal. These preferred sites are referred to in the Review of Environmental Factors (REF) as the Warren Road site, the Hue Hue Road site and the McPherson Road site.

Construction working hour options

The duration of the proposal construction and the associated likely disturbance to traffic and nearby sensitive receivers were considered to determine the most appropriate construction working hours for the proposal. The options considered for construction working hours were:

- Standard construction working hours, being; Monday to Friday from 7am to 6pm, Saturday from 8am to 1pm and no work on Sundays or public holidays.
- Extended construction working hours, being standard construction hours, plus the following additional times: Monday to Friday from 6am to 7am and 6pm to 8pm, Saturday from 7am to 8am and 1pm to 5pm.
- 24-hour construction, seven days a week.

Following consideration of a range of matters, it was decided to adopt extended construction working hours for the proposal. Extensive community consultation will be undertaken concurrent with the REF display and it is planned to keep the community, stakeholders and road users informed of the proposal, its likely impacts and methods to manage these impacts.

Statutory and planning framework

This proposal is assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. In this REF, Roads and Maritime also considers clause 228 of the Environmental Planning and Assessment Regulation 2000 and matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) applies to this proposal. Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

Community and stakeholder consultation

Roads and Maritime have consulted with Wyong Shire Council in accordance with Part 2 of the ISEPP. Consultation with other public authorities has also been undertaken including NSW Office of Water, Planning and Infrastructure, Transport for NSW, Office of Environment and Heritage, and Gosford City Council.

The proposal was announced to the community on 18 October 2013 and a public comment period was undertaken from 18 October 2013 to 13 December 2013. The participation and communication activities conducted during this period included a community update mail out to about 13,000 local residents and businesses,

community information sessions, information about the proposal posted on the Roads and Maritime website, newspaper advertising and the provision of a Question and Answer (Q&A) sheet for the proposal.

Environmental impacts

A number of detailed technical investigations were undertaken to assess the potential impacts of the proposal and associated works, and to identify safeguards and management measures to mitigate these impacts. The major environmental impacts associated with the proposal are related to:

- Traffic and transport.
- Noise and vibration during construction.
- Traffic noise during operation.
- Biodiversity.

Traffic and transport

The proposal would result in improvement to traffic and transport in the regional road network. The proposal would reduce traffic congestion and improve safety for all road users. The provision of a third lane in each direction on the motorway would increase average travel speeds through the corridor.

Upgrades proposed at the Warnervale Interchange would result in reduced congestion and improved network efficiency. The provision for cyclists and pedestrians along Sparks Road would be enhanced with a new shared pedestrian/cyclist bridge constructed to the immediate north of the Sparks Road bridge over the motorway.

At the Doyalson Link Road Interchange two new motorway ramps are being investigated which would provide; a southbound motorway off ramp onto Doyalson Link Road and a northbound motorway on ramp from Doyalson Link Road. Staging options for the construction of these ramps are still being considered. The provision of these new ramps would increase accessibility to and from the motorway network and provide improved travel times for a number of journeys, however the construction of these ramps will be subject to further design and investigation including traffic modelling.

Impacts on traffic would occur during the construction period. Construction is expected to take about three and a half years. Construction staging for the proposal would necessitate reduced speed limits and other forms of traffic management. There would be additional traffic generated during this period from construction vehicles, plant and machinery.

Noise and vibration during construction

Roads and Maritime is proposing to use extended working hours for the duration of the proposal construction in order to reduce the duration of construction. Extended working hours would consist of an additional time at the start and end of each working day when compared to standard construction working hours. The proposed working hours are Monday to Friday from 6am to 8pm, Saturday from 7am to 5pm with no work on Sundays or public holidays. Some critical work would also be undertaken beyond extended hours (during the night time).

Noise modelling has been undertaken to determine the impact of planned working

hours on sensitive receivers located near the proposal area. Based on the construction activities, plant and equipment that would be used to construct the proposal, construction noise is expected to exceed guideline levels at some sensitive receivers.

The number of receivers where construction noise is predicted to exceed the management levels would depend on the proposal staging. As the construction effort progresses along the motorway over time, receivers would not be exposed to line of sight view of noisy activities for an extended period of time. There would be periodic exposure during different construction stages.

Roads and Maritime is planning a range of mitigation measures aimed at reducing construction noise. Roads and Maritime will communicate directly with residents who are predicted to experience construction noise impacts.

Traffic noise during operation

Assessment of operational noise for the proposal was undertaken for the years 2019 and 2029. In 2019 noise at 142 sensitive receivers (mostly residential dwellings) during the day and at 160 sensitive receivers during the night is predicted to exceed the applicable operational noise criteria. Of these, 53 sensitive receivers in the day and 60 sensitive receivers in the night would be acutely affected by operational road noise.

Traffic noise at residences will be addressed with consideration of reasonable and feasible noise management measures. Measures may include architectural treatments to houses that are assessed to be acutely affected, once the detailed design is complete.

Biodiversity

The proposal is expected to require the clearing of up to 18 hectares of native vegetation, including about 5.5 hectares in total of three endangered ecological communities (EECs).

Three ecological communities listed under the TSC Act as endangered were identified within the proposal area. These are: Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (SSFCF), River Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEFCF) and Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion (LHSGIF). The proposal was assessed as not likely to result in a significant impact on these EECs, however biodiversity offsetting of this impact is being considered.

No threatened flora species were observed within the proposal area. However, reliable records from the OEH Wildlife Atlas of *Tetratheca juncea* and *Grevillea parviflora* subsp. *parviflora* indicate their likely presence within the proposal area. The proposal was assessed as not likely to result in a significant impact on these species.

The proposal has been assessed as having the potential to affect 21 fauna species listed under the *Threatened Species Conservation Act 1995* however the proposal is not likely to result in a significant impact on these species.

The proposal has the potential to impact upon SEPP14 wetlands and on SEPP44 koala habitat.

Justification and conclusion

The M1 Pacific Motorway widening and replacement, Tuggerah to Doyalson proposal would best address the Roads and Maritime objectives for this transport corridor. The proposal is justified because it provides value for money in addressing the proposal objectives. These include replacing the existing deteriorated pavements along the corridor, reducing congestion and increasing the safety of the corridor for all road users.

The proposal is consistent with Government strategic planning at Commonwealth, State and regional levels. It would reduce predicted future congestion and provide the capacity to accommodate future traffic growth. Replacement of the existing deteriorated road surfaces would improve the safety and amenity of the motorway and this would substantially reduce maintenance disturbance and costs.

The proposal would improve safety through the construction of additional traffic lanes, improvements to intersections, the formalisation of commuter car parking and with the installation of new signalised intersections and improved interchange design.

This REF finds the proposal is unlikely to have a significant impact on the environment and therefore an environmental impact statement (EIS) is not required.

Display of the review of environmental factors

This review of environmental factors is on display for comment between 6 August 2014 and 3 September 2014. You can access the documents in the following ways:

Internet

The documents will be available as pdf files on the Roads and Maritime Services website at http://www.rms.nsw.gov.au/roadprojects/projects/central_coast_region/m1_motorway/tuggerah_doyalson/index.html

Display

The review documents can be viewed at the following locations:

- Tuggerah Library and Council Services

  Westfield Tuggerah, 50 Wyong Road, Tuggerah NSW 2259

  Monday - Friday 9:00am - 5:30pm

  Saturday 9:00am - 3:00pm

  Telephone (02) 4350 1560

- Lake Haven Library and Council Services

  Lake Haven Shopping Centre, Goobarabah Ave, Lake Haven NSW 2263

  Monday - Friday 9:00am - 5:30pm

  Saturday 9:00am - 3:00pm

  Sunday 10:00am - 2:00pm

  Telephone (02) 4350 1570

- The Entrance Library and Council Services

211a The Entrance Road, The Entrance NSW 2261

Monday - Friday 9:30am - 4:30pm

Saturday 9:00am - 12 noon

Telephone (02) 4350 1550

- Bateau Bay Library

  Bateau Bay Square, 10 Bay Village Road, Bateau Bay NSW 2261

  Monday - Friday 9:00am - 5:30pm

  Saturday 9:00am - 3:00pm

  Telephone (02) 4350 1580

Purchase

The review documents are available for purchase in hard copy ($25.00) or CD ($10.00) by contacting Simon Cusack on (02) 4379 7001 (during business hours).

How can I make a submission?

To make a submission on the proposal, please send your written comments to:

Simon Cusack, Roads and Maritime Services project manager:
Roads and Maritime Central Coast office
PO Box 766
Woy Woy NSW 2256

Central.Coast.Office@rms.nsw.gov.au

Submissions must be received by 3 September 2014.

Privacy information

All information included in submissions is collected for the sole purpose of assisting in the assessment of this proposal. The information may be used during the environmental impact assessment process by relevant Roads and Maritime Services staff and its contractors.

Where the respondent indicates at the time of supply of information that their submission should be kept confidential, Roads and Maritime Services will attempt to keep it confidential. However there may be legislative or legal justification for the release of the information, for example under the *Government Information (Public Access) Act 2009* or under subpoena or statutory instrument.

The supply of this information is voluntary. Each respondent has free access at all times to the information provided by that respondent but not to any identifying information provided by other respondents if a respondent has indicated that the representation should be kept confidential.

Any respondent may make a correction to the information that they have provided by writing to the same address the submission was sent.

The information will be held by the Roads and Maritime Services, Roads and

Maritime Central Coast office, 29-37 George St Woy Woy NSW 2256.

What happens next?

Following the submissions period, Roads and Maritime will collate submissions. Acknowledgement letters will be sent to each respondent. The details of submission authors will be retained and authors will be subsequently advised when project information is released. After consideration of community comments Roads and Maritime will determine whether the proposal should proceed as proposed, or whether any alterations to the proposal are necessary. The community will be kept informed regarding this Roads and Maritime determination.

If the proposal is approved, Roads and Maritime Services proceeds with final design and tenders are called for construction of the project.

If you have any queries, please contact the Roads and Maritime project manager Simon Cusack on (02) 4379 7001 (during business hours).

Contents

List of figures

Appendices

1 Introduction

1.1 Proposal identification

Roads and Maritime Services (Roads and Maritime) is proposing to replace and widen around 12.3 kilometres of the Pacific Motorway (or M1 Pacific Motorway) to six lanes between Wyong Road, Tuggerah, and the Doyalson Link Road, Kiar. The proposal is located in the Wyong local government area (LGA) and Roads and Maritime Hunter region. The location of the proposal in a regional context is shown in the inset on Figure 1-1.

The motorway is located between the Tuggerah Lakes system to the east and the ridges of the Watagan Forest to the west. The land to either side of the motorway is generally heavily vegetated interspersed with areas of rural residential and urban development. The proposal crosses Deep Creek and the Wyong River and contains six twin bridges. The motorway passes over several local roads but does not intersect them. Motorway service centres, accessed via separate on and off ramps, are located on both the northbound and southbound carriageways around three kilometres south of the Warnervale Interchange. The landscape is generally flat through this section of the motorway. SEPP 14 wetlands have been identified to the east of the proposal in the northern section.

The M1 Pacific Motorway (formerly F3 Freeway), extends 127 kilometres between Sydney and Newcastle. It is a primary freight route, forming a critical part of the National Transport Network. About 65,000 motorists and 7,000 freight vehicles travel daily between Sydney, the Central Coast and Newcastle. At its northern extent the motorway links with the New England Highway and the Pacific Highway providing connections to northern NSW regional centres and Queensland.

The F3 Freeway was originally planned in the 1950s to provide a road of freeway standard between Sydney and Newcastle. The section between the Hawkesbury River and Mount White was the first to be completed and was opened in 1965. The section between Wyong Road, Tuggerah, and the Doyalson Link Road, Kiar was constructed in the mid-1980s and first opened to traffic in 1986. The F3 Sydney – Newcastle Freeway operated as a tollway until 1988 when it became part of the National Highway network.

High traffic volumes are recorded on the M1 Pacific Motorway between Sydney and Newcastle, with the southern section experiencing the greatest traffic flow. The motorway is subject to congestion, particularly during peak periods.

The proposal would generally involve the following:

- Provision of two additional lanes (one each northbound and southbound) on 12.3 kilometres of the M1 Pacific Motorway by techniques including pavement widening and new line-marking.
- Provision of an additional lane by new line-marking on five northbound and six southbound motorway bridges.
- Provision of an additional lane by bridge widening and new line-marking on the northbound motorway bridge over St Johns Road.
- Provision of an additional lane in each direction south of the Wyong River between Wyong Road and Wyong River (about three kilometres) by constructing

a widened flexible (asphalt) pavement section in the existing central median, placing an asphalt overlay over the existing traffic lanes, and then implementing new line-marking to achieve three lanes on each carriageway.

- Replacement of the existing pavement and stabilisation of the subgrade through full removal and reconstruction of around 9.3 kilometres of rigid concrete pavement (north of the Wyong River).
- Upgrades to the existing Warnervale Interchange (Sparks Road) including a new separated northbound G-loop entry ramp that connects with the motorway north of the Doyalson Link Road off ramp, reconfiguration of intersections and approaches, and provision of a new pedestrian overbridge at Sparks Road.
- Provision of new signalised intersections at the Warnervale Interchange where Sparks Road joins the southbound motorway off ramp and where Sparks Road joins the northbound motorway on ramp.
- Upgrades to the Doyalson Link Road Interchange including reconstruction of the Doyalson Link Road northbound off ramp to extend over the proposed Sparks Road northbound extended on ramp.
- Provision for a future southbound motorway off ramp on to Doyalson Link Road and a new motorway northbound on ramp from Doyalson Link Road including a new bridge over the motorway (subject to further investigation including traffic modelling).
- Lengthening of the northbound and southbound motorway on ramps from both motorway service centres.
- Minor reconfiguration of the northbound and southbound motorway off ramps to both service centres to accommodate the widening.
- Provision of a commuter car park on the south-west corner of the Warnervale Interchange.
- Ancillary facilities to support construction activities including stockpiling, storage, concrete batching and crushing.

An overview of the proposal is shown in Figure 1-1.

The objectives of the proposal are described in Section 2.3 and include:

- Replacement of the existing deteriorating road pavement.
- Reducing travel times and congestion through the addition of one northbound and one southbound travel lane.
- Providing for future predicted local, regional and interstate traffic growth.
- Reducing the crash rate on the M1 Pacific Motorway.

The capital cost of the proposal is estimated to be between $220 million and $260 million. The proposal is identified in the ‘F3 Productivity Package’. Funding for the proposal and three other projects in the package was identified in the Nation Building Agreement 2014-15 to 2018-19, with commitment from the Federal Government to provide funding of up to $195.8 million for the estimated $391.6 million cost of the four projects. The NSW Government would provide the balance of funds towards the proposal.

Construction is proposed to start in 2016 and would be expected to take around three and a half years to complete.

Figure 1.1 Proposal overview and location

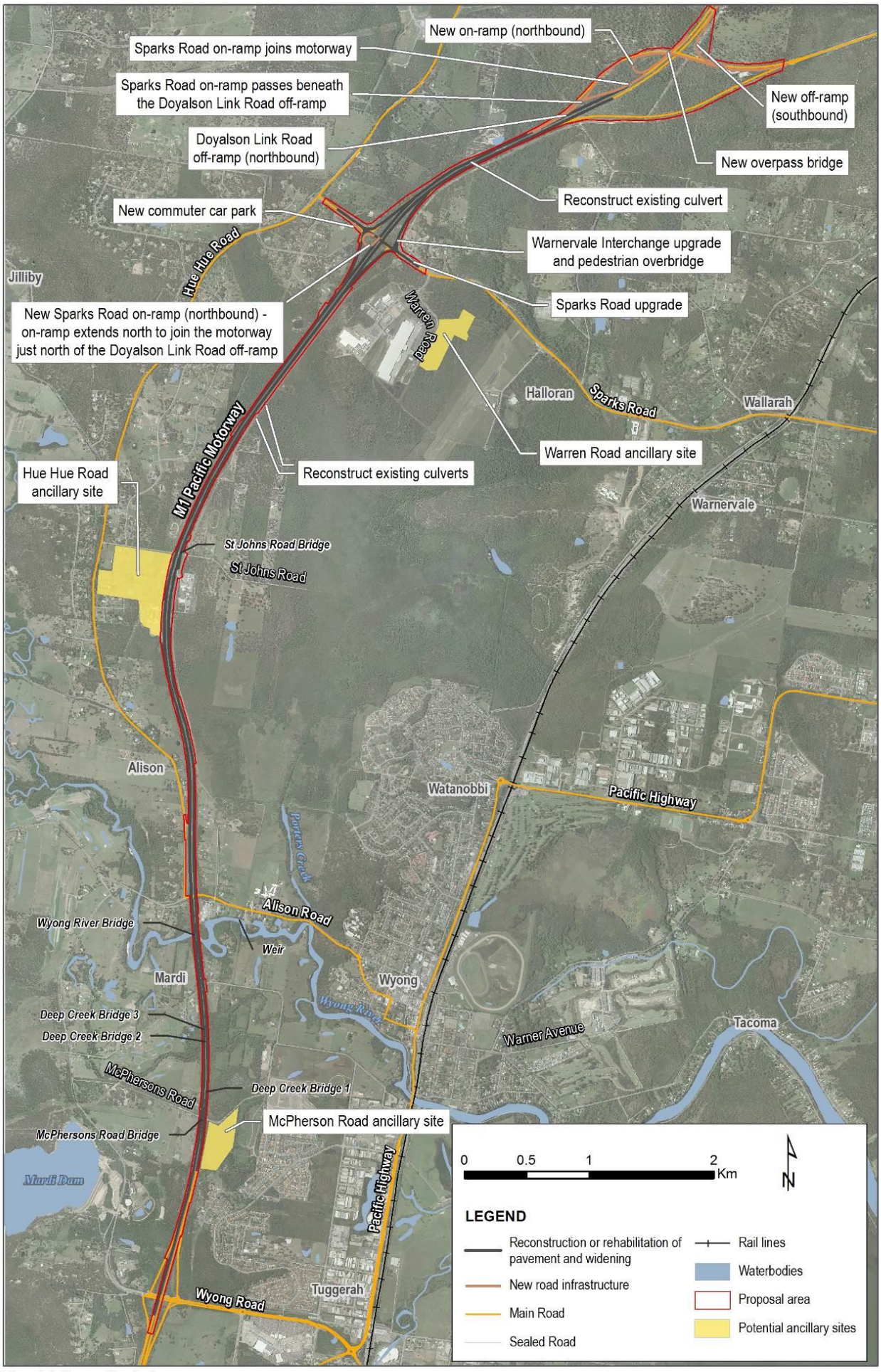


Figure 1.2 Proposal key features

1.2 Purpose of the report

This REF has been prepared by SMEC Australia on behalf of Roads and Maritime. For the purposes of these works, Roads and Maritime is the proponent and determining authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (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 protective measures to be implemented.

The description of the proposed works and associated environmental impacts have been undertaken in context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the REF helps to fulfil the requirements of section 111 of the EP&A Act, which requires that Roads and Maritime examines and takes into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

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 and Infrastructure under Part 5.1 of the EP&A Act.
- The significance of any impact on threatened species as defined by the TSC Act and/or FM Act, in section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement.
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

(blank page)

2 Need and options considered

2.1 Strategic need for the proposal

The proposal has been developed in response to the need to replace the existing pavement which has severe cracking along much of its length. The existing pavement has a residual life of about five years. The work activities for the replacement of the existing asset are consistent with similar pavement replacement and maintenance activities routinely undertaken by Roads and Maritime throughout the road network, on a greater scale.

Traffic growth predictions indicate that congestion of this section of the motorway would continue to deteriorate without the upgrade. Improvements planned at interchanges and the provision of an additional through lane on the motorway in each direction will contribute to the alleviation of this predicted congestion.

The strategic background to the proposal is drawn from a number of wider strategic plans at the national, state and subregional level, as well as for transport and road infrastructure more generally. Applicable strategic plans and their relevance to the proposal are discussed below.

Nation Building Program – Improving the National Network

The National Land Transport Network is a single integrated network of land transport linkages of strategic national importance, which is funded by Federal, State and Territory Governments. The National Network is based on national and inter-regional transport corridors including connections through urban areas, links to ports and airports, rail, road and intermodal connections that together are of critical importance to national and regional economic growth development and connectivity. The Sydney to Newcastle M1 Pacific Motorway is part of the National Land Transport Network.

The Federal Government has stated a commitment to contributing to the development of an integrated National Network which:

- Improves national and inter-regional connectivity for people, communities, regions and industry.
- Improves national, inter-regional and international logistics and trade.
- Enhances health, safety and security.
- Is consistent with the obligation to current and future generations to sustain the environment.
- Is consistent with viable, long-term economic and social outcomes.
- Is linked effectively to the broader transport network.

The proposal is consistent with these objectives.

In May 2013, the Federal Budget for 2013-2014 announced the “F3 Productivity Package” comprising four packages of work:

- Kariong Interchange to Somersby Interchange widening.
- Kariong Interchange ramp upgrades.
- Tuggerah to Doyalson widening (this proposal).

- Weakleys Drive Intersection.

The objectives of the Productivity Package are to improve productivity through reduced travel times and improved freight network connectivity.

National Infrastructure Plan

The National Infrastructure Plan (Infrastructure Australia, 2013) was released in July 2013 outlining a clear set of actions over the next 50 years to drive infrastructure development in Australia. The Plan includes the latest update of Infrastructure Australia's Infrastructure Priority List, with the M1 Pacific Motorway widening and replacement, Tuggerah to Doyalson being identified as NSW's only threshold project which is the second highest priority rating, only behind the Pacific Highway upgrade which was confirmed as 'Ready to proceed' (or priority 1).

The Office of the Infrastructure Coordinator (June 2013) noted that "moving people more efficiently from the Central Coast to Sydney will contribute to Infrastructure Australia's strategic priority of 'developing our cities and regions' through improving access to job markets".

Sydney-Brisbane Corridor Strategy

The Sydney-Brisbane Corridor Strategy (DTRS, 2007) is part of the National Network strategic planning development which builds on existing state government planning. The Sydney–Brisbane Corridor is one of the busiest links on the Australian transport network. Forty per cent of Australia's population lives along the corridor. The Sydney–Brisbane transport corridor caters for passenger and commercial freight traffic moving between Sydney and Brisbane. It links major towns and regional centres and is an important tourism route. With local and regional passenger and freight movement between Sydney and Brisbane expected to triple over the next 20 years, road congestion and capacity constraints on the M1 Pacific Motorway are expected to increase substantially. The 2007 report projected that on the subject section of the motorway, the traffic volume is expected to grow to 90,000 vehicles per day by 2029, though more recent forecasts suggest volumes in 2029 would be between 75,000 and 80,000 vehicles per day.

The Strategy identifies that managing congestion, capacity, safety and traffic issues on urban and near-urban sections of the road corridor as being a key challenge as a result of the projected growth. One of the short term priorities identified in the Strategy is to address capacity and congestion issues including on the Central Coast of NSW including along the M1 Pacific Motorway from Wahroonga to the Warnervale/Wyong area.

National Road Safety Strategy 2011-2020

The National Road Safety Strategy 2011–2020 was released on 20 May 2011 by the Australian Transport Council (ATC), with a vision that no person should be killed or seriously injured on Australia's roads. The strategy presents a 10-year plan to reduce the annual numbers of deaths and serious injuries on Australian roads by at least 30 per cent (ATC, 2011). The proposal is consistent with the strategy given it would improve the safety of both the road network, assisting to reduce injuries and fatalities including those between cyclists or pedestrians and vehicles.

High Speed Rail Study

The proposed High Speed Rail Corridor would comprise about 1,748 kilometres of dedicated route between Brisbane, Sydney, Canberra and Melbourne. The Phase 2

report (Department of Infrastructure and Transport, 2012) for the High Speed Rail Corridor confirms the recommended alignment and provides details to support civil construction cost estimates to be made. The broad corridor that has been identified would run parallel to and west of the M1 Pacific Motorway.

The study recommends the construction of the high speed rail in stages, with the Newcastle to Sydney section proposed for main construction commencement in 2037. The proposal is unlikely to impact on the high speed rail project as it would be completed prior to the commencement of the rail project and would not create a barrier to the construction of the rail project.

NSW 2021: A plan to make NSW number one

NSW 2021: A plan to make NSW number one (NSW 2021) sets the NSW Government's agenda for change in NSW. It is a 10 year plan to rebuild the economy, return quality services, renovate infrastructure, restore accountability to government, and strengthen local environments and communities (NSW Government, 2011).

The five core strategies are supported by 32 goals. Transport is one of five sectors of focus under 'Return quality services'. Achievement of the various goals identified would be driven by a range of targets and related priority actions. Relevant goals include reducing travel times, improving road safety, investing in critical infrastructure, and protecting our natural environment.

The proposal is consistent with the goal of reducing travel times because it would provide additional road capacity and alleviate future traffic congestion.

The proposal would be designed to current safety standards, would provide a higher standard of pavement and is expected to improve the current level of road safety. Reduced congestion would also improve road safety. The proposal is therefore consistent with the goal of improving road safety.

The proposal itself is an investment in critical infrastructure. The design of the proposal has been aimed to minimise impacts to the natural environment. The proposal is consistent with *NSW 2021* as it assists in achieving these goals.

NSW State Infrastructure Strategy 2012–2032

The *NSW State Infrastructure Strategy 2012–2032* was released on 3 October 2012. The Strategy builds on the NSW Government's existing public commitments and outlines a forward program of more than 70 urban and regional projects and reforms across transport, freight, aviation, energy, water, health, education and social infrastructure that should take priority over the next five, 10 and 20 years (Infrastructure NSW, 2011).

The *State Infrastructure Strategy* notes that Infrastructure NSW's assessment of infrastructure capability and forecast demand highlights a number of priorities including reducing congestion of the metropolitan road network and improving public transport services by improving speed, reliability and frequency. The proposal contributes to the achievement of these priorities.

The Strategy has analysed NSW in three parts including Greater Sydney which comprises the outer suburbs of metropolitan Sydney and the Central Coast. This region is home to 46 per cent of the State's population and contributes 34 per cent of Gross State Product (Infrastructure NSW, 2011). The Strategy recognises that Global

Sydney, Greater Sydney and Regional NSW as being interdependent and highlights the importance of identifying infrastructure investments that provide benefits for both freight and people across the whole State, such as addressing congestion around Sydney's gateways. The Strategy identifies the need for investment in new and upgraded roads as being essential to meet the transport tasks in Greater Sydney. The proposal is consistent with the objectives of the *State Infrastructure Strategy*.

NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (Transport for NSW (TfNSW), 2012a) sets the direction for transport planning for the next 20 years, providing a framework for transport policy and investment decisions that respond to key transport challenges.

The proposal is nominated in the plan as a priority for the Central Coast region. The proposal will assist in achieving the objectives of the plan by expanding and optimising the use of the transport network and easing congestion

Draft Metropolitan Strategy for Sydney to 2031

The draft Metropolitan Strategy for Sydney (DP&I, 2013) sets out the NSW Government's vision for Sydney. The strategy identifies priorities for sub-regions, including the improvement of the regional connection to the Central Coast, Newcastle, Hunter, Northern NSW and Brisbane to enhance people and freight movements. The proposal is consistent with the objectives of the Strategy.

Freight and Ports Strategy

The NSW Freight and Ports Strategy (TfNSW, 2013) sets out the NSW Government's plan to manage the efficient and effective movement of freight across the network, to reduce inefficiencies and capacity constraints and to identify actions to achieve the outcomes it promotes. The proposal is consistent with the strategic actions identified in the Strategy, including network efficiency, capacity and sustainability.

NSW Bike Plan 2010

Following the Metropolitan Transport Plan's $158 million commitment to improve urban cycle networks, the NSW Government's Bike Plan outlines how the NSW Government will work in partnership with local councils, communities and businesses to grow bike-riding over ten years. The NSW Bike Plan includes a number of actions to promote and improve cycling, including provision of shared pedestrian and cycle off-road facilities in all appropriate locations as part of State road projects in the Greater Metropolitan Region (NSW Government, 2010).

The proposal would provide for cyclists on the shoulders in both directions of the upgraded motorway, similar to the provisions for cyclists on the existing motorway. The new Sparks Road overbridge would provide shared pedestrian and cycle facilities. The proposal is consistent with the NSW Bike Plan.

Central Coast Regional Strategy

The Central Coast Regional Strategy (Department of Planning, 2008) is the NSW Government's long term land use plan for the region, which covers the Gosford City and Wyong Shire local government areas. The regional strategy contains policies and actions designed to cater for the region's projected housing and employment growth over the period to 2031. The region's population is expected to grow by around 100,000 over this period.

The Strategy acknowledges that the region is currently highly car-dependent in terms of travelling between centres, railway stations and other key destinations and there are also a large number of workers who commute out of the region for work by train and by road, predominantly by the M1 Pacific Motorway. The strategy identifies the important national and state freight function of the motorway and indicates that it is susceptible to disruption by fire and storm damage.

The proposal supports the Central Coast Regional Strategy through the provision of additional capacity on existing key regional infrastructure to support the projected growth demands for the region and to address congestion and connectivity issues. The proposal also provides a commuter car park on the south western corner of the Sparks Road and motorway interchange, supporting and encouraging current car-pooling practices.

North Wyong Structure Plan

The North Wyong Structure Plan (DP&I, 2012) aims to provide an integrated approach to the planning and delivery of land for residential and employment development. It relates to an area of about 11,500 hectares between the M1 Pacific Motorway to the west, Lake Macquarie to the north and Wyong to the south. The Plan is intended to be incorporated into the Central Coast Regional Strategy when it is next reviewed.

An objective of the plan is to consider key infrastructure requirements to support new precincts. The proposal supports this objective by providing increased capacity on the areas main transport link.

Warnervale Urban Release Area

Warnervale/Wadalba Urban Release Area is located off the M1 Pacific Motorway and is bisected by Sparks Road. It covers the suburbs of Warnervale, Hamlyn Terrace, Woongarrah, Wallarah and Wadalba. It includes a mix of new housing states, an established residential village at Warnervale, rural areas and a rural residential section. It has been identified as a growth area in metropolitan planning strategies for over 30 years. In July 2006 the Warnervale Town Centre and the Wyong Employment Zone (WEZ) were declared by the NSW Minister for Planning as state significant sites under the State Environmental Planning Policy (Major Developments) 2005.

The WEZ covers an area of over 744 hectares and has the potential to create 6,000 new jobs and an estimated $1.9 billion of new investment on the Central Coast (Wyong Shire Council, 2008). Wyong Shire Council commissioned a traffic study as part of WEZ State Significant Site investigations (ARUP, 2006). The study suggests that traffic movements along Sparks Road, east of the M1 Pacific Motorway would increase by about 15 per cent annually, from the current 12,000 vehicles per day to 33,000 vehicles per day by the year 2018. While more recent projections are for slower growth in traffic, there would still be substantial growth on Sparks Road over the next decade.

2.2 Existing road and infrastructure

The M1 Pacific Motorway corridor is the principal road corridor linking Sydney with Newcastle and areas further north including the north coast of NSW and on to Brisbane. It is currently used by more than 70,000 vehicles per day servicing long distance freight transport, a relatively large proportion of heavy vehicles, commuters

travelling between the Central Coast and Sydney and tourist traffic during holiday periods.

Capacity constraints have been identified along the motorway and are likely to increase in line with projected population growth in the region. Traffic volume on the subject section of the M1 Pacific Motorway has increased by about 1.6 per cent each year between 2007 and 2010. Recent state-wide infrastructure improvements such as the expansion of the M1 Pacific Motorway to six lanes to the south of the proposal between Wahroonga and Kariong and the opening of the Hunter Expressway towards the north of the proposal will continue to increase the traffic volume on the M1 Pacific Motorway.

The subject section of the motorway currently comprises two lanes in each direction, separated by a wide median. The central median is vegetated with plants that have naturally propagated following the motorway construction.

The M1 Pacific Motorway generally runs in a north-south direction, turning towards the east at the northern end of the proposal. The posted speed limit on the motorway is 110 km/h for the length of the proposal. The average actual speed of traffic during surveyed peak periods is substantially lower than the posted limit at 97 km/h in southbound direction and 96 km/h in the northbound direction for the AM and PM peaks.

For road links, level of service (LoS) is a qualitative measure describing operational conditions within a traffic stream, and the perception of motorists and/or passengers. It considers factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and safety. There are six levels of service, designated from A to F, with LoS A representing the best operating condition and LoS F the worst. The motorway currently generally operates at LoS B during peak periods, with some areas including interchanges sometimes operating at LoS C or LoS D. With the predicted growth of traffic over the next ten years, the motorway level of service is predicted to become worse.

Analysis of crash data indicates that crash rates in the proposal area are already substantially higher than in other comparable sections of motorway. The current crash rate in the proposal area is 3.6 crashes per kilometre per year.

There are no dedicated pedestrian or cyclist facilities provided along the motorway, although cyclists are able to use the northbound and southbound shoulders. No parking or stopping is permitted along the motorway, however along the length of the proposal there are 11 breakdown bays with emergency telephones, one variable message sign (VMS) and five emergency cross-over points.

The motorway passes over and under several local roads but does not intersect with them except via grade separated interchanges, Warnervale Interchange and Doyalson Link Road Interchange. The distance between the Warnervale Interchange and the Doyalson Link Road Interchange is about one kilometre. This relatively short distance between interchanges results in a ‘merge and weave’ safety issue caused by northbound vehicles entering from Sparks Road merging right, while vehicles exiting at the Doyalson Link Road off-ramp are merging left.

An emergency access intersection is provided between the motorway northbound carriageway and Hue Hue Road about 550 metres north of the Alison Road overpass Temporary traffic barriers have been placed across the access to prevent vehicles moving between the motorway and Hue Hue Road at this location other than under

direction as part of approved traffic management or incident management arrangement.

Northbound and southbound motorway service centres are located about three kilometres south of the Warnervale Interchange. The existing on-ramps providing access to the motorway from the service centres are not long enough for some heavy vehicles to accelerate to motorway traffic speed. This causes through traffic on the motorway to merge into the centre lane to avoid reducing speed as heavy vehicles enter the motorway.

The existing pavement is constructed from asphalt south of the Wyong River and from concrete north of the Wyong River. The concrete pavement is in poor condition and is close to the end of its design life. Pavement maintenance and repair costs are an ongoing substantial expense. The poor pavement condition also increases vehicle operating costs by way of increasing wear and tear on vehicles.

2.2.1 Interchanges

Sparks Road generally accommodates one lane of through traffic in each direction and a kerbside cycleway on each shoulder. Sparks Road widens to accommodate turning lanes onto the motorway, into private property and into intersecting local roads in the vicinity of the motorway interchange..

The posted speed limit of Sparks Road is 70 km/h. The interchange with the M1 Pacific Motorway is a grade separated diamond configuration catering for all movements. Movements on and off the motorway in the northbound direction are signalised. Movements on and off the motorway in the southbound direction are not signalised. Sparks Road carries about 12,000 vehicles per day.

At the Doyalson Link Road Interchange a northbound motorway off ramp connects with Doyalson Link Road via a bridge that crosses over the motorway. Doyalson Link Road in this direction provides two lanes and has a posted speed limit of 100 km/h. There is currently no on ramp provided for traffic travelling on Doyalson Link Road wishing to proceed northbound on the motorway.

In the southbound direction Doyalson Link Road connects to the motorway via a southbound motorway on ramp. There is currently no off ramp for southbound traffic on the motorway needing to join Doyalson Link Road.

About six kilometres east of the Doyalson Link Road Interchange, Doyalson Link Road connects with the Pacific Highway. Doyalson Link Road carries about 17,000 vehicles per day (in 2010).

2.2.2 Bridges and drainage

The existing motorway includes six twin bridges as follows:

- McPhersons Road bridge.
- Deep Creek bridge No.1.
- Deep Creek bridge No.2.
- Deep Creek bridge No.3.
- Wyong River bridge.
- St Johns Road bridge.

Drainage across the motorway is provided beneath bridges and through a series of concrete box culverts and concrete pipe culverts. Pavement drainage is generally provided for with pits, pipes and swale drains.

2.3 Proposal objectives

The objectives of the proposal are as follows:

- Reduce travel times and congestion and provide for future predicted local and regional traffic growth by increasing capacity of the M1 Pacific Motorway from two to three lanes in each direction between Tuggerah Interchange and Doyalson Link Road Interchange.
- Reduce the crash rate of the subject section of the M1 Pacific Motorway particularly with regard to the high number of crashes that occur when the road surface is wet.
- Widen within the existing M1 Pacific Motorway corridor road reserve with a view to reducing the construction footprint and impact on remnant vegetation and biodiversity in general.
- Maintain or improve the visual driving experience and amenity in this section of the M1 Pacific Motorway so as to be consistent with the styles and themes of the sections to the north and south forming a continuous corridor from an urban design and landscape design perspective.
- Minimise disruptions and delays to traffic during construction and ensure that road users are keep informed of travel conditions during works.
- Minimise the broader social and environmental impacts of the development.
- Achieve an overall proposal result that provides the best value for money for the entire project lifecycle.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

An Options Assessment Report (Roads and Maritime, 2013) was prepared to summarise the investigations associated with the development of potential options for the proposal. As part of the options development process, a pavement options workshop was held to examine the issues and potential options associated with pavement rehabilitation on this section of the M1 Pacific Motorway. This was also informed by a technical feasibility report on pavement options prepared by the Roads and Maritime Road Pavement and Geotechnical Engineering team.

Roads and Maritime considered the relative advantages and disadvantages of each option against the proposal objectives, engineering considerations, design performance, value for money, safety and property impacts. Given the importance of maintaining reliable traffic conditions on the M1 Pacific Motorway, the options considered were further assessed against their relative ability to accommodate construction under live traffic conditions.

Roads and Maritime undertook modelling to test the performance of the short listed options, where relevant. Further detail of the options selection process is included in the following sections.

2.4.2 Identified options

Options identified and discussed in this section focus primarily on design elements along the existing motorway corridor and the options to construct the preferred design. Broader alternatives to the proposal were considered in the context of the original motorway design which provides elements such as a wide median to accommodate widening. Other transport initiatives such as the proposed High Speed Rail Corridor are considered complementary and address longer-term transport needs for NSW.

Do nothing option

In considering broader alternatives to the proposal, the do nothing option was examined. Under this option the pavement would not be replaced, the motorway would remain as two lanes in each direction between Tuggerah and Doyalson and the Warnervale and Doyalson Link Road interchanges would not be upgraded.

Design options considered

Following confirmation of the need to widen the existing motorway from two lanes to three, design options were identified for each of the following discrete elements of the design:

- Proposal alignment options.
- Pavement replacement options.
- Bridge widening options.
- Warnervale Interchange (Sparks Road) options.
- Doyalson Link Road options.

These options are described in further detail under the headings below.

Proposal alignment options for the main carriageways

A number of different vertical and horizontal alignment options for the main carriageways were considered during the options investigation process. These options are briefly described below.

- Matching existing horizontal and vertical alignments - This option would match the existing horizontal and vertical geometry of the motorway alignment with the new design elements. The guardrails and shoulder areas to the left of each carriageway would be retained. Widening would generally be extended from this limit into the central median.
- Variation of vertical and horizontal alignments – This option would build new pavement on top of the existing pavement formation. The additional resulting height of the pavement would necessitate batter widening on each side of both carriageways.
- Modification of pavement cross fall - This option was considered because the motorway terrain is relatively flat making drainage of the carriageways problematic. This option would provide new pavement constructed on top of the existing pavement. The new pavement would be graded to provide enhanced cross fall on each carriageway. Increased height of pavement would necessitate some additional battering on the motorway shoulders.

Pavement replacement and widening options

Three options were considered for the replacement and widening of the existing pavement. All options were consistent for the southern three kilometre section between Wyong Road and Wyong River. Under each option, the additional lane in each direction would be achieved by constructing a widened flexible (asphalt) pavement section in the median, placing an asphalt overlay over the existing traffic lanes, and then implementing new line-marking to achieve three lanes on each carriageway. The broad pavement replacement and widening options considered for the concrete pavement section are described below:

- Complete replacement of all existing concrete pavement - This option would require the full removal and replacement all of the existing concrete pavement and the underlying sub grade material. This option recognised the severe failing in the existing pavement and sub grade material. It took consideration of the risk that overlaying pavements on flawed existing pavements could result in rapid failure or accelerated dilapidation of the new pavements.
- Overlay of the existing concrete payment - This option sought to reduce the amount of disturbance and materials required during construction by overlaying the existing pavement with a new flexible pavement layer and then establishing a new concrete layer on top of this. This option would have minimised some construction risk and traffic disruption. However, the longevity of the new pavement could not be assured.
- Provision of flexible asphalt pavement widening into the median - This option considered the provision of asphalt pavement widening into the central median adjacent the existing concrete pavement. This option was considered to present the lowest cost options with the least impact to traffic in the short term. However, the option would leave the existing failing concrete pavement in place and an extensive program of reconstructing sections of concrete slabs as or just prior to failure would be required over the next five to ten years.

Bridge widening options

Two motorway bridge widening options were considered, as follows:

- Retaining the existing bridges and remarking lanes - This option would involve retaining the existing motorway bridges without structural alteration and remarking the motorway lanes to provide three lanes on each bridge. This option would result in the provision of narrow shoulders on each bridge. This option is consistent with the original planning for and construction of the motorway which provided bridges for future widening to three lanes reduced shoulder widths (as shown below).

- Augmentation of existing bridges – This option would involve widening of the existing motorway bridge structures to allow for three through lanes in each direction and the provision of wide shoulders.

Warnervale Interchange options

There were a limited number of design options for treatment of the Warnervale Interchange given the constraints imposed by the existing road alignments, the width of the existing road reserves, the preference to avoid unnecessary land acquisition and the location of nearby developments.

The following options were considered for the southbound motorway on ramp and southbound motorway off ramp:

- Traffic control signals at southbound ramps intersection - This option proposed signalisation of the intersections where the southbound motorway on and off ramps meet Sparks Road.
- Roundabout at southbound ramps intersection - This option proposed a B-triple compatible roundabout at the intersection where the southbound motorway on and off ramps meet Sparks Road.

The following options were considered for the intersections with the northbound motorway on ramp:

- Maintaining signalised right turn from Sparks Road westbound onto the northbound motorway on ramp - This option maintained the existing access arrangement for the westbound traffic on Sparks Road wanting to travel north on the motorway.
- Provision of a G-loop northbound motorway on ramp - This option proposed a similar arrangement to that recently completed at the Tuggerah interchange with a 'G-loop' arrangement for westbound traffic on Sparks Road wanting to travel north on the motorway. This would enable traffic to turn left into the new G-loop on-ramp, thereby avoiding the need for eastbound traffic on Sparks Road to be stopped by traffic turning right at signals.

The current arrangement of the interchange overlaid with the proposal elements is provided in Figure 3-3.

Doyalson Link Road Interchange options

An existing traffic weave and merge issue exists for motorists travelling northbound between the Warnervale Interchange northbound motorway on ramp and the Doyalson Link Road northbound motorway off ramp. The proximity of these two ramps presents a safety risk as traffic interacts during merges onto and off the motorway over a relatively short distance. The following options for addressing improvements to the northbound off ramp onto Doyalson Link Road were considered:

- Sparks Road northbound on ramp lane extended to just north of the Doyalson Link Road off ramp - This option extends from the Sparks Road G-loop on ramp option (described above), to provide a separated additional lane along the western side of the northbound carriageway. The additional lane would pass beneath the Doyalson Link Road northbound off ramp before connecting with the motorway.
- New Doyalson Link Road off ramp - This option involves providing a new northbound Doyalson Link Road off ramp about 250 metres north of the existing exit and reducing the design and posted speeds on Doyalson Link Road from the current arrangement. This option would reduce the required length of the ramp and move the off-ramp diverge further away from the Sparks Road Interchange. The existing off ramp would need to be decommissioned or could be maintained for incident traffic management.

To provide additional capacity for the Doyalson Link Road Interchange, options were investigated to provide for additional movements. The following options for additional ramps were considered:

- New southbound off ramp – Currently, traffic traveling south on the motorway cannot exit onto Doyalson Link Road. This option would provide a new motorway exit connecting southbound motorway traffic to Doyalson Link Road, eastbound. The new off ramp would be constructed on a fill formation.
- New northbound on ramp – This option would provide for traffic westbound on Doyalson Link road to connect northbound onto the motorway. This option would involve widening Doyalson Link Road at its current diverge about 600 metres east of the motorway to provide a new westbound lane alongside the existing eastbound lanes. The new westbound lane would cross over the motorway on a new bridge and the northbound motorway on ramp would be provided by a new loop located between the existing northbound Doyalson Link Road off ramp and the northbound carriageway of the motorway.

The proposed new ramps between the motorway and Doyalson Link Road are subject to further design and investigation, including traffic modelling to confirm if they will form part of the construction package.

The current arrangement of the interchange overlayed with the proposal elements is provided in Figure 3-5.

Construction ancillary site options

The proposal would require specific construction ancillary sites to be established and used during the construction phase. Ancillary sites would need to be appropriately sized, have good motorway access and be otherwise fit for purpose against a range of criteria.

The options identified were shortlisted from 12 properties located directly adjacent to or nearby the motorway that were initially nominated for consideration as construction ancillary sites. One option considered was for the 12 properties to be assessed for suitability during a later proposal development phase by the selected construction contractor.

An alternative option considered was to undertake an assessment of the 12 proposed ancillary sites against the typical criteria used by the Department of Planning and Environment for major project approvals of ancillary sites. This process would create a ‘short list’ of properties that would be unlikely to be seriously constrained by environmental or social aspects. This option then provided for more detailed field based assessment of the short listed properties to identify the final construction ancillary site facilities that would form part of the proposal and to develop appropriate impact management measures for their use.

Construction working hour options

The duration of the proposal construction and the associated likely disturbance to traffic and nearby sensitive receivers were considered to determine the most appropriate construction working hours for the proposal. The options considered for construction working hours were:

- Standard construction working hours, being; Monday to Friday from 7am to 6pm,

Saturday from 8am to 1pm and no work on Sundays or public holidays.

- Extended construction working hours, being: Monday to Friday from 6am to 8pm, Saturday from 7am to 5pm and no work on Sundays or public holidays.
- 24-hour construction, seven days a week.

2.4.3 Analysis of options

Do nothing option

Strong population and employment growth proposed for the Central Coast, as outlined in the *North Wyong Shire Structure Plan* and the *Central Coast Regional Strategy (2006–2031)*, would substantially increase demand on the local road network and would increase the local role of the M1 Pacific Motorway. The projected population growth in the Central Coast region as well as projected increases in passenger vehicle and freight movements along the east coast of Australia suggest that congestion and its associated costs would continue to increase and add pressure to the M1 Pacific Motorway and surrounding network.

The proposed upgrade is consistent with the *National Building Program*, the *Sydney – Brisbane Corridor Strategy*, the *State Infrastructure Strategy* and other key strategic plans for the region (refer to Section 2.2). The do nothing option would not provide for consistency with these strategies and is not an acceptable option

Traffic modelling suggests that the motorway and interchanges within the proposal area would experience substantial congestion during peak hours by 2039 (refer to Section 6.1). Times of high traffic demand are predicted to spread further throughout the day and across the weekend. As the population of the local area increases the costs of increasing congestion would begin to be recognised by the community.

Analysis of crash data indicates that crash rates in the proposal area are already substantially higher than in other comparable sections of motorway. The current crash rate is 3.6 crashes per kilometre per year. Without the proposal the crash rate is predicted to increase (refer to Section 6.1).

The motorway pavement between Tuggerah Interchange and Doyalson Interchange has considerable cracking along much of its length and the existing concrete pavement has a residual design life of about five years. The poor condition of the pavement increases safety risks to the travelling public, creates additional wear on vehicles and is associated with high costs for ongoing repair and maintenance.

Given these factors, the do-nothing option was not regarded as an acceptable solution and was not considered further.

Design options

Proposal alignment options for the main carriageways

The three options considered for the alignment were modelled to understand the relative performance of each against relevant design standards. This analysis determined that each of the proposed main alignment options could provide a solution that met the proposal objectives and complied with relevant standards and guidelines. As such a hybrid of the options considered was adopted that would provide for the best value for money and which also importantly complemented the pavement replacement options selected (see section below).

The preferred option is to match the existing pavement vertical alignment for areas south of the Wyong River where flexible pavement is provided and is in good condition. Carriageway widening to provide for three lanes in each direction is into the central median with no additional lane widening proposed beyond the extent of the existing shoulders.

For areas north of the Wyong River the height of the concrete pavement would typically be increased by between 100 millimetres – 300 millimetres. A typical cross fall of about three per cent would be provided towards the motorway outside shoulders. Widening would be provided predominantly into the central median however the increased height of the pavement would require the extension of some localised minor batters on the outside of the existing carriageway shoulders.

Pavement replacement and widening options

As noted above, all options investigated relating to pavement replacement and widening were consistent for the southern three kilometre section between Wyong Road and Wyong River. Under each option, the additional lane in each direction would be achieved by constructing a widened flexible (asphalt) pavement section in the median, placing an asphalt overlay over the existing traffic lanes, and then implementing new line-marking to achieve three lanes on each carriageway.

Technical pavement engineering investigations have identified that a concrete pavement overlay or an asphalt pavement overlay over the existing plain concrete pavement would present a high risk of reflective cracking. The minimum 40 year design service life would not likely be achieved. This is in part due to the severe state of deterioration of the existing concrete pavement and in part due to the instability and lack of adequate support provided by the select/subgrade material underlying the existing pavement.

Following the assessment of pavement options it was determined that, considering the high risk of any new pavement cracking in a similar nature to the existing pavement, the option of removing and replacing the existing concrete pavement, as well as the entire base and sub-base would be the preferred option.

North of the Wyong River the existing rigid concrete pavement would be replaced by a new rigid concrete pavement. This option was considered to be of a longer term benefit by reducing the likelihood that cracking could occur in the new pavement, resulting in lower overall maintenance and improved whole-of-life cost.

Bridge widening options

Widening of the existing motorway bridge structures was identified as being very costly. Given that value for money is a major driver for the proposal, it was considered that retaining the existing motorway bridge structures would provide for better value for money.

The preferred option is to provide three lanes in each direction by re-marking the lanes within the space provided on the decks of the existing structures. The motorway bridges would have narrow shoulders under this option after the lane re-marking due to the additional space taken up by the additional lanes. The cost savings and reduced complexity of construction would be major advantages.

Warnervale Interchange options

Increased traffic demand predicted for the motorway related to proposed developments including the WEZ, was among the considerations in assessing the preferred option for the Warnervale Interchange.

The intersections at the Warnervale Interchange currently operate between LoS B in and LoS D. The traffic modelling predicts that with increased future demand, without the proposal (base case) level of service at the interchange would remain similar in 2019 however by 2029 without the proposal the interchange would operate at between LoS B and LoS F. Level of service would continue to deteriorate into 2039 and 2049 and this would represent an unacceptable level of congestion. The need to upgrade the interchange was therefore confirmed.

To upgrade the southbound ramps, the roundabout option was tested with traffic modelling. It was found to provide insufficient capacity and would result in extended queuing that would substantially affect motorway through traffic.

Similar modelling of the southbound ramps with traffic signals indicated substantial improvements in level of service in 2019 providing for an AM peak between LoS B and C and LoS B in the PM peak. In 2029 the southbound ramps would provide for LoS between B and C in the AM peak and LoS B in the PM peak. By 2049 this option would continue to provide for between LoS B and C in the peaks. Given the much better intersection performance achieved by the signalised intersections compared to the roundabout option, the signalised option is the preferred option.

For the northbound ramps, it was determined that the 'G-loop' on-ramp arrangement from the left hand lane of Sparks Road entering the motorway northbound would be result in the greatest reduction of morning and afternoon queuing. The arrangement would achieve improved motorway mainline level of service. This positive impact on traffic is also demonstrated by a similar arrangement at the recently upgraded Tuggerah Interchange.

The G-loop on-ramp option was assessed to meet acceptable design criteria for heavy vehicle motorway merge speeds. As such it was adopted as the preferred option.

Doyalson Link Road Interchange options

To address the merge and weave issue associated with Sparks Road on ramp traffic entering the motorway northbound conflicting with traffic exiting at Doyalson Link Road the two identified options were tested with traffic modelling and an analysis of the relative safety benefits. The option to extend the Sparks Road on ramp northbound to join the motorway beyond the Doyalson Link Road off ramp was favoured because it provides a longer overall on ramp from Sparks Road which would cope with more traffic and because it completely eliminates the potential merge and weave safety issue. The option of providing a new Doyalson Link road off ramp further from the Sparks Road on ramp did not produce either of the same benefits.

Value for money for the extended Sparks Road on ramp option was assessed and found to result in a minor increase in project overall cost. The additional cost was assessed to be acceptable when considered against the greater safety and traffic benefits that it provided. The option therefore forms part of the preferred option for the proposal.

Options to provide a new southbound off ramp to Doyalson Link road and to provide a new northbound on ramp from Doyalson Link Road were assessed. Preliminary investigations suggest that both proposed movements provide some benefit to the overall traffic flow and amenity. These benefits would only be fully realised when the demand from developments proposed in the *North Wyong Structure Plan* eventuate.

Allowing for the future provision of these connections appeared sensible and as such they have been assessed as part of the proposal. Further consideration and confirmation of their inclusion will occur during detailed design.

Construction ancillary site options

The initially identified 12 potential ancillary sites were subject to a desktop review against the following criteria in order to shortlist sites for more detailed field investigation:

- Be located more than 50 metres from a waterway.
- Have ready access to the road network or direct access to the construction corridor.
- Be located in areas of low ecological significance and require minimal clearing of native vegetation (not beyond that already required by the project).
- Be located on relatively level land.
- Be separated from the nearest residences by at least 200 metres (or at least 300 metres for a temporary batching plant).
- Not unreasonably affect the land use of adjacent properties.
- Be above the 20 year average recurrence interval (ARI) flood level unless a contingency plan to manage flooding is prepared and implemented.
- Provide sufficient area for the storage of raw materials to minimise, to the greatest extent practical, the number of deliveries required outside standard construction hours.
- Be located in areas of low heritage conservation significance (including identified Aboriginal cultural value) and not impact on heritage sites beyond those already impacted by the proposal.

The desktop assessment was used as the basis for eliminating seven sites from further consideration and resulted in five potential ancillary sites being shortlisted for detailed field assessment.

The five shortlisted potential construction ancillary sites were subjected to detailed site based investigations. These investigations identified that several of the shortlisted sites had constraints including sensitive vegetation communities or previously unidentified land use limitations. Field investigations eliminated a further two potential construction ancillary sites from the proposal.

The remaining three construction ancillary sites are included in the preferred option for the proposal. The sites are shown in Figure 1-2. They are assessed in this REF and referred to throughout as the Hue Hue Road site, the McPherson Road site and the Warren Road site.

Construction working hour options

Two main considerations drove decision making on the most appropriate construction working hours to adopt for the proposal. These were the likely impact of construction noise on sensitive receivers along the proposal alignment and the economic impact caused by increased travel time given construction would require reduced motorway speed limits over a considerable motorway length for an extended period of time.

In addition, the construction staging arrangements would be such that if an incident,

such as a collision or vehicle breakdown was to occur during construction, the ability for emergency vehicle response to attend or for traffic management measures to be implemented would likely be substantially constrained. As any incident during the construction phase could generate substantial delays and inconvenience a very large number of road users the shortest possible duration of construction would bring substantial benefit. Working longer hours is one way to achieve this reduced construction time frame.

An analysis was undertaken of the likely construction durations under different construction working hour options. The option of using standard working hours indicated a construction period of about four years. The option of using extended working hours would likely reduce construction time by around six months. The option of using 24 hour construction would likely further reduce the construction time by a further three to six months.

The predicted construction duration difference between using extended working hours and 24-hour construction was determined to be relatively minor. This is due to inefficiencies related to night work, construction staging issues and shift scheduling. Construction noise modelling was undertaken which indicated about 680 sensitive receivers would be likely to be exposed to construction noise exceeding that recommended in the Interim Construction Noise Guideline (ICNG). As such the construction time reductions achievable by using 24 hour construction compared to extended working hours was not considered to outweigh the substantial night time construction noise impacts on nearby sensitive receivers. The option of 24 hour construction was discounted from further consideration.

Construction noise modelling was undertaken for the extended working hour option. The modelling indicated that construction noise at about 600 sensitive receivers would be likely to exceed the ICNG recommended levels. In comparison the model predicts about 360 sensitive receivers would be affected by exceedances during standard working hours.

The predicted construction duration differences between using standard working hours and extended working hours was determined to be about six months. Reducing the construction period by about six months by using extended working hours was considered substantial and worthwhile due to the safety, economic and productivity benefits of reducing the duration of construction phase delays. These benefits would be realised for the 70,000 vehicles per day that use the motorway.

On balance, it was decided to adopt extended working hours, being Monday to Friday from 6am to 8pm, Saturday from 7am to 5pm and no work on Sundays or public holidays. Extensive community consultation is planned to keep the affected residents informed of the proposal, its likely impacts, and methods that Roads and Maritime is putting in place to manage temporary construction noise impacts.

2.4.4 Preferred option

The proposal would widen the M1 Pacific Motorway to create a third lane for the northbound and southbound carriageways. Widening would be predominantly into the central median. Existing bridges would generally be retained with no widening, however lane re-marking would provide for three lanes in each direction over bridges, with a reduced shoulder width. The northbound bridge over St Johns Road (just north of the service centre) would be widened to enable the provision of the third northbound lane and a lengthened on ramp from the service centre.

The Warnervale Interchange would be reconfigured with signalised intersections at the southbound ramps. A new G-loop on-ramp would be provided allowing westbound traffic on Sparks Road to enter the motorway in a northbound direction. The new on ramp would form into a dedicated lane that extends north to the Doyalson Link Road Interchange where it would pass beneath the Doyalson Link Road off ramp and then connect with the motorway. A new movement has been designed and assessed for future provision of a ramp so that southbound motorway traffic can turn eastbound onto Doyalson Link Road. A new connection has also been designed and assessed so that westbound traffic on Doyalson Link Road can enter the motorway in a northbound direction. These two potential new movements will be subject to further investigation and design, including traffic modelling during detailed design.

The preferred option involves full removal and replacement of the existing concrete pavement and sub grade material for both carriageways for the sections north of Wyong River. A flexible asphalt pavement will be provided south of the Wyong River and a rigid concrete pavement will be provided north of the Wyong River matching existing pavements in place south and north of the river respectively.

A more detailed description of the proposal is provided in Chapter 3.

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

Roads and Maritime proposes to replace the existing pavement and widen around 12.3 kilometres of the M1 Pacific Motorway from two lanes in each direction to three lanes in each direction between Wyong Road, Tuggerah, and the Doyalson Link Road, Kiar.

The proposal would generally involve the following:

- Provision of two additional lanes (one each northbound and southbound) on 12.3 kilometres of the M1 Pacific Motorway by techniques including pavement widening and new line-marking.
- Provision of an additional lane by new line-marking on five northbound and six southbound motorway bridges.
- Provision of an additional lane by bridge widening and new line-marking on the northbound motorway bridge over St Johns Road.
- Provision of an additional lane in each direction south of the Wyong River between Wyong Road and Wyong River (about three kilometres) by constructing a widened flexible (asphalt) pavement section in the existing central median, placing an asphalt overlay over the existing traffic lanes, and then implementing new line-marking to achieve three lanes on each carriageway.
- Replacement of the existing pavement and stabilisation of the subgrade through full removal and reconstruction of around 9.3 kilometres of rigid concrete pavement (north of the Wyong River).
- Upgrades to the existing Warnervale Interchange (Sparks Road) including a new separated northbound G-loop entry ramp that connects with the motorway north of the Doyalson Link Road off ramp, reconfiguration of intersections and approaches, and provision of a new pedestrian overbridge at Sparks Road.
- Provision of new signalised intersections at the Warnervale Interchange where Sparks Road joins the southbound motorway off ramp and where Sparks Road joins the northbound motorway on ramp.
- Upgrades to the Doyalson Link Road Interchange including reconstruction of the Doyalson Link Road northbound off ramp to extend over the proposed Sparks Road northbound extended on ramp.
- Provision for a future southbound motorway off ramp on to Doyalson Link Road and a new motorway northbound on ramp from Doyalson Link Road including a new bridge over the motorway (subject to further investigation including traffic modelling).
- Lengthening of the northbound and southbound motorway on ramps from both motorway service centres.
- Minor reconfiguration of the northbound and southbound motorway off ramps to both service centres to accommodate the widening.

- Provision of a commuter car park on the south-west corner of the Warnervale Interchange.
- Ancillary facilities to support construction activities including stockpiling, storage, concrete batching and crushing.

The alignment and design elements of the proposal are discussed in further detail in sections below.

Figure 1-2 provides an overview of the proposal. More detailed concept design drawings are provided in Appendix B.

3.2 Design

3.2.1 Design criteria

The section of the M1 Pacific Motorway between Wyong Road, Tuggerah, and the Doyalson Link Road, Kiar was constructed in the mid-1980s and first opened to traffic as the F3 Freeway. In the original design, provision was made for the future addition of a traffic lane in each direction within the central median. In addition, the bridges were all constructed to allow for re-line marking to provide for three traffic lanes with narrower shoulders. The parameters utilised in developing the design for this proposal were therefore guided by the existing carriageways with the characteristics generally relatively fixed.

The concept design for the proposal has therefore taken advantage of the space reserved in the original motorway design, while also satisfying the objectives of the proposal and considering environmental and community issues and constraints. The design components of the proposal would be generally consistent with AUSROADS *Guide to Road Design* and the Roads and Maritime supplements.

A typical cross-section of the existing motorway is provided in Figure 3-1, and an indicative cross section illustrating the proposed widening is provided in Figure 3-2. General design parameters are identified in Table 3-1.

Table 3-1: Design parameters

Item	Element	Value
Main carriageways along motorway		
Design speed	Horizontal alignment	110 kilometres per hour
	Vertical alignment	110 kilometres per hour
Road space allocation / widths	Main carriageway traffic lanes	3.5 metres (3.3 on bridges south of Alison Road)
	Shoulder lane (offside)	1.0 to 1.5 (0.7 on bridges south of Alison Road)[1]
	Shoulder lane (nearside)	3.0 (2.5 on bridges south of Alison Road)[1]
	Median width	8.0 to 16.0 metres
Minimum curve radius		1,800 metres
Maximum grades		2% south of Alison Road At 4.1% at Alison Road 2.5% north of Alison Road

[1] Width outside guideline limits proposed on existing bridges to avoid widening the bridge structures

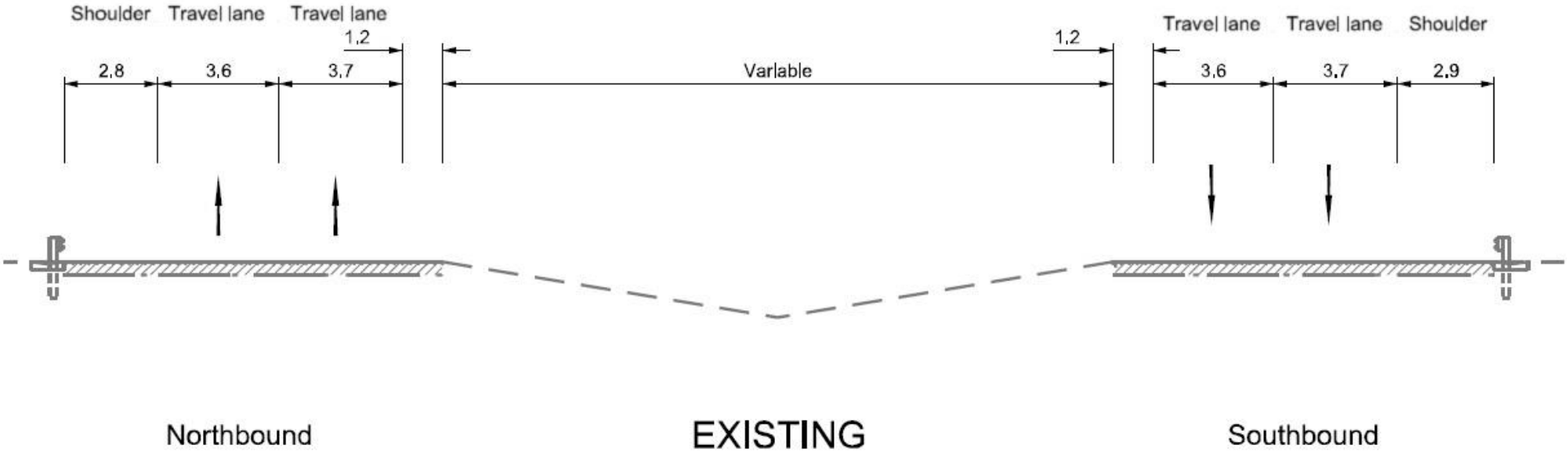


Figure 3-1: Typical existing cross section of the motorway providing two lanes in each direction

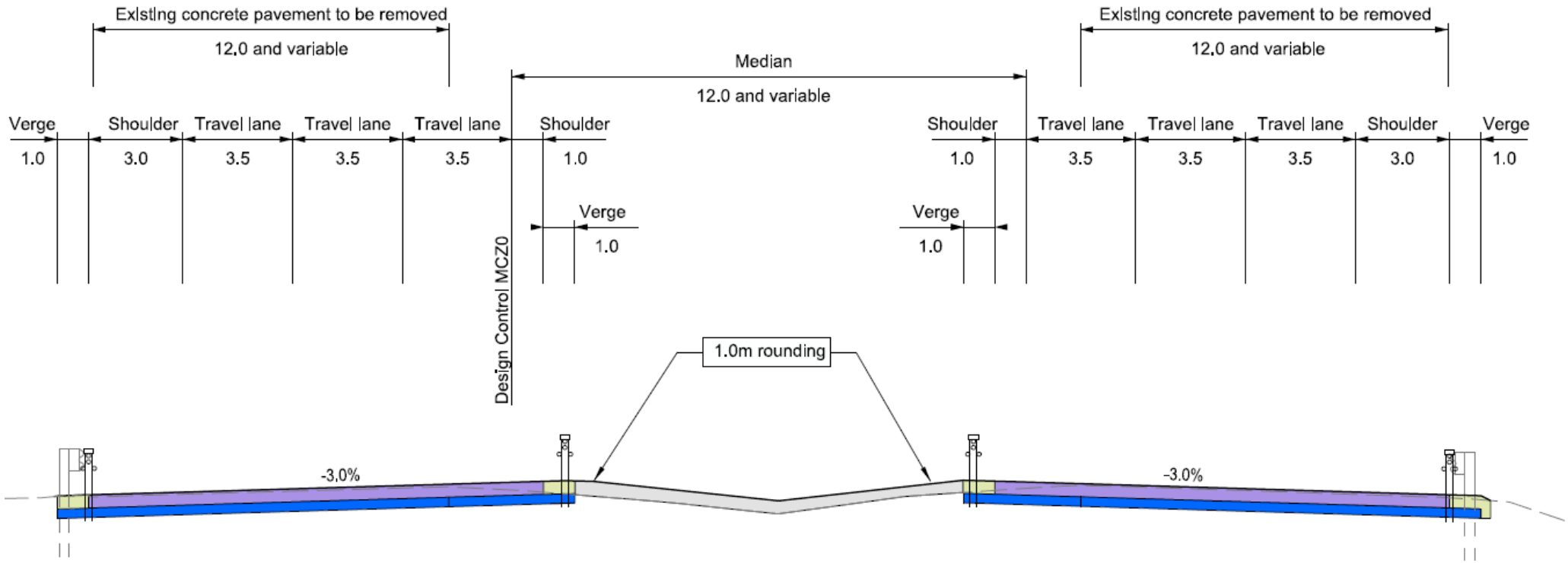


Figure 3-2: Proposed typical cross-section of the motorway providing three lanes in each direction

3.2.2 Engineering constraints

Engineering constraints have been identified through value engineering and constructability workshops. These constraints were considered during the design development:

- Ensuring worker safety given worker proximity to traffic during construction.
- Design must be able to accommodate future provision of intelligent transport system (ITS) infrastructure.
- Aquaplaning is currently an issue due to existing vertical grading being quite flat, with localised carriageway flooding north of Alison Road.
- Access to and operation of the two existing services centres should be maintained during construction.
- General traffic management during construction, including construction staging,
- The proposal would generate substantial quantities of redundant concrete pavement.
- Design issues associated with provision of new pavement over the existing Patonga Claystone sub-grade.
- Design must cater for potential underground mining development at the northern extent of the proposal.
- Bridge width design standards.
- Measures for operational incident management.

3.2.3 Urban design objectives

The broad urban design approach for the proposal is to provide a clear response to the needs of the community, and the varying landscape and urban characteristics of the motorway alignment. The proposal lies generally within the existing road corridor and passes through a well vegetated corridor surrounded by rural lands and suburban holdings set back from the road corridor varying distances.

The urban design objectives and principles for the proposal have been guided by the design principles as set out in *Beyond the Pavement* (RTA, 2009). Each of these overarching principles is supported by a set of proposal-specific objectives, as presented in Table 3-2. Additional detail about urban design objectives and principles can be found in the Urban Design, Landscape Character and Visual Impact Assessment technical report in Appendix I.

Table 3-2: Urban design objectives and principles

Objectives	Principles
Upgrade works are to improve the visual appearance and character of the road corridor	• Enhance the visual quality of the corridor. • Be constructed of appropriate materials that are contextually responsive. • Provide/establish a consistent and identifiable architectural language.
Motorway elements are to complement the surrounding setting	• Develop the corridor in a manner which is consistent with and responsive to the existing character of the corridor. • Protect and enhance the visual out look of the properties adjoining the corridor, particularly those

Objectives	Principles
	immediately adjacent.
Maintain a safe and accessible corridor	• The new works should maintain a safe and accessible corridor which reinforces safe driver behaviour and provides a pleasant and interesting travel experience. • Hard and soft landscape should be used to emphasise road geometry, yet retain views for driver safety. • Pedestrian and cycleway access should be addressed consistent with Bike Plan and design standards.
Improve connectivity	• Maintain, improve and strengthen the connectivity of the community across the motorway corridor. • Maintain and enhance key view fields within the corridor, in order to retain its connection to the surrounds and sense of progression.
Revegetation strategies need to relate to scale, composition and colour of the adjacent built form	• Revegetation should respond to natural vegetation communities. • Implement a management strategy for the long term control of weeds within the corridor.
Protect and enhance the natural systems and ecology of the corridor	• Natural vegetation communities should be enhanced. • Weed infestations should be managed and controlled. • The existing landscape character is to be strengthened so that a continuous and prominent backdrop of landscape is created and maintained. • Impacts on adjacent SEPP 14 Wetlands, Wyong River, and nearby Tuggerah Lakes should be minimised through the use of appropriate stormwater devices.
Maintenance of hard and soft landscape elements must be accessible and maintainable with minimal resources	• Achieve a simple and unified design which minimises maintenance and associated long term costs.

3.3 Design elements

This section describes each of the design elements of the proposal as they apply to the following main design features. The concept design described in this REF has been guided by the design criteria discussed in Section 3.2, environmental and community issues and constraints, and the principles of ecologically sustainable development (ESD). Further design refinements are anticipated during detailed design.

3.3.1 Replacement of the existing pavement and widening

In the three kilometre section south of Wyong River, an additional lane in each direction would be provided by constructing a widened flexible (asphalt) pavement

section in the central median adjacent the existing asphalt pavement. A thin asphalt overlay would be placed over the existing traffic lanes, and then new line-marking would be undertaken to achieve three lanes on each carriageway.

The existing 9.3 kilometre concrete motorway pavement north of Wyong River would be removed and reconstructed on both carriageways. This would involve removing the existing concrete pavement and stabilising the subgrade prior to placing a new rigid concrete pavement over the strengthened base. Pavement reconstruction is discussed further in Section 3.3.5.

The main carriageway would be widened from generally two northbound and two southbound lane carriageways with 3.7 metre wide lanes to provide three northbound and three southbound lanes, each with 3.5 metre lane widths. A cross section showing a typical lane configuration for the proposal is shown in Figure 3.2.

Lane remarking would commence on the northbound carriageway from around 150 metres south of the Wyong Road interchange (also known as the Tuggerah Interchange). The tie-in at this location would match the recently constructed upgrading work at the Tuggerah Interchange. The northbound carriageway at the Wyong Road overbridge was constructed for three through lanes, with two being currently marked and an adjacent widened shoulder. This arrangement would be altered by amending the line marking to three lanes.

The southbound carriageway currently provides for three lanes through this section. Widening to three lanes commences around 1,300 metres north of the Wyong Road overbridge where the southbound carriageway currently only provides two lanes. Widening to three lanes would continue from this location along the northbound and southbound carriageways partially within the existing median and through lane remarking until the bridge over the Wyong River. The provision of three lanes northbound and southbound over the Wyong River bridge would be accommodated wholly on the existing bridge structure by line re-marking.

North of the Wyong River the additional northbound and southbound lanes would be provided predominantly within the central median. Line re-marking and some minor widening on the outside of the carriageway is proposed in some discrete locations.

A new G-type northbound on ramp would be provided at the Warnervale Interchange. The on ramp would be separated from the main carriageway with concrete barriers. It would extend north to the Doyalson Link Road Interchange where the on ramp would pass beneath the Doyalson Link Road northbound off ramp and then would join the motorway. Upgrades to the Warnervale Interchange and Doyalson Link Road Interchange are discussed in further detail in Section 3.3.2 and Section 3.3.3.

The section of motorway extending from the north of the Warnervale interchange to the proposed new Doyalson Link Road off ramp would be widened predominantly into the central median. Line re-marking and some minor widening on the outside of the carriageway would occur in some discrete locations. The motorway would then transition from three lanes back to two lanes about 200 metres north of the Doyalson Link Road off ramp.

Existing median cross-overs for emergency and service vehicle access are anticipated to be retained, and additional new cross-overs may be provided. Cross-overs would be used during motorway incidents to manage traffic and to allow traffic contra-flows. Cross-over locations are subject to change and would be confirmed during detailed design.

Widening into the central median to provide the additional lanes would reduce the central median width to between three and 17 metres. A depressed central median longitudinal drain would generally be retained. The existing formation width would generally be retained with only isolated alteration to the existing batters anticipated.

The reconstructed concrete pavement level would typically be 100 millimetres to 300 millimetres higher than the existing pavement levels. Where necessary, additional pavement height would require battering back to the surface levels within the existing formation, generally at a 2:1 slope. Median batter slopes required for the proposal generally vary between 6:1 and 10:1 at different locations along the proposal length.

The central median would be revegetated and wire rope safety barrier would be installed to run parallel and about 1.7 metres from the edge of the right travel lane for both northbound and southbound carriageways.

3.3.2 Warnervale Interchange upgrade

Upgrades proposed for the Warnervale Interchange include:

- Converting the area that currently contains the footpath on the northern side on the Sparks Road overpass into a traffic lane.
- Construction of a separate pedestrian/cyclist bridge structure over the motorway on the northern side of the existing Sparks Road overpass around three metres wide and around 200 metres long.
- Construction of a new northbound G-loop entry ramp on a tight curve radius. The on ramp is separated from the main carriageway and extends north to join the motorway just north of the Doyalson Link Road northbound off ramp.
- Provision of a formalised commuter parking area immediately west of the Sparks Road intersection adjacent to the existing northbound off ramp. Entry to the parking area would be with a dedicated slip lane access from Sparks Road. The parking area would provide at least 60 parking spaces.
- Minor reconfiguration of intersections for the existing motorway northbound on and off ramps.
- Widening the southbound off ramp for around 180 metres to provide additional right turn lanes onto Sparks Road heading west.
- Signalising and reconfiguring the intersections between Sparks Road and the southbound motorway ramps.
- Widening along Sparks Road approaches to the interchange to provide:
  - A dedicated left turn lane onto the southbound on ramp and two through lanes approaching the motorway overbridge from the east.
  - A dedicated left turn lane onto the northbound on ramp and two through lanes approaching the motorway overbridge from the west.

The Warnervale Interchange overbridge would remain at its current width with an additional vehicle lane provided to replace the existing footpath area on the northern side. New bridge barriers and screens would likely be proposed on the northern side, but this would be confirmed during detailed design.

Figure 3-3 provides the current interchange arrangement in an aerial photograph, overlaid with the proposal elements. Figure 3-4 shows the typical cross section of the proposed Sparks Road motorway overpass.

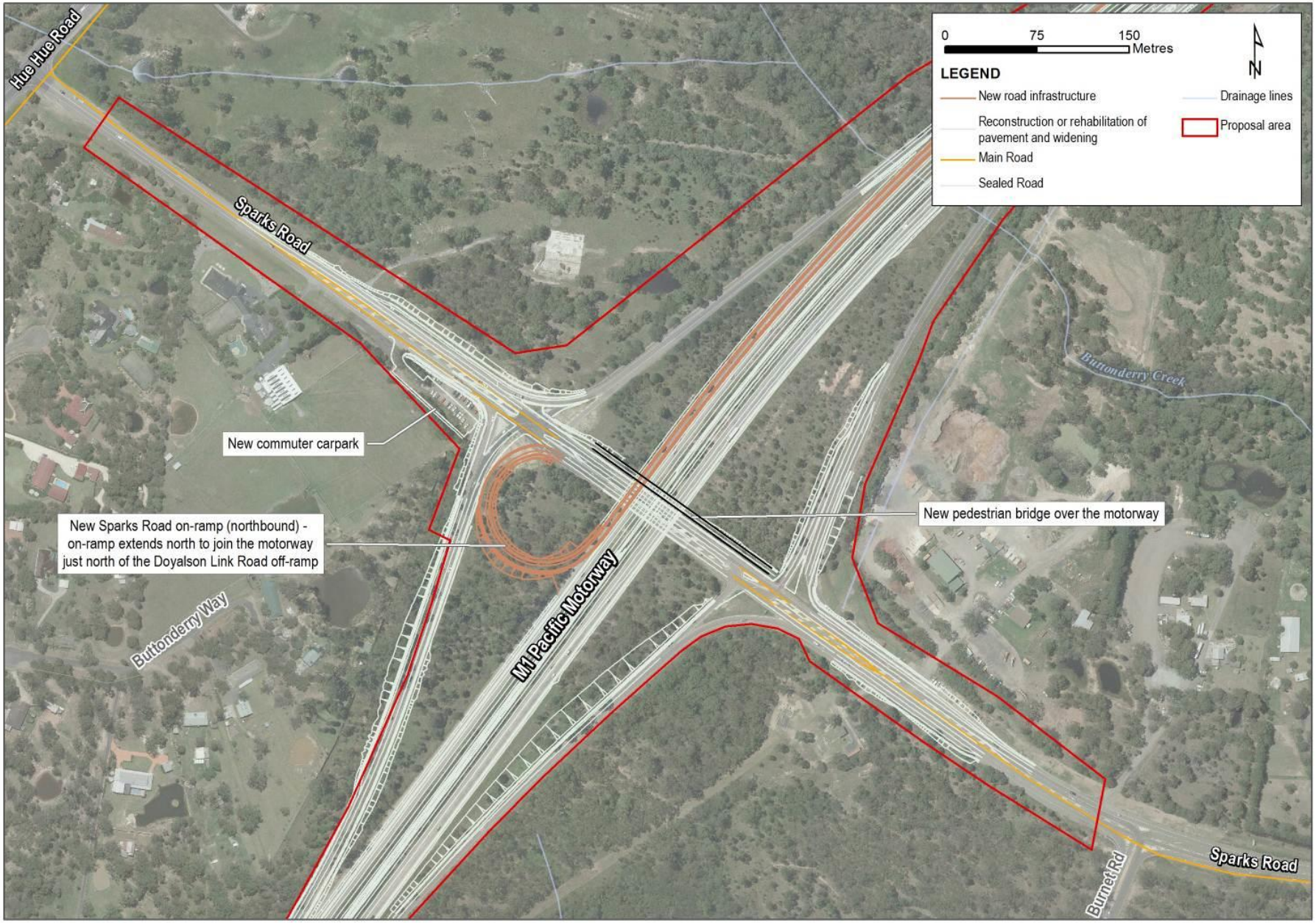


Figure 3.3 Warnervale Interchange upgrade

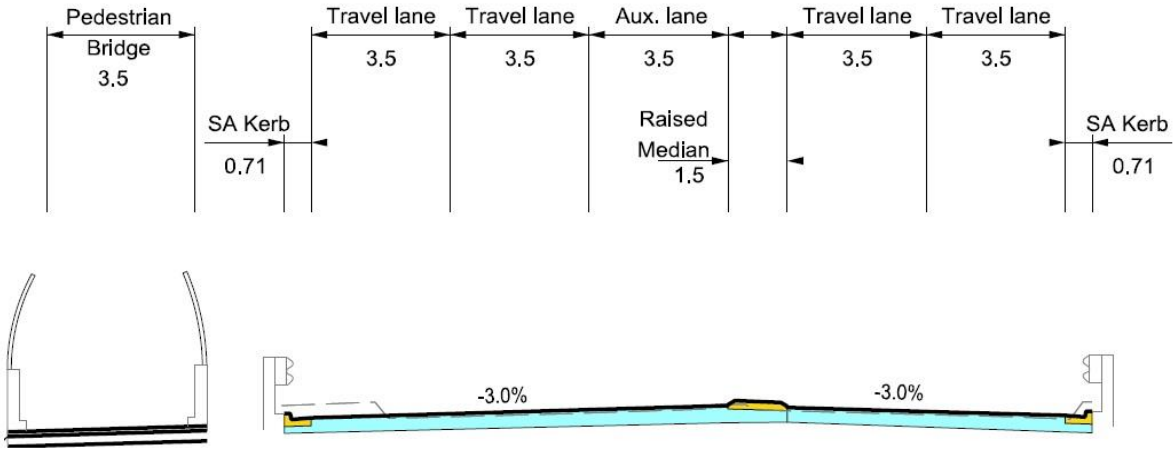


Figure 3-4: Sparks Road bridge over the motorway – typical cross section looking east

3.3.3 Doyalson Link Road Interchange

The existing Doyalson Link Road Interchange elements would be modified and several new elements would be provided.

The Sparks Road on ramp will extend to the Doyalson Link Road as a separated dedicated lane. As the Sparks Road on ramp dedicated separated lane needs to pass beneath the Doyalson Link Road off ramp, part of the Doyalson Link Road off ramp would need to be reconstructed. The new Doyalson Link Road off ramp would grade from the motorway in its current location upwards to provide adequate heavy vehicle clearance from the Sparks Road on ramp below. The off ramp would pass over the on ramp with a bridge structure and then grade to tie in with the existing Doyalson Link Road west of the motorway overpass.

Future provision of a new southbound off ramp from the motorway to Doyalson Link Road has been designed and assessed. The off ramp would deviate from the motorway about 400 metres north of the Doyalson Link Road bridge over the motorway. The formation would be constructed on fill and tie into Doyalson Link Road with a dedicated merge lane about 600 metres east of the motorway. This ramp is subject to further design and investigation and may be constructed independent of the remainder of the proposal.

Future provision of a new northbound motorway on ramp from Doyalson Link Road to be provided via a new formation has also been designed and assessed. The new formation would provide a new westbound lane as a separated carriageway with about a 10 metre wide median. It will commence from where the existing Doyalson Link Road off ramp meets the existing deviation for the southbound on ramp and would continue as a new bridge over the motorway adjacent to and south of the existing overpass bridge.

After crossing over the motorway, a tight radius loop located between the Doyalson Link Road off ramp and the northbound motorway carriageway grading down to the motorway level would provide the northbound motorway on ramp. The new on ramp would pass beneath the overpass between the existing overpass bridge western abutment and western bridge pier. The footprint of the on ramp merge lane would then extend about 15 metres west of the existing northbound carriageway to join existing northbound motorway carriageway about 800 metres north of the Doyalson Link Road overpass. This new bridge and ramp connection is also subject to further

design and investigation and may be constructed independently to the remainder of the proposal.

A plan view of the proposed Doyalson Link Road off-ramp is shown in Figure 3-5 and a typical cross section is provided in Figure 3-6.

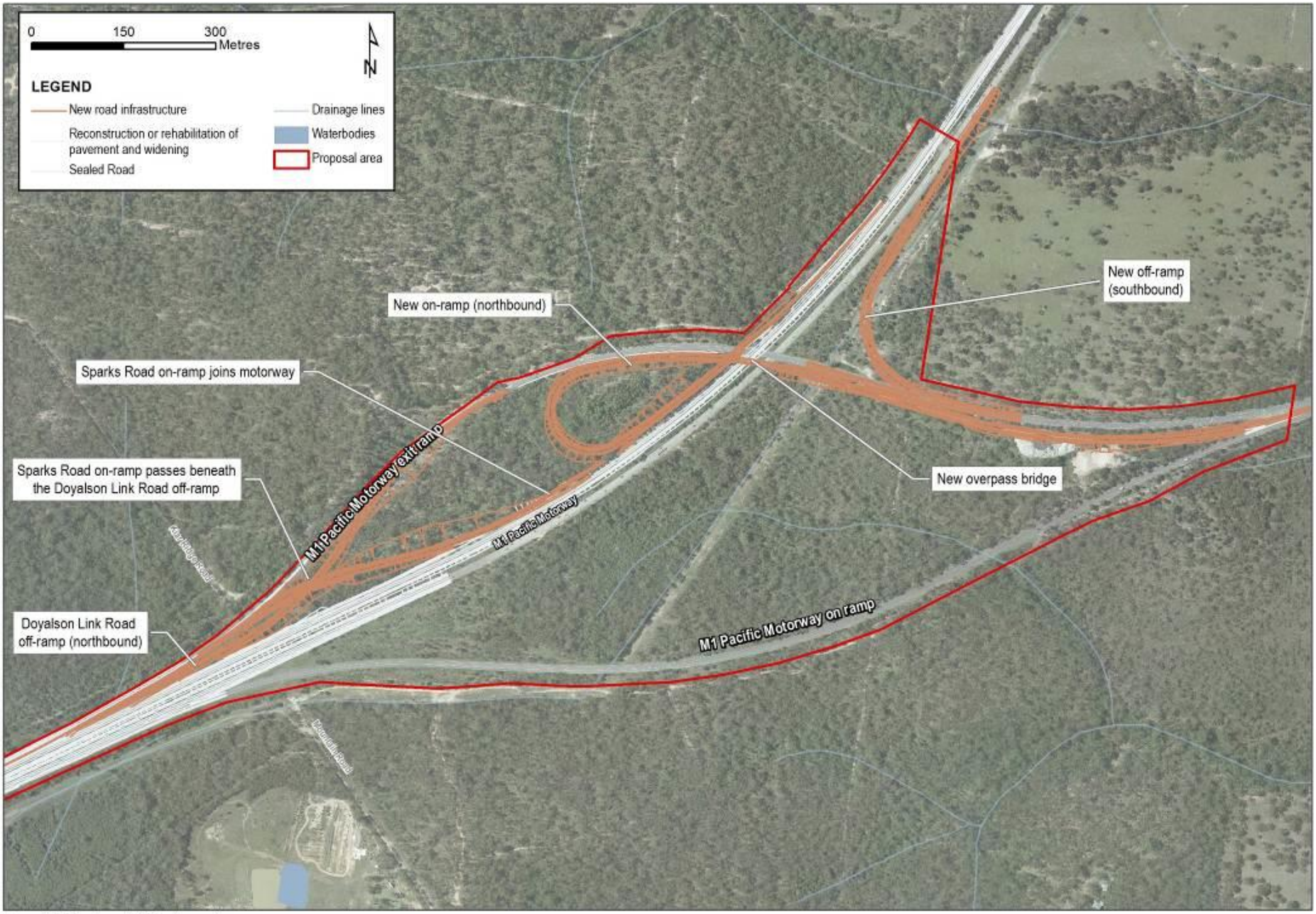
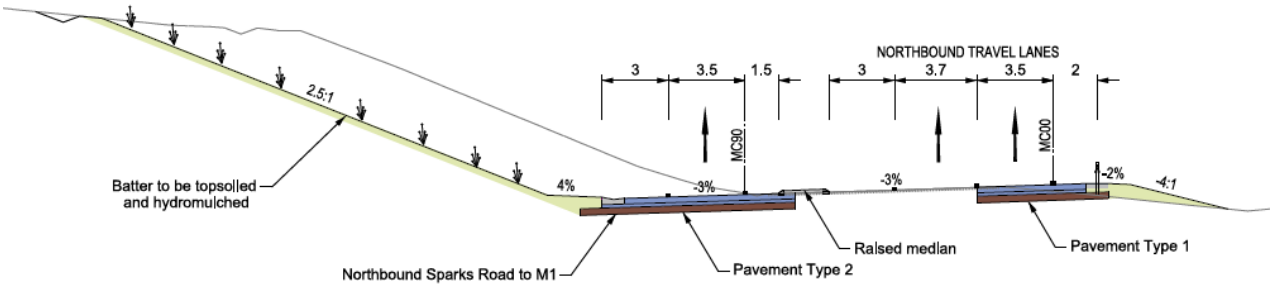
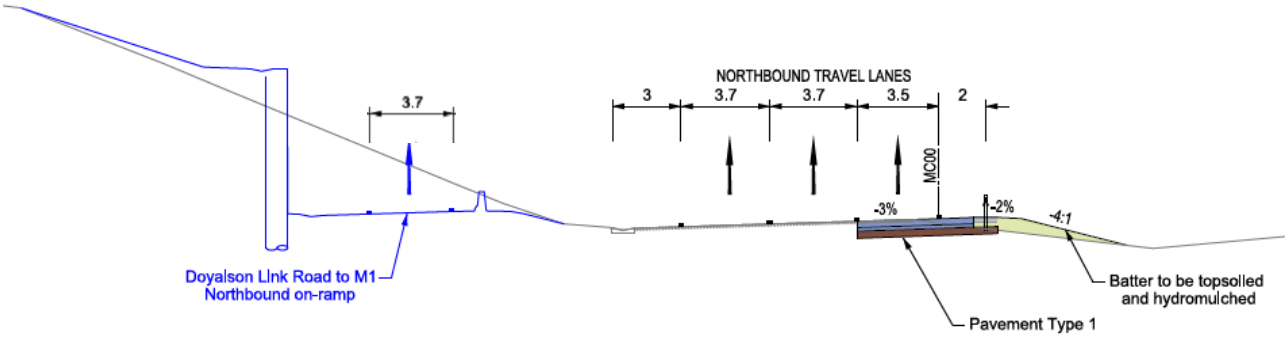


Figure 3.5 Doyalson Link Road upgrade

Below: Cross section showing northbound motorway carrigeway and Sparks Road on ramp at the Doyalson Link Road Interchange, just north of the northbound Doyalson Link Road off ramp



Below: Cross section showing the northbound motorway carriageway and new northbound Doyalson Link Road on ramp just south of the existing overpass bridge



Note: For pavement type definitions refer to Appendix B.

Figure 3-6: Doyalson Link Road Interchange typical cross section

3.3.4 Local roads and access

As discussed in Section 3.3.2, upgrades are proposed to around an 800 metre section of Sparks Road at the Warnervale Interchange, which includes the Sparks Road overbridge. In addition to reconfiguring existing motorway on and off ramps, and provision of a new pedestrian and cyclist bridge, Sparks Road would be widened in each direction to provide:

- A dedicated left turn lane onto the southbound on ramp and two through lanes approaching the bridge from the east.
- A dedicated left turn lane onto the northbound on ramp and two through lanes approaching the bridge from the west.
- A left turn slip lane into a new formalised parking area.
- Investigation of access arrangements at Sparks Road and Burnet Road.

No other changes to local roads and access are proposed.

3.3.5 Pavement and drainage

Pavement reconstruction and widening

As discussed in Section 3.3.1, in addition to widening the carriageways to provide an additional lane, full removal and reconstruction is also proposed for the existing concrete pavement on both carriageways. This would involve laying around 9.3 kilometres of rigid concrete pavement. The replacement materials proposed are consistent with the existing pavement materials. Pavement widening with flexible asphalt pavement would be undertaken south of Wyong River into the median area adjacent to the existing asphalt carriageways. North of Wyong River, the existing rigid concrete pavement would be removed, the subgrade would be re-compacted and stabilised before a new rigid concrete pavement layer is placed.

Reconstruction of the existing concrete pavement would extend from the northern side of the bridge over Wyong River along the northbound carriageway to around 50 metres south of the Doyalson Link Road Interchange overpass. For the southbound carriageway, the concrete pavement reconstruction would commence on the northern side of the bridge over Wyong River, extending to around 650 metres south of the Doyalson Link Road Interchange overpass.

Pavement drainage

Existing motorway drainage infrastructure is located along the alignment. No major pavement drainage structure works are required for the proposal however augmentation of the existing drainage system is required to accommodate the widened footprint of the proposal. The surface inlet levels of existing pavement drains would be adjusted at all existing drainage pits along the motorway. Construction of new drainage pits and connection to the existing network would be required at a number of locations where pavement widening is undertaken.

New drainage networks would be constructed for the new ramps and bridge structures at the Warnervale Interchange and Doyalson Link Road Interchange. These would comprise new drainage pits and pipes, and connection to the existing road drainage network.

It is likely that portions of the existing drainage system would be damaged during construction in the central median areas. As such, the modifications to the existing drainage system may be undertaken as an early construction package to provide for a functioning pavement drainage system during construction. There are also a number of utilities that require similar adjustment and subject to confirmation of relocation designs. This work could also proceed as part of an early works package.

Cross drainage

All existing cross drainage culverts would require extension and additional catch/junction pits would be constructed. The existing cross drainage pipe culverts to be extended vary from 450 mm to 1,050 mm in diameter – predominantly the former with pipe culvert diameters tending to increase around interchanges locations.

A number of existing pipe outlets are located in proximity to mapped SEPP 14 wetlands, with one existing 450 mm outlet less than 10 metres away from a mapped wetland. Potential hydrological impacts of the proposal, including on SEPP 14 wetlands, are discussed in Section 6.4.

Two three-cell box culverts with dimensions of 3,000 mm by 1,800 mm are located about 1,500 metres and 1,600 metres respectively south of the Warnervale Interchange overbridge. Both of these box culverts are proposed to be removed and replaced as part of the proposal. One three-cell box culvert located with dimensions

3,000 mm by 1,500 mm is located about 900 metres north of the Warnervale Interchange overbridge and may need to be removed and reconstructed. The need for replacement of this culvert would be confirmed following condition surveys during detailed design.

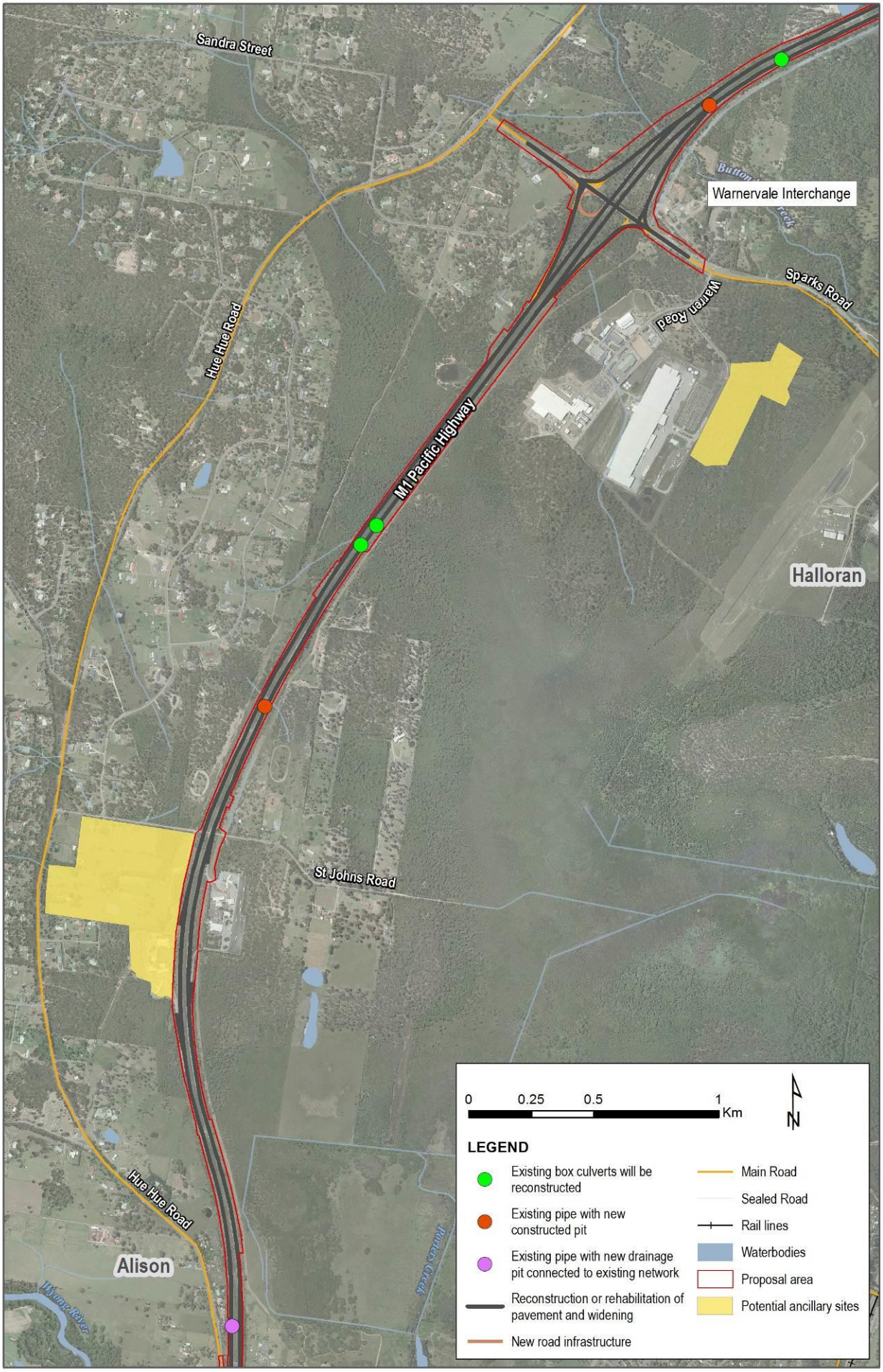


Figure 3.7 Proposal drainage upgrades

3.3.6 Bridges and other structures

There are six existing twin bridges along the motorway (refer to Figure 1-2) as follows (identified from south to north):

- Bridges over McPhersons Road.
- Bridges over Deep Creek No.1.
- Bridges over Deep Creek No.2.
- Bridges over Deep Creek No.3.
- Bridges over Wyong River.
- Bridges over St Johns Road.

With the exception of the northbound bridge over St Johns Road the proposal does not involve any physical widening of the motorway bridge structures. Replacement of existing bridge joints and barriers may be required however this will be confirmed during detailed design.

Additional lanes would be accommodated wholly within the existing road pavement through lane re-marking and with the provision of reduced shoulder widths (with the exception of St Johns Road bridge) to cater for the additional third vehicle lane. St Johns Road bridge was originally constructed for a wider carriageway and would retain full width shoulders.

A typical cross section for the bridges is shown in Figure 3-8.

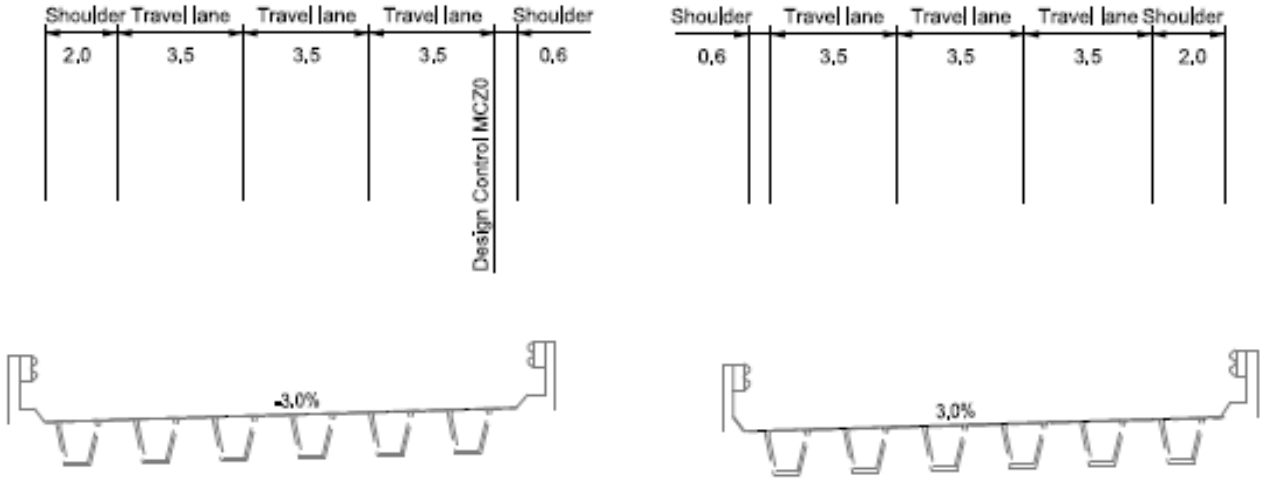


Figure 3-8: Typical bridge cross section

The northbound bridge over St Johns Road would be widened into the central median by 3.2 metres. This is required to accommodate extension of the northbound service centre on ramp acceleration lane. This provides for increased road safety for motorists entering the motorway from the service centre.

There are four bridges crossing over the motorway along the proposal length. The overbridge at the Warnervale Interchange includes a new pedestrian/cyclist bridge as

part of the proposed works which as discussed in Section 3.3.2. The overbridge at Doyalson Link Road identifies a new northbound on ramp bridge that has been designed and assessed as described in Section 3.3.3 and may be constructed independent of the remainder of the proposal.

The other motorway overbridges with no proposed works are as follows:

- Wyong Road/Cobbs Road interchange bridge - located at the southern tie-in, and completed during previous construction work.
- Alison Road bridge over the motorway - a local road with no access to the motorway.

3.3.7 Pedestrian and cyclist facilities

Due to the substantial distances between communities connected by the motorway, the number of cyclists using the motorway is expected to be low. Local roads and the Pacific Highway both provide viable options for cyclists. Notwithstanding, the proposed shoulder width of 2.5 metres would provide a separation of about 1.5 metres between a bicycle and the traffic lane, which is suitable for a vehicle speed of 100 km/h in the *Guide to Traffic Engineering Part 14 Bicycles* (Austroads, 1999). The guide does not provide suitable separation distances for speeds greater than 100 km/h.

Pedestrian and cyclist access currently provided at the Warnervale Interchange would be enhanced with a new pedestrian/cyclist bridge over the motorway to be provided on the northern side of the existing Sparks Road overbridge. This is further discussed in Section 3.3.2.

3.3.8 Operational components

New variable message signs (VMS) are proposed along the length of the motorway. Emergency telephones would be co-located with any new VMS. Locations of proposed VMS and emergency telephones are intended to be determined during detailed design of the proposal.

A typical VMS bay cross section is shown in Figure 3-9. ‘Type C’ variable message signs are proposed, with typical dimensions of around 8.7 metres in total height, the bottom of the sign being about 5.5 metres above road height and a sign height of around 1.8 metres.

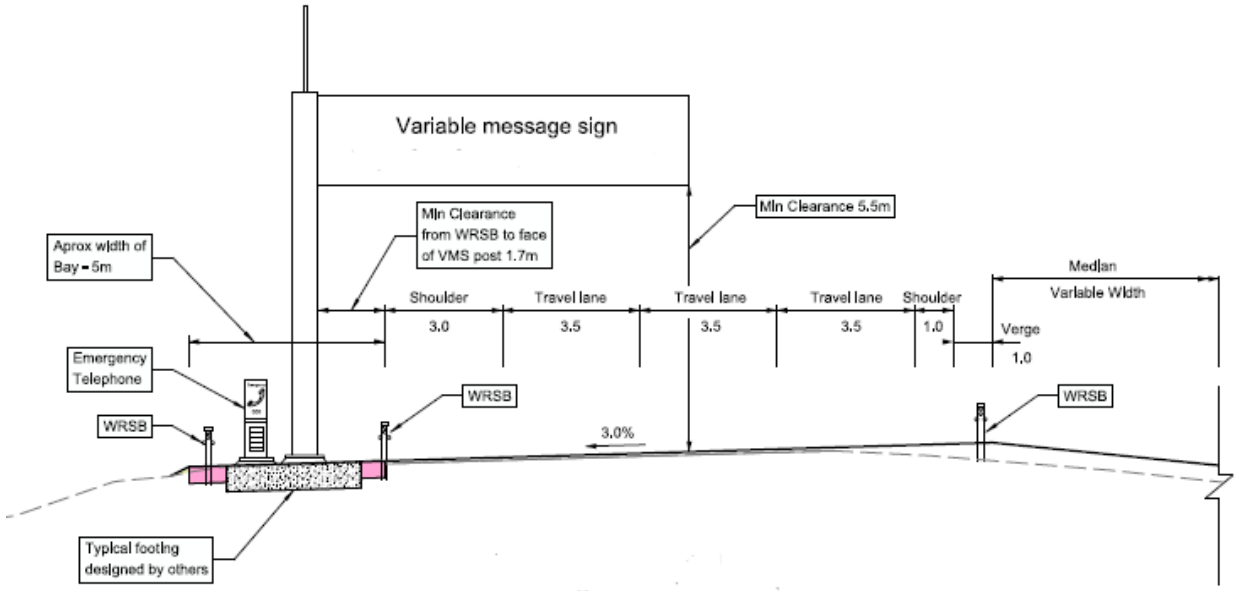


Figure 3-9: VMS and emergency phone bay typical section

A plan view of a VMS and emergency telephone bay is provided in Figure 3-10. The arrangement generally comprises a parking area of around five metres in width from the motorway pavement, gradually tapering to the motorway over about 40 metres. Power and telemetry for the infrastructure would be provided in buried conduits typically laid in the central median running longitudinally with transverse connections beneath the carriageway to each VMS base.

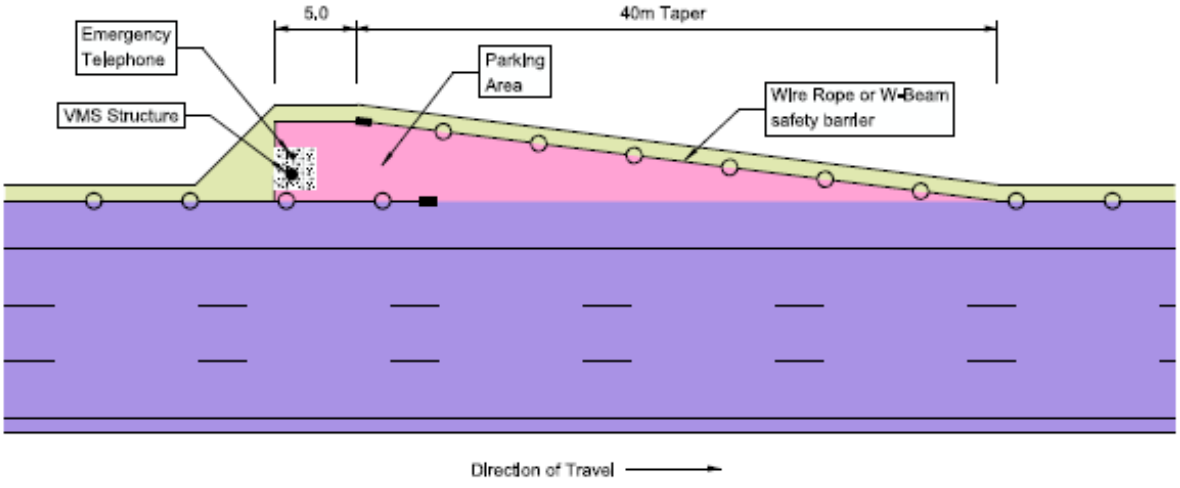


Figure 3-10: VMS and emergency phone bay typical layout

3.4 Construction activities

3.4.1 Work methodology

Construction is anticipated to commence in 2016 and would take about three and a half years to complete (weather permitting).

The proposal development process has considered a range of construction techniques and methods to provide:

- Flexibility in the final choice of design and delivery.
- Flexibility in construction methods.

Typical methods and sequencing of construction for the proposal have been developed and are described below. Construction of the proposal would likely adopt standard techniques employed on motorway upgrade projects and would generally use conventional plant and machinery.

Motorway pavement widening

Widening of the motorway carriageways would be undertaken on sections of the motorway consistent with the staging plan (Appendix C). Construction activities would generally involve the following:

- Identify and protect environmentally sensitive areas.
- Set up traffic and safety controls for relevant stage of construction.
- Establish erosion and sediment controls.
- Remove existing barrier or wire rope (if applicable).
- Clear and grub existing median vegetation.
- Establish haul road and temporary drainage within median.
- Excavate median and box out carriageway widening and contra-flow crossovers.
- Stabilise and compact the existing sub-grade material.
- Place and compact select material zone.
- Construct pavement layers to meet the existing carriageway level.
- Line-mark widened section and place concrete barriers outside the median side edge line.
- Concurrent with the above would be extension/replacement/augmentation of the existing cross drainage and pavement drainage.

Removal of existing pavement

A majority of the existing concrete pavement would need to be removed to enable new pavement to be constructed. This includes up to nine linear kilometres of concrete pavement on both the northbound and southbound carriageways north of the Wyong River. The remaining concrete pavement in the vicinity of the Doyalson Link Road is of a good standard and would be retained, with new concrete pavement placed adjacent to provide for the additional lanes. The original pavements to be removed comprise:

- About 150 millimetres of asphalt.
- About 150 to 200 millimetres of asphalt sub-base.
- About 230 millimetres plain concrete base.
- About 150 millimetres of lean mix sub-base.

This equates to demolition and removal of about 9,500 cubic metres of asphalt, about 11,000 cubic metres of asphalt sub-base, about 32,000 cubic metres of lean mix concrete sub-base and about 49,000 cubic metres of plain concrete base. The total of all these different material types equates to 101,500 cubic metres (AT&L, 2013).

The plain and lean mix concrete on the existing carriageways would be broken up by a combination of saw cutting and rock hammers. The resulting slabs of concrete would be loaded into dump trucks and hauled to a designated ancillary facility for stockpiling and processing. Concrete slabs would be separated from the steel elements such as dowels and tie bars. The concrete would then be able to be crushed and reprocessed.

A reprocessing plant would be located within an ancillary site (refer to Section 3.5) to process the material. Materials would be stockpiled for re-use on this proposal or on other Roads and Maritime proposals where reasonably practicable, in preference to disposal to landfill or similar.

An alternative construction method may involve determining the location of dowel and tie bars in the plain concrete base and using a milling machine to mill the concrete slabs that are free of dowels and tie bars. For this method, the concrete slabs with the dowel and tie bars would have to be broken up and hauled to the designated site compound facility for processing. The milling operation would provide greater efficiency in reducing double handling of some materials.

Due to the limited space available within the existing median, stockpiling is not anticipated within the work zone. The crushed concrete would be recycled for use as construction haul road base material, blended with virgin material for use as aggregate for the new concrete[1], and drainage and select material layers.

Pavement construction/reconstruction

While the final type and design of new pavement would be determined during detailed design, the anticipated construction activities for construction of sections of new and replacement pavement are described below.

The existing natural sub-grade consists of Patonga Claystone and is likely to require stabilisation. This process could be undertaken in-situ with spreaders and mixers, or the sub-grade material may be excavated and hauled to a designated site compound facility to be mixed in a pug-mill prior to hauling back for placing and compaction. The existing sub-grade would be stabilised to a depth of about 200 millimetres.

For mainline concrete and flexible pavement, typically a 150 millimetre Select Material Zone (SMZ) would be placed on the stabilised sub-grade. Potentially, the concrete removed from the existing concrete carriageways could be crushed and processed for re-use as this select material.

The new asphalt pavement would be constructed with a select material layer, a bound granular sub-base layer and deep lift asphalt layer. The deep lift asphalt pavement would typically be constructed with conventional asphalt pavers and rollers. Asphalt layers would be constructed sequentially, to a total thickness of about 320 millimetres.

The concrete pavement would be constructed with multi-lane concrete paving machines and associated equipment for curing, texturing and saw-cutting. Conventional two layer construction is envisaged which comprises placement and

[1] Roads and Maritime are currently developing a modified specification to allow for this, subject to meeting other engineering standards.

stabilisation of a sub-base layer about 150 mm thick and then the placement and stabilisation of a structural base layer, about 270 mm thick. A concrete batch plant would be established at one or more of the ancillary sites to provide the concrete used in these layers (this is further discussed in Section 3.5).

Widening of on and off ramps for interchanges and the service centres would be constructed in a similar pavement to the existing. The pavement types for new on ramps and off ramps would be determined during detailed design.

Sparks Road bridge over the motorway (Warnervale Interchange)

As discussed in Section 3.3.2, the existing Sparks Road overbridge would be retained and reconfigured to provide additional turning lanes required for the new interchange arrangement. This would involve removal of the existing footpath on the northern side of the overbridge and conversion of the old footpath to a new traffic lane.

A new dedicated pedestrian/cyclist bridge would be constructed over the motorway, parallel to the existing road bridge on the northern side. The pedestrian/cyclist bridge is likely to be constructed in stages to align with the reconstruction of the Sparks Road interchange. This would allow for bridge construction works over the motorway to be undertaken while the section below is under construction to minimise impacts to the operating motorway.

Construction of the western abutment would be undertaken in conjunction with the construction of the new northbound on ramp G-loop and northbound carriageway while traffic is under contra-flow on the southbound carriageway. Construction of the eastern abutment would be undertaken in conjunction with the reconstruction of the southbound carriageway while traffic is under contra-flow on the northbound carriageway.

It is envisaged that the main construction activities undertaken for the Sparks Road shared pedestrian and cyclist bridge over the motorway would be as described below, although the sequence of works may vary depending on the final project staging option adopted:

- Identify and protect environmentally sensitive areas.
- Set-up site fencing and delineation, erosion and sediment controls.
- Milling out footpath and reconstruction to accommodate vehicle traffic.
- Construction of new bridge barriers if required.
- Excavate existing batter slopes and provide temporary support for existing overbridge abutment.
- Excavate and bench for pedestrian bridge abutments, piers and centre median pier.
- Install piles at abutment and pier locations.
- Form and pour side abutments, side pile cap and median pile cap.
- Form and pour piers and median piers.
- Install bearings pads onto the piers.
- Install girders over carriageway spans.

- Install fixings such as railings and screens to girder.
- Complete girder infill, railing and screen connections.

Doyalson Link Road bridge over the motorway

As discussed in Section 3.3.3, a new bridge has been designed which would be provided over the motorway to provide a new northbound on ramp from Doyalson Link Road. The new bridge would be located parallel to and immediately south of the existing Doyalson Link Road overbridge. A separation of about 10 metres would be provided between the two bridges however this may be adjusted during detailed design.

Construction of the western abutment would be undertaken in conjunction with the construction of the new on ramp loop road. Construction of the eastern abutment would likely be undertaken in conjunction with the reconstruction of the southbound carriageway while traffic is under contra-flow on the northbound carriageway.

It is envisaged that the main construction activities undertaken for the new Doyalson Link Road bridge over the motorway would be as described below, although the sequence of works may vary depending on the final project staging option adopted:

- Set-up site fencing and delineation, erosion and sediment controls.
- Identify and protect environmentally sensitive areas.
- Excavate existing batter slopes.
- Excavate and bench for bridge abutments, piers and centre median pier.
- Install piles at abutment and pier locations.
- Form and pour side abutments and pile caps.
- Form and pour piers.
- Install bearings pads onto the piers.
- Install girders over carriageway spans.
- Install bridge barriers.
- Construct pavement overlay.

Motorway bridges

The existing motorway bridges are identified in Section 3.3.6. Upgrading of these motorway bridges would generally be limited to line remarking to provide the additional lane on each carriageway. The replacement of existing bridge joints and barriers may be necessary, and this would be considered further during detailed design.

The northbound bridge over St Johns Road (just north of the service centre) would be widened and then re-line marked to enable the provision of the third northbound lane and a lengthened on ramp from the service centre.

It is envisaged the main construction activities undertaken for the widening of the bridge over St Johns Road would be as described below:

- Set up traffic management barriers and work zone (including traffic contra-flow arrangements where required).
- Set up a hanging platform below the bridge deck to catch debris from the demolition and construction processes.
- Remove existing steel railings and connections to adjacent road barriers.
- Jackhammer existing concrete barriers to deck level. Removing existing steel reinforcement.
- Load demolished concrete and steel reinforcement and remove scabble and level construction joint.
- Drill and dowel in new starter bars.
- Install and fix steel reinforcement cages plus railing fixing points.
- Fix barrier formwork and barrier construction joints.
- Pour and finish concrete.
- Strip formwork.
- Fix steel railings (if design provides for these).
- Remove debris catch platform.
- Line mark bridge for final configuration (lane lines and edge lines)

Drainage structures

Construction of new drainage infrastructure is anticipated to use conventional plant and traditional materials. The construction of drainage would be staged to coincide with carriageway construction operating under contra-flow or may be undertaken as an early works package to provide for a pavement drainage system is operational throughout construction. Works to provide new cross drainage culverts, culvert extensions and new pavement drainage would be undertaken as described below:

- Set out limits of work area (marking with para-web fencing or similar).
- Identify and protect environmentally sensitive areas.
- Set up erosion and sediment controls.
- Provide safe access to work area.
- Provide for diversion of existing upstream catchments to flow into via temporary piping.
- Clear and grubbing would be undertake as part of pavement demolition works.
- Construct catch drains and junction pits in the central median.
- After demolition of existing carriageway and stabilisation of sub-grade, excavate trenches for new drains.
- Place bedding material in trenches.
- Install new culverts, culvert extensions or new pipes.
- Back fill to sub-grade level.

3.4.2 Construction hours and duration

Construction of the proposal is anticipated to commence in 2016 and would take about three and a half years to complete.

Standard construction hours in NSW are provided in Table 3-3.

Table 3-3: Standard construction hours

Day	Start time	Finish time
Monday to Friday	7am	6pm
Saturday	8am	1pm
Sunday/public holiday	No work	

Roads and Maritime is seeking approval for standard construction hours plus additional time at the start and end of each day (extended construction hours). Extended construction hours would apply across the full length of the proposal. Targeted consultation with affected residents is proposed to be undertaken in association with the public exhibition of this REF.

Due to high traffic volumes along the motorway during the day, some out of hours work would be required to minimise disruptions to motorists and protect the safety of workers and the travelling public. Work outside of standard construction hours and extended construction hours would be undertaken in accordance with approvals and notification requirements of any Environment Protection Licence (EPL) for construction of the project.

Extended construction hours and out of hours works are discussed further below.

Extended work hours

The construction would require the full closure of one carriageway in each direction during different stages of the construction period (refer to Appendix C for staging plans). Carriageway closure would be necessary to enable full replacement of large sections of the existing concrete pavements as well as to achieve the required widening. In this regard, the proposal is unique, given that typical motorway widening projects do not usually require replacement of the existing carriageway pavements, and therefore do not typically require the full closure of either carriageway.

When required, certain activities would be undertaken during extended construction hours as described in Table 3-4.

Table 3-4: Proposed (extended) construction hours

Day	Start time	Finish time
Monday to Friday	6am	8pm
Saturday	7am	5pm
Sunday/public holiday	No work	

Activities that would be undertaken during these extended construction periods are as follows, and potential noise impacts are described and assessed in Section 6.2.

- Compound operation including concrete reprocessing, stockpiling, concrete batching and general office duties.
- Deliveries of materials, such as large pre-cast concrete components.

- Establishment of temporary traffic facilities and traffic switches to enable motorway traffic flows to be maintained during construction.
- Removal of existing pavements.
- Haulage of material.
- Earthworks, including haulage, placement and compaction.
- Concrete pouring, curing and concrete cutting where required.
- Asphalting.
- Pile driving and/or boring at bridges.
- Finishing works.
- Placement of bridge girders where proposed bridges cross operating roadways.
- Utility adjustments where required.

Extended construction hours at the start and finish of each working day are considered to be in the greater public interest as they would:

- Shorten the overall construction period by about six months or 12 per cent. This would minimise the disruption to the M1 Pacific Motorway traffic and improve access between Sydney, Newcastle and the Central Coast.
- Reduce the publics' exposure to a substandard and inefficient road, reducing the potential for crashes.
- Potentially reduce the overall cost of construction.

Consultation with affected residents would be undertaken prior to work commencing.

Out-of-hours work

Some construction activities would be undertaken outside of the standard and extended construction hours in the following circumstances:

- If works do not cause construction noise to exceed the noise management levels.
- For the delivery of materials or oversized structural elements such as pre-cast bridge elements, required outside these hours by the police or other authorities for safety reasons.
- Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.
- As agreed through negotiations between Roads and Maritime and potentially affected sensitive receivers. Any such agreement would be recorded in writing and a copy kept on-site for the duration of the works.
- As agreed by the EPA for a specific activity, determined on a case-by-case basis.

These types of activities would need to be undertaken outside of normal and extended construction hours to minimise road safety risks, minimise disruption to regional and local traffic flows and/or for technical and timetabling reasons. Possible reasons for out-of-hours work and typical justifications would include:

- Completion of tie-ins at interchanges and temporary traffic facilities, and completion of temporary diversions and traffic switches – justified because completing or installing these items at night when traffic flows on the M1 Pacific Motorway are lower would minimise disruption to regional and local traffic and

minimise any potential safety conflict between construction personnel and traffic.

- Bridge girder placement where bridges cross operating roadways – justified because during construction, bridge girders would need to be placed across operating roadways. Due to the potential safety risks to road users and construction personnel associated with operating over the existing alignment, these works would need to be undertaken at night when there are lower traffic flows. Avoiding peak periods would also minimise the disruption to traffic.
- Delivering large pre-cast concrete components, such as bridge girders – justified because it would minimise disruption to highway and local traffic flows.
- Concrete cutting – justified because concrete sampling for quality control purposes requires cutting of cores from the concrete pavement. Depending on the hardening rate of the concrete, core sampling may require cutting any time within four and 24 hours after the concrete pavement is laid. Roads and Maritime specifications state the timing requirements for concrete sampling after it has been laid and this may need to be undertaken outside of normal construction hours. Construction compounds would also need to be operational during these periods to support these activities.
- Concrete pouring/curing - justified because, similar to the requirements for concrete cutting, Roads and Maritime has specifications for the placement of concrete that relate to temperature and rainfall. Specifically, concrete pouring and curing cannot occur when the temperature is below 5˚C or above 38˚C, and concrete, when curing, cannot be exposed to rain. Average temperatures for the region do not fall below or above these temperatures, however the frequency of rain events may require more intensive concrete pour/curing activity during periods of good weather.
- Utility adjustments - justified because utility adjustments usually need to be undertaken during out of hours work periods to minimise the impact on consumers, road traffic and to protect the safety of workers involved.

A Construction Noise Management Plan and Community Consultation Plan would be prepared to provide a framework for managing any out of hours work. These would be implemented in conjunction with the EPL for the project, and would provide for appropriate notification periods. All feasible and reasonable mitigation measures would be implemented so that the potential for adverse impact on the local community is minimised.

3.4.3 Plant and equipment

Plant and machinery to be used to construct the proposal would be consistent with the construction methodology provided in Section 3.4.1. The final construction and staging plans would be determined following the appointment of the successful construction contractor(s).

Table 3-5 lists the likely construction plant and equipment usage at each of the major work sites, together with the anticipated duration of the works. Not all the construction plant and equipment outlined in Table 3-5 would be used at each work site. Variations to construction processes would be discussed with regulatory agencies and would be addressed in the CEMP.

Table 3-5: Equipment likely to be used for construction activities

Activities	Locations	Plant and equipment	Approximate duration
Site compounds	Major compound Locations as detailed in Section 3.5.	• Fences • Sheds • Fuel storage tanks • Concrete batching plant(s)	42 months
Site compounds	Minor compounds at each structure site	• Fences • Sheds • Fuel storage tanks • Plant parking areas • Equipment storage areas	6 to 12 months
Site protection and site preparation (including temporary works, clearing of vegetation, topsoil stripping and storage)	Full length of proposal	• Excavators • Scrapers • Graders • Trucks • Chainsaws • Wood chippers/mulchers • Graders • Traxcavators • Loaders	4 months
Services relocations/installations (electricity, telecom, water, lighting, sewerage, ITS conduits)	Various locations to be determined	• Trucks • Cranes • Elevated platform vehicle • Backhoes • Trenchers • Excavators • Small equipment	18 months
Structures	Bridges	• Concrete trucks • Concrete pumps • Trucks • Cranes	6 to 12 months
Earthworks	Full length of proposal	• Dozers • Scrapers • Water carts • Compactors • Vibratory rollers • Excavators (minor works)	18 months
Existing material processing for re-use	Site compound	• Pug mill • Concrete re-processing plant	18 - 30 months
Drainage works (cross and longitudinal)	Various locations, full length of proposal	• Excavators • Backhoes • Trucks • Small equipment	12 months

Activities	Locations	Plant and equipment	Approximate duration
Select subgrade	Full length of proposal	• Trucks • Graders • Watercarts • Vibratory rollers • Possible need for tractor, spreader and pulvimixer	6 - 18 months

3.4.4 Earthworks and pavement reconstruction

The majority of earthworks for the proposal comprise the box-out works for pavement widening, filing in median verges, fill for new bridge abutments, the cut required for the new Doyalson Link Road northbound on ramp and the potential filling of embankments for the new southbound off ramp to Doyalson Link Road.

It is likely that recycled existing concrete pavements would be used as select fill. To be used as general fill, the material would most likely need to be blended with additional material for use. The final quantity of material to be used and its composition would be subject to further refinement during detailed design and construction planning.

The majority of sub grade comprises Patonga Claystone and it is intended to stabilise this material for use as select sub-grade. In addition and where required, there is potential for the recycled crushed concrete to be blended for use in the SMZ.

Table 3-6 provides a summary of the likely cut and fill earthworks requirements for the proposal, subject to development of detailed design.

Table 3-6: Summary of earthworks

Material	Cut (m^3)*	Fill (m^3)*
Topsoil	9,500	-
Excluding removal of existing M1 concrete pavement	49,000	70,000
Existing M1 pavement (demolish and remove)	81,000	-
Crushed concrete as select material	-	40,000
Verge material won from site	-	7,000
Imported verge material	-	7,000
Unsuitable	15,000	-
Crushed Concrete as unsuitable replacement	-	15,000
Totals	**154,500**	**139,000**

*Volumes are estimates only, to be confirmed during detailed design

3.4.5 Source and quantity of materials

Other materials would be required throughout the proposal for road construction and drainage structures. Table 3-7 lists anticipated imported material requirements for the proposal. The material type and quantities shown would vary depending on the pavement design finally selected.

Table 3-7: Major raw materials to be imported

Product	Imported materials	Quantity (m^3)
Stabilisation of subgrade	Cement	900
Concrete sub-base	• Aggregate • Sand • Cement	17,550 19,500 1,950
Concrete base	• Aggregate • Sand • Cement	28,000 35,000 7,000
Granular pavement	Dense graded asphalt	400,000
Motorway surfacing	Open graded asphalt	120,500

Potential sources of material are identified in Table 3-8, subject to final decision by the appointed construction contractor.

Table 3-8: Potential sources of material

Material	Possible source	Location	Distance to site (km)
General fill	Doyalson link Road new northbound off-ramp cut	Doyalson Link Road	12
Select subgrade material	Processed crushed concrete	Site adjacent to the Sparks Road northbound on ramp	8
Aggregate	Metromix SCE Hebden Holcim	Teralba Singleton Arndell Park	47 132 105
Sand	Various suppliers	Local region	Various
Cement	Various suppliers	Newcastle and/or Sydney	100
Crushed rock/gravel	Various suppliers	Various	Various
Asphalt	Boral Fulton Hogan	Newcastle and/or Sydney Doyalson	100 15
Concrete pipes and box culverts	Humes	Newcastle and/or Sydney	100
Reinforcing steel	One Steel	Newcastle and/or Sydney	100
Wire rope safety fence	Ingal	Newcastle and/or Sydney	100
Guardrail	Ingal Above and Beyond Concepts	Newcastle and/or Sydney Thornton	100
Concrete barrier units	Coates Hire and Roads and Maritime Hunter	Newcastle and/or Sydney	100

3.4.6 Traffic management and access

Maintaining traffic flow during construction is a key consideration for construction traffic planning for the proposal. Existing access to the service centres may be temporarily affected or relocated while sections of the motorway are rebuilt and alternative access arrangements would be made. Roads and Maritime would work with the owners and operators of the service centres to minimise impacts during construction. Roads and Maritime would endeavour to provide access 24 hours a

day, seven days a week. Access to interchange on and off ramps would also generally be maintained.

Construction traffic would predominantly be generated from the movement of construction personnel, the movement of materials such as concrete and steel between the motorway and ancillary sites, and from the haulage of materials to and from the site from external sources. Construction plant and traffic undertaking construction activities would travel on haul roads within the section under construction, on the existing M1 Pacific Motorway and on adjacent state and local roads.

Haul roads would be provided within the section of motorway under construction to allow construction plant and vehicles to travel as much as reasonably practicable without having to use the motorway. These would be located within the proposal road corridor.

Anticipated haulage routes for construction vehicles are described in Table 3-9 below and considered in further detail in the construction traffic assessment in Section 6.1 and Construction traffic and transport technical note in Appendix L.

Table 3-9: Proposed construction traffic routes

Trip haulage	Route
Deliveries of materials from sources north and south of the site	• M1 Pacific Motorway
Workers commuting from the north and south	• M1 Pacific Motorway
Deliveries from local suppliers east of the site	• Wyong Road/Cobbs Road • Sparks Road Hue Hue Road
Workers commuting from the east	• Wyong Road/Cobbs Road • Sparks Road Hue Hue Road
Disposal of spoil and waste materials off site	• M1 Pacific Motorway
Trip haulage	• Site haul roads • Wyong Road/Cobbs Road • Sparks Road Hue Hue Road
Movement of materials to and from work zone to site facilities	• Site haul roads • M1 Pacific Motorway • Hue Hue Road • Old Maitland Road • Cobbs Road • McPhersons Road • St Johns Road • Doyalson Link Road

Table 3-10 presents an estimate of the number of construction vehicle trips likely to be generated by the project for trip intensive construction activities.

Table 3-10: Construction trip generation

Activity	From	To	Truck movements per day	Truck movements per hour
Demolition of existing concrete pavement	M1 Pacific Motorway alignment	Ancillary facilities	196	11
Stabilisation of sub-grade	Ancillary facilities	M1 Pacific Motorway alignment	83	9
Haul select material (crushed concrete)	Ancillary facilities	M1 Pacific Motorway alignment	138	15
Construct lean mix base	Ancillary facilities	M1 Pacific Motorway alignment	240	13
Construct plain concrete base	Ancillary facilities	M1 Pacific Motorway alignment	195	11
Delivery of sand/aggregate and cement for sub-base	Sydney or Newcastle	Ancillary facilities	240	13
Delivery of sand/aggregate and cement for base	Sydney or Newcastle	Ancillary facilities	204	9
Delivery of asphalt	Sydney or Newcastle	M1 Pacific Motorway alignment	80	8

At this stage, a detailed construction program has not been prepared although, based on the above, it is assumed that the maximum number of truck trips per shift would be generated by concurrent construction activities of:

- Demolition of existing pavement.
- Stabilisation of subgrade.
- Hauling of select material.

Truck trips would generally be between the area of the proposal under construction and the construction ancillary sites. A maximum of 417 truck trips per shift is predicted, equating to about 35 trips per hour on average. This assumes that the extended construction hours would be applied. For construction personnel light vehicles a maximum of 152 movements per day would be expected.

Comprehensive information of all traffic management staging, to advise road users of the temporary traffic changes such as contra-flow and reduced speed limits would be provided throughout construction of the proposal. This is discussed in Section 6.1.

3.5 Ancillary facilities

During site preparation works, compound sites (administration, road and bridge construction compounds), temporary stockpiling sites, concrete re-processing, concrete batching plants and sedimentation detention basins would be established to support construction.

Due to the large scale of the proposal and the limited construction zone/area, a number of offsite ancillary work sites would be required. Potential ancillary sites were shortlisted based on their ability to meet certain criteria (refer to Section 2.4.3). This resulted in three main ancillary sites being proposed as identified in Table 3-11 and

shown in Figure 1-2. Alternative or additional sites may be identified during detailed design or at a later stage during construction. Further assessment for such sites would be undertaken as appropriate.

Table 3-11: Suitable potential ancillary site use

Ancillary site	Suitable potential activities	Size (ha)
Warren Road	• Concrete re-processing • Concrete batch plant • Site compound • Stockpiling • Office accommodation	8.9
Hue Hue Road	• Concrete batch plant • Site compound • Stockpiling • Office accommodation	18.8
McPherson Road	• Site compound • Stockpiling • Office accommodation	8.4

The Warren Road site has been identified as suitable for the reprocessing of demolished concrete and for the production of concrete for new pavement. This location was identified for this purpose due to:

- Existing accessibility of the site for heavy vehicles.
- Relatively large area of the site.
- Proximity to the northern end of the proposal, suiting construction staging requirements.
- Relative distance from the site to sensitive residential receivers.
- Provides northbound and southbound access to the site from the motorway (via Sparks Road).

The Warren Road site, Hue Hue Road site and McPherson Road site have large cleared areas available which would be used for material storage and stockpiling. Construction activities would generate substantial volumes of stripped topsoil and large volumes of excavated and demolished pavement materials that would need to be stockpiled prior to reuse or removal offsite. In addition to the excavated materials, stockpile areas would be required for any imported material, such as aggregates or lime, as well as material that is processed on site, such as crushed concrete pavement.

All stockpiles, particular those stockpiles of organic material, would require suitable protection to prevent erosion and sedimentation of the stockpiled material. Stockpiles would be managed in accordance with the *Stockpile Site Management Procedure* (RTA, 2001b) and the *QA Specification R44 – Earthworks*.

The proposal would require office facilities with access to services such as water, electrical and telecommunications. The location of office facilities for the proposal would be determined by the construction contractor once appointed.

Smaller sized sites located along the length of the proposal within the motorway corridor would be used for various purposes during construction. This may include additional site compounds, temporary site sheds and bathrooms, storage of plant or the stockpiling of materials.

3.6 Public utility adjustments

Given the proposal generally involves widening of the M1 Pacific Motorway into the central median, existing major utility corridors located along the motorway shoulders would be largely unaffected by the proposal.

There is an existing VMS located between Alison Road and McPherson Road, about 300 metres south of the Wyong Rover on the northbound carriageway. It would not be affected by the proposal. The services proposed to power and communicate with the existing VMS would likely be extended from this existing VMS to provide for the new VMS. During detailed design investigations on the utilities potential to provide for the additional VMS would be investigated.

Similarly, existing emergency telephones are located at various locations northbound and southbound along the motorway. Some emergency telephones and the associated utilities would need to be relocated for the proposal.

The current and future requirements for street lighting around the interchanges will be assessed during detailed design of the proposal. This could require modification or relocation of existing lighting as well as installation of additional lighting. The proposed commuter car park on the south western corner of the Warnervale Interchange would be assessed for lighting requirements. Any lighting required in this location would be positioned to minimise light spillage into residential properties and other sensitive areas.

The new traffic signals on Sparks Road connecting the southbound on and off ramps to the motorway would require power and communications for the signals and for any closed circuit television (CCTV) that is implemented. In-pavement detectors would be installed as part of the commissioning of the traffic signal. The traffic signals would require a controller box to be located on the ground behind the kerb, in close proximity to connection points for power and communications but set back sufficiently so as to not cause a safety issue for motorists, pedestrians/cyclists or workers maintaining the signal controller.

New utilities for the proposal would be required for new emergency telephones and VMS installations. The locations of emergency telephones and VMS would be determined during detailed design. Power and communications required to service any new emergency telephones or VMS would be buried. Connections to the items would be made from the existing power and communications cables already located within the motorway corridor.

Utilities are suspended from the Sparks Road overbridge. Works at the bridge would be likely to affect these utilities. They would be protected from construction impact, or relocated as necessary early in the construction period. The provision of services to surrounding areas would be unaffected.

The proposed southbound off ramp to the Doyalson Link Road crosses a high pressure gas easement. The buried gas pipeline would need to be uncovered prior to construction and protected from damage that may occur during construction. The proposed off ramp is to be provided as a new fill embankment over the pipeline.

During detailed design Roads and Maritime would consult with the asset owner on this aspect of the proposal.

Approval from the relevant utility authorities and organisations would be obtained for any utility relocations or adjustments before the commencement of any works.

The required utilities adjustments may be undertaken early in the construction program to facilitate a more rapid commencement of the main construction work. These staging plans would be further explored during detailed design.

3.7 Property acquisition

The proposal would not require any property acquisition or property boundary modification because the entire proposal footprint has been designed to be located within the existing road corridor.

Leasing arrangements would be required for some of the proposed construction ancillary sites. The details of the proposed uses for each ancillary site would be determined during the pre-construction phase. The proposed activities would be discussed in advance with each landholder and would be included in any leasing agreement. Section 3.5 identifies some of the potential activities that each of the ancillary sites is considered suitable for.

Section 6.6 provides a discussion on land uses surrounding the proposal and the potential impacts of the proposed ancillary activities on these properties.

(blank page)

4 Statutory and planning framework

4.1 State Environmental Planning Policies

4.1.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road and is to be carried out by Roads and Maritime Services, it can be assessed under Part 5 of the EP&A Act.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by State Environmental Planning Policy No. 26 - Littoral Rainforests or State Environmental Planning Policy (State and Regional Development) 2011.

Part 2 of the ISEPP 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 the ISEPP (where applicable), is discussed in Chapter 5 of this REF.

4.1.2 State Environmental Planning Policy 14 Coastal Wetlands

State Environmental Planning Policy 14: Coastal Wetlands (SEPP 14) aims to protect and preserve coastal wetlands for economic and environmental reasons. The policy applies to local government areas outside the Sydney metropolitan area that front the Pacific Ocean and identifies over 1300 wetlands of high natural value. Land clearing, drainage work or filling may only be carried out within these wetlands with the consent of the local council and the agreement of the Director-General of DP&I. Such development also requires that an environmental impact statement accompany any development application.

There is a SEPP 14 wetland immediately east of the motorway south of the Warnervale Interchange. DP&I mapping shows an area of mapped SEPP14 wetland extending onto a section of the southbound motorway carriage about one kilometre south of the Warnervale interchange (refer to Figure 4-1).

As discussed in Section 3, the proposal involves both widening and replacement activities for the motorway. The area of the proposal that falls within the bounds of SEPP 14 involves only the works for the replacement of the existing asset. The work proposed for the replacement of the existing asset is consistent with similar pavement replacement and maintenance activities undertaken routinely by Roads and Maritime throughout the NSW road network. The M1 Pacific Motorway, the section of the motorway between Tuggerah and Doyalson has severe cracking along much of its length and the existing pavement has a residual design life of about five years.

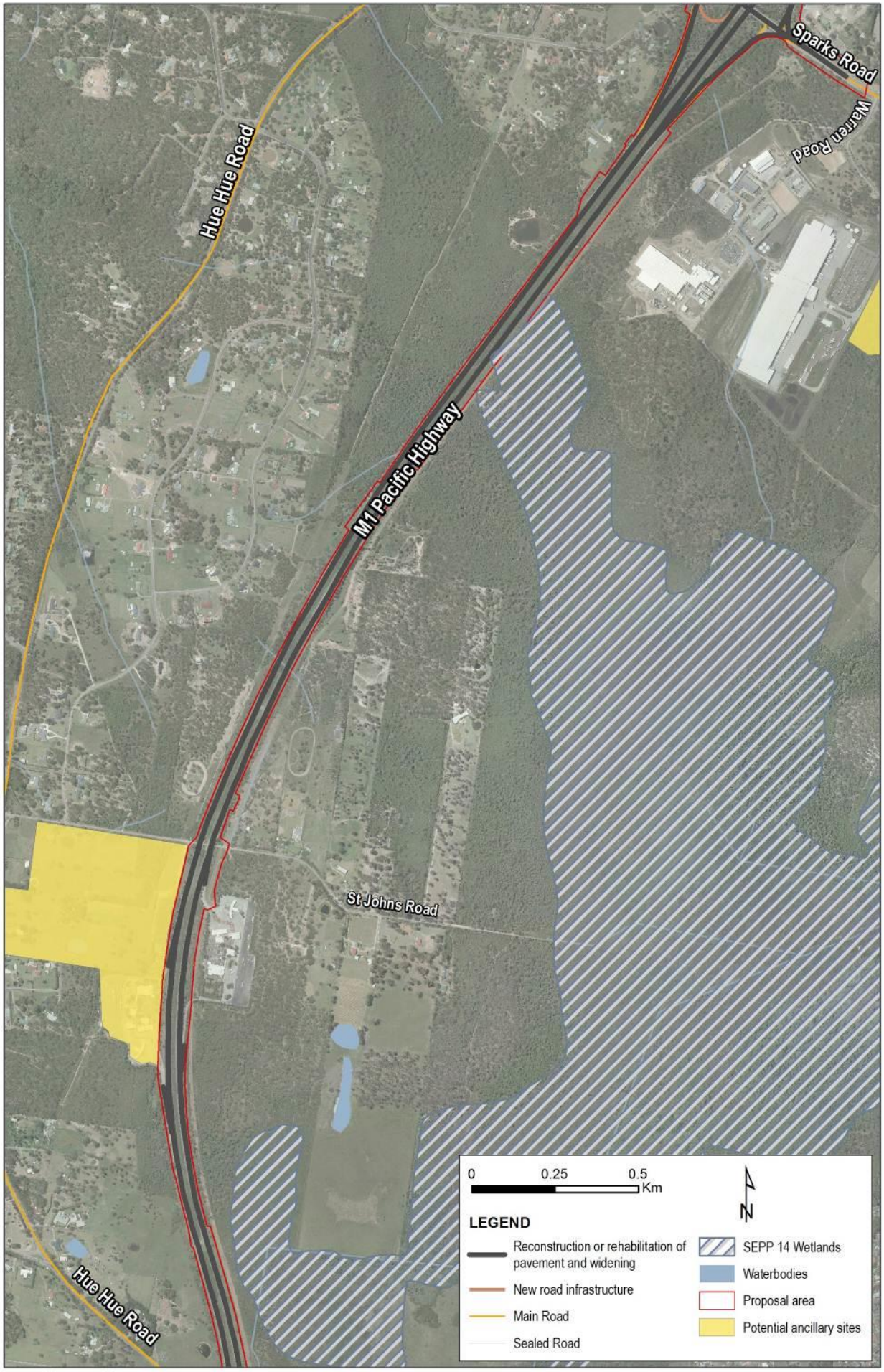


Figure 4.1 SEPP 14 Wetlands

As the proposal comprises both motorway widening *and* pavement replacement activities a dual characterisation can appropriately apply, being both:

- development for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority (applying to the widening activities); *and*
- routine maintenance works carried out on an existing public road or on land that is adjacent to such a road (applying to the pavement replacement activities).

Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. However, this is limited by clause 94(2)(b) which provides that:

> "*emergency works, or routine maintenance works, carried out on an existing public road or on land that is adjacent to such a road (including on land to which State Environmental Planning Policy No 14 - Coastal Wetlands or State Environmental Planning Policy No 26 - Littoral Rainforests applies but, if they are on such land, only if any adverse effect on the land is restricted to the minimum possible to allow the works to be carried out).*"

The pavement replacement activities can therefore be undertaken without consent as they constitute routine maintenance works. This includes the pavement replacement activities located within the mapped bounds of the SEPP 14 area.

SEPP 14 does not specifically define wetlands, therefore there is no statutory definition of a wetland, however it has been noted that the selection criteria used in the survey for the original maps for SEPP 14 can be used as a guideline (Winning, 1991). The wetland components mapped by the survey are listed as mangroves, saltmarshes, *Melaleuca* forests, *Casuarina* forests, sedgelands, brackish and freshwater swamps and wet meadows. The conceptual limits of the wetland communities that were mapped for the policy were primarily established by a number of "main exclusion criteria" which included the exclusion of disturbed or modified wetlands determined from aerial photos exhibiting all five of the following:

1. Presence of functional drains.
2. Presence of fence lines.
3. Paddock differentiation.
4. Signs of reclamation, extensive clearing or contraction of permanently inundated area.
5. Lack of lateral boundary (on at least one side) with bushland, estuary or large waterway (Adam, 1985).

Generally, it can be said that wetlands are areas of land that are wet by surface water or groundwater, or both, for long enough periods that the plants and animals in them are adapted to, and depend on, moist conditions for at least part of their lifecycle, such as shallow lakes and lagoons, estuaries, rivers, floodplains and swamps (Nelson, 2011).

Clause 7(1) of SEPP 14 states that:

> *In respect of land to which this policy applies, a person shall not:*
>
> *(a) clear that land,*
>
> *(b) construct a levee on that land,*
>
> *(c) drain that land, or*
>
> *(d) fill that land,*
>
> *except with the consent of the council and the concurrence of the Director.*

With reference to clause 7(1)(a), clause 7(4) defines 'clearing' as

> *…the destruction or removal in any manner of native plants growing on the land, but does not include:*
>
> *(a) the destruction or removal of a plant declared to be a noxious weed within the meaning of the Noxious Weeds Act 1993, by means not likely to be significantly detrimental to the native ecosystem, or*
>
> *(b the incidental destruction or removal of native plants lying adjacent to any such noxious plants occurring unavoidably during the process of destroying or removing those noxious plants, or*
>
> *(c) the destruction or removal of native plants, within 3 metres of the boundary between the lands owned or occupied by different persons, for the purpose of erecting or maintaining a dividing fence between those lands, or*
>
> *(d) the destruction or removal of native plants, within 0.5 metres of the boundary between the lands owned or occupied by different persons, for the purpose of enabling a survey to be carried out along that boundary by a surveyor registered under the Surveyors Act 1929.*
>
> ***native plants** means plants indigenous to the State of New South Wales, including trees, shrubs, ferns, vines, herbs and grasses indigenous to the State.*

The standard instrument defines fill as:

> *Fill means the depositing of soil rock or other similar, extractive material obtained from the same or some other site, but does not include:*
>
> *a. The depositing of topsoil or feature rock imported to the site that is intended for use in garden landscaping/turf or garden bed establishment or the top dressing of lawns and that does not significantly alter the shape, natural form or drainage of the land, or*
>
> *b. The use of the land as a waste disposal facility.*

The definition of filling of land was considered in Kempsey Shire Council v Thrush & Anor [2011] NSWLEC 93 (27 May 2011). Justice Pain found that while 'the filling of land' could theoretically include almost anything, for the purposes of the SEPP the building up of land, to the natural surrounding level, with introduction of fill, may constitute the creation of a levee, in relation to that particular case, but does not also constitute filling of land.

Consequently, the removal and replacement of an existing asset such as the M1 Pacific Motorway pavement would be consistent with Justice Pain's decision, that such an activity would not constitute filling of land on this occasion and therefore there would be no breach of Clause 7(1)(d), consistent with the judgement in Kempsey Shire Council v Thrush & Anor.

The following provides an evaluation against Clause 7(1) in this regard:

a) There would be no clearing of native vegetation, as defined in Clause 7(4).
b) There would be no construction of a levee.
c) There would be no drainage of the land at this location.
d) The proposal would comprise the replacement of an existing asset, namely the motorway pavement, at this location. This activity would be consistent with Justice Pain's finding that this would not constitute filling of land.

The land would need to be raised for the replaced asset to meet current design standards.

Therefore, notwithstanding the characterisation of the pavement replacement activities as routine maintenance works and therefore permissible without consent

including in locations within the bounds of SEPP 14, the above consideration of relevant case law further confirms that consent from Council or concurrence from the Director-General of DP&I would not be required.

4.1.3 State Environmental Planning Policy 71 Coastal Protection

State Environmental Planning Policy 71 Coastal Protection (SEPP 71) aims to protect and manage the natural, cultural , recreational and economic attributes of the NSW Coast, to protect and improve public access to and along coastal foreshores and to the scenic quality of the surrounding area is maintained.

A section of the proposal corridor, to the north and south of Alison Road around the Wyong River is subject to SEPP 71.

Clause 8 details matters for consideration that need to be considered by a consent authority when it determinations a development application to carry out development on land to which the policy applies. The matters for consideration and the proposal response are presented in Table 4-1.

Table 4-1: SEPP 71 Clause 8 matters for consideration

Clause	Matter	Response
2(1)(a)	to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast, and	The proposal has been developed with consideration for the surrounding environment and communities. Refer Section 6 for more detailed discussion.
2(1)(b)	to protect and improve existing public access to and along coastal foreshores to the extent that this is compatible with the natural attributes of the coastal foreshore, and	The proposal does not interact with the coastal foreshore therefore does not have the potential to provide new public access to and along the coastal foreshore.
2(1)(c)	to ensure that new opportunities for public access to and along coastal foreshores are identified and realised to the extent that this is compatible with the natural attributes of the coastal foreshore, and	The proposal does not interact with the coastal foreshore therefore does not have the potential to provide new public access to and along the coastal foreshore.
2(1)(d)	to protect and preserve Aboriginal cultural heritage, and Aboriginal places, values, customs, beliefs and traditional knowledge, and	The proposal would not impact on known Aboriginal places or heritage. Refer Section 6.9, Aboriginal heritage.
2(1)(e)	to ensure that the visual amenity of the coast is protected, and	The proposal would not impact on the coast. Refer Section 6.7, Visual impact.
2(1)(f)	to protect and preserve beach environments and beach amenity, and	The proposal does not impact on any beach environments or beach amenity.
2(1)(g)	to protect and preserve native coastal vegetation, and	The proposal has sought to minimise the amount of vegetation impacted and would not impact on native coastal vegetation. Refer Section 6.8, Biodiversity.
2(1)(h)	to protect and preserve the marine environment of New South Wales, and	The proposal would not impact on the marine environment. Refer

Clause	Matter	Response
		Section 6.4, Soil and Water.
2(1)(i)	to protect and preserve rock platforms, and	The proposal does not impact on any rock platforms.
2(1)(j)	to manage the coastal zone in accordance with the principles of ecologically sustainable development (within the meaning of section 6 (2) of the *Protection of the Environment Administration Act 1991*), and	The proposal has been developed with consideration for the principles of ESD. Refer Section 6 and Section 8.2.
2(1)(k)	to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area, and	The project comprises widening of an existing motorway which is appropriate to the location. Refer Section 6.7, Visual Impact.
2(1)(l)	to encourage a strategic approach to coastal management.	Strategic need for the proposal is addressed in Section 2.1.
8(a)	Aims of the policy set out in Clause 2	(see above)
8(b)	existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and, where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved,	The proposal would not impact on existing public access to and along the coastal foreshore.
8(c)	opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability,	The proposal does not interact with the coastal foreshore therefore does not have the potential to provide new public access to and along the coastal foreshore.
8(d)	the suitability of development given its type, location and design and its relationship with the surrounding area,	The proposal comprises a widening of an existing motorway in order to meet increased traffic demands. The relationship with the surrounding area is provided in more detail in Section 6.6, Land use.
8(e)	any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore,	The proposal would not impact on the amenity of the coastal foreshore. Refer Section 6.7, Visual Impact.
8(f)	the scenic qualities of the New South Wales coast, and means to protect and improve these qualities,	Refer Section 6.7, Visual impact.
8(g)	measures to conserve animals (within the meaning of the *Threatened Species Conservation Act 1995*) and plants (within the meaning of that Act), and their habitats,	Refer Section 6.8, Biodiversity.
8(h)	measures to conserve fish (within the meaning of Part 7A of the *Fisheries Management Act 1994*) and marine vegetation (within the meaning of that	The proposal would not impact on fish or fish habitat. Refer Section 6.8, Biodiversity.

Clause	Matter	Response
	Part), and their habitats	
8(i)	existing wildlife corridors and the impact of development on these corridors,	Refer Section 6.8, Biodiversity.
8(j)	the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards,	The project would not be impacted by or have an impact on coal processes and coastal hazards.
8(k)	measures to reduce the potential for conflict between land-based and water-based coastal activities,	The proposal would not create conflict between land-based and water based coastal activities.
8(l)	measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals,	The proposal would not impact on known Aboriginal places or heritage. Refer Section 6.9, Aboriginal heritage.
8(m)	likely impacts of development on the water quality of coastal waterbodies,	Refer Section 6.4, Soil and water.
8(n)	the conservation and preservation of items of heritage, archaeological or historic significance,	The proposal would not impact on known items of heritage, archaeological or historic significance. Refer Section 6.10, Non-Aboriginal heritage.
16	The consent authority must not grant consent to a development application to carry out development on land to which this Policy applies if the consent authority is of the opinion that the development will, or is likely to, discharge untreated stormwater into the sea, a beach, or an estuary, a coastal lake, a coastal creek or other similar body of water, or onto a rock platform.	Refer Section 3.3.5 and Section 6.4 Soil and water.

4.1.4 State Environmental Planning Policy 44 Koala Habitat Protection

State Environmental Planning Policy 44 Koala Habitat Protection (SEPP 44) seeks to encourage the proper conservation and management of areas that provide habitat for koalas. SEPP 44 applies to the Wyong LGA.

One eucalypt species, *Eucalyptus robusta* (Swamp Mahogany) listed as a koala feed tree under Schedule 2 of SEPP 44 was recorded within two areas of the assessed proposal area. *Eucalyptus robusta* comprises about 15 per cent of vegetation at the Sparks Road potential ancillary site (listed as Site 3a in the Biodiversity Technical Study provided in Appendix H) and about 15 per cent of the vegetation at the Hue Hue Road ancillary site (listed as Site 7c in the biodiversity technical study provided in Appendix H).

Due to the vegetation constraint on the Sparks Road site it was subsequently excluded from further consideration and does not form part of the proposal. The core koala habitat identified at the Hue Hue Road ancillary site would be protected by excluding construction activities from stands of *Eucalyptus robusta*. In addition, no clearing of native vegetation for temporary work on ancillary sites (other than undergrowth or groundcover) would be permitted. As a result the proposal would not affect core koala habitat.

4.1.5 State Environmental Planning Policy (Major Development) 2005

State Environmental Planning Policy (Major Development) 2005 (Major Development SEPP) identifies major projects for the purpose of planning approval for State significant sites.

The Major Development SEPP designates Council as the consent authority for development on land within the Wyong Employment Zone (WEZ). However Schedule 3 Part 15 Clause(11)(1) states that development for the purpose of infrastructure under the ISEPP is permissible without consent, therefore the provisions of the Major Development SEPP do not apply to the proposal.

The WEZ is listed as a State significant site under Schedule 3 of the Major Development SEPP. The road corridor is excluded from the Major Development SEPP however parts of the proposal area are located directly adjacent to the existing road reserve. The WEZ is directly adjacent to the proposal area from about 1.5 kilometres south of the Warnervale Interchange to about 500 metres north of the Warnervale Interchange. The Warren Road construction ancillary site is also located within the WEZ boundary.

4.2 Local Environmental Plans

4.2.1 Wyong Local Environmental Plan 1991

The Wyong Local Environmental Plan 1991 (LEP) was repealed in December 2013 and replaced with the Wyong Local Environmental Plan 2013 (Wyong LEP).

4.2.2 Wyong Local Environmental Plan 2013

The Wyong LEP 2013 was gazetted in December 2013. The proposal is located within the SP2 Infrastructure zone and is consistent with the objectives of the zone. The objectives for this zone are:

- 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 recognise existing railway land and to enable future development for railway and associated purposes.
- To recognise major roads and to enable future development and expansion of major road networks and associated purposes.
- To recognise existing land and to enable future development for utility undertakings and associated purposes.

The proposed ancillary sites are located on land with various zonings. These are listed in Table 4-2.

Table 4-2: Zoning objectives for proposed ancillary sites

Construction ancillary site	Zoning
Warren Road ancillary site	IN1 General Industrial
Hue Hue Road ancillary site	R5 Large Lot Residential E2 Environmental Conservation E3 Environmental Management
McPherson Road ancillary site	E3 Environmental Management

The Major Development SEPP Schedule 3 Part 15 Clause (5)(1) states that this policy and all other SEPPs apply according to their terms to land within the Wyong Employment Zone. Schedule 3 Part 15 Clause (3) identifies that Wyong Shire Council is the consent authority for development on land within the WEZ.

The Major Development SEPP (Schedule 3 Part 15 Clause (9)) provides that within Zone E2 Environmental Conservation development for the purpose of drainage, environmental facilities and roads is permitted only with development consent. Development for the purposes of roads is permitted with consent on land within Zone IN1 General Industrial.

Schedule 3 Part 15 Clause (11)(1) provides that this Part does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development that is permitted to be carried out with or without consent or that is exempt development under the ISEPP. Therefore the proposed activities within the WEZ are permissible without consent.

Council has been informed of the proposal and would continue to be consulted throughout the proposal development and construction. Consultation activities are discussed further in Section 5.

4.3 Other relevant legislation

4.3.1 NSW Legislation

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (PoEO Act) is administered by the NSW Environment Protection Authority (EPA). It provides an integrated system of licenses to set out protection of the environment policies and to adopt more innovative approaches to reduce pollution in the environment, having regard to the need to maintain ecologically sustainable development.

Part 3.2 of the PoEO Act requires an Environment Protection Licence for scheduled development work and the carrying out of scheduled activities. The proposal includes the widening of about 12.3 kilometres of road in a non-metropolitan area and therefore is a scheduled activity.

The PoEO Act also identifies a number of pollution offences, including offences relating to:

- The wilful or negligent disposal of waste in a manner that harms or is likely to harm the environment.
- The wilful or negligent causing of a substance to leak, spill or otherwise escape (whether or not from a container) in a manner that harms or is likely to harm the environment.
- The wilful or negligent causing of any controlled substance to be emitted into the atmosphere in contravention of the regulations under the *Ozone Protection Act 1989* and in a manner that harms or is likely to harm the environment.
- Water pollution.
- Air pollution.
- Noise pollution.
- Land pollution and waste.

The construction contractor and Roads and Maritime are obliged to notify the EPA if a pollution incident occurs that causes or threatens material harm to the environment.

Threatened Species Conservation Act 1995 (TSC Act)

The TSC Act aims to conserve biological diversity by protecting and encouraging the conservation of threatened species, populations and ecological communities and their critical habitats.

An assessment of the potential impacts of the proposal on threatened species, populations, ecological communities and critical habitat listed on the TSC Act has been undertaken in accordance with Section 5A of the EP&A Act.

Assessments of significance ('seven part tests') have been prepared for state-listed threatened biota, which have been recorded or have the potential to occur within the proposal footprint. This includes three threatened ecological communities, nineteen threatened fauna species, nine threatened flora species and one endangered population.

Assessments of significance pursuant to the commonwealth Department of Environment *Significant Impact Guidelines 1.1* (DEWHA, 2009) have been prepared for matters of national environmental significance (MNES) with the potential to occur within the proposal footprint. This includes five threatened fauna species and eight threatened flora species.

The results are discussed in Section 6.8, with 'seven part tests' included in Appendix H. No potential significant impacts were identified provided suggested mitigation measures are implemented.

Water Management Act 2000

The *Water Management Act 2000* provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The Act controls the extraction of and use of water, the construction of works such as dams and weirs, and the carrying out of activities in or near water sources in NSW. 'Water sources' are defined broadly and include the whole or any part of a river, lake, estuary, place where water occurs naturally on or below the surface of the ground, and NSW coastal waters.

Elements of the proposal would meet the requirements for needing 'controlled activity' approval given that there would be works within 40 metres of waterfront land. However, under section 38 of the Water Management (General) Regulation 2011, Roads and Maritime is exempt from the requirement to obtain a 'controlled activity' approval. A notification of the activity would need to be provided to the NSW Office of Water at least 30 days before the activity commences.

If groundwater extraction is required for the proposal, an aquifer interference approval would be required for the work under clause 91F of the *Water Management Act 2000*.

Fisheries Management Act 1994 (FM Act)

The FM Act and the Fisheries Management Regulation 2010 aim to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. If a proposal is likely to cause a significant effect on a threatened species of fish or marine vegetation, population or ecological community, a species impact statement (SIS) would need to be completed.

The proposal includes the intention to retain the existing bridge structures and no work is proposed within waterways. As a result there is not expected to be any impact on fish or marine vegetation species relevant to the FM Act or Regulation.

Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* provides for a coordinated approach to the removal and control of scheduled noxious weeds across the NSW. No permits or approvals are required under this Act, but it is the responsibility of Roads and Maritime to provide for the removal and proper disposal of any listed weeds found within the proposal site. Noxious weeds are discussed and management measures proposed in Section 6.8.

Mine Subsidence Compensation Act 1961

The *Mine Subsidence Compensation Act 1961* provides for the proclamation of mine subsidence districts. The Mine Subsidence Board (MSB) has confirmed that the motorway corridor is not within a mine subsidence district (MSD) and that MSB approval of the proposal is not required (refer Appendix D).

The MSB did note that the section of Sparks Road west of the M1 Pacific Motorway lies within the Hue Hue MSD district. Development in this area would need to be designed to cater for ground strains of +/- 2 mm/m. It was also advised that further information from the Department of Industry – Mineral Resources regarding proposed mine subsidence effects on the M1 Pacific Motorway in this area should be sought.

4.4 Commonwealth legislation

4.4.1 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 MNES or the environment of Commonwealth land. These are considered in Appendix A and Section 6 of the REF.

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. Accordingly, the proposal has not been referred to the Australian Government Department of Environment.

4.5 Confirmation of statutory position

The proponent and determining authority for the proposed M1 Pacific Motorway replacement and widening, Tuggerah to Doyalson is NSW Roads and Maritime Services. State Environmental Planning Policy (Infrastructure) 2007 provides that the proposed works may be carried out without the need for development consent and are therefore is subject to assessment under Part 5 of the EP&A Act.

The matters prescribed by clause 228 of the Environmental Planning and Assessment Regulation 2000, for consideration by assessments under Part 5, are reviewed at Appendix A.

Referral of the proposal to the Australian Government Department of the Environment is not considered necessary.

Section 6.18 lists all relevant licenses, permits, notifications and approvals needed to construct and operate the proposal.

(blank page)

5 Stakeholder and community consultation

5.1 Consultation strategy

During development of the proposal, consultation with the community and Government agencies has been undertaken. The consultation techniques have been undertaken in accordance with the Roads and Maritime *Community Involvement and Communications: A resource manual for staff*.

The purpose of consultation has been to:

- Involve relevant government agencies, community representatives, residents, and landowners in providing input to the concept design.
- Inform the community of the proposal to upgrade the road.
- Canvas comments and issues about the proposal from those who may be affected.
- Seek community ideas to be considered in finalising the design.
- Advise potentially directly affected stakeholders of the proposed upgrade and its possible property impacts.
- Advise stakeholders on how they may obtain further information on the proposal.
- Provide stakeholders with information on how they may communicate concerns, complaints or suggestions related to the proposal.

5.2 Community involvement

The 2013/14 Commonwealth budget introduced a proposed program of works (known then as the F3 Productivity Package) to deliver around $400 million in State and Commonwealth funding to a range of upgrade projects, including the current proposal, over the five years 2014/15 to 2018/19. Roads and Maritime developed a community update describing the proposal, which was released to the community on 18 October 2013. A public comment period was provided from 18 October 2013 to 13 December 2013. The participation and communication activities conducted during this period included:

- Community update mail out to about 13,000 local residents and businesses around the proposal area.
- Community information sessions.
- Information on the Roads and Maritime website.
- Newspaper advertising.
- Media activities.
- Submission response letter.
- Provision of a ‘question and answer’ sheet.

Comments were received from the community through 24 written submissions, seven telephone calls and 12 feedback forms from the community information sessions.

The key issues raised by the community are summarised in Table 5-1.

Table 5-1: Community comments on issues

Issue	Number of comments made about issue
Noise mitigation measures	12
Access to service centres	10
Pavement treatment	8
Traffic noise	7
Lane arrangements	7
Consultation process	6
Heavy vehicle noise	4
Interchange at Alison Road	4
Doyalson Link Road interchange	3
Illegal U-turns at service centres	3
Access for emergency services	2
Access to service station businesses	2
Construction noise	2
Drainage issues	2

These submissions have been considered in the development of the proposal and REF. Further detail about the community involvement is provided in the Issues Summary Report provided in Appendix O.

5.3 Aboriginal community involvement

Aboriginal community consultation is an integral part of the assessment of Aboriginal cultural heritage significance. Consultation was undertaken in accordance with Stage 2 of the *Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime, 2011).

Initial consultation to identify interested local Aboriginal parties was undertaken by Roads and Maritime with the Darkinjung Local Aboriginal Land Council (DLALC). DLALC was invited to participate in the field survey in accordance with Stage 2 of the PACHCI.

Sharon Hodgetts, DLALC Project Officer, and Stephen Knight, Roads and Maritime Aboriginal Cultural Heritage Officer, participated in the fieldwork on 1-2 May 2013. The fieldwork methodology and proposed development were discussed with the participants, and topographic maps and aerial photographs were made available to guide the survey. For safety reasons, no pedestrian access to any part of the paved motorway areas was permitted, including the central median strip, shoulder and breakdown bays. Entry to private properties and road reserves was through defined access points. The survey was undertaken on foot, with personnel transported between access points by vehicle.

Information provided by the fieldwork participants during the field survey has been integrated into the assessment. Further detail on the methodology and consultation process is provided in Appendix J.

The results of the survey and the proposed recommendations were discussed with Ms Hodgetts in the field, and no objections were raised. DLALC was also invited by Roads and Maritime to prepare a cultural heritage survey report advising on

Aboriginal cultural heritage issues that may arise as a result of the proposal, in accordance with Stage 2 of the PACHCI.

Further detail on Aboriginal cultural heritage consultation is included in Appendix J.

5.4 ISEPP consultation

Part 2, Division 1, Clauses 13-15 of the ISEPP specify consultation requirements for infrastructure development to be carried out under the ISEPP. These largely relate to the requirement for public authorities other than local councils to consult with the relevant local council as part of the assessment process. Consultation is required if the proposal would affect council infrastructure or services, impact on a local heritage item or if development would impact on flood liable lands.

Table 5-2 provides a summary of the consultation requirements for the proposal in accordance with the ISEPP.

Table 5-2: Summary of ISEPP consultation requirements

Clause	Details	Response
13 (1) (a)	Likely to have a substantial impact on stormwater management services provided by council.	No
13 (1) (b)	Likely to generate traffic to an extent that will strain the capacity of the road system in a local government area.	Yes, during construction the proposal would increase traffic on local roads. These would include Sparks Road, Warren Road, Hue Hue Road, St Johns Road, Yarramalong Road, McPherson Road and Wyong Road.
13 (1) (c)	Involves connection to, and substantial impact on the capacity of any part of a sewerage system owned by a council.	No
13 (1) (d)	Involves connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council.	No
13 (1) (e)	Involves the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential.	No, The section of Sparks Road west of the northbound offload ramp from the M1 Pacific Motorway is a regional road under the care and control of Wyong Shire Council. Any disruption on this section of Sparks Road is likely to be minor and inconsequential, unless Roads and Maritime diverts traffic to Hue Hue Road as a result of an incident. There is already an agreement in place for this with Council under the M1 incident management plan. This would not be a project specific impact. In addition, the proposal ancillary sites would generate some minor additional traffic on local roads.
13 (1) (f)	Involves excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for	No, there are no council owned footpaths subject to excavation along roads affected by the proposal.

Clause	Details	Response
	which council is the roads authority under the Roads Act.	
14 (1) (a)	Is likely to have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item) or a heritage conservation area.	No, there would be no impact on local heritage items.
15 (2)	Development that is to be carried out on flood liable land that may be carried out without consent and that would change flood patterns other than to a minor extent.	No, the proposal would include work in the Wyong River catchment but modelling has indicated the proposal would not change the probable maximum flood levels.
16 (2) (a)	development adjacent to land reserved under the *National Parks and Wildlife Act 1974*	No.
16 (2) (b)	development adjacent to a marine park declared under the *Marine Parks Act 1997*	No.
16 (2) (c)	Development adjacent to an aquatic reserve declared under the *Fisheries Management Act 1994*	No.
16 (2) (d)	Development in the foreshore area within the meaning of the *Sydney Harbour Foreshore Authority Act 1998*	No.
16 (2) (e)	Development comprising a fixed or floating structure in or over navigable waters—the Maritime Authority of NSW	No.
16 (2) (f)	Development for the purposes of an educational establishment, health services facility, correctional centre or group home, or for residential purposes, in an area that is bush fire prone land (as defined by the Act).	No.

Formal letters of notification, in accordance with clause 13 of the ISEPP, were sent to Wyong and Gosford councils on 4 July 2013. Neither Council provided a formal reply, however consultation with Wyong Shire Council will continue throughout planning, and subject to approval, delivery of the proposal. A copy of the letter sent to the Councils is included in Appendix D.

5.5 Government agency and stakeholder involvement

In addition to Wyong and Gosford councils, a range of other government agencies and stakeholders have been identified based on the potential environmental constraints identified for the proposal. In preparing this REF, the following stakeholders were contacted and invited to provide input into the environmental assessment process:

- NSW Office of Water.
- Planning and Infrastructure.

- Transport for NSW.
- Office of Environment and Heritage.
- Gosford City Council.
- NSW Trade and Investment.
- Hunter – Central Rivers Catchment Management Authority.
- Department of Infrastructure and Transport (Commonwealth).
- Gosford Primary Industries Institute (Fisheries).
- Bicycle NSW.
- Mine Subsidence Board.
- Warnervale Airport.
- NSW Rural Fire Service.
- NSW police.
- Red Bus Services.
- Gosford Busways.
- Wyong Busways.
- Warner Business Park.

The issues raised by stakeholders during this process are summarised with the Roads and Maritime responses in Table 5-3. Copies of the correspondence with stakeholders are provided in Appendix D.

Consultation was undertaken with the EPA in December 2013 regarding construction noise and the potential to use extended construction working hours for the proposal. Further details on this are provided in Section 3.4.2 and in the next section.

Ongoing consultation with the EPA would be undertaken throughout the detailed design and construction phases of the proposal.

Table 5-3: Summary of Government and stakeholder consultation undertaken for the proposal

Agency/stakeholder	Date of response	Comment	Response	Where addressed in this report
NSW Trade and Investment	30 July 2013	Advised it supported the proposal.	Noted.	Section 6.5 (Socio economic)
Environment Protection Authority	No formal response received	Discussions were held with EPA in December 2013 to discuss the proposal. In particular the discussions centred on the construction noise impacts that the proposal may result in and, options for construction working hours being considered by Roads and Maritime and the implications that these decisions would make on any subsequent application for an EPL.	The EPA provided guidance and advice about the likely EPL implications of various construction working hours strategies. It was suggested by the EPA that community consultation should be undertaken on the issue with affected sensitive receivers if extended working hours was proposed. Refer to Section 5.6	Section 3.4.2 Section 5.6 Section 6.2 (noise and vibration)
Wyong Coal	29 July 2013	Wyong Coal has no objection to the proposal and advised that no future proposed activities by Wyong Coal are likely to constrain Roads and Maritime' M1 widening project. Provided detail on Wallarah 2 Coal Project which would be situated on industrially zoned land in the northeast quadrant of the intersection of the M1 Pacific Motorway and the Doyalson Link Road, close to the proposal boundaries. Advised that the EIS for the Wallarah 2 Coal Project identified that the	Noted. Roads and Maritime will continue to liaise with Wyong Coal on this matter.	Section 6.6 (Land use)

Agency/stakeholder	Date of response	Comment	Response	Where addressed in this report
		project would contribute to local traffic generation over the long term, although no road haulage of coal is proposed. They also advised that while the M1 Pacific Motorway will not be subject to conventional subsidence effects due to future longwall mining by the Wallarah 2 Coal project, it is possible that minor 'far-field' effects could be registered along such linear rigid infrastructure. Wallarah 2 Coal Project will undertake to closely liaise with Roads and Maritime with respect to detailed subsidence planning and monitoring prior to longwall mining activity. Also, it is recommended that Roads and Maritime consult with Mine Subsidence Board in relation to any specific design and construction requirements that might be required.		
NSW Trade and Investment – Resource and Energy	31 July 2013	NSW Department of Trade & Investment – Mineral Resources Branch (MRB) advised that the subject area is covered by three coal titles including exploration licences EL5903 and EL4911, and authorisation A405. These are all held by Kores Australia Pty Ltd (proposed Wallarah No. 2 Colliery). Kores indicative longwall area, as shown in the project EIS is approximately 800 metres west of the motorway at its nearest point. As project works will almost entirely be within existing road and interchange corridors, and will not impact on the Wallarah Coal Project or on future coal extraction beneath the area. MRB reported no concerns with the proposal.	Noted. The MSB has been consulted. See below.	Section 6.6 (Land use)

Agency/stakeholder	Date of response	Comment	Response	Where addressed in this report
		The subject area borders the Wyong and Hue Hue mine subsidence districts and MRB recommends that the MSB be consulted.		
Mine Subsidence Board	11 July 2013	The MSB confirmed that the M1 Pacific Motorway is located outside of a mine subsidence district and that the Board's approval would not be required provided the extra lanes are located in the middle of the current lanes. Noted that the section of Sparks Road west of the M1 Pacific Motorway lies within the Hue Hue MSD district. Development in this area will need to be designed to cater for +/- 2mm/m ground strains. Advised that further information from the Department of Industry – Mineral Resources regarding proposed mine subsidence effects on the M1 motorway in this area should be sought.	Noted.	Section 4.3 and Section 6.6 (Land use)
Warner Business Park	31 July 2013	Noted that the proposal has the potential implications for the approved development of Warner Business Park and would appreciate the opportunity to review detailed drawings and plans and to review the flood modelling information when available.	Noted.	Section 6.6 (Land use)

5.6 Ongoing or future consultation

An outcome of the December 2013 discussion with EPA was the identification of a need to undertake consultation with residents likely to be affected by the proposed extended construction working hours and out-of-hours work. In response, Roads and Maritime has prepared a community update that will be distributed to potentially affected sensitive receivers during the REF exhibition period. The community update would outline the:

- Proposed construction working hours.
- Types of construction activities that would be undertaken.
- Predicted noise impacts.

The community update is planned to be released concurrently with the REF public exhibition. This would allow the community to further consider issues of concern and to make formal comment during the submissions period that would be captured within the REF submissions report.

The community update would provide a dedicated phone line for enquires from the community and the community would be invited to contact Roads and Maritime to discuss any specific concerns. Roads and Maritime is planning to run community information sessions and if required in addition may arrange face to face meetings to discuss issues directly.

The results of this consultation would be summarised in the REF submissions report and would be made publicly available on the Roads and Maritime website. Any actions or outcomes from this targeted consultation would be documented in the Submissions Report and would be considered in the proposal planning.

Relevant stakeholders and the community would be informed of any major design changes that occur during detailed design, and that may impact upon them either collectively or individually.

(blank page)

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 proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of the factors specified in the guidelines *Is an EIS required?* (DUAP, 1999) and *Roads and Related Facilities* (DUAP, 1996b) as required under clause 228(1)(b) of the Environmental Planning and Assessment Regulation 2000. The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are considered in Appendix A. Proposal specific safeguards are provided to ameliorate the identified potential impacts.

6.1 Traffic and transport

An operational traffic and transport assessment has been prepared for the proposal. A full copy of the report is provided in Appendix E and a summary is provided below. An additional construction phase traffic and transport impact assessment technical note was prepared for the proposal and is provided in Appendix L and a summary is provided below.

6.1.1 Existing environment

The existing road network within the vicinity of the proposal area consists of:

- The M1 Pacific Motorway – classified as a national freeway.
- Wyong Road, Sparks Road and Doyalson Link Road – classified as state roads.
- Hue Hue Road - classified as a regional road.
- Burnet Road, Tonkiss Street and Woodbury Park Drive - classified as local roads.

Access to the motorway in the proposal area is via three interchanges at Wyong Road, Sparks Road and Doyalson Link Road. There are also on and off ramps from the northbound and southbound service centres near St Johns Road bridge.

The M1 Pacific Motorway, Wyong Road, Sparks Road and Doyalson Link Road are dedicated B-double routes. Wyong Road and Doyalson Link Road have height restrictions of 4.6 metres.

Traffic volumes

Existing traffic volumes and average travel speeds in the proposal area were collated from Roads and Maritime permanent and temporary counting stations. Traffic counts were also conducted for the operational traffic and transport study conducted in April and May 2013. The existing traffic volumes are provided in Appendix E and are summarised in Table 6-1.

Table 6-1: Traffic data and annual average traffic growth 1992 - 2010

Station no.[2]	Location	Average annual daily traffic				% growth p.a. (2004-10)
		1992	1998	2004	2010[(1)]	
05.007	Pacific Motorway at Alison Road overpass, Alison	32,746	46,413	60,093	65,007	1.36
05.049	Wyong Road, east of Pacific Highway, Tuggerah	13,547	30,223	35,266	37,917	1.25
05.161	Wyong Road, east of Pacific Motorway, Tuggerah	13,466	27,848	32,973	25,637	-3.71
05.302	Doyalson Link Road west of Pacific Highway, Blue Haven	11,678	12,240	16,130	17,089	0.99

(1) Average Daily Traffic (ADT) data was used for year 2010 as average annual daily traffic (AADT) data was not available; (2) Source: PB, 2014.

The data shows that the M1 Pacific Motorway experienced a high level of growth between 1992 and 2004 with an average annual growth rate of seven per cent. This slowed after 2004, with an average annual growth rate between 2004 and 2013 of less than two per cent.

The traffic volumes in the proposal area can be summarised as follows:

- On the M1 Pacific Motorway the greatest traffic volumes are at the southern end of the proposal area.
- Generally, traffic flows on the M1 Pacific Motorway are greatest in the southbound direction in the AM and in the northbound direction in the PM. However south of the Tuggerah Interchange, the southbound direction is the most prominent in the PM.
- At Sparks Road the general traffic patterns show that the primary traffic flow is westbound along Sparks Road and then southbound onto the M1 Pacific Motorway in the AM. In the PM the reverse of this is the primary movement. This indicates that Sparks Road is currently used for access by the adjoining residential areas, with traffic volumes flowing out of the area in the AM and returning in the PM.
- At the Tuggerah Interchange general traffic patterns show that traffic flows southbound along the M1 Pacific Motorway onto Wyong Road eastbound in the AM. In the PM the reverse of this is the primary movement. This indicates that Wyong Road is currently used to access the adjoining commercial and industrial areas, with traffic volumes flowing into the area in the AM and leaving in the PM.
- Doyalson Link Road shows major movements southbound in the AM and northbound in the PM which indicates that this road may be utilised by local residents travelling to and from workplaces located towards the south.
- On roads surrounding the M1 Pacific Motorway, traffic volumes are generally higher in the developed areas east of the motorway.
- West of the motorway the traffic volumes are typically low.

Motorway performance

The M1 Pacific Motorway currently generally operates at a LoS B or LoS C during the AM and PM peak periods. LoS D or better is generally accepted as an appropriate level of operation.

Table 6-2 provides travel times for the M1 Pacific Motorway for the year 2012. It shows that existing travel speeds on the motorway are about 12 per cent below the posted speed limit of 110 km/h.

Table 6-2: Average surveyed existing motorway travel speeds

Time period	Direction	Average speed (km/h)
6.00 am – 10.00 am	Northbound	96
6.00 am – 10.00 am	Southbound	97
3.00 pm – 7.00 pm	Northbound	96
3.00 pm – 7.00 pm	Southbound	97

Intersection performance

The intersections within the proposal area provide for LoS between B and D in the AM and PM peak periods. There are some intersection approaches that are beginning to show limitations in terms of performance; these are as follows:

- The Woodbury Park Road (northern) approach to the Wyong Road roundabout reaches LoS D in the AM peak. This is due to the significant traffic volumes travelling eastbound along Wyong Road, which limit the opportunity for traffic from the north to enter the roundabout.
- The M1 Pacific Motorway/Sparks Road West Interchange reaches LoS D at the southern approach for the AM and PM peaks.
- The M1 Pacific Motorway/Sparks Road East Interchange reaches LoS D at the northern approach for the AM and PM peaks.

Freight

TfNSW has defined the following road sections as freight routes located within the proposal area:

- M1 Pacific Motorway – Primary freight route which serves the needs of freight for access interstate and to strategically important ports, airports, industrial areas, freight terminals and hubs within the Sydney, Newcastle and Wollongong area. This route typically carries high volumes of heavy freight vehicles (>4000 heavy vehicle average annual daily traffic (AADT)) and concentrations of road freight including high concentrations of long distance and high capacity tucks.
- Wyong Road, Sparks Road, Pacific Highway and Doyalson Link Road – Tertiary freight routes which provide connection from the state road system to the primary freight routes. These routes serve the numerous major businesses and freight origins and destinations within a subregion and carry less than 2,000 heavy vehicles per day.

Traffic survey data shows:

- The percentage of heavy vehicles on the M1 Pacific Motorway is currently between 7.7 per cent and 13.6 per cent, indicating that the motorway carries a higher percentage of heavy vehicles than other roads within the proposal area.
- Generally, heavy vehicles enter the M1 Pacific Motorway from Wyong Road in the AM peak and exit the motorway to Wyong Road in the PM peak.
- The percentage of heavy vehicles on Sparks Road is projected between 5.5 per cent in the AM and 8.8 per cent in the PM. Generally, Sparks Road carries a greater percentage of heavy vehicles than Wyong Road as industrial developments are located adjacent to the Sparks Road interchange. Heavy vehicles perform U-turns at the Sparks Road interchange to travel between the Hunter Region and Doyalson as there are no northbound ramps provided at the Doyalson Link Road interchange.
- Generally, heavy vehicles exit the motorway to Doyalson Link Road in the AM peak hours and enter the motorway from Doyalson Link Road in the PM peak.

Public transport

The main northern rail line, which runs between Sydney and Brisbane, lies just to the east of the proposal area. There are three train stations in the vicinity of the proposal area, Warnervale Station, Wyong Station and Tuggerah Station.

There are no local bus routes that use the M1 Pacific Motorway. Coastal Liner Services and Red Bus Services operate bus services within the proposal area that cross (over or under) the motorway. The majority of routes are serviced infrequently during both peak and off-peak periods.

Cycle and pedestrian networks

Cyclists are permitted to use the shoulders along the length of the M1 Pacific Motorway. Cyclists can also use the shoulder facilities provided along Wyong Road, Sparks Road and Doyalson Link Road.

There are dedicated cycle lanes located on Sparks Road on the approaches to the motorway interchange. For the remainder of Sparks Road, cyclists are required to use the shoulder or share with general traffic.

There is a minimal pedestrian network within the proposal area adjacent to the M1 Pacific Motorway. This is due to a lack of adjacent development. There are currently no pedestrian crossings in the proposal area.

The only pedestrian-specific facilities are footpaths located on the northern side of the Sparks Road and Wyong Road overbridges. There are no footpaths connecting to these. Pedestrians are required to use the road verges.

An informal parking area located on Sparks Road, west of the motorway, is generally used by carpooling travellers. Motorists who have parked in the informal carpooling parking areas typically access the opposite side of the motorway using informal pedestrian paths along Sparks Road.

6.1.2 Potential impacts

Potential impacts from the proposal on traffic and transport are discussed separately

for the construction phase and the operational phase.

Construction

Impacts on traffic

Movements of construction vehicles on the M1 Pacific Motorway and other local roads would vary depending on:

- The construction staging option adopted by the construction contractor.
- The number of work sites operating within each section of the proposal under construction at any time.
- The number of plant and trucks operating at each work site.
- The maximum capacity for vehicle movements at site facilities where materials are stockpiled, delivered to or hauled from.

These construction planning details would be determined by the contractor. Until supply contracts have been awarded for the materials required on site, details of the origin of construction vehicles and the route they are likely to take cannot be confirmed. Notwithstanding this, designated access routes for construction and spoil vehicles would be along the arterial road network where practicable. Details of routes used for access and haulage during construction would be developed in consultation with relevant stakeholders upon confirmation of material source and disposal locations.

A large quantity of existing pavement material would be removed and processed at nearby construction ancillary facilities. In addition, construction materials would need to be transported to the site from external sources. To accommodate these movements, construction-related traffic would travel on the existing M1 Pacific Motorway and local roads for part of each trip.

Anticipated haulage routes for construction vehicles are illustrated in Figures 1 and 2 of Appendix L.

Based on the peak traffic generation assessments and potential haulage routes, an assessment of the impacts on the local road network has been prepared and is presented in Table 9 in Appendix L. The key findings from the construction traffic impact assessment on the operation of key local roads are:

- Levels of service for all key roads assessed would be unchanged from existing with the addition of the proposal construction traffic.
- The traffic volumes would increase substantially during construction on Wyong Road, west of Wyong Road interchange (increase of 21.9 per cent) and Sparks Road, west of Sparks Road interchange (increase of 18.5 per cent). Despite the increase in traffic volumes, each of these roads currently operates at LoS A, which would not be altered during construction.
- The proportion of heavy vehicles on Sparks Road and Wyong Road would increase notably during construction (between 1.2 per cent and 5 per cent). However, Wyong Road and Sparks Road are designated B-double routes, which would accommodate the proposed construction vehicles.

The current posted speed limit on the M1 Pacific Motorway is 110 km/h. The average travel speed on the section of the motorway proposed for upgrade was measured to be about 12 per cent lower than the posted speed limit at 96 to 97 km/h (PB, 2014). With a proposed construction speed limit of 80 km/h on the M1 Pacific Motorway

during construction, the travel time for general traffic over the full 12.3 kilometre length of the proposed upgrade would increase by about two minutes and 30 seconds for vehicles currently travelling at 110 km/h on this section of the motorway or, one minute and 36 seconds for vehicles travelling at 97 km/h. However, the proposal would be constructed in stages to minimise disruptions to traffic and the actual impact is likely to much less than these figures.

Reduced temporary construction speed limits associated with traffic switches and temporary lane or road closures would be scheduled outside peak periods to minimise impacts on traffic on the road network, where reasonably practicable.

Access to construction ancillary facilities

It has been estimated that construction ancillary facilities would generate up to 35 heavy vehicle trips per hour and up to 76 light vehicle trips per hour during peak construction periods. The proposed construction ancillary facilities are located in close proximity to the M1 Pacific Motorway and adjacent arterial routes. As such, when construction traffic is required to utilise local roads, the extent of impact would generally be limited to about 250 to 500 metres, at which point traffic would enter designated heavy vehicle routes within the construction zone.

It is anticipated that up to 76 management, supervisory and construction personnel would require car parking spaces within or nearby a construction ancillary sites. To limit the impact of the proposal on existing parking facilities, a temporary parking area would be provided for use by construction staff at a construction compound (likely to be the Warren Road ancillary site). Accordingly, the additional construction vehicles associated with the proposal would not be expected to impact the capacity of existing parking facilities in the proposal area.

Impacts on public transport

The impact of the proposal on existing passenger and school bus routes during construction would be negligible because no bus routes would need to be modified during construction. Minor and temporary travel time increases may be experienced due to reduced construction speed limits. No bus stops would require temporary relocation during construction.

Impacts on local roads and properties

Roads used by heavy vehicles during construction may experience additional wear as a result of use by construction vehicles. Dilapidation surveys of local roads around the proposal area would be undertaken prior to construction as well as after construction is complete. Any damage to roads, other than typical wear and tear attributable to use by construction vehicles would be repaired.

Access to all properties would be maintained throughout the construction phase.

Impacts on pedestrians

There is currently no pedestrian access along the M1 Pacific Motorway. There are minimal pedestrian facilities along the other roads impacted by the construction of the proposal.

Pedestrians currently accessing the informal parking area located on Sparks Road, west of the motorway would be prevented from accessing the informal parking area during the construction of the proposal, due to the conversion of this area to a formal parking area. Options to deliver the commuter car park early in the overall project delivery would be explored to minimise impacts for commuters.

The short length of existing pedestrian path on the northern side of the Sparks Road bridge over the motorway would need to be closed during part of the construction period while Sparks Road was upgraded and a new pedestrian bridge provided over the motorway. Specific provisions for pedestrians along this section of Sparks Road would be addressed in a construction traffic management plan. Options to deliver the new pedestrian/cyclist bridge over the motorway as an early deliverable would be explored during detailed design.

Impacts on cyclists

The existing shoulder on the M1 Pacific Motorway would be narrowed or removed during construction. As a result, cyclists would be prevented from using the motorway during construction. During construction, cyclists would be required to use alternative routes to avoid the sections of the M1 Pacific Motorway undergoing upgrade. Alternative cyclist routes typically would increase the distance to be travelled substantially (by up to 23 kilometres) and would require cyclists to generally share traffic lanes with vehicles. It is understood that the primary cyclist groups that currently use the M1 Pacific Motorway are training cyclists. These cyclist groups would be consulted prior to the commencement of construction and advised to use alternative sections of the M1 Pacific Motorway or alternative routes during the construction period. Appropriate signage and way finding provisions would be implemented.

The shoulders along Sparks Road and Doyalson Link Road are likely to be narrowed during construction. During the construction, cyclists on these roads would be required to share lanes with general traffic.

Impacts on emergency services

To avoid traffic congestion emergency services vehicles can currently drive on the existing motorway shoulders and can use the median cross over points to perform U-turns. These access provisions allow emergency services to access areas of the motorway as needed. During construction the shoulders and crossovers would not be available for this use, in any section currently under construction.

Options to provide access during construction in specific circumstances to construction access tracks would be explored during detailed design as part of traffic management and incident response planning. The construction traffic management plans would provide for an appropriate level of emergency services access during all phases of construction.

Impacts on safety

Temporary arrangements and construction road work zones increase the potential for crashes that could affect the safety of construction personnel and other the road users. A detailed construction traffic management plan and control measures implemented by the contractor would aim to:

- Provide adequate safety for workers and motorists.
- Minimise disruption and inconvenience to road users during the construction period.
- Provide adequate warning, information and guidance for road users during the construction period.

Appropriate construction speed limits would be implemented in consultation with Roads and Maritime to facilitate safety of road users and construction personnel.

Certain construction activities would be undertaken during the night. Traffic management plans would address night works safety for motorists and for construction personnel.

Temporary accesses, ancillary site entrances and exits, road works and other traffic management measures would be designed and operated to conform with relevant road safety and Roads and Maritime requirements and would aim to maintain the safety of the users of the existing road network.

Incident management

Traffic management following collisions on the motorway is particularly challenging, with lengthy delays being experienced in the past following incidents on some sections of the M1 Pacific Motorway. During construction, managing incidents would be more complex due to the adjacent work zones and changed road configuration that would include reduced median widths and reduced lane widths. The temporary removal or narrowing of breakdown lanes or emergency cross-over points during construction would also pose similar risks of delay if an incident was to occur during the construction phase.

The M1 Pacific Motorway has an existing Incident Management Program to manage traffic during an incident. The plan includes provisions where if an incident results in the need to close all lanes of the M1 in one direction, a contra flow can be put into operation to divert traffic onto the opposite carriageway. Constraints related to construction of the proposal in the footprint available would, at times, prevent the use of this arrangement in the sections under construction. This is a key reason why the proposal would be constructed in at least three or four separate and staged construction zones, with only one zone under construction at any time.

To address the potential impacts to traffic and transport during construction, the contractor would consult with Roads and Maritime Traffic Commanders, Traffic Emergency Patrols (TEP) and the Transport Management Centre (TMC) to plan the construction to allow for appropriate incident response plans to be implemented.

Operation

Impacts on traffic

Strong population and employment growth proposed for the Central Coast, as outlined in the North Wyong Shire Structure Plan and the Central Coast Regional Strategy (2006–2031), would have a substantial impact on the local road network and would increase the local role of the Pacific Motorway.

The traffic modelling process for the M1 Pacific Motorway is complex, with a large number of variables to consider when comparing the traffic outcomes predicted with the proposal compared to without the proposal. These variables include:

- Spatially, where the traffic metrics are measured (i.e. at the service centres or at the Warnervale Interchange).
- Whether the traffic is considered during the AM or the PM peak times.
- Whether the traffic is considered for the northbound or the southbound direction.

- The year in which the traffic is considered (i.e. 2019, 2029, 2039 or 2049).
- Level of service modelling outcomes.
- Average link speed (i.e. the average speed of vehicles traveling along the motorway between Wyong Road and Doyalson Link Road).
- Average travel times (i.e. the average time it takes a vehicle to travel the length of the proposal).
- Average link volumes (i.e. the number of vehicles that can travel the motorway length in a modelled time period).
- Overall demand release at intersections (a measure of the percentage of traffic able to enter or leave the motorway through the interchanges within the modelled timeframes).

Analysis of these variables in isolation can disguise the improvements that the proposal demonstrates over the base case. By analysing the traffic modelling outcomes holistically, the benefits of the proposal are apparent. Detailed quantitative modelling outcomes are provided in Appendix E. This section simplifies the quantitative modelling outcomes across the large number of considered variables to provide a more descriptive analysis of the predicted outcomes.

Section 6.1.1 indicated that without the proposal the motorway would become increasingly congested. Travel speeds along the motorway would drop considerably and lengthy delays would be experienced at the interchanges and along the motorway.

In some circumstances, the traffic modelling predicts counter-intuitive results such as reduced motorway level of service or reduced average travel speeds as a result of the proposal. Analysis of these variables in isolation does not describe the true benefits of the proposal well. This is because as the motorway traffic volume increase and interchanges become more congested, there is a trend for fewer vehicles to be able to enter the motorway. With fewer vehicles able to enter the motorway, the modelling predicts those fewer vehicles that are already on the motorway would able to complete the journey faster than would be possible with the larger traffic volumes catered for by the proposal.

Using a holistic analysis, the modelling predicts that with the proposal, average travel time and travel speed for vehicles would generally be substantially improved when compared to the base case in all years modelled. Traffic speeds would be generally improved by the proposal in the northbound and southbound direction while the number of vehicles able to enter and leave the motorway (i.e. the motorway capacity) would be increased.

The traffic modelling shows that with the proposal the motorway would operate satisfactorily up to the year 2039. In 2049, the motorway shows reduced travel speeds however this is primarily due to congestion overflowing from the interchanges.

The results for the entire modelled network include the interchanges, which exhibit congestion issues for future years. The traffic modelling shows that without the proposal, the proposal area would become severely congested by 2039. The proposal would extend the effective operation of the network, with the proposal area experiencing moderate congestion in 2039 and severe congestion by 2049.

Warnervale Interchange traffic

At the Warnervale Interchange the modelling predicts that in modelled years, 2019, 2029, 2039 and 2049, the proposal would result in substantially improved traffic flow and level of service compared to the base case. The proposed traffic signals at the Sparks Road (west) interchange ramps would provide for an improvement in 2049 from LoS F to LoS C in the AM peak and from LoS E to LoS C in the PM peak. This would be associated with a substantial reduction in travel time through the intersections of about three minutes in the AM peak and about 30 seconds in the PM peak compared to the base case.

The Sparks Road (east) intersections would also perform substantially better with the proposal than they would without. This would be attributable to the signalisation of the intersections. In 2049 the intersection performance is predicted to improve from LoS F to LoS B in both the AM and PM peaks. This would be associated with a substantial reduction in travel time through the intersections of about sixteen minutes in the AM peak and about 12 minutes in the PM peak compared to the base case.

The proposal would impact property accesses on the north eastern side of the motorway/Sparks Road interchange by restricting right turn access from the two properties located immediately north east of the interchange. Access options will be further explored with the property owners during detailed design.

Doyalson Link Road Interchange traffic

Performance of the Doyalson Link Road Interchange would be largely unchanged with or without the proposal. This is because the interchange only currently manages traffic to and from the east. The interchange does not introduce competing turning movements such as in a typical diamond interchange (e.g. the Warnervale Interchange).

The proposal provides for two future new turning movements at the Doyalson Link Road Interchange. These are southbound off the motorway to Doyalson Link Road and northbound onto the motorway from Doyalson Link Road. These new ramps would not have traffic signals. These additional movements would be likely to reduce demand on the Warnervale Interchange and may contribute to a reduction in traffic congestion across the network. The additional ramps would provide for more direct travel for motorists between the M1 Pacific Motorway and communities such as Blue Haven, Budgewoi, Munmorah and further north along the Pacific Highway. These two connections between the Doyalson Link Road and the motorway are subject to further investigation and design, including traffic modelling. It is possible that these connections may not be constructed as part of the main proposal works but could be constructed later as traffic and development in the area grows.

Further detailed information about the traffic and transport modelling is provided in Appendix E.

Impacts on safety

A crash analysis was undertaken which predicted that by 2049, the predicted overall crash rate for proposal (8.0 crashes/100 MVKT or 2.8 crashes/km/year) would be lower than without the proposal (10.4 crashes/100 MVKT or 3.6 crashes/km/year). These safety improvements were assessed to be a result of the design improvements, including:

- Provision of an additional travel lane on the Pacific Motorway in each direction.
- Provision of a median safety barrier.
- Provision of new pavement to replace the existing deteriorated road surface.
- Provision of traffic signals and other intersection improvements at the Warnervale Interchange.
- Eliminating the conflict point (weave manoeuvre) between northbound vehicles exiting to Doyalson Link Road and northbound vehicles using the northbound on ramp to the motorway from Sparks Road.

Impacts on freight

The proposal would provide benefits to freight transport in the area through improvements to congestion levels on the national and local network. As freight is most heavily reliant on the M1 Pacific Motorway link, freight will see a greater benefit than general traffic as the M1 Pacific Motorway would maintain effective operation for longer than the overall network (the motorway interchanges reach capacity prior to the motorway).

Impacts on public transport

Rail would not be affected by the proposal.

The bus network and service frequencies are expected to grow from the current provision as development increases in the area.

Local buses do not currently use the M1 Pacific Motorway so no impact on bus services would result from the improvements.

Bus priority signals would not be provided as part of the proposal. Bus routes using Sparks Road, Wyong Road and Doyalson Link Road would be affected by the proposal in the same manner as general traffic. The proposal would provide benefits to bus transport in the area through reductions in congestion levels on the local network.

Impacts on cyclists and pedestrians

The proposal would benefit pedestrians and cyclists at the Warnervale Interchange where it is proposed to provide a separated shared path along the northern side of Sparks Road. Currently the Sparks Road Interchange has on-street bicycle lanes and a footpath on the northern side of the bridge over the motorway. There are no footpaths leading to or from this point along Sparks Road. The upgrade would provide a substantial improvement to safety for pedestrians and cyclists compared to the current situation.

In other areas that would see no change in cyclist facilities, cyclists using the existing shoulder areas of the M1 Pacific Motorway and Doyalson Link Road would, over time, be exposed to increased traffic volumes in the adjacent lanes. This would present a greater safety risk to cyclists. This would be likely to occur regardless of whether the proposal was constructed.

There are some locations of the M1 Pacific Motorway, at bridge locations in

particular, where the proposal involves a reduction in the existing shoulder width to two and a half metres, though the rest of the upgraded motorway would provide three metre wide shoulders. While the narrower shoulders on the bridges could pose an increased safety risk to cyclists using the motorway, the overall proposal would provide a positive safety outcome.

6.1.3 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential hydrological impacts. These mitigation and management measures have been identified in Table 6-3 and are incorporated in the environmental management measures in Section 6.17.

Table 6-3: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Impacts on traffic during construction	• Prepare and implement a detailed traffic management plan (TMP) as part of the Construction Environmental Management Plan (CEMP). The TMP is to include appropriate guidelines and procedures required to ensure the continuous, safe and efficient movement of construction and non-construction traffic in and around the project area. The TMP would be submitted in stages to reflect the progress of the work and would detail: • Signage requirements. • Lane possession and approval process during periods of online construction • Measures to minimise disruption and inconvenience to road users during the construction period. • Traffic control devices such as temporary signals. • A local and regional communications strategy. • Measures to provide adequate warning, information and guidance for road users during the construction period. • Appropriate construction speed limits to be implemented in consultation with Roads and Maritime to facilitate safety of road users and construction personnel. • Specific traffic management plans to address night works safety for motorists and for construction personnel. • Temporary accesses, ancillary site entrances and exits and other traffic management measures to be designed in accordance with relevant road safety and Roads and Maritime requirements • Design and construct temporary accesses, ancillary site entrances and exits and other traffic management measures that do not impact upon the safety of the users of the existing road network. • Provide safe pedestrian access for the public along Sparks Road during construction. • Temporary parking for use by construction staff is to be provided at a	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	construction compound. • Access to all properties including the motorway service centres to be maintained throughout the construction. • Investigate options to provide access for emergency services vehicles to pass through construction zones under specific circumstances as part of traffic management and incident response planning or other suitable alternate arrangements and update the local emergency services on the staging and progress of works that would affect their movement.		
Damage to roads from construction traffic	• Dilapidation surveys of local roads around the proposal area should be undertaken prior to their use for construction and after construction is complete. • Any damage to local roads beyond standard wear and tear as a result of the construction traffic should be repaired.	Construction contractor	Construction
Impacts to cyclists during construction	• Cyclist groups would be consulted prior to the commencement of construction and advised to use alternative sections of the M1 Pacific Motorway or alternative routes during the construction period. • Appropriate signage and way finding provisions would be implemented for cyclist detours.	Construction contractor	Construction
Provision of incident management during construction	• The contractor would consult with Roads and Maritime Traffic Commanders, Traffic Emergency Patrols (TEP) and the Transport Management Centre (TMC) to plan the construction to allow for appropriate incident response plans to be implemented.	Construction contractor	Construction
Impacts to traffic during operation	• Access arrangements for properties located along Sparks Road will be designed in consultation with the property owners	Roads and Maritime	Detailed design

6.2 Noise and vibration

A noise and vibration assessment was carried out by Wilkinson Murray (2014). A complete copy of the report is available in Appendix F, and a summary is provided below. The noise and vibration assessment identifies sensitive receivers and assesses potential noise and vibration impacts against noise and vibration criteria presented in the NSW Road Noise Policy (RNP) (DECCW, 2011), the Interim Construction Noise Guideline (ICNG) (DECC, 2009), Assessing Vibration: a technical guideline (DECC, 2006) and the Environmental Noise Management Manual (ENMM) (RTA, 2001).

6.2.1 Existing environment

Sensitive receivers

Sensitive receivers that would potentially be affected by noise or vibration impacts related to the construction or operation of the proposal were identified. For the operational noise assessment (with the upgrade built), 621 sensitive receivers were identified including 619 residential properties, one community centre (Woodbury Park Community Centre) and one child care facility (23 Buttonderry Way, Jilliby). Given that construction noise can be louder than operational noise and therefore can travel further, the number of sensitive receivers considered for the construction noise assessment (about 700) was greater than for the operational noise assessment.

Noise catchment areas

To facilitate the assessment of potential noise impacts from the proposal, sensitive receivers identified along the proposal route were divided into Noise Catchment Areas (NCAs). NCAs are areas that are likely to experience similar noise exposures, on the basis of factors such as topography, road design (cuttings, embankments and pavement type), setbacks and types of residences or other noise receptors. For the purpose of this assessment, the NCAs were defined within 600 metres of the road alignment in order to capture all identified sensitive receivers. Six NCAs were delineated as described below and are shown in Figure 6-1.

NCA 1 is located on the eastern side of the motorway. It extends from the southern end of the proposal at Wyong Road, to the Wyong River bridge crossing. This catchment contains 375 sensitive receivers including isolated sensitive receivers, a large cluster of residential receivers in the western extent of the suburb of Mardi and the Woodbury Park Community Centre (a non-residential sensitive receiver).

NCA 2 is located on the western side of the motorway. It extends from the southern extent of the proposal at Wyong Road, to the Wyong River bridge crossing. This catchment contains 31 sensitive receivers including isolated sensitive receivers and some small clusters of residences.

NCA 3 is located on the eastern side of the motorway. It extends from the Wyong River to Sparks Road. This catchment contains 44 sensitive receivers including isolated sensitive receivers and some small clusters of residences.

NCA 4 is located on the western side of the motorway. It extends from the Wyong River to Sparks Road. This catchment contains 162 sensitive receivers including isolated sensitive receivers, some small clusters of residences and a childcare facility at 23 Buttonderry Way, Jilliby.

NCA 5 is located on the eastern side of the motorway. It extends north from Sparks Road to the Doyalson Link road Interchange. This catchment contains seven isolated sensitive receivers.

NCA 6 is located on the western side of the motorway. It extends north from Sparks Road to the Doyalson Link road Interchange. This catchment contains two isolated sensitive receivers.

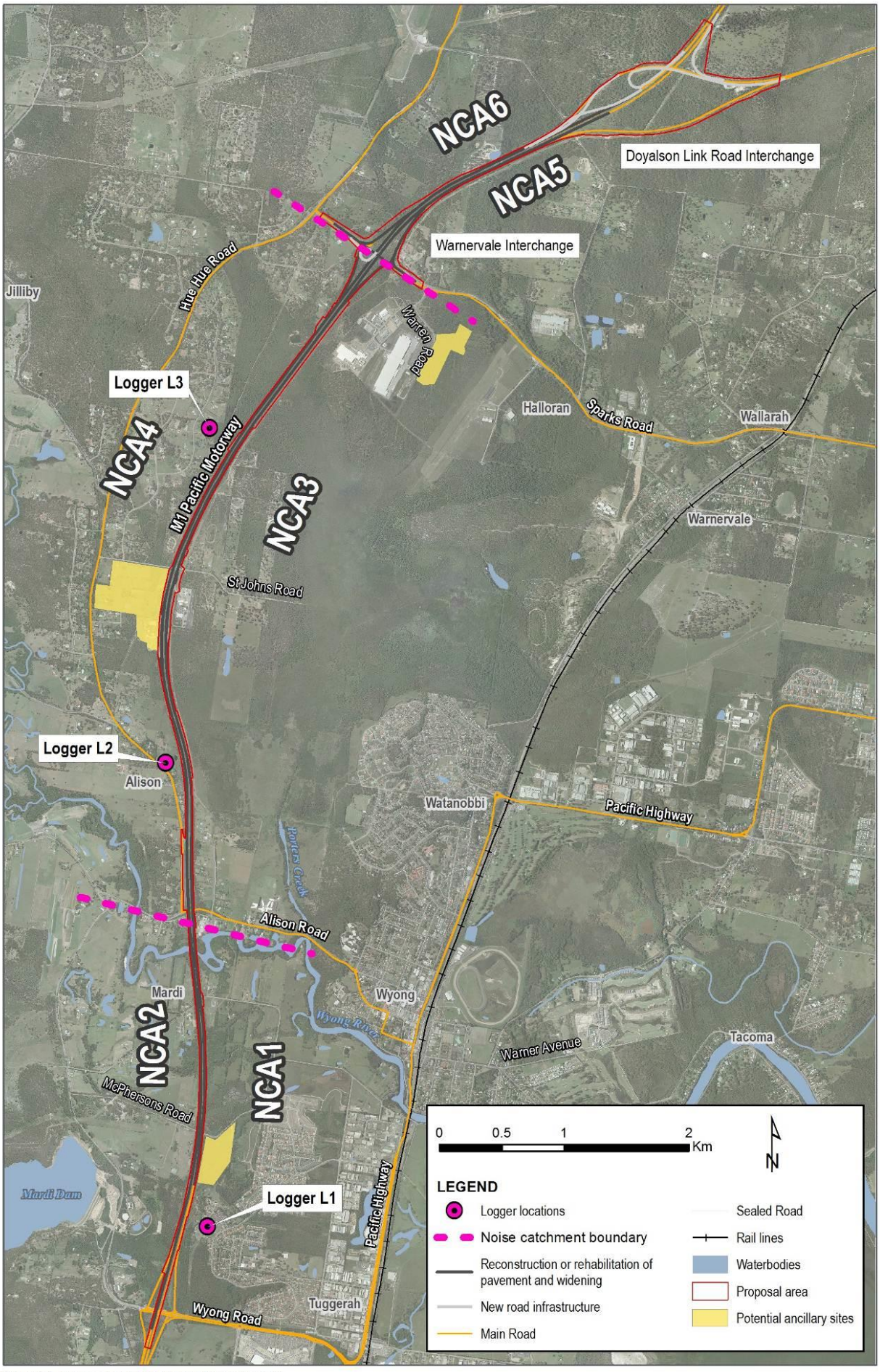


Figure 6.1 Noise catchment areas and logger locations

Background noise monitoring

Background noise monitoring was undertaken at three locations (Figure 6-1) along the proposal route to determine existing background noise levels. These levels were used to define construction noise criteria and to measure average noise levels from the existing roads (to calibrate the operational noise model). Background noise monitoring was undertaken in accordance with all relevant guidelines and the procedures contained in the Interim Noise Policy (INP), the ICNG and the RNP.

Monitoring was conducted concurrently with traffic counts at three locations between 4 April and 16 April 2013. Locations are described in Table 6-4.

Table 6-4: Long term noise monitoring locations

Logger no.	NCA	Address	Distance to M1 Pacific Motorway
L1	NCA 1	Woolmers Crescent, Mardi	96 metres
L2	NCA 2	Hue Hue Road, Alison	25 metres
L3	NCA 4	Holloway Drive, Jilliby	169 metres

Logging results have been edited to exclude periods of rain or excessive wind, or times when noise at the logger was not due to traffic noise from the M1 Pacific Motorway. These exclusions are based on engineering judgement and are marked on the logger charts in Appendix A of Appendix F.

The noise monitoring methodology and a graphical recorded output from long term noise monitoring is included in Appendix F. The graphs in Appendix F were analysed to determine a single Rating Background Level (RBL) for each day, evening and night period, in accordance with the INP. In order to assess existing traffic noise, $L_{Aeq(15hr)}$ and $L_{Aeq(9hr)}$ traffic noise descriptors were measured as relevant for arterial roads. The existing ambient noise levels and RBLs are presented in Table 6-5.

Table 6-5: Measured existing ambient (L_{Aeq}) noise levels and RBL, dB(A)

Noise monitoring location	L_{Aeq}		Rating background level		
	15hr	9hr	Day[1]	Evening[2]	Night[3]
L1 - Woolmers Crescent, Mardi	55.6	48.1	46	46	38
L2 - Hue Hue Road, Alison	73.8	69.4	68	64	46
L3 - Holloway Drive, Jilliby	60.2	53.5	50	49	42

Notes: 1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays and Public Holidays
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday and Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays and Public Holidays

6.2.2 Criteria

Construction noise criteria

The ICNG is the EPA's standard policy for assessing construction noise. According to the ICNG a quantitative noise assessment taking into account existing background noise levels is required when construction activities would be likely to impact a single noise-sensitive receiver for more than three weeks. As construction of the proposal would be carried out over a three and half year period, the ICNG is applicable for assessing noise generated during the construction phase of the proposal.

Table 6-6 (reproduced from Table 2 of the ICNG) sets out the construction noise management levels and how they are to be applied for residential receivers.

Table 6-6: Noise at residences using quantitative assessment

Time of Day	Management Level $L_{Aeq\ (15min)}$ [1]	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(A)	• The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. • 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.
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Highly noise affected 75dB(A)	• 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 proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. • If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside standard hours	Noise affected + 5dB	• 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 5dB(A) above the noise affected level, the proponent should negotiate with the community.

Notes: 1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

For the proposal, separate management levels were calculated for locations within 100 metres of the motorway and locations more than 100 metres from the motorway. This enabled a more accurate and detailed construction noise impact assessment to be prepared.

The construction noise management levels specific to each NCA, at each distance from the motorway and for each management period (early morning, daytime and early evening) are shown in Table 6-7.

Table 6-7: Construction noise management levels

Location	Distance from motorway	RBL / management level	Period		
			Early morning	Day	Early evening
NCA 1	< 100 m	RBL	41	46	46
		Management level	46	56	51
NCA 1	> 100 m	RBL	49	63	61
		Management level	54	73	56
NCA 2	< 100 m	RBL	41	46	46
		Management level	46	56	51
NCA 2	> 100 m	RBL	49	63	61
		Management level	54	73	56
NCA 3	< 100 m	RBL	48	51	51
		Management level	53	61	56
NCA 3	> 100 m	RBL	54	68	66
		Management level	59	78	71
NCA 4	< 100 m	RBL	48	51	51
		Management level	53	61	56
NCA 4	> 100 m	RBL	54	68	66
		Management level	59	78	71
NCA 5	< 100 m	RBL	48	51	51
		Management level	53	61	56
NCA 5	> 100 m	RBL	54	68	66
		Management level	59	78	71
NCA 6	< 100 m	RBL	48	51	51
		Management level	53	61	56
NCA 6	> 100 m	RBL	54	68	66
		Management level	59	78	71

As discussed in Section 3.4.2, in accordance with the ICNG, most construction works would be undertaken within standard construction working hours being Monday to Friday 7.00am - 6.00pm, Saturday 8.00am - 1.00pm and no construction work is to take place on Sundays or Public Holidays.

However, it is proposed that the construction working hours be extended to provide for more flexibility and efficiency in construction. The proposed extended construction working hours are:

- Monday to Friday 6am - 8pm.
- Saturdays 7am - 5pm.
- No construction work is to take place on Sundays or public holidays.

Construction noise sleep disturbance

The ICNG requires the potential impacts on sleep disturbance to be considered where construction works are planned to extend over more than two consecutive nights. The ICNG refers to the Environmental Criteria for Road Traffic Noise (Australia) (ECRTN) to provide the appropriate assessment approach. The ECRTN has now superseded by the RNP, for assessment of sleep disturbance. However the RNP refers to the ECRTN as being the most appropriate assessment. As such the ECRTN will be referenced for sleep disturbance.

The ECRTN suggests that for night-time activities, the $L_{A1\ (60\ second)}$ noise levels should be calculated and compared with the RBL plus 15 dB(A) as the sleep disturbance screening criterion. Further assessment is recommended where the screening criterion is exceeded, with consideration given to how often these exceedances occur.

The ECRTN also suggests that:

- Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly.

Given that a building with an open window provides up to 10 dB(A) noise attenuation from outside to inside, it is reasonable to assume that external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Construction vibration criteria

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the more stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it follows that compliance would be achieved with the building damage objectives.

Assessing Vibration: A Technical Guideline (DEC, 2006) provides acceptable values for continuous and impulsive vibration in the range 1-80 Hz. Vibration sources are defined as continuous, impulsive or intermittent. Section 2 of the technical guideline defines each type of vibration as follows:

- Continuous vibration continues uninterrupted for a defined period (usually throughout the day time and/or night time).
- Impulsive vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than two seconds.
- Intermittent vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude.

Both preferred and maximum peak particle velocity (PPV) vibration limits are defined for various locations and are shown in Table 6-8.

Table 6-8: Preferred and maximum PPV values for continuous and impulsive vibration

Location	Assessment period[1]	Preferred values (PPV)	Maximum values (PPV)
Continuous vibration			
Critical areas	Day or night time	0.14	0.28
Receivers	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices, schools, educational institutions and places of worship	Day or night time	0.56	1.1
Workshops	Day or night time	1.1	2.2
Impulsive vibration			
Critical areas	Day or night time	0.14	0.28
Receivers	Daytime	8.6	17.0
	Night time	2.8	5.6
Offices, schools, educational institutions and places of worship	Day or night time	18.0	36.0
Workshops	Day or night time	18.0	36.0

1. Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.

The limits in Table 6-8 relate to a long term (16 hours for daytime), continuous exposure to vibration sources. Where vibration is intermittent, a vibration dose is calculated and acceptable values are shown in Table 6-9.

Table 6-9: Acceptable vibration dose values for intermittent vibration (m/s)

Location	Daytime[1]		Night time[2]	
	Preferred value	Maximum values	Preferred value	Maximum values
Critical areas	0.10	0.20	0.10	0.20
Receivers	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

1. Daytime is 7.00am to 10.00pm
2. Night time is 10.00pm to 7.00am

In regard to potential building damage, German Standard DIN 4150 (Table 1) provides guideline values for short term vibration for commercial buildings, houses and heritage buildings which are dependent on the frequency of vibration. The recommended vibration levels for sensitive heritage buildings ranges from 3 to 10 mm/s, and 5 to 20 mm/s for dwellings.

Operation noise criteria

The RNP sets out criteria for assessment of noise from vehicles on public roads. The RNP sets out noise criteria for ‘freeways’, ‘arterial’, ‘sub-arterial’ and ‘local roads’. The M1 Pacific Motorway and all associated ramps are considered to be in the freeway category.

Noise criteria for redevelopment of freeways and for sensitive land uses present in the proposal area are provided in Table 6-10.

Table 6-10: RNP criteria for redevelopment of freeways

	Assessment criterion dB(A)	
	Day (7am to 10pm)	Night (10pm to 7am)
Freeway	$L_{Aeq, 1hr}$ 60 (external)	$L_{Aeq, 9hr}$ 55 (external)

Table 4 of the RNP sets guidelines for the assessment of traffic noise on sensitive land uses such as schools, hospitals, places of worship and recreation areas. As discussed in Section 6.2.1, two non-residential sensitive receivers were identified, being a child care centre and a community centre.

Noise criteria for non-residential receivers are provided in Table 6-11.

Table 6-11: Noise criteria for non-residential receivers

Type of development	Assessment criterion dB(A) from 7am to 10pm
School classrooms	$L_{Aeq, 1hr}$ 40 (internal) when in use
Open space (active use)	$L_{Aeq, 15hr}$ 60 (external) when in use
Open space (passive use)	$L_{Aeq, 15hr}$ 55 (external) when in use
Childcare facilities	Sleeping rooms $L_{Aeq, 1hr}$ 35 (internal) Indoor play areas $L_{Aeq, 1hr}$ 40 (internal) Outdoor play areas $L_{Aeq, 1hr}$ 55 (external)

To predict internal noise levels in school classrooms and childcare facilities, it is assumed that internal noise would be 10 dBA less than external noise. This is based on a façade with windows open for ventilation.

Assessment years (operational noise)

In accordance with the RNP, road redevelopment projects are required to be assessed against two timeframes:

- Opening year – within one year of changed traffic conditions.
- Design year – for design year (typically 10 years) with changed traffic conditions.

For each timeframe the RNP requires comparison between:

- Road traffic noise levels if the proposal proceeds.
- The corresponding road traffic noise levels, due to general traffic growth, that would have occurred if the project had not proceeded.

The opening year for the proposal is considered to be 2019, hence opening year refers to 2019 and design year refers to 2029.

Acute noise levels (operational noise)

Roads and Maritime's *Environmental Direction Number 24 Noise assessment for acute levels of noise – redevelopment of existing roads* provides guidance that, following a road development, application of all feasible and reasonable noise mitigation should be considered with the aim to achieve the RNP noise criteria where:

- There is predicted to be a noticeable increase in road traffic noise.
- Road traffic noise levels are predicted to be acute.

A receiver is considered acutely affected if the predicted noise levels are equal to or

greater than a daytime $L_{Aeq(15hour)}$ of 65 dB(A) or a night-time $L_{Aeq(9hour)}$ of 60 dB(A).

6.2.3 Potential impacts

Construction noise

Construction activities have the potential to generate a range of impacts on sensitive receivers along the project alignment. These have been considered separately and are as follows:

- Impacts from construction noise sources and activities.
- Impacts during standard construction hours.
- Impacts during extended construction hours.
- Impacts during out-of-hours construction activities including sleep disturbance.
- Impacts from temporary construction ancillary facilities.

Impacts from construction noise sources and activities

For the purposes of this assessment, five main construction activities have been identified. The equipment expected to be used and the expected working hours for each construction activity are provided in Table 6-12. Sources of construction noise and vibration would comprise a range of heavy vehicles, plant and equipment and hand tools. Based on the typical sound power levels for these sources, noise level predictions have been undertaken (refer Appendix F).

Table 6-12: Construction activities, equipment and expected working hours

Activity	Typical equipment used	Sound power level dB(A)	Expected duration	Expected working hours
Clearing or paving	Road trucks, concrete trucks, paving plant, concrete vibrators, chainsaws, mulching plant and chipper, profiler, sweeper, compressor, generator.	110	12 months	Standard Extended Out-of-hours (night)
Earthworks	Road trucks, compactor, grader, multi-tyred and vibratory rollers, concrete trucks, concrete vibrator, asphalt paving plant, backhoe, sweeper, compressor, generators, rock crusher.	114	12 months	Standard Extended
Saw cutting	Concrete saw.	115	12 months	Standard Extended Out-of-hours (night)
Piling or hammering	Bored piling rig, rock hammer, jackhammers, impact (driven) piling rig.	125	12 months	Standard Extended
Landscaping	Excavators, chainsaws, mulching plant and chipper, cranes, generators, bobcat, powered hand tools, air compressor.	110	6 months	Standard Extended

The noise level at any receiver along the route would depend upon many factors, such as distance to the noise source, shielding between the noise source and the receiver, and the type of construction activity. There would typically be a 20 dB(A) range of

construction noise levels experienced at receivers depending on the construction activity taking place. The quietest activities include site preparation, and the noisiest activities would be breaking up existing pavement using rock breakers and saw cutting. Noise levels would be lesser whenever the construction takes place in cut or where it is otherwise shielded compared with that undertaken on fill.

As the construction effort will progress along the motorway over time, receivers are typically not exposed to line of sight view of plant and equipment for an extended period of time. There would be periodic exposure during different construction stages. Noise impacts at some receivers would therefore be restricted to a limited time period.

Impacts during standard construction hours

Based on the typical construction activities, plant and equipment presented in Table 6-12, the construction noise experienced at sensitive receivers would exceed the ICNG management levels during standard working hours. The number of receivers where noise is predicted to exceed the management level for various activities during standard working hours is provided in Table 6-13.

Table 6-13: No. of residences predicted to exceed construction noise management levels during standard construction hours

NCA	Clearing or paving	Earthworks	Saw cutting	Piling or hammering	Landscaping
1	11	29	35	167	11
2	4	18	20	31	4
3	0	0	0	34	0
4	0	0	0	128	0
5	0	0	0	4	0
6	0	0	0	0	0

Typically the noisiest construction activities would be planned to be undertaken during standard working hours. This would include concrete breaking and use of concrete saws. These activities are only likely to occur for a small fraction of the total construction period.

Impacts during extended construction hours

The ICNG permits certain types of work that may be undertaken outside normal construction hours. This includes public infrastructure works in which extended construction hours would shorten the length of the project and are supported by the affected community.

Roads and Maritime is proposing extended working hours for the duration of the proposed construction in order to reduce the construction period (the justification for this decision is provided in Section 2.4.3). Extended working hours would consist of additional time at the start and end of each working weekday (6am to 7am and 6pm to 8pm Monday to Friday; plus 7am to 8am and 1pm to 5pm on Saturday).

Noise modelling has been undertaken to determine the impact of extended hours during the morning shoulder period (6am–7am Monday to Friday and 7am–8am on Saturday). The full results of this noise modelling are provided in Appendix E.

Based on the typical construction activities, plant and equipment presented in Table 6-12, construction noise at sensitive receivers would exceed the ICNG management levels during the morning shoulder period if these activities were undertaken during this period. The number or receivers where construction noise is predicted to exceed the management levels for the modelled activities during the morning shoulder (if

undertaken during that time period) is provided in Table 6-14.

Table 6-14: Number of receivers predicted to exceed the ICNG construction noise criteria during extended construction hours - early morning (6am – 7am)

NCA	Clearing or paving	Earthworks	Saw cutting	Piling or hammering	Landscaping
1	70	157	167	348	70
2	30	31	31	31	30
3	19	35	37	45	19
4	63	138	159	251	63
5	3	4	4	7	3
6	0	0	2	2	0

It is not intended to undertake very noisy activities during this period (morning shoulder) unless it is unavoidable. The extended hours in the morning shoulder would typically provide construction personnel with the opportunity to commence planning and set-up for the work day. Activities during the morning extended period hours would typically comprise low noise emissions including deliveries, site access, refuelling, office works, foot-based activities and work at construction ancillary sites.

Noise modelling has also been undertaken to determine the impact of extended hours during the early evening/afternoon shoulder period (6pm–8pm Monday to Friday and 1pm–5pm on Saturday). The full results of this noise modelling are provided in Appendix E.

Based on the typical construction activities, plant and equipment presented in Table 6-12, construction noise at sensitive receivers would exceed the ICNG management levels during the early evening/afternoon shoulder period. The number of receivers where construction noise is predicted to exceed the management levels for the modelled activities during the early evening / afternoon shoulder is provided in Table 6-15.

Table 6-15: Number of receivers predicted to exceed the ICNG construction noise criteria during extended construction hours – early evening (6pm – 8pm)

NCA	Clearing or paving	Earthworks	Saw cutting	Piling or hammering	Landscaping
1	35	44	70	286	35
2	21	27	30	31	21
3	0	9	13	45	0
4	3	28	40	248	3
5	0	1	2	7	0
6	0	0	0	0	0

It is not intended to undertake very noisy activities during this shoulder period (early evening) unless it is unavoidable. The extended hours in the early evening shoulder period would typically provide construction personnel with the opportunity to extend normal planned construction activities for about an additional hour and then to demobilise for the day and set-up the worksites for the following work day. During the Saturday afternoon shoulder, normal construction activities would typically be planned

which would include clearing, earthworks, paving, breaking up concrete and landscaping.

Table 6-14 and Table 6-15 identify a large number of sensitive receivers where construction noise would likely exceed the ICNG criteria outside of standard working hours. As the construction effort will progress along the motorway over time, receivers are typically not exposed to line of sight view of noisy activities for an extended period of time. There would be periodic exposure during different construction stages. Noise impact at some receivers would therefore be restricted to a limited time period.

Impacts from out-of-hours construction activities including sleep disturbance

As identified in Section 3.3.2, some construction activities would need to be undertaken outside of the standard and extended construction hours to facilitate road safety, minimise disruption to regional and local traffic flows and/or for technical and timetabling reasons. Out of hours activities may cause sleep disturbance. The extent of this impact would be dependent on the specific details of the works, such as equipment and what type of works would be undertaken.

Out-of-hours construction activities may include activities such as the completion of tie-ins at interchanges, establishment of temporary traffic management facilities, establishment of temporary diversions and traffic switches, bridge girder placement where bridges need to cross operating roadways, delivery of large pre-cast concrete components such as bridge girders, concrete cutting, concrete pouring/curing or utility adjustments. Out-of-hours activities would only be undertaken:

- If works do not cause construction noise to exceed the noise management levels.
- If required to be undertaken out-of-hours by the police or other authorities for safety or operational reasons.
- Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.
- As agreed through negotiations between Roads and Maritime and potentially affected sensitive receivers. Any such agreement would be recorded in writing and a copy kept on-site for the duration of the works.
- As agreed by the EPA for a specific activity, determined on a case-by-case basis.

Table 6-16 presents the predicted number of sensitive receivers that would exceed the sleep disturbance criteria in the ICNG. This is based on the loudest potential night time construction activities that were modelled, saw cutting and concrete hammering.

Table 6-16: Predicted exceedances construction noise (sleep disturbance)

Criterion	Activity and SWL $L_{A1, 1min}$ dBA	
	Concrete saw	Hammering
	120	125
Receivers predicted to exceed sleep disturbance criteria (65 dBA)	180	196
Typical distance at which construction noise could exceed 65 dBA	300 metres	400 metres

The extent of any sleep disturbance impacts would be dependent on the specific details of the works, such as equipment and what type of works would be undertaken and the location of the noise source. Potential for sleep disturbance would need to be included in any future planning for out of hours work. Table 6-16 represents a worst-

case scenario, which would not occur on this proposal. It is based on the assumption of the noisy activity occurring over the full 12.3 kilometre proposal length. Construction is likely to proceed in three or four kilometre construction stages.

Impacts from temporary construction ancillary facilities

Three potential construction ancillary sites are proposed to be used during construction. These are the Warren Road site, Hue Hue Road site and McPherson Road site. These construction ancillary sites are described in Section 3-5 and are shown on Figure 1-2.

Ancillary site activities at each proposed location would include stockpiling, materials storage, office facilities and concrete batching. In addition to this the Warren Road site would also be used for concrete processing. Of these activities, concrete batching is typically the loudest. The source noise level of batch plants can be as low as 108 dBA. However, the total noise from a batch plant is typically increased by operation of other equipment nearby such as front end loaders and concrete trucks.

Noise modelling has been undertaken for the construction ancillary sites based on a typical total noise level from a batch plant of $L_{Aeq,15min}$ 115 dBA. This is considered reasonable to assess the potential for a batch plant, with one truck and one front end loader operating simultaneously.

Results of the modelling indicate the number of sensitive receivers that would be noise affected during different construction periods, at each site. These results are presented in Table 6-17.

Table 6-17: Noise assessment of batch plants – $L_{Aeq,15min}$

Ancillary site	Distance to nearest receiver	Receivers exceeding the noise management levels		
		Early morning (6am – 7am)	Day (7am – 6pm)	Early evening (6pm – 8pm)
Warren Road	400 metres	0	0	3
Hue Hue Road	500 metres	0	3	12
McPherson Road	400 metres	50	0	10

Exceedances of the ICNG noise management levels were identified. Detailed construction planning would carefully consider exceedances when planning and siting plant and equipment at ancillary sites.

Construction vibration

Vibration-intensive works may occur during each phase of the project. Vibration generated during construction has the potential to cause structural/cosmetic damage or cause human discomfort by continuous, intermittent and impulsive vibration generated by general construction activity. Ground-borne noise impacts may also be caused by vibration-generating activities, such as compacting or drilling.

The extent of the potential impact is dependent on the type of equipment, the activity being undertaken and the separation distance. The minimum distance identified from any dwelling to the existing motorway carriageway is 40 metres, and most houses are more than 50 metres away. For works other than those requiring hydraulic hammers or vibratory rollers, the vibration is predicted to be below the criteria for human comfort at all residences where the work comes within 30 to 40 metres of the residence.

A number of heritage listed places, structures and objects are located near the proposal. These are discussed in detail in Section 6.10. They include:

- Jilliby cemetery.

- Alison homestead – a homestead complex.
- Former Wyong dairy (a complex of buildings that has been adapted to house several commercial ventures including a fitness centre, a veterinary clinic, a café and a processed food factory).
- Road bridge over Deep Creek.
- Dwelling at Mardi Road.
- Old Maitland Road.
- Felton Matthew's survey tree.

All identified heritage places, structures and objects are located more than 50 metres from areas of proposed construction. Vibration levels are predicted to be less than 3 mm/s, and therefore would comply with the lowest (most stringent) building damage criterion for heritage buildings.

As construction would usually be at distances greater than 40 metres from dwellings, vibration levels would also be below the criteria for building damage. Vibration from construction activities would not result in levels that cause damage to buildings.

In general, any work near a residence would be temporary and intermittent. Impacts to human comfort or buildings would be minor and temporary as the active construction site moves away from the residential areas. However, there are likely to be instances where vibration-intensive activities (such as concrete hammering) cannot be avoided. The underlying geological site conditions or the proximity of the building/receiver to the active construction site would be factors affecting the level of vibration experienced at receivers. Planned setback distances provided in Table 6-18 would need to be implemented to manage potential impacts.

Table 6-18: Recommended safe working distances for vibration intensive plant

Plant	Rating / description	Safe working distance	
		Cosmetic damage	Human response
Vibratory roller	< 50 kN (Typically 1-2t)	5 m	5 m
	< 100 kN (Typically 2-4t)	15-20 m	15-20 m
	< 200 kN (Typically 4-6t)	6 m	6 m
	< 300 kN (Typically 7-13t)	20 m	20 m
	> 300 kN (Typically 13-18t)	12 m	12 m
	> 300 kN (> 18 t)	40 m	40 m
Small hydraulic hammer	(300 kg – 5-12t excavator)	15 m	15 m
Medium hydraulic hammer	(900 kg – 12-18t excavator)	100 m	100 m
Large hydraulic hammer	(1,600 kg – 18-34t excavator)	20 m	20 m
Vibratory pile driver	Sheet piles	100 m	100 m
Pile boring	≤ 800 mm	25 m	25 m
Jackhammer	Handheld	100 m	100 m

Operational noise

The proposal has the potential for a range of impacts on sensitive receivers along the proposal alignment during operation.

Noise modelling has been used to predict noise levels at 619 receivers, being the sensitive receivers nearest to the M1 Pacific Motorway along the proposal, and within 600 metres of the assessment boundary.

Predictions of operational noise were undertaken for the years 2019 and 2029, both 'with the proposal' and 'without the proposal'. For the 'with proposal' option in 2019 noise at 142 receivers during the day and at 160 during the night would exceed the applicable RNP operational noise criteria (with some receivers experiencing exceedances during both the daytime and night-time periods). Of these, 53 receivers in the day and 60 receivers in the night would be acutely affected.

For the 'with proposal' option in 2029 noise at 172 receivers during the day and at 186 receivers during the night would exceed the applicable RNP operational noise criteria (with some receivers experiencing exceedances during both the daytime and night-time periods). Of these, 64 receivers in the day and 69 receivers in the night would be acutely affected.

Table 6-19 provides a summary of the number of receivers in each NCA which exceed either the RNP noise criteria and exceed the acute noise criteria, with and without the proposal. Comparisons of the noise levels for the 'without proposal' option against the RNP criteria are provided to demonstrate the effects the proposal has on noise levels in relation to the criteria.

Table 6-19: Number of receivers exceeding noise criteria

NCA	Year	Exceeds RNP criterion				Exceeds acute criterion			
		Proposal		No proposal		Proposal		No proposal	
		Day	Night	Day	Night	Day	Night	Day	Night
1	2019	10	14	12	12	2	3	4	4
	2029	14	14	15	16	3	3	4	4
2	2019	10	10	13	13	5	6	7	7
	2029	11	12	17	17	6	6	7	7
3	2019	31	32	28	29	13	15	8	9
	2029	33	34	30	31	17	18	10	10
4	2019	87	100	78	82	30	33	24	29
	2029	108	119	94	96	35	39	30	32
5	2019	4	4	6	6	3	3	3	3
	2029	6	7	7	7	3	3	3	3
6	2019	0	0	0	0	0	0	0	0
	2029	0	0	0	0	0	0	0	0
Total	**2019**	**142**	**160**	**138**	**143**	**53**	**60**	**46**	**52**
	2029	**172**	**186**	**164**	**168**	**64**	**69**	**54**	**56**

Operational noise modelling was undertaken to compare the existing traffic background noise with the predicted noise at the time of the proposal opening and again 10 years

after opening. These results were compared to the operational traffic noise that was predicted if the proposal was not undertaken. Modelling results show that the noise environment at the receivers along the motorway would increase due to the growth in traffic flow which would be unrelated to the proposal. The modelling also indicates some small increases in operational noise would be attributable to the proposal.

As the proposal would not generate extra traffic, noise differences between 'with proposal' and 'without proposal' would be expected to be solely due to the proposal. This would be predominantly caused by the proposed increases in the vertical alignment which slightly changes the amount the motorway is shielded from residences. The extent of impact can be seen in Table 6-20 which shows the difference between the 'with proposal' and 'without proposal' exceedances and acute exceedances.

Table 6-20: Additional receivers impacted by the proposal

Year	Additional receivers that exceed RNP criterion with the proposal		Additional receivers that exceed acute criterion with the proposal	
	Day	Night	Day	Night
2019	4	17	7	8
2029	8	18	10	13

Specific results of the noise modelling have indicated that of the 621 receivers considered:

- 47 receivers are predicted to experience acute levels of noise (exceeding the RNP criteria) and the increase in noise would be less than 2 dB(A) more than that currently experienced.
- 22 receivers are predicted to experience acute levels of noise (exceeding the RNP criteria) and the increase would be more than 2 dB(A) greater than currently experienced.
- 182 receivers are predicted to experience noise above the RNP criteria (but would not be acute noise) and the increase in noise would be less than 2 dB(A) more than that currently experienced.
- Four receivers are predicted to experience noise above the RNP criteria (but would not be acute noise) and the increase would be more than 2 dB(A) greater than currently experienced.

In accordance with the RNP and the ENMM (RTA, 2001), feasible and reasonable noise mitigation measures were considered as part of the noise impact assessment for the proposal. Consistent with Section 3.4.1 of the RNP, measures in the following order of priority were considered (refer to Table 6-21):

1. Road design and traffic management.
2. Quieter pavement surfaces.
3. In-corridor noise barriers/mounds.
4. At-property treatment or localised barriers/mounds.

Table 6-21: Consideration of RNP requirements

Consideration	Comment
Road design and traffic management	As discussed in Section 3.3.1, the proposal includes pavement replacement and widening within the existing road corridor, with few changes to the current alignment. The M1 Pacific Motorway is relatively straight with gradual curvatures and the road design is not considered to create excessive noise. Given the intent of staying within the current corridor, little opportunity to minimise impact is presented here.
Quieter pavement surfaces	The southern section of the proposal (south of the Wyong river) currently has low noise open grade asphalt pavement. The northern section of the proposal (north of the Wyong River) currently has concrete pavement. It is proposed to remove and replace the existing pavements providing like for like (ie asphalt pavement south of Wyong River and concrete pavement north of Wyong River). Where the existing road has low noise pavement all lanes of the widened road would have low noise pavement. Where the existing road has concrete pavement, all lanes of the widened road would have concrete pavement. Options to introduce longitudinal tining or diamond grinding to further reduce the noise of the concrete pavements would be investigated as part of detailed design.
In-corridor noise barriers/mounds	Noise barriers have been considered in several areas where there are groups of receivers with acute noise levels. The analysis is provided in Section 9 of Appendix F, and has been carried out in accordance with the recommendations of the ENMM. The barriers analysed did not provide the minimum performance specified in the ENMM to be considered feasible and reasonable.
At-property treatment or localised barriers/mounds	At receivers where at-road treatments are not considered feasible and reasonable, architectural treatments would be considered only where predicted noise levels due to the 'with proposal' option are acute (i.e. equal to or more than $L_{Aeq,15hr}$ 65dBA or $L_{Aeq,9hr}$ 60dBA). There were 69 residences predicted to be acute under the 'build' option. These are spread along the route as a few low density clusters. These were assessed as suitable for architectural treatment. Four residences were predicted under the build option to have noise levels above the RNP criterion and to have increases more than 2 dB(A), but without being classed as acute noise. These were assessed as suitable for architectural treatment.

6.2.4 Safeguards and management measures

Mitigation and management measures would be implements to avoid, minimise or manage potential noise impacts. These mitigation and management measures have been identified here and incorporated in the environmental management measures in Section 6.17.

Impact	Environmental safeguards	Responsibility	Timing
Noise impacts resulting from design elements	• An assessment of feasible and reasonable noise mitigation measures for operation of the proposal is to be undertaken during detailed design in accordance with the Roads and Maritime Environmental Noise Management Manual Practice Note 4. • The detailed design should consider pavement treatments such as longitudinal tining or low noise diamond grinding to reduce operational road noise.	Roads and Maritime Detailed design	Pre-construction Pre-construction
Noise impacts resulting from construction activities	• Appropriate mitigation and management measures are to be used to minimise construction noise and vibration at noise sensitive receivers as described in the approved construction noise and vibration management plan (CNVMP).	Construction contractor	Construction
	• Prepare and implement a CNVMP that identifies reasonable and feasible approaches to reduce noise impacts during construction including for ancillary facilities. • Undertake at-receiver noise mitigations that are planned to manage operational noise at the commencement of construction. • Inform the community at least 48 hours before any out of hours work is to be undertaken and provide the following information: • Programmed times and locations of construction	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	work. • Construction noise and vibration impact predictions. • Construction noise and vibration mitigation measures being implemented on site. • Provide specific details of all out of hours work to the EPA. • Implement a notification and consultation procedure to identify when noise impacts during extended hours and out of hours work are above relevant criteria and enable appropriate management measures to be developed. • Implement a phone line and complaints handling procedure for noise and other construction related complaints. • Include specific noise mitigation measures in the CNVMP including: • Noise intensive construction works would be carried out during standard construction hours wherever practicable. • Noisy activities that cannot be undertaken during standard construction hours would be scheduled as early as possible during the evening and/or night-time periods. • Appropriate plant would be selected for each task, to minimise the noise impact. • Deliveries would be carried out during standard construction hours where practical and safe to do so. • Non-tonal reversing alarms would be fitted on all construction equipment where possible.		

Impact	Environmental safeguards	Responsibility	Timing
	• If it is safe, night-time activities would be planned and conducted in such a manner as to eliminate or minimise the need for audible warning alarms. • The offset distance between noisy plant items and nearby residential receivers would be maximised. • Noisy equipment would be oriented away from residential receivers. • Site access points, ancillary site accesses and ancillary facilities would be positioned as far as practicable away from residential receivers. • Plan the internal layout and operation of construction ancillary facilities to maximise the separation distance between sensitive receivers and noisy on-site activities. • Consideration would be given to erection of temporary structures or enclosures to shield residential receivers from noise sources where practicable. • Trucks would travel via internal haul routes and major roads and routes where practicable and would not be allowed to queue near residential dwellings. - Respite periods would be considered during times of noise intensive works where sensitive receivers would be adversely impacted for extended periods. These could include late start and/or early finishes. - Wherever practicable, noise intensive works would be scheduled/programmed in the following order of priority to minimise the		

Impact	Environmental safeguards	Responsibility	Timing
	potential impacts on sensitive receivers. 1. Standard working hours. 2. Extended working hours. 3. Night time working hours.		
Construction vibration	• Prepare and implement a CNVMP that identifies reasonable and feasible approaches to reduce vibration impacts during construction including for ancillary facilities. • Include specific vibration mitigation measures in the CNVMP including: - Vibration intensive works would not occur outside the safe working distances outlined in Table 6-18 unless necessary. - If vibration intensive works would be required outside the safe working distances outlined in Table 6-18, alternative equipment would be used to minimise potential vibration impacts as much as reasonably practicable.	Construction contractor	Construction
Exceedance of RNP where the predicted level is acute or more than two dB(A) higher than under the 'no build' option	• The suitability of architectural treatment of sensitive receivers would be considered on a case by case basis by Roads and Maritime, and treatment options would be negotiated with property owners.	Roads and Maritime	Operation

6.3 Hydrology

A Hydrology and Hydraulics Technical Study was prepared for the proposal. The full report is provided in Appendix G and a summary is provided below.

6.3.1 Existing environment

Surface water

Fourteen sub-catchments of Tuggerah Lake ranging in size from eight hectares to 357 km^2 were identified from the topographic mapping as feeding watercourses that cross the proposal. All drain generally in an easterly direction into Tuggerah Lake. In addition to a number of un-named watercourses, the watercourses major that cross the proposal include the following named creeks:

- Mardi Creek.
- Deep Creek.
- Wyong River.
- Buttonderry Creek.

Mardi Creek has a catchment area of about 2.8 square kilometres upstream of the crossing of the motorway. Within this catchment, Mardi Dam, an off stream storage reservoir, impounds a 1.8 square kilometre portion of the catchment. This portion of the catchment is diverted for water supply purposes.

Deep Creek has a catchment area of about 5.4 square kilometres and drains to Wyong River about one kilometre downstream (east) of the existing motorway. In the upper reaches of the catchment, the topography is relatively steep, interspersed with isolated small areas of flatter grade. Four twin bridges have been provided at the motorway for this catchment which receives overflows from the Wyong River catchment to the north in major flood events.

The largest waterway crossed by the proposal is the Wyong River which has a total catchment area of about 357 square kilometres upstream (west) of the motorway. Flood waters in the Wyong River are conveyed to the eastern side through twin bridges in addition to the four sets of twin flood relief bridges located in the Deep Creek catchment to the south.

The Wyong River catchment comprises mixed land uses including forest and agricultural land with urban development in the lower reaches. The most recent major flood on the Wyong River occurred in June 2007, when the Wyong River peaked at the Wyong Railway Bridge at RL 2.63 metres Australian Height Datum (AHD). This was a major event in the catchment resulting in widespread flooding. At Wyong Weir, a 24 hour rainfall total of 335 millimetres was recorded.

Buttonderry Creek has a catchment area upstream of the motorway of about 6.9 square kilometres. It has a well-defined low flow channel and is densely vegetated, with a meandering alignment. The floodplain generally consists of grassland with scattered trees.

Existing cross drainage structures and hydraulic performance present along the length of the proposal are listed in Table 6.22. These are divided into the catchments identified by number in Figure 6-2.

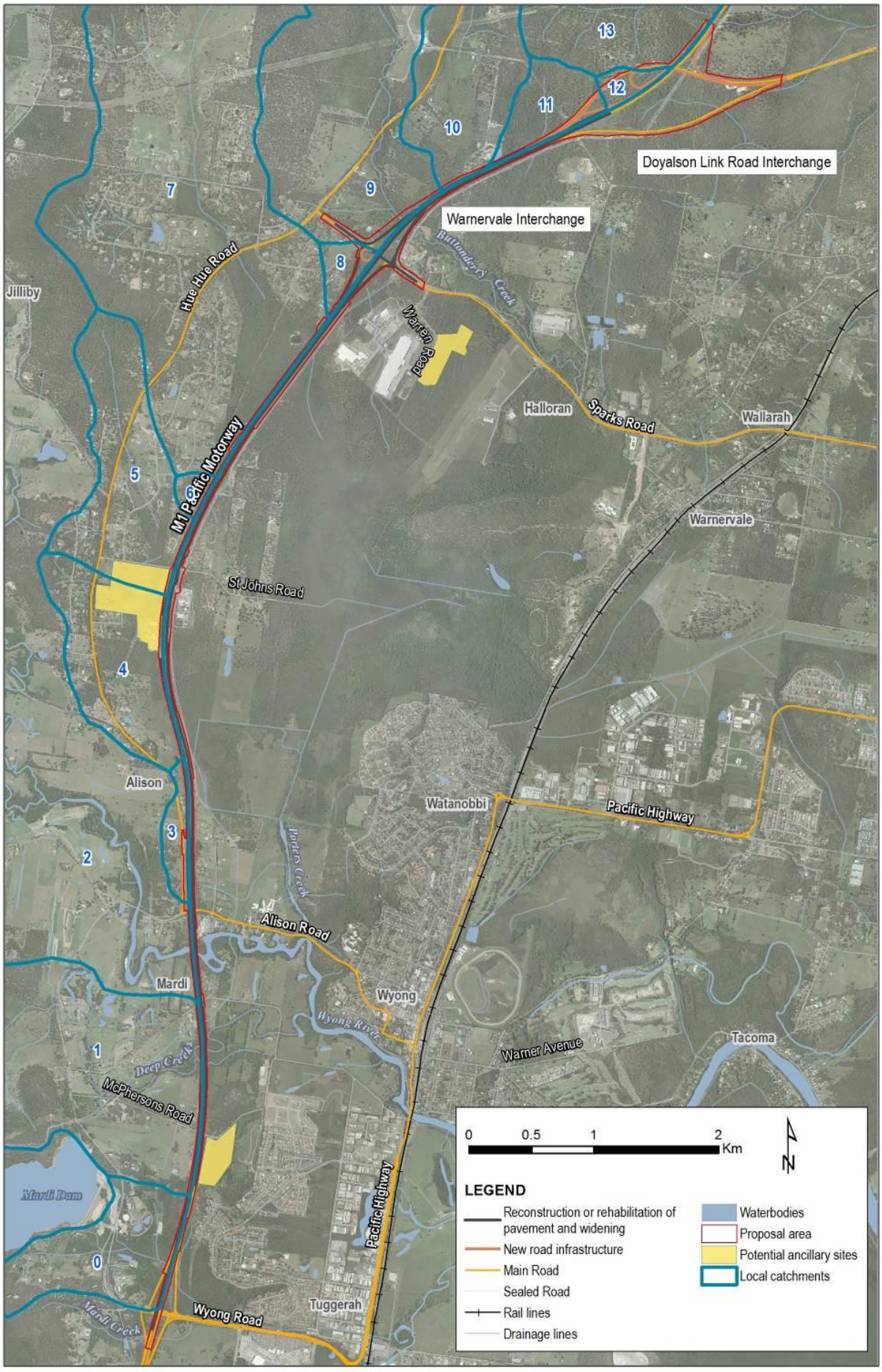


Figure 6.2 Sub-catchments crossing the proposal

Table 6-22: Summary of existing transverse drainage and peak flow rates

Catchment ID	Chainage (m)	Size	Type	Comments	100 year ARI flow rate (m^3/s)	Peak water level (mAHD)	Design pavement level (mAHD)
Mardi Creek							
0	85700	Unknown	Unknown		14.1	unknown	18.4
Deep Creek							
1	86600 to 87300	Unknown	4xBridges		47.0	6.6	7.8
Wyong River							
2	88100	Unknown	Bridge		1461	6.8	8.9
3	89200	1x900 diameter	RCP	Invert level RL 9.0m AHD	3.5	10.64	11.2
4	90200	3x3000x1800	RCBC	Invert level RL 1.75m AHD	15.8	3.78	7.73
5	91200	30.6m opening	Bridge		18.3	8.53	12.6
6	91740	1x900 diameter	RCP	Invert level RL 8.30m AHD	1.8	9.92	11.7
7	92500	3x3000x1800	RCBC[1]	Invert level RL 4.99m AHD	75.1	7.5	8.3
7	92600	3x3000x1800	RCBC[1]	Invert level RL 4.99m AHD			
8	93900	1x1350 diameter	RCP	Invert level RL 13.80m AHD	3.0	15.51	16.5
Buttonderry Creek							
9	94550	1x4000x4000	RCBC	Invert level RL 15.15m AHD	66.0	20.02	20.4
9	94725	1x1500 diameter	RCP	Invert level RL 17.01m AHD			
10	95100	3x3000x1500	RCBC[1]	Invert level RL 17.25m AHD	22.5	18.75	20.29
11	95600	1x1500 diameter	RCP	Invert level RL 18.3m AHD	6.8	21.13	22.54
12	96640	1x1200 diameter	RCP	Invert level RL 30.2m AHD	2.3	31.6	32.5
13	97520	1x4000x4000	RCBC	Invert level RL 14.9m AHD	26.2	18.67	27.92

Notes: [1] It is proposed to reconstruct three existing three cell box culverts and construct new drainage pit and connect to existing network to maintain existing flow regime at these locations.

RCP - reinforced concrete pipe

RCBC - reinforced concrete box culvert

Groundwater

A search of the Office of Water Online Database identified five groundwater wells registered within a 500 metre radius of the proposal. The Online Database provides data including standing water level, water bearing zone and the bore yield, which is included in Table 6-23.

Table 6-23: Summary of groundwater bore information

Well ID	Standing Water Level (m BGL)	Water Bearing Zone (m BGL)	Yield (L/s)	Comments
GW200566	-	19	2	Well location 500m west of the motorway, off Old Maitland Road. The well is 150m deep and used for test bore purposes for the water treatment plant.
GW048749	--	18.3 - 24.4	3.8	Well located about 500m east of the proposal area, off Mardi Road. The well is 26.2m deep and used for domestic purposes.
GW058789	--	15 - 23	--	Well located about 500m west of the proposal and near Burlington Avenue. The well is 29m deep and used for monitoring purposes. Water identified as salty.
GW200938	14	17 - 18 30 - 31	0.1 0.5	Well located about 1100m west of the proposal, off Hue Hue Road. The well is 36m deep and used for domestic stock bore. Water identified as fresh.
GW047948	--	--	--	Well located about 250m west of the proposal, adjacent to St John Road. The well is 8.0m deep and used for domestic irrigation.

1. BGL = Below ground level

Of the five wells identified, three are used for domestic purposes (irrigation and stock watering), one is a test bore for the nearby water treatment plant, and one is for monitoring purposes.

6.3.2 Methodology

Surface water

Hydrologic and hydraulic modelling of the concept design was undertaken to assess stormwater flow regimes and to determine the potential for broad flooding impacts on surrounding land that could result from the proposal. Detailed assessments of the drainage system capacity would be undertaken during detailed design of the proposal.

Modelling was used to determine the design flow rates in watercourses traversing the motorway. Models developed as part of the Wyong River Catchment Flood Study (BMT WBM, 2013), for Wyong River and Deep Creek, were adopted for use in the hydrologic and hydraulic study. For the waterways not covered in the Wyong River Catchment Flood Study, flow rates were determined using the Rational Method for Eastern New South Wales described in Australian Rainfall and Runoff (Pilgrim, 1987).

The hydraulics of the existing waterways not covered in the Wyong River Catchment Flood Study were assessed for the proposal using a HECRACS model.

The Wyong River and Deep Creek flooding characteristics were assessed using TUFLOW two-dimensional flood modelling software which was developed for the Wyong Catchment Flood Study. The model used incorporated the whole of the cleared floodplain areas for the Wyong River and several other major watercourses.

Catchment areas were defined using topographic survey, supplemented with ground survey within the motorway corridor, and in some cases there was limited information available to define catchment boundaries or waterway locations. Furthermore, for waterways not analysed in the Wyong River Catchment Flood Study there was an absence of ground survey beyond the upstream or downstream corridor, meaning that boundary conditions were assumed using limited data.

6.3.3 Potential impacts

Surface water

During construction, potential impacts of the proposal on hydrology are:

- Stockpiling or material storage reducing flood storage areas and/or impeding flood flows.
- Earthworks affecting flow paths.

During operation, potential impacts of the proposal on the hydrology are:

- Increased flow rate and velocity of surface water runoff (downstream of the proposal).
- Reduced floodplain storage as a result of new proposal elements (upstream of the proposal).

Stockpiling or material storage reducing flood storage areas

Reducing the capacity of the floodplain to store flood water due to materials being stockpiled or stored on floodplains takes up area previously available for water storage. This could lead to increases in the extent and level of flooding.

The three main construction ancillary sites are located above the 100 year ARI flood zone. They would not reduce floodplain storage or result in any changes to the existing flood levels for events up to the 100 year ARI event.

Earthworks affecting flow paths

The total volume of cut for the proposal would be about 154,500 cubic metres and the total volume of fill would be about 139,000 cubic metres. Any excess material not re-processed for construction reuse would be removed from site. No material would be stored at ancillary sites permanently. Apart from minor and localised potential impacts, given the staged nature of the proposal construction, the volume of material at any one time at stockpile sites would not be sufficient to alter local flood paths.

Each individual stockpile site would need to be carefully managed to avoid localised ponding or the creation of new flow paths.

Increased flow rates and velocities of surface water runoff

The effects of increased flows and velocities can include downstream scour or altered hydraulic conditions in waterways.

The proposal utilises existing drainage infrastructure and existing motorway bridges are to be retained without structural modification. All existing cross-drainage culverts would require extension and additional catch/junction pits would be constructed. The existing cross drainage pipe culverts to be extended vary from 450 mm to 1,050 mm

in diameter – predominantly the former with pipe culvert diameters tending to increase around interchange locations.

Two three-cell box culverts with dimensions 3,000 mm by 1,800 mm are located about 1,500 metres and 1,600 metres respectively, south of the Warnervale Interchange overbridge. Both of these box culverts are proposed to be removed and replaced as part of the proposal. One three-cell box culvert located with dimensions 3,000 mm by 1,500 mm is located about 900 metres north of the Warnervale Interchange overbridge and this culvert may need to be removed and reconstructed. The need for replacement of this culvert would be confirmed following condition surveys during detailed design.

Table 6-22 provides a summary of the predicted 100 year ARI flows for each waterway crossed by the proposed alignment. It indicates hydraulic performance, peak water levels and the relevant road pavement levels to allow comparison of flooding effects presented by the existing infrastructure and by the proposal. The existing culverts have the capacity to pass the 100 year ARI flood event without overtopping of the motorway.

An increase in pavement surface area would result from the proposed widening into the median and from new pavement surface area provided at the Warnervale Interchange and the Doyalson Link Road Interchange. Increases in impervious pavement surface areas are expected to generate a slight increase in discharge volume at existing culverts along the proposal length however the additional volume of water would be negligible.

An assessment of the relative change in discharges at pavement drainage system outlets was carried out to assess the likely impact of the proposal on localised road discharge. Local discharge increases of up to a maximum of 10 per cent in the 100 year ARI are predicted. These localised pavement flow increases, when combined with flows from the large transverse catchments crossing the alignment, would result in a negligible increase in flow rates in the waterways downstream of the proposal.

Given the minor increase in flows and velocities and with the application of standard management measures such as scour protection, downstream environments, including sensitive downstream environments such as the SEPP 14 wetlands and the Tuggerah Lakes system, would not be adversely affected by increased flows or flow velocities as a result of the proposal.

Reduced floodplain storage as a result of new proposal elements

The proposal includes a minor increase in vertical alignment of the main motorway carriageways and several new major elements such as bridge abutments and new ramps at the Warnervale interchange and Doyalson Link Road Interchange.

The extent that the proposal would result in a reduction to the capacity of the floodplain to store flood water was assessed by modelling the flood behaviour of the sub-catchments under existing conditions and for the proposal. The modelling indicated that there would be no material change to the flood levels as a result of the proposal. This was confirmed by verifying that the existing motorway culverts have the capacity to pass the 100 year ARI flood event without overtopping.

Groundwater

Given the proximity of the proposal to the Wyong River, Porters Creek wetlands and other nearby watercourses, it is possible that groundwater would be encountered within alluvial sediments at about 20 metres below ground level based on the well logs observed. Perched groundwater may also occur nearer to the surface along the road corridor.

Potential impacts to groundwater recharge may result from the proposal construction or operation through:

- Temporary works areas, including ancillary sites, either through storage of plant and equipment blocking surface water movements and causing localised ponding, or through compaction of soils reducing infiltration rates.
- Substantial earthworks for new motorway ramps and bridges at the Warnervale Interchange and the Doyalson Link Road Interchange may result in displacement of any perched groundwater.

These potential impacts are predicted to be minor or inconsequential considering the large extent of the existing road footprint and associated infrastructure compared to the temporary footprint of the works areas and ancillary sites. Further, the majority of new proposal permanent footprint would be located within the motorway central median. This area is currently drained through pits and pipes and so does not currently discharge to groundwater recharge areas. No substantial net change in the currently undrained area would occur.

6.3.4 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential hydrological impacts. These mitigation and management measures have been identified in Table 6-24 and are incorporated in the environmental management measures in Section 6.17.

Table 6-24: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Stockpiling or material storage may reduce flood storage areas	• All stockpile locations and construction ancillary sites should be located above the 100 year ARI flood level.	Construction contractor	Construction
Earthworks may affect flow paths	• All piped and channelised water should be directed to existing points of discharge.	Construction contractor	Construction
Increased flow rates and velocities of runoff may affect downstream environments	• The design will incorporate measures such as energy dissipation measures, scour protection and other design features to control flow intensity and direction of flow. • Erosion and sediment control measures will be implemented where warranted. A preliminary assessment has identified that temporary Construction Basins may not be required subject to other management measures and controls. Operational basins and scour protection will be investigation during detailed design, as drainage designs and construction staging are finalised.	Design team Construction contractor	Detailed design Construction
Groundwater	• Any potential for changes in the groundwater table and any	Design team	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
	resulting impacts will be reviewed in response to any design refinements. Where necessary, measures to manage the changes will be designed and implemented during construction and operation.	Construction contractor	Construction

6.4 Soil and water

6.4.1 Existing environment

Landform, geology and soils

The proposal area has an elevation of between five metres and 25 metres AHD. The area has been previously modified as result of the existing motorway construction that occurred in early 1980s and as a consequence is relatively flat. The existing freeway was designed and built to allow additional traffic lanes to be added into the existing central median.

The proposal is located within the Wyong area within the larger Hornsby Plateau subdivision of the Sydney Basin. The underlying geology comprises consolidated sediments of the Triassic Hawkesbury and Narrabeen sandstone series. Hawkesbury sandstone outcrops along the Kulnura Plateau, while sediments from the Narrabeen sandstone series occur across the majority of the region. Extensive areas of unconsolidated alluvial soils also occur along major valleys and streams, and large deposits of Quaternary marine and aeolian sands occur along the coastline.

The soil landscape as described in the Soil Landscapes of the Gosford-Lake Macquarie 1:100,000 Sheet (Murphy, 1993) identifies the proposal corridor as being part of the Central Coast Lowlands. This physiographic region is described as relatively low-lying terrain with low rises and alluvial plains.

The proposal would require excavation works encountering the Erina and Woodbury Bridge soil landscapes in the south and the Woodburys Bridge, Gorokan, Yarramalong and Wyong soil landscapes in the north.

The Erina and Gorakan soil landscapes are derived from the Terrigal formation of the Narrabeen Group of lithic and quartz sandstone, siltstone, claystone and conglomerate. The soil materials found in these landscapes exhibit erodibility ranging from moderate to high for non-concentrated flows, and up to very high for concentrated flows. The erosion hazard for both non-concentrated and concentrated flows is considered to be very high, while wind erosion hazard is considered slight.

The Woodburys Bridge soil landscape is a residual landscape formed on the Patonga Claystone formation and is often found to be overlayed by the Erina soil landscape, making the interface between these soil landscape quite variable.

The Wyong soil landscape is generally poorly drained deltaic floodplains and alluvial flats. The geology of the Wyong soil landscape is identified as consisting of Quaternary sediments. The soil materials found in this landscape exhibits erodibility ranging from high to extreme. The erosion hazard is slight for both non-concentrated and wind. For concentrated flows it is considered slight to moderate.

No salinity risk has been identified for the proposal area (DLWC, 1999).

The proposal area is not identified as vulnerable land (steep or highly erodible) according to the soil landscape mapping (Murphy, 1993).

Acid sulfate soils

The landform in this area is identified by the soil maps as both a high and low risk of acid sulfate soil (ASS) conditions occurring. ASS risk occurs within the proposal area for about 3.1 kilometres of the proposal corridor, generally associated within the Wyong and Yarramalong soil landscapes (refer to Appendix M).

The proposal would intersect the natural soil horizons to a minor extent in areas where this ASS risk occurs. The extent of ground engagement in risk areas would be limited to culvert extensions and culvert surface stabilisation works. A map of the

proposal ASS risk locations is provided in Figure 6-3.

Contamination

Land contamination is most often the result of past land uses. It can arise from activities that took place on or adjacent to a site and be the result of improper chemical handling or disposal practices, or accidental spillages or leakages of chemicals during transport or storage. Activities not directly related to a site may also cause contamination; for example, from diffuse sources such as polluted groundwater migrating under a site or dust settling out from industrial emissions.

The natural soil formations in the proposal area have been generally overlaid with fill materials associated with the construction of the original F3 Freeway in 1983. The imported fill materials that were used are likely to have been sourced for their engineering properties such as high compaction and load strength as required by geotechnical requirements for road construction. Contamination of these areas is unlikely, however temporary ancillary facilities used during construction of the motorway such as concrete batch plant sites may represent a higher risk associated with potentially land contaminating activities at these locations.

All construction activities prior to 1986 have the potential for asbestos-containing materials to be present. The manufacture and use of asbestos products was banned nationally from 31 December 2003. Construction activities associated with the proposal could potentially encounter telecommunications pits, conduits and water mains piping manufactured with asbestos containing materials. The flexible pavement section of the proposal south of Wyong River is known to contain slotted asbestos subsoil drainage pipes. Appropriate mitigation and management measures would be implemented in these sections and any materials removed would be done so by appropriately licensed professionals.

Figure 6-3 contains two images that show examples of possible asbestos contamination.

Road corridors can be subject to uncontrolled filling events from unknown sources, particularly in urban areas. Uncontrolled fill material being encountered within the road corridor during construction is a low risk scenario and is likely to be adequately managed through an unexpected finds protocol developed for this purpose. Fill material from unknown sources may have contaminant concentrations that exceed the allowable criteria for the currently zoned or intended land use for the site, and may cause groundwater contamination.

There is a risk of the proposal encountering contaminated land during temporary occupation of the existing motorway corridor and at ancillary sites required during construction. A search of the EPA contaminated land record of notices returned four records for the Wyong local government area. None are located near the proposal area or within the proposed ancillary sites.

Potentially contaminating land uses identified within the corridor catchments and adjoining areas are identified in Appendix M. They include landfill sites, former industrial land uses, service stations and a stockpile site. These potentially contaminated sites are shown on a map in Figure 6-3.

Roads and Maritime has conducted a soil sampling and analysis program for a preliminary assessment of soil conditions within the proposal area. The Contamination Assessment Soil Analysis - EAL Job Number C6826 (EAL, June 2013) concluded that the soils assessed are characterised by low metal concentration and contain no detectable concentrations of pesticides or polychlorinated biphenyl. Soil data collected are considered to meet the Residential Contaminated Lands guidelines for the parameters tested.

Waterways and surface water bodies

The proposal is located within the Central Coast Catchment and is managed by the Hunter-Central Rivers Catchment Management Authority. Surface water from the majority of the proposal area flows generally south-east in accordance with the general slope of the catchments towards Tuggerah Lake.

Surface water quality within the proposal area is important because it drains into sensitive areas including drinking water supply, SEPP14 wetlands, Wyong River, numerous creeks, areas of sensitive vegetation and Tuggerah Lake.

Water supply on the Central Coast is jointly provided by Gosford City Council and Wyong Shire Council, via the Central Coast Water Corporation. The Central Coast Water Cooperation pumps water from the Wyong River at Woodburys Bridge Pumping Station (located just upstream of the Wyong River Weir) to Mardi Dam through a 2.1 kilometre buried water pipeline. The Wyong River Weir is located about 600 metres east of the motorway bridges over the Wyong River. The river is used for a water supply because Mardi Dam itself has a very small catchment of about four square kilometres.

Woongarrah Creek, Buttonderry Creek and Hue Hue Creek cross the M1 Pacific Motorway and come together on the eastern side of the motorway at Porters Creek Wetland. The Porters Creek Wetland is subject to the provisions of SEPP 14 (refer to Section 4.1 and Figure 4-4). Porters Creek Wetland is the largest remaining freshwater wetland on the Central Coast of NSW with a catchment of about 55 square kilometres. It plays a critical role filtering water on its way to the Wyong River which then flows into Tuggerah Lakes. Together these waterways provide habitat for a diversity of flora and fauna, support fishing and tourism enterprises and offer public recreational opportunities.

Porters Creek flows from Buttonderry in the northwest to Woongarah and Kanwal in the east and joins the Wyong River downstream of the Wyong River Wier. Figure 6.2 shows the sub-catchments that are upstream of the motorway.

There is limited water quality data available for the proposal area. Water quality is affected by runoff from urban development and agricultural land uses. Urban stormwater is generally not treated (except for gross pollutants) and typically drains to local creeks. The quality of the water entering local waterways is therefore a function of the contaminants in the urban stormwater system. Common stormwater pollutants include litter, chemicals (detergents, oils, fertilisers) and organic matter.

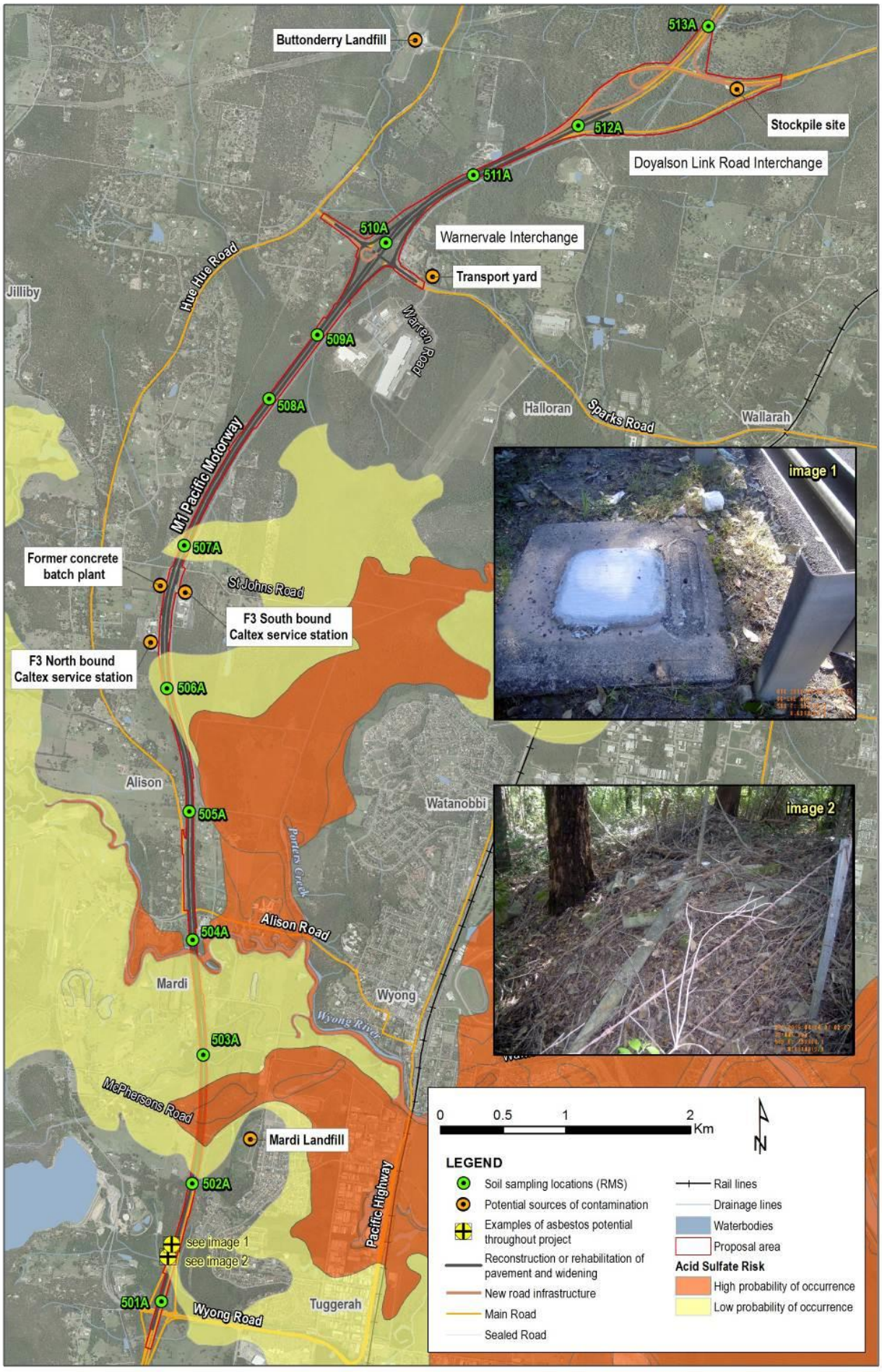


Figure 6.3 Contaminated lands environmental areas of concern

6.4.2 Potential impacts

Construction

Soil, sediment and water quality

During construction, the proposal has the potential to generate sediment and nutrient runoff during rainfall events. This could occur where there is ground disturbance associated with construction activity such as where there is excavation or vegetation removal. Sediment mobilisation from soil deposited on the road pavement during works is a further potential impact.

The staging proposed for managing traffic flow between the demolition of existing pavement and the construction of new pavement would substantially reduce the area of exposed soil at any time during construction. This staging would help to manage runoff impacts however there are a number of potential soil and water quality impacts which could occur if the appropriate mitigation measures are not implemented or maintained. These potential impacts include:

- Water quality impacts related to potential pollution of stormwater run-off with sediments, fuels and other hazardous materials from the construction site and equipment.
- Impacts associated with increased sediment loading, including increased turbidity, and an increased potential for the transport of contaminants bound to sediment particles.
- Soil erosion as a result of exposure to wind and water runoff, removal of topsoil, exposure of buried structures, sedimentation, increased turbidity levels in waterways and the local stormwater system and reduced air and water quality.

A Preliminary Erosion and Sedimentation Assessment (PESA) undertaken for the proposed works undertaken in accordance with the Roads and Maritime *Erosion and Sedimentation Risk Assessment Procedure (RTA, 2004)*. This procedure considers the proposal works to be high risk due to the following criteria being encountered:

- Areas of land greater than two hectares would likely be disturbed.
- Soil erodability and erosion hazard has been mapped as very high for some parts of the proposal.
- SEPP 14 wetlands are located to the east of the proposal in Porters Creek Wetland.
- A small sub-catchment of the proposal drains to drinking water catchment for Central Coast Water Supply Corporation.

Wyong drinking water catchment

Construction activities including excavation and filling as required in traffic cross overs and pavement demolition and reconstruction pose an elevated risk to water quality in downstream waterways through the increased likelihood of movement of sediment off exposed soils.

An estimated 700 metres of the proposal area near the Wyong River falls within the Wyong River drinking water catchment (refer to Appendix M, Figure 5). Ground engaging works identified within this Wyong River drinking water catchment would include:

- Removal and replacement of pavement.
- Temporary lane crossovers.

Porters Creek wetlands

About 1.4 kilometres of the proposal length is adjacent to the SEPP 14 Porters Creek wetlands. Ground engaging works within this area would include pavement removal and replacement, reconstruction of box culverts and general disturbances from construction plant and machinery.

Impacts of these activities on SEPP 14 wetlands would be related to the potential pollution of stormwater runoff from construction sites and equipment, with sediments, fuels or other hazardous materials.

Ancillary sites

The proposed ancillary sites would support activities that have a high potential to impact downstream water quality and downstream environments, if not adequately managed. Potential impacts would be related to spills of pollutants and the mobilisation of sediment. The activities identified with potential to impact include:

- Storage of chemicals.
- Vehicle wash down and refuelling.
- High frequency of vehicle movements.
- Concrete batch plants.
- Material storage and stockpile areas.
- Office compounds.

Contaminated land

Potential environmental impacts associated with the proposal in relation to contaminated land management include:

- Adverse effects on human health (construction personnel/ community).
- Release of contaminants into underlying soils.
- Release of contaminants into groundwater.
- Movement of contaminated sediments into waterways.
- Contaminated or hazardous waste not being correctly handled and/or disposed of.
- Increasing waste amounts from improper practices eg poor fill management.
- Adverse effect on flora and fauna.

There is potential to encounter contaminated land during the construction of the proposal. The findings of the preliminary soil contamination survey (EAL, 2013), indicate soil qualities within the survey area are generally low risk for contamination.

Areas of concern that may contain contamination have been identified by an initial risk assessment. Disturbance of soils at these areas of concern could result in potential impacts.

The site survey identified potentially asbestos-containing materials within service conduits and communications pits along the proposal. Interactions with asbestos containing material can result in human health impacts.

Construction ancillary sites would be temporarily occupied for the purposes of construction. These ancillary sites provide individual contamination risk profiles that would need to be assessed prior to occupation to establish benchmark conditions for management of each site.

Acid sulfate soils

The potential impacts from ASS affected landscapes during construction include:

- Generation of additional acidity from in-situ potential ASS disturbance (ie. Material exposed and allowed to oxidise) and inadequate management.
- Export of existing acidity upon disturbance and wetting.
- Generation of low pH waters (surface and groundwater) and potentially elevated dissolved metals.
- Impacts on sensitive environments (flora and fauna).
- Potential for soil structural decline.
- Potential for infrastructure decline (corrosion etc.).
- Adverse community perceptions of the proposal.

There is potential for ASS to be encountered during construction through excavation or dewatering activities where ASS risk has been identified (refer to Figure 6-3). In particular, disturbance of ASS has the potential to impact the SEPP14 listed Porters Creek Wetland and surrounding areas resulting in possible:

- Terrestrial vegetation impacts due to soil and groundwater pollution.
- Aquatic flora and fauna impacts due to pollution of waterways.
- Damage to building and infrastructure; damage to agriculture and aquaculture industries.

Operation

Soil, sediment and water quality

Pollutants can collect on road surfaces as a result of road maintenance activities, vehicle movement, and wear and tear. Water quality can be directly influenced by operational road runoff. The potential for a reduction in water quality of receiving environments include:

- Mobilisation of unconsolidated materials where surfaces are not stabilised or successfully revegetated.
- Suspended sediment and suspended solids interfere with the respiration and feeding of aquatic plants and animals. Chemically, many other potential pollutants such as nutrients, heavy metals and organic substances, are adsorbed to, and travel with, sediments.
- Heavy metals of concern in road runoff include cadmium, chromium, copper, nickel, lead and zinc. The concentrations of metals found in road runoff, especially from heavily trafficked areas, are commonly far in excess of current ANZECC (2000) guidelines for the protection of fresh and marine waters.
- Elevated levels of nutrients such as phosphorous and nitrogen in road runoff can contribute to the accelerated growth of aquatic plants and cause a reduction in the levels of dissolved oxygen. Nutrients are usually associated with the fine suspended sediment in the runoff.
- Hydrocarbons in road runoff derived from oil and grease residues in pavements

Contaminated land

There is potential for accidental spillage of hazardous materials during the operational stage of the proposal. Without satisfactory means of containment, the spillage of contaminants could pass rapidly into the drainage system and impact downstream environments. Spills of chemicals or petrol in accidents can impact the ecology of waterways and terrestrial ecosystems.

The risk of such spillage already exists and the proposal would not materially

contribute to the risk. The likelihood of a potential spill of hazardous substances would be lower as a result of the proposal due to the improved road design standards proposed.

Acid sulfate soils

The potential for ongoing impact on ASS, once the construction phase has been completed and the remediated areas have been stabilised, is considered low.

6.4.3 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential impacts to soil and water. These mitigation and management measures are identified in Table 6-25 and incorporated in the environment management measures in Section 6.17.

Table 6-25: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Erosion and sedimentation	• A Construction Environmental Management Plan (CEMP) and associated sub-plans would be prepared for all construction and maintenance activities associated with the proposal. The CEMP should be prepared in accordance with Roads and Maritime guidelines and specification, including, but not limited to G38, G39 and G40. The CEMP would be supported by a Soil and Water Management Plan (SWMP).	Construction contractor	Pre-construction
	• A qualified soil conservationist should develop the construction phase soil and water management strategy in accordance with the principles and practises detailed in *Managing Urban Stormwater: Soils and Construction (*Landcom, 2004) and in consultation with relevant government agencies and Council. The soil and water management strategy should be documented within the SWMP.	Construction contractor	Pre-construction
	• The SWMP should contain as a minimum the following elements: • Consideration of appropriate erosion and sediment control during staging of the main widening and replacement construction works. • Consideration of appropriate erosion and sediment controls at ancillary sites with particular consideration of sediment basins at batch plant sites or where significant material processing or stockpiling will occur. • Measures to develop, maintain, monitor and improve progressive, site specific Erosion and Sedimentation Control Plans (ESCPs). • Identification of site conditions or construction activities that could potentially result in erosion and associated sediment runoff. • Methods to minimise potential adverse impacts of construction activities on the	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	water quality within surrounding waterways. • Details of specific measures to protect sensitive areas including SEPP14 wetlands, drinking water catchments and sensitive vegetation (EECs). • Details of measures to minimise any adverse impacts of sedimentation on the surrounding environment. • Details of measures to minimise soil erosion caused by all construction works including clearing, grubbing and earthworks. • Details of measures to make site personnel aware of the requirements of the SWMP by providing information within induction, toolbox and training sessions. • Details of the roles and responsibilities of personnel responsible for implementing the SWMP. • Details of measures for the inspection and maintenance of construction phase water treatment devices and structures.		
	• Soil and water management measures in the ESCP are to be consistent with the principles and practises detailed in Landcom's (2004) Managing Urban Stormwater: Soils and Construction.	Construction contractor	Pre-construction
	• The proposal (including ancillary sites) may require sediment control basins. Temporary basins are to be sized accordingly to the area of land being disturbed and activities being conducted at each site. Sediment basins are to be considered at concrete batch plant sites and or where significant material stockpiling or processing occurs.	Construction contractor	Construction
	• No stockpiles of materials or storage of fuels or chemicals would be located within the 100 year ARI flood zone.	Construction contractor	Construction
Disturbance to asbestos	• An Asbestos Management Plan is to be developed in accordance with the Roads and Maritime Services (2013b) Asbestos Management Plan.	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
containing materials	• If previously unidentified asbestos contamination is discovered during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with the relevant EPA and WorkCover Guidelines and include the proposed methodology for the remediation of the asbestos contamination. Remediation activities must not take place until receipt of the investigation report by occupational health professional. Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology.	Construction contractor	Construction
Disturbance to contaminated land	• A Contaminated Land Management Plan is to be prepared for construction areas identified as contaminated land or any land contamination caused by the proposal.	Construction contractor	Construction
	• The Contaminated Land Management Plan is to detail procedures to: • Include measures to identify and manage acid sulphate soils. • Protect the environment by implementing control measures to divert surface runoff away from the contaminated land. • Capture and manage any surface runoff contaminated by exposure to the contaminated land. • Investigate the contamination to determine the concentration and type of contaminants and the extent of contamination. • Assess the requirement to notify relevant authorities, including the EPA. • Manage the remediation and subsequent validation of the contaminated land, including any certification required.	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	• Each of the ancillary sites proposed, requires a preliminary environmental survey to be undertaken prior to Roads and Maritime occupying the site. The presence of fill (and potential contamination) would be determined by undertaking site inspections.	Construction contractor	Construction
	• Additional assessment is to be undertaken for soils requiring off-site disposal to ensure the correct waste classification is determined. Excavated material that is not suitable for on-site reuse or recycling, such as contaminated material should be transported to a site that may legally accept that material for reuse or disposal.	Construction contractor	Construction
	• If previously unidentified contamination is discovered or suspected during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of any contamination. The level of reporting must be appropriate for the identified contamination in accordance with OEH Guidelines for Consultants Reporting on Contaminated Sites (2011).	Construction contractor	Construction
Accidental spills during construction	• Vehicles and machinery should be properly maintained to minimise the risk of fuel/oil leaks. Routine inspections of all construction vehicles and equipment should be undertaken for evidence of fuel/oil leaks.	Construction contractor	Construction
	• All fuels, chemicals and hazardous liquids should be stored within an impervious bunded area in accordance with Australian standards and EPA guidelines. • Any on-site refueling would occur in a designated area with impervious surfaces.	Construction contractor	Construction

6.5 Socio-economic

6.5.1 Existing environment

The proposal is located wholly within the Wyong LGA. The location of the proposal in a regional context is shown in the inset on Figure 1-1.

Wyong LGA covers about 740 square kilometres and forms the northern part of the Central Coast Region, which comprises both Wyong and Gosford LGAs. Wyong LGA is bounded by the Tasman Sea to the east, Gosford LGA in the south and south west, the Dooralong and Yarramalong Valleys to the west, Cessnock LGA to the north-west and Lake Macquarie LGA to the north.

The National Economic Indicators for Local Areas for Wyong LGA indicate that in 2011/2012 the LGA had a Gross Regional Product of $4,655m, representing 1.06 per cent of the state. There were 50,196 jobs in the LGA and the unemployment rate was 7.58 per cent compared to 5.08 per cent for the state (economy id, 2013).

In 2011, the median age in the Wyong LGA was 40, compared to 36 in Greater Sydney and 38 in NSW. The median weekly household income in Wyong LGA was $934 in 2011, compared to $1,447 in Greater Sydney and $1,237 in NSW (profile id, 2013).

In 2012 the estimated residential population of Wyong LGA was 155,342. The population grew by nearly 10,000 from 2006 to 2011. The Central Coast Region had a population of 312,202 residents in 2011.

Just over half, 54.5 per cent, of residents aged 15 years and over were in the labour force in 2011, compared to 61.7 per cent in Greater Sydney and 59.7 per cent in NSW. The rates of employment in Wyong LGA were similar in 2011 to 2006.

Of the 39,569 people who work in Wyong Shire, 73.7 per cent also live in the area. More than one-third (36.8 per cent) of Wyong LGA's working residents, travel outside of the area to work. In 2006, the top 10 local government areas residents of the Wyong LGA travelled to for employment were:

- Wyong (49.7 per cent).
- Gosford (17.6 per cent).
- Lake Macquarie (2.8 per cent).
- Sydney City (2.7 per cent).
- Hornsby (2.2 per cent).
- Newcastle (1.9 per cent).
- Willoughby (1.0 per cent).
- Ryde, Parramatta and Ku-ring-gai (0.7 per cent each).

Based on an interpretation of the local road network between Wyong, Gosford and Lake Macquarie LGA's, fewer than 10 per cent of Wyong LGA residents would use the M1 Pacific Motorway to travel to their respective places of employment.

In Wyong LGA in 2011, only 5.2 per cent of workers used public transport as their main method of travel to work, with 74.5 per cent travelling by motor vehicle (car, truck or taxi). In comparison 13.7 per cent of NSW workers used public transport as their main method of travel to work, with 64.2 per cent travelling by motor vehicle.

Wyong LGA had higher rates of car ownership by household than Greater Sydney, with 71.6 per cent owning one or two motor vehicles, compared to 67.2 per cent in Greater Sydney and 69.1 per cent in NSW. In Wyong LGA, the number of journeys to work by car as a driver increased by 5,910 between 2006 and 2011.

Population projections

The Wyong LGA population is projected to grow by 1.49 per cent per annum between 2013 and 2031. This would provide an additional 47,663 residents in the area for a total population of 203,448 in 2031.

The Wyong social planning district (SPD) is projected to grow from 15,357 in 2011 to 21,148 in 2031, with an average annual change of 1.59 per cent (forecast.id, 2013). The Rural West SPD (west of the motorway) is projected to grow from 2,025 in 2011 to 2,149 in 2031.

Forecasting suggests that an additional 64,000 people will move to the Central Coast in the next 20-25 years. The Central Coast Regional Strategy (2006-31) estimates that in 2031 the Central Coast will have a population of just over 400,000 people and an additional 56,000 dwellings (DoP, 2008). The growth forecasts include further growth in the commuting workforce. The region will also have sufficient employment land and retail and commercial floor space to provide capacity for more than 45,000 additional jobs (DoP, 2008).

The Wyong Shire Council Community Plan 2008-2013 (Wyong Shire Council, 2008a) notes that continuing population growth will place increasing pressure on the need to generate local employment, which has not kept pace with population growth to date, requiring many residents to commute outside the region for work. Outward commuting is likely to continue in the light of the projected population growth.

Motorway users

The Sydney–Brisbane Corridor is one of the busiest links on the Australian transport network. Forty per cent of Australia's population lives along the corridor. The Sydney–Brisbane transport corridor caters for passenger and commercial freight traffic moving between Sydney and Brisbane. It links major towns and regional centres and is an important tourism route. Recognising expected high levels of growth in local and regional passenger and freight movement between Sydney and Brisbane, which are expected to triple over the next 20 years, road congestion and capacity constraints are expected to increase.

The motorway is also an important connection for local residents commuting to employment centres in Newcastle and Sydney. The Wyong Shire Council Community Plan identifies that due to the low rate of employment opportunities on the Central Coast, connectivity to places where jobs are is important to residents.

Several locations within the proposal area have been identified from field investigations as informal commuter car parks for people car-pooling (refer to Figure 6-4a and Figure 6.4b). A survey of the informal car park occupancy rate was undertaken on the 23rd and 24th October 2013 between 4am and 7.30pm. The survey showed that occupancy varied during the day. The maximum number of vehicles occupying the informal car parking area was 46, which occurred at 9am.

Community values and attitudes

The Wyong Shire Council Community Plan 2008-2013 identifies reasons why residents moved to the area including the lifestyle the area offers, affordability, work purposes and the environmental features (beaches, lakes, bushland, visual amenity) (Wyong Shire Council, 2008a). The current amenity enjoyed by residents is that of a rural residential area surrounded by a green, natural environment.

Findings from the quality of life survey undertaken by Council in 2012 identified that the community has strong concerns with the lack of adequate infrastructure, both hard and soft, including local employment and public transport and transport infrastructure.

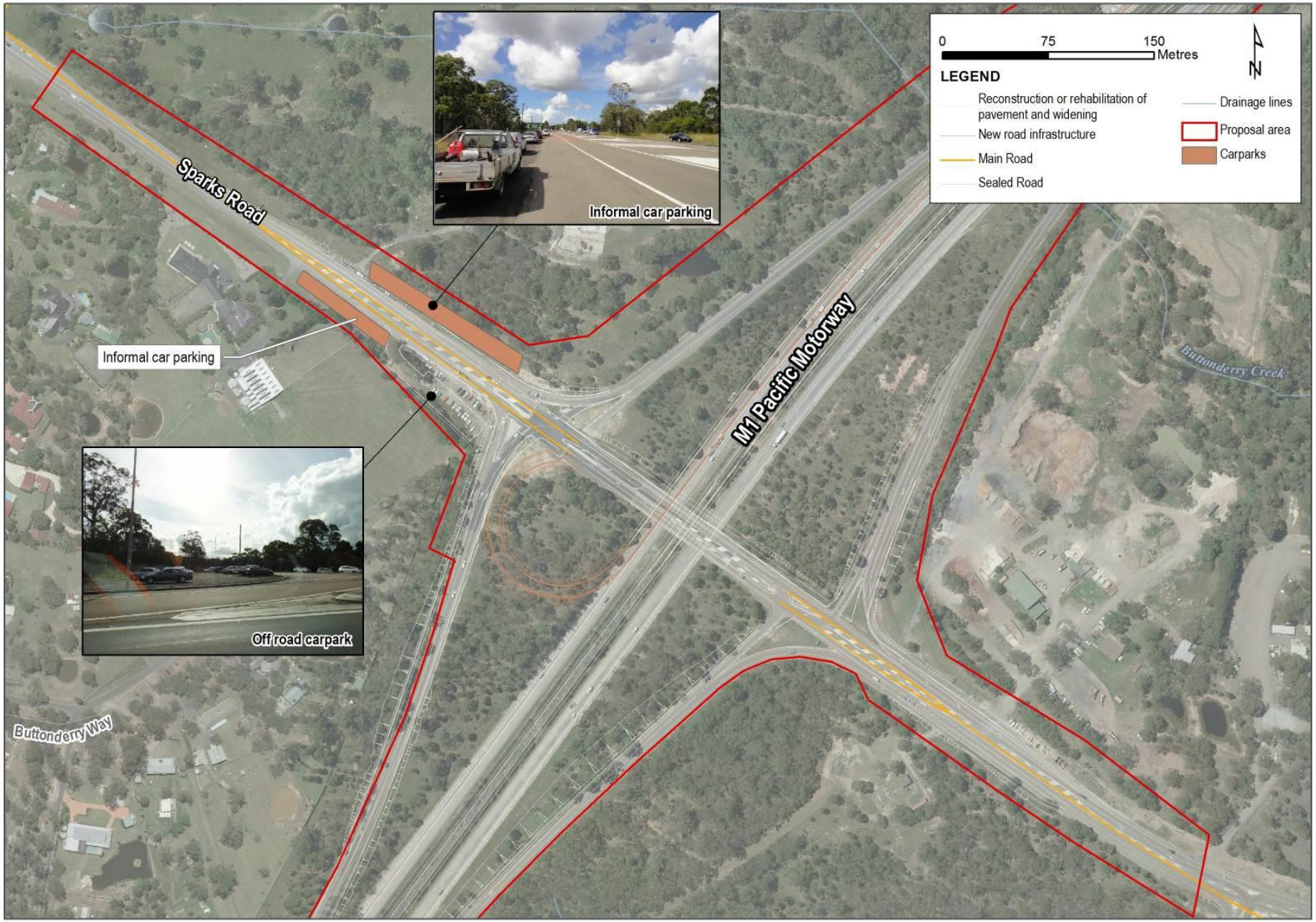


Figure 6.4a Informal commuter car parking locations in the vicinity of the proposal

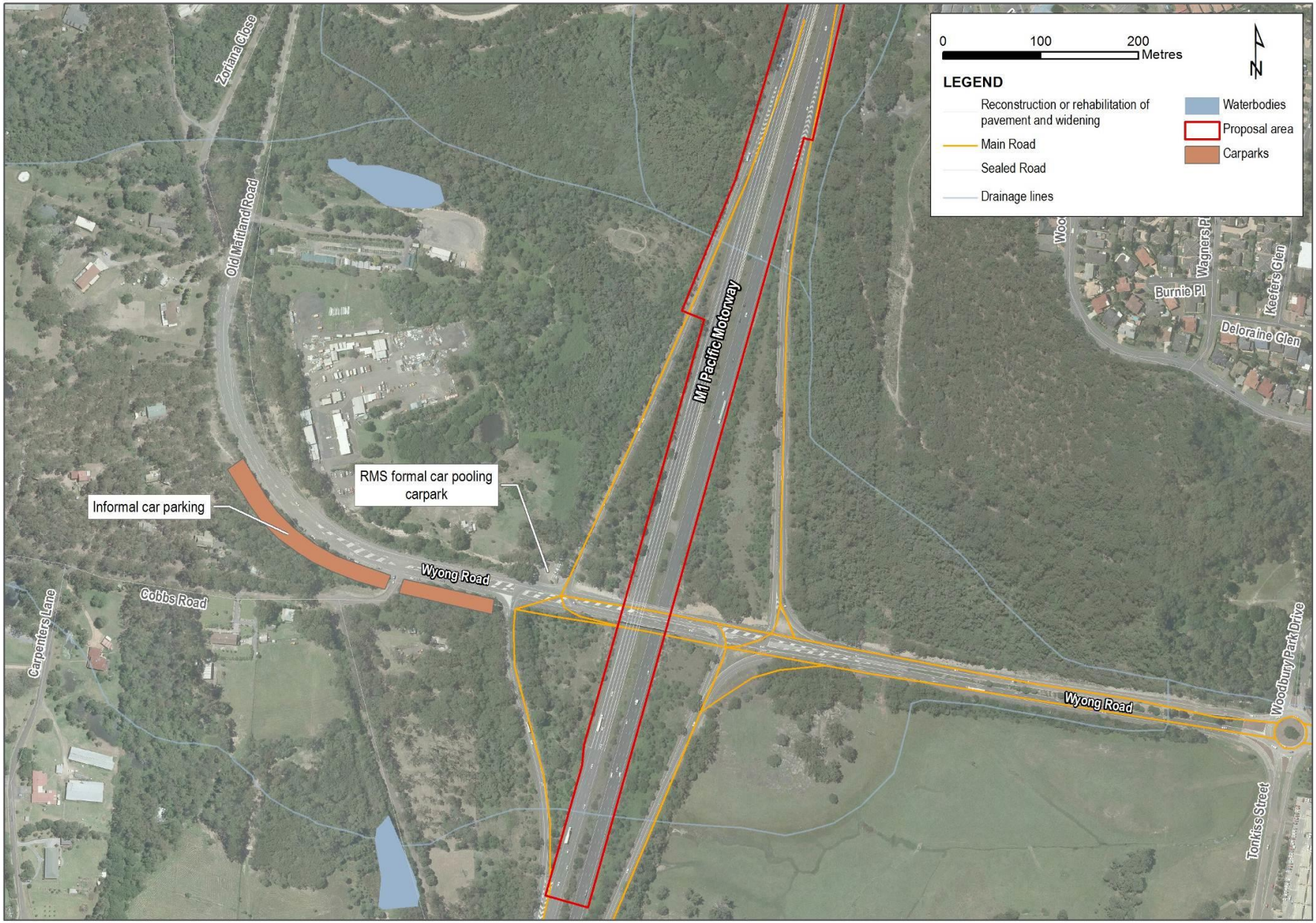


Figure 6.4b Informal commuter car parking locations in the vicinity of the proposal

Consultation undertaken by Council has highlighted the difficulties of living in an area with large travel distances, rising petrol prices, increasing congestion and public transport that does not meet the needs of the majority of its residents, noting that Wyong LGA is particularly difficult to get around without a car. The Community Plan observes that residents find it difficult to get to and from appointments and locating services. Social service providers and other organisations have difficulty in accessing their clients.

Future development

A new town centre is being planned at Warnervale, to the east of the northern end of the proposal. The Warnervale town centre is about 119 hectares in size and is bounded by Hakone Road to the north, Hiawatha Road to the east, Sparks Road to the south and extends west of the Sydney-Newcastle Railway to include land that is owned by the NSW Department of Planning and Environment, adjacent to the Sydney-Newcastle Railway. The site was rezoned to create about 15 hectares for retail and commercial uses and 64 hectares for residential uses. The remainder of the site will be rezoned open space, conservation and special activities, including an eight hectare nature reserve that is being created primarily to protect the Commonwealth listed Heath Wrinklewort.

The town centre will contain a balance of shopping, community facilities, entertainment facilities and open space as well as a new major railway station including bus interchange and commuter carpark, employment opportunities for approximately 1,200 people in retail, commercial and bulky goods sectors and housing for approximately 3,600 residents. The draft Central Coast Transportation Strategy states that construction of the new railway station will be completed by 2016.

The population of the Warnervale – Wadalba SPD is projected to grow from 14,566 in 2011 to 40,126 in 2026, with an average annual change of 5.28 per cent. Whilst outside the proposal area, the proposed Sparks Road upgrade works would directly support the project growth in the town centre.

The strategic planning for the area includes the WEZ, which provides for future intensified usage at the northern end of the proposal at the Sparks Road Interchange. It is anticipated that the area will facilitate approximately 6,000 local jobs and generate a minimum of $1.5 billion of investment in the Central Coast economy.

6.5.2 Methodology

Social impacts have been defined by the NSW Office of Social Policy (1995) as significant events experienced by people as changes in one or all of the following:

- *People's way of life – how they live, work, play and interact with one another on a day to day basis.*
- *Their culture – shared beliefs, customs and values.*
- *Their community – its cohesion, stability, character, services and facilities.*

Social impact assessment, in the context of the proposal, is the analysis of social changes and impacts on community that are likely to occur as a result of the proposal.

Economic impact assessment is a useful tool in understanding changes to income, employment opportunities and wider effects on economic development in the region. Used together, a socio-economic impact assessment can provide a comprehensive, co-ordinated picture of these overlapping issues, providing information on potential economic impacts as well as important social values held by the community which inform likely attitudes and responses to the proposal.

A baseline profile of existing socio-economic conditions was prepared in order to understand existing conditions, using data from the Australian Bureau of Statistics (ABS) and other relevant strategic planning documents. Potential types of impacts or benefits of the proposal were predicted, based on an examination of the design and the potential environmental and social impacts that could be expected. Consideration was given to impacts identified on other similar projects. Input from stakeholder consultation was also used to identify key issues of concern in relation to the proposal. An assessment of the proposal during both construction and operation phases was undertaken to evaluate the potential impacts of the proposal, utilising input from the specialist studies prepared as part of the assessment process. Mitigation and monitoring measures to enhance to proposal's benefits and avoid, manage or mitigate its potential impacts were then identified.

6.5.3 Potential impacts

Amenity

Construction

In the short term during construction, the overall amenity of the proposal area may be affected by increases in construction traffic, traffic delays, dust, changes to visual amenity, and noise. These issues have been outlined and assessed in other sections of this REF.

As noted in Section 3.4.2 and Section 3.4.6, traffic management and construction work outside of standard construction working hours would be required during the proposal. This would have the potential to impact on all road users including local, regional and interstate motorists, affecting travel times.

The proposed construction ancillary sites would generate additional traffic and noise during construction which may result in a reduction in local amenity for some neighbouring property owners. Where possible the proposed ancillary sites have been selected with consideration of proximity to sensitive receivers.

There is currently informal commuter car-parking adjacent the Sparks Road interchange with the motorway. Throughout construction of the proposal this parking will be impacted. The proposal includes provision of a new commuter car park on the south west corner of the interchange. Opportunity to provide this replacement parking as an upfront construction activity will be explored during detailed design. This would mitigate the impact of the loss of adjacent informal parking opportunities.

Operation

The proposal would increase the footprint of the M1 Pacific Motorway resulting in slightly reduced amenity for local residents. However, the increase in footprint would be minor and would be offset by improvements in congestion and connectivity that would be achieved through the completion of the proposal.

The proposed construction ancillary sites would be restored to pre-existing condition, or to an extent agreed with the relevant property owner. There would be no ongoing amenity impacts from the proposed ancillary sites to surrounding property owners once the proposal is operational.

Accessibility

Construction

The NRMA Business Wise Congestion Survey (May 2013) found that over the 12 months prior to May 2013, traffic congestion in NSW had contributed to increase in fuel costs, increase in capital and running costs, slowdown in overall productivity and increase in staff late to work. The survey also found that out of almost 1,000 businesses, one third have reported an increase in both fatigue and reduced

productivity at work due to traffic congestion.

For general road users, congestion associated with delays in travel times associated with construction can result in frustration, wasted time and reduced productivity. For commercial road users, it can result in added delivery times, decreased reliability and increased costs. Impacts to travel times would be experienced by all road users throughout the three and a half year long construction phase.

Impacts of the proposal would generally be temporary in nature as intersections and access arrangements are not being removed, only upgraded. Ultimately, travel times would be improved during the operational phase of the proposal.

There would be changes to access for properties on the northern side of Sparks Road east of the Warnervale Interchange. This includes a landscape supply business. Access arrangements would be modified, which would remove the right turn out of the landscape supply business. This manoeuvre would be facilitated by an upgrade to the intersection with Sparks Road and Burnet Road.

Operation

There are potentially two additional access points proposed as part of the proposal. These are a new southbound off ramp from the motorway onto Doyalson Link Road and a new northbound on ramp to the motorway from Doyalson Link Road. The majority of the work, including the provision of these new access ramps would take place within the road reserve with the result that the proposal would not impact on properties adjacent to the motorway. The local community and travelling public would benefit from increased accessibility and reduced travel times afforded by the new motorway ramps. The new motorway ramps to and from Doyalson Link Road are subject to further investigation and may implemented at a later stage when warranted from a traffic perspective.

The proposal would reduce congestion and improve connectivity between the Central Coast, Newcastle and Sydney, producing long term benefits for road users and economic performance. As development in the adjacent WEZ and Warnervale Town Centre generates new pressures on the area, the congestion reduction opportunities from the proposal would have a positive flow on effect for local and regional economies. The Department of Trade and Investment has also advised their opinion that the proposed widening would lower travel times and improve the contribution to the state economy by the Central Coast commuter labour force.

Investigations undertaken for the State Significant Site (SSS) Study for the WEZ identified that commuting affects the economy through escape spending and the negative environmental impact of vehicle travel as well as affecting the lifestyles and quality of life of those commuting. This is largely because long term commuting is disruptive to the family in terms of time spent together, energy levels and ability to cope with family stress; and the social structure of the community in terms of the ability and time to participate in activities (Wyong Shire Council, 2008b). The proposal would contribute indirectly to addressing the impact of commuting on local residents through the provision of improved access to future employment zones off Sparks Road in the WEZ.

Correspondence from the Department of Trade and Investment has confirmed that the M1 Pacific Motorway is important economic development infrastructure and that Central Coast businesses would benefit from increased capacity through more efficient movement of raw materials and finished goods to and from markets up and down Australia's east coast. Intra-regional and inter-regional transport would also be enhanced by easier movement at peak traffic times, with potential savings in energy from less traffic congestion.

The Department also noted that at present vehicle frequency at peak time results in

unsafe travel conditions. The provision of extra lanes would increase distances between vehicles, which would improve safety performance and save lives.

Informal commuter car parking

The proposal would include the provision of kerb and guttering along Sparks Road (west) where there is currently an informal area used by carpooling commuters. The proposal would prevent the use of this area as an informal car park.

As part of the proposal Roads and Maritime would provide a new formal commuter car park at Sparks Road (west); refer to Figure 6.4a. This new formal car park would provide at least 60 formal car parking spaces to offset the loss of the informal car parking. The car park would provide a safer alternative for commuters and would encourage the continued use of carpooling in the area. The construction of the new car park would be scheduled as an early activity in the construction program so that any impacts on commuters would be minor and temporary. The formalised car park would provide for safer carpooling than the current informal areas provide.

For a previous proposal, Roads and Maritime provided a similar formalised car park for commuters that were parking informally at the Wyong Road Interchange, (refer to Figure 6-4b). The proposal would not alter the car parking arrangements provided on Wyong Road.

6.5.4 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential socio-economic impacts. These mitigation and management measures have been identified in Table 6-26 and incorporated in the environmental management measures in Section 6.17.

Table 6-26: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Traffic delays during construction	• A Traffic Control Plan (TCP) is to be prepared in accordance with RTA's *Traffic Control at Work Sites Manual* (2003), and approved by Roads and Maritime prior to implementation. The TCP is to include the notification of any traffic alterations or closures. • The TCP is to include procedures for individual notification with directly impacted residences, businesses, emergency services, utility authorities, transport industry groups and government stakeholders. • Timely notification of changes to informal car parking arrangements is to be undertaken prior to construction commencing.	Contractor	Pre-construction
Disturbance from activities on	• Consult with sensitive receivers located nearby to construction ancillary sites about likely	Roads and Maritime	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
ancillary sites	impacts prior to construction. • Site plant and equipment likely to cause disturbance to sensitive receivers located nearby ancillary sites at a suitable distance to minimise impacts.	Contractor	
Uncertainty surrounding construction activities	• The TCP is to include a construction communications plan including requirements to provide details and timing of proposed activities to affected residents, 24 hour contact name and number for complaints and details of a notification plan for changed conditions during the construction period. • The communications plan is to be prepared in accordance with Roads and Maritime's *Community Participation and Communications Manual* (2010).	Contractor	Pre-construction
Exclusion from the proposal area during construction for informal parking	• The new car park at the Warnervale Interchange should be scheduled for construction as early in the construction program as possible.	Contractor	Construction
Emergency access	• Relevant emergency services, including fire, ambulance and police, are to be consulted to ensure that safe access is maintained during the construction period in the event of an emergency.	Contractor	Pre-construction

6.6 Land use

6.6.1 Existing environment

The M1 Pacific Motorway was constructed in the mid-1980s. It is zoned SP2 Special Infrastructure. Within the proposal area, the access points to the motorway are limited to the Wyong Road interchange at the southern end and the Sparks Road and the Doyalson Link Road interchanges at the northern end.

Two motorway service centres are located within the proposal area adjacent to the northbound and southbound carriageways. These service centres each contain a Caltex petrol station and restaurants. Otherwise the M1 Pacific Motorway is completely separated from surrounding land uses.

Land use surrounding the proposal corridor is predominantly rural residential, at the southern end and bushland at the northern end (refer to Figure 6-5).

The Warnervale Business Park, situated off Sparks Road (east) in the northern section of the proposal area, covers 47.6 hectares and contains various industrial and light industrial uses. Coastal Transport Services runs a distribution service for the region's industry sector from the site. Woolworths Regional Distribution Centre covers 81,000 square metres and Pacific Beverages recently opened the Bluetongue Brewery within the business park. Subdivisions for new lots continue to be released in this business park.

Mine subsidence

As noted in Section 4, whilst the main motorway alignment is located outside of a mine subsidence district, the section of Sparks Road, west of the M1 Pacific Motorway, is located within the Hue Hue mine subsidence district (MSD).

The NSW Department of Trade & Investment – Mineral Resources Branch has advised that the proposal area is covered by three coal titles including exploration licences EL5903 and EL4911, and authorisation A405. These are all held by Kores Australia Pty Limited (proposed Wallarah No. 2 Colliery, also known at the Wallarah 2 Coal Project). The Kores indicative longwall area, as shown in the project Environmental Impact Statement, is about 800 metres west of the motorway at its nearest point.

Ancillary sites

As detailed in Section 4.2.2, the proposed ancillary sites are located on a number of different properties that have a range of applicable land use zonings. The existing environment and potential activities to be carried out during construction at each site are described in Section 3.5.

The proposed ancillary site off Warren Road is located opposite the Woolworths distribution centre. The site is cleared of vegetation and surrounded by established vegetation.

The proposed ancillary site off Hue Hue Road is located just north of the northbound Caltex Service Centre and extends north to St Johns Road. Access to the site would be through the car park of the service centre. The site contains scattered vegetation and a rural residential property.

The proposed ancillary site off MacPherson Road is located adjacent to the former Mardi landfill site, situated along the eastern boundary and the south-west corner of the 30 Mardi Road property.

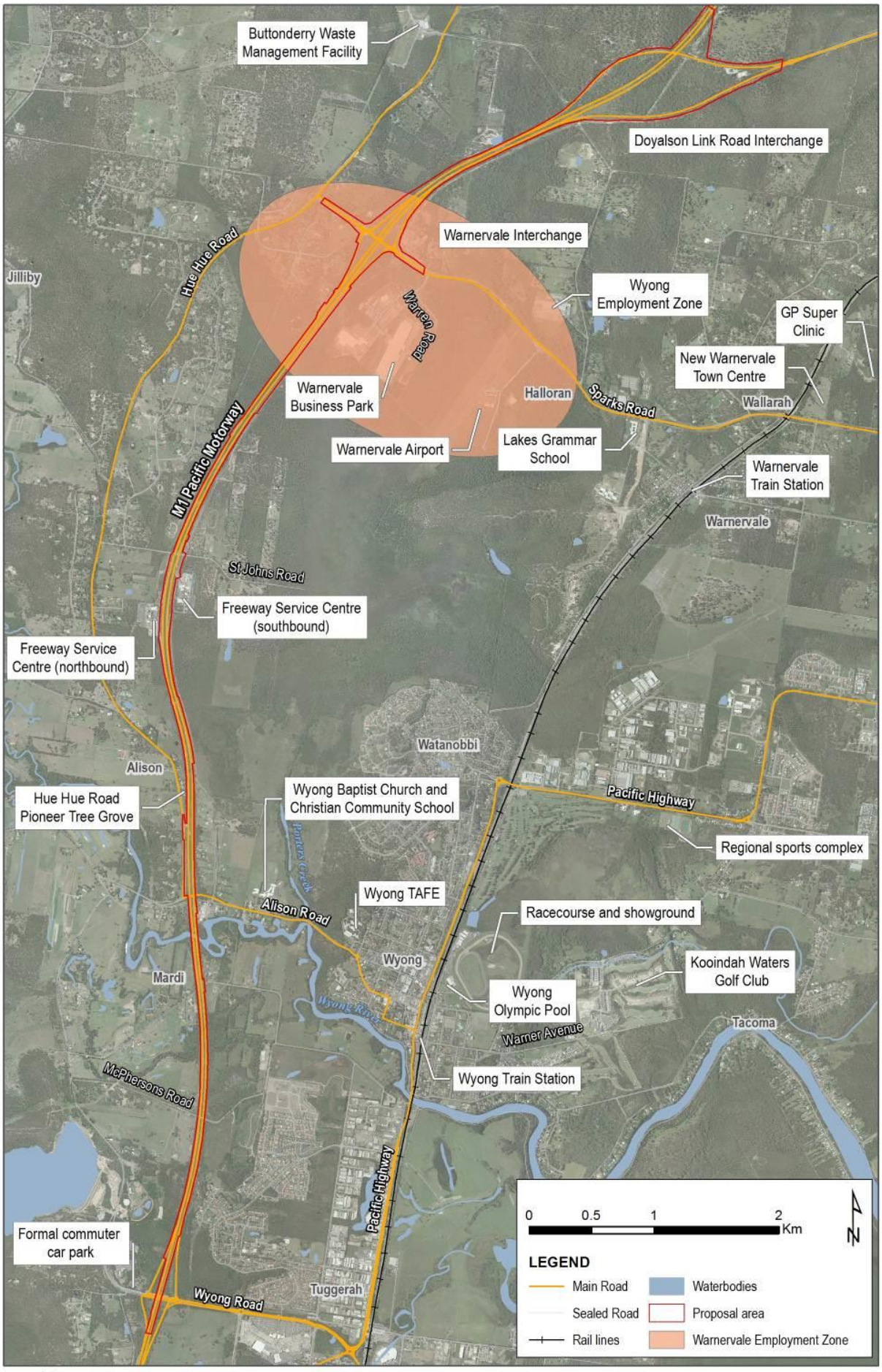


Figure 6.5 Land uses surrounding the proposal

Future development

The Wyong LEP 2013 establishes the land use zoning for the LGA. In the southern section of the proposal area the zoning is largely consistent with existing land uses, with intensification of residential development not supported to the west of the M1 Pacific Motorway.

The WEZ covers a total area of 744 hectares. The WEZ is bounded by Porters Creek wetland to the south, bisected by Sparks Road and bordered by Hue Hue Road to the west. Of the 744 hectares, about 340 hectares is proposed for development, with the remainder identified and zoned for environmental conservation and water management purposes. This will enable treatment of stormwater and maintenance of wetting and drying cycles downstream in Porters Creek wetland (Wyong Shire Council, 2010).

As part of the WEZ, the Warner Industrial Park is proposed to cover an area of about 106 hectares on the north-west corner of the Sparks Road and M1 Pacific Motorway intersection. The Warner Industrial Park has obtained concept approval and project approval for an industrial subdivision and associated works. The Warner Industrial Park's Masterplan allows for 90 industrial lots for a broad range of industrial and associated land uses such as warehousing, distribution centres, transport depots and manufacturing.

As noted in Section 6.5.1, predicted growth in the Central Coast region, higher than average unemployment in the region and the high level of commuters who travel outside of the region on a daily basis, mean that the demand for additional industrial land to meet local employment needs is essential for economic growth in the area.

6.6.2 Potential impacts

Construction

No property acquisition is anticipated to be required for the proposal. A number of ancillary sites, as discussed in Section 3.5, would be temporarily leased during construction, limiting their use for other activities during construction.

The proposed ancillary sites have been chosen in part because they already have large areas cleared of native vegetation. No clearing of remnant vegetation on these sites is proposed.

The MSB has advised that development in the vicinity of Sparks Road, west of the M1 Pacific Motorway would need to be designed to cater for ground strains of ± 2mm/m.

New VMS are proposed along the length of the motorway with emergency telephones co-located. The additional land required for these services would be within the existing road corridor. Further detail on the proposed VMS bays is provided in Section 3.3.8.

The proposal has the potential to impact on development plans for projects in the WEZ and the neighbouring Warnervale Town Centre, which are being developed concurrently. Impacts may include interface issues and construction traffic and noise impacts. Refer to Section 6.14 for further discussion on potential cumulative impacts of the proposal.

No major utility relocations, new services easements or property acquisitions are proposed.

Operation

The proposal is not expected to have an impact on land use within the proposal area once operational.

The MSB has advised that as the proposal works would almost entirely be within existing road and interchange corridors, the proposal would not impact on the Wallarah 2 Coal Project or on future coal extraction beneath the area (or vice versa). Correspondence from the Wallarah 2 Coal Project has advised that while the M1 Pacific Motorway would not be subject to conventional subsidence effects due to future longwall mining by the Wallarah 2 Coal project, it is possible that due to the interconnectedness of the underlying geology, unpredictable subsidence effects from outside of the proposal area could damage the motorway elements. Wallarah 2 Coal Project has undertaken to closely liaise with Roads and Maritime with respect to detailed subsidence planning and monitoring prior to longwall mining activity.

The proposal would have an indirect benefit in providing improved access to employment lands and the new town centre at Warnervale. This has the potential to facilitate new development in this location as a result of the improved access.

The proposed construction ancillary sites would be restored to pre-existing condition, or to an extent agreed with the relevant property owner. There would be no ongoing land use impact from the proposed ancillary sites to surrounding property owners once the proposal is operational.

6.6.3 Safeguards and management measures

Mitigation and management measures would be implements to avoid, minimise or manage potential land use impacts. These mitigation and management measures have been identified in Table 6-27 and incorporated in the environmental management measures in Section 6.17.

Table 6-27: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Property acquisition	• If property acquisition is required, all acquisition is to be undertaken in accordance with the *Land Acquisition (Just Terms) Compensation) Act 1981*.	Roads and Maritime	Pre-construction
Impact on ancillary sites	• All ancillary sites are to be restored to pre-existing conditions or to a condition agreed with the land owner, at the completion of construction.	Construction contractor	Construction
Potential long term far field effects from mine subsidence	• Roads and Maritime and Wallarah 2 Coal Project are to continue to closely liaise with respect to detailed subsidence planning and monitoring prior to longwall mining activity. • Detailed design, in the vicinity of Sparks Road, west of the M1 Pacific Motorway, is to cater for ground strains of ± 2 mm/m. • Further consultation is to be undertaken with the MSB during detailed design to ensure all potential impacts and risks are identified and mitigated.	Roads and Maritime Detailed design	Pre-construction Construction Operation

6.7 Landscape and visual character

An urban design, landscape character and visual impact assessment (UDVIA) was carried out by Tract Consultants (2014). A complete copy of the report is available in Appendix I, and a summary is provided below.

6.7.1 Existing environment

The proposal runs through several landscapes of differing character from commercial and mixed use, light industrial and residential, to rural. The landscape character of a region is defined by its cultural, social and natural attributes. For the purposes of the UDVIA the character of the corridor's existing environment is defined in terms of eight Character Zones (refer to Figure 6-6):

Character Zone 1 (CHZ1): Motorway corridor

The corridor is relatively consistent in its form consisting of two travel lanes in either direction with a wide vegetated median (refer to Appendix I Figures 14 and 16). Generally each carriageway is concealed from view of the other. Connection to the surrounding landscape is limited with relatively consistent vegetated screening. Views to the higher ridges to the south, east and west are evident.

Character Zone 2 (CHZ2): Pastoral landscape between just north of Wyong Road and Alison Road (to the west of the alignment)

Wyong Road intersection has recently been upgraded introducing a harder edge to the road including concrete walls and an exposed sandstone face. Beyond this point the motorway traverses a valley defined by a vegetated ridge as part of the Mardi Dam Catchment. The foreground is dominated by rolling cleared hills used for large acreages, equestrian agistment and scattered rural residential holdings (refer to Appendix I Figure 17).

Character Zone 3 (CHZ3): Low-lying lands and rural residential precinct between just north of Wyong Road and Alison Road to the east of the alignment

The area is flat with minimal level change with vegetation dominated by swamp forest communities of *Melaleuca* species. It is defined to the east by Mardi Road which marks the limit of intensive residential development. This development is screened from the motorway by a ridge and vegetated buffer. Small rural holdings have been developed which adjoin the road corridor (refer to Appendix I Figure 18).

Character Zone 4 (CHZ4): The Knoll precinct, a small ridge at Alison Road and Hue Hue Road

This area represents a high point in the proposal area and a significant cutting within the alignment of the motorway corridor (refer to Appendix I Figure 19). The hill is vegetated with a number of large lot residential holdings present. Also present, to the east of the alignment is the historic property of Alison Homestead screened from the corridor by a stand of eucalypt trees.

Character Zone 5 (CHZ5): Jilliby rural residential area north of Alison Road to just south of Sparks Road

To the west of the motorway corridor Hue Hue Road and a small ridge just beyond it mark the limits of the catchment of this character zone. This land lies slightly higher than that on the opposite side of the highway and consequently has been developed as a low density rural residential type community, dominated by large residential holdings within a woodland type setting. This community forms the township of Jilliby and includes a historic cemetery (refer to Appendix I Figure 20).

Character Zone 6 (CHZ6): Porters Wetland

Located east of the motorway this character zone is dominated by the low lying extents of Porters Wetland, a SEPP 14 Coastal Wetland. The vegetation community, when viewed from the motorway, provides an open character which means that hills beyond can be viewed (refer to Appendix I, Figure 21).

Character Zone 7 (CHZ7): Industrial precinct area just South of Sparks Road located on a small ridge area at the headwaters of Porters Wetland

The area has been recently been developed as an industrial development (refer to Appendix I Figure 22) and adjoins Warnervale Airport.

Character Zone 8 (CHZ8): Forest Precinct Sparks Road to Doyalson Link Road Interchange

This character zone is undulating with steeper terrain than most of the corridor occurring to the north of the proposal area. This area is heavily vegetated, dominated by *Eucalypt* forest with limited development having occurred to date (refer to Appendix I, Figure 23). Wyong Shire Council's forward planning (based on LEP 2012) proposes that the area be developed for industrial uses.

6.7.2 Methodology

Landscape character

To assess the landscape character of the proposal area an understanding of the context and the implications of the proposal was gained and changes to these zones as a result of the proposal were analysed. This included the altered motorway footprint, revisions to interchanges and construction of a new pedestrian bridge.

The proposal has been assessed in terms of its potential impacts on the character zones. Potential impacts were ranked in terms of sensitivity to change. The landscape character assessment differs from a visual impact assessment in that it assesses the overall impact of a project on an area's character and sense of place.

Visual impact

The potential visual impact of the proposal has been assessed in relation to a number of key viewpoints and groups of viewpoints. It is based on the existing pattern of land use and development adjoining the motorway corridor. The methods applied for the visual impact assessment involved:

- Defining the scale of the proposed work.
- Identifying key visual envelopes, viewpoints and groups of viewpoints from where the proposed works would be visible.
- Assessing the level of potential visual impact on viewers at these viewpoints from the proposed works.

All construction works and operational aspects associated with the proposal were considered as part of the visual impact assessment. These works include:

- Construction of new and expanded road pavement and ramps.
- Removal of vegetation, this is proposed to predominantly affect the median although clearing extents permit some clearance within the verge.
- Construction of new pedestrian bridge over the motorway at Sparks Road.
- Construction of new fill batters, cuttings and access tracks.
- Construction of sediment basins, drainage channels, and drainage devices.
- Revegetation.

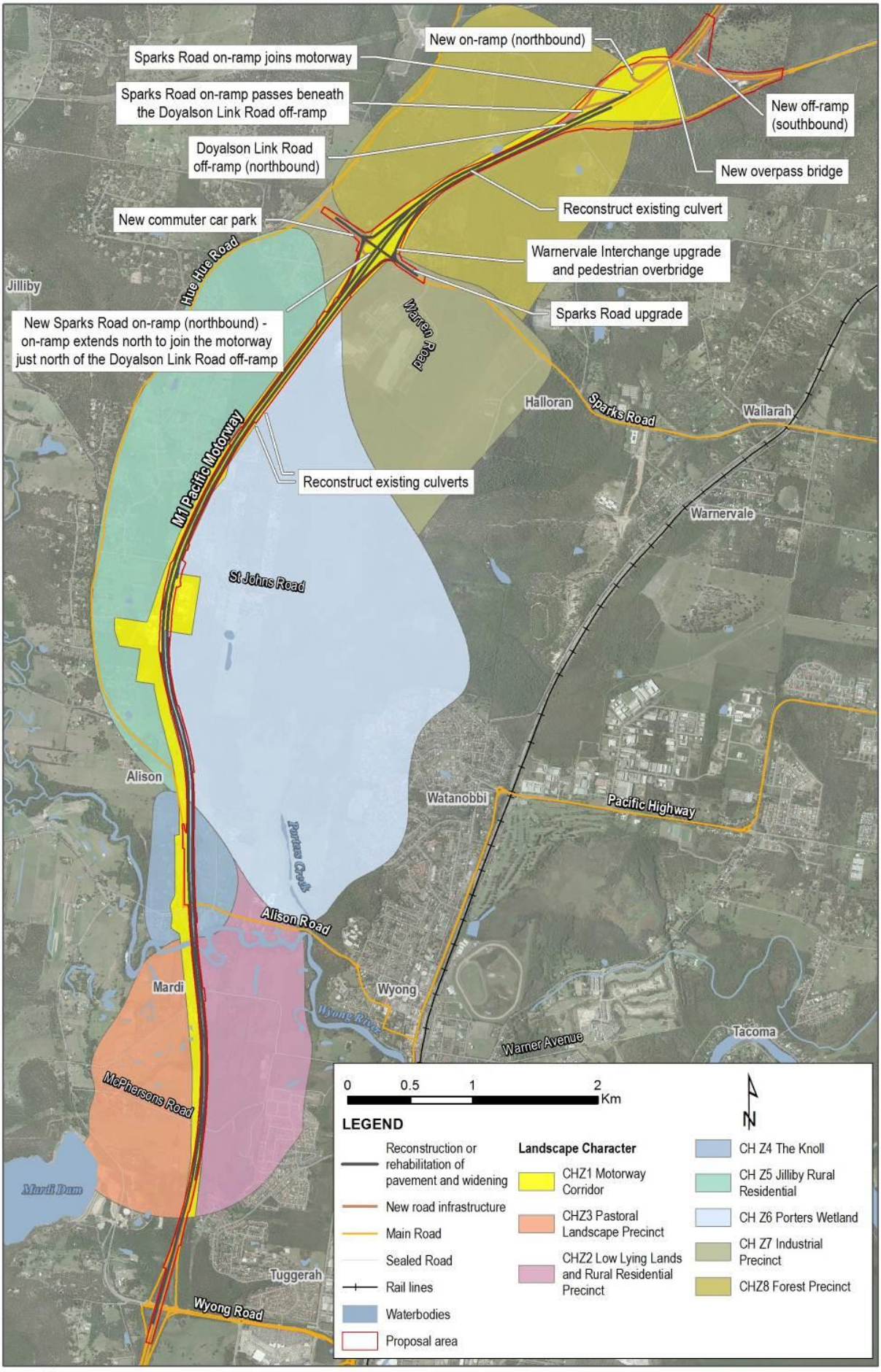


Figure 6.6 Landscape Character Zones

Landscape character and visual assessment matrix

In assessing the landscape character and visual impacts of the motorway corridor, it is important to assess the impacts on the place in terms of character and the vantage point. For character, it is the physical compositional change and its scale that is being assessed and a determination is made as to if the context can absorb it. For visual attributes, it is the view point or viewer which is being assessed, the sensitivity of the viewer to establish the degree and significance of the change, and an assessment of the need to mitigate a potential impact.

As part of this process an impact assessment matrix has been adopted by Roads and Maritime for the undertaking of landscape character and visual assessments (refer to Table 6-28). This was used to assess the potential impacts.

Table 6-28: Landscape Character and Visual Assessment Matrix

		Magnitude					
		High	Moderate - high	Moderate	Low - moderate	Low	Negligible
Sensitivity	High	High impact	High impact	Moderate - high	Moderate - high	Moderate	Negligible
	Moderate - high	High impact	Moderate - high	Moderate - high	Moderate	Moderate	Negligible
	Moderate	Moderate - high	Moderate - high	Moderate	Moderate	Moderate - low	Negligible
	Low - moderate	Moderate - high	Moderate	Moderate	Moderate - low	Moderate - low	Negligible
	Low	Moderate	Moderate	Moderate - low	Moderate - low	Low impact	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

6.7.3 Potential impacts

Landscape Character

Having characterised the alignment into eight landscape character zones including the corridor itself, the potential impact of the proposal on each character zone was ranked and the cumulative impact on sensitivity and magnitude was assessed.

The nature of the works, being predominantly an upgrade into the central median, combined with the assessment of the corridor as being its own distinct character zone with variable connection to the adjoining characters zones, has meant that the likely impacts to character zones would generally be low or negligible. Details of potential impacts to each of the landscape character zones are provided in Appendix I. A summary of the assessment is presented in Table 6-29.

Table 6-29: Summary of landscape character assessment

Character zone	Sensitivity	Magnitude	Impact
Zone 1	Low- moderate	Moderate	Moderate
Zone 2	Low- moderate	Low	Low- moderate
Zone 3	Low- moderate	Low	Low- moderate
Zone 4	Low	Low	Low
Zone 5	Low	Low	Low
Zone 6	Low	Negligible	Negligible
Zone 7	Negligible	Negligible	Negligible
Zone 8	Negligible	Negligible	Negligible

The greatest impact of the proposal to landscape character is to the users of the motorway corridor itself. Motorists would experience a moderate change in character as the road changes in scale with the addition of a new lane in either direction, median width is reduced and vegetation cover is reduced.

The character zones adjoining the motorway generally would experience minimal impact as either a sizeable buffer exists between the proposal and the character zone or because the land use of the character zone is relatively immune from the changes in road form, such as the industrial land uses.

In zones where screening or the ability to screen is relatively constrained, the loss of vegetation would result in a reduced definition of the character zones boundary and increased exposure to the motorway corridor.

Visual impact

Visual envelope map

The extent from which the proposal area is visible from adjoining areas varies along the proposal length. Visibility of the proposal is influenced by topography, vegetation, buildings and land use patterns. A field and desktop assessment was undertaken to determine the areas from where the proposal would be visible. These areas are defined as the Visual Envelope Map (VEM) (refer to Figure 6-7).

Key viewpoints

Within the VEM, key viewpoints or groups of viewpoints have been identified. This involved the analysis of views from the motorway to identify the extent to which houses and other buildings were visible. The analysis provided an indication of the likely level of visibility from places around the proposal area.

A review of roads adjoining the corridor and any significant vantage points which may offer the opportunity to view the site from a distance were reviewed. This was limited to a view of field within two kilometres of the road because the likely impact beyond that distance would be negligible.

Table 6-30 provides a summary of the predicted visual impacts that would form the proposal elements at each of the key viewpoints.

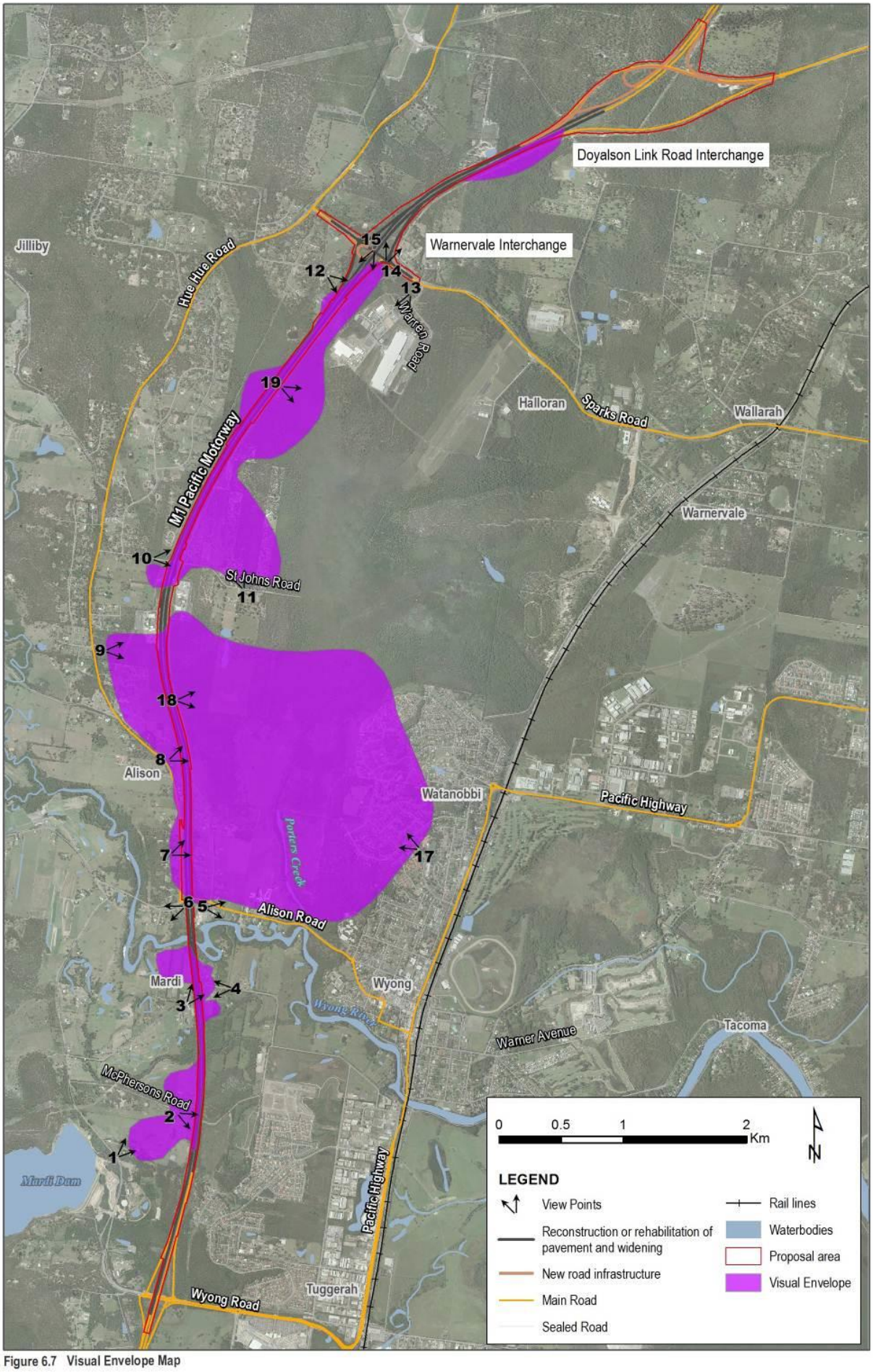


Figure 6.7 Visual Envelope Map

Table 6-30: Visual impact assessment

Key viewpoint	Views	Sensitivity	Magnitude	Impact
VPT1 Old Maitland Road	Distant views from about 850 m and elevation of 30 m across open paddocks from road alignment (refer to Appendix I Figure 25). Vegetation along motorways edge terminates views and restricts visibility to glimpses.	Low	Low	The visual impact here is considered to be low, as a result of the existing vegetation buffer between the area of works and the viewpoint, and the distance from works.
VPT2 McPherson Road	The underpass forms the dominant view from the road as a distinct tree lined avenue exists to either side of McPherson Road. Adjacent to the underpass and to the north are two rural residential properties, (refer to Appendix I Figure 26). These properties are in close proximity to the alignment being within 50 m and 125 m of the motorway corridor.	Moderate	Moderate	The close proximity of houses to the motorway, combined with only partial screening, which may be impacted by the works, mean that the view point is both sensitive to the proposed changes and that the change could be relatively high if screen planting is impacted. Consequently the viewpoint has been assessed as having a moderate to high impact.
VPT3 Collies Lane	Along Collies Lane views are limited approaching the motorway (refer to Appendix I, Figure 27). The valley has open views as the area has been cleared for rural residential and horse studs. Two Individual properties are in close proximity to the alignment lying between 60 and 80 metres from the boundary. Both have some vegetation within their property assisting in separation from the road corridor.	Moderate	Moderate	The close proximity of houses to the motorway, combined with the potential to impact screening vegetation, mean that the view point is both sensitive to the proposed changes. The presence of screening beyond the motorway mitigates against the magnitude of this change and so the magnitude of change has been assessed as moderate. Consequently the viewpoint has been assessed as having a moderate impact.
VPT4 Mardi Road	Mardi Road runs at 90 degrees to the motorway and terminates just outside the road corridor (refer to Appendix I Figure 28). Three individual rural residential properties are in close proximity to the motorway lying between 50 and 100 m of it.	Moderate to High	Moderate	The close proximity of houses to the motorway, combined with only partial screening, which may be impacted by the works, mean that the view point is sensitive to the proposed changes. The

Key viewpoint	Views	Sensitivity	Magnitude	Impact
	Residential plantings provide some screening of the alignment as does planting within the corridor verge. Traffic can be viewed on the alignment from the eastern end of the alignment up to 500 m away.			change would only be moderate due to the partial nature of the vegetation screening which presently exists. The site as a result has been assessed as having a moderate to high impact.
VPT5 and VPT6 Alison Road	Alison Road is an overpass road which provides a vantage point with views both up and down the motorway (refer to Appendix I, Figure 29). There are a number of buildings in the vicinity including the Cheese factory which supports an associated tourism industry. These buildings look down towards Wyong Creek and the motorway. A cottage looks down onto the motorway and is visible from the Alison Road. North of Alison Road is Alison Homestead a heritage cottage which is screened by vegetation within the corridor verge.	Low to Moderate	Moderate	Properties located around Alison Road are generally off set some distance from the motorway. They are screened either partially or fully from the corridor and have it as a mid to distant view. The scale of change proposed by the works, primarily the removal of median vegetation has the potential to increase the visibility of the road pavement. The culmination of these two impacts is considered to be moderate.
VPT 7 Hue Hue Road at Allison Road	Hue Hue Roads cuts around the edge of a knoll between the motorway and adjacent properties at a nominal elevation of 30 m above the motorway (refer to Appendix I, Figure 30). Rural residential properties are set within a wooded landscape. The elevated position of Hue Hue Road and the adjoining properties provides views down to the motorway and into the cut over a distance of 100 m.	Moderate	Low to moderate	The presence of residential properties with views of the motorway increases the sensitivity to change. The distance from the corridor and the presence of vegetation between the house and corridor reduces this impact and so these properties have been assessed as moderately sensitive. The scale of change proposed would expose both carriageways to view due to the removal of median vegetation but this is to be reinstated. The culmination of the two assessment criteria would mean that there is a potential for a moderate impact from the works.
VPT8	Hue Hue Road runs parallel to the motorway. Between the	High	Moderate	The proximity of residences sees this

Key viewpoint	Views	Sensitivity	Magnitude	Impact
Emergency Cross over/ cut fill interface	motorway and Hue Hue Road are three properties, which overlook the motorway as it transitions from level to cut. The distance of the properties varies but ranges from 40 and 80 m. Some vegetation screening exists but provides only partial screening of the motorway.			viewpoint identified as being sensitive to change. The close proximity to the changes means that the magnitude of the changes is also of a moderate order. Resulting in a moderate to high visual impact.
VPT9 Jilliby	Hue Hue Roads follows the ridge line or just below it through this section at a nominal elevation of 30 m. Lands have been cleared creating a grassland landscape. Scattered trees and rural residential properties line the road (refer to Appendix I, Figure 32). The elevated position of the road provides views down to the motorway over a distance of 300 - 500 m. The nearest properties lie within 200-300 m of the motorway.	Low to Moderate	Low to Moderate	The visual impact is primarily influenced by its offset from the alignment and has been assessed to be low to moderate. A key influence here would be the impact on vegetation cover and its re-establishment/reinstatement.
VPT10 Brolga Way Peacock Avenue Holloway Drive	A woodland setting defines the area of Brolga Way and Peacock Avenue, (refer to Appendix I Figure 33). Vegetation to the east of the properties limits views of the motorway and service centre. Generally a 100 to 300 m buffer of planting along the interface between motorway and cleared property exists.	Low to negligible	Low to negligible	Visually the separation and screening that exists here means that the impacts of works within the alignment are low to negligible.
VPT11 St Johns Road	The motorway is visible approaching the underpass, with existing vegetation limiting the views. East of the alignment a number of land holdings are located on a small rise and overlook the motorway which is located on fill (refer to Appendix I Figure 34). The setting of these properties is open woodland which limits the visibility of traffic. These views range from 200-400 m.	Low to moderate	Low	Due to the level of screening and off set from the highway it is considered that the impact would be low – moderate.
VPT12 Buttonderry Way	Properties back onto the off -ramp at Sparks Road (refer to Appendix I Figure 35). Views are filtered by woodland vegetation and an off set of between 90–100 m. Some	Moderate to Low	Low	The proximity of residential properties with only partial screening of the alignment raises the sensitivity of this area. However the nature of works is

Key viewpoint	Views	Sensitivity	Magnitude	Impact
	properties however are still able to see traffic on the motorway.			minimal and so a low to moderate impact is anticipated.
VPT13, VPT 14 and VPT15 Sparks Road	Sparks Road is the next overpass over the motorway after Alison Road and provides an opportunity to view up and down the motorway (refer to Appendix I, Figure 36). To the East of Sparks Road – Warnervale Industrial Precinct is set some 150 m from the motorway and comprises large scale warehouse and factory developments.	Low	Low	The various land-uses in proximity to Sparks Road, limit the sensitivity of the site. The nature of the works is confined within the existing road corridor and so there is no significant change in visual attributes of the proposal. The impact in this area is considered to be low.
VPT16 Doyalson Link Road Interchange	Doyalson Link Road Interchange is set within a heavily wooded section of the road corridor. The land use is indicated as Transitional and industrial suggesting a change in character is planned. A rural residential property overlooks the interchange (refer to Appendix I, Figure 37). This is located at a distance of 1.1 km from the interchange.	Low	Low	The limited visibility to sensitive residential receptors along with a transitional landuse, have led to this area being assessed as of low visual impact.
VPT17 Watanobbi	Watanobbi is a suburban development to the north west of Wyong and is the main residential population which overlooks the motorway (refer to Appendix I, Figure 38). It is a distance of greater than 1.4 kilometres from the motorway and views can be gained from Weaver Crescent, Guardian Road and Britannia Way. These are distant views and are defined by the moving traffic on the motorway rather than the motorway itself. A high point of 47 m AHD is located at Cornet Park.	Low	Low	While a significant residential area the offset from the motorway means that the views are background views and that the change is relatively low when viewed from here. The visual impact is assessed as being low.
VPT18 and VPT19 Views from the motorway	The motorway provides both views along the road corridor but also to lands adjoining. For much of the motorway these are generally contained by both verge and median planting, landform in the form of cuttings also limits this. Median planting forms a near continuous planting which removes the opposite carriageway from view in most instances. The key opportunity to view lands adjoining the road corridor	Low	Low	The visual impact is considered to be low- moderate. This reflects the transitory nature of the viewers and the scale of construction.

Key viewpoint	Views	Sensitivity	Magnitude	Impact
	are essentially adjoining Porters Wetland (refer to Appendix I Figure 39), where the vegetation cover is relatively low and consequently does not obstruction the view of the landforms beyond.			
VPT20 Mardi	Located at the southernmost limits of the proposal area, parts of the suburb of Mardi are within 100 m of the proposal. Properties in Wolmers Crescent may have views, although vegetation forms a buffer and no views were evident from the public domain. Generally development is east of a ridge (up to 40 m in height) which limits views of the suburb from the motorway and also to the motorway from the residences.	Low	Low	This residential area like that of Watanobi is removed from the proposal, the impact of the proposed works from this viewpoint have been assessed as low.
VPT21 The M1 motorway	The visual impact within the motorway is relatively consistent for the length of the works, with the key change being the reduction in median width and subsequent removal/reduction in vegetation cover. When viewed by motorists the views are temporary and transitory. In addition to these key changes there are additional works at both Sparks Road and Doyalson Link Road Interchanges. Sparks Road represents the most significant change with an additional ramp added, and a pedestrian bridge. The changes are contained within the area of the bridge and are consistent with the context. At Doyalson Link Road Interchange, the alignment of the off ramp is changed bring it closer to the main alignment. The area is vegetated and ultimately would not represent a significant change in view from that which exists.	Low - moderate	Low - moderate	A low to moderate impact has been determined for the views along the proposal reflecting the scale of change and the ability to mitigate this.
Construction ancillary sites	In addition to the proposals impacts, there would be short term indirect impacts during construction related to ancillary sites, including construction site compounds, batch plants, concrete processing plant, soil disposal sites and associated construction	Temporary	Temporary	From a visual perspective the best compound areas are those which minimise exposure to residents or passing traffic. Consequently sites

Key viewpoint	Views	Sensitivity	Magnitude	Impact
	stockpiles. Construction site compounds would comprise offices and material lay-down areas and would be fenced and generally covered in hardstand. Offices would generally be prefabricated and material storage areas would include purpose built temporary structures as required. Construction site establishment would involve the placement of temporary concrete safety barriers and fencing to create a safe work zone.			located in areas zoned industrial provide the best opportunity for a compound site from a visual perspective. The impacts of compound sites are however short term and temporary in nature. The consideration of the impacts raised need to be viewed against this short term nature and appropriate measures made in the determination of the site and its configuration so that the impacts are minimised.

Visually the impacts of the proposal are generally of a low to moderate nature, with the greatest potential for change to the landscape character being at the southern section of the proposal up to St Johns Road. This reflects the land use of the area and proximity of residences.

A conservative approach in assessing potential impacts resulting from vegetation removal was undertaken. By implementing safeguards and management measures outlined in Section 6.7.4 visual impacts would be reduced and in some cases impacts may be avoided.

6.7.4 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential landscape and visual character impacts. These mitigation and management measures are identified in Table 6-31 and incorporated in the Environment Management measures in Section 6.17.

Table 6-31: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing

General reduction of landscape character and visual amenity	• Revegetation by planting or seeding of the median should be undertaken where median width permits.
	• An effective visual barrier should be created between the two carriageways where this is achievable.
	• Species used should be endemic and frangible.
	• Key locations where median screening plays an important role and should be provided include:
	  • On sweeping curves to combat glare from headlights.
	  • Just north of Alison Road where the alignment is over looked by a number of properties.
	  • Between the two motorway service centres.
	• Revegetation on the verges within the alignment corridor is to be undertaken to provide separation and screening from the motorway.
	• Protection, retention and enhancement of existing vegetation cover should be considered, in particular, at:
	  • McPherson Road
	  • Collies Lane
	  • Mardi Road
	  • Alison Road
		Detailed design
		
		Roads and Maritime
		
		Construction contractor
			Pre-construction
			
			Construction

Impact	Environmental safeguards	Responsibility	Timing
	• Hue Hue Road • St Johns Road.		
Consistency with built form	• Design of the pedestrian bridge at Sparks Road should consider the approaches of the Urban Design Strategy including the following key issues: • Pier form and spacing • Superstructure depth and relationship to existing bridge structure • Throw screens and the need for consistency of form with existing throw screens along the corridor.	Detailed design Roads and Maritime	Pre-construction

6.8 Biodiversity

A biodiversity technical study was undertaken for the proposal. A complete copy of the study is available in Appendix H, and a summary is provided below.

For the purposes of the biodiversity assessment, the proposal area refers to those areas that would be directly impacted during construction including proposed locations of construction ancillary sites. The study area refers to a wider area that has been investigated to identify and assess the potential direct and indirect impacts of the proposal.

6.8.1 Existing environment

For the majority of the proposal area, the central median is vegetated and the side verges are cleared to within about 5-10 metres of the motorway. The extent of this cleared area changes along the length of the proposal.

There are six existing twin bridges and four overbridges along the proposal length. Riparian vegetation is present around bridge structures providing connectivity corridors for fauna.

Flora

Based on database search results, 22 flora species have been recorded within 10 kilometres of the proposal area, of which 21 are listed under the TSC Act and 19 under the EPBC Act. Using a risk based approach of the likelihood of occurrence, the study area is considered to provide suitable habitat for 10 of these species.

Species that have a medium to high chance of occurring within the study area include: *Acacia bynoeana (*Bynoe's wattle*), Angophora inopina (*Charmhaven apple*), Cryptostylis hunteriana (*leafless tongue-orchid*), Eucalyptus parramattensis subsp. parramattensis (*TSC only, population*), Melaleuca biconvexa (*biconvexa paperbark*), Prostanthera junonis (*Somersby mintbush*), Rutidosis heterogama (*heath wrinklewort*), Tetratheca juncea (*black-eyed susan*) and Thelymitra sp. adorata (*Wyong sun orchid*)*.

No threatened flora species were observed within the proposal area during site surveys. However, reliable records of *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* indicate their presence within the proposal area.

Six exotic species listed in Wyong Shire under the *Noxious Weeds Act 1993* were identified within the proposal area during the autumn 2013 field survey. ESU sites 2b, 3b, 10, 11 and 12 had noxious weeds present which generally indicates a presence of noxious weeds throughout the proposal area.

The identified exotic species in the proposal area include *Pennisetum macrorum* (African feather grass), *Ageratina adenophora* (crofton weed), *Asparagus asparagoides* (bridal creeper) *Lantana camara* (lantana), *Rubus fruticosus* (blackberry) and *Cortaderia selloana* (pampas grass). Four additional identified weed species; lantana, bridal creeper, blackberry and *Senecio madagascariensis* (fireweed), are listed as weeds of national significance (WoNS).

Vegetation communities

Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) (Somerville, 2009) mapping revealed seven LHCCREMS plant communities within the study area. Roadside vegetation consists mainly of cleared, disturbed vegetation, Wyong paperbark Swamp Forest, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum – Ironbark Forest and some Alluvial Tall Moist Forest (refer to Appendix H Figures 4 and 5).

Wyong City Council mapping (2002) revealed the study area is comprised primarily of a combination wet sclerophyll forest, dry sclerophyll forest and forested wetlands. Eight Wyong plant communities exist within the construction footprint, with three potential endangered ecological communities (EECs); Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF), River Flat Eucalypt Forest on Coastal Floodplains (RFEFCF) and Lower Hunter Spotted Gum Ironbark Forest (LHSGIF). Refer to Appendix H, Figure 6 and Figure 7.

The majority of roadside vegetation comprises disturbed vegetation, disturbed regrowth or the Wyong plant community Narrabeen Dooralong Spotted Gum-Ironbark Forest. Adjacent to the proposal area are freshwater wetlands of the Wyong community Alluvial Floodplain Swamp Paperbark thicket (refer to Appendix H, Figures 6 and 7).

Survey results

Seven vegetation communities were identified within the proposal area and all are listed as locally significant in Wyong Shire (refer to Appendix H Figure 8 and Figure 9). These vegetation communities are:

- Smooth-barked Apple - Turpentine - Blackbutt open forest on ranges of the Central Coast.
- Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast.
- Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands.
- Smooth-barked Apple open forest on coastal lowlands of the Central Coast.
- Paperbarks - Woollybutt swamp forest on coastal lowlands of the Central Coast.
- Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast
- Alluvial Tall Moist Forest.

Nine vegetation communities of local significance for Wyong Shire were identified within the wider study area. These are:

- Narrabeen Coastal Blackbutt Shrubby Forest
- Narrabeen Dooralong Spotted Gum-Ironbark Forest
- Narrabeen Buttonderry Footslopes Forest
- Narrabeen Coastal Sheltered Peppermint-Apple Forest
- Alluvial Woollybutt-Melaleuca Sedge Forest
- Coastal Sand Bangalay Paperbark Forest
- Alluvial Redgum Footslopes Forest
- Riverine Alluvial Gallery Rainforest-Moist Forest
- Alluvial Riparian Blackbutt Forest.

Three ecological communities listed under the TSC Act as endangered were identified within the proposal area (refer to Figure 6-8). These are:

- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (SSFCF).

- River Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (RFEFCF).
- Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion (LHSGIF).

Coastal wetlands

SEPP 14 aims to protect and preserve coastal wetlands in the environmental and economic interests of the State. While coastal wetlands covered under SEPP 14 have been mapped adjacent to the M1 Pacific Motorway, there are obvious inconsistencies with the mapping as it currently extends across part of the existing motorway. The Paperbark Swamp vegetation adjacent to the roadside is within 2-3 metres from the road shoulder of the northbound lanes and at least 10 metres from the road shoulder of the southbound lanes, outside the proposal area. As such, the proposal is not expected to impact SEPP 14 Coastal Wetlands.

Detailed discussion of SEPP 14 with regard to the proposal is presented in Section 4.1.2.

Fauna

Thirty-nine threatened fauna species were recorded within 10 kilometres of the proposal area, of which 37 are listed under the TSC Act and 18 under the EPBC Act (refer to Appendix 3 of Appendix H). Using a risk based approach the likelihood of occurrence of these species within the proposal area was assessed. The proposal area was assessed to provide suitable habitat and availability of resources for 21 of these fauna species.

Species that have a medium to high chance of occurring within the proposal area include: *Crinia tinnula* (wallum froglet), *Anthochaera phrygia* (regent honeyeater), *Calyptorhynchus lathami* (glossy black-cockatoo), *Daphoenositta chrysoptera* (varied sittella), *Glossopsitta pusilla* (little lorikeet), *Grantiella picta* (painted honeyeater), *Hieraaetus morphnoides* (little eagle), *Lathamus discolour* (swift parrot), *Ninox strenua* (powerful owl), *Tyto novaehollandiae* (masked owl), *Falsistrellus tasmaniensis* (eastern false pipistrelle), *Miniopterus australis* (little bentwing-bat), *Miniopterus schreibersii oceanensis* (eastern bentwing-bat), *Mormopterus norfolkensis* (eastern freetail-bat), *Petaurus norfolcensis* (squirrel glider), *Phascolarctos cinereus* (koala), *Potorous tridactylus tridactylus* (long-nosed potoroo), *Pseudomys novaehollandiae* (new Holland mouse), *Pteropus poliocephalus* (grey-headed flying-fox), *Saccolaimus flaviventris* (yellow-bellied Sheathtail bat) and *Scoteanax rueppellii* (greater broad-nosed bat).

Potential koala habitat as defined under SEPP 44 was recorded within the surveyed area (refer to Figure 6-10). One eucalypt species *Eucalyptus robusta* (Swamp Mahogany) listed as a koala feed tree under Schedule 2 of SEPP 44 was recorded on the Hue Hue Road proposed construction ancillary site and just outside of the proposal area north west of the Warnervale Interchange. In these locations the species comprised about 15 per cent of the vegetation.

There were no records of any fish species occurring in the Wyong LGA that are listed as threatened under the FM Act.

No threatened fauna species were observed during the surveys.

Wildlife connectivity and habitat fragmentation

Within the proposal area, there are areas of vegetation including EECs, remnant vegetation and riparian vegetation that form part of ecological corridors in the region (refer to Figure 6-11).

The existing M1 Pacific Motorway is a permanent barrier to connectivity and dispersion for a number of ground dwelling and arboreal fauna species. However,

connectivity still exists in some areas, as vegetation in the median would act as a refuge for fauna dispersing or moving across the motorway. Existing box culverts running beneath the motorway could also potentially support some cross motorway movement of fauna.

Existing road bridges cross over the motorway and provide connections to ecological corridors of riparian vegetation located on either side of the motorway. These bridges potentially provide for east-west movement of fauna across the proposal area.

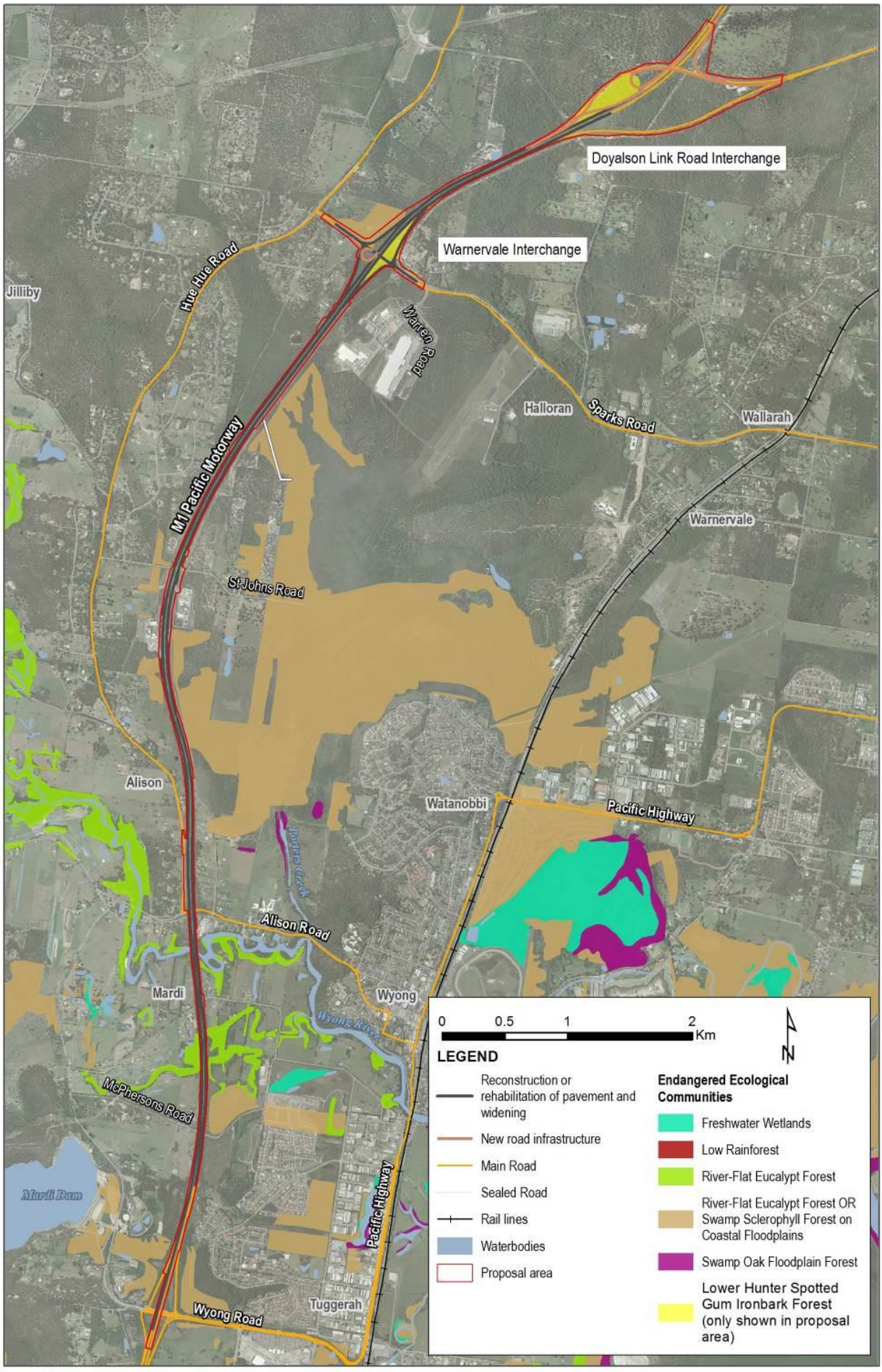


Figure 6.8 Distribution and condition of endangered ecological communities

6.8.2 Methodology

The biodiversity assessment was undertaken to determine the potential impacts on threatened flora, fauna and ecological communities within the study area.

Database searches and literature reviews

Desktop research was undertaken prior to the commencement of field surveys and included database searches and a review of relevant literature to determine if targeted surveys for specific species were required. These searches served to identify threatened biota known or likely to occur in the study area.

The following databases and resources were interrogated:

- NSW OEH Atlas of NSW Wildlife Database within a 10 kilometre buffer of the proposal area.
- Protected Matters Report which documents all matters of National Environmental Significance (MNES) within 10 kilometres of site. MNES include threatened species, communities and migratory species which are listed under the Commonwealth EPBC Act (Department of Sustainability, Environment, Water, Population and Communities).
- NSW Flora Online Search – Rare or Threatened Australian Plants (ROTAP) species (The Royal Botanic Gardens and Domain Trust, 2011).
- Department of Primary Industry – Fishing and Aquaculture: Threatened and Protected Species, Wyong LGA (DPI, 2013a).
- Vegetation Types Database, Vegetation Benchmarks Database Threatened Species Profile Database (OEH, 2012).
- Wyong vegetation mapping (Somerville, 2009; Bell, 2008).
- NSW Department of Primary Industries Noxious Weeds List (DPI, 2013b).
- Ecological investigation, [former] RTA project, intersection of Sparks Road and the F3 Freeway, Halloran (Lesryk Environmental Consultants, 2010).

Field survey

Based on desktop and on-ground assessment, a terrestrial flora and fauna habitat assessment of the study area was conducted on 17–18 April 2013, 22 May 2013, 5–6 June 2013 and 7 March 2014, targeting threatened species that occurred, or were likely to occur, within the proposal area.

The survey design applies the method of ecological sampling units (ESUs) to avoid the need to undertake full coverage surveys in locations that are not comprised of remnant native vegetation, or where access is limited due to safety risks.

ESUs are sections of the proposal area stratified by habitat type and delineated to sample all habitat types. Twelve survey sites within the proposal area were surveyed around the proposal area (refer to Figure 6-9). Each survey site was divided into specific ESUs based on habitat type, and surveyed using either a rapid assessment or comprehensive plot assessment techniques.

To determine the floristic diversity and vegetation cover throughout the proposal area rapid assessments were conducted of most survey sites, particularly in cleared or highly disturbed sites. Areas that potentially contain an EEC, based on interrogation of existing vegetation mapping of the area (Bell, 2008), were subjected to a more intensive plot survey.

For survey sites 1, 4, 5, 6, 7b, 8, 9 and 11, a rapid assessment survey was undertaken. For each of these ESUs, the random meander technique was used to target threatened species throughout each site. Rapid assessment surveys were

carried out during the random meander of the site, with the cover and abundance of the three most dominant species in each stratum (top, mid and under-storey levels) recorded.

For survey sites 2, 3, 7a, 7c, 7d, 7e and 10, a 20 x 20 metre plot survey was undertaken. Due to constraints in the width of the plots within the motorway central median, a 10 x 50 metre plot survey was conducted for Site 12. These assessments included a complete survey of all species encountered within the plot. The random meander technique of the whole site was used to target threatened species.

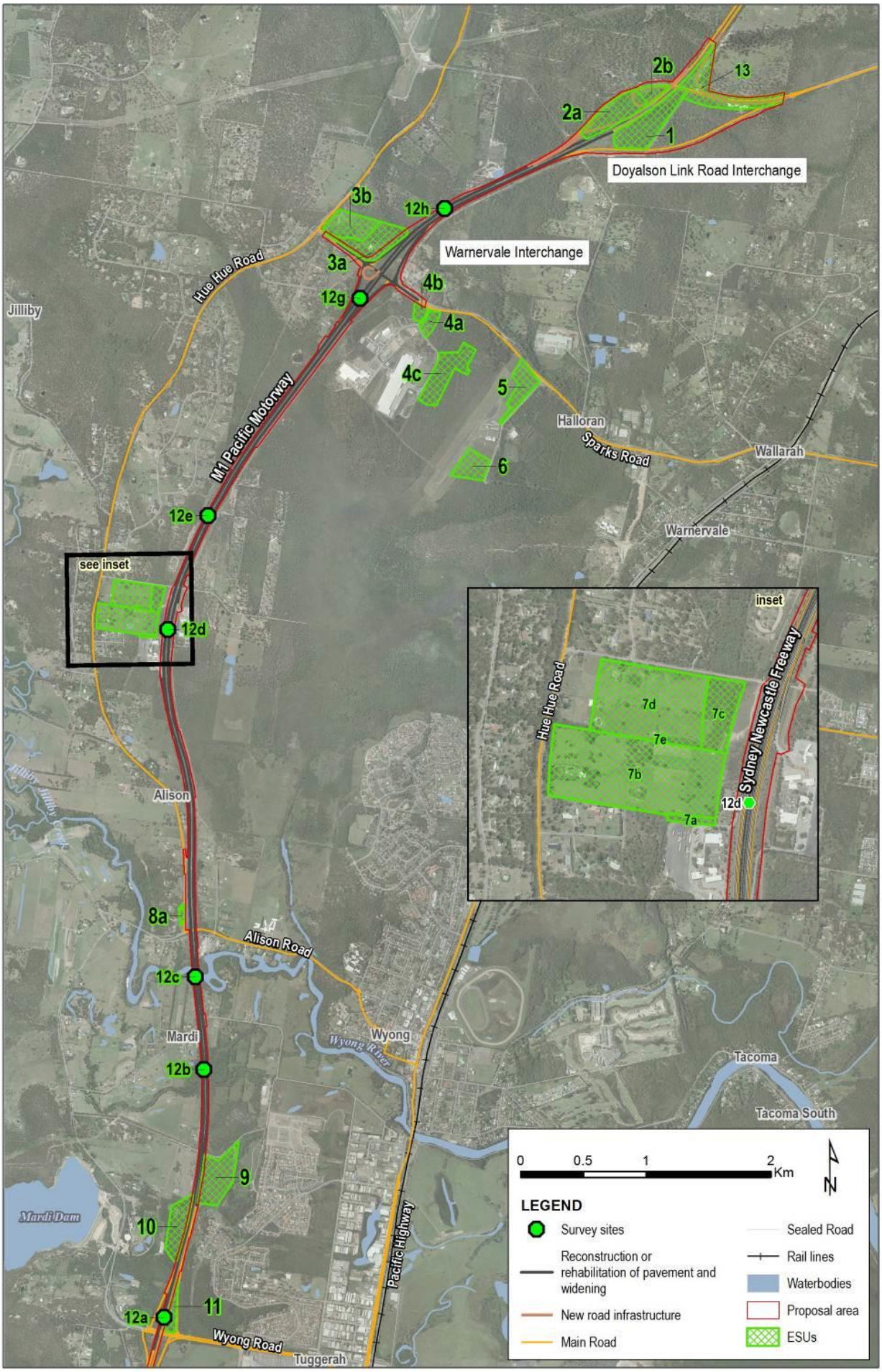


Figure 6.9 Ecological sampling units (ESUs) within the study area

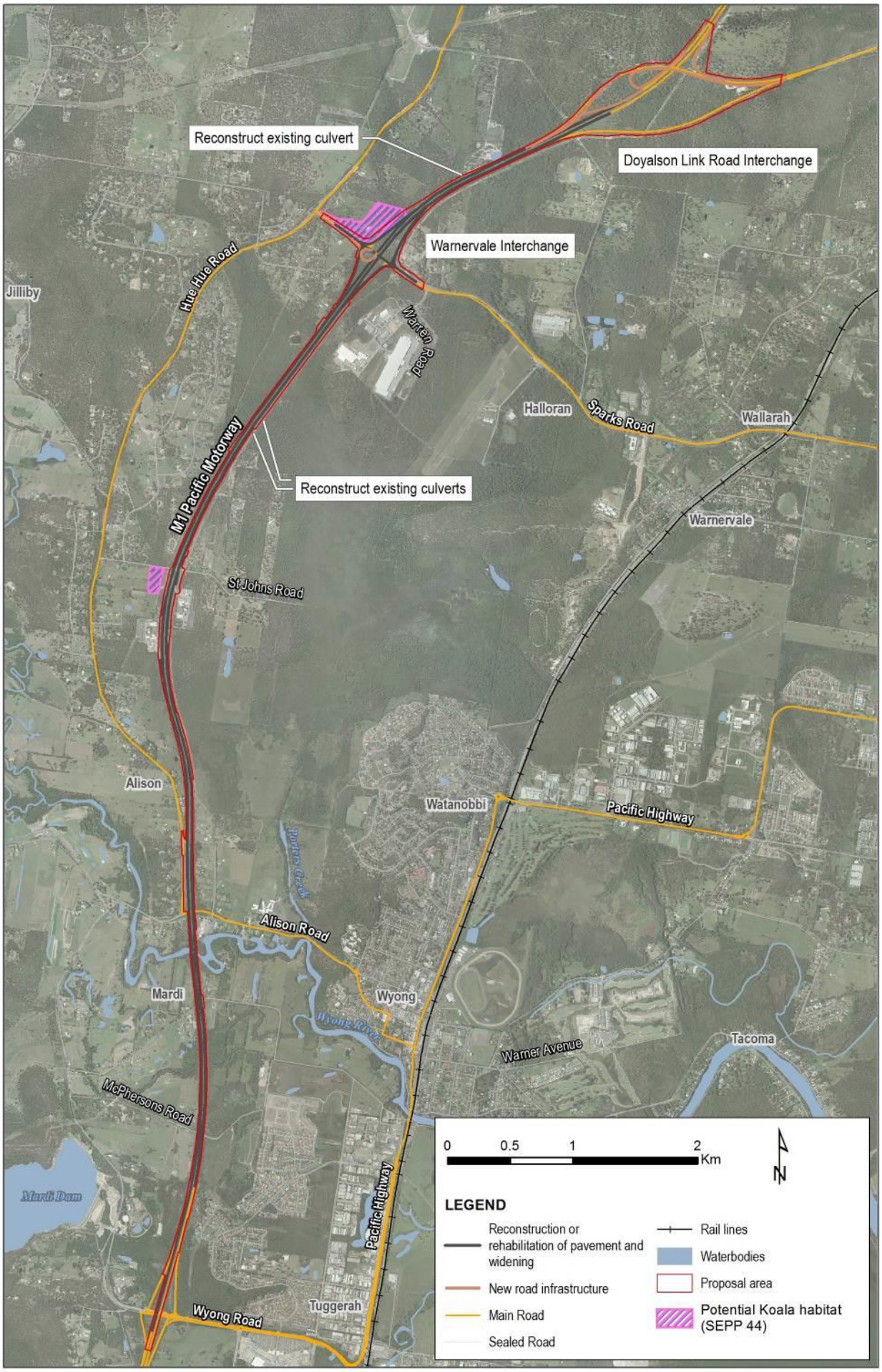


Figure 6.10 Potential Koala habitat

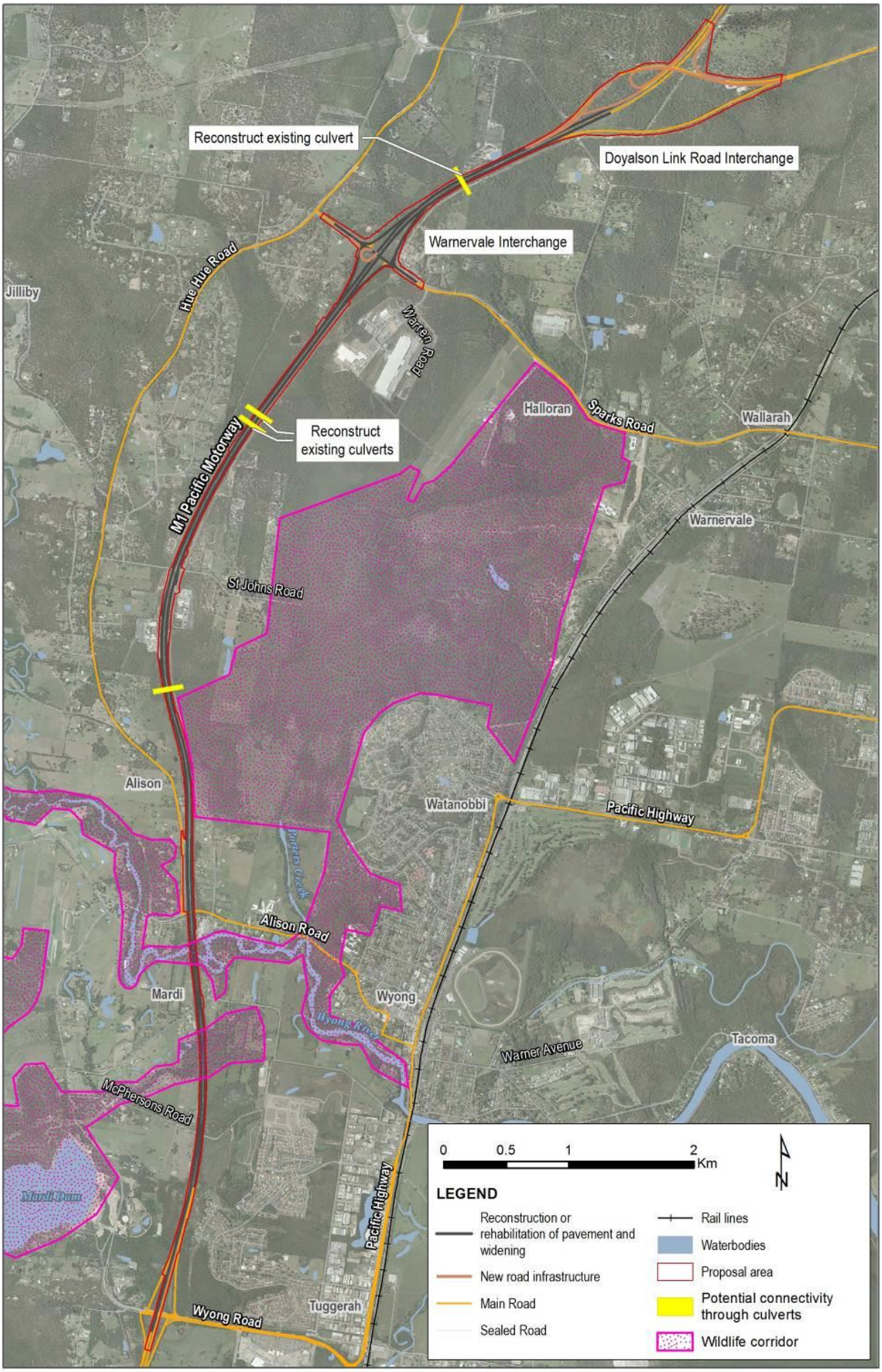


Figure 6.11 Wildlife connectivity and corridors

6.8.3 Potential impacts

Loss of vegetation and habitat

Potential impacts due to clearing of vegetation and habitat to facilitate the proposal would include the loss of vegetation/habitat, restriction of wildlife movement, loss of wildlife corridor connectivity, fauna injury or mortality, the spread of weeds, pests and pathogens.

In total, the proposal is expected to require the clearing of up to 18 hectares of native vegetation, including about 5.5 hectares of EEC. The individual clearing areas are provided in Table 6-32 for each of the communities affected.

Table 6-32: Summary of vegetation clearing for the proposal

Vegetation community (Bell 2008)	TSC Act listed	EPBC Act listed	Area to be cleared
Alluvial Bluegum-Paperbark Mesic Palm Forest	Yes	No	0.02 ha
Alluvial Redgum Footslopes Forest	Yes	No	0.66 ha
Alluvial Woollybutt-Melaleuca Sedge Forest	Yes	No	1.45 ha
Narrabeen Buttonderry Footslopes Forest	No	No	4.43 ha
Narrabeen Coastal Blackbutt Shrubby Forest	No	No	0.34 ha
Narrabeen Dooralong Spotted Gum Ironbark Forest	Yes	No	4.6 ha (3.4 ha EEC)
Narrabeen Doyalson Coastal Woodland	No	No	0.41 ha
Disturbed (canopy only)	-	-	5.64 ha
Disturbed (regrowth)	-	-	0.25 ha

Ancillary sites

Site biodiversity surveys have assisted in the selection and refinement of suitable areas considered for potential ancillary sites. Constraints such as EECs, locally significant vegetation communities and potential core koala habitat have been considered in the site suitability decision making. No clearing of mature vegetation would be undertaken on proposed construction ancillary sites.

Some of these proposed ancillary sites contain sensitive areas including sensitive vegetation and vegetation communities that could be impacted by the proposal if they were not protected during construction. Refer to Figure 6-12 and Figure 6-13 for proposed construction exclusion zones to prevent inadvertent impacts on these ecological values.

The proposed Warren Road ancillary site is indicated in vegetation mapping sources to contain an important vegetation community. Aerial photographs also show this site to be covered by vegetation. However on inspection this site was found to be completely cleared of vegetation.

Road side verge

Along the majority of the proposal area, the road side verge is cleared within about 5-10 metres of the motorway. Although the widening and replacement works are

generally confined to the central median and existing pavement footprint, the proposal would result in loss of some vegetation along the road verge in order to provide construction access. These comprise mostly non-EEC native vegetation communities.

There are some important areas of land containing sensitive or mature vegetation along the road side verges that would need to be retained and protected during construction. These areas are shown in Figure 6-12 and Figure 6-13.

Riparian vegetation would not be disturbed due to the retention of bridge structures in the proposal design. This riparian vegetation contains good quality habitat that would continue to act as a wildlife corridor for squirrel gliders and other fauna species. No construction phase temporary waterway crossings would be required.

Central median

The vegetation in the central median is native vegetation, however it is highly disturbed and weed infested. Removal of the central median vegetation for the purposes of the proposal is not expected to result in any substantial impacts.

The existing motorway is a barrier to most fauna movement, with median vegetation potentially facilitating movement of gliders and some bird and bat species. The motorway widening would result in loss of all vegetation within the existing median of the proposal area.

The existing median contains largely immature trees that are not of sufficient height to facilitate movement of gliders. Bird and bat species are highly mobile and unlikely to be impeded by the removal of median vegetation.

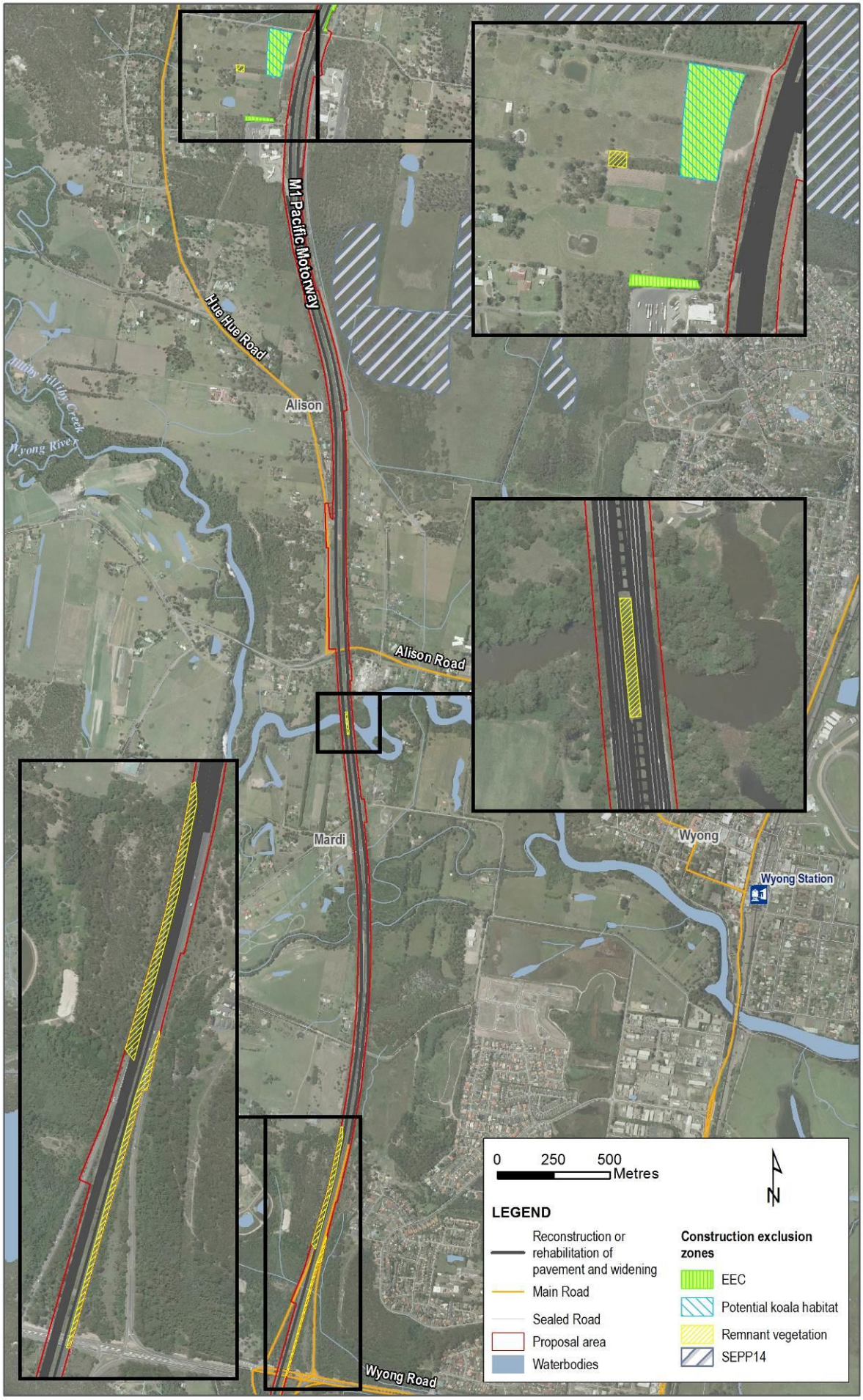


Figure 6.12 Construction exclusion zones within study area based on flora and fauna habitat surveys - southern section

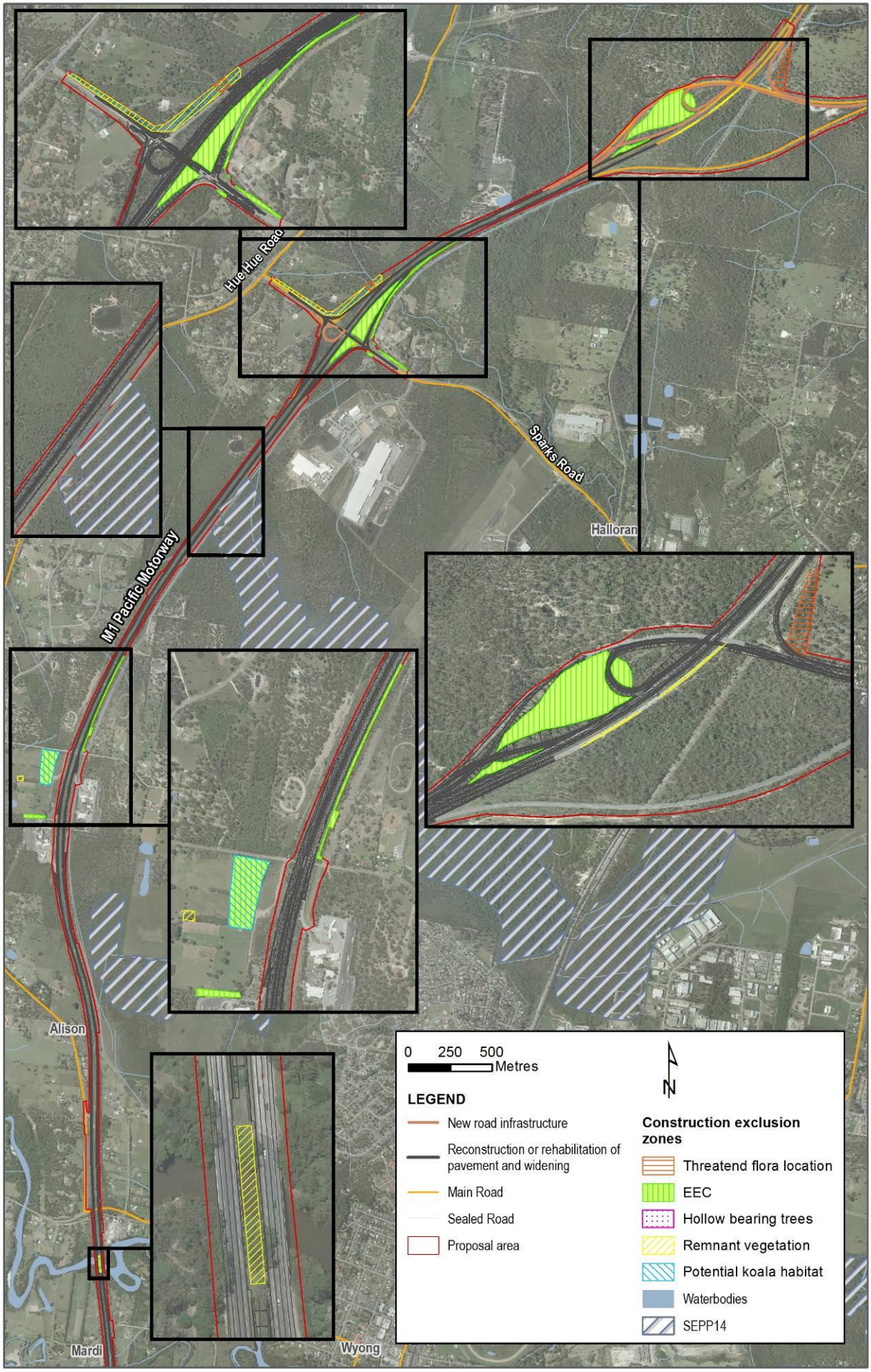


Figure 6.13 Construction exclusion areas within study area based on flora and fauna habitat surveys - north

SEPP14 wetlands

The proposal is located in the vicinity of the mapped SEPP 14 wetlands. The implications of SEPP 14 on the proposal are described in detail in Section 4.1.2.

The existing area mapped as SEPP 14 wetland within the proposal area is highly disturbed with the predominant wetland vegetation (Paperbark Swamp) generally more than 10 metres from the edge of the southbound carriageway. Within the proposal area, the roadside verge does not comprise any wetland vegetation or indications of waterlogging, seasonal inundation or other indications of a wetland environment. Notwithstanding the proposal would not clear any vegetation in any area mapped as SEPP 14 wetland. Construction exclusion zones provided in Figure 6-12 and Figure 6-13 show the mapped SEPP 14 wetland areas as construction exclusion zones to prevent any impact.

Motorway interchange and intersection works

Work associated with the Warnervale Interchange and the Doyalson Link Road Interchange would intersect areas of remnant vegetation, including locally significant communities and EECs. Impacts would include the loss of vegetation and habitat in these areas.

The upgrade of the Sparks Road Interchange would result in the loss of about one hectare of previously disturbed dry sclerophyll forest vegetation including about 0.7 hectares of LHSGIF, an EEC. Removal of this vegetation would be required to construct a new pedestrian bridge over the motorway and to upgrade the southbound motorway off ramp to provide for an additional turning lane.

There are reliable records from the OEH Wildlife Atlas of the vulnerable *Grevillea parviflora* subsp. *parviflora* that show it to be located near the Sparks Road northbound motorway on ramp. Actual occurrence of this species was unable to be confirmed during field surveys. Survey during flowering season prior to construction would identify the presence or absence of this species. If identified it would be protected from construction disturbance to avoid impact, where reasonably practicable. Where individuals are identified that would be unavoidably affected by the proposal, consideration would be given to translocating in consultation with OEH.

Several mature potential hollow bearing trees are present within the vicinity of the Warnervale Interchange and these would be retained where possible.

An area between the northbound motorway carriageway and the Doyalson Road Interchange northbound off ramp would be partially cleared for the proposal. This would result in the loss of about 2.7 hectares of moderate to good quality LHSGIF. This vegetation community is considered to meet the definition of Lower Hunter Spotted Gum Ironbark Forest EEC.

No threatened flora or fauna were identified within this area, however at the proposed Doyalson Link Road southbound motorway off ramp there are reliable records from the OEH Wildlife Atlas of the vulnerable species *Tetratheca juncea*. The actual occurrence of *Tetratheca juncea* could not be confirmed during field surveys. Survey during flowering season prior to construction would need to be undertaken to identify any individuals of *Tetratheca juncea* near/in the proposal area. Some individuals may need to be removed by the proposal where they lie within the proposed footprint of the new southbound off ramp. Consideration would be given to translocating these individuals in consultation with OEH. Where individuals are identified outside of the footprint they would be protected and disturbance avoided during construction.

Wildlife connectivity and habitat fragmentation

The proposal would result in complete removal of vegetation in the median which would present a further barrier to connectivity and dispersion for a number of ground

dwelling and arboreal fauna species. However as discussed in Section 6.8.1, median vegetation is not considered to provide good corridor connectivity in its current form, and as such impacts are not anticipated to increase as a result of the proposal.

The proposal does not involve alterations to the major existing bridge structures, does not include any works within waterways, nor alterations to waterway crossings. As such the proposal is unlikely to result in adverse impacts on the connectivity of these existing ecological corridors.

Koala habitat

SEPP 44 provides for the protection of core koala habitat, with evidence of koala usage, or areas of native potential habitat. Core koala habitat is defined by the Policy as 'an area of land with a resident population of koalas, evidenced by attributes such as breeding females'.

Despite having the potential to occur, there is no evidence to suggest a resident koala population exists within the proposal area. No individuals, or characteristic scratching or scats, were identified within the proposal area during the flora and fauna habitat survey. Koala habitat would not be cleared or otherwise affected as part of the proposal.

As such, it has been assessed that koalas and core koala habitat would not be impacted by the proposal.

Injury and mortality of wildlife

Vegetation clearance for the proposal may lead to incidences of fauna injury or mortality during the clearing process. Mitigation measures such as pre-clearance investigations by a qualified ecologist in accordance with the *Roads and Maritime Biodiversity Guidelines: Guide 1- Pre-clearing process for fauna rescue associated with road works* (RTA, 2011), as listed in Section 6.8.4 and Section 6.17, would reduce this risk to an acceptable level.

Removal of fauna habitat trees and reduction in habitat quality may also result in injury or mortality to wildlife. Injury or mortality may occur as a result of interactions with vehicles during dispersal and re-settlement of mobile fauna species.

Pests and pathogens

Two invasive mammals were detected within the proposal area. These were the European fox and rabbit. Habitat disturbance, land clearing and a reduction in structural diversity of vegetation as a result of the proposal may aid the spread of these pest species.

Although vegetation in the study area did not appear to be obviously affected by Myrtle rust, the proposal area is potentially contaminated. DPI has mapped Wyong Shire as a 'red' management zone, where the fungus is considered to be widely distributed. Myrtle rusts are serious pathogens which affect plants belonging to the family Myrtaceae including Australian natives like bottle brush (*Callistemon* spp.), tea tree (*Melaleuca* spp.) and eucalypts (*Eucalyptus* spp.). These occur in the proposal area. Infection of native plants by Myrtle rust can indirectly affect threatened fauna species through the loss of cover, food resources and nesting habitat.

Weed spread

The proposal has the potential to facilitate the movement of exotic weeds, including those declared noxious weeds under the *Noxious Weeds Act 1993*, during both construction and operation. Exotic weed species have the potential to impact on the biodiversity of the adjoining habitats and are known to reduce the ecological functioning of adjacent native communities, particularly EECs.

The proposal could facilitate the movement of weeds as a result of:

- The increase in human activity in ancillary sites and areas requiring clearing to facilitate construction.
- Machinery movements involved in construction.
- Removal of vegetation and disturbance of soil profiles.

Following completion of the proposal, there is the potential that weeds may establish within the proposal area and adjacent areas.

Significance assessments

Assessments of significance ('seven part tests') have been prepared for state-listed threatened biota, which have been recorded or have the potential to occur within the proposal area. This includes three threatened ecological communities, 21 threatened fauna species and 10 threatened fauna species.

Full details of the seven part tests are included in Appendix H.

Assessments of significance pursuant to the Commonwealth *Significant Impact Guidelines 1.1* (DEWHA, 2009) have been prepared for MNES with the potential to occur within the proposal footprint. This includes four threatened fauna species and four threatened flora species.

These assessments were undertaken with the following provisions taken into account:

- The road widening would result in the loss of about 18 hectares of native vegetation, comprising:
    - About 1.5 hectares within the central median.
    - About 5.4 hectares along the motorway verges.
    - About 6.9 hectares at the Doyalson Link Road Interchange.
    - About 4.2 hectares at the Warnervale Interchange.
- No vegetation clearing, other than of groundcover and undergrowth would be undertaken on proposed construction ancillary sites.

The assessments of significance concluded there is likely to be no species significantly impacted by the proposal under the TSC Act or EPBC Act provided the proposed mitigation measures and recommendations are implemented.

Key threatening processes

The following nine key threatening processes (KTPs) listed on the schedule of the TSC Act are considered relevant to the current proposal:

- Clearing of native vegetation.
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis.
- Invasion and establishment of exotic vines and scramblers.
- Invasion by native plant communities by exotic perennial grasses.
- Invasion, establishment and spread on lantana (*Lantana camara L. sens. lat*).
- Loss of hollow-bearing trees.
- Predation by the European Red Fox (*Vulpes vulpes)*.
- Removal of dead wood and dead trees.
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.

The proposal would have the potential for impacts through the above listed KTPs however given the disturbed nature of the existing motorway corridor it is evident that these are already occurring in the proposal area. The existing motorway has allowed for the introduction of pathogens, and has enabled a number of feral and exotic flora and fauna species to spread. The general degradation of native vegetation through edge effects has occurred in the proposal area.

It is not expected that the proposal would substantially facilitate these KTPs, though some impacts due to the proposed vegetation clearing and construction activities is likely.

Appropriate safeguards and management measures have been proposed in Section 6.8.4 to reduce the likelihood of the proposal facilitating these KTPs.

6.8.4 Safeguards and management measures

Mitigation and management measures would be implements to avoid, minimise or manage potential biodiversity impacts. These mitigation and management measures have been identified in Table 6-33 and incorporated in the Environment Management measures in Section 6.17.

Table 6-33: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
General construction impacts on flora and fauna	• Prepare a Flora and Fauna Management Plan, including weed management, and ensure that it is integrated with the landscape plan for the project. • Prepare a Vegetation Management Plan (VMP) detailing restoration, regeneration and rehabilitation of areas of native vegetation in the vicinity of the project. Preparation of the VMP should involve consultation with local Landcare groups and the CMA.	Construction contractor	Pre-construction
Risk to fauna in remnant vegetation to be removed or modified by the proposal	• Limit of work temporary fencing is to be established. • Pre-clearing processes are to be undertaken in accordance *Roads and Maritime Biodiversity Guidelines* (2011) and RMS Biodiversity Guidelines: Guide 4 - Clearing of vegetation and removal of bushrock (RTA, 2011). • A fauna relocation site would be identified prior to construction to release any uninjured fauna encountered on site.	Roads and Maritime	Pre-construction
Minimise impacts of the proposal on EECs and SEPP 14 wetlands	• Offsetting for impacts on EEC vegetation should be investigated in accordance with the Roads and Maritime Guideline for Biodiversity Offsets (2011). • Where possible, retain vegetation that contains EECs present in the proposal area and adjacent sites. • Exclusion zones detailed in Figure 6-12 and Figure 6-13 are to be established and maintained throughout construction. Ensure that exclusion zones are fenced off and signage erected in accordance with the RMS Biodiversity guidelines: Guide 2 – Exclusion Zones (RTA, 2011).	Roads and Maritime Construction contractor	Pre-construction
Maintenance of habitat corridor and wildlife connectivity	• The design of replacement box culverts would ensure that that they continue to be able to be used by fauna for movement across the motorway. • Culverts would be designed to facilitate opportunistic fauna crossing under the	Detailed design	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	M1 Motorway. • Construction of the proposal should be undertaken in accordance with *Roads and Maritime Wildlife Connectivity Guidelines* (2011).	Roads and Maritime Construction contractor	
Retention of native vegetation, habitat trees (including hollow bearing trees) and potential koala habitat	• Threatened flora present in the survey area would be protected and retained where possible. • Targeted surveys for *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* are to be undertaken by a qualified ecologist in appropriate flowering season to confirm threatened plant records at Doyalson Link Road Interchange, Sparks Road Interchange and within the road corridor between these two interchanges. • Where individuals of *Tetratheca juncea* or *Grevillea parviflora subsp. parviflora* are identified that would be unavoidably affected by the proposal, consideration would be given to translocating in consultation with OEH. • Where individuals of *Tetratheca juncea* or *Grevillea parviflora subsp. parviflora* are identified outside of the construction footprint they would be protected and disturbance avoided during construction. • In the event that unexpected threatened species are detected at the site prior to construction the RMS Unexpected Threatened Species Finds Procedure should be enacted (RTA, 2011) • During detailed design consideration is to be given to minimising, where possible, any vegetation clearance required as a result of the design. In particular, potential koala habitat should be avoided or the construction footprint locally minimised where avoidance cannot be achieved. • Retain and protect potential koala habitat from disturbance during construction. • Establish exclusion zones around remnant vegetation, habitat trees, water bodies and EEC to be retained to prevent inadvertent disturbance during	Detailed design Roads and Maritime Construction contractor Qualified ecologist	Pre-construction Construction

Impact	Environmental safeguards	Responsibility	Timing
	construction. • Vegetation that has been protected is not to be removed. • If native vegetation must be removed, wood debris and any bush rock encountered should be stockpiled for later re-use or relocation in appropriate environments following *Roads and Maritime Biodiversity Guidelines* (2011). • Construction access tracks and construction areas along the motorway verge should be sited to avoid or minimise disturbance of native vegetation. • There should be no clearing of any mature trees on construction ancillary sites.		
Site specific environmental induction	• All staff working on site are to undertake a site-specific environmental induction. The induction is to include items such as: - sensitivity of surrounding vegetation (particularly EECs, remnant and riparian vegetation) - site environmental procedures (vegetation management, sediment and erosion control protective fencing and noxious weeds) - what to do in case of emergency (chemical spills, fire or fauna encountered) - key contact in case of environmental incident. - details of threatened flora species and risk of myrtle rust.	Construction contractor Roads and Maritime	Pre-construction
Staged habitat removal	• Where possible, habitat trees and hollow bearing trees are to be retained throughout the proposal area. • If hollow bearing trees are unable to be retained, a qualified ecologist is to be present on-site for staged habitat removal and hollow clearing and must follow the Roads and Maritime Staged Habitat Removal Process.	Construction contractor Qualified ecologist	Construction
Minimise risk of establishment and spread of invasive species and disease	• The use of pesticides in weed control is to be minimised to reduce threat to fauna species. • Inspection and maintenance procedures are to be implemented to reduce the	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
due to the proposed development activities	carriage of weed material on machinery. • All pathogens (eg Chytrid, Myrtle Rust and Phytophthora) are to be managed in accordance with the *Roads and Maritime Biodiversity Guidelines - Guide 7 (Pathogen Management)* and DECC Statement of Intent 1: Infection of native plants by *Phytophthora cinnamomi* (for Phytophthora), DPI Myrtle rust response 2010–11: Preventing spread of Myrtle Rust in bushland and OEH Interim management plan for Myrtle rust in bushland (2011). • Declared noxious weeds are to be managed according to requirements under the *Noxious Weeds Act 1993* and Guide 6 (Weed Management) of the *Roads and Maritime Biodiversity Guidelines* (2011).		
Flora and fauna encountered	• If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the Unexpected Threatened Species Finds Procedure in the *Roads and Maritime Biodiversity Guidelines* – Guide 1 (Pre-clearing process). • WIRES is to be consulted if any injured fauna are encountered as outlined in site specific environmental inductions. • Fauna handling must be carried out in accordance with the requirements the *Roads and Maritime Biodiversity Guidelines* - Guide 9 (Fauna Handling).	Construction contractor	Construction
Re-establishment of any native vegetation disturbed or removed by the proposal	• Revegetate or replant disturbed areas with native vegetation following construction. • Revegetation and replanting is to be carried out following *Roads and Maritime Biodiversity Guidelines*.	Construction contractor	Post-construction

6.9 Aboriginal heritage

An Aboriginal Archaeological Survey Report for the proposal was prepared by AMBS. The report is attached in Appendix J. This section provides a summary of the findings from the report.

6.9.1 Existing environment

There are no Aboriginal heritage items or places listed on the National Heritage List, Commonwealth Heritage List, State Heritage Register, Roads and Maritime Section 170 register or the Wyong LEP within the proposal area or in its vicinity.

A search of the AHIMS database was undertaken on 26 February 2013, and again on 24 April 2014. 83 registered Aboriginal sites, as well as one Aboriginal Place, were identified within about three kilometres of the proposal area. The search results are summarised in Table 6-34.

Table 6-34: Summary of Aboriginal sites previously recorded near the proposal area

Site type	Number	Per cent
Open Camp Site	28	33.73
Isolated Find	18	21.69
Axe Grinding Grooves	14	16.87
Midden	4	4.82
Not an Aboriginal Site	3	3.61
Scarred Tree	3	3.61
Bora/Ceremonial	2	2.41
Shelter with Art	2	2.41
Potential Archaeological Deposit (PAD), Open	2	2.41
Quarry	1	1.20
Shelter with Deposit	1	1.20
Shelter with Art and Deposit	1	1.20
Restricted Site	1	1.20
Stone Arrangement	1	1.20
Axe Grinding Groove, Open Camp Site	1	1.20
Axe Grinding Groove, Shelter with Art	1	1.20
Total	83	100

Source: Data obtained from AHIMS search [ID: 93527] on 26/2/13

No Aboriginal sites are registered within the proposal area. Sites identified in the database search tend to cluster in areas that have been subject to previous archaeological survey, and along creeks and lakes. The closest registered site to the proposal area was identified as being about 14 metres west of the proposal area, however the site card for the item notes that the artefacts were previously collected. The next nearest sites are located about 155 to 160 metres east of the proposal area, in the vicinity of Sparks Road.

The OEH website identifies that the listed Aboriginal Place within three kilometres of the proposal area is of significance to the local Aboriginal community because of its traditional usage. The area was used for gathering wild resources and is also known

locally as a traditional meeting place. The area was a place for learning and education and has a great aesthetic and spiritual presence for local Aboriginal people. Further, the Aboriginal Place is an Aboriginal reburial site where ancestral remains have been returned to Country.

The proposal area has been subject to high levels of ground disturbance arising from the development of the M1 Pacific Motorway, commercial and industrial development, the installation of subsurface gas and telecommunications infrastructure including high pressure mains and optic fibre cables, waste disposal and vegetation clearance for rural and agricultural land use.

On the basis of a review of previous archaeological studies and the archaeological sites registered in the region, the following conclusions can be drawn regarding the potential presence and location of Aboriginal heritage sites within the landscape of the proposal area:

- The sites most likely to be present in the study area, given its distance from the coast and estuarine lakes, are small stone artefact sites. These are the most common site type occurring in this type of landscape (i.e. non-coastal/estuarine) in the area, and comprise predominantly small surface and associated low-density subsurface scatters of stone artefacts. While found in all environmental contexts, larger and denser sites tend to be found on elevated, well-drained land near freshwater sources or other resources, as well as ridgelines and other areas that offer movement routes. However, any such sites are likely to have been significantly disturbed (and hence not in situ) by the construction of the M1 Pacific Motorway, houses, driveways and other development. More intact sites are most likely to be located in the ancillary areas outside of the original motorway construction area.
- Stone artefact density would be greater in closer proximity to major water resources such as Wyong River and the creeks in the area; however, the regional evidence suggests that these sites may provide fairly low-density of artefacts.

6.9.2 Methodology

The Aboriginal Archaeological Survey Report was prepared in accordance with the principles of the Burra Charter (The *Australia ICOMOS charter for the conservation of places of cultural significance*). Aboriginal community consultation is an integral part of the assessment of Aboriginal cultural heritage significance. Consultation and the assessment of Aboriginal heritage significance has been undertaken in accordance with the requirements of the OEH guidelines as specified in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010) and the requirements of Stage 2 of the *Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime, 2011).

Initial consultation to identify interested local Aboriginal parties was undertaken by Roads and Maritime with the Darkinjung Local Aboriginal Land Council (DLALC). The DLALC was invited to participate in the field survey, in accordance with Stage 2 of the PACHCI.

Sharon Hodgetts, DLALC Project Officer, and Stephen Knight, Roads and Maritime Aboriginal Cultural Heritage Officer, participated in the fieldwork on 1-2 May 2013. The fieldwork methodology and proposed development were discussed with the participants, and topographic maps and aerial photographs were made available to guide the survey. For safety reasons, no pedestrian access to any part of the paved motorway areas was permitted, including the central median strip, shoulder and breakdown bays. Entry to private properties and road reserves was through defined access points. The survey was undertaken on foot, with personnel transported

between access points by vehicle.

Information provided by the fieldwork participants during the field survey has been integrated into the assessment. Further detail on the methodology and consultation process is provided in Appendix J.

The results of the survey and the proposed recommendations were discussed with Ms Hodgetts in the field, and no objections were raised. DLALC was also invited by Roads and Maritime to prepare a cultural heritage survey report advising on Aboriginal cultural heritage issues that may arise as a result of the proposal, in accordance with Stage 2 of the PACHCI.

6.9.3 Potential impacts

Field survey investigations

No Aboriginal sites were identified during the field survey investigations. Much of the land to either side of the motorway is densely vegetated, and consequently had no ground surface visibility. The vegetation is predominantly regrowth following land clearance and no trees of an age suitable to bear evidence of Aboriginal cultural scarring were observed within the proposal area. Small sandstone exposures were noted at the northern end of the proposal, in the vicinity of the Doyalson Link Road Interchange, however, they are highly weathered and no Aboriginal grinding grooves or engravings were present.

Given the lack of ground surface visibility during the survey, an estimate of archaeological potential for the proposal area has been made. Based on the results of previous Aboriginal heritage investigations which have identified low numbers of Aboriginal artefacts in the vicinity of the current proposal area, previous ground disturbance, and limitations of the underlying soil landscapes, it is not considered that there is any potential for in situ or stratified archaeological deposits to remain in the proposal area.

Potential impacts

Given the recent land use history and high level of disturbance observed within the proposal area, as well as environmental factors including soil landscapes that have high to extreme soil erosion susceptibility, and localised areas that are seasonally or permanently waterlogged, it is considered unlikely that any in situ or stratified subsurface archaeological deposits remain to be impacted within the proposal area.

Mapping information on the OEH website identifies that the listed Aboriginal Place is located entirely within Tuggerah Nature Reserve, and so would not be impacted by the proposal.

The assessment of Aboriginal heritage significance found that there are no Aboriginal heritage constraints on the proposal. Although the Central Coast region was identified as having social value to the local Aboriginal community, DLALC did not identify any further specific cultural significance attached to the study area.

Further, during the survey, no specific Aboriginal cultural issues or sensitivities were identified by Ms Hodgetts or Mr Stephen Knight. Assessment against the OEH heritage assessment criteria found that the proposal area is not considered to have historic, scientific (archaeological), or aesthetic value.

It was concluded that no further Aboriginal heritage assessment or community consultation would be required prior to the proposed development.

6.9.4 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential Aboriginal heritage impacts. These mitigation and management measures have been identified in Table 6-35 and incorporated in the environment

management measures in Section 6.17.

Table 6-35: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Unexpected impacts on Aboriginal heritage values	• Should Aboriginal archaeological material be unexpectedly uncovered during construction, all works are to cease within the vicinity of the material/find and the steps in the *RTA Standard Management Procedure: Unexpected Archaeological Finds* must be followed. Roads and Maritime Environmental Manager would be notified immediately.	Construction contractor	Construction
Unexpected impacts on human remains	• In the event that construction of the project reveals possible human skeletal material (remains) the RMS Standard Management Procedure: Unexpected Archaeological Finds would be implemented and NSW Police would be notified immediately.	Construction contractor	Construction

6.10 Non-Aboriginal heritage

A historic heritage impact assessment for the proposal was prepared by Australian Museum Business Services (AMBS) and is attached in Appendix K. This section provides a summary of the findings from that investigation. The investigations are broadly consistent with the principles of the Burra Charter (*The Australia ICOMOS charter for the conservation of places of cultural significance*) and have been prepared in accordance with current best-practice heritage guidelines as identified in the *NSW Heritage Manual* (DUAP, 1996).

6.10.1 Existing environment

Database searches

There are no historic heritage items listed on the National Heritage List or the Commonwealth Heritage List within the proposal area or in its vicinity. There are no heritage items listed on the Roads and Maritime Section 170 Register within the study area or its vicinity.

Seven local heritage items are listed on Schedule 1 'Heritage Items' of the Wyong LEP which are within the proposal area or its vicinity (refer to Figure 6-14 and Table 6-36). Three local heritage items are located near the proposal area; Alison Homestead, the former Wyong Dairy Co-operative and a residential property at 30 Mardi Road, Mardi.

Table 6-36: Heritage items listed on the Wyong LEP

Item	Significance
Alison Homestead	Regional
Wyong Dairy Co-operative [former]	Local
Dwelling at Mardi Road	Local
Jilliby Cemetery	Regional
Road bridge over Deep Creek	Local
Old Maitland Road	Regional

NSW Heritage Council recognises state and local levels of heritage significance only. Items in Table 6-36 listed as Regional significance are not currently listed on the State Heritage Register, having local significance only. The items are listed here as they are considered to have particular value to the local community.

Site survey

A survey and assessment of the proposal area was undertaken on 1-2 May 2013 by AMBS archaeologists Ngaire Richards and Ronan McEleney for historic cultural heritage purposes. For safety reasons, no pedestrian access to any part of the paved motorway areas was permitted, including the central median strip, shoulder and breakdown bays. Entry to private properties and road reserves was through defined access points. The survey was undertaken on foot, with personnel transported between access points by vehicle.

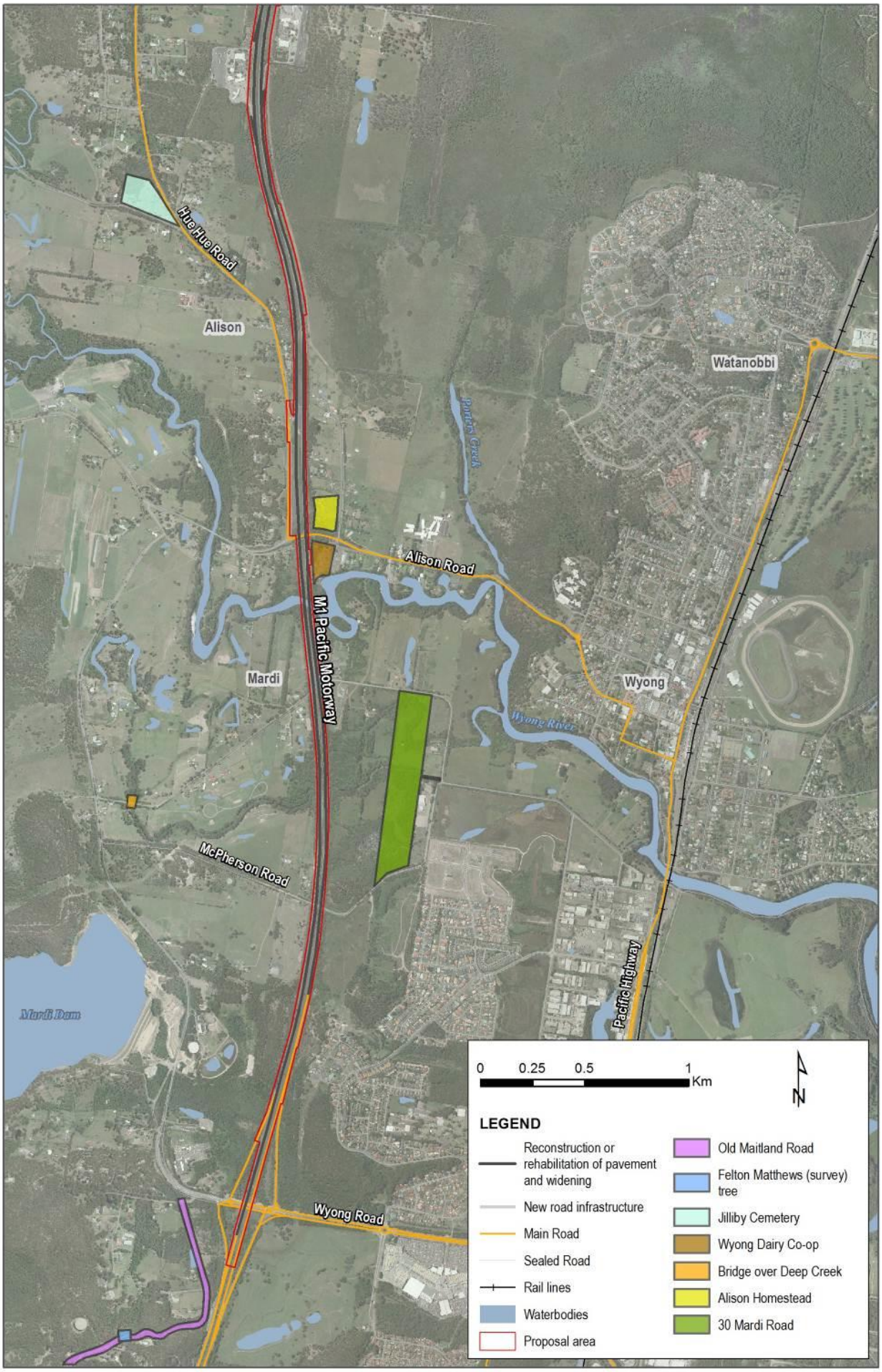


Figure 6.14 Non-Aboriginal heritage items

The Alison Homestead is located on the eastern side of the M1 Pacific Motorway immediately north of the Alison Road motorway overpass. The Homestead property stands above the level of the motorway from which it is not visible. From below the overpass it is screened from view by a dense growth of trees and bushes.

Since a substantial fire in 2011, the Alison Homestead has been protected behind a chain link safety fence. At the time of the survey the Alison Homestead Museum was closed to the public and was not accessed. However, it was noted that the property is well vegetated with large trees, gardens and a number of small out-buildings.

A row of large trees at the rear of the house define the site's western property boundary along the motorway corridor. There is a considerable fall in the ground level between the western edge of the tree line and the motorway below. The trees along the western and southern boundaries provide shelter to the out-buildings on the property and are integral to the character of the site. In addition, they provide a visual buffer to the motorway and overpass and may dissipate some of the road noise generated along the motorway.

The former Wyong Dairy Co-operative is located on the eastern side of the motorway, immediately to the south of the Alison Road motorway overpass and directly across the road from the Alison Homestead complex. Although the site is visible from the motorway, it is elevated above it and the motorway is therefore not visible from the complex. It is also below the level of the overpass, from which it can be seen. The complex has been adapted to house several commercial ventures including a fitness centre, a veterinarian, a café and a processed food factory. A new entry and concreted car park have recently been added to the west side of the property, along its boundary with the motorway corridor. No direct access to the motorway is provided.

The dwelling at Mardi Road is obscured from view by the surrounding garden of dense vegetation. The house is located about 400 metres from the motorway and is not visible from it. The south-west corner of the property is diagonally opposite the north-east corner of the proposed McPherson Road construction ancillary site. Its southern boundary is separated from the Mardi Landfill site by McPherson Road. The proposed McPherson Road construction ancillary site, is more than 900 metres from the dwelling itself.

The landscape on either side of the motorway is characterised by a mixture of pastoral farmland and light scrub, with occasional areas of swamp. The Wyong Dairy co-operative is located on a meandering bend of the Wyong River, which is the most prominent topographical feature in the immediate vicinity of the survey area. The fertile alluvial soils deposited by the river are likely to be one of the factors that enticed early European settlers to the area. Construction of the motorway has had a substantial impact on the lands along the road corridor, with the construction of road embankments and cuttings through local prominences.

Construction ancillary sites

The McPherson Road construction ancillary site is characterised by rough uneven ground, overgrown with grass, shrubs and bushes. The previous use of this land makes it highly unlikely that historic relics would remain intact, which was supported by the visual inspection. The land is covered by a series of mounds to create an uneven ground indicating relatively recent disturbance.

The Hue Hue Road construction ancillary site is rural in character and is used for cultivation and as agistment for horses. According to a local resident, part of this area was used as a concrete batching site during construction of the motorway. Evidence

of this was found, in the form of some concrete spillage, off a side track in the north east corner of the site. The southern lot of the proposed site is occupied by the northbound motorway service centre.

At the time of the survey, the Warren Road construction ancillary site had been cleared of almost all vegetation. Grass had begun to regrow over parts of the site, including over several large spoil heaps. There was also a dam on the property and evidence of construction of modern drainage features.

6.10.2 Potential impacts

The historic background and physical analysis have identified the Alison Homestead and the former Wyong Co-op Dairy, on land formerly granted to Cape, and later purchased by Alison, as the only listed heritage items within the near vicinity of the proposed works.

VMS can potentially have visual impacts on some heritage items or places such as the Alison Homestead. Any VMS proposed during detailed design should consider potential visual impacts in the context of the Alison Homestead.

Despite its proximity to the motorway and the proposed improvement works, the proposal would not impact on the landmark qualities of the former Wyong Dairy Co-operative. The motorway corridor is clearly demarcated by the fence line and that part of the site that is closest to the proposed upgrade works is occupied by a new car park.

Construction of the original motorway in the early to mid-1980's is likely to have disturbed or destroyed any archaeological resources that may have been present within the M1 Pacific Motorway median area.

The Mardi Road property, particularly the residence, is separated from the focus of proposed activities by a considerable distance and as such is unlikely to be affected by the proposal.

No non-Aboriginal heritage features have been identified on any of the proposed construction ancillary sites.

6.10.3 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential non-Aboriginal heritage impacts. These mitigation and management measures have been identified in Table 6-37 and incorporated in the environment management measures in Section 6.17.

Table 6-37: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Impact on aesthetic values of heritage listed property	• The screening plantings along the western and southern boundaries of the Alison Homestead should be maintained and, if removed, replaced with appropriate alternative plantings following construction works.	Contractor	Pre-construction Construction
Unexpected impacts on	• Should archaeological material be unexpectedly uncovered	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
non-Aboriginal heritage values	during construction, all works are to cease within the vicinity of the material/find and the steps in the *RTA Standard Management Procedure: Unexpected Archaeological Finds* must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.		

6.11 Air quality

A qualitative assessment of potential changes in local air quality during construction and operation of the proposal is provided in this section.

6.11.1 Existing environment

Background air quality

Air quality is highly dependent on the processes of wind, temperature inversions and rainfall. To assess potential air quality impacts it is necessary to have information on existing pollutant levels in the area in which the proposal would be likely to contribute to these levels.

Pollutant emissions

A search of the National Pollutant Inventory undertaken on 14 January 2014 for the Wyong LGA identified 41 air pollutant substances emitted from 16 facilities in the 2011 to 2012 reporting period from industry data and 72 substances emitted from diffuse data (Commonwealth Department of the Environment, 2012).

Most commonly reported substances for the location included particulate matter 10.0 um (PM_{10}) and carbon monoxide. Sources of pollutants include power stations (Colongra and Vales Point), Jemena Munmorah Offtake, Metering, Compressor and Delivery Stations, LMS Generation Wyong Renewable Energy Facility Mannering Colliery, Kleenheat Gas, Council owned sewage treatment plants (Nora Head Outfall and Wonga Point Outfall) and food and beverage manufacturing (Mars, Bluetongue Brewery and Sanitarium).

Major emissions to air in the LGA from motor vehicles are detailed in Table 6-38. This table indicates the proportion of emissions generated by motor vehicles in relation to all emissions for each substance.

Table 6-38: Summary polluting substances within Wyong LGA for 2011-2012

Substance	Sourced from motor vehicles (kg)	Percentage of total (%)
PM_{10}	106,199.5	14
Oxides of nitrogen	3,424,733	17
Total Volatile Organic Compounds	1,841,787	39
Carbon monoxide	16,631,844	74
Ethanol	112560	26

Source: National Pollutant Inventory (Commonwealth Department of the Environment, 2012)

Regional air quality

The EPA has a monitoring station at Wyong Racecourse, situated to the east of the proposal area. Monitoring data from this site has been used as representative of regional air quality for the proposal area. Regional air quality data for the period 1 January 2013 to 1 January 2014 is presented in Table 6-39.

Table 6-39: Recorded air quality concentrations at Wyong and comparison to the EPA criterion

Pollutant	Averaging time	Recorded concentration	EPA criterion
Carbon monoxide (CO)	Maximum 8-hour average		9.0 ppm
	Annual average (derived from 8h rolling average)	0.1 ppm	
Nitrogen dioxide (NO_2)	Maximum 1-hour average		0.12 ppm[2]
	Annual average (derived from 1h average)	0.5 pphm[3]	
Particulate matter (PM_{10})	Maximum 24-hour average		50 µg/m^3
	Annual average (derived from 24h average)	16.5 µg/m^3	
Particulate matter ($PM_{2.5}$)	Maximum 24-hour average		25 µg/m^3
	Annual average (derived from 24h average)	6.6 µg/m^3	

Source: Air Quality Data Search (OEH, 2014)

The Regional air quality index (AQI) for Wyong was 38 on 14 January 2014, which is rated as 'good' (OEH, 2014). In 2013, the Wyong station did not record any exceedances for NO_2 or CO and one count each of exceeding the PM10 and PM 2.5 criterion.

Land use and sensitive receivers

Land use in the proposal area predominantly comprises rural residential houses, agricultural land, and some industrial and commercial premises. Sensitive receivers include known or likely future locations where people are likely to work or reside. This includes but is not limited to dwellings, schools, hospitals, offices or public recreational areas (DEC, 2005).

Sensitive receivers along the M1 Pacific Motorway corridor include:

- Existing residences.
- Future residences along the M1 Pacific Motorway corridor.
- Businesses near the M1 Pacific Motorway corridor.
- Public areas.
- M1 Pacific Motorway road users.

Climate and meteorology

The region is characterised by mild to warm summers and cool winters. Climate statistics have been collected by the Bureau of Meteorology (BoM) for the Narara (Gosford) weather station, located around 12.2 kilometres from Wyong, between 1954 until mid-2013. The data reveals that January is typically the warmest month, with mean daily maximum temperature of 27.6 degrees and July is the coolest month with mean daily minimum temperature of 4.8 degrees. Rainfall data shows that February is typically the wettest month with a mean rainfall of 154.7 millimetres and

[2] ppm – parts per million
[3] pphm – parts per hundred million

the driest month is September with a mean rainfall of 68.5 millimetres. The average annual rainfall is 1,328.5 millimetres with an average of 92.1 days of rain over one millimetre per year (BOM, 2013).

Wind direction

Wind data, including annual wind roses representative of the morning and afternoon conditions in the area of the proposal, was obtained from the BOM Narara weather station.

Local wind patterns play an important role in the transportation and dispersion of air pollutants. Wind data from the Narara weather station indicates that the mean 9am wind speed ranges from 6.1 metres per second in April to 10 metres per second in October. Both morning and afternoon winds at Narara are shown to blow predominantly from the south east.

6.11.2 Methodology

The EPA has set air quality assessment criteria as part of their *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005). In general, these criteria relate to the total concentration of a pollutant in the air and not just the contribution from project-specific sources.

While the EPA also sets criteria for other pollutants from motor vehicles, such as air toxics, the pollutants listed in Table 6-40 are key pollutants for road air quality assessments. For each of the key pollutants, an acute (short term exposure) and chronic (longer term exposure) criterion has been identified by the EPA.

Table 6-40: EPA assessment criteria for key pollutants for road air quality assessments

Pollutant	Averaging time	Criterion
Carbon monoxide	Maximum 1-hour average	30 mg/m^3
	Maximum 8-hour average	10 mg/m^3
Nitrogen dioxide	Maximum 1-hour average	246 µg/m^3
	Annual average	62 µg/m^3
PM_{10}	Maximum 24-hour average	50 µg/m^3
	Annual average	30 µg/m^3

Notes: µg/m^3 = micrograms per cubic metre.
mg/m^3 = milligrams per cubic metre.

These air quality criteria have been used to assess the existing air quality and the potential impacts of the proposal.

Operational assessment methodology

Vehicle emission estimates and dispersion modelling were used to quantify potential air quality impacts of the proposal and included consideration of background air quality, future traffic volumes and the proportion of heavy vehicles.

Review of air quality and meteorological data

Air quality monitoring can be used to characterise the existing air quality of an area and to establish 'background' levels. No air quality monitoring has been carried out specifically for the project. The EPA operates an air quality monitoring station at Wyong, located at the Wyong Racecourse to the east of the proposal area. As well as meteorological data, the station measures both particulate matter and nitrogen dioxide concentrations and is situated in a residential/semi-rural area. Air quality data sourced from this location was considered representative of the study area.

Regional air quality data for key pollutants and the Regional AQI rating, as calculated by OEH, have been used as an indicator of existing air quality. OEH uses the highest AQI as the Regional AQI for that region.

Traffic forecasts

Low and high growth scenarios were developed with reference to the North Wyong Shire Structure Plan which provides a high level overview of the long term development planning for the area. The approach detailed in the Operational Traffic and Transport Report (PB, 2014) (refer Section 6.1) was used to develop the AADT for the M1 Pacific Motorway at the Alison Road overpass, shown in Table 6-41. The high growth scenarios were used in the air quality assessment for a highly conservative analysis.

Table 6-41: Summary of existing and growth scenario – AADT

	2013	2019^	2029^	2039^	2049^
Existing	69,600				
High growth scenario		77,900	85,300	94,300	103,200
Low Growth scenario		71,600	76,300	82,000	88,100

^ *Factored daily traffic counts*

Dispersion modelling

A worst-case analysis of operational air quality has been undertaken for the proposal using TRAQ. Tool for Roadside Air Quality (TRAQ v1.2) is a tool developed by Roads and Maritime which calculates vehicle emissions and also provides a simple 'first pass' screening assessment of potential air quality impacts of a new or existing roadway, using a conservative approach.

Vehicle emission factors from the World Road Association are used by TRAQ to estimate vehicle emissions factors for different road gradients, vehicle speeds and for vehicles conforming to different European emission standards. Existing pollutant levels for rural areas from EPA monitoring stations is included in the TRAQ background air quality database and incorporated into the dispersion model.

TRAQ uses the CALINE model assumptions to provide empirical data for greenhouse gas emissions (CO_2-e), CO concentrations, NO_2 concentrations and PM_{10} concentrations at varying distances from the roadside. These figures have been compared to the OEH air quality assessment criteria and can be used to inform air quality assessment and design requirements for future stages of project development. This is a conservative approach to estimating air quality impacts as it does not consider any improvements to regional air quality resulting from improved vehicle emission standards.

6.11.3 Potential impacts

Construction

Based on long-term wind trends for the area, winds in the general vicinity of the proposed construction works come predominantly from the south east in the morning and afternoon. As such, dust emitted during construction of the proposal has a higher potential to result in short-term impacts at nearby sensitive receptors to the north west of the proposal including the suburbs of Mardi, Alison and Jilliby.

Although the BOM wind direction statistics show wind blows predominantly from the south east near the proposal, records show winds occurring from all directions at different frequencies and strengths. As such, it is expected that air quality sensitive receivers in all directions from the proposal would be potentially impacted for the

duration of construction activities.

Construction of the proposal would comprise the following activities:

- Site establishment including vegetation clearance.
- Drainage and sediment controls.
- Earthworks.
- Construction of pavement.
- Road upgrades and other works.
- Site rehabilitation.

Dust generation would be the main potential impact on air quality during construction. There is potential for dust emissions to cause impacts if activities are located close to sensitive receptors, such as residential dwellings and/or local businesses. The magnitude of dust impacts would depend on the extent of earthworks involved at a particular location, the duration of activities, and the local weather at the time, particularly the wind speed and direction in relation to sensitive receivers.

Sources of air emissions associated with construction would include excavation works and the formation of stockpiles, as well as combustion emissions from plant and equipment. Typical plant and equipment used during construction may include, but not be limited to excavators, bobcats, dozers, rollers, and asphalt trucks. A listing of plant and equipment, based on similar road construction projects is provided in Table 3-5.

Pollutants emitted during construction would consist primarily of dust, as well as products of fuel combustion during operation of vehicles and equipment. Odours generated during the application of asphalt as part of construction may also affect nearby sensitive receivers.

The temporary increase in construction traffic volumes along the M1 Pacific Motorway is anticipated to result in localised impacts to air quality, including dust and combustion emissions. Impacts may be experienced to a greater extent at construction access points. However, the nature of such impacts would be minor, short-term and temporary.

Provided appropriate safeguards are implemented (refer to Section 6.11.4), it is expected that the impact on local air quality and nearby sensitive receivers for the duration of construction would be manageable.

Operation

The proposal would increase the operational carrying capacity of the M1 Pacific Motorway to suit current volumes of traffic as well as accommodating the projected increase in traffic volume resulting from population growth and economic growth. This increase in traffic would impact on local air quality through the associated increase in vehicle emissions.

TRAQ model results

The TRAQ model was run using worst case conditions in order to achieve a highly conservative result. Some of the model inputs that were adopted as a worst case basis include:

- Maximum 3.9 per cent grade assumed for a 2.5 kilometre road length.
- Maximum peak hour traffic projections along the road length used.

- Accelerated traffic increases used (2019 scenario modelled at year 2016 and 2029 scenario modelled at year 2026).
- Rural environment used.
- Worst case season for air emissions used.
- Worst case wind angle used.
- Cold start emissions included.
- Shoulder lanes and verge not included in model.

The following points should also be further noted in relation to the operational air quality analysis:

- Predicted pollutant concentrations from the proposal when added to background concentrations are likely to be an overestimation of pollutants as the background concentration would include existing regional vehicle emission concentrations.
- The highest pollutant concentrations would occur near the kerb. Concentrations of air pollutants would rapidly decrease with distance from the kerb, due to dispersion.
- The motorway typically has two three-metre wide shoulders on the outside and one metre verges. There are no sensitive receivers located at the kerb or within 40 metres of the motorway.
- Operational impacts are based on meteorological conditions that increase concentrations and therefore on average, carbon monoxide, nitrogen dioxide and particulate matter concentrations would be lower than predicted.

The model predictions for carbon monoxide, nitrogen dioxide and particulate matter concentrations during operation of the proposal for the 2019 opening year and in 2029 10 years after opening were generally consistent with or improved on the existing conditions. All receptor locations beyond 20 metres from kerb were compliant in all scenarios.

Table 6-42: Summary of air quality compliance modelling

Substance	Existing AQ	2019 AQ*	2029 AQ^
Max CO 1 hour	Compliant	Compliant	Compliant
Max CO 8 hour	NC at kerb (0m)	NC at kerb (0m)	NC at kerb (0m)
Max NO_2 1 hour	NC 0m-20m	**NC at kerb (0m)**	**Compliant**
Max NO_2 annual	NC at kerb (0m)	**Compliant**	**Compliant**
Max PM10 24 hour	NC 0m-10m	NC 0m-10m	**NC at kerb (0m)**
Max PM10 annual	NC at kerb (0m)	NC at kerb (0m)	NC at kerb (0m)

Notes:
NC = Non compliant
* Based on high growth traffic scenario of 77,900 AADT in 2019 (nearest estimate available).
^ Based on high growth traffic scenario of 85,300 AADT in 2029 (nearest estimate available).
BOLD text indicates an improvement on existing air quality.

The modelling shows that the proposal would not result in a deterioration of air quality and in some cases would improve the air quality. This suggests that air quality would not be greatly affected as a result of the proposal and that further, more detailed assessment is not required.

Depending on the anticipated traffic mix, travel speeds and distances from sensitive receivers associated with the proposal, meeting EPA goals for particulate matter

could conceivably present challenges. However, given the existing background environment, conservatism of the model and assumed inputs this is considered unlikely. Further, the proposal includes shoulder lanes two to three metres in width in addition to verges of about one metre. The nearest sensitive receivers are located 40 metres from the road carriageway.

Based on the highly conservative operational air quality analysis, air quality impacts during operations are not expected to materially change from existing conditions.

6.11.4 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage potential air quality impacts. These mitigation and management measures have been identified in Table 6-43 and incorporated in the environment management measures in Section 6.17.

Table 6-43: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Impacts on local air quality during construction	• Prepare an Air Quality Management Plan (AQMP) as part of the CEMP. This Plan must show the locations of all potentially affected properties and residences on a map and provide details of air quality control measures to be undertaken during construction, including: – air quality and dust management objectives consistent with DECCW guidelines; – potential sources and impacts of dust, identifying all dust sensitive receptors; – an environmental risk assessment to address potential impacts and mitigation measures to minimise dust impacts to sensitive receivers and to the environment; – mitigation measures to be implemented, including measures during weather conditions where high dust episodes are likely (such as strong winds in dry weather); – a monitoring program to assess compliance with the identified objectives; – a progressive stabilisation/ rehabilitation strategy for disturbed surfaces with the aim of minimising exposed surfaces;	Contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	– contingency plans to be implemented in the event of non-compliances and/or complaints about dust; and – procedures for regularly reviewing the effectiveness of the AQMP.		
Impacts on local air quality during construction	• The AQMP is to be followed and updated as required for the duration of construction works. • Construction plant and equipment is to be maintained in order to ensure exhaust emissions comply with applicable regulations (POEO Act). Emissions controls used on vehicles and construction equipment would comply with standards listed in Schedule 4 of the Protection of the Environment Operations (Clean Air) Regulation 2010. In addition, plant would be operated in a proper and efficient manner. • Controlling truck speed and movements onsite and restrict trucks to designated roadways. • Modifying or stopping construction activities during periods of high wind, if necessary. • Vehicle loads involving loose materials are to be covered when travelling off-site. • Implementing control measures, such as compaction or stabilisation, in order to minimise dust from stockpile sites, work areas and exposed soils. • Regularly inspecting and maintaining erosion control structures to ensure silt does not become a source of dust. • Maintaining all equipment for dust control to keep it in good operating condition. The equipment would be operable at all times with the exception of shutdowns required for maintenance.	Contractor	Construction

6.12 Resource and waste management

Proposed construction activities would create a number of waste streams generating volumes of waste that require a coordinated management process. This section provides a description of each waste stream, and where known the expected quantities of waste materials that would be generated. Additionally, the section details the policy settings and provides management measures for waste material applicable to the proposal. Strategies aimed at reducing waste and enhancing recycling of waste are outlined.

6.12.1 Policy setting

The PoEO Act, the Protection of the Environment Operations (Waste) Regulation 2005 and the hierarchy prescribed in the *Waste Avoidance and Resource Recovery Act 2007* (WARR Act) are the key pieces of legislation that regulate waste in NSW. They contain the requirements for managing, storing, transporting, processing, recovering and disposing of waste.

In addition to managing waste in accordance with the relevant legislation, Roads and Maritime manages waste according to the *NSW Waste Avoidance and Resource Recovery Strategy 2007* and the *NSW Waste Classification Guidelines* (DECCW, 2009) as summarised below.

Resource recovery exemptions

Applying waste to land in NSW or using it as a fuel may trigger various regulatory requirements such as the need to hold an environment protection licence or pay the waste and environment levy.

However in certain cases, the OEH has the power to exempt a person from some of these requirements when waste is used for these purposes.

These 'resource recovery exemptions' are granted by OEH where the land application or use as fuel of a waste material is a genuine, fit for purpose, reuse of the waste rather than another path to waste disposal. An exemption facilitates the use of these waste materials outside of certain requirements of the waste regulatory framework.

OEH will issue a resource recovery exemption only where the intended use:

- Will be beneficial.
- Will cause no harm to the environment or human health.

In order for an exemption to apply, all the conditions of the exemption must be met. These conditions include, but are not limited to, sampling and testing requirements, chemical thresholds, use restrictions and record-keeping requirements.

Exemptions issued by OEH:

- Do not release those using them from the requirement to obtain the necessary planning consents or approvals from the appropriate regulatory authority.
- Do not alter or override the requirements or conditions of any other relevant legislation in relation to the waste being applied to land or used as fuel, such as the need to maintain a Material Safety Data Sheet (MSDS).
- Do not apply to any waste received at a licensed landfill.
- Do not apply to waste received for processing at a recycling facility.

OEH issues both general and specific resource recovery exemptions. A general exemption can be issued for commonly recovered, high-volume and well-characterised waste materials. These exemptions may be used by anyone, without

seeking approval from OEH, provided the generators, processors and consumers fully comply with the conditions they impose.

The following general resource recovery exemptions of most relevance to road construction projects and would apply to the M1 Pacific Motorway:

- Excavated natural material (ENM).
- Excavated public road material.
- Raw mulch.
- Reclaimed asphalt pavement.
- Recovered aggregate.

NSW Waste Avoidance and Resource Recovery Strategy 2007

The *NSW Waste Avoidance and Resource Recovery Strategy 2007* (Waste Strategy 2007) aims to maximise conservation of natural resources and to minimise environmental harm from waste management and disposal of solid waste. To promote these objectives, the strategy identifies waste avoidance and resource recovery goals and targets in four key result areas:

- Preventing and avoiding waste.
- Increasing recovery and use of secondary materials.
- Reducing toxicity in products and materials.
- Reducing litter and illegal dumping.

Broad targets for each of these key result areas are specified in Waste Strategy 2007. Of particular relevance to Roads and Maritime is the target by 2014, to increase recovery and use of materials from the construction and demolition sector, from 65 per cent (in 2000) to 76 per cent. The Waste Strategy 2007 targets form the basis for waste generation and recycling of construction materials for the proposal.

NSW Waste Classification Guidelines

The *NSW Waste Classification Guidelines* (DECCW, 2009) describe a number of pre-classified wastes and provide specific direction on the classification of waste, based on chemical composition and associated environmental impacts. Waste streams require different management, transportation and disposal depending on their classification. The six waste categories outlined in the guidelines are:

- Special waste (eg clinical and related, asbestos and tyres).
- Liquid waste (eg human waste).
- Hazardous waste (eg waste with pH ≤ 2, coal tar, lead paint waste, etc.).
- Restricted solid waste.
- General solid waste (putrescibles) (eg household waste, manure, food waste, etc.).
- General solid waste (non-putrescible) (eg glass, plastic, rubber, garden waste, etc.).

Potential wastes generated from the construction, operational and decommissioning stages of the proposal are described in Section 6.12.2.

Potential impacts

Waste generated during construction would primarily be from excavation of existing flexible and concrete pavement, cuttings, excavation of existing median, civil works associated with site preparation, relocation of utilities, construction of road infrastructure and landscaping as outlined in Section 3.4.

Waste-generating activities would include:

- Vegetation clearance, generating green waste such as logs and mulched material.
- Construction of temporary construction compounds, construction roads, ancillary sites and alternative property access would require road surface grading, temporary drainage structure installation and the placement of gravel road base where required, generating general asphalt waste, pipe cuts and green waste.
- Installation of environmental controls, fencing, silt fences and lockable gates, generating material off-cuts.
- Excavation of existing asphalt and concrete pavements and sub-grade.
- Excavation of cuttings at the proposed new Doyalson Link Road Interchange.
- Excavation of existing median.
- Removal and replacement of culverts.
- General earthworks, placement of pavement layers, drainage, utilities placement and protection, installation of lighting, fencing and road furniture.

Waste materials would include:

- Asphalt pavement.
- Concrete pavement.
- Steel.
- Soil.
- Rock.
- Contaminated soils that may be exposed (refer Section 6.4).
- Surplus construction materials such as fencing, sediment, concrete, steel, formwork, and sand bags.
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics and wrapping materials.
- Vegetative waste from clearance and grubbing.
- Plant and vehicle maintenance waste, such as oil containers.
- General office wastes such as paper, cardboard and food wastes.
- Sewage waste generated through the use of personnel facilities.

The stockpiling of material can cause impacts when materials are mixed. For example, mixing of topsoils with sub soils, mixing of suitable and unsuitable material or mixing contaminated material with previously uncontaminated material can lead to what would have ordinarily been reused or recycled being rendered as waste.

Waste generated by this proposal would be minimised through the implementation of the safeguards and management measures listed in Section 6.12.2.

6.12.2 Safeguards and management measures

Mitigation and management measures would be implemented to avoid, minimise or manage resources and waste. These mitigation and management measures have been identified in Table 6-44 and incorporated in the environmental management measures in Section 6.17.

Table 6-44: Safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Construction waste	• A Materials Management Plan is to be prepared by the construction contractor as part of the CEMP prior to the commencement of relevant site works. The Materials Management Plan is to ensure that wastes are properly managed during construction in a way that it is consistent with the principles of avoidance, reduction, reuse and recycling. • The Materials Management Plan would: - Identify the waste streams that would be generated during construction - Detail for each of the identified waste streams: ▪ its waste classification ▪ how and where the waste is to be reused, recycled, stockpiled or disposed ▪ the receptacles that would be used for storing identified waste materials prior to reuse, recycling, stockpiling or disposal ▪ how, and by whom, the waste would be transported between generation, storage and point of reuse, recycling, stockpiling or disposal (including maintenance of a waste management register) ▪ specify the methods to be used for monitoring the implementation of the Materials Management Plan ▪ comply with the requirements of the PoEO Act for any non-licensed as well as licensed waste activities that involve the generation, storage and/or disposal of waste ▪ identify the need or otherwise for Section 143 Notices to be obtained from landowners of sites where waste is to be deposited	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	▪ comply with any relevant NSW Resource Recovery Exemptions when applying waste to land. • The Resource Management Hierarchy principles of the WARR Act are to be adopted in the Materials Management Plan, as follows: - unnecessary resource consumption is to be avoided as a priority - generation of excess materials is to be avoided as a priority - resource recovery including the reuse of materials, reprocessing, recycling, and energy recovery would be implemented throughout construction - disposal is only to be undertaken as a last resort. • Reuse opportunities for the proposal would be considered within the Materials Management Plan and may include: - re-use of recovered aggregates and excavated road materials in road construction in accordance with Roads and Maritime pavement specifications - weed free topsoil may be stockpiled and reused on batters or in landscaping and revegetation works - ENM may be sent offsite to a place that can legally accept this material for reuse or reprocessing. To facilitate future re-use, excavated natural material should not be mixed with any other types of waste - virgin excavated natural material (VENM) may be sent offsite to a place that can legally accept this material for reuse or reprocessing. To facilitate future re-use, virgin excavated natural material should not be mixed with any other types of waste. • The Materials Management Plan is to include the following as a minimum: - all wastes, including contaminated wastes, would be identified and classified in accordance with OEH's *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (DEC, 1997).		

Impact	Environmental safeguards	Responsibility	Timing
	- excavated material that is not suitable for on-site reuse or recycling would be transported to a site that may legally accept that material for reuse or disposal - green waste that could not be reused during revegetation works would be transported to an appropriate waste depot for recycling. - putrescible and other waste, such as chemical waste that cannot be recycled, would be regularly collected and disposed of at an appropriate disposal site - other recyclable wastes would be separated and transported to a suitable recycler - contaminated wastes would be disposed of at an appropriate waste facility - should contaminated land be found during construction activities, a contaminated land management plan would be developed and implemented in accordance with G36 - construction waste material would not be left on-site once the works have been completed - loads being transported from the site for disposal would be covered - excavated flexible and concrete pavement would be recycled where possible. - working areas would be maintained, kept free of rubbish and cleaned up at the end of each working day.		
Materials use	• Where reasonable and feasible, procure materials with recycled content or re-use materials for road construction and maintenance such as recycled aggregates in road pavement and surfacing (including crushed concrete, granulated blast furnace slag, glass, slate waste and fly ash). This measure forms part of RMS' implementation of the NSW Government's 'Waste Reduction and Purchasing Policy' (WRAPP).	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Construction waste	• The Materials Management Plan would be implemented for all stages of construction. • The Materials Management Plan would be regularly reviewed and revised as necessary. • Wastes would be properly managed during construction in a way that it is consistent with the principles of avoidance, reduction, reuse and recycling.	Construction contractor	Construction

6.13 Climate change

6.13.1 Policy setting

Climate change refers to the warming temperatures and altered climate conditions associated with the concentration of gases in the atmosphere, known as greenhouse gases (GHG). There is a need to understand these potential changes to future climatic conditions and the effect they could have on all existing and potential new projects and infrastructure. GHG emission requirements and considerations are included in a growing number of legislative and policy mechanisms in Australia (State and Commonwealth) and internationally.

The Kyoto Protocol to the United Nation Framework Convention on Climate Change (UNFCCC) was signed in 1997 and Australia ratified the protocol in December 2007. The Kyoto Protocol's objective is to reduce GHG emissions through setting reduction targets for GHG emissions produced by ratifying countries. These targets are set using the countries' 1990 baseline emissions. Australia is committed to a target of 108 per cent of 1990 emission levels by the end of 2012. A key issue of ongoing international negotiations is how and if these targets will develop post 2012.

The Australian Government's Climate Change Plan details policies to reduce GHG emissions and transition to a clean energy future for Australia. The Commonwealth Government has committed to a target of reducing carbon pollution by five per cent below 2000 emission levels by 2020 irrespective of what other countries do and by up to 15 or 25 per cent depending on the scale of global action. The long term carbon pollution reduction target is 80 per cent below 2000 emission levels by 2050.

The former Department of Environment, Climate Change and Water NSW (DECCW) has compiled a 'first pass' integrated assessment of some of the likely impacts of climate change in NSW. The report presents estimates of the impact of climate change in NSW to the year 2050 and predicts the climate of Sydney is likely to change significantly over the operating life of the proposal (DECCW, 2010).

The potential impacts of climate change on the proposal can be managed by adapting design standards where considered necessary to reduce the vulnerability of infrastructure to predicted effects.

The following are the relevant predicted effects of climate change on the proposal as identified for the Sydney/Central Coast region:

- Expected increases to the mean daily maximum and minimum temperature of between 1.5°C and 3°C by 2050 which could cause damage to infrastructure and may reduce work capacity and increase risk of heat stress for employees.
- Increased maintenance costs of infrastructure, as materials need to be replaced more often (possibly with more resilient products).

More intense and increased rainfall, in particular during summer, which may affect the existing stormwater system and result in increased erosion and sediment loss. Average runoff depths are predicted to increase by between six per cent and 28 per cent by 2030 in summer.

6.13.2 Potential impacts

Potential climate change impacts on the proposal

During construction, increases in temperatures may cause scheduling impacts to various construction activities such as the laying of asphalt.

During construction, changes in rainfall patterns may result in erosion impacts on the site and associated sediment loss, seasonal shortages of water for construction and alterations to construction timing. Increases in temperature may affect the integrity of pavement, bridges and other construction, either directly or through evaporative changes and then changes to soil moisture content and soil instability which may eventually impact on foundations of structures, softening of pavements, and road rutting.

The proposal is not in a coastal location and would not be directly affected by sea level changes. However, in the long-term, localised flooding of watercourses may result in:

- Increased potential for localised flooding of the site.
- Drainage and stormwater impacts.
- Aquaplaning (cars sliding in pooled water on the road).
- Changes to pest and weed species and distribution, and alterations to ecosystem services.
- Erosion impacts on the site, resulting in sediment export from the site.
- Potential overtopping of sedimentation basins (during major and extreme rainfall events).

Potential impacts of the proposal on climate change

The effect of GHG emissions on climate is believed to be the main factor driving climate change. Each gas that has been identified by the IPCC has been classified with a global warming potential, the units of which are 'carbon dioxide equivalents'. Greenhouse gas emissions are also categorised according to the source of emission (World Business Council for Sustainable Development's Greenhouse Gas Protocol, 2004). Scope one emissions are created directly by a person, for example fuel consumption. Scope two emissions are indirect emissions and include the generation of electricity. Scope three emissions are indirect emissions generated by the wider economy for example coal mining and export.

Construction

Construction of the proposal would result in greenhouse gas emissions being emitted, including:

- Carbon dioxide would be generated from land clearing (decomposition of cleared vegetation).
- Carbon dioxide and nitrous oxide would be generated from liquid fuel use in plant and vehicles (diesel, petrol) during construction, disposal and transport of materials.
- Methane may be generated from landfilling of any carbon based waste, and potential result in fugitive emissions.

- Embodied energy in construction materials, including concrete.
- Emissions associated with electricity use.

Operation

During operation of the proposal, GHG emissions would largely be associated with the operation of streetlights and traffic lights and vehicles using the motorway (but this would be common to the entire motorway). The majority of the estimated GHG emissions that would be produced during operation would be associated with street lighting.

6.13.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
GHG emissions	• Specify construction materials with lower emissions intensity in the detailed design (e.g. recycled steel in place of virgin steel) where engineering and other technical specifications can be met and the alternative is reasonable and feasible.	Designer Contractor	Detailed design Construction
GHG emissions	• Plant and equipment will be switched off when not in use. • Vehicles, plant and construction equipment will be appropriately sized for the task and properly maintained so as to achieve optimum fuel efficiency. • Materials will be delivered with full loads and will come from local suppliers, where possible.	Contractor	Construction
Impact of increased flood events	• Detailed design should take the effect of climate change on the proposal into consideration, including for the drainage design.	Roads and Maritime	Pre-construction
GHG emissions	• The energy efficiency and related carbon emissions will be considered in the selection of vehicle and plant equipment.	Contractor	Pre-construction

6.14 Cumulative impacts

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal and the additive effects of other external projects. Roads and Maritime is required under Clause 228(2) of the EP&A Act to take into account potential cumulative impacts as a result of the proposal.

6.14.1 Potential impacts

Warnervale Town Centre and Sparks Road

Planning is being finalised for a new intersection and improvements on Sparks Road between Minnesota Road and Virginia Road at Woongarrah. Construction of the new intersection on Sparks Road would provide access to the new Warnervale Town Centre. Depending on the timing of construction of this upgrade, it would have the potential to contribute to temporary additional traffic delays and inconvenience for users of Sparks Road.

Warnervale Business Park

The expansion of the existing Warnervale Business Park would continue and the growth in traffic, both construction and operation, would have a cumulative impact on the local area.

Warnervale Industrial Park

The proposal has the potential to impact on development plans for the Warner Industrial Park. If construction commences at the Industrial Park during the construction phase for the proposal, there is the potential for cumulative impacts such as traffic, noise and air quality to be generated. Meetings have been held with representatives of the park to co-ordinate the construction plans and to share relevant information and consultation would continue throughout the detailed design and construction phases.

North Warnervale Railway Station

A new North Warnervale Railway Station is proposed to be constructed by Sydney Trains adjacent to the Warnervale Town Centre. Further detail is not known at this stage, however the draft Central Coast Transportation Strategy states that construction of the new railway station will be completed by 2016. This is prior to the commencement of the proposal so would contribute to negligible cumulative impact.

Pacific Highway Upgrade through the Wyong Town Centre

Road and Maritime is currently planning the upgrade of the Pacific Highway through the Wyong Town Centre. Construction timing of this project would likely overlap with the proposal. Given the distance between the Wyong Town Centre and the proposal it is unlikely that there would be noticeable cumulative impacts from these two concurrent developments.

Wallarah 2 Coal Project

The developer has advised that the EIS for the Wallarah 2 Coal Project identified that the project would contribute to local traffic generation over the long term, although no road haulage of coal is proposed. The project would also have the potential to generate additional traffic during construction. In August 2013 the project was in the process of addressing submission comments and had yet to be approved by the Planning Assessment Commission. Therefore the Wallarah 2 Coal Project may have a slight cumulative impact regarding an increase in construction traffic however this would depend on timing of both this project and the proposal.

High speed rail

Strategic planning has commenced for the future high speed rail corridor which is likely to interact with the proposal corridor. However any construction activities associated with the high speed rail in this vicinity are likely to be well into the future and unlikely to contribute to cumulative impacts of the proposal.

6.14.2 Safeguards and management measures

The potential for adverse cumulative impacts would be addressed through the application of individual project specific environmental safeguards and management measures as summarised in Section 6.17. The following mitigation measure would need to be implemented to manage cumulative impacts.

Table 6-45: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Cumulative impacts	• Roads and Maritime would undertake ongoing consultation with the Department of Planning and Environment and Wyong Shire Council.	Roads and Maritime	Pre-construction Construction
Cumulative impacts	• Works would be staged to avoid and minimise impacts along the entire length where possible.	Contractor	Construction

6.15 Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided with reference to environmental management plans and relevant Roads and Maritime Services QA specifications. A summary of site-specific environmental safeguards is provided as detailed in Chapter 6 and the licence and/or approval requirements required prior to construction are also listed.

6.16 Environmental management plans (or system)

A number of safeguards and management measures have been identified 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 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 safeguards and management measures identified. These plans will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The plans will be prepared prior to construction of the proposal and must be reviewed and certified by the Roads and Maritime Services Environmental Officer, Hunter 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: QA Specification G36 – Environmental Protection (Management System), QA Specification G38 – Soil and Water Management (Soil and Water Plan) and the QA Specification G40 – Clearing and Grubbing.

6.17 Summary of safeguards and management measures

Environmental safeguards outlined in this document would be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards would minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 6-46.

Table 6-46: Summary of site specific environmental safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing

1	General	• All environmental safeguards must be incorporated within the following documents:
		  • Project Environmental Management Plan
		  • Detailed design stage
		  • Contract specifications for the proposal
		  • Contractor's Environmental Management Plan
			Project manager	Pre-construction

2	General	• A risk assessment must be carried out on the Proposal in accordance with the Roads and Maritime Services Audit Pack and OSD risk assessment procedures to determine an audit and inspection program for the works. The recommendations of the risk assessment are to be implemented. • A review of the risk assessment must be undertaken after the initial audit or inspection to evaluate is the level of risk chosen for the project is appropriate. • Any works resulting from the proposal and as covered by the REF may be subject to environmental audit(s) and/or inspection(s) at any time during their duration.	Project manager and regional environmental staff	Pre-construction After first audit
3	General	• The environmental contract specification G36, G38 and G40 must be forwarded to the Roads and Maritime Services Lead Environmental Officer for review at least 10 working days prior to the tender stage. • A contractual hold point must be maintained until the CEMP is reviewed by the Roads and Maritime Services Senior Environmental Officer.	Project manager	Pre-construction
4	General	• The Roads and Maritime Services Project Manager must notify the Roads and Maritime Services Environmental Officer Hunter Region at least 5 days prior to work commencing.	Project manager	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
5	General	• All businesses and residences likely to be affected by the proposed works must be notified at least 5 working days prior to the commencement of the proposed activities.	Project manager	Pre-construction
6	General	• Environmental awareness training must be provided, by the contractor, to all field personnel and subcontractors.	Contractor	Pre-construction and during construction as required.
7	Impacts on traffic during construction	• Prepare and implement a detailed traffic management plan (TMP) as part of the Construction Environmental Management Plan (CEMP). The TMP is to include appropriate guidelines and procedures required to ensure the continuous, safe and efficient movement of construction and non-construction traffic in and around the project area. The TMP would be submitted in stages to reflect the progress of the work and would detail: • Signage requirements. • Lane possession and approval process during periods of online construction • Measures to minimise disruption and inconvenience to road users during the construction period. • Traffic control devices such as temporary signals. • A local and regional communications strategy. • Measures to provide adequate warning, information and guidance for road users during the construction period. • Appropriate construction speed limits to be implemented in consultation with Roads and Maritime to facilitate safety of road users and construction personnel. • Specific traffic management plans to address night works safety for motorists and for construction personnel.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Temporary accesses, ancillary site entrances and exits and other traffic management measures to be designed in accordance with relevant road safety and Roads and Maritime requirements • Temporary accesses, ancillary site entrances and exits and other traffic management measures that do not impact upon the safety of the users of the existing road network. • Safe pedestrian access for the public along Sparks Road during construction. • Temporary parking for use by construction staff at a construction compound. • Access to all properties including the motorway service centres to be maintained throughout the construction. • Make provision for emergency services vehicles to pass through construction zones and update the local emergency services on the staging and progress of works that would affect their movement.		
8	Damage to roads from construction traffic	• Dilapidation surveys of roads around the proposal area should be undertaken prior to their use for construction and after construction is complete. • Any damage to roads as a result of the construction traffic should be repaired.	Construction contractor	Construction
9	Impacts to cyclists during construction	• Cyclist groups would be consulted prior to the commencement of construction and advised to use alternative sections of the M1 Pacific Motorway or alternative routes during the construction period. • Appropriate signage and way finding provisions would be implemented for cyclist detours.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
10	Provision of incident management during construction	• The contractor would consult with Roads and Maritime Traffic Commanders, Traffic Emergency Patrols (TEP) and the Transport Management Centre (TMC) to plan the construction to allow for appropriate incident response plans to be implemented.	Construction contractor	Construction
11	Impacts to traffic during operation	• Access arrangements for properties located along Sparks Road will be designed in consultation with the property owners.	Roads and Maritime	Detailed design
12	Noise impacts resulting from design elements	• An assessment of feasible and reasonable noise mitigation measures for operation of the proposal is to be undertaken during detailed design in accordance with the Roads and Maritime Environmental Noise Management Manual Practice Note 4. • The detailed design should consider pavement treatments such as longitudinal tining or low noise diamond grinding to reduce operational road noise.	Roads and Maritime Detailed design	Pre-construction Pre-construction
13	Noise impacts resulting from construction activities	• Appropriate mitigation and management measures are to be used to minimise construction noise and vibration at noise sensitive receivers as described in the approved construction noise and vibration management plan (CNVMP).	Construction contractor	Construction
14	Noise impacts resulting from construction activities	• Prepare and implement a CNVMP that identifies reasonable and feasible approaches to reduce noise impacts during construction including for ancillary facilities. • Undertake at-receiver noise mitigations that are planned to manage operational noise at the commencement of construction. • Inform the community at least 48 hours before any out of hours work is to be undertaken and provide the following information:	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Programmed times and locations of construction work. • Construction noise and vibration impact predictions. • Construction noise and vibration mitigation measures being implemented on site. • Provide specific details of all out of hours work to the EPA. • Implement a notification and consultation procedure to identify when noise impacts during extended hours and out of hours work are above relevant criteria and enable appropriate management measures to be developed. • Implement a phone line and complaints handling procedure for noise and other construction related complaints. • Include specific noise mitigation measures in the CNVMP including: • Noise intensive construction works would be carried out during standard construction hours wherever practicable. • Noisy activities that cannot be undertaken during standard construction hours would be scheduled as early as possible during the evening and/or night-time periods. • Appropriate plant would be selected for each task, to minimise the noise impact. • Deliveries would be carried out during standard construction hours where practical and safe to do so. • Non-tonal reversing alarms would be fitted on all construction equipment where possible. • If it is safe, night-time activities would be planned and conducted in such a manner as to eliminate or minimise the need for audible warning alarms. • The offset distance between noisy plant items and nearby		

No.	Impact	Environmental safeguards	Responsibility	Timing
		residential receivers would be maximised. • Noisy equipment would be oriented away from residential receivers. • Site access points, ancillary site accesses and ancillary facilities would be positioned as far as practicable away from residential receivers. • Plan the internal layout and operation of construction ancillary facilities to maximise the separation distance between sensitive receivers and noisy on-site activities. • The use of Structures or enclosures will be investigated during detailed design and would be used to shield residential receivers from noise sources where considered practicable and effective. • Trucks would travel via internal haul routes and major roads and routes where practicable and would not be allowed to queue near residential dwellings. - Respite periods would be considered during times of noise intensive works where sensitive receivers would be adversely impacted for extended periods. These could include late start and/or early finishes. - Wherever practicable, noise intensive works would be scheduled/programmed in the following order of priority to minimise the potential impacts on sensitive receivers. 1. Standard working hours. 2. Extended working hours. 3. Night time working hours.		
15	Construction	• Prepare and implement a CNVMP that identifies reasonable	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	vibration	and feasible approaches to reduce vibration impacts during construction including for ancillary facilities. • Include specific vibration mitigation measures in the CNVMP including: - Vibration intensive works would not occur outside the safe working distances outlined in Table 6-18 unless necessary. - If vibration intensive works would be required outside the safe working distances outlined in Table 6-18, alternative equipment would be used to ensure these distances are not exceeded.		
16	Exceedance of RNP where the predicted level is acute or more than two dB(A) higher than under the 'no build' option	• The suitability of architectural treatment of sensitive receivers would be considered on a case by case basis by Roads and Maritime, and negotiated with property owners.	Roads and Maritime	Operation
17	Stockpiling or material storage may reduce flood storage areas	• All stockpile locations and construction ancillary sites should be located above the 100 year ARI flood level.	Construction contractor	Construction
18	Earthworks may affect flow paths	• All piped and channelised water should be directed to existing points of discharge.	Construction contractor	Construction
19	Increased flow rates and	• The design will incorporate measures such as energy dissipation measures, scour protection and other design features to control flow	Design team	Detailed design Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	velocities of runoff may affect downstream environments	intensity and direction of flow. • Erosion and sediment control measures will be implemented. These will include scour protection and water quality basins.	Construction contractor	
20	Groundwater	• Any potential for changes in the groundwater table and any resulting impacts will be reviewed in response to any design refinements. Where necessary, measures to manage the changes will be designed and implemented during construction and operation.	Design team Construction contractor	Detailed design Construction
21	Erosion and sedimentation	• A Construction Environmental Management Plan (CEMP) and associated sub-plans would be prepared for all construction and maintenance activities associated with the proposal. The CEMP should be prepared in accordance with Roads and Maritime guidelines and specification, including, but not limited to G38, G39 and G40. The CEMP would be supported by a Soil and Water Management Plan (SWMP).	Construction contractor	Pre-construction
22	Erosion and sedimentation	• A qualified soil conservationist should develop the construction phase soil and water management strategy in accordance with the principles and practises detailed in *Managing Urban Stormwater: Soils and Construction (*Landcom, 2004) and in consultation with relevant government agencies and Council. The soil and water management strategy should be documented within the SWMP.	Construction contractor	Pre-construction
23	Erosion and sedimentation	• The SWMP should contain as a minimum the following elements: • Consideration of appropriate erosion and sediment control during staging of the main widening and replacement construction works. • Consideration of appropriate erosion and sediment controls	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		at ancillary sites with particular consideration of sediment basins at batch plant sites or where significant material processing or stockpiling will occur. • Measures to develop, maintain, monitor and improve progressive, site specific Erosion and Sedimentation Control Plans (ESCPs). • Identification of site conditions or construction activities that could potentially result in erosion and associated sediment runoff. • Methods to minimise potential adverse impacts of construction activities on the water quality within surrounding waterways. • Details of specific measures to protect sensitive areas including SEPP14 wetlands, drinking water catchments and sensitive vegetation (EECs). • Details of measures to minimise any adverse impacts of sedimentation on the surrounding environment. • Details of measures to minimise soil erosion caused by all construction works including clearing, grubbing and earthworks. • Details of measures to make site personnel aware of the requirements of the SWMP by providing information within induction, toolbox and training sessions. • Details of the roles and responsibilities of personnel responsible for implementing the SWMP. • Details of measures for the inspection and maintenance of construction phase water treatment devices and structures.		

No.	Impact	Environmental safeguards	Responsibility	Timing
24	Erosion and sedimentation	• Soil and water management measures in the ESCP are to be consistent with the principles and practises detailed in Landcom's (2004) Managing Urban Stormwater: Soils and Construction.	Construction contractor	Pre-construction
25	Erosion and sedimentation	• The proposal (including ancillary sites) may require sediment control basins. Temporary basins are to be sized accordingly to the area of land being disturbed and activities being conducted at each site. Sediment basins are to be considered at concrete batch plant sites and or where significant material stockpiling or processing occurs.	Construction contractor	Construction
26	Disturbance to asbestos containing materials	• An Asbestos Management Plan is to be developed in accordance with the Roads and Maritime Services Asbestos Management Plan (2013).	Construction contractor	Construction
27	Disturbance to asbestos containing materials	• If previously unidentified asbestos contamination is discovered during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with the relevant EPA and WorkCover Guidelines and include the proposed methodology for the remediation of the asbestos contamination. Remediation activities must not take place until receipt of the investigation report by occupational health professional. Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
28	Disturbance of contaminated material	• A Contaminated Land Management Plan is to be prepared for construction areas identified as contaminated land or any land contamination caused by the proposal.	Construction contractor	Construction
29	Disturbance of contaminated material	• The Contaminated Land Management Plan is to detail procedures to: • Include measures to identify and manage acid sulphate soils. • Protect the environment by implementing control measures to divert surface runoff away from the contaminated land. • Capture and manage any surface runoff contaminated by exposure to the contaminated land. • Investigate the contamination to determine the concentration and type of contaminants and the extent of contamination. • Assess the requirement to notify relevant authorities, including the EPA. • Manage the remediation and subsequent validation of the contaminated land, including any certification required.	Construction contractor	Construction
30	Disturbance of contaminated material	• Each of the ancillary sites proposed, requires a preliminary environmental survey to be undertaken prior to Roads and Maritime occupying the site. The presence of fill (and potential contamination) would be determined by undertaking site inspections.	Construction contractor	Construction
31	Disturbance of contaminated material	• Additional assessment is to be undertaken for soils requiring off-site disposal to ensure the correct waste classification is determined. Excavated material that is not suitable for on-site reuse or recycling, such as contaminated material should be	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		transported to a site that may legally accept that material for reuse or disposal.		
32	Disturbance of contaminated material	• If previously unidentified contamination is discovered or suspected during construction, work in the affected area must cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of any contamination. The level of reporting must be appropriate for the identified contamination in accordance with OEH Guidelines for Consultants Reporting on Contaminated Sites (2011).	Construction contractor	Construction
33	Accidental spills during construction	• Vehicles and machinery should be properly maintained to minimise the risk of fuel/oil leaks. Routine inspections of all construction vehicles and equipment should be undertaken for evidence of fuel/oil leaks. • No stockpiles of materials or storage of fuels or chemicals would be located within the 100 year ARI flood zone.	Construction contractor	Construction
34	Accidental spills during construction	• All fuels, chemicals and hazardous liquids should be stored within an impervious bunded area in accordance with Australian standards and EPA guidelines. • Any on-site refueling would occur in a designated area with impervious surfaces.	Construction contractor	Construction
35	Traffic delays during construction	• A Traffic Control Plan (TCP) is to be prepared in accordance with RTA's *Traffic Control at Work Sites Manual* (2010), and approved by Roads and Maritime prior to implementation. The TCP is to include the notification of any traffic alterations or closures. • The TCP is to include procedures for individual notification with directly impacted residences, businesses, emergency services,	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		utility authorities, transport industry groups and government stakeholders. • Timely notification of changes to informal car parking arrangements is to be undertaken prior to construction commencing.		
36	Disturbance from activities on ancillary sites	• Consult with sensitive receivers located nearby to construction ancillary sites about likely impacts prior to construction. • Site plant and equipment likely to cause disturbance to sensitive receivers located nearby ancillary sites at a suitable distance to minimise impacts.	Roads and Maritime Contractor	Pre-construction
37	Uncertainty surrounding construction activities	• The TCP is to include a construction communications plan including requirements to provide details and timing of proposed activities to affected residents, 24 hour contact name and number for complaints and details of a notification plan for changed conditions during the construction period. • The communications plan is to be prepared in accordance with Roads and Maritime's *Community Participation and Communications Manual* (2010).	Contractor	Pre-construction
38	Exclusion from the proposal area during construction for informal parking	• The new car park at the Warnervale Interchange should be scheduled for construction as early in the construction program as reasonably practicable.	Contractor	Construction
39	Emergency access	• Relevant emergency services, including fire, ambulance and police, are to be consulted to ensure that safe access is maintained during the construction period in the event of an emergency.	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
40	Property acquisition	• If property acquisition is required, all acquisition is to be undertaken in accordance with the *Land Acquisition (Just Terms) Compensation) Act 1981*.	Roads and Maritime	Pre-construction
41	Impact on ancillary sites	• All ancillary sites are to be restored to pre-existing conditions or to a condition agreed with the land owner, at the completion of construction.	Construction contractor	Construction
42	Potential long term far field effects from mine subsidence	• Roads and Maritime and Wallarah 2 Coal Project are to continue to closely liaise with respect to detailed subsidence planning and monitoring prior to longwall mining activity. • Detailed design, in the vicinity of Sparks Road, west of the M1 Pacific Motorway, is to cater for ground strains of ± 2 mm/m. • Further consultation is to be undertaken with the MSB during detailed design to ensure all potential impacts and risks are identified and mitigated.	Roads and Maritime Detailed design	Pre-construction Construction Operation

43	General reduction of landscape character and visual amenity	• Revegetation by planting or seeding of the median should be undertaken where median width permits.
		• An effective visual barrier should be created between the two carriageways where this is achievable.
		• Species used should be endemic and frangible.
		• Key locations where median screening plays an important role and should be provided include:
		  • On sweeping curves to combat glare from headlights.
		  • Just north of Alison Road where the alignment is over looked by a number of properties.
		  • Between the two motorway service centres.
		• Revegetation on the verges within the alignment corridor is to be undertaken to provide separation and screening from the
			Detailed design
			
			Roads and Maritime
			
			Construction contractor
				Pre-construction
				
				Construction

No.	Impact	Environmental safeguards	Responsibility	Timing

		motorway.
		• Protection, retention and enhancement of existing vegetation cover should be considered, in particular, at:
		  • McPherson Road
		  • Collies Lane
		  • Mardi Road
		  • Alison Road
		  • Hue Hue Road
		  • St Johns Road.		

44	Consistency with built form	• Design of the pedestrian bridge at Sparks Road should consider the approaches of the Urban Design Strategy including the following key issues:
		  • Pier form and spacing
		  • Superstructure depth and the relationship to the existing bridge structure
		  • Throw screens and the need for consistency of form with existing throw screens along the corridor.
			Detailed design
			
			Roads and Maritime
				Pre-construction

45	General construction impacts on flora and fauna	• Prepare a Flora and Fauna Management Plan, including weed management, and ensure that it is integrated with the landscape plan for the project. • Prepare a Vegetation Management Plan (VMP) detailing restoration, regeneration and rehabilitation of areas of native vegetation in the vicinity of the project. Preparation of the VMP should involve consultation with local Landcare groups and the CMA.	Construction contractor	Pre-construction
46	Risk to fauna in	• Limit of work temporary fencing is to be established.	Roads and Maritime	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	remnant vegetation to be removed or modified by the proposal	• Pre-clearing processes are to be undertaken in accordance *Roads and Maritime Biodiversity Guidelines* (2011) and RMS Biodiversity Guidelines: Guide 4 - Clearing of vegetation and removal of bushrock (RTA, 2011). • A fauna relocation site would be identified prior to construction to release any uninjured fauna encountered on site.		
47	Minimise impacts of the proposal on EECs and SEPP 14 wetlands	• Offsetting for impacts on EEC vegetation should be investigated in accordance with the Roads and Maritime Guideline for Biodiversity Offsets (2011). • Where possible, retain vegetation that contains EECs present in the proposal area and adjacent sites. • Exclusion zones detailed in Figure 6-12 and Figure 6-13 are to be established and maintained throughout construction. Ensure that exclusion zones are fenced off and signage erected in accordance with the RMS Biodiversity guidelines: Guide 2 – Exclusion Zones (RTA, 2011).	Roads and Maritime Construction contractor	Pre-construction
48	Maintenance of habitat corridor and wildlife connectivity	• The design of replacement box culverts would ensure that that they continue to be able to be used by fauna for movement across the motorway. • Culverts would be designed to facilitate opportunistic fauna crossing under the M1 Motorway. • Construction of the proposal should be undertaken in accordance with *Roads and Maritime Wildlife Connectivity Guidelines* (2011).	Detailed design Roads and Maritime Construction contractor	Pre-construction
49	Retention of native vegetation, habitat trees	• Threatened flora present in the survey area would be protected and retained where possible. • Targeted surveys for *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* are to be undertaken by a qualified ecologist	Detailed design Roads and Maritime	Pre-construction Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	(including hollow bearing trees) and potential koala habitat	in appropriate flowering season to confirm threatened plant records at Doyalson Link Road Interchange, Sparks Road Interchange and within the road corridor between these two interchanges. • Where individuals of *Tetratheca juncea* or *Grevillea parviflora subsp. parviflora* are identified that would be unavoidably affected by the proposal, consideration would be given to translocating in consultation with OEH. • Where individuals of *Tetratheca juncea* or *Grevillea parviflora subsp. parviflora* are identified outside of the construction footprint they would be protected and disturbance avoided during construction. • In the event that unexpected threatened species are detected at the site prior to construction the RMS Unexpected Threatened Species Finds Procedure should be enacted (RTA, 2011) • During detailed design consideration is to be given to minimising, where reasonably practicable, any vegetation clearance required as a result of the design. In particular, potential koala habitat should be avoided or the construction footprint locally minimised where avoidance cannot be achieved. • Retain and protect avoided potential koala habitat from disturbance during construction. • Establish exclusion zones around remnant vegetation, habitat trees, water bodies and EEC to be retained to prevent inadvertent disturbance during construction. • Vegetation that has been protected is not to be removed. • If native vegetation must be removed, wood debris and any	Construction contractor Qualified ecologist	

No.	Impact	Environmental safeguards	Responsibility	Timing
		bush rock encountered should be stockpiled for later re-use or relocation in appropriate environments following *Roads and Maritime Biodiversity Guidelines* (2011). • Construction access tracks and construction areas along the motorway verge should be sited to avoid or minimise disturbance of native vegetation. • There should be no clearing of any mature trees on construction ancillary sites.		
50	Site specific environmental induction	• All staff working on site are to undertake a site-specific environmental induction. The induction is to include items such as: - sensitivity of surrounding vegetation (particularly EECs, remnant and riparian vegetation) - site environmental procedures (vegetation management, sediment and erosion control protective fencing and noxious weeds) - what to do in case of emergency (chemical spills, fire or fauna encountered) - key contact in case of environmental incident. - Details of threatened flora species and risk of myrtle rust.	Construction contractor Roads and Maritime	Pre-construction
51	Staged habitat removal	• Where possible, habitat trees and hollow bearing trees are to be retained throughout the proposal area. • If hollow bearing trees are unable to be retained, a qualified ecologist is to be present on-site for staged habitat removal and hollow clearing and must follow the Roads and Maritime Staged Habitat Removal Process.	Construction contractor Qualified ecologist	Construction
52	Minimise risk of establishment	• The use of pesticides in weed control is to be minimised to	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	and spread of invasive species and disease due to the proposed development activities	reduce threat to fauna species. • Inspection and maintenance procedures are to be implemented to reduce the carriage of weed material on machinery. • All pathogens (eg Chytrid, Myrtle Rust and Phytophthora) are to be managed in accordance with the *Roads and Maritime Biodiversity Guidelines - Guide 7 (Pathogen Management)* and DECC Statement of Intent 1: Infection of native plants by *Phytophthora cinnamomi* (for Phytophthora), DPI Myrtle rust response 2010–11: Preventing spread of Myrtle Rust in bushland and OEH Interim management plan for Myrtle rust in bushland (2011). • Declared noxious weeds are to be managed according to requirements under the *Noxious Weeds Act 1993* and Guide 6 (Weed Management) of the *Roads and Maritime Biodiversity Guidelines* (2011).		
53	Flora and fauna encountered	• If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the Unexpected Threatened Species Finds Procedure in the *Roads and Maritime Biodiversity Guidelines* – Guide 1 (Pre-clearing process). • WIRES is to be consulted if any injured fauna are encountered as outlined in site specific environmental inductions. • Fauna handling must be carried out in accordance with the requirements the *Roads and Maritime Biodiversity Guidelines* - Guide 9 (Fauna Handling).	Construction contractor	Construction
54	Re-establishment of any native vegetation disturbed or	• Revegetate or replant disturbed areas with native vegetation following construction. • Revegetation and replanting is to be carried out following *Roads and Maritime Biodiversity Guidelines*.	Construction contractor	Post-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	removed by the proposal			
55	Unexpected impacts on Aboriginal heritage values	• Should Aboriginal archaeological material be unexpectedly uncovered during construction, all works are to cease within the vicinity of the material/find and the steps in the *RTA Standard Management Procedure: Unexpected Archaeological Finds* must be followed. Roads and Maritime Environmental Manager would be notified immediately.	Construction contractor	Construction
56	Unexpected impacts on human remains	• In the event that construction of the project reveals possible human skeletal material (remains) the RMS Standard Management Procedure: Unexpected Archaeological Finds would be implemented and NSW Police would be notified immediately.	Construction contractor	Construction
57	Impact on aesthetic values of heritage listed property	• The screening plantings along the western and southern boundaries of the Alison Homestead should be maintained and, if removed, replaced with appropriate alternative plantings following construction works.	Contractor	Pre-construction Construction
58	Unexpected impacts on non-Aboriginal heritage values	• Should archaeological material be unexpectedly uncovered during construction, all works are to cease within the vicinity of the material/find and the steps in the *RTA Standard Management Procedure: Unexpected Archaeological Finds* must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.	Contractor	Construction
59	Impacts on local air quality during construction	• Prepare an Air Quality Management Plan (AQMP) as part of the CEMP. This Plan must show the locations of all potentially affected properties and residences on a map and provide details of air quality control measures to be undertaken during construction, including:	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		– air quality and dust management objectives consistent with DECCW guidelines; – potential sources and impacts of dust, identifying all dust sensitive receptors; – an environmental risk assessment to address potential impacts and mitigation measures to minimise dust impacts to sensitive receivers and to the environment; – mitigation measures to be implemented, including measures during weather conditions where high dust episodes are likely (such as strong winds in dry weather); – a monitoring program to assess compliance with the identified objectives; – a progressive stabilisation/ rehabilitation strategy for disturbed surfaces with the aim of minimising exposed surfaces; – contingency plans to be implemented in the event of non-compliances and/or complaints about dust; and – procedures for regularly reviewing the effectiveness of the AQMP.		
60	Impacts on local air quality during construction	• The AQMP is to be followed and updated as required for the duration of construction works. • Construction plant and equipment is to be maintained in order to ensure exhaust emissions comply with applicable regulations (POEO Act). Emissions controls used on vehicles and construction equipment would comply with standards listed in Schedule 4 of the Protection of the Environment Operations (Clean Air) Regulation 2010. In addition, plant would be operated in a proper and efficient manner.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Controlling truck speed and movements onsite and restrict trucks to designated roadways. • Modifying or stopping construction activities during periods of high wind, if necessary. • Vehicle loads involving loose materials are to be covered when travelling off-site. • Implementing control measures, such as compaction or stabilisation, in order to minimise dust from stockpile sites, work areas and exposed soils. • Regularly inspecting and maintaining erosion control structures to ensure silt does not become a source of dust. • Maintaining all equipment for dust control to keep it in good operating condition. The equipment would be operable at all times with the exception of shutdowns required for maintenance.		
61	Construction waste	• A Materials Management Plan is to be prepared by the construction contractor as part of the CEMP prior to the commencement of relevant site works. The Materials Management Plan is to ensure that wastes are properly managed during construction in a way that it is consistent with the principles of avoidance, reduction, reuse and recycling. • The Materials Management Plan would: - Identify the waste streams that would be generated during construction - Detail for each of the identified waste streams: ▪ its waste classification ▪ how and where the waste is to be reused, recycled, stockpiled or disposed	Construction contractor	Pre- construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		▪ the receptacles that would be used for storing identified waste materials prior to reuse, recycling, stockpiling or disposal ▪ how, and by whom, the waste would be transported between generation, storage and point of reuse, recycling, stockpiling or disposal (including maintenance of a waste management register) ▪ specify the methods to be used for monitoring the implementation of the Materials Management Plan ▪ comply with the requirements of the PoEO Act for any non-licensed as well as licensed waste activities that involve the generation, storage and/or disposal of waste ▪ identify the need or otherwise for Section 143 Notices to be obtained from landowners of sites where waste is to be deposited ▪ comply with any relevant NSW Resource Recovery Exemptions when applying waste to land. • The Resource Management Hierarchy principles of the WARR Act are to be adopted in the Materials Management Plan, as follows: - unnecessary resource consumption is to be avoided as a priority - generation of excess materials is to be avoided as a priority - resource recovery including the reuse of materials, reprocessing, recycling, and energy recovery would be implemented throughout construction - disposal is only to be undertaken as a last resort. • Reuse opportunities for the proposal would be considered		

No.	Impact	Environmental safeguards	Responsibility	Timing
		within the Materials Management Plan and may include: - re-use of recovered aggregates and excavated road materials in road construction in accordance with Roads and Maritime pavement specifications - weed free topsoil may be stockpiled and reused on batters or in landscaping and revegetation works - ENM may be sent offsite to a place that can legally accept this material for reuse or reprocessing. To facilitate future re-use, excavated natural material should not be mixed with any other types of waste - virgin excavated natural material (VENM) may be sent offsite to a place that can legally accept this material for reuse or reprocessing. To facilitate future re-use, virgin excavated natural material should not be mixed with any other types of waste. • The Materials Management Plan is to include the following as a minimum: - all wastes, including contaminated wastes, would be identified and classified in accordance with OEH's *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (DEC, 1997). - excavated material that is not suitable for on-site reuse or recycling would be transported to a site that may legally accept that material for reuse or disposal - green waste that could not be reused during revegetation works would be transported to an appropriate waste depot for recycling. - putrescible and other waste, such as chemical waste that		

No.	Impact	Environmental safeguards	Responsibility	Timing
		cannot be recycled, would be regularly collected and disposed of at an appropriate disposal site - other recyclable wastes would be separated and transported to a suitable recycler - contaminated wastes would be disposed of at an appropriate waste facility - should contaminated land be found during construction activities, a contaminated land management plan would be developed and implemented in accordance with G36 - construction waste material would not be left on-site once the works have been completed - loads being transported from the site for disposal would be covered - excavated flexible and concrete pavement would be recycled where possible. - working areas would be maintained, kept free of rubbish and cleaned up at the end of each working day.		
62	Materials use	• Where feasible and reasonable, procure materials with recycled content or re-use materials for road construction and maintenance such as recycled aggregates in road pavement and surfacing (including crushed concrete, granulated blast furnace slag, glass, slate waste and fly ash). This measure forms part of RMS' implementation of the NSW Government's 'Waste Reduction and Purchasing Policy' (WRAPP).	Construction contractor	Construction
63	Construction waste	• The Materials Management Plan would be implemented for all stages of construction. • The Materials Management Plan would be regularly reviewed and revised as necessary.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		• Wastes would be properly managed during construction in a way that it is consistent with the principles of avoidance, reduction, reuse and recycling.		
64	GHG emissions	• Specify construction materials with lower emissions intensity in the detailed design (e.g. recycled steel in place of virgin steel) where engineering and other technical specifications can be met and the alternative is feasible and reasonable.	Designer Contractor	Detailed design Construction
65	GHG emissions	• Plant and equipment will be switched off when not in use. • Vehicles, plant and construction equipment will be appropriately sized for the task and properly maintained so as to achieve optimum fuel efficiency. • Materials will be delivered with full loads and will come from local suppliers, where possible.	Contractor	Construction
66	Impact of increased flood events	• Detailed design should take the effect of climate change on the proposal into consideration, including for the drainage design.	Roads and Maritime	Pre-construction
67	GHG emissions	• The energy efficiency and related carbon emissions will be considered in the selection of vehicle and plant equipment.	Contractor	Pre-construction

6.18 Licensing and approvals

The following licenses, permits, notifications and/or approvals are needed to construct/operate the proposal.

Table 6-47: Summary of licensing and approval required

Requirement	Timing
An applicable road occupancy licence would be required. A road occupancy licence allows the proponent to use a specified road space at approved times, provided certain conditions are met. The licence applies to the occupation of the "road space" only and does not imply permission or approval for the actual (physical) works being undertaken.	An applicable road occupancy licence would need to be in place prior to the commencement of construction.
Elements of the proposal would meet the requirements for needing 'controlled activity' approval given that there would be works within 40 metres of waterfront land. However, under section 38 of the Water Management (General) Regulation 2004, Roads and Maritime is exempt from the requirement to obtain a 'controlled activity' approval. Notification of the activity to the NSW Office of Water would be required.	A notification of the activity would need to be provided to the NSW Office of Water at least 30 days before the activity commences.
If groundwater extraction is required, an aquifer interference approval would be required for the work under Section 91F of the *Water Management Act 2000.*	Prior to construction commencement or during construction as required.
The proposal would be a scheduled activity under the *Protection of the Environment Operations Act 1997*. An environment protection licence (EPL) would be required under Section 48 of this act to authorise the carrying out of scheduled development	An EPL would be required prior to undertaking the scheduled work. Each period of 12 months (commencing from the issue of a licence) is a licence fee period for a licence. The administrative fee for any licence fee period of a licence must be paid not later than 60 days after the beginning of that licence fee period.

(blank page)

7 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 Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

7.1 Justification

The proposal is considered to be consistent with Commonwealth, NSW and regional strategic planning, including:

- Nation Building Program - Improving the National Network.
- Sydney-Brisbane Corridor Strategy.
- National Road Safety Strategy.
- National Infrastructure Plan.
- State Infrastructure Strategy.
- NSW 2021: A plan to make NSW number one.
- Central Coast Regional Strategy.

The M1 Pacific Motorway is a primary freight route, forming a critical part of the National Transport Network, connecting Sydney, the Central Coast and Newcastle. It links with the New England Highway and Pacific Highway connecting northern NSW regional centres and Queensland. Some of the highest traffic volumes in Australia are recorded on the motorway between Sydney and Newcastle and the motorway is predicted to experience increasing congestion in the future particularly during peak periods. Furthermore, the current pavement has experienced severe cracking and has reached the end of its design life.

The proposal would allow for the replacement and upgrade of the M1 Pacific Motorway between Tuggerah and Doyalson. Replacing the existing deteriorated road surfaces would improve the safety and amenity of this vital infrastructure and would substantially reduce maintenance disturbance and costs. Upgrade of the motorway to provide three lanes in each direction would reduce travel times and congestion and provide for future predicted local and regional traffic growth as well as improving safety along this section of the motorway.

While there would be some environmental impacts as a consequence of the proposal, they have been avoided or minimised where reasonably practicable through design and site-specific safeguards summarised in Section 6.17. The table in Section 6.17 also identifies project specific management measures to reduce potential environmental impacts.

The beneficial effects of the proposal are considered to outweigh any adverse impacts associated with the proposal.

7.2 Objects of the EP&A Act

Object	Comment
5(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The proposal comprises the replacement and widening of an existing motorway. The proposal is required due to the condition of the existing motorway, to ease existing congestion and to meet future growth and the substantial increase in traffic volumes that are expected. A number of mitigation measures have been included which would minimise the impacts of the proposal on the environment.
5(a)(ii) To encourage the promotion and co-ordination of the orderly economic use and development of land.	The proposal would provide improved capacity for access to new development areas in the Warnervale Town Centre and WEZ.
5(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.	The proposal would not impact on communication and utility services.
5(a)(iv) To encourage the provision of land for public purposes.	The proposal would not impact on land available for public purposes.
5(a)(v) To encourage the provision and co-ordination of community services and facilities.	The proposal involves works for the purpose of replacing and widening an existing motorway. The proposal would benefit the community by extending the life of this important motorway within the National highway network and would cater for future traffic growth in the area.
5(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	Construction of the proposal would require the clearing of some native vegetation. This impact on native vegetation, plants and threatened species, populations and ecological communities is discussed in Section 6.6. The proposal would minimise where possible the impacts on other vegetation and habitats located near the proposal. Appropriate safeguards have been identified to minimise impacts on biodiversity.
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 7.2.1 – 7.2.4 below.
5(a)(viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the proposal.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the proposal however Roads and Maritime would continue to consult with other government agencies regarding the proposal.
5(c) To provide increased opportunity for public involvement	Consultation activities for the proposal are discussed in Section 5.

Object	Comment
and participation in environmental planning and assessment.	

7.2.1 The precautionary principle

This principle states that 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.

Evaluation and assessment of alternative options have aimed to reduce the risk of serious and irreversible impacts on the environment. Stakeholder consultation raised issues for consideration and a range of specialist studies were undertaken for key issues to provide accurate and impartial information to assist in the evaluation of options.

The detailed assessment of potential environmental impacts in the preparation of the concept design has sought to minimise impacts on the urban and natural amenity of the proposal area while maintaining engineering feasibility and safety for all road users. A number of safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed as a result of lack of scientific certainty.

A construction environment management plan would be prepared prior to commencing construction. This requirement would ensure that the proposed activities achieve a high-level of environmental performance. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

7.2.2 Intergenerational equity

The principle states that 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'.

The proposal would replace an important existing asset that has significant cracking that required repair and improve road safety. The proposal would also provide increased capacity to alleviate existing traffic congestion and meet future projected traffic growth. The proposal would benefit future generations by ensuring that the proposal does not give rise to long-term adverse impacts on the environment and potential impacts would be minimised by implementation of appropriate safeguards.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a lower level of service on this important motorway which is part of the national highway network. Travel times and the number of accidents along the motorway are likely to increase as the volume of traffic increases over time.

The proposal would benefit future generations by ensuring that road safety is improved, with this being a positive benefit for all road users.

7.2.3 Conservation of biological diversity and ecological integrity

This principle states that the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.

A thorough assessment of the existing local environment has been undertaken in order to identify and manage any potential impacts of the proposal on local biodiversity. Specific design efforts have been taken to avoid and minimise impacts on biodiversity.

An area of around 18 hectares of native vegetation (including about 5.5 hectares of EEC) would require clearing as part of the proposal. Assessments of significance for the removal of vegetation concluded that a significant impact is not likely.

Three threatened flora species and 21 threatened fauna species have the potential to be impacted by the proposal. Assessments of significance for these species concluded that a significant impact as a result of the proposal is not likely.

The proposal is not considered to have a significant impact on biological diversity and ecological integrity.

An ecological assessment and appropriate site-specific safeguards are provided in Section 6.8 and Appendix H.

7.2.4 Improved valuation, pricing and incentive mechanisms

This principle requires that 'costs to the environment should be factored into the economic costs of a project'.

The REF has examined the environmental consequences of the proposal and identified management measures and safeguards for areas which have the potential to experience adverse impacts.

Requirements imposed in terms of implementation of these mitigation measures would result in an economic cost to Roads and Maritime. The implementation of management measures and safeguards would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

The design for the proposal has been developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the concept design for the proposal has been developed with an environmental objective in mind.

7.3 Conclusion

The proposed to replace and widen the M1 Pacific Motorway between Tuggerah and Doyalson is subject to assessment under Part 5 of the EP&A Act. The 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 conservation agreements and plans of management under the NPW Act, joint management and biobanking agreements under the TSC Act, wilderness areas, critical habitat, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on waste generation and biodiversity, in addition to short term noise, traffic and water quality impacts during construction. Mitigation measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also replace an existing asset which has reached the end of its design life and requires replacement to improve road safety. It will also alleviate existing traffic congestion and provide additional capacity for project traffic growth. On balance the proposal is considered justified.

The environmental impacts of the proposal are not likely to be significant and therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought for the proposal from the Minister for Planning under Part 5.1 of the EP&A Act. The proposal is unlikely to affect threatened species, populations or ecological communities or their habitats, within the meaning of the *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994* and therefore a Species Impact Statement is not required. The proposal is unlikely to affect SEPP 14 wetlands. The proposal is also unlikely to affect Commonwealth land or have an impact on any MNES.

(blank page)

8 Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Peter Fawcett
Environment Manager
SMEC Australia
Date: 25 July 2014

I have examined this review of environmental factors and the certification by Peter Fawcett of SMEC Australia and accept the review of environmental factors on behalf of Roads and Maritime Services.

Name: Simon Cusack
Position title: A/Project Development Manager
Roads and Maritime Central Coast
Date: 25 July 2014

(blank page)

9 References

Adam et al, 1985: 38 in Winning, 1991. Winning, G (1991) "Some problems in determining the boundaries of SEPP 14 wetlands" Wetlands (Australia) 11 pp14-20.

Airbiz (2006) *Warnervale Aerodrome ANEF / OLS Report Australian Noise Exposure Forecast – 2025 Obstacle Limitation Surfaces*, March 2006.

AMBS (2013a) *M1 Pacific Motorway Widening: Tuggerah to Doyalson - Aboriginal Archaeological Survey Report*, report prepared for SMEC Australia.

AMBS (2013b) *M1 Pacific Motorway Widening: Tuggerah to Doyalson – Historic Heritage Impact Assessment*, report prepared for SMEC Australia.

ANZECC (2000) *Australian and New Zealand guidelines for fresh and marine water quality: Volume 1 – the guidelines*.

AT&L (2013) *M1 Pacific Motorway Widening Upgrade Tuggerah to Wyong Construction Methodology Report*, prepared for Roads and Maritime.

Australian Transport Council (ATC) (2011) *National Road Safety Strategy 2011-2010.*

Austroads (1999) *Guide to Traffic Engineering Part 14 Bicycles.*

BMT WBM (2013) *Lower Wyong River Floodplain Risk Management Study and Plan,* prepared for Wyong Shire Council.

Bureau of Meteorology (2014) Gosford (Narara Research Station) AWS Monthly Climate Statistics, accessed from http://www.bom.gov.au/climate/averages/tables/cw_061087.shtml on 14 January 2014.

Coffey (2006) Preliminary environmental site assessment.

Commonwealth Department of the Environment (2012) National Pollutant Inventory – Wyong LGA, accessed from http://www.npi.gov.au/npidata/action/load/summary-result/criteria/lga/298/destination/ALL/source-type/ALL/subthreshold-data/Yes/substance-name/All/year/2012 on 14 January 2014.

DEC *(1997) Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes*.

DEC (2005) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* prepared by the NSW Environment Protection Authority, August 2005.

DEC (2006) *Assessing Vibration: A technical guideline*.

DECC *(2007) NSW Waste Avoidance and Resource Recovery Strategy.*

DECC (2008a) *Managing Urban Stormwater: Soils and Construction, Volume 2A: Installation of Services*.

DECC (2008b) *Managing Urban Stormwater: Soils and Construction, Volume 2D: Main Road Construction*.

DECC (2009) *Interim Construction Noise Guideline*.

DECCW (2010) *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.*

DECCW (2011) *NSW Road Noise Policy*.

DECCW 2009) *NSW Waste Classification Guidelines.*

Department of Infrastructure and Transport (2012) *High Speed Rail Study - Phase 2 Report*.

Department of Planning (2008) *Central Coast Regional Strategy 2006-2031*.

Department of Planning and Infrastructure (2013) *Draft Metropolitan Strategy for Sydney to 2031*. March 2013.

Department of Planning and Infrastructure (2010) *North Wyong Structure Plan*, October 2010.

DTRS (2007) Department of Transport and Regional Services, *Sydney-Brisbane Corridor Strategy; Building our National Transport Future*.

DEWHA (2009) SEWPaC *Significant Impact Guidelines 1.1: Matters of National Environmental Significance,* http://www.environment.gov.au/epbc/publications/pubs/nes-guidelines.pdf.

DLWC (1999) salinity hazard mapping, Department of Land and Water Conservation, Resource Planning and Assessment, Muswellbrook.

DSEWPaC (2012) *Protected Matters Database* - Search Tool available from: http://www.environment.gov.au/epbc/pmst Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

DUAP (1996) *NSW Heritage Manual.*

DUAP (1996b) EIS Guidelines Volume D: *Roads and Related Facilities.*

DUAP (1999) *Is an EIS required?*

EAL (2013) *Contamination Assessment Soil Analysis* - EAL Job Number C6826.

economy.id (2013) *National economic indicators for local areas*, accessed from http://economic-indicators.id.com.au 3 June 2013.

Infrastructure Australia (2013) *National Infrastructure Plan.*

Infrastructure NSW (2011) *NSW State Infrastructure Strategy 2012-2032.*

Landcom/Department of Housing (2006) *Managing Urban Stormwater, Soils and Construction,* Landcom, Parramatta

LesryK Environmental Consultants (2010). *Ecological investigation, RTA project, intersection of Sparks Road and the F3 Freeway, Halloran*. A report prepared for the Road Traffic Authority (RTA) by LesryK Environmental Consultants.

Murphy (1993) *Soil Landscapes of the Gosford-Lake Macquarie 1:100,000 Sheet*.

Nelson, P, Parolin, B and Tang, N (2011) "Incorporating Stereoscopic technology to improve data accuracy – SEPP 14 mapping" DP&I presentation, accessed from http://esriaustralia.com.au/u/lib/cms/incorporating-stereoscopic-technology-to-enhance-spatial-accuracy_p-nelson_pdf.pdf

NSW Government (2010) *NSW BikePlan*. Publication number 10.133.

NSW Government (2011) *NSW 2021: A plan to make NSW Number 1.* Department of Premier and Cabinet, September 2011.

NSW Office of Social Policy (1995) *Techniques for effective social impact assessment: a practical guide*, NSW OSP, Sydney.

OEH (2012). Atlas of NSW Wildlife. Office of Environment and Heritage, New South Wales. Available from: http://www.bionet.nsw.gov.au.

OEH (2013). Office of Environment and Heritage, New South Wales. Threatened species advanced search. Available from: http://www.environment.nsw.gov.au/threatenedSpeciesApp

OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites.

Office of Environment and Heritage (2014) NSW Air Quality Index Table accessed from http://www.environment.nsw.gov.au/aqms/aqitable.htm on 14 January 2014.

Parsons Brinckerhoff (2014) Pacific Motorway Widening – Tuggerah to Doyalson: Draft Traffic and Transport Report, March 2014

Pilgrim, D (1987) *Australian Rainfall and Runoff Volume One: A guide to flood estimation*.

profile.id (2013) *Wyong Shire Community Profile*, accessed from http://profile.id.com.au/wyong 3 June 2013.

Roads and Maritime Services (2011) *Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation.*

Roads and Maritime Services (2013) *Options Assessment Report Pacific Motorway Widening Tuggerah to Doyalson.*

Roads and Maritime Services (2013b) *Asbestos Management Plan*.

Roads and Maritime Services (Roads and Maritime) (2012) *Community Engagement and Communications: A resource manual for staff*. October 2012.

Roads and Traffic Authority (2000) *Road Design Guide.*

Roads and Traffic Authority (2001) *Environmental Noise Management Manual*.

Roads and Traffic Authority (2001b) *Stockpile Site Management Procedure.*

Roads and Traffic Authority (2004) *Erosion and Sedimentation Risk Assessment Procedure*.

Roads and Traffic Authority (2009) *Beyond the Pavement - RTA Urban Design Policy, Procedures and Design Principles.*

SMEC (2014) *Biodiversity Technical Study M1 Widening (Tuggerah to Doyalson)*, report prepared for Roads and Maritime.

SMEC (2014b) *Hydrology and Hydraulics Technical Study*, report prepared for Roads and Maritime.

SMEC (2014c) *Construction Traffic Technical Note*, report prepared for Roads and Maritime.

SMEC (2014d) *Soil and Water Quality Technical Report*, report prepared for Roads and Maritime.

SMEC (2014e) *Issues Summary Report*, report prepared for Roads and Maritime.

Somerville, M (2009) *Hunter, Central and Lower North Coast Vegetation Classifications and Mapping Project Volume 1: Vegetation classifications technical report*. Prepared by HCCREMS/Hunter Councils Environment Division for Hunter-Central Rivers Catchment Management Authority. Tocal, NSW.

Tract (2014) *M1 Pacific Motorway Widening Tuggerah to Doyalson Urban Design, Landscape Character and Visual Impact Assessment Report*, report prepared for Roads and Maritime.

Transport for NSW (2012a) *NSW Long Term Transport Master Plan,* December 2012.

Transport for NSW (2013b) *NSW Freight and Ports Strategy*, November 2013,

Western Australian Department of Health (WA DOH) (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia*.

Wilkinson Murray (2014) Noise and Vibration Technical Study: M1 Pacific Motorway replacement and widening: Tuggerah to Doyalson.

Winning, G (1991) "Some problems in determining the boundaries of SEPP 14 wetlands" Wetlands (Australia) 11 pp14-20.

Wyong Shire Council (2008a) *State Significant Site Study – Wyong Employment Zone*, January 2008.

Wyong Shire Council (2008b) *Wyong Shire Council Community Plan 2008 – 2013*.

Wyong Shire Council (2010) *Wyong Employment Zone Fact Sheet*, available at http://www.wyong.nsw.gov.au/DownloadDocument.ashx?DocumentID=486, accessed 12 August 2013.

Wyong Shire Library Service (2008) *Wyong Shire Place Names*, available at http://www.wyong.nsw.gov.au/my-community/libraries/local-studies/ Accessed 7 March 2013.

Terms and acronyms used in this REF

Acronym	Definition/Explanation
AHD	Australian height datum
AQMP	Air quality management plan
ARI	Average Recurrence Interval
ASS	Acid sulfate soils
ATC	Australian Transport Council
AusLink	Mechanism to facilitate cooperative transport planning and funding by Commonwealth and state and territory jurisdictions
BGL	Below ground level
BOM	Bureau of Meteorology
CASA	Civil Aviation Safety Authority
CEMP	Construction environmental management plan
DLALC	Darkinjung Local Aboriginal Land Council
DP&I	Department of Planning and Infrastructure (now the Department of Planning and Environment)
DTRA	Department of Transport and Regional Services (Commonwealth)
ECRTN	Environmental Criteria for Road Traffic Noise
EEC	Endangered Ecological Community
EIA	Environmental impact assessment
ENMM	Environmental Noise Management Manual (RTA, 2001)
EPA	Environment Protection Authority
EPL	Environment Protection Licence
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
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.
ESCP	Erosion sedimentation control plan
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
ESU	Ecological survey unit
FM Act	*Fisheries Management Act 1994* (NSW)
GHG	Greenhouse gas
Heritage Act	*Heritage Act 1977* (NSW)
IPCC	Intergovernmental Panel on Climate Change
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
ITS	Intelligent transport systems
LALC	Local Aboriginal Land Council
LHCCREMS	Lower Hunter and Central Coast Regional Environmental Management Strategy
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local government area
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
MSB	Mine Subsidence Board
MSD	Mine subsidence district
MVKT	Million vehicle kilometres travelled
NES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
NCA	Noise catchment area
NW Act	*Noxious Weeds Act 1993* (NSW)
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
OLS	Obstacle limitation surface
PACHCI	Roads and Maritime Procedure for Aboriginal Cultural Heritage

Acronym	Definition/Explanation
	Consultation and Investigation
PoEO Act	*Protection of the Environment Operations Act 1997*
pphm	Parts per hundred million
ppm	Parts per million
PPV	Peak particle velocity
QA Specifications	Specifications developed by Roads and Maritime Services for use with roadworks and bridgeworks contracts let by Roads and Maritime Services
RBL	Rating background level
REF	Review of Environmental Factors
RFEFCF	River Flat Eucalypt Forest on Coastal Floodplains
RL	Relative level
ROTAP	Rare or Threatened Australian Plants
RNP	Road Noise Policy (DECCW, 2011)
Roads and Maritime	Road and Maritime Services
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP 14	State Environmental Planning Policy No.14 – Coastal Wetlands
SEPP 44	State Environmental Planning Policy No.14 – Koala Habitat
SEPP 71	State Environmental Planning Policy No. 71 – Coastal Protection
SSFCF	Swamp Sclerophyll Forest on Coastal Floodplains
SMS	Short message service
SMZ	Select material zone
SPD	Social Planning District
SSS	State Significant Site
SPL	Sound power levels
SWMP	Soil and water management plan
TCP	Traffic control plan
TEP	Traffic Emergency Patrols
TfNSW	Transport for NSW
TRAQ	Tool for Roadside Air Quality
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
UDVIA	Urban design, landscape character and visual impact assessment
VEM	Visual envelope map
VMS	Variable message sign
WARR Act	*Waste Avoidance and Resource Recovery Act 2007* (NSW)
WEZ	Wyong Employment Zone