Newell Highway - West Wyalong to Forbes Flood Immunity Project

Preliminary environmental investigation

Transport | June 2021

NSW GOVERNMENT

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Preliminary environmental investigation

Transport | June 2021

Prepared by Jacobs Pty Ltd and Transport for NSW (Transport)

Document controls

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Executive summary

This document is a preliminary environmental investigation (PEI) for the Newell Highway (the highway) flood immunity solution between Compton Road, West Wyalong and Hereford Street, Forbes (the proposal). The information and recommendations in this PEI will be used to inform the options investigations and design process for the proposal with an aim to avoid or minimise environmental and social impacts wherever possible.

The proposal

Transport for New South Wales (Transport) has started investigating potential flood immunity solutions for the highway between Compton Road, West Wyalong and Hereford Street, Forbes. The proposal is expected to be delivered in segments with a combined length of about 105 kilometres (km).

The proposal will be funded under the NSW government spend of $200 million in flood proofing the highway between Forbes and West Wyalong. This proposal aims to deliver on that promise as well as prioritising further flood immunity initiatives for the highway.

This proposal is focussed on addressing food prone areas on the highway and seeks to develop an appropriate flood immunity solution for the Forbes to West Wyalong section of the highway.

Flood prone areas of the highway were identified by reviewing historical data of the submerged sections of the highway in a high volume rainfall event over a six week period in 2016 between West Wyalong to Forbes, including but not limited to the areas of Marsden, Caragatel Flood Channel, Forbes and West Wyalong.

Key features of the proposal include:

- Upgrade of the highway to meet the flood immunity objectives
- Consideration of detours for flood events
- Tie ins at the northern and southern extents at each upgraded location
- Ancillary sites and works during construction.

Need for the proposal

The Newell Highway is a national highway that forms a primary freight and passenger transport link between Victoria and Queensland, and between regional centres in western NSW. The highway is prone to flooding between Forbes and West Wyalong and has a history of road closures during periods of heavy rain in the Lachlan Catchment. Detours during flooding events have been further hampered by the flooding and subsequent closure of alternate routes, adding substantial distances to travel within the region.

In September 2016 the West Wyalong to Forbes section of the highway experienced a 43 day closure due to heavy rain and flooding within the wider Lachlan Catchment. About 20 km of the highway was flooded.

Proposal objectives

The primary objective of the proposal is to provide increased flood immunity along the highway between West Wyalong and Forbes by:

- Achieving a minimum flood passable level of service for an equivalent 2016 flood event
- Achieving a minimum flood immunity of 1 in 20 year annual recurrence intervals
- Assessing options for flood immunity and flood passable for up to a one in 50 year flood event.

Community and stakeholder consultation

To date there has been limited consultation carried out for the proposal. The consultation has included one meeting with Forbes Shire Council held in September 2020 and a media release to introduce the proposal. One email was sent from Transport to NSW to farmers requesting land data.

The media release was published in the Forbes Advocate on the 29 October 2020 to notify the community of design and environmental investigations had commenced for the proposal.

No other community consultation has been carried out for the proposal to date.

During the next phase of assessment, a Community and Stakeholder Engagement Plan (CSEP) will be prepared for the planning, development and delivery of the proposal. This plan will identify key stakeholders, proposed communication tools, key messages and protocols to be implemented.

Summary of issues and recommendations

Key environmental issues/constraints for the proposal were identified during the preparation of this PEI within a study area broadly identified as 100 metres (m) either side of the existing road centre line. Recommendations have been made to address each constraint identified. These constraints and recommendations will be considered during the design development and detailed environmental assessment to avoid, minimise and mitigate impacts to the greatest extent possible.

Based on the PEI the following are considered key environmental issues:

- Disruption and management of traffic and transport on the highway, including heavy and light vehicle movements
- Potential to disrupt access to and from rural/residential properties, and agricultural/commercial land
- Parts of the highway are located within the road reserve while other parts are located out the road reserve corridor. Some of the parts of the highway that are outside of road reserve are within crown land.
- Threats to registered outstanding biodiversity values in the locality and specific ecological values, primarily due to the indicative vegetation distribution map detailing the potential presence of seven listed communities under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and nine Threatened Ecological Communities (TECs) listed under the *Biodiversity Conservation Act 2016* (BC Act) within the locality.
- Threats to ecological values, primarily due to potential presence of derived native grasslands associated with a threatened ecological community (e.g. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered Community) that may not be identified in the indicative regional vegetation mapping.
- Some communities have been inaccurately mapped, such as some areas of Weeping Myall Woodland (listed under the BC Act and EPBC Act). Additionally, areas that appear to be co-dominated by Eucalyptus populnea (Poplar Box) may meet the listing criteria and condition threshold for EPBC Act listed Poplar Box Grassy Woodland on Alluvial Plains (Endangered) TEC, which has not been mapped
- Potential habitat and presence of threatened flora and fauna listed under the EPBC Act and BC Act within the study area including the Glossy-black Cockatoo *(Calyptorhynchus lathami*), Brown Treecreeper (*Climacteris picumnus victoriae*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) and Blue-billed Duck (Oxyura australis) which have been confirmed in the study area.
- Impacts to populations of threatened flora species occur in disturbed roadside vegetation, e.g. *Austrostipa metatoris* (A spear-grass) *Austrostipa wakoolica* (A spear-grass)*, Dichanthium setosum* (Bluegrass) and the *Swainsona murrayana* (Slender Darling Pea)

- Key potential impacts on the ecological attributes identified as potentially present within the study area include:
  - Clearing of endangered and critically endangered ecological communities
  - Clearing of habitat for EPBC Act and BC Act listed threatened flora and fauna species
  - Direct clearance of EPBC Act and BC Act listed threatened flora species
  - Increased habitat fragmentation and edge effects through the widening of the highway corridor
  - Potential indirect impact to KFH and waterways that are habitat for threatened fish species
  - Potential for weed invasion, including listed priority weeds, and spread into adjacent sensitive habitats such as areas of TECs
  - Introduction of pathogens as Phytophthora cinnamomi (dieback) and Uredo rangelii (Myrtle Rust) into the environment.
- Potential impact on connectivity corridors for wildlife including clearing and changes to vegetated reserves associated with Crown Land located next to the existing highway, vegetated riparian corridors, vegetated road reserves, isolated patches of woodlands within farmland and paddock trees.
- The proposal contains several landforms and resource zones which have the potential to contain Aboriginal archaeological sites
- Sixteen Aboriginal items recorded on the Aboriginal Heritage Information Management Systems (AHIMS) are located in and near the study area
- Potential direct impacts on 22 local heritage items along the study area between West Wyalong and Forbes, including the Forbes Railway Station Group which is listed as a State Heritage Item
- Management of potential soil erosion
- Water quality and hydrology, due to potential indirect impacts to ephemeral waterbodies
- Management of flooding risk to and from the proposal as Sections of the study area where the highway is located are subject to flooding. In major flood events the highway may become impassable between West Wyalong and Forbes
- Noise and vibration issues to local rural/residential land uses
- Disruptions to landscape character and visual amenity
- Socio-economic impacts due to an influx of workers placing pressure on local infrastructure and competition for construction labour and materials
- Cumulative issues to the local community and environment due to other major projects in the region.

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1. Introduction

This chapter introduces the proposal and provides the context of the preliminary environmental investigation (PEI). In introducing the proposal, the objectives and proposal development history are detailed, and the purpose of the report provided.

1.1 The proposal

Transport for NSW (Transport) has started planning for potential flood proofing and immunity solutions for the Newell Highway (the highway) between Compton Road, West Wyalong to Hereford Street, Forbes (the proposal).

The proposal forms part of the Newell Highway Corridor Strategy (Transport, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the highway. The proposal will be funded under the Newell Highway Package of Works.

This proposal is focussed on addressing areas on the highway and seeks to develop an appropriate flood immunity solution for the West Wyalong to Forbes section of the highway. Flood prone areas of the highway were identified by reviewing historical data of the submerged sections of the highway in a high volume rainfall event over a six week period in 2016 between West Wyalong to Forbes, including but not limited to the areas of Marsden, Caragatel Flood Channel, Forbes and West Wyalong.

Key features of the proposal include:

- Increasing the height of the highway to meet the flood immunity objectives
- Pavement, bridge and drainage improvements to allow water to pass freely under the highway
- Tie ins at the northern and southern extents at each upgraded location
- Ancillary works including safety barriers, signage, line marking, landscaping and environmental protection works as required
- Temporary ancillary facilities including site compounds and stockpile sites.

The proposal is expected to be delivered in segments with a combined length of about 105 kilometres (km). The following four segments have been used in the PEI for reporting purposes as described in **Table 1-1** and shown on **Figure 1-2**.

Table 1-1 Segments for the PEI

Segment number	Locality	Location coordinates north of West Wyalong to Forbes	Approximate chainage (m)
1	West Wyalong	The segment starts at Compton Road intersection of the West Wyalong Bypass and extends 1,900 metres (m) to the start of segment 2.	0 - 19500
2	Marsden	Segment starts about 2 km north of Boxalls State Forest on the highway and ends about 1 km north of the West Plains Road on the highway.	19500 - 60000
3	Caragatel Flood Channel	Segment starts about 1 km north of the West Plains Road on the highway and ends at the Lachlan Valley Way intersection in Forbes.	60000 - 95000

Segment number	Locality	Location coordinates north of West Wyalong to Forbes	Approximate chainage (m)
4	Forbes	The segment starts from the Lachlan Valley Way intersection in Forbes and ends on the highway intersecting Hereford Street in Forbes.	95000 - 103500

1.1.1 Definitions

The following terms are used in the PEI:

- The 'proposal' and 'the highway' refers to the proposed flood immunity solutions to the Newell Highway between West Wyalong and Forbes as shown on **Figure 1-1**
- The 'study area' includes all the segments to be upgraded as part of the proposal and applies a 100 m either side of the existing road centre line as shown on **Figure 1-2**
- 'The locality' encompasses the area in a 10 km radius of the study area
- 'Flood immunity' is defined as one lane - each way (both north and south bound lanes) dry and trafficable for all vehicles
- 'Flood passable' is defined as one way – one lane trafficable for all vehicles under traffic management
- 'Flood proof' is the term flood proof is defined as no closure required during a defined flood event.

1.2 Location of the proposal

The proposal is located in the Central West of NSW, and traverses the Bland, Weddin and Forbes Local Government Areas (LGA). The locality of the proposal is shown on **Figure 1-1**. The study area and environmental constraints are shown on **Figure 1-2**.

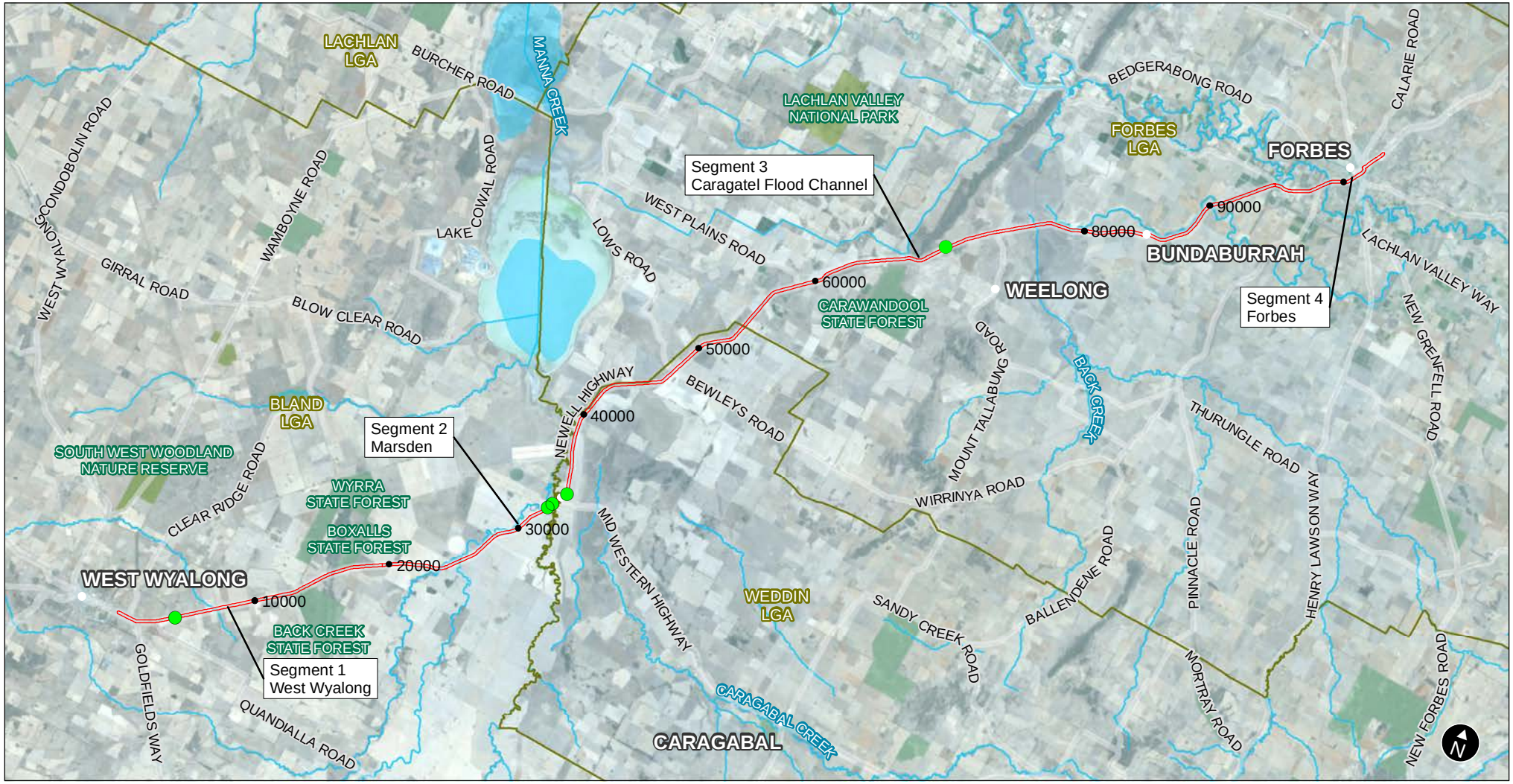
1.3 Purpose of the report

This PEI has been prepared by Jacobs on behalf of Transport. The purpose of the PEI is to:

- Identify potential environmental, social and planning issues and opportunities for the proposal
- Provide recommendations to inform future stages of proposal development
- Integrate environmental, economic and social outcomes into decision making
- Assist in applying the principles of Ecologically Sustainable Development (ESD).

The information and recommendations in this PEI will be used to inform the options investigations and ongoing design process that addresses the need and objectives of the proposal (refer to **Section 2.2** and **Section 2.3** respectively) with an aim to avoid or minimise environmental and social impacts wherever possible.

Once a preferred option has been identified and a concept design developed, a detailed environmental impact assessment will be prepared and will detail environmental safeguards and management measures that will be implemented.



Legend

- Study area
- Local Government Area
- State Forest
- National Park
- Waterway
- Rest area

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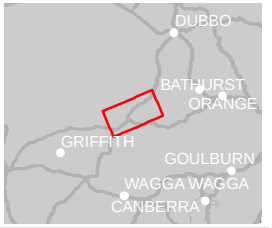
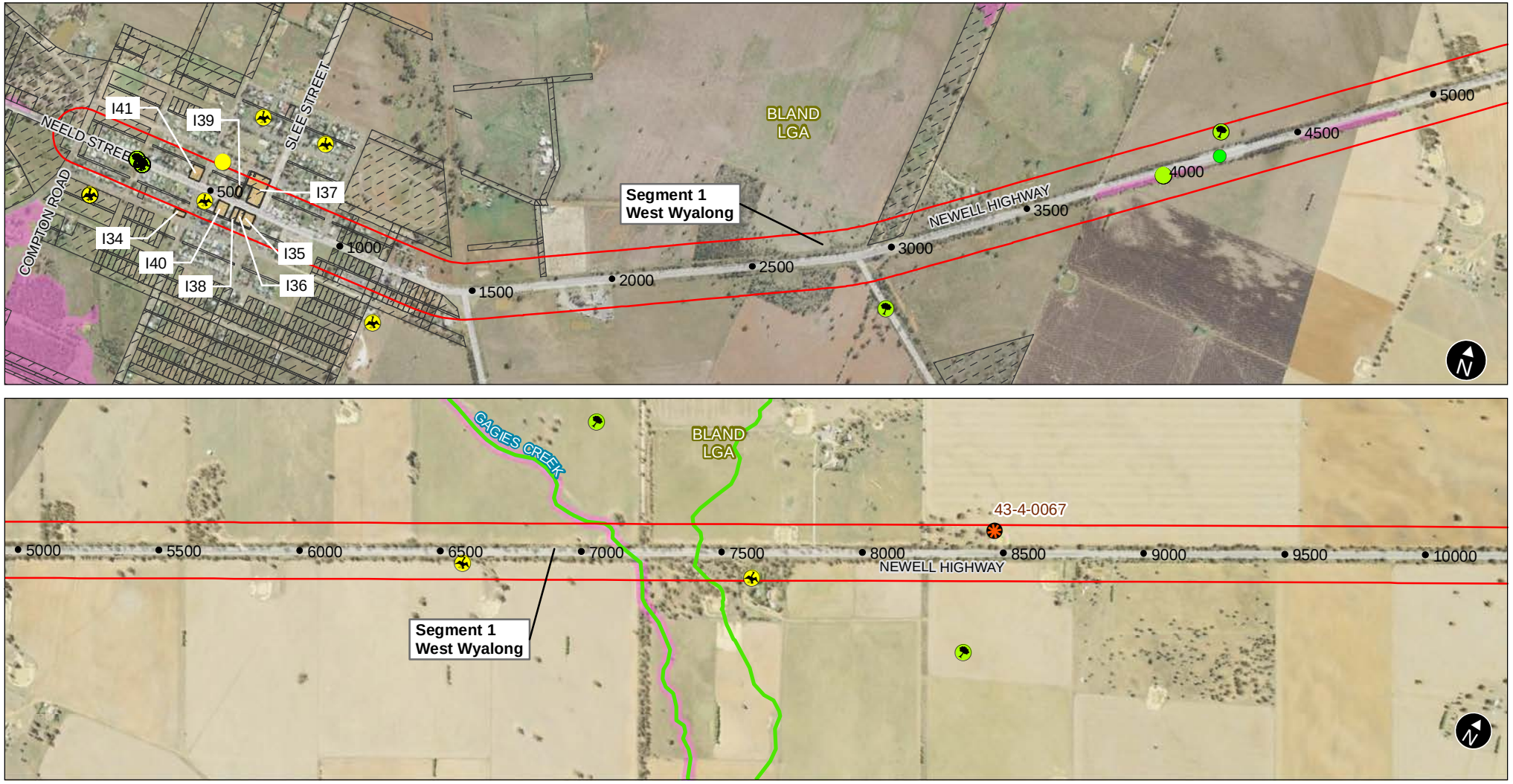


Data sources

Jacobs 2020
NSW Spatial Services 2020
GDA94 MGA55

Figure 1-1 Location of the proposal



Legend

- Study area
- Local Government Area
- State Forest
- Crown land
- Waterway
- AHIMS Site
- Threatened flora
- Threatened fauna
- Areas of outstanding biodiversity value
- Item - Landscape
- Item - Archaeological
- Item - Aboriginal
- Item - General
- Key Fish Habitat
- Eel Tailed Catfish/Silver Perch
- Flathead Galaxias
- Olive Perchlet
- Purple Spotted Gudgeon
- Rest area

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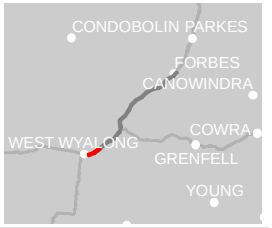

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

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Figure 1-2 The investigation area

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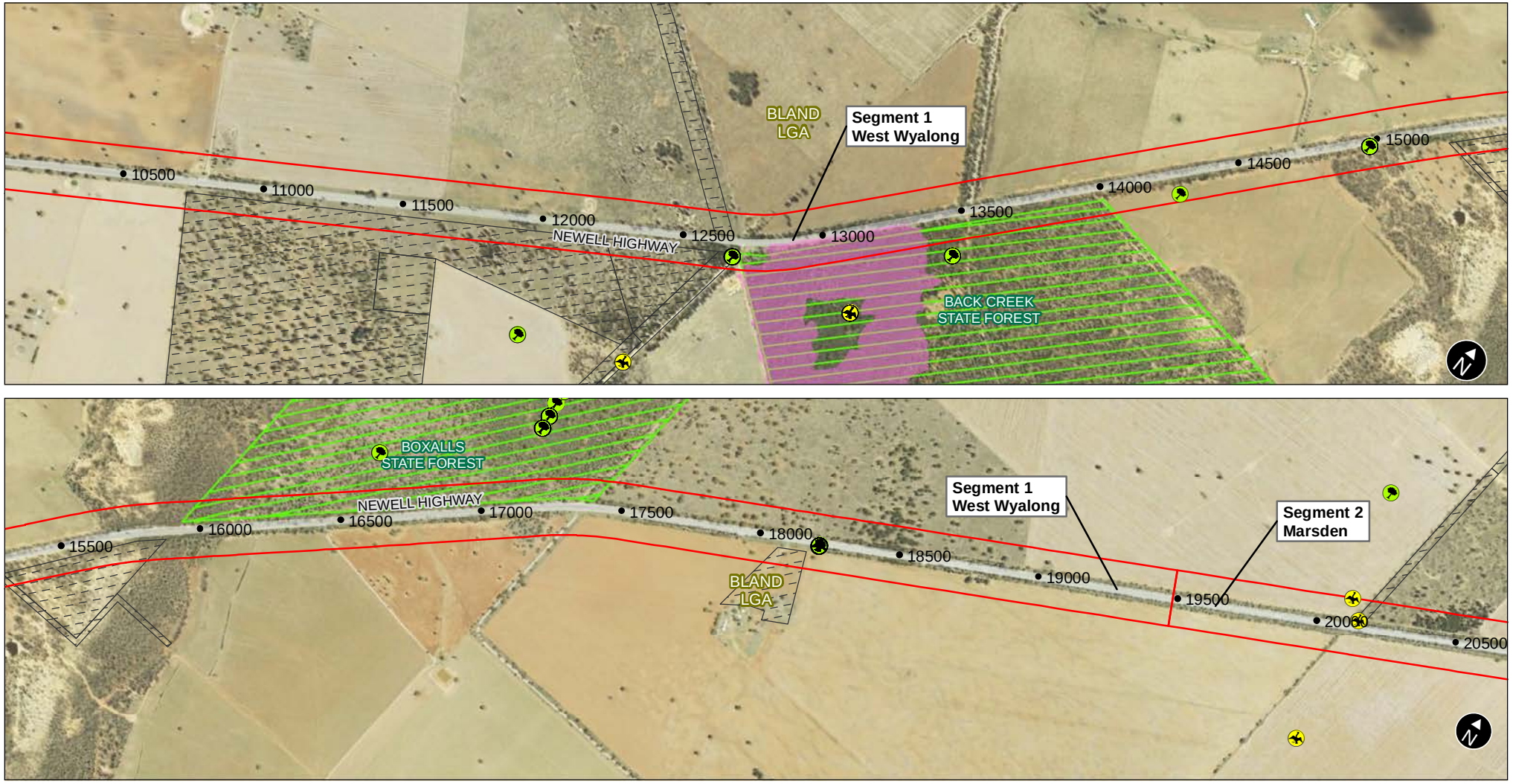

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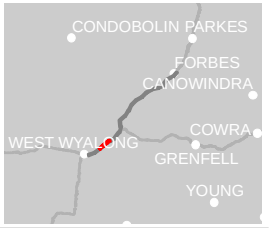

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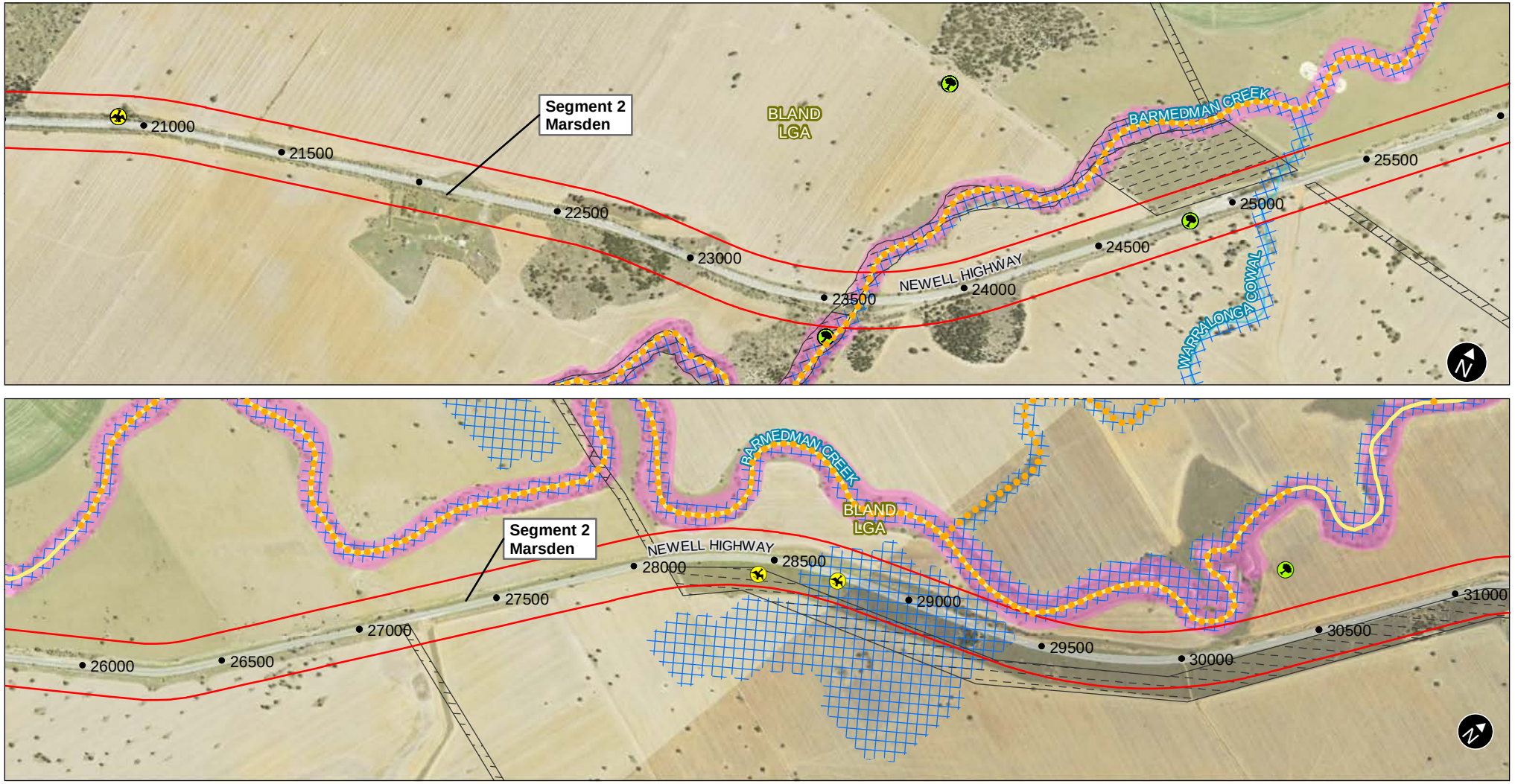

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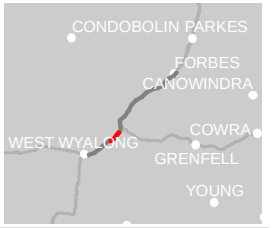

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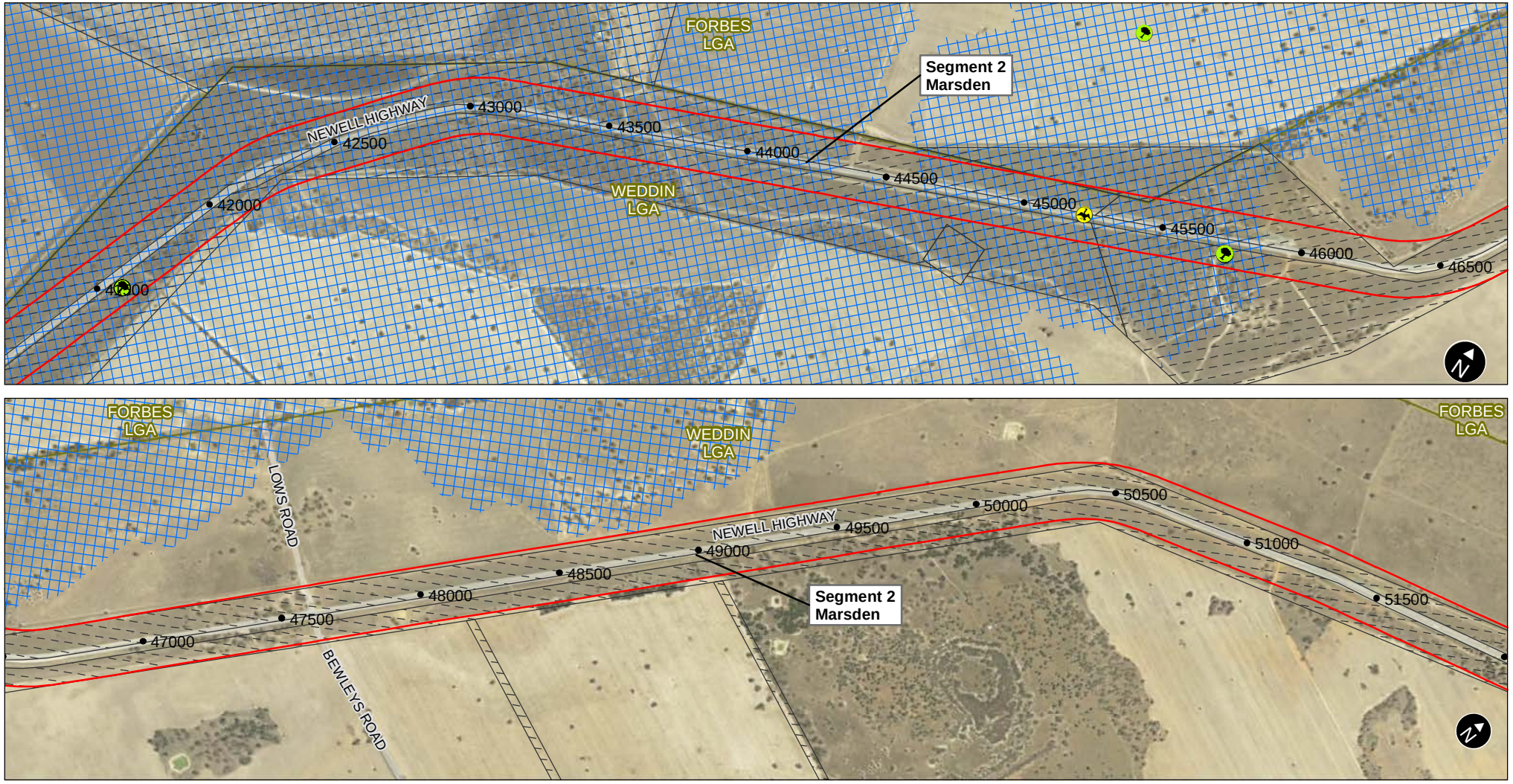

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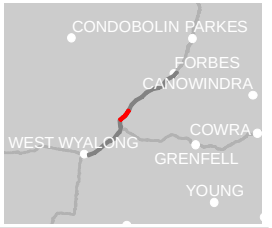

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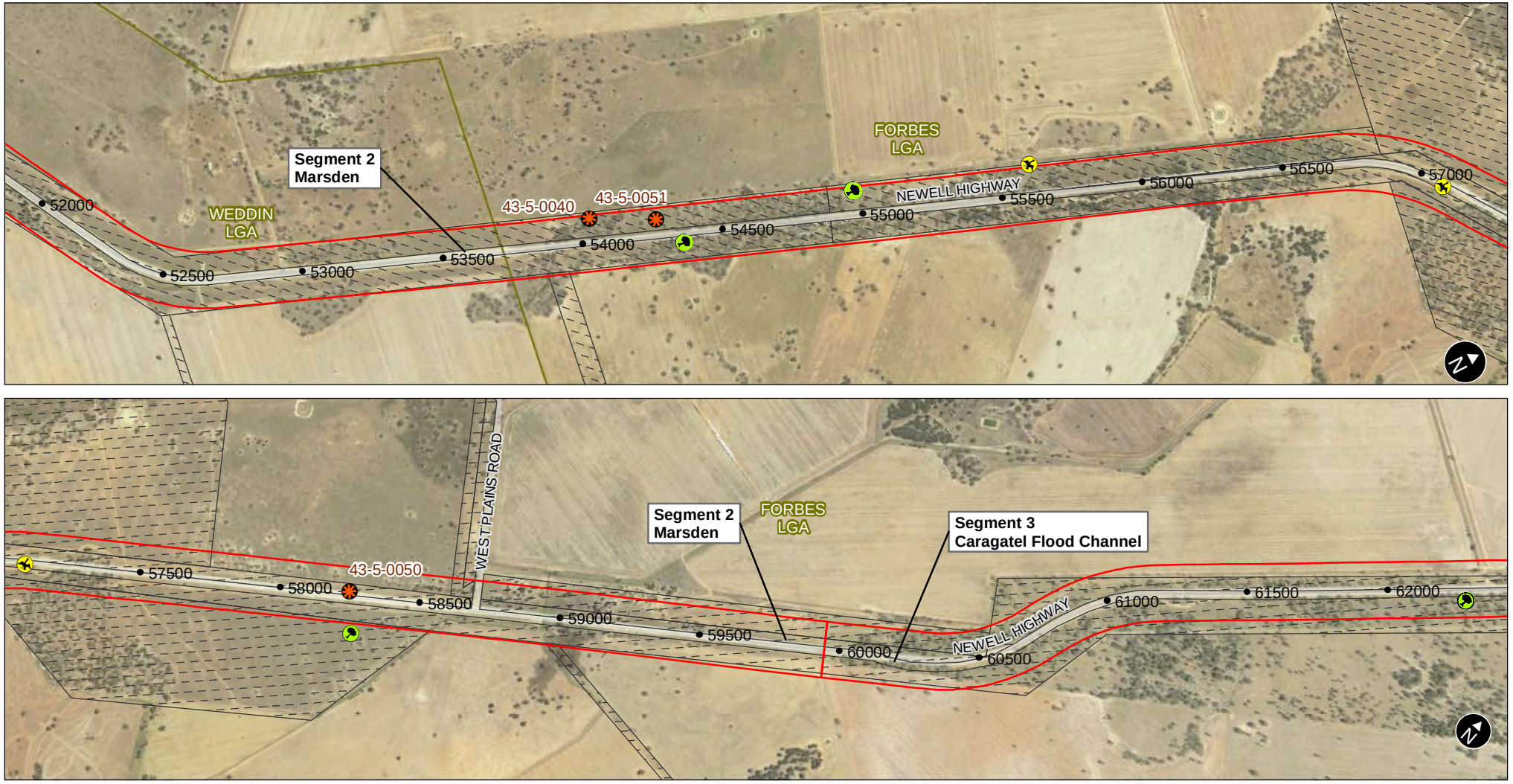

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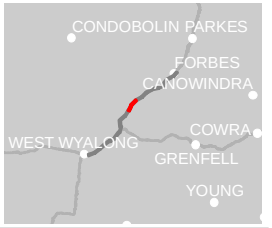

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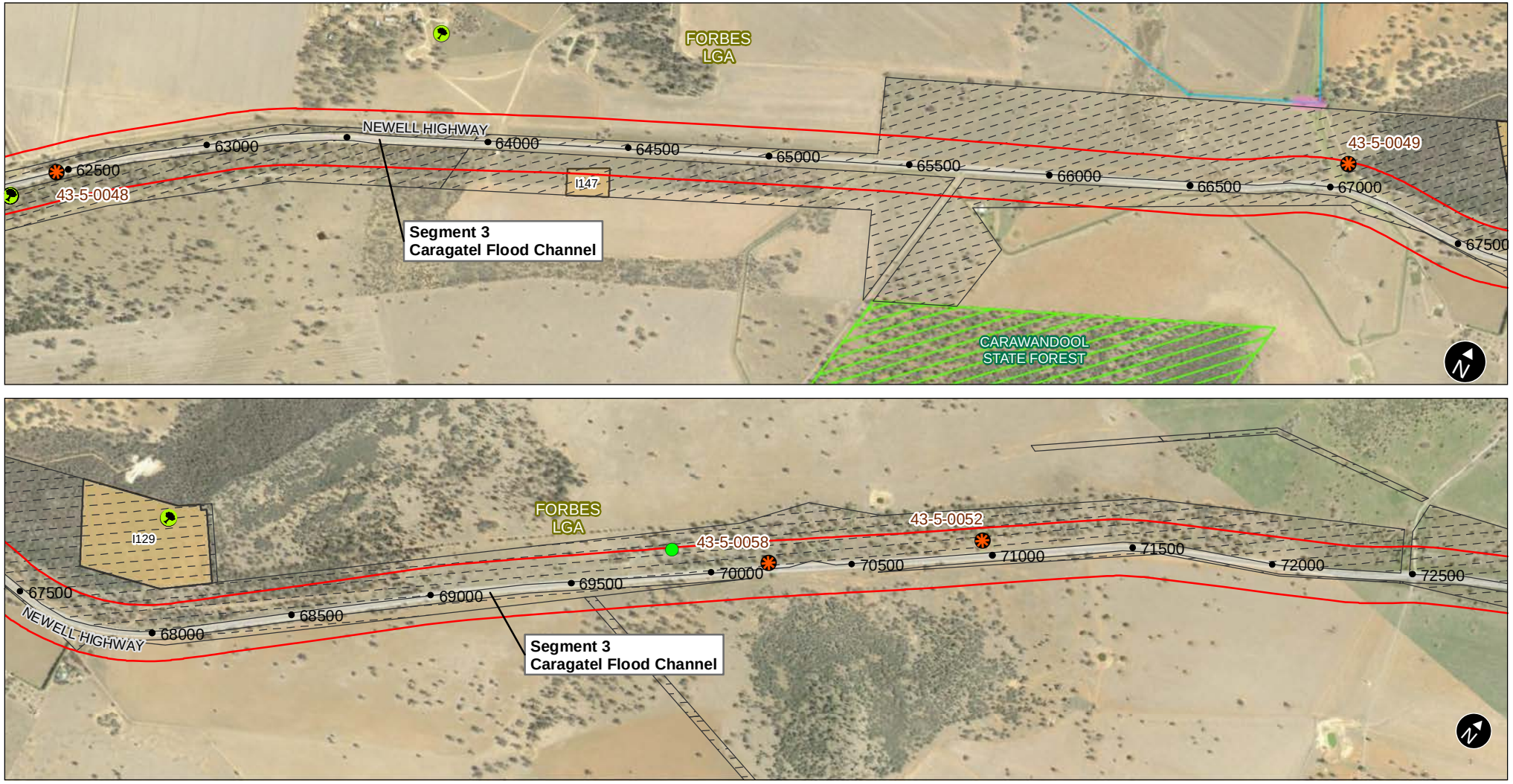

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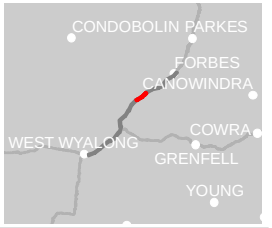

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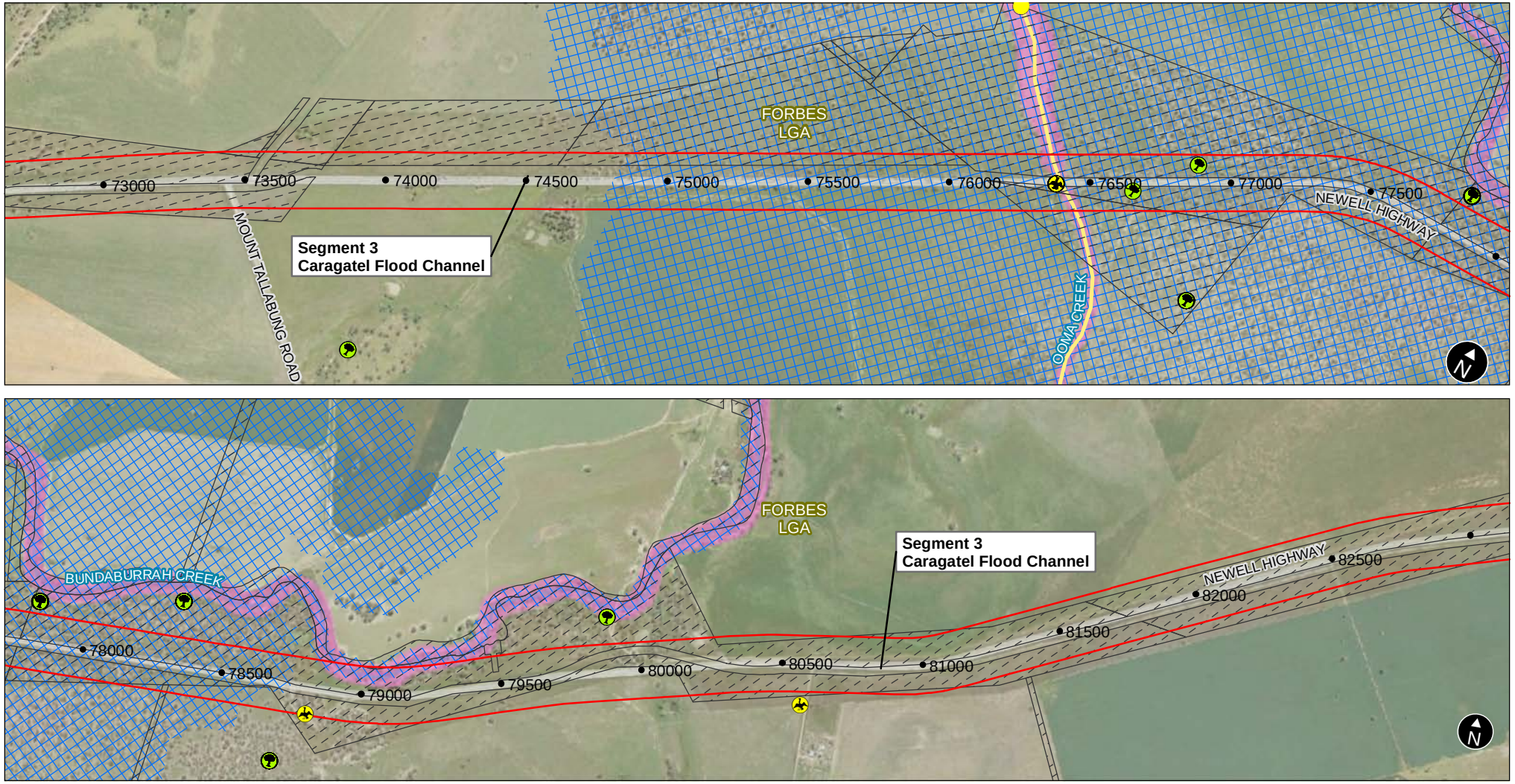

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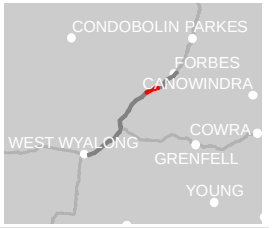

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

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Figure 1-2 The investigation area

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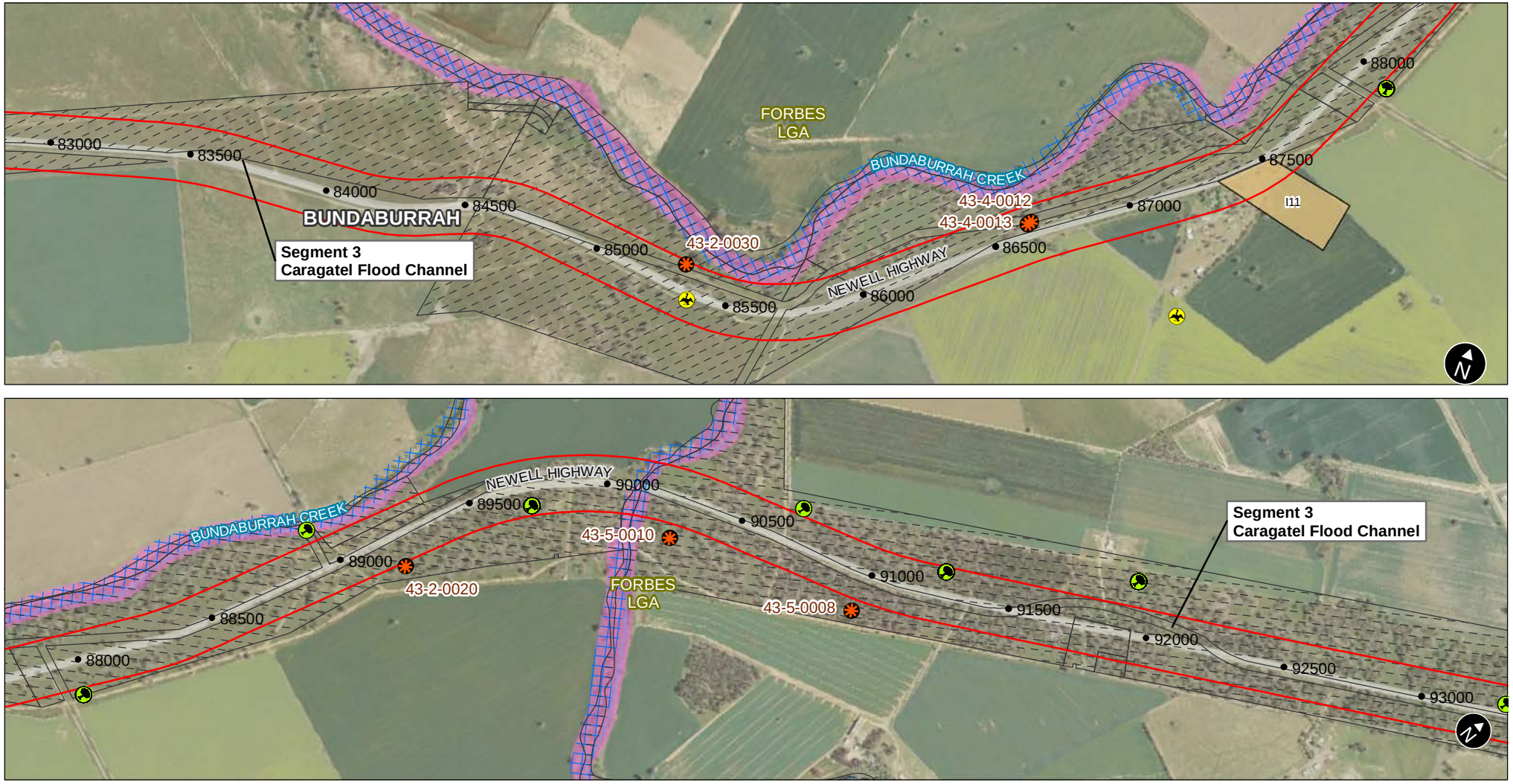

Legend

- Study area
- Local Government Area
- State Forest
- Crown land
- Waterway
- AHIMS Site
- Threatened flora
- Threatened fauna
- Areas of outstanding biodiversity value
- Item - Landscape
- Item - Archaeological
- Item - Aboriginal
- Item - General
- Key Fish Habitat
- Eel Tailed Catfish/Silver Perch
- Flathead Galaxias
- Olive Perchlet
- Purple Spotted Gudgeon
- Rest area

0 500 1000 m

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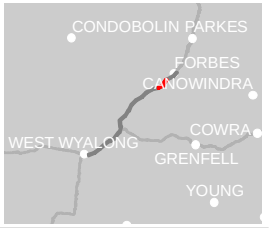

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

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Figure 1-2 The investigation area

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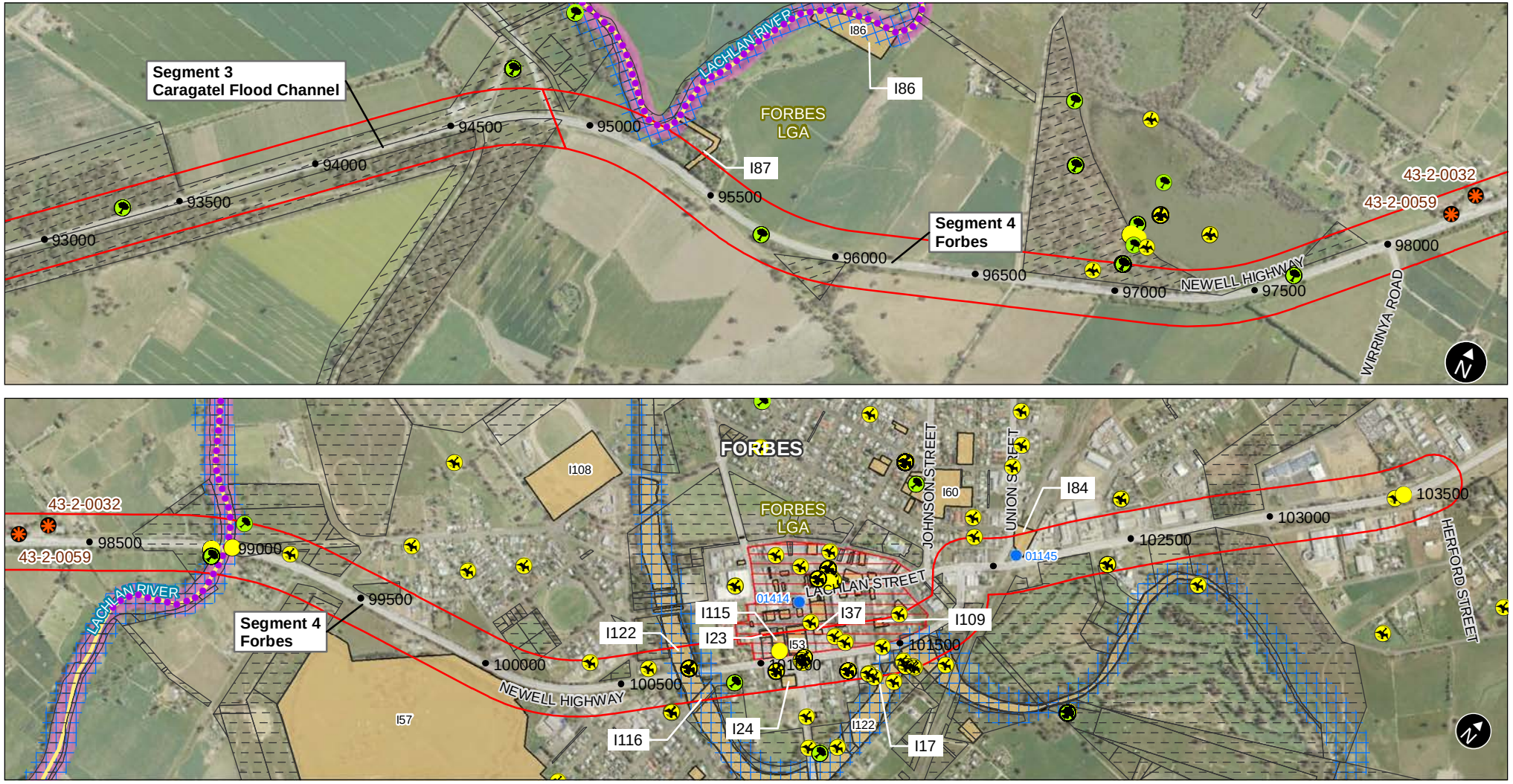

Legend

- Study area
- Local Government Area
- State Forest
- Crown land
- Waterway
- AHIMS Site
- Threatened flora
- Threatened fauna
- Areas of outstanding biodiversity value
- Item - Landscape
- Item - Archaeological
- Item - Aboriginal
- Item - General
- Conservation Area - General
- State Heritage Register item
- Key Fish Habitat
- Eel Tailed Catfish/Silver Perch
- Flathead Galaxias
- Olive Perchlet
- Purple Spotted Gudgeon
- Rest area

0 500 1000 m

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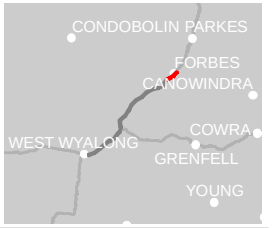

Data sources

Jacobs 2020
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NSW OEH 2020

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Figure 1-2 The investigation area

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2. Proposal need

This chapter describes the need for the proposal in terms of its strategic setting and operational need.

2.1 Strategic context

The Newell Highway (the highway) corridor (A39) is the longest highway in NSW, extending about 1,058 km. It provides an essential connection for central western NSW and a vital transport corridor between Victoria, NSW, and Queensland. The highway supports access between key regional primary industries and export markets in addition to regional tourism.

Newell Highway Corridor Strategy 2015

The Newell Highway Corridor Strategy (Transport, 2015) was released in May 2015 to address the transport needs of the corridor, including support for greater use of Higher Productivity Vehicles (HPVs) over the full length of the highway. The medium term investment priority 'Identify solutions to improve flood immunity' and the long-term investment priority 'Address nuisance flooding' in the strategy addresses the objectives of the proposal by providing the planning solutions, and the design for a flood free route along the highway.

There is a low level of flood immunity along the entire route. The highway is currently susceptible to nuisance flooding, as well as flooding from larger events including swollen river systems and sheet flow over expansive flood plains. The current infrastructure in the study area does not support weather events and results in flooding along the highway.

The NSW Long Term Transport Master Plan (Transport, 2012) also identified adapting our transport infrastructure to be resilient including the need to understand the vulnerability of existing transport infrastructure to these impacts, reinforce and maintain these assets, and carefully plan where we build infrastructure in the first place.

The highway is the longest highway in NSW, running north to south through the State and providing an essential road connection for central western NSW. This strategy sets out how the NSW Government will manage road transport along the highway in the long-term from Tocumwal on the Victorian border to Goondiwindi on the Queensland border.

The Newell Highway Corridor Strategy (Transport, 2015) will be delivered over a 20 year timeframe, in line with regional transport plans and other relevant National and State planning frameworks. From road safety and transport efficiency to asset maintenance issues, this strategy sets the direction for managing the highway into the future.

The proposal will support increased reliability for flood immunity for road users between West Wyalong and Forbes.

The National Land Transport Network

The National Land Transport Network is an integrated network of national and inter-regional transport corridors that are of strategic importance because of their role in supporting national and regional economic growth and connectivity.

The highway is part of the National Land Transport Network and is the principal inter-capital freight route between Melbourne and Brisbane. It is also a critical link for regional producers in central and western NSW. Freight movements within the corridor are expected to grow strongly, supported by robust population growth in both Melbourne and Brisbane.

The proposal will provide safer connections, more efficient travel during flooding and increased reliability for flood immunity for road users between West Wyalong and Forbes.

NSW State Infrastructure Strategy 2018-2038

The NSW State Infrastructure Strategy 2018-2038 (Infrastructure NSW 2017) (the State Infrastructure Strategy) sets out the government's priorities for the next 20 years and combined with the Future Transport Strategy 2056 (Future Transport Strategy) and the Regional Development Framework, brings together infrastructure investment and land-use planning for NSW cities and regions.

The State Infrastructure Strategy identifies a number of key actions to connect people and places, including a number of recommendations designed to improve the efficiency of regional and interstate transport connections. The State Infrastructure Strategy highlights the benefits of the proposal, such as improving travel times and improving road safety within the study area.

The proposal would therefore be consistent with the aim of a competitive and connected regional economy by improving the reliability and capacity of the highway between West Wyalong and Forbes during flood events.

Future Transport Strategy 2056

The *Future Transport Strategy 2056* (Transport, 2018) is an update of NSW's Long Term Transport Master Plan (Transport, 2012). The Future Transport Strategy sets the 40 year vision for transport in regional NSW. The broad aims of the strategies and plans are to provide better connections between regions rather than the previous focus on connections to Sydney. The highway improvements are identified as a regional initiative to be investigated within 0-10 years. A focus in the *Newell Highway Corridor Strategy* (Transport, 2015) is on managing a resilient transport system. This includes managing a transport system that is resilient to significant weather events including floods, fog, and bush fires. The proposal would support this initiative by improving the flood immunity, reliability, and safety of the highway for road users which would assist in improving the highway.

The Future Transport Strategy is a vision for how transport can support growth and the economy of NSW over the next 40 years. It is underpinned by the Services and Infrastructure Plans (SIPs), which set the customer outcomes for Greater Sydney and Regional NSW for the movement of people and freight to meet customer needs and deliver responsive, innovative services. The proposal will help to deliver these customer outcomes identified in the Regional SIP.

National Partnership Agreement

The Australian Government entered into a new National Partnership Agreement with the NSW Government on 10 October 2014. The National Partnership Agreement aims to facilitate achievement of the following outcomes:

- Improved land transport infrastructure that supports economic growth and productivity
- Improved connectivity for communities, regions and industry
- Improved transport safety
- Integrated and innovative network-wide planning for land transport infrastructure projects.

The highway is part of the National Land Transport Network and a key focus for improving national freight efficiency and productivity given the relatively high volumes of road freight carried on this route. The proposal will reduce delays currently experienced by freight vehicles on this section of the highway by improving the flood immunity and providing efficient detours which indirectly improves travel speeds/reliability and reducing crash risk, and therefore reducing travel times and vehicle operating costs for freight vehicles travelling on the highway.

NSW Freight and Ports Plan 2018-2023

The National Land Transport Network (Roads) includes the highway. The regional freight network supports the regional NSW road network and aims to facilitate this through making regional roads more efficient and safer including the following outcomes:

- Improved east-west connections
- Maintenance and capacity enhancements
- Reducing the impact of flooding.

The proposal would assist in reducing the impact of flooding on the highway.

2.2 Need for the proposal

The highway is a national highway that forms a primary freight and passenger transport link between Victoria and Queensland, and between regional centres in central western NSW.

The highway is prone to flooding and has a history of road closures during periods of heavy rain in the Lachlan Catchment. The section of the highway between West Wyalong and Forbes is particularly susceptible to flooding by the Bland Creek causeway system at Marsden.

Heavy rainfall in September 2016 caused flooding of about 20 km of the highway between Forbes and West Wyalong. The flooding resulted in a 43 day road closure. Flooded sections were located in clusters around Marsden, the Caragatel Flood Channel and Forbes.

Detours during flooding events have been further hampered by the flooding and subsequent closure of alternate routes, adding substantial distances to travel within the region.

The proposal is required to improve the flood immunity of the highway between West Wyalong and Forbes. The environmental findings of this PEI will form part of the decision-making process for preferred flood immunity solutions in subsequent stage of the proposal.

2.3 Proposal objectives

The primary objective of the proposal is to provide increased flood immunity along the highway between West Wyalong and Forbes by:

- Achieving a minimum flood passable level of service for an equivalent 2016 flood event
- Achieving a minimum flood immunity of 1 in 20 year annual recurrence interval
- Assessing options for flood immunity and flood passable for up to a one in 50 year flood event.

3. Statutory and planning framework

This chapter outlines the planning and approvals processes that may apply to the proposal.

3.1 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the main piece of legislation regulating land use planning and development assessment in NSW. The applicable planning approvals pathway for a development under the EP&A Act is generally dependent on the development's size, environmental impact and capital cost, as well as relevant planning provisions under other pieces of NSW legislation, including State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs).

The two main parts of the EP&A Act that are relevant to the proposal, as a development for the purposes of a road that will be carried out by or on behalf of Transport, are Division 5.1 and Division 5.2.

The applicable approval process is generally determined by reference to the relevant environmental planning instruments and other controls. Pursuant to section 3.28 of the EP&A Act there is a general presumption that a SEPP prevails over a LEP in the event of an inconsistency.

The appropriate planning pathway will be confirmed as part of the detailed environmental assessment.

3.1.1 State Environmental Planning Policies

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 for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent, provided that the proposal is not carried out on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act).

The proposal is not located on land reserved under the NPW Act and does not require development content or approval under the State Environmental Planning Policy (Coastal Management) 2018, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Development) 2005.

As the proposal is for a road and being carried out by Transport, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities before the start of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), will be determined in the detailed environmental assessment phase.

Other specific consultation requirements for the proposal will need to be determined during design development and the detailed environmental assessment phases.

State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) identifies development that is State Significant Infrastructure (SSI). Schedule 3 Clause 1 of SRD SEPP provides that the following general public authority activities are SSI:

> 'Infrastructure or other development that (but for Division 5.2 of the Act and within the meaning of Division 5.1 of the Act) would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent, require an environmental impact statement (EIS) to be obtained under Division 5.1 of the Act.

The potential for the proposal to be classified as SSI would be dependent on whether, in the opinion of Transport, an EIS is required under Division 5.2 of the EP&A Act.

State Environmental Planning Policy (Koala Habitat Protection) 2020

The Weddin Shire and Forbes LGAs are listed in Schedule 1 of State Environmental Planning Policy (Koala Habitat Protection) 2020 (SEPP 2020). This SEPP encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure that permanent free living populations are maintained over their present range and reverse the current trend of koala population decline.

While this SEPP does not affect the permissibility of the proposal as a Division 5.1 assessment, consideration would be required regarding the proposal's impact on koala habitat.

Targeted surveys will need to be carried out during the detailed environmental assessment phase of the proposal to confirm the presence of koalas and more detailed field survey will be required to determine if any 'core koala habitat', as defined under the SEPP, exists in the study area.

3.1.2 Local Environmental Plans

The proposal is located in the Bland, Weddin and Forbes LGA. The Bland Local Environmental Plan 2011 (Bland LEP), Weddin Local Environmental Plan 2011 (Weddin LEP) and Forbes Local Environmental Plan 2013 (Forbes LEP) are applicable to the proposal.

Bland Local Environmental Plan 2011

As shown in **Figure 3-1**, the following land zones (established under the Bland LEP) are located in the study area: Segments 1 and 2 of the proposal are within the Bland LGA.

- B6 – Enterprise Corridor
- E3 – Environmental Management
- IN1 – General Industrial
- R1 – General Residential
- RE1 – Public Recreation
- RU1 - Primary Production
- RU3 – Forestry
- SP2 – Infrastructure.

Weddin Local Environmental Plan 2011

As shown in **Figure 3-1**, RU1- Primary Production and SP2 - Infrastructure land zone (established under the Weddin LEP) is located in the study area. Segments 2 and 3 are within Weddin LGA.

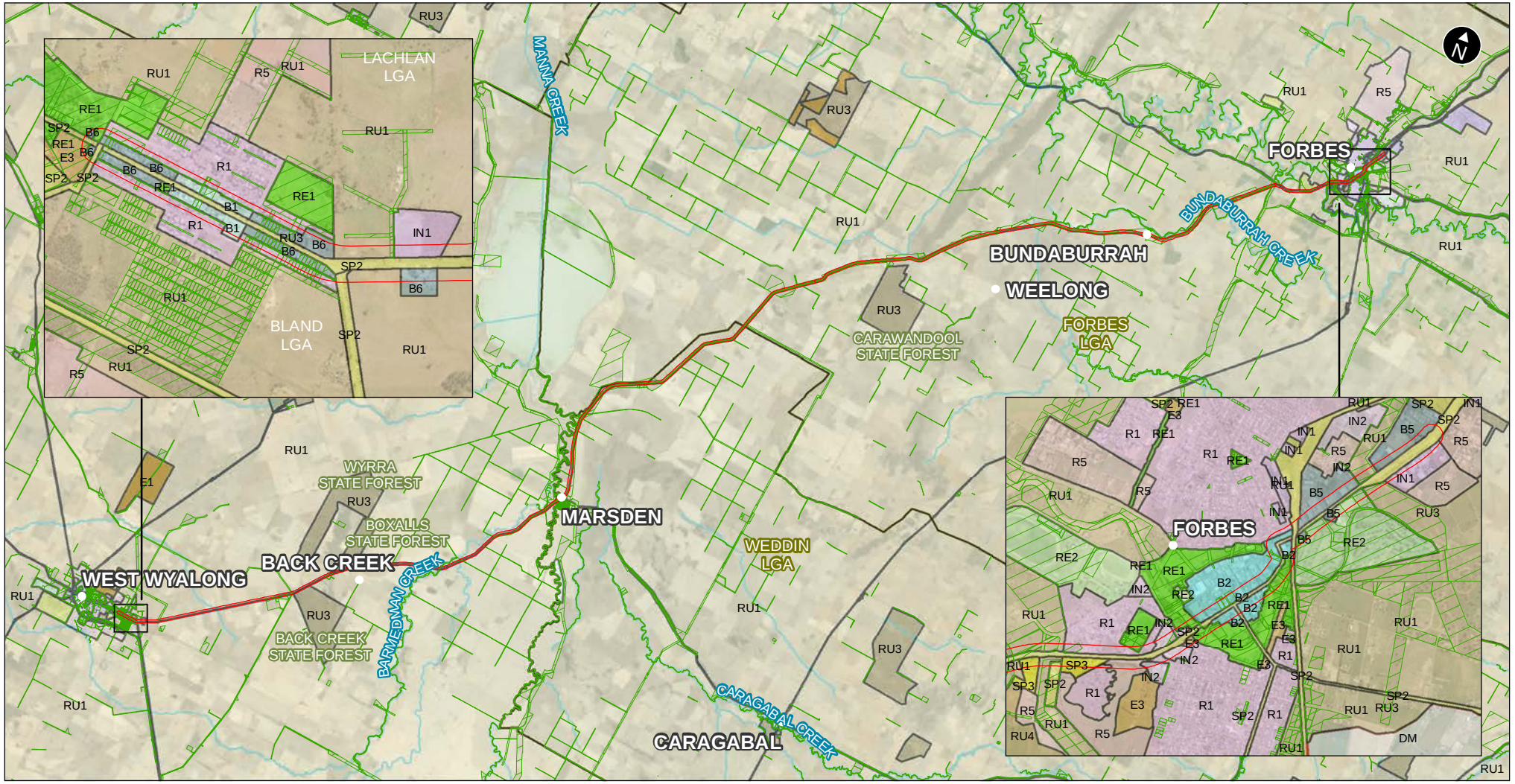
Forbes Local Environmental Plan 2013

As shown in **Figure 3-1**, the following land zones (established under the Forbes LEP) are located in the study area: Segments 3 and 4 are within Forbes LGA.

- R1 – General Residential
- R5 – Village
- RU1 – Primary Production
- SP2 – Infrastructure
- SP3 – Tourist
- IN1 – General Industrial
- IN2 – Light Industrial
- E3 – Environmental Management
- RU1 – Primary Production
- RE1 – Public Recreation
- RE2 – Private Recreation
- B2 - Local Centre
- B5 - Business Development.

Development for the purposes of a road is generally permitted with consent within the above land zones in the Bland, Weddin and Forbes LGAs.

As outlined in **Section 3.1.1**, the ISEPP states that the proposal could be carried out by or on behalf of Transport without development consent from Bland, Weddin or Forbes Councils.



Legend

- Study area
- Local Government Area
- Crown land
- Waterway

Land zoning

B1	Neighbourhood Centre	IN1	General Industrial	RU3	Forestry
B2	Local Centre	IN2	Light Industrial	RU4	Rural Small Holdings
B5	Business Development	R1	General Residential	RU5	Village
B6	Enterprise Corridor	R5	Large Lot Residential	SP2	Infrastructure
E1	National Parks and Nature Reserves	RE1	Public Recreation	SP3	Tourist
E3	Environmental Management	RE2	Private Recreation	DM	Deferred matters
		RU1	Primary Production		

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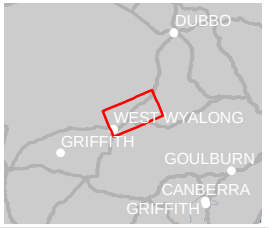

Data sources

Jacobs 2020
NSW Spatial Services 2020
GDA94 MGA55

Figure 3-1 LEP land zoning

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3.2 Other relevant NSW legislation

3.2.1 Protection of Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) administers environment protection licences (EPLs) for specific activities relating to air, water and noise pollution, and waste management. The NSW Environment Protection Authority (EPA) and local government, where relevant, administer the POEO Act. Development activities require an EPL under the POEO Act if those activities meet the assessment criteria outlined in Schedule 1 of the Act.

Clause 35 of Schedule 1 identifies 'road construction' as a scheduled activity and states:

1. This clause applies to road construction, meaning the construction, widening or re-routing of roads, but does not apply to the maintenance or operation of any such road.
2. The activity to which this clause applies is declared to be a scheduled activity if it results in the existence of 4 or more traffic lanes (other than bicycle lanes or lanes used for entry or exit) for at least:
    a. where the road is classified, or proposed to be classified, as a main road (but not a freeway or tollway) under the Roads Act 1993:
        i. 3 km of their length in the metropolitan area, or
        ii. 5 km of their length in any other area.

Other scheduled activities listed under Schedule 1 that may apply to the upgrade work include 'extractive industries', 'crushing, grinding and separating' and/or 'contaminated soil treatment', depending on whether the volumes specified in Schedule 1 are exceeded.

In addition, during the construction phase, Transport would be obliged to notify if a 'pollution incident' occurs that causes or threatens 'material harm' to the environment.

The maintenance and operation of the proposal is not expected to be a scheduled activity under the POEO Act and will be managed under Transport's existing Environmental Management System.

3.2.2 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides for the operation, maintenance and use of roadways in NSW including managing authorities, rites of passage and classification of roads. It also provides for the declaration of Transport and other public authorities as roads authorities for both classified and unclassified roads. It also regulates carrying out various activities in, on and over public roads.

Under section 138(1) of the Roads Act, various activities in, on or over public roads require consent from the roads authority. However, Transport may exercise its function as the roads authority under section 64, thereby not requiring consent to carry out work on a classified road under Schedule 2, clause 5(1) of the Roads Act.

A road occupancy license (ROL) will be required, however, be sought for the temporary closure of traffic lanes and, if required, the movement of over-sized vehicles during construction.

3.2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. Part 7 of the FM Act provides for the protection of aquatic habitats including providing management of dredging and reclamation work within permanently or intermittently flowing watercourses. The proposed construction work near and within waterways may meet the definition of reclamation work under section 198A of the FM Act, which defines reclamation as:

1. Using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land, or
2. Depositing any such material on water land for the purpose of constructing anything over water land (such as a bridge) or
3. Draining water from water land for its reclamation.

The proposal is not expected to directly impact aquatic habitat or block the passage of fish. The extent and location of the flood immunity work is yet to be determined. Bridges and large culverts may be upgraded as part of the proposal. Notice to the Minister has not been identified as required at this stage.

The potential approval and consultation requirements for the proposal under the FM Act will be considered during the detailed environmental assessment phase.

3.2.4 National Parks and Wildlife Act 1974

The NPW Act is administered by the Department of Planning, Industry and Environment (DPIE) Environment, Energy and Science (EES) and provides for:

- Protection of Aboriginal sites or remains
- Reservation of land for protection under the Act, including reservation of National Parks.

The above provisions of the NPW Act, including consideration of how such provisions could apply to the proposal, are discussed in the following sections.

Aboriginal sites or remains

Under section 90(1) of the NPW Act, where harm to an Aboriginal object or Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit (AHIP) is required. As discussed in **Section 5.3.4**, a Stage 1 clearance letter will be required, with Stage 2 expected to be carried out in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011). Previously recorded Aboriginal heritage items were identified within the study area in the AHIMS search.

The NPW Act provides for the protection of Aboriginal objects and Aboriginal places. Under the Act (section(s) 5), an Aboriginal object is defined as:

> ‘any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises New South Wales, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction and includes Aboriginal remains.

An Aboriginal place is defined under this Act as an area that has been declared by the Minister administering the NPW Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

Under Section 85 of the NPW Act, the Chief Executive of DPIE is responsible for the care, protection and preservation of Aboriginal objects and places in NSW.

Under Section 89A of the NPW Act it is a requirement to notify the Chief Executive of DPIE of the location of an Aboriginal object. Identified Aboriginal items and sites are registered with NSW on the Aboriginal Heritage Information Management Systems (AHIMS).

Under Section 86(1) of the NPW Act it is an offence to knowingly destroy, deface, damage or desecrate, or cause or permit the destruction, defacement, damage or desecration of an Aboriginal object or Aboriginal place, without the prior written consent from the Chief Executive of DPIE. Penalties apply to the offence of knowingly impacting on an Aboriginal object or Aboriginal place. The largest penalties apply when a person

harms an object that they know to be an Aboriginal object (called a 'knowing offence'). However, a 'strict liability' offence still applies, under Section 86(2), whether or not a person knows it is an Aboriginal object or place.

Section 87(2) of the NPW Act provides that it is a defence to the provisions of Section 86(2) if the defendant exercised due diligence to determine whether an Aboriginal object would be harmed, and reasonably determined that no Aboriginal object would be harmed. This is not a defence to the offence of knowingly harming an Aboriginal object (offences that contravene Section 86(1)).

Five Aboriginal heritage items occur within the study area and 13 Aboriginal heritage items occur within 100 m either side of the existing road centre line. Further details on Aboriginal heritage is provided in **Section 5.3**.

3.2.5 Aboriginal Land Rights Act 1983 (NSW)

The *Aboriginal Land Rights Act 1983* recognises the rights of Aboriginal people in NSW and provides a vehicle for the expression of self-determination and self-governance.

The purposes of the Act are:

- To provide land rights for Aboriginal persons in NSW
- To provide for representative Local Aboriginal Land Councils (LALC) in NSW
- To vest land in those LALCs
- To provide for the acquisition of land, and the management of land and other assets and investments, by or for those LALCs and the allocation of funds to and by those LALCs
- To provide for the provision of community benefit schemes by or on behalf of those LALCs.

3.2.6 Native Title (NSW) Act 1994

The *Native Title (NSW) Act 1994* was introduced to ensure that the laws of NSW are consistent with the *Commonwealth Native Title Act 1993*. It validates past and intermediate acts which may have been invalidated because of the existence of native title.

There are no determinations of Native Title within the study area. However, there is one Native Title application which was filed in 21 August 2020 by the West Wyalong LALC for an area of approximate size of 0.5872 square kilometres (km^2). The study area is not covered by this application. The closest parcel of this application is within the highway corridor, approximately 750m south west of the study area.

3.2.7 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, work, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the State. Matters protected under the Heritage Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under section 170 of the Act by NSW Government agencies (Section 170 Registers). The Heritage Act also provides for the protection of archaeological 'relics', being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.

Approval under section 60 of the Heritage Act is required for any action that would adversely affect an item that is subject to an Interim Heritage Order or a listing on the State Heritage Register. An excavation permit

under section 139 of the Heritage Act is required for activities that will result in or are likely to result in the disturbance or excavation of a 'relic'.

The potential for previously unrecorded heritage items or archaeological relics to be present within the study area was not addressed as part of this PEI and will need to be considered during the detailed environmental assessment phase of the proposal.

Non-Aboriginal heritage is discussed further in **Section 5.8**.

3.2.8 Crown Land Management Act 2016

The *Crown Land Management Act 2016* provides the legislative framework for the administration of land that is vested in the Crown in NSW. Ministerial approval is required to grant a 'lease, licence, permit, easement or right of way over a Crown Reserve'.

Crown land is mapped next to the existing highway, and within all segments of the study area. Partial acquisition of Crown land may be required for the proposal. Transport will consult with the Minister for Lands during detailed environmental assessment and send a formal letter stating interest in this parcel of land for the proposal if required.

Any works proposed on the Crown lands will need landowners' consent and a license for the works themselves. Crown land within the study area is shown on **Figure 1-2**. Travelling stock reserves (TSR) are present either side of the highway between West Wyalong and Marsden and between Marsden to Forbes.

3.2.9 Biosecurity Act 2015

Under the *Biosecurity Act 2015* (Biosecurity Act), all plants, including weeds, are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

The Biosecurity Act and regulations provide specific legal requirements for high risk activities and State level priority weeds.

The presence of declared priority weeds within the study area will be assessed during further biodiversity surveys and managed during construction of the proposal as required (refer to **Section 5.2**).

3.2.10 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) sets out the environmental impact assessment framework for threatened species, threatened ecological communities (TECs) and Areas of Outstanding Biodiversity Value (AOBVs) (formerly critical habitat) for Division 5.1 activities (amongst other types of development).

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) or Biodiversity Development Assessment Report (BDAR) must be prepared in accordance with the Director-General's requirements.

As discussed in **Section 5.2.2**, based on the likelihood of occurrence assessment 14 threatened flora species, 60 threatened fauna species and nine TECs listed under the BC Act were considered to have a likelihood of occurring within the locality.

The potential for the proposal to impact on threatened species listed under the BC Act will need to be considered during the detailed environmental assessment phase. This will include the preparation of

Assessments of Significance for any BC Act listed threatened flora and fauna that has the potential to occur within the study area.

3.2.11 Water Management Act 2000

The *Water Management Act 2000* (WM Act) Act provides for the protection and management of water resources in NSW. The WM Act controls the extraction of water, how water can be used, the construction of works such as dams and weirs, and the carrying out of activities on or near water sources. The WM Act also enables the State's water resources to be managed under water sharing plans, which establish the rules for protecting the environment, water extraction, the sharing of water in a particular water source between water users and the environment, and rules for the trading of water in a particular water source (DPIE 2021).

The Lachlan Unregulated and Alluvial Water Sources water sharing plan currently applies to the study area.

An approval under the WM Act would be required if access to ground or surface water is required during construction, owing to the existence of water sharing plans. Some provisions of the WM Act (eg for stock and domestic uses and harvestable rights) enable some activities or works to be carried out without the need for licences, provided certain conditions are met.

Transport will consult with WaterNSW to ensure that all applicable licences and/or approvals for any impacts to surface and ground water are obtained prior to construction.

3.3 Commonwealth legislation

3.3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects matters of national environmental significance (MNES) (as defined under the Act) and the environment of Commonwealth land. Under the EPBC Act, a referral to the Commonwealth Department of Agriculture, Water and the Environment (DoAWE) is required for proposed ‘actions’ that have the potential to have a significant impact on any MNES or the environment of Commonwealth land. A ‘strategic assessment’ approval was granted by the Federal Minister in accordance with the EPBC Act in September 2015. The strategic assessment approval means that most Transport Division 5.1 activities do not require referral to DoAWE provided that impacts are considered and addressed in regard to nationally listed threatened species, ecological communities and migratory species.

MNES to be considered includes:

- World heritage
- National heritage
- Wetland of international importance
- Listed threatened species or communities
- Listed migratory species
- Commonwealth marine area
- Proposal involving nuclear action (including uranium mining)
- Water resource, in relation to coal seam gas development and large coal mining development
- Any impact (direct or indirect) to Commonwealth land.

The only MNES of relevance to the proposal is listed threatened species and ecological communities and migratory species.

A search of the EPBC Protected Matters Search Tool (PMST) was carried out on 13 August 2020 with a 10 km buffer on the study area. This search identified 13 threatened flora species and 288 threatened fauna species listed under the EPBC Act that may occur in the study area due to the presence of suitable habitat for these species. The PMST is provided in **Appendix A**.

Seven TECs listed under the EPBC Act were also considered known or likely to occur within the study area. These are considered in **Chapter 5.2**.

Survey and assessment will be required to determine the absence or presence of protected species and communities under the EPBC Act. Assessments according to the EPBC Act significant impact guidelines will need to be carried out for MNES to determine the need for a referral to the DoAWE.

3.4 Summary of planning issues

The main planning issues identified are summarised below:

- The proposal may be assessed under Division 5.1 of the EP&A Act in which case a review of environmental factors would be prepared to document the environmental assessment. Transport would be the proponent and determining authority. Other approvals may also be required for the proposal as set out below
- Should the proposal become an SSI under Division 5.2 of the EP&A Act an EIS would be prepared in accordance with environmental assessment requirements of the Secretary of DPIE and the Minister for Planning and Public Spaces would be the consent authority. Some approvals required under other legislation do not apply in respect of SSI
- The appropriate planning pathway is to be confirmed during future proposal stages
- Parts of the highway are located within the road reserve corridor and some parts are located out the road reserve corridor. Some of the part of the highway that are outside of road reserve are contained within Crown land which may require acquisition
- A Road Occupancy Licence (ROL) will need to be obtained as necessary prior to construction commencing
- Transport will consult with the WaterNSW to ensure that all applicable licences and/or approvals for any impacts to surface and ground water are obtained prior to construction
- The potential approval and consultation requirements for the proposal under the FM Act would be considered during the detailed environmental assessment phase
- The potential for previously unrecorded heritage items or archaeological relics to be present within the study area was not addressed as part of this PEI and will need to be considered during the detailed environmental assessment phase of the proposal.

4. Stakeholder engagement and community consultation

This chapter discusses the consultation carried out to date for the proposal and the consultation proposed for the future.

4.1 Identified stakeholders

Stakeholders that are anticipated to have an interest in the proposal are listed in **Table 4-1**. These stakeholders were identified through a desktop review of the following resources:

- Networks and business/industry associations listed on the Bland, Weddin and Forbes Council websites
- Previous submissions made by organisations and other special interest groups on the *Newell Highway Corridor Strategy* (Transport, 2015)
- Key issues, opportunities and constraints identified within the study area during the preparation of this PEI in the context of the area of expertise of potentially interested organisations and/or special interest groups (e.g. the National Roads and Motoring Association (NRMA) interest in traffic and transport related issues associated with the proposal).

The list of potential stakeholders in **Table 4-1** is not intended to be exhaustive; a number of other organisations, interested parties and/or special interest groups would likely have an interest in the proposal. Therefore, the list of stakeholders will need to be further refined during the subsequent stages of consultation for the proposal.

Table 4-1 Potential stakeholders identified

Stakeholder category	Stakeholder
Government agencies	• Federal Government - Member for Riverina • State Government - Member for Orange and Member for Cootamundra • Local Government - Bland Shire Council, Weddin Shire Council and Forbes Shire Council • DPIE • DPIE Environment, Energy and Science Group (EES) • DPIE Crown Land • Department of Primary Industries - Fisheries (DPI Fisheries) • Department of Regional NSW • EPA • ARTC • Emergency services (police, fire, ambulance, State Emergency Services) • Road Freight Industry Council • Transport • WaterNSW.

Stakeholder category	Stakeholder
Local business, educational facilities and the community	Residents, local business and community facilities near the study area and within West Wyalong, Wyalong, Marsden, Bundaburrah and Forbes. Road users such as local motorists, local tourist and caravan users.
Special interest groups	• LALC – West Wyalong (Wiradjuri people) • Central West Lachlan Landcare • Riverina Local Land Services • Bland Shire Community Reference Group • National Roads and Motoring Association • Road freight and other transport companies • Australian Industry Group. • Newell Highway Task Force.
Utility companies	• Essential Energy • APA Group gas – Central West Pipeline • Jemena Gas Country • NBN • Nextgen • Telstra NSW • WaterNSW.

4.2 Consultation strategy

During the next phase of assessment, a Community and Stakeholder Engagement Plan (CSEP) will be prepared for the planning, development and delivery of the proposal. This plan will identify key stakeholders, proposed communication tools, key messages and protocols to be implemented. The plan will provide an agreed approach to communication and engagement.

4.3 Community involvement

No community involvement has been carried out for the proposal to date. Following the proposal announcement, it is anticipated that broader community and stakeholder consultation will commence. Any issues raised during this consultation will be considered in further design development and detailed environmental impact assessment.

Transport issued an email to local farmers requesting flooding data in early 2020. No other community involvement has been carried out.

A media release was published in the Forbes Advocate on the 29 October 2020 (Forbes Advocate, October 29 2020) to notify the community design and environmental investigations had commenced for the proposal.

4.3.1 Aboriginal community involvement

No Aboriginal heritage consultation activities have occurred as part of the preparation of this PEI. During the environmental assessment stage requirements of the PACHCI will be required. This procedure is consistent with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Department of Environment Climate Change and Water (DECCW), (DECCW 2010).

4.4 Government agency and stakeholder involvement

A meeting was held with Forbes Shire Council on 18 September 2020 to introduce the proposal and seek the flood study data. To date, no other agency consultation has been carried out for the proposal.

4.5 Ongoing or future consultation

Transport will carry out the following consultation activities during the subsequent phases of the proposal as and if required, including:

- Consultation with adjacent and potentially affected residences, groups and landowners
- Consultation with DPIE to coordinate the transfer of Crown lands if required for the proposal
- Ongoing consultation with the Bland, Weddin and Forbes Shire Councils
- Utility providers
- Consultation with government agencies and emergency services
- Engage with community groups throughout the duration of the proposal
- Consultation with Aboriginal stakeholders according to the PACHCI if required
- Consultation with freight providers / industry and emergency services using the highway before the start of construction and before any changes to access for private properties.

The CSEP will be refined during later stages of the proposal to include the start of construction notifications.

5. Environmental issues

This section of the PEI provides a description of the potential environmental issues associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. Recommendations and opportunities to be considered during design development and detailed environmental assessment phases of the proposal are provided.

5.1 Traffic, transport and access

This section addresses the potential constraints within the study area on traffic, transport and access for the proposal.

5.1.1 Methodology

The traffic, transport and access methodology comprised of a desktop review of constraints within the study area, including the following resources:

- Aerial photography and mapping for the study area
- Existing traffic data held by Transport
- *Newell Highway Corridor Strategy* (Transport, 2015)
- Bland, Weddin and Forbes LGA published data
- The schedule of classified and unclassified roads
- Bus timetables and route maps available on Transport's website.

5.1.2 Existing environment

Road network

The highway is a classified State road (A39) and is about 1,058 km long. The highway extends from the NSW and Victorian border near Tocumwal to the NSW and Queensland border at Goondiwindi in Queensland, and is the major interstate freight corridor network between regional and export market primary industries.

The highway between West Wyalong and Forbes is about 105 km long and was built between the 1950's and 1960s. Parts of the highway are now below standard due to the poor conditions of the highway during flooding events.

The highway within the study area typically contains undivided carriageways with narrow shoulders, and a broken centre line as shown in **Photo 5-1** and **Photo 5-2**.

The speed limit is 100 to 110 km per hour (km/hr), slowing to 80 and 50 km/hr on approach to Forbes and West Wyalong.

Much of the highway road corridor also includes areas of TSRs.

Photo 5-1 Existing highway showing narrow road shoulders, broken white dividing line and no drainage infrastructure

Photo 5-2 Section of the highway that has been upgraded on the Newell Highway at Bellata (Source: Narrabri Courier, 2020)

Key roads within the study area

There are a number of local roads and unnamed access tracks that connect to the highway within the study area (refer to **Figure 1-2**).

Existing traffic volumes, road network performance

The existing daily traffic volume was estimated using the Transport Traffic Volume Viewer. There are three classifier stations on the highway between West Wyalong and Forbes. The 2019 data was used to represent the traffic movement. This is due to the Coronavirus disruption in 2020 and 2021 which impacted travel and transport to the usual vehicle movements.

The Wyalong traffic volume counter is located 460 m east of Nicolson Lane Wyalong. The average daily movements are 1,865 vehicles using the highway, with about 39 per cent classified as heavy vehicles and 61 per cent light vehicles in 2020.

The traffic volume counter is located between Wyalong and Forbes on the highway and is about 250 m south of Mid-Western Highway, Caragabal. The average daily movements for 2019 are about 1,970 vehicles using the highway in both directions. Heavy vehicles make up 44 percent and light vehicles make up about 56 percent.

Forbes closest traffic volume counter is located 150 m west of Greens Road, Forbes. Average daily movements of vehicles using the highway in 2020 is about 2,616. Heavy vehicles make up about 37 per cent and light vehicles make up about 63 per cent using the highway.

The highway is an approved heavy vehicle route with freight and tourism being the main sources of road traffic. The location and severity of crashes shown on **Figure 5-1.**

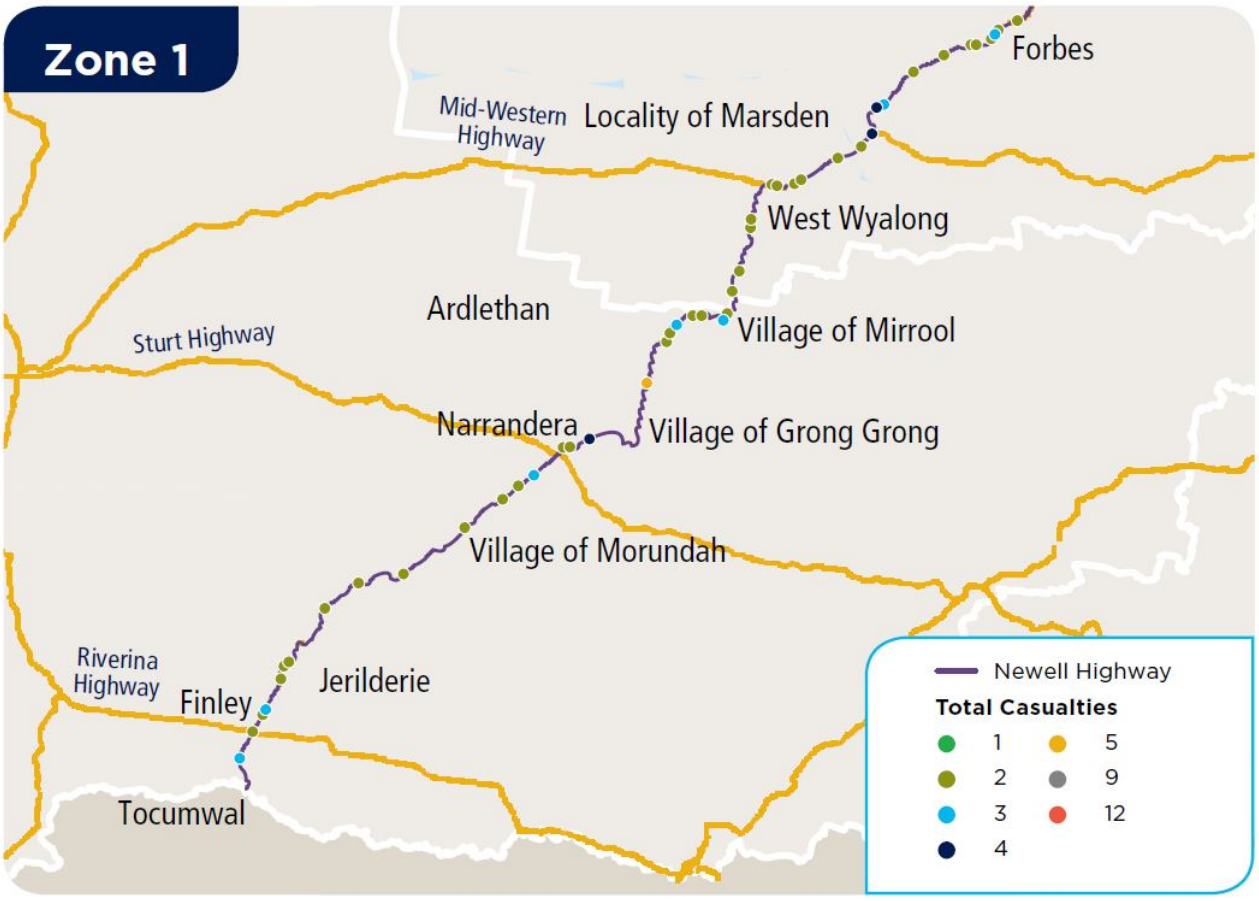


Figure 5-1 Location and severity of crashes in 2007 to 2011 (Source: Transport Newell Highway Corridor Strategy, 2015)

The crash history for the highway between 2007 and 2011, indicates that there were seven crashes and 16 casualties between West Wyalong to the intersection with the Mid-Western Highway and 10 crashes and 24 casualties between the intersection with the Mid-Western Highway to Forbes.

Public transport, cycling and road user facilities

Local bus services operate in both West Wyalong and Forbes town centres. There are no formal public bus stops along the highway and local bus services are not known to use the highway. The closest public bus service stop to the study area is about 950 m south of the study area at Forbes Hospital, Elgin Street in the north and a coach bus stop about 2.8 km south west of the study area in Church Street, West Wyalong.

The public bus service route from West Wyalong to Forbes includes roads that connect West Wyalong to Temora, Cootamundra, Young, Grenfell to Forbes.

School bus services stop at a number of informal locations along the highway to pick up and drop off passengers. The highway is used by a number of daily, long distance coaches that service the towns in central western NSW from major capital cities and larger regional centres.

The study area crosses the Stockinbingal-Parkes train line near the intersection of the highway and Union Street in Forbes, with an active crossing with boom gates and flashing lights.

There is no designated pedestrian or cycling paths provided along the highway from West Wyalong to Forbes.

Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being.

The social infrastructure within the study includes:

- Local bus services operate in both West Wyalong and Forbes town centres. The closest public bus service stop to the study area is about 950 m south of the study area at Forbes Hospital, Elgin Street in the north and a coach bus stop about 2.8 km south west of the study area in Church Street, West Wyalong
- The public bus service route from West Wyalong to Forbes includes roads that connect West Wyalong to Temora, Cootamundra, Young, Grenfell to Forbes
- There are a number of informal school bus stops along the highway
- The highway is used by a number of long distance coaches that service the towns in central western NSW from major capital cities and larger regional centres
- The closest train infrastructure intersects the study area in Forbes between the highway and Union Street on the Stockinbingal-Parkes train line, with an active crossing with boom gates and flashing lights
- There are nine vehicle rest areas located along the highway within the study area, as shown on **Figure 1-2.**

5.1.3 Summary of findings

Potential impacts associated with construction of the proposal include:

- Traffic access management has the potential to slow traffic during the construction
- Potential intersection treatments for local roads that connect to the highway
- Residential and property access in both northbound and southbound lanes will be required to be maintained from the highway
- Parts of the highway are located within the road reserve and some parts are located out the road reserve corridor. Parts of the highway that are outside of road reserve are contained within crown land, Should Transport choose to establish a formal road reserve corridor, strip acquisition of private and publicly owned land would be required.

5.1.4 Recommendations-

Traffic, transport and access issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-1**.

Table 5-1 Summary of recommendations – traffic, transport and access

Issue	Recommendation	Timing
Impacts to road users during construction	Consider the need for construction staging within design development to ensure access for heavy vehicles is maintained. Construction staging would also consider any other road upgrades (including safety works) occurring simultaneously along the highway.	Design development
Traffic assessment	Carry out a traffic assessment and traffic modelling to estimate the proposals effect on surrounding road network performance.	Design development
	Include consideration of the construction traffic impacts on the surrounding road network in the traffic assessment.	Design development
Cumulative impacts	Consultation with ARTC regarding the proposed inland rail project in Forbes to ensure cumulative traffic and transport impacts are understood and assessed.	Design development
Property and landowner access	Any change requirements to local access arrangements will be confirmed during detailed design and in consultation with the local road authority and any affected landowners.	Design development
Opportunity	**Recommendation**	**Timing**
Improved road safety	Investigation of the opportunity to improve the local road intersections with the highway (in areas flooded in 2016).	Design development
Bus stops	Investigation of the opportunity for wider areas for school bus pick and drop off areas.	Design development
Road reserve	Consider the need for creating a road reserve for the highway	Design development

5.2 Biodiversity

Potential constraints within the study area on biodiversity are presented in this section. The aim of this section is to access all available data within the locality to identify and assess key biodiversity values / constraints that are potentially within the study area and may be impacted as a result of the proposal. The results presented are based on a desktop review and rapid field assessment of the proposal study area.

5.2.1 Methodology

The methodology for the biodiversity assessment involved:

- A rapid field survey was carried out in person by Jacobs ecology specialist on 2 and 3 September 2020. The rapid survey consisted of the ecologist observing the length of the study area, stopping and walking across the study area where feasible, focusing on surveying areas of environment and habitat feature changes for flora and fauna. This assessment is also supported by a review of regional vegetation mapping
- A separate field survey was carried out on 8 September 2020 by AREA Environmental Consultants & Communication (AREA) along the highway near Gullifer's Road (as part of a separate Transport proposal) within this proposal's study area. The survey consisted of two ecologists' ground truthing the area. Gullifer's Road is located about 20 km south of the Forbes township on the highway. Survey results are discussed in **Section 5.2.3**.
- A desktop review of relevant databases and previous studies within the study area to identify Commonwealth and State listed threatened species, populations and ecological communities. The following was used to carry out the background research:
  - Databases searches to identify Commonwealth and State listed threatened species, populations, and ecological communities:
    - BioNet (DPIE EES BioNet, 2021) – the website for the Atlas of NSW Wildlife and Threatened Biodiversity Data Collection (searched 13 August 2020) search area of 10 km radius of the study area (the locality)
    - BioNet Vegetation Classification database (accessed 13 August 2020) within the locality
    - PMST (accessed on 13 August 2020) within the locality of the study area
    - Register of Declared Areas of Outstanding Biodiversity Value (accessed October 2020)
    - DoAWE (DoAWE, 2021) directory of important wetlands (viewed 18 August 2020).
  - A review of regional mapping within the study area:
    - State Vegetation Type Map: Central West / Lachlan Region Version 1.4. VIS_ID 4468 (DPIE, 2015)
    - Mitchell Landscapes Version V3.1 (DECC, 2008)
    - NSW Biodiversity Values Map and Threshold Tool (accessed on 18 August 2020)
    - Central Resource for Sharing and Enabling Environmental Data in NSW (accessed on 13 August 2020).
  - A review of existing relevant literature and biodiversity studies of the study area and region:
    - Biodiversity Development Assessment Report, Wyalong Solar Farm, NSW (Ecolink, 2019)
    - Cowal Gold Operations Processing Rate Modification - Flora and Fauna Survey Report (AMBS Ecology and Heritage, 2017).

- An assessment of the likelihood of occurrence of Commonwealth and State listed threatened species using the criteria shown in **Table 5-2**. The likelihood of occurrence of a species was based an analysis of previous recorded sightings in the locality and the potential for suitable habitat within the study area.

Table 5-2 Likelihood of occurrence criteria

Likelihood	Criteria
High	It is highly likely that the species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), recent records in the locality (10 km) are numerous and/or widespread and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area and has been recently recorded in the locality (10 km). Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. May include cryptic flora species that have little or no records in the locality though can occur in disturbed areas.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10 km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat features are not present in the study area.
Unlikely	Suitable habitat is absent from the study area.

Database information, particularly wide-scale vegetation mapping, should be used only as an indication of what may be present in an area of concern. Wide-scale vegetation mapping is based on modelling that considers factors such as geology, soil and elevation to predict a community type, and as such is often subject to error. Likewise, records of threatened species can be submitted by any member of the public and hence cannot be confidently verified. Threatened species records are often subject to geographical error and may not have been recorded where the point exists. These information sources typically provide a preliminary assessment of what is likely to be on a site to direct the survey methods of onsite investigations.

5.2.2 Existing environment

IBRA bioregions and sub-regions

The study area is located within the Lower Slopes Interim Biogeographic Regionalisation for Australia (IBRA) sub-regions of the NSW South Western Slopes IBRA (DoAWE, 2020). The characteristic landforms of the Lower Slopes encompass undulating and hilly ranges and isolated peaks set in wide valleys at the apices of the Riverina alluvial fans (Thackway et al, 1995). Soils typically consist of extensive red-brown earths on undulating plains and more extensive grey clays on alluvium (Morgan and Terrey, 1992).

Land use

The study area predominantly traverses a landscape dominated by dryland agriculture and grazing (Bureau of Meteorology (BoM), 2020). Additionally, areas of irrigated agriculture and forestry land uses occur within the locality (NPWS, 2003).

Within the locality, three national parks surround the study area comprising South West Woodland Nature Reserve, Lachlan Valley National Park and Weddin Mountains National Park. The southern portion of the study area traverses three NSW State Forests, including Wyrra (segment 1), Boxalls (segment 1) and Back Creek (segment 1). The northern portion of the study area (segment 3) is located near the Carawandool NSW State Forest, refer **Figure 1-2**.

NSW landscape regions (Mitchell landscapes)

The study area crosses nine NSW (Mitchell) landscapes, these include:

- Lachlan - Bland Channels and Floodplains
- Calarie Plains
- Bimbi Plains
- Cowal Lakes, Swamps and Lunettes
- Jemalong Range and Slopes
- Talabung Mountain
- Manitoba Hills and Footslopes
- Eugowra Plains
- Manna Hills and Footslopes.

Vegetation communities

Table 5-3 lists the Plant Community Types (PCT) mapped within the study area, including their State (BC Act) and Commonwealth (EPBC Act) conservation status. Some PCTs have multiple associated TECs listed in the BioNet Vegetation Classification database. **Figure 5-2** shows the regional vegetation extents based on currently available mapping. The total area of mapped native vegetation within the study area is about 1,320.78 hectares (ha) and includes 24 PCTs.

There is also the potential for the occurrence of derived native grasslands, where the original PCT has been cleared and only native groundcover species remain. These areas have not been mapped regionally and may occur along the roadsides of cleared parts of the study area. About 753.39 ha of “Not native” vegetation is mapped in the locality. Some derived native grasslands are included in EPBC Act listed TECs, such as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered Community). This vegetation can only be identified by detailed floristic surveys.

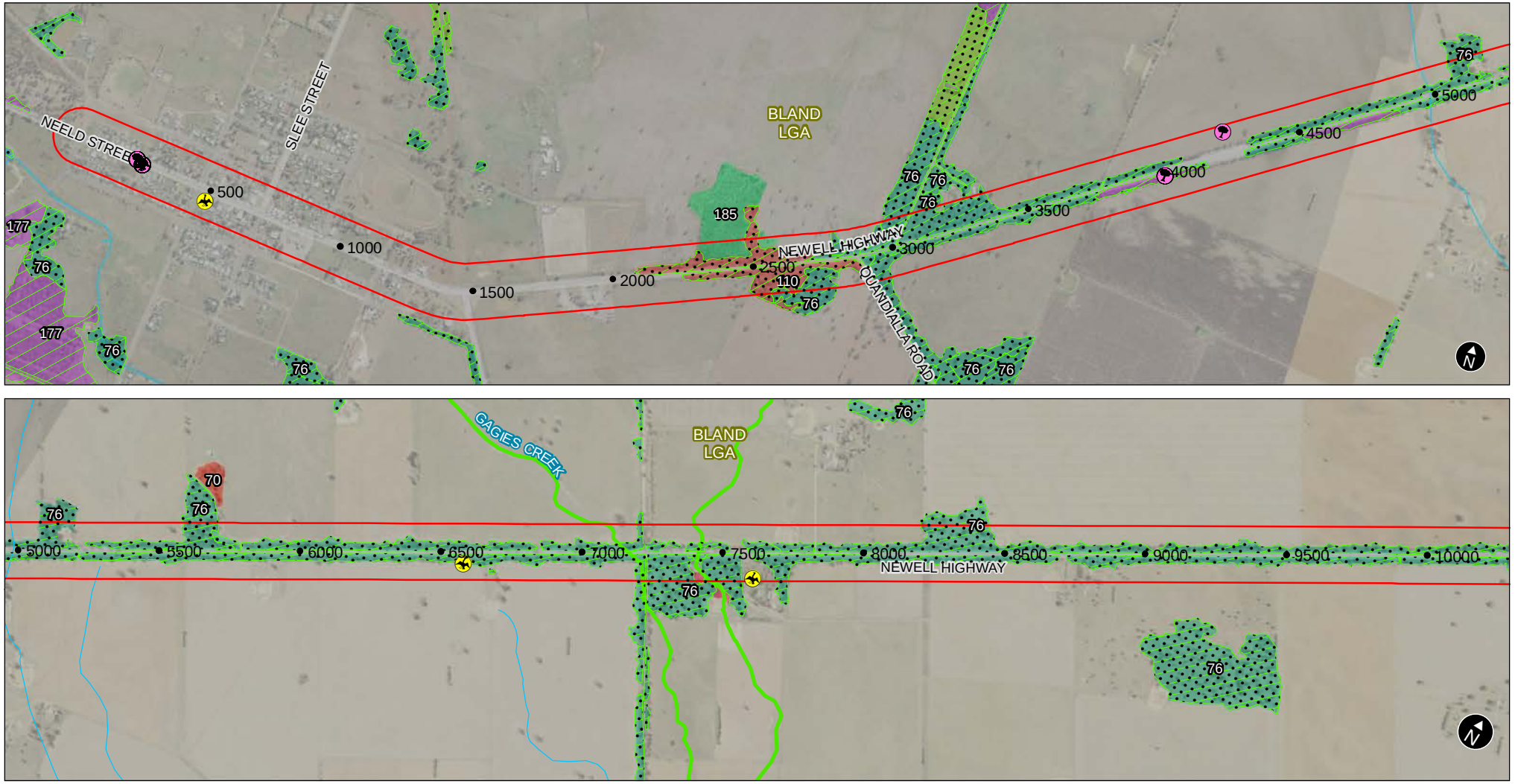
Table 5-3 Vegetation communities and associated TECs within the study area based on regional vegetation mapping

Plant Community Type*	Associated TEC Status*		Area (ha)*
	BC Act #	EPBC Act #	
PCT 55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions 55	E	E & CE	34.54
PCT 13: Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Not listed	Not listed	0.72
PCT 279: Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion	CE	CE	0.54
PCT 277: Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	CE	CE	31.65
PCT 177: Blue Mallee - Bull Mallee - Green Mallee very tall mallee shrubland of the West Wyalong region, NSW South Western Slopes Bioregion	CE	Not listed	7.09
PCT 54: Buloke - White Cypress Pine woodland in the NSW South Western Slopes Bioregion	Not listed	Not listed	1.08
PCT 796: Derived grassland of the NSW South Western Slopes	CE	CE	1.94
PCT 250: Derived tussock grassland of the central western plains and lower slopes of NSW	CE	CE	70.24
PCT 185: Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	Not listed	Not listed	1.94
PCT 201: Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	E	Not listed	23.71
PCT 248: Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW	E & CE	E	1.27
PCT 217: Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion	CE	Not listed	15.90
PCT 45: Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	CE	E	568.86
PCT 11: River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Not listed	Not listed	9.74

Plant Community Type*	Associated TEC Status*		Area (ha)*
	BC Act #	EPBC Act #	
PCT 9: River Red Gum - Wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Not listed	Not listed	0.69
PCT 249: River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	CE	E	61.29
PCT 53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	CE	E	18.54
PCT 27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	E & CE	E	2.43
PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	E	E	25.06
PCT 110: Western Grey Box - Cypress Pine shrubby woodland on stony footslopes in the NSW South Western Slopes Bioregion and Riverina Bioregion	E	E	5.49
PCT 80: Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	E & CE	E	59.16
PCT 76: Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	E	E	272.94
PCT 70: White Cypress Pine woodland on sandy loams in central NSW wheatbelt	Not listed	Not listed	14.76
PCT 77: Yarran shrubland of the NSW central to northern slopes and plains	CE	Not listed	91.19
		Total area of PCTs	**1,320.78**

E = Endangered, CE = Critically Endangered

*PCTs were identified using the regional vegetation mapping, associated TECs were identified from the BioNet Vegetation Classification database and area was calculated using data from the regional vegetation mapping.



Legend

- Study area
- Local Government Area
- State Forest
- Waterway

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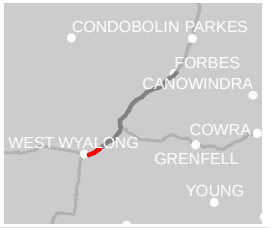

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

Figure 5-2 Plant Community Types (PCT)

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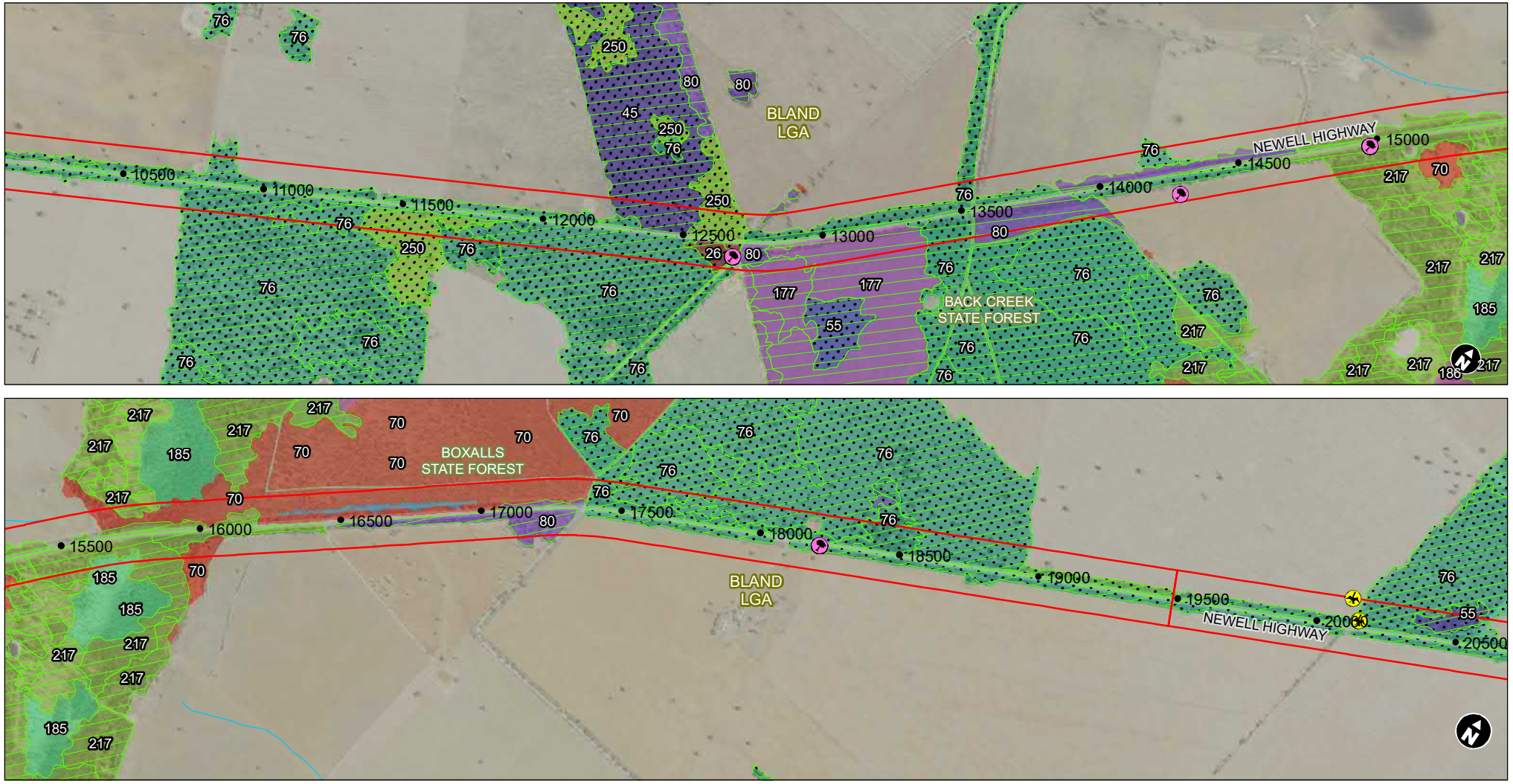

Legend

- Study area
- Local Government Area
- State Forest
- Waterway

0 500 1000 m

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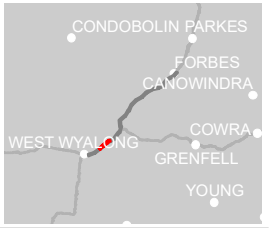

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

Figure 5-2 Plant Community Types (PCT)

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Legend

- Study area
- Local Government Area
- State Forest
- Waterway

0 500 1000 m

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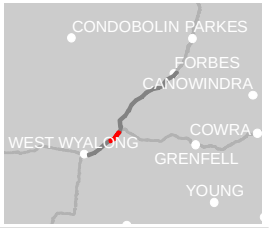

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NSW OEH 2020

GDA94 MGA55

Figure 5-2 Plant Community Types (PCT)

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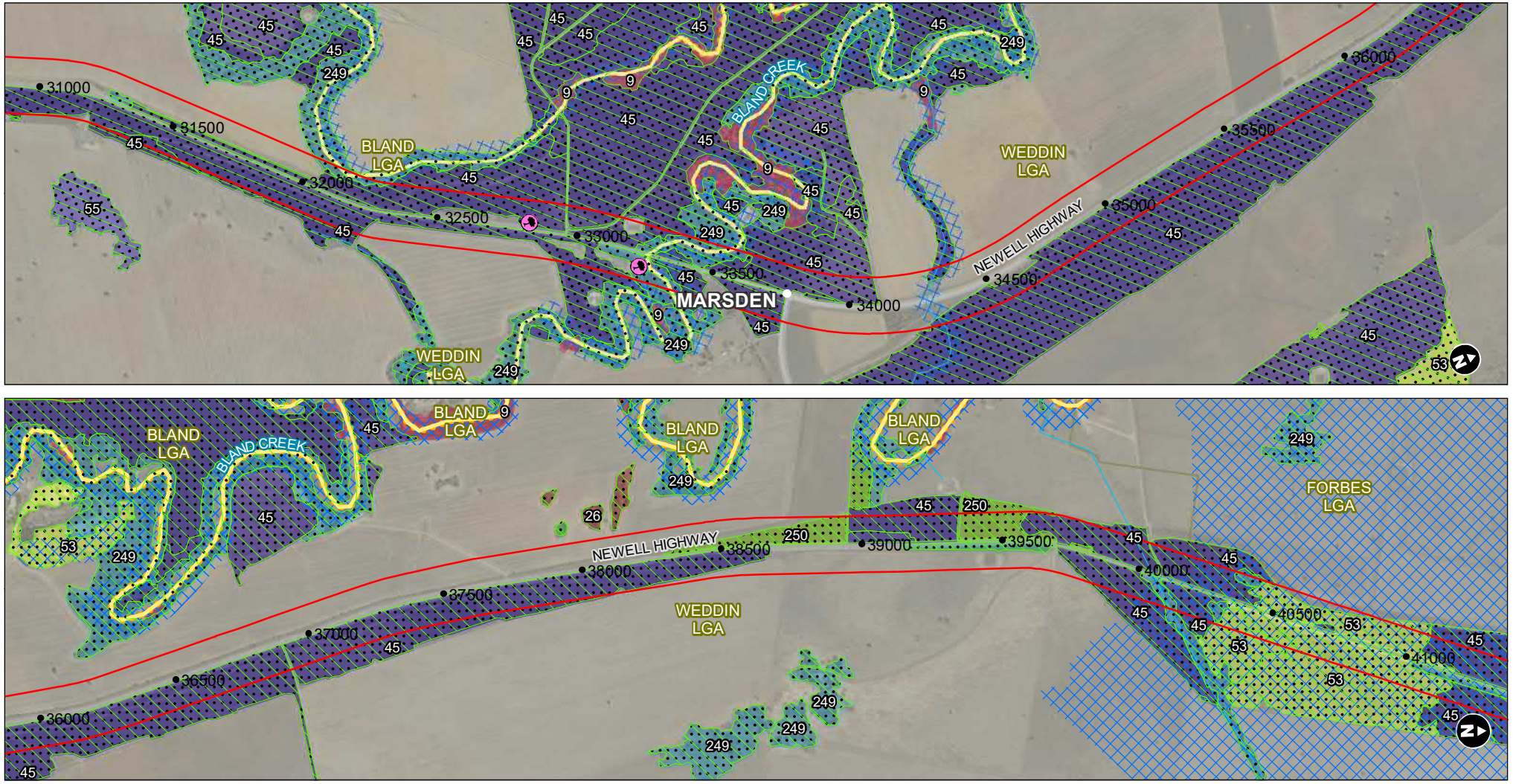

Legend

- Study area
- Local Government Area
- State Forest
- Waterway

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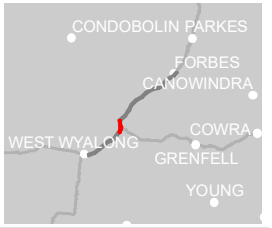

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

Figure 5-2 Plant Community Types (PCT)

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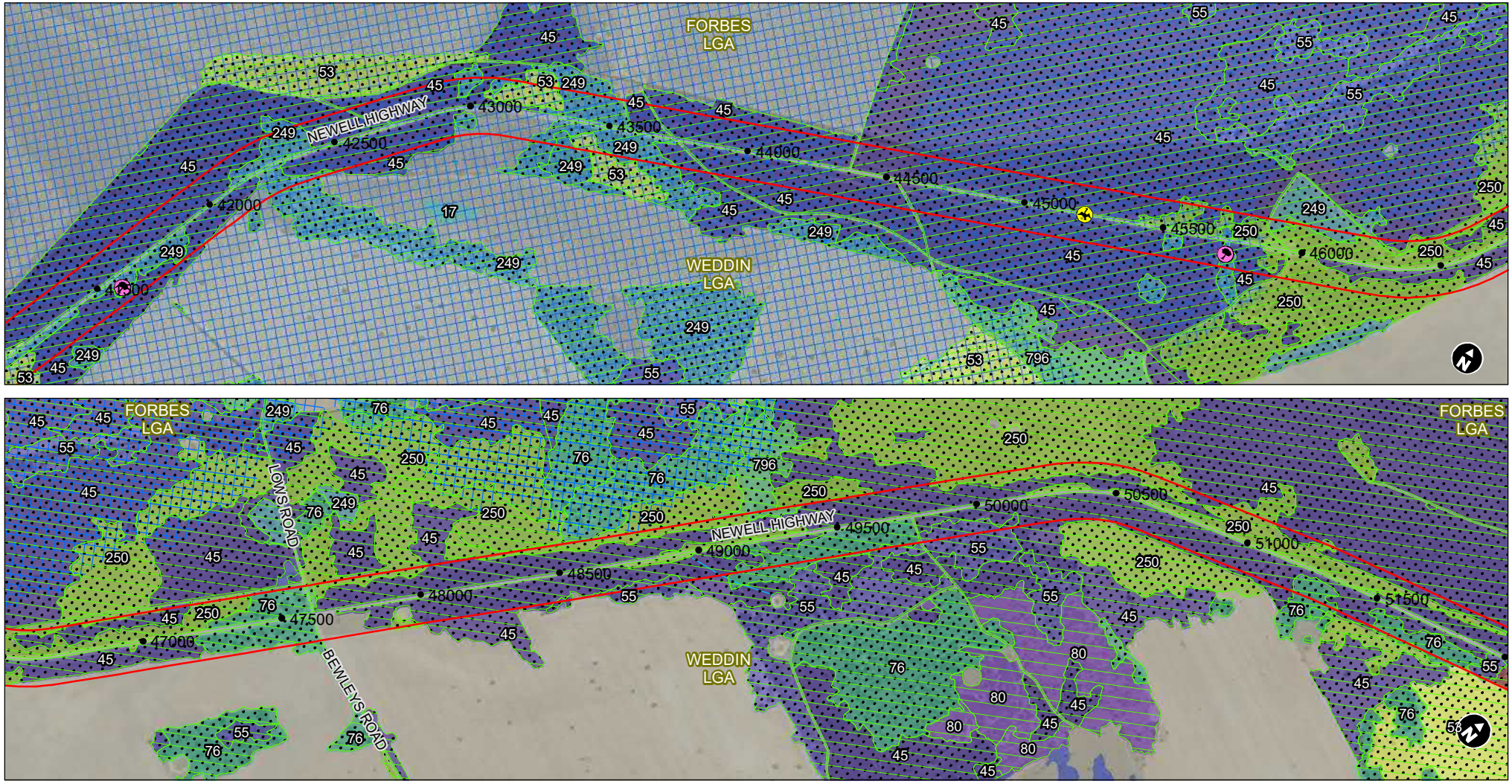

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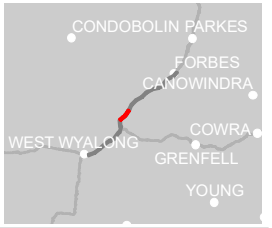

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NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

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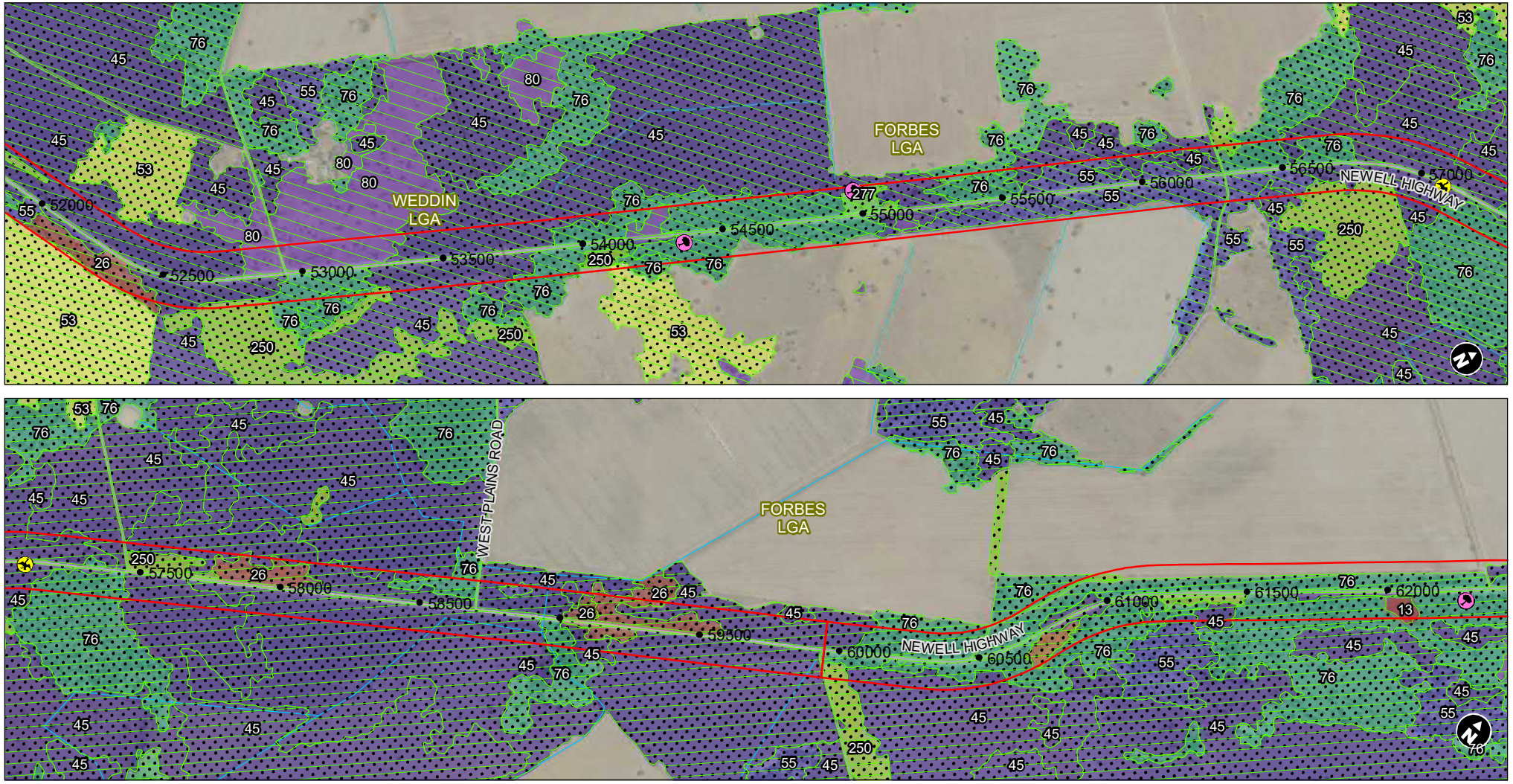

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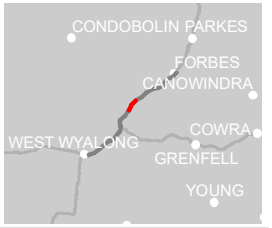

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

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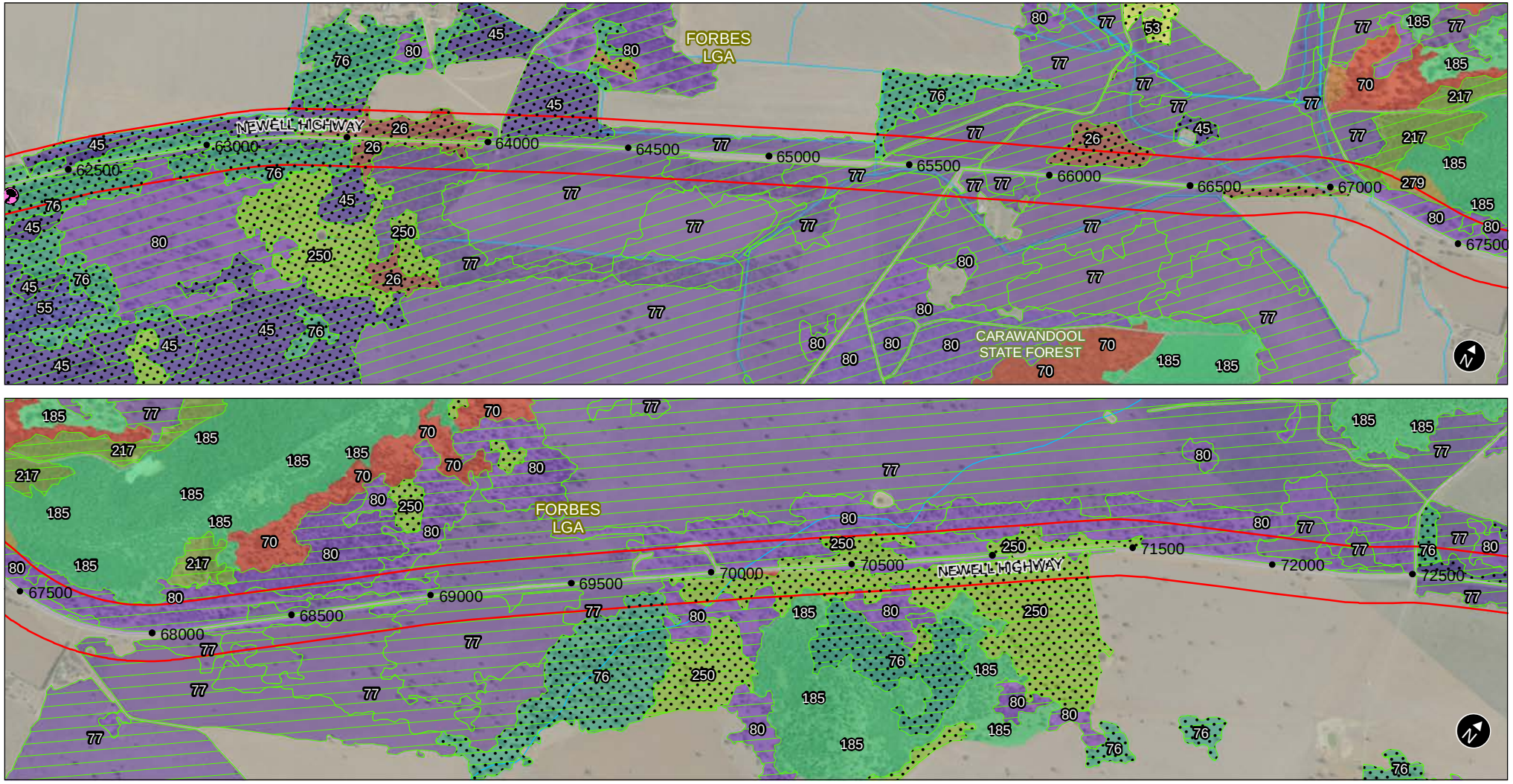

Legend

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- Local Government Area
- State Forest
- Waterway

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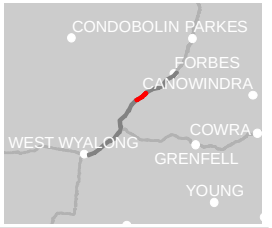

Data sources

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Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

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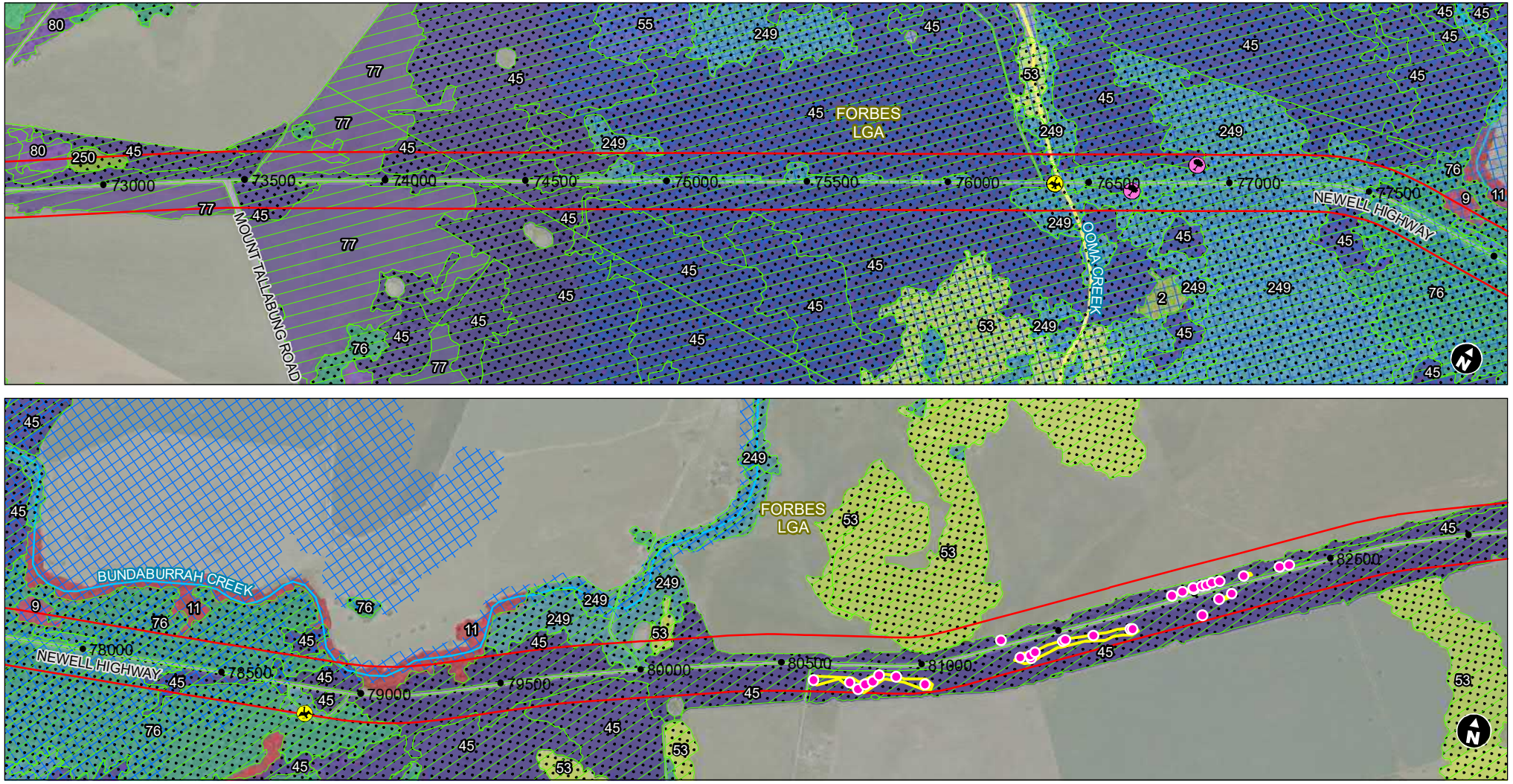

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

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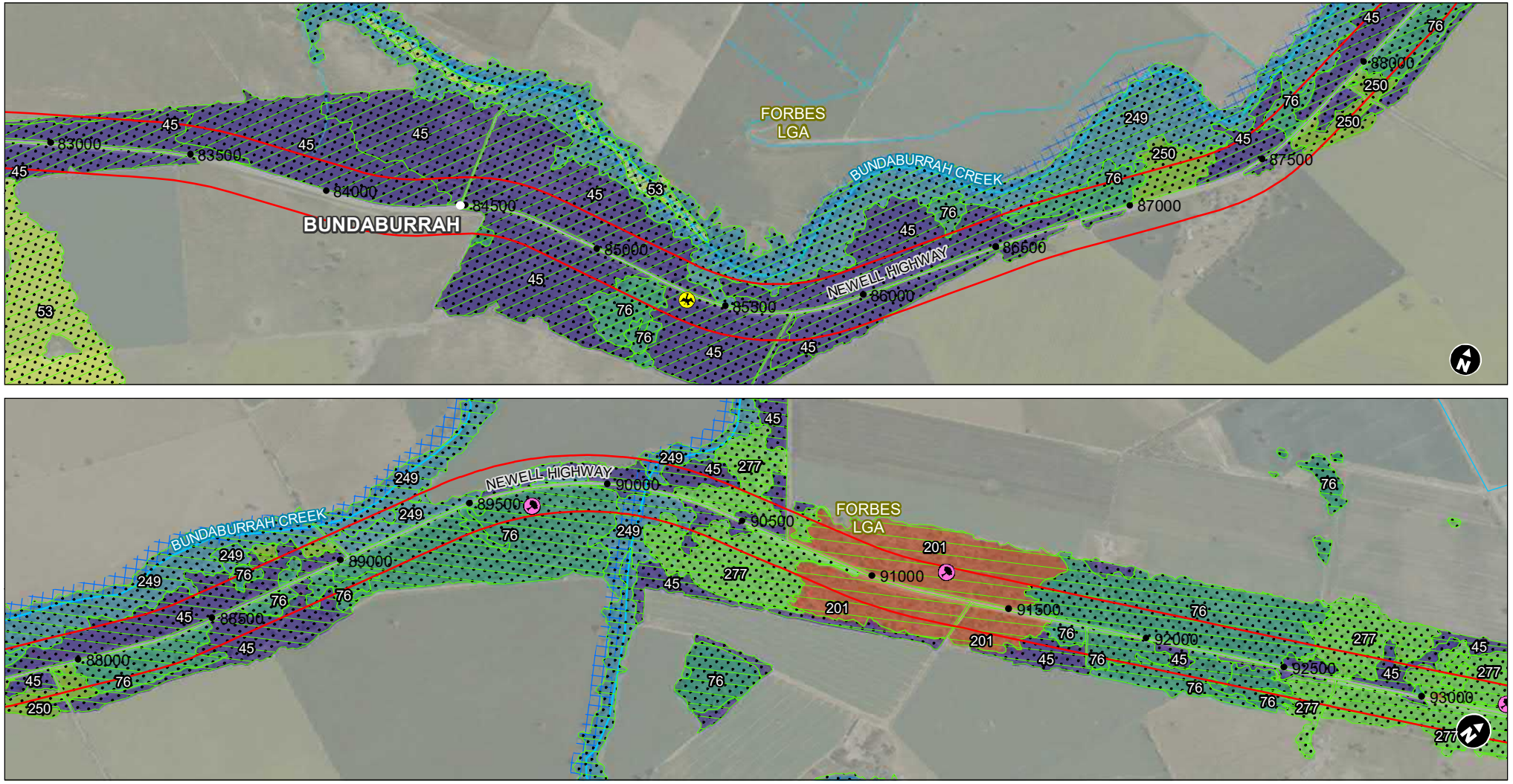

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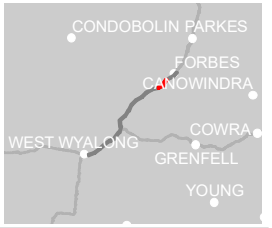

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NSW OEH 2020

GDA94 MGA55

Figure 5-2 Plant Community Types (PCT)

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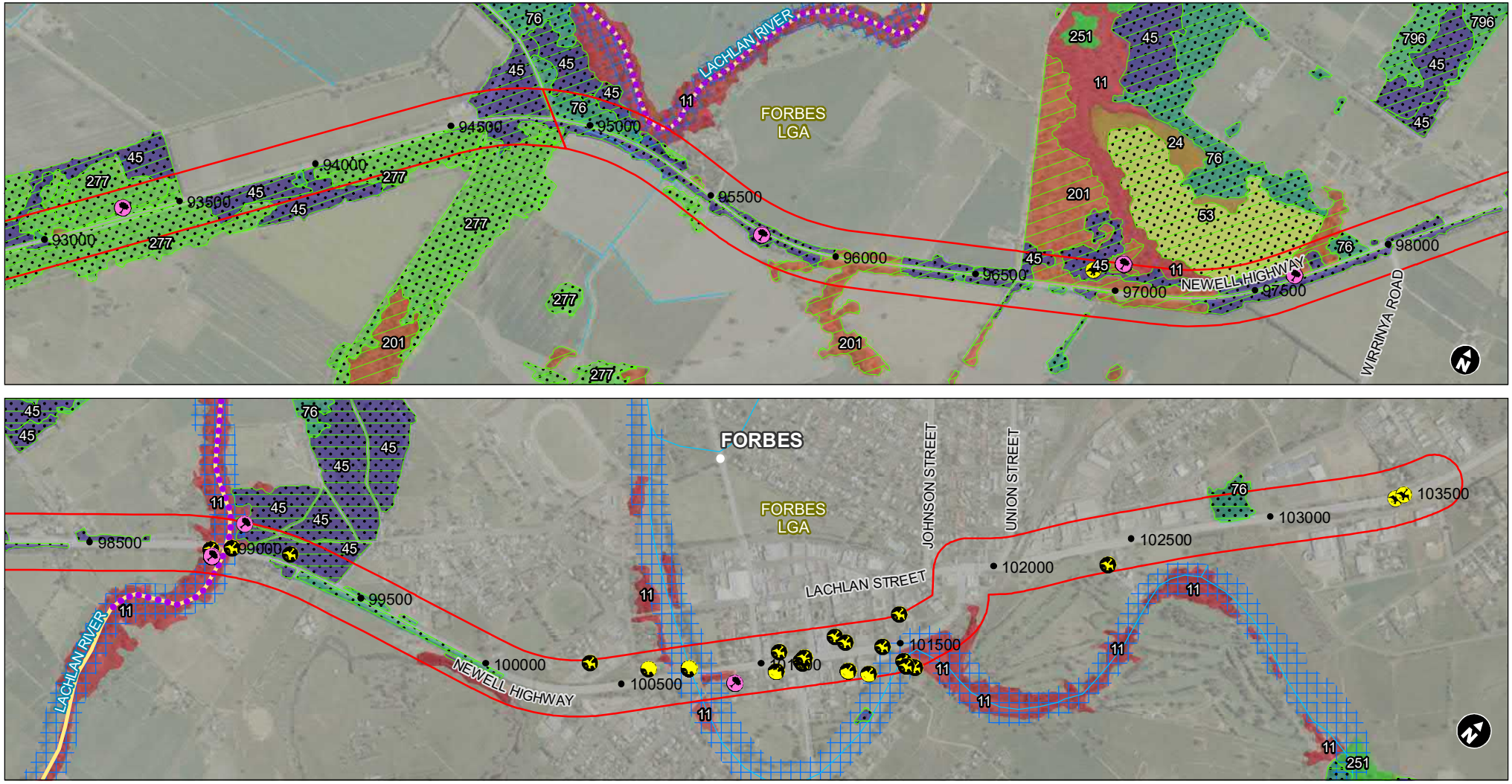

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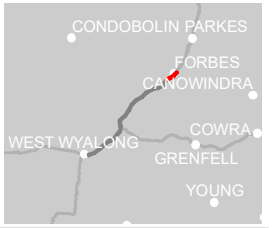

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NSW Spatial Services 2020
NSW OEH 2020

GDA94 MGA55

Figure 5-2 Plant Community Types (PCT)

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Created by : HK | QA by : XX

LEGEND SHEET

- Threatened flora
- Threatened fauna
- Key Fish Habitat
- Eel Tailed Catfis
- Flathead Galaxias
- Olive Perchlet
- Purple Spotted Gudgeon
- Swainsona murrayana Slender Darling Pea
- Swainsona murrayana Slender Darling Pea area

Threatened Ecological Communities

- EPBC Act listed TECs
- BC Act listed TECs

Plant community types

- Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (PCT 55)
- Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)
- Blakelys Red Gum - White Cypress Pine woodland on footslopes of hills in central part of the NSW South Western Slopes Bioregion (PCT 279)
- Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion (PCT 277)
- Blue Mallee - Bull Mallee - Green Mallee very tall mallee shrubland of the West Wyalong region, NSW South Western Slopes Bioregion (PCT 177)
- Buloke - White Cypress Pine woodland in the NSW South Western Slopes Bioregion (PCT 54)
- Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains (PCT 24)
- Derived grassland of the NSW South Western Slopes (PCT 796)
- Derived tussock grassland of the central western plains and lower slopes of NSW (PCT 250)
- Dwyers Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion (PCT 186)
- Dwyers Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion (PCT 185)
- Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion (PCT 201)
- Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)
- Mixed Eucalypt woodlands of floodplains in the southern-eastern Cobar Peneplain Bioregion (PCT 251)
- Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW (PCT 248)
- Mugga Ironbark - Western Grey Box - cypress pine tall woodland on footslopes of low hills in the NSW South Western Slopes Bioregion (PCT 217)
- Not Native
- Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45)
- Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (PCT 56)
- River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 11)
- River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)
- River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW (PCT 249)
- River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW (PCT 2)
- Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains (PCT 53)
- Shallow marsh wetland of regularly flooded depressions on floodplains mainly in the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 12)
- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (PCT 27)
- Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26)
- Western Grey Box - Cypress Pine shrubby woodland on stony footslopes in the NSW South Western Slopes Bioregion and Riverina Bioregion (PCT 110)
- Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion (PCT 80)
- Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions PCT 76)
- White Cypress Pine woodland on sandy loams in central NSW wheatbelt (PCT 70)
- Yarran shrubland of the NSW central to northern slopes and plains (PCT 77)
- Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion (PCT 75)

Threatened ecological communities

A review of regional vegetation mapping (DPIE, 2015), BioNet Vegetation Classification database (DPIE, 2020), FM Act, DPI Fisheries spatial data portal NSW (DPI Fisheries, 2020b) and Strahler (1952a) identified nine TECs listed under the BC Act (**Table 5-4**), seven listed under the EPBC Act (**Table 5-5**) and one listed under the FM Act as potentially occurring within the study area. According to vegetation mapping within the study area, the total area of TECs includes about 1,153.95 ha listed under the EPBC Act and 1,291.85 ha listed under the BC Act. Additionally, according to the mapped waterway data associated with the TEC listed under the FM Act, the total area of intersecting waterways within the study area includes approximately 5.71 ha of named waterways and approximately 3.67 ha of unnamed waterways (see below). The TECs listed under the BC Act and EPBC Act are shown in **Figure 5-2**.

The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River is listed as an Endangered Ecological Community (EEC) in NSW under the FM Act. The Lowland Catchment of the Lachlan River is part of the Murray-Darling Basin. The area covered by this EEC includes all natural rivers, creeks, streams and associated lagoons, billabongs, lakes, wetlands, paleochannels, flood-runners, effluent streams and the floodplains of the Lachlan River within the State of NSW, and including Lake Brewster, Lake Cargelligo and Lake Cowal (DPI, 2006). The waterways associated with this TEC that intersect the study area include:

- Barmedman Creek – 6th order stream with an area of 1.37 ha within the study area
- Bundaburrah Creek – 2nd order stream with an area of 2.18 ha within the study area
- Bland Creek – 7th order stream with an area of 0.03 ha within the study area
- Gagies Creek – 5th order stream with an area of 0.49 ha within the study area
- Lachlan River – 8th order stream with an area of 0.89 ha within the study area
- Ooma Creek – 6th order stream with an area of 0.59 ha within the study area
- Warralonga Cowal – 3rd order stream with an area of 0.16 ha within the study area
- Unnamed waterways – 1st to 7th order streams with an area of 3.67 ha within the study area.

The PMST also identified an additional TEC listed under the EPBC Act (**Appendix A**) as being considered likely to occur near the study area, including the Poplar Box Grassy Woodland on Alluvial Plains (Endangered).

Table 5-4 TECs listed under the BC Act, associated with regional vegetation mapping

Threatened Ecological Community (TEC) – BC Act*	BC Act Status#	Associated PCTs*	Area (ha)*
Artesian Springs Ecological Community in the Great Artesian Basin	CE	27, 45, 53, 248, 249	1,163.76
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	E	26, 27, 55	
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	E	76, 80, 110, 248	

Threatened Ecological Community (TEC) – BC Act*	BC Act Status#	Associated PCTs*	Area (ha)*
Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia, in the NSW South Western Slopes Bioregion	CE	77, 80, 177, 217	
Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions	E	55	
Native vegetation on Cracking Clay Soils of the Liverpool Plains	E	55	
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar	E	55	
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	E	201	23.71
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	CE	250, 277, 279, 796	104.38
Total area of BC Act TECs			**1,291.85**

#E = Endangered CE = Critically Endangered

*TECs associated with a PCT were identified from the BioNet Vegetation Classification database using the associated PCTs identified from the regional vegetation mapping and area was calculated using data from the regional vegetation mapping. Note: TECs listed with the same associated PCT correspond collectively within the calculated area (ha) i.e. PCT 55 has a total area of 34.54 ha and is associated with four TECs, the total area for all four TECs is 34.54 ha (refer to **Table 5-3** for respective PCT area (ha)).

Table 5-5 TECs listed under the EPBC Act, associated with regional vegetation mapping

Threatened Ecological Community (TEC) – EPBC Act*	Status#	Associated PCTs*	Area (ha)*
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E	55	
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE	55	
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	55	1,049.58
Weeping Myall Woodlands	E	26, 27, 55	
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	E	27, 45, 53, 248, 249	

Threatened Ecological Community (TEC) – EPBC Act*	Status#	Associated PCTs*	Area (ha)*
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	E	76, 80, 110, 248	
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	250, 277, 279, 796	104.38
Total area of EPBC Act TECs			**1,153.95**

#E = Endangered CE = Critically Endangered

*TECs associated with a PCT were identified from the BioNet Vegetation Classification database using the associated PCTs identified from the regional vegetation mapping and area was calculated using data from the regional vegetation mapping. Note: TECs listed with the same associated PCT correspond collectively within the calculated area (ha) i.e. PCT 55 has a total area of 34.54 ha and is associated with four TECs, the total area for all four TECs is 34.54 ha (refer to **Table 5-3** for respective PCT area (ha)).

Threatened flora

The BioNet Atlas of NSW Wildlife search returned 168 records of 14 threatened flora species listed under the BC Act within the locality (refer to **Appendix A**).

A search of the PMST identified 13 threatened flora species listed under the EPBC Act as being known to occur or considered likely to occur within the locality (refer to **Appendix A**).

Based on the likelihood of occurrence assessment, 14 threatened flora species identified from the BioNet Atlas of NSW Wildlife and PMST are considered as having a moderate or high likelihood of occurring within the locality (**Table 5-6**). The assessment used the criteria listed in **Table 5-2** and is based an analysis of previous recorded sightings in the locality and the potential for suitable habitat within the study area.

Table 5-6 BC Act and EPBC Act listed threatened flora database results with a moderate or high likelihood of occurring within the study area

Scientific name	Common name	Status#		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Acacia ausfeldii	Ausfeld's Wattle	V	Not listed	1 - BioNet	High
Ammobium craspedioides	Yass Daisy	V	V	PMST	Moderate
Androcalva procumbens	-	V	V	PMST	Moderate
Austrostipa metatoris	A spear-grass	V	V	1 - BioNet, PMST	Moderate
Austrostipa wakoolica	A spear-grass	E	E	80 – BioNet, PMST	High

Scientific name	Common name	Status[#]		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Diuris tricolor	Pine Donkey Orchid	V	Not listed	2 - BioNet	Moderate
Eleocharis obicis	Spike-Rush	V	V	7 - BioNet, PMST	Moderate
Lepidium aschersonii	Spiny Peppercress	V	V	8 - BioNet, PMST	Moderate
Lepidium monoplocoides	Winged Peppercress	E	E	2 - BioNet, PMST	Moderate
Pilularia novae-hollandiae	Austral Pillwort	E	Not listed	7 - BioNet	Moderate
Swainsona murrayana	Slender Darling Pea	V	V	10 - BioNet, PMST	Confirmed
Swainsona sericea	Silky Swainson-pea	V	Not listed	5 - BioNet	Moderate
Thesium australe	Austral Toadflax	V	V	PMST	Moderate
Tylophora linearis	-	V	E	36 – BioNet, PMST	Moderate

[#]V = Vulnerable species, E = Endangered species

Threatened fauna

The BioNet Atlas of NSW Wildlife search returned 5,959 records of 61 threatened fauna species listed under the BC Act, refer to **Appendix A**.

The PMST search identified 288 threatened fauna species listed under the EPBC Act as being known to occur or considered likely to occur, refer to **Appendix A**.

Based on a preliminary likelihood of occurrence assessment (aided by site-walkover), 60 threatened fauna species identified from the BioNet Atlas of NSW Wildlife and PMST are considered to have at least a moderate likelihood of occurring within the study area (refer to **Table 5-7**). This includes 41 birds, 13 mammals, two frogs, three fish and one reptile. The assessment used the criteria listed in **Table 5-2** and is based on analysis of previous recorded sightings in the locality and the potential for suitable habitat within the study area. Additionally, four bird species (stated as “confirmed” in **Table 5-7**) were identified within and next to the existing highway during the rapid assessment.

Table 5-7 BC Act and EPBC Act listed threatened fauna database results with a moderate or high likelihood of occurrence within the study area

Scientific name	Common name	Status[#]		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Birds					
Anseranas semipalmata	Magpie Goose	V	Not listed	19 - BioNet	Moderate
Anthochaera phrygia	Regent Honeyeater	E	CE	22 - BioNet, PMST	High
Ardeotis australis	Australian Bustard	E	Not listed	2 - BioNet	Moderate
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	Not listed	587 - BioNet	High
Botaurus poiciloptilus	Australasian Bittern	E	E	7 - BioNet, PMST	Moderate
Burhinus grallarius	Bush Stone-curlew	E	Not listed	14 - BioNet	Moderate
Calidris ferruginea	Curlew Sandpiper	E	CE, M	3 - BioNet, PMST	Moderate
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	Not listed	12 – BioNet	Confirmed
Certhionyx variegatus	Pied Honeyeater	V	Not listed	8 - BioNet	Moderate
Chthonicola sagittata	Speckled Warbler	V	Not listed	497 – BioNet	High
Circus assimilis	Spotted Harrier	V	Not listed	25 – BioNet	Moderate
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	Not listed	1,514 – BioNet	Confirmed

Scientific name	Common name	Status[#]		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Daphoenositta chrysoptera	Varied Sittella	V	Not listed	83 – BioNet	High
Epthianura albifrons	White-fronted Chat	V	Not listed	31 – BioNet	Moderate
Falco hypoleucos	Grey Falcon	E	Not listed	49 - BioNet, PMST	Moderate
Falco subniger	Black Falcon	V	Not listed	36 – BioNet	Moderate
Glossopsitta pusilla	Little Lorikeet	V	Not listed	114 – BioNet	High
Grantiella picta	Painted Honeyeater	V	V	38 – BioNet, PMST	High
Grus rubicunda	Brolga	V	Not listed	16 – BioNet	Moderate
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	18 – BioNet	Moderate
Hamirostra melanosternon	Black-breasted Buzzard	V	Not listed	5 – BioNet	Moderate
Hieraaetus morphnoides	Little Eagle	V	Not listed	65 – BioNet	High
Hirundapus caudacutus	White-throated Needletail	Not listed	V, M	PMST	Moderate
Hylacola cautus	Shy Heathwren	V	Not listed	115 – BioNet	Moderate
Lathamus discolor	Swift Parrot	E	CE	69 - BioNet, PMST	High
Limosa limosa	Black-tailed Godwit	V	M	1 - BioNet, PMST	Moderate

Scientific name	Common name	Status[#]		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	Not listed	19 - BioNet	Moderate
Lophoictinia isura	Square-tailed Kite	V	Not listed	4 - BioNet	Moderate
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	Not listed	155 - BioNet	High
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	Not listed	181 - BioNet	High
Neophema pulchella	Turquoise Parrot	V	Not listed	254 - BioNet	High
Ninox connivens	Barking Owl	V	V	18 - BioNet	Moderate
Oxyura australis	Blue-billed Duck	V	Not listed	24 - BioNet	Confirmed
Pachycephala inornata	Gilbert's Whistler	V	Not listed	273 - BioNet	High
Petroica boodang	Scarlet Robin	V	Not listed	22 - BioNet	Moderate
Petroica phoenicea	Flame Robin	V	Not listed	34 - BioNet	Moderate
Polytelis swainsonii	Superb Parrot	V	V	397 - BioNet, PMST	High
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	Not listed	438 - BioNet	Confirmed
Rostratula australis	Australian Painted Snipe	E	E, M	7 - BioNet, PMST	Moderate
Stagonopleura guttata	Diamond Firetail	V	Not listed	560 - BioNet	High

Scientific name	Common name	Status[#]		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Stictonetta naevosa	Freckled Duck	V	Not listed	39 – BioNet	High
Mammals					
Cercartetus nanus	Eastern Pygmy-possum	V	Not listed	2 – BioNet	Moderate
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	PMST	Moderate
Chalinolobus picatus	Little Pied Bat	V	Not listed	11 – BioNet	Moderate
Dasyurus maculatus	Spotted-tailed Quoll	V	E	7 – BioNet, PMST	Moderate
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	Not listed	1 – BioNet	Moderate
Myotis macropus	Southern Myotis	V	Not listed	1 - BioNet	Moderate
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	7 – BioNet, PMST	Moderate
Petauroides volans	Greater Glider	Not listed	V	PMST	Moderate
Petaurus norfolcensis	Squirrel Glider	V	Not listed	15 – BioNet	Moderate
Phascolarctos cinereus	Koala	V	V	9 - BioNet, PMST	Moderate
Pseudomys novaehollandiae	New Holland Mouse	Not listed	V	PMST	Moderate
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	7 - BioNet, PMST	Moderate

Scientific name	Common name	Status[#]		Number of records (source)	Likelihood of occurrence
		BC Act	EPBC Act		
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	Not listed	11 - BioNet	Moderate
Frogs					
Crinia sloanei	Sloane's Froglet	V	E	3 - BioNet	Moderate
Litoria raniformis	Southern Bell Frog	E	V	1 - BioNet	Moderate
Fish					
Galaxias rostratus	Flathead Galaxias	CE	CE	PMST	Moderate
Maccullochella peelii	Murray Cod	Not listed	V	PMST	Moderate
Macquaria australasica	Macquarie Perch	E	E	PMST	Moderate
Reptiles					
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	16 - BioNet, PMST	Moderate

[#] V = Vulnerable species, E = Endangered species, CE = Critically Endangered species, M = Migratory species

Wildlife connectivity and corridors

Wildlife corridors are vital for the maintenance of ecological processes, including the movement of animals and the continuation of viable populations. Corridors can consist of a sequence of stepping stones across the landscape (discontinuous areas of habitat such as paddock trees, wetlands and roadside vegetation), continuous lineal strips of vegetation and habitat (such as riparian strips, ridge lines etc.), or they may be parts of an extensive patch of vegetation (DEC 2004).

Connectivity is provided in the study area by:

- Large vegetated tracts associated with Crown Land (eg Wyrra State Forest, Boxalls State Forest, Back Creek State Forest, Carawandool State Forest and vegetation along the highway)
- Vegetated riparian corridors (eg Barmedman Creek, Bland Creek, Bundaburrah Creek, Ooma Creek, Lachlan River, Warralonga Cowel)
- Vegetated road reserves
- Small isolated patches of woodland within farmland
- Paddock trees.

Areas of Crown Land (including TSR) occur throughout the study area. These often occur along road reserves, paper roads (eg 'laneways' along property boundaries) or in association with creeks and rivers, providing continuous linear strips of vegetation. In some locations these connect to larger patches of vegetation elsewhere, providing increased connectivity in the landscape.

Stepping stone connectivity is provided by small patches of woodland vegetation retained in farmland, as well as isolated paddock trees. These areas are particularly important for mobile species such as birds and bats. Culverts, bridges and man-made structures have the potential to provide roosting areas for bats.

Areas of Outstanding Biodiversity Value

Areas of AOBVs are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. These are areas declared by the Minister for Environment. The Biodiversity Values Map spatial data (DPIE, 2020) identified two types of AOBVs (refer to **Figure 1-2**) that traverse the study area, specified as 'Protected Riparian Land' and 'Threatened species or communities with potential for serious and irreversible impacts' (this land is associated with part of Back Creek State Forest).

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems of plants and animals which have their species composition and their natural ecological processes determined by the water beneath the earth surface where the earth or rocks are completely saturated (DLWC, 2002). Potential GDEs (in the study area mapped by BoM (BoM, 2021) (refer to **Figure 5-3**), include:

- Aquatic ecosystems in wetland in the vicinity of Ooma Creek and to the east of Lake Cowal (high potential for groundwater interaction)
- Numerous pockets of forest (ranging from low to high potential for groundwater interaction) around various unnamed wetlands, Barmedman Creek, Bland Creek and Bundaburrah Creek.

There is also likely that the vegetation communities listed in **Table 5-3** have some level of dependence on groundwater.

Aquatic habitat

The study area intersects 23 mapped waterways (some of these may be the same waterway intersected more than once, refer **Figure 1-2**. Six of these waterways are mapped as 'Key Fish Habitat' (KFH) (DPI Fisheries, 2020a) including:

- Barmedman Creek
- Bland Creek
- Bundaburrah Creek
- Lachlan River
- Ooma Creek
- Warralonga Cowal.

Freshwater fish communities mapped within the study area in relation to Bland Creek, Barmedman Creek and Ooma Creek are classified as poor fish habitat and the Lachlan River has very poor fish habitat. Threatened fish indicative habitat mapping (DPI, 2020) shows habitat along waterways in the study area for the following six species:

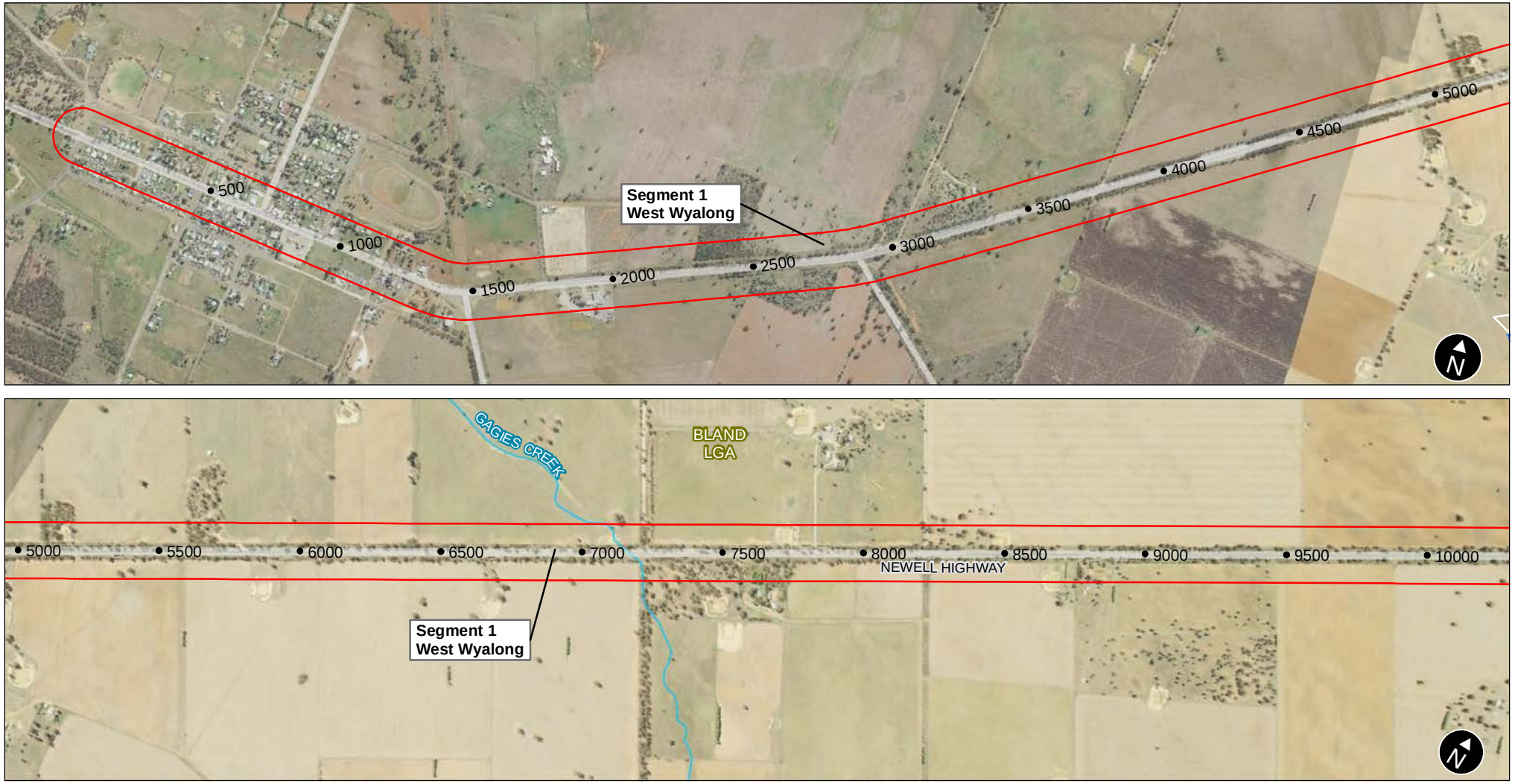
- Eel Tailed Catfish (*Tandanus tandanus*)
- Flathead Galaxias (*Galaxias rostratus*)
- Hanleys River Snail (*Notopala hanleyi*)
- Olive Perchlet (*Ambassis agassizii*)
- Purple Spotted Gudgeon (*Mogurnda mogurnda*)
- Silver Perch (*Bidyanus bidyanus*).

The PMST also identified Murray Cod (*Maccullochella peelii*) as known to occur and Macquarie Perch (*Macquaria australasica*) as potentially occurring in the locality.

The riparian zone around much of these waterways is identified by the Biodiversity Values Map as 'Protected Riparian Land', which likely coincides with the KFH mapping.

There are no Ramsar Wetlands or Important Wetlands as listed in the Directory of Important Wetlands of Australia in the study area. The closest nationally important wetland is the Lake Cowal/Wilbertroy Wetlands which is around 11 km downstream (Bland Creek and Bundaburrah Creek) of the study area, refer to **Figure 5-4**. This wetland is discussed further in **Section 5.4.2**.

Aquatic habitat values and KFH within the study area are shown on **Figure 1-2**.

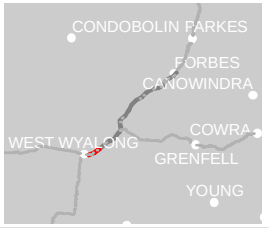


Legend

- Study area
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4



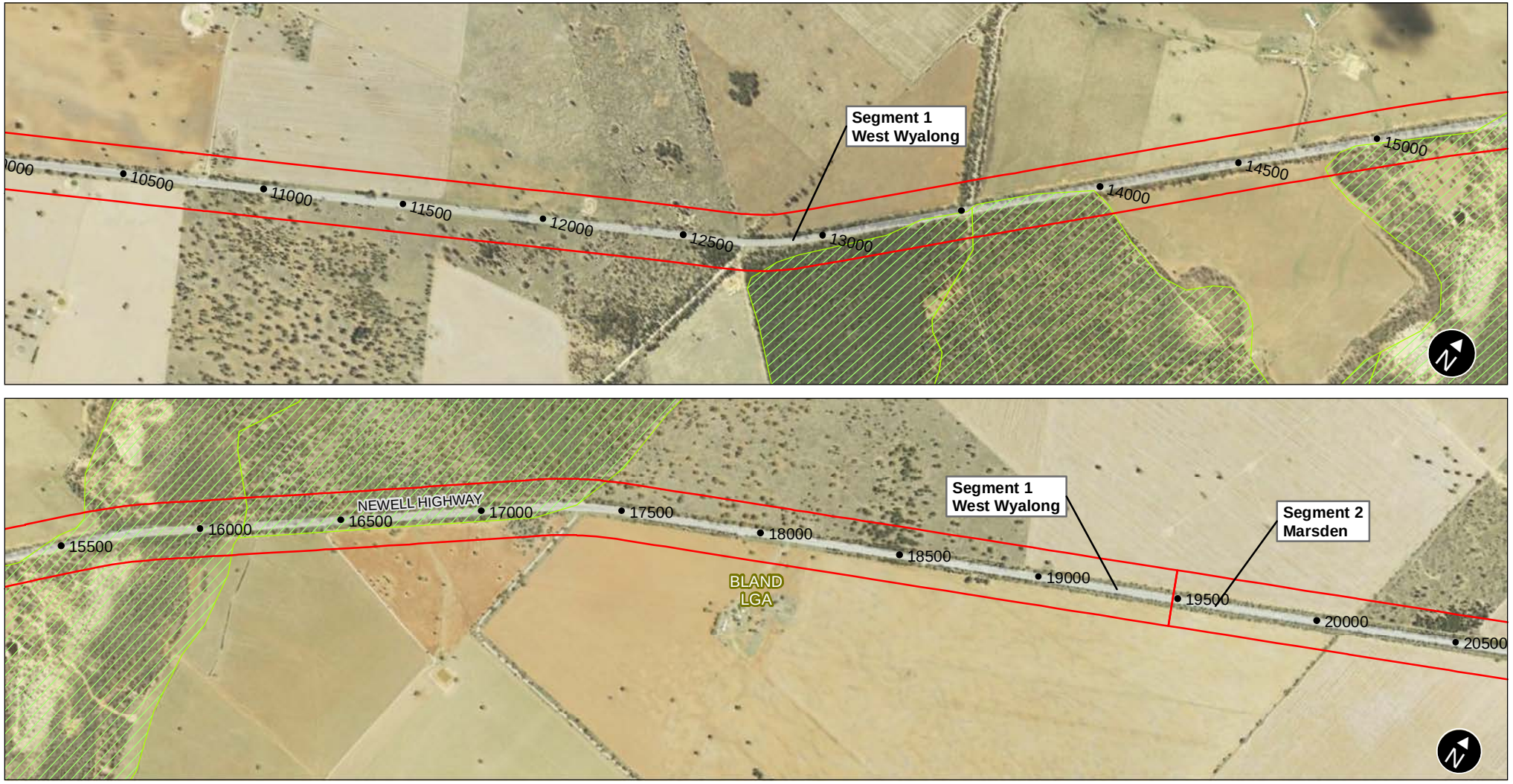
Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

Date: 12/02/2021 Path: \\jacobs.com\ANZ\IE\Projects\04_Eastern\IS340100\22 Spatial\GIS\Directory\Templates\Figures\IS340100_GIS_F006_Water_r1.mxd
Created by : HK | QA by : XX



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- Aquatic groundwater dependent ecosystems
- Waterway

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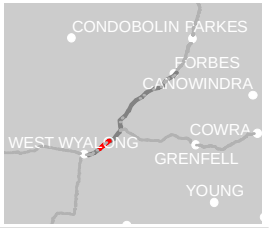
1:20,000 at A4



Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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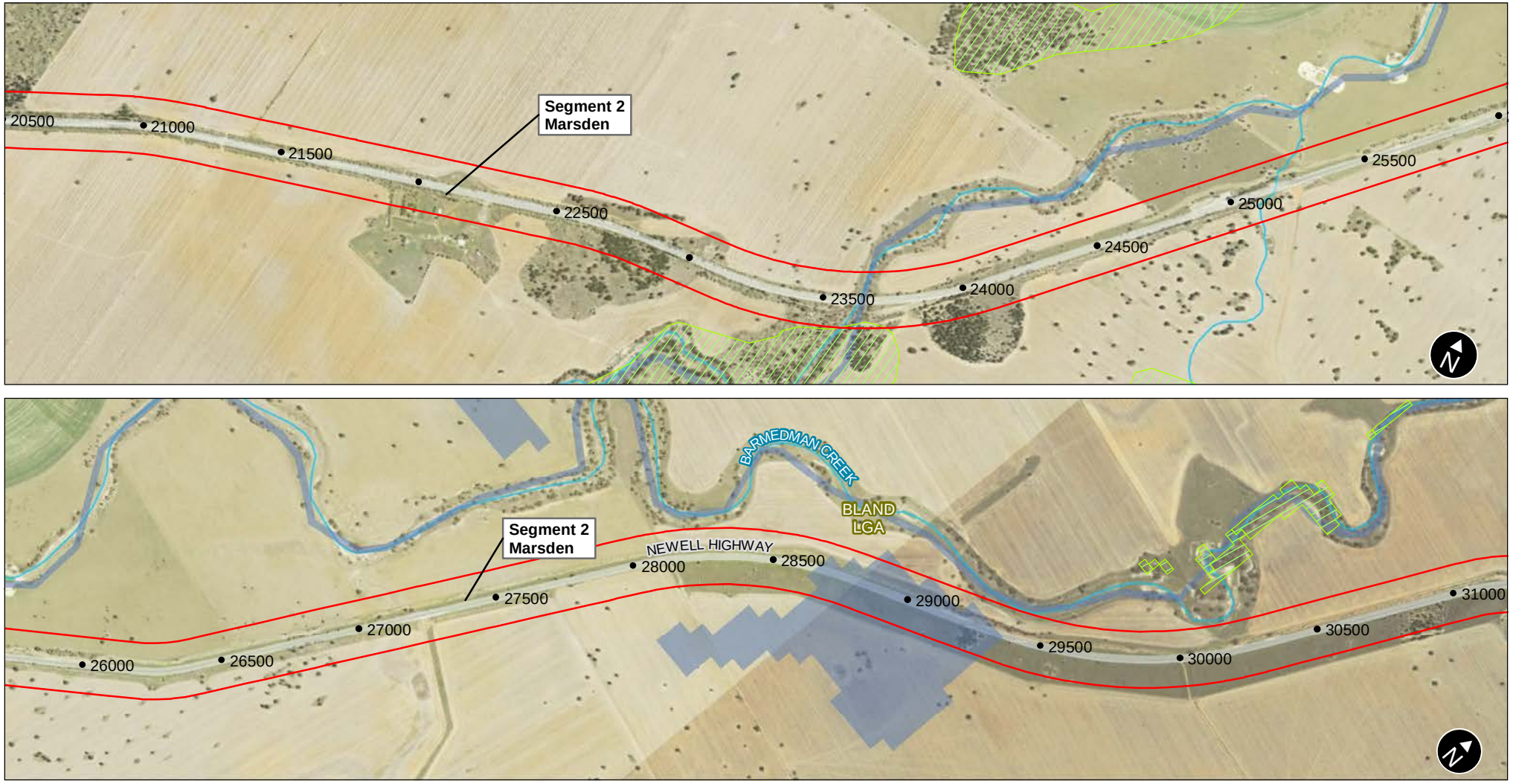
Created by : HK | QA by : XX



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- Aquatic groundwater dependent ecosystems
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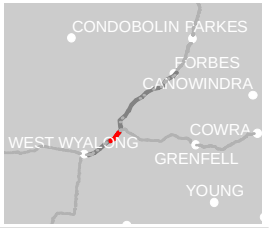
1:20,000 at A4



Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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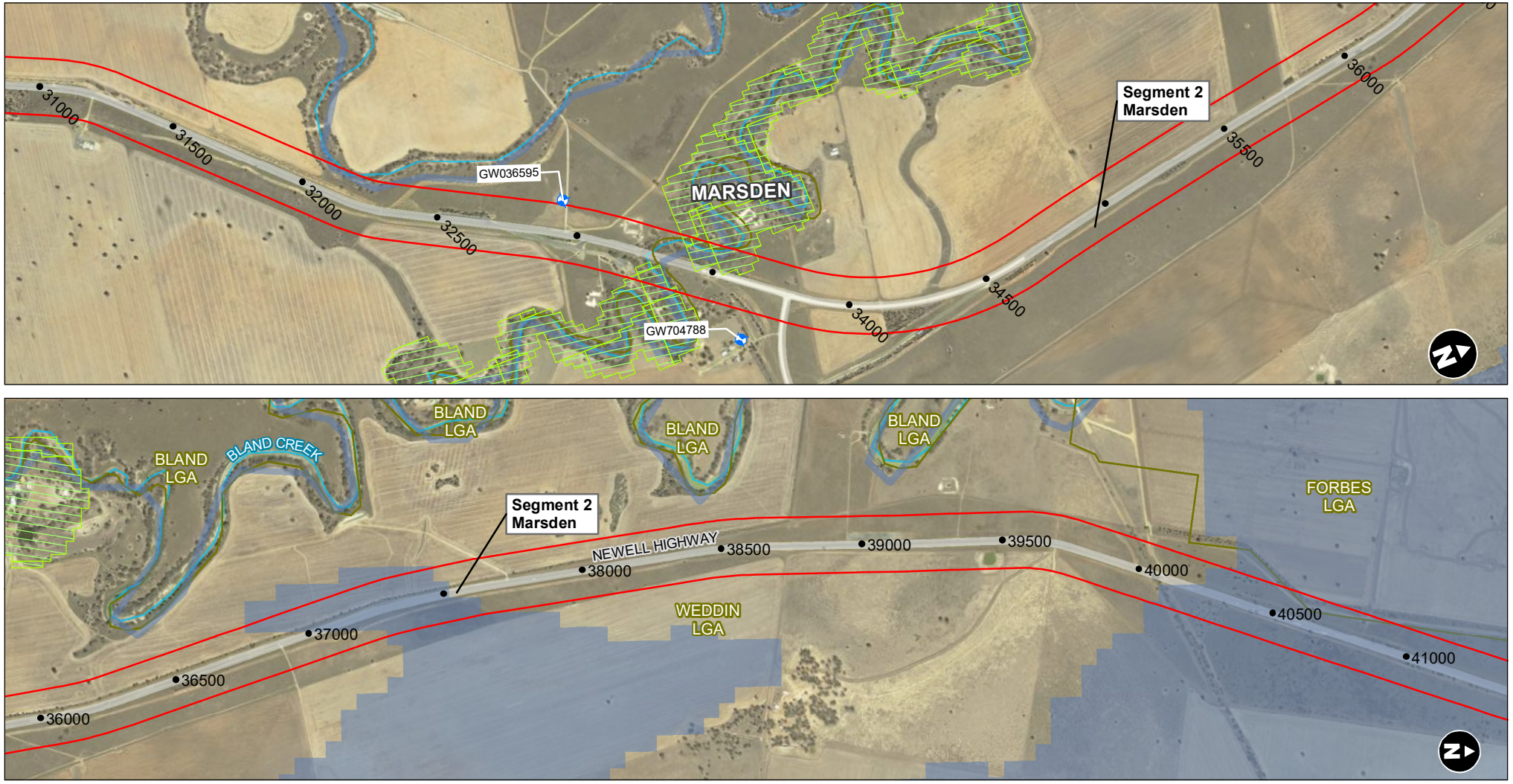

Legend

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- Local Government Area
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- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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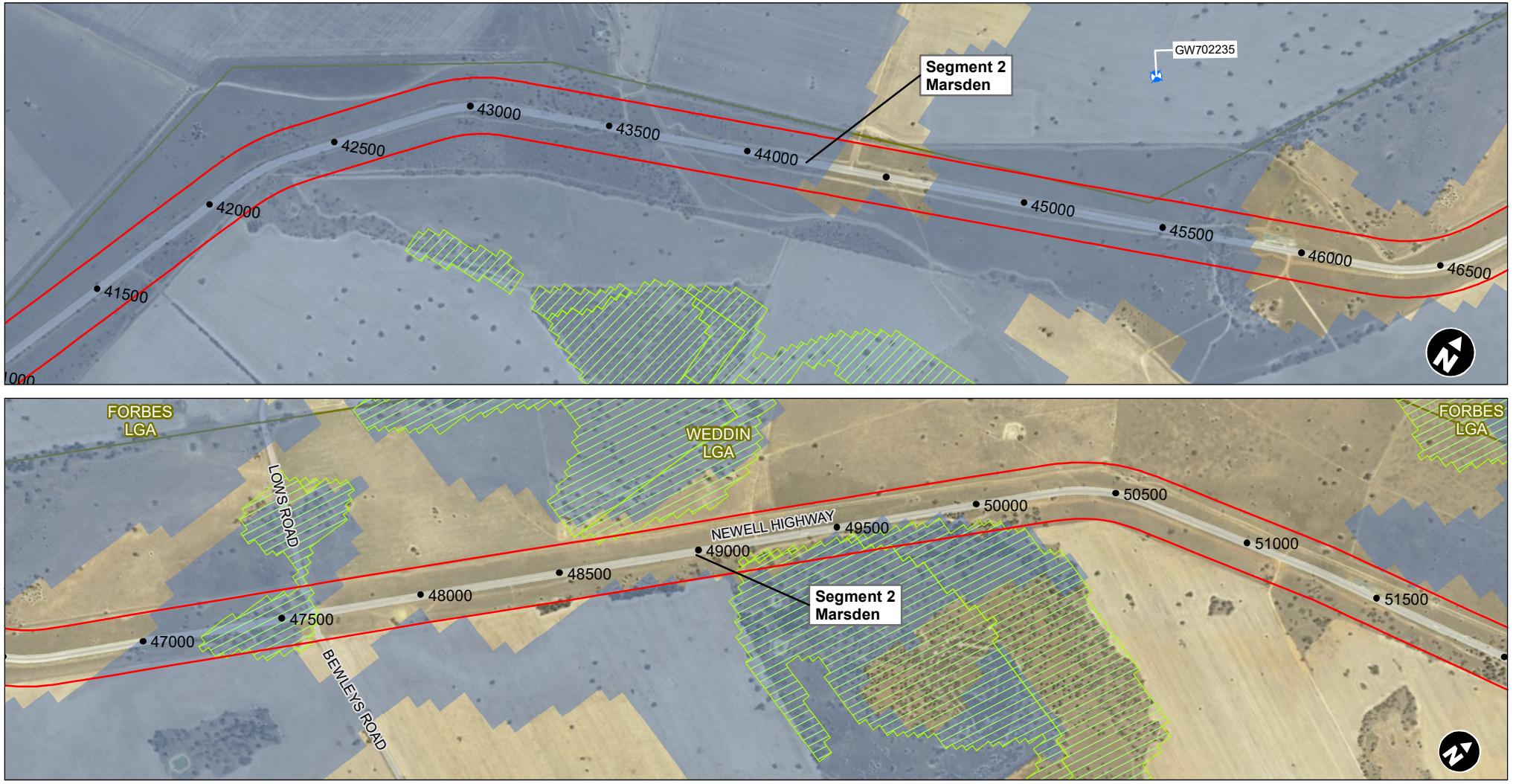

Legend

- Study area
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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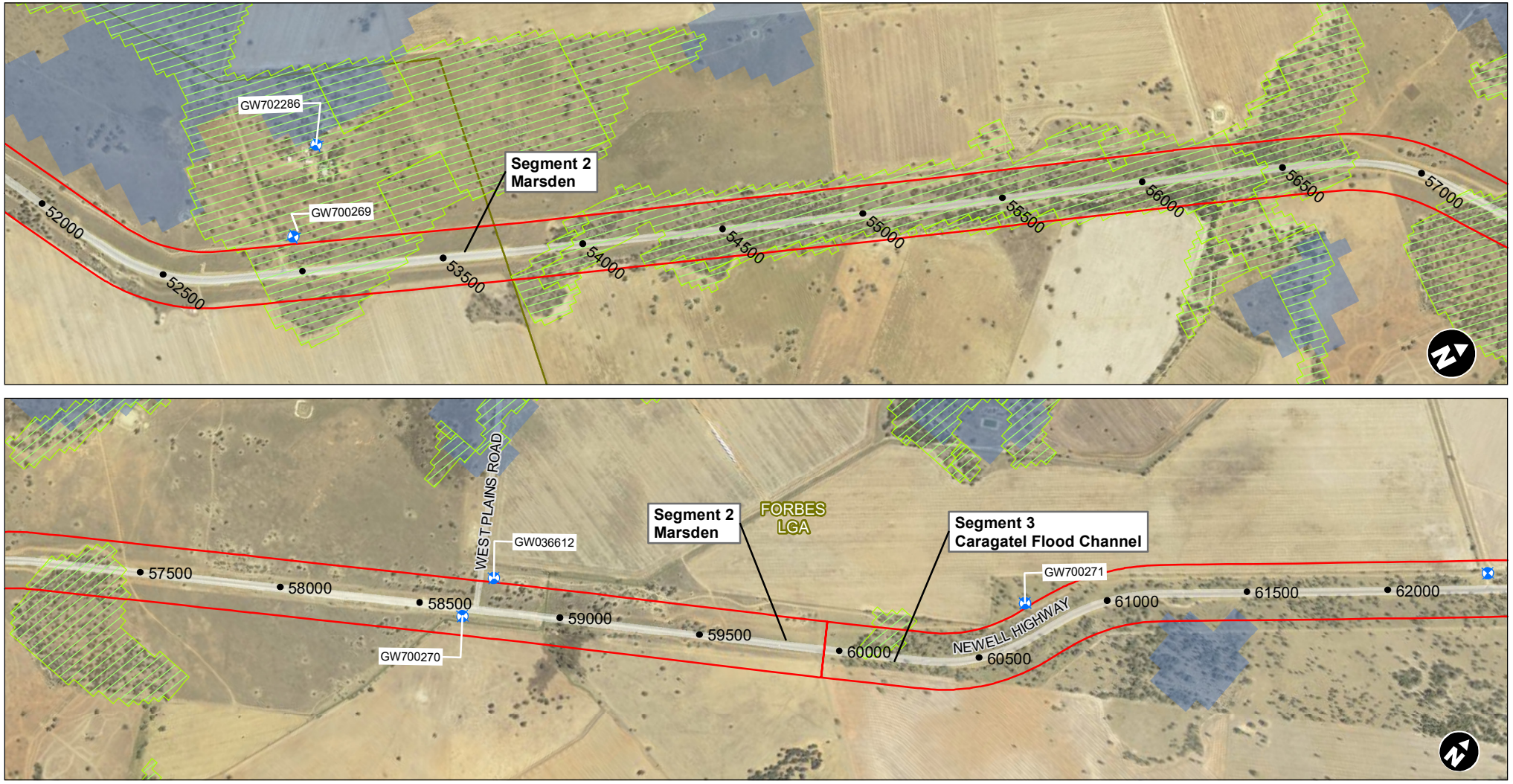

Legend

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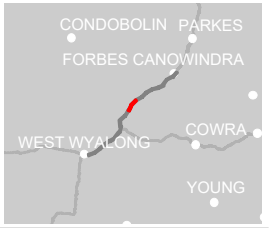
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4



Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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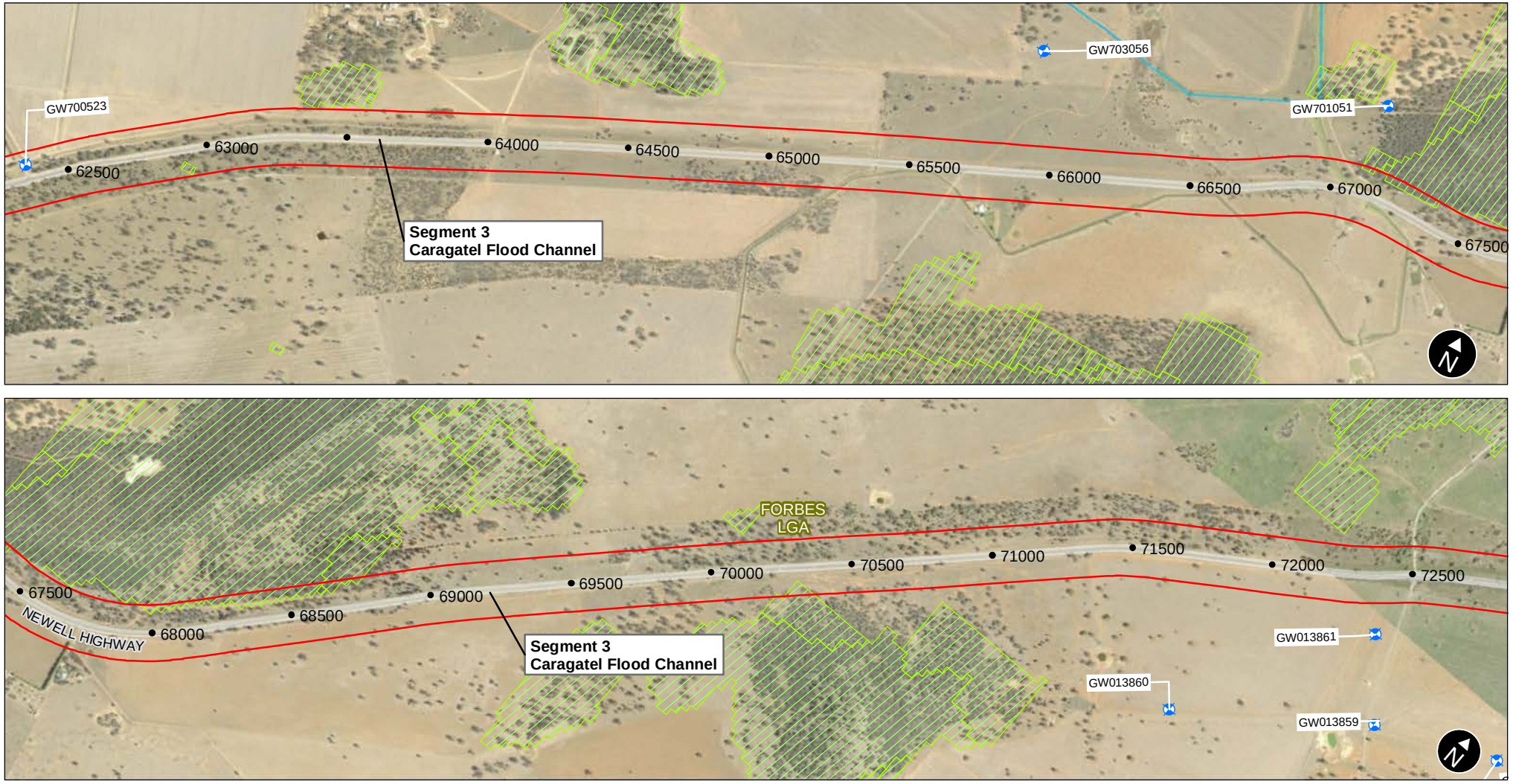
Created by : HK | QA by : XX



Legend

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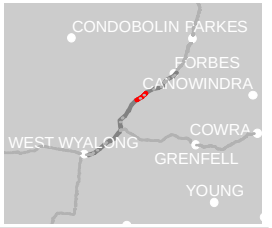
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4



Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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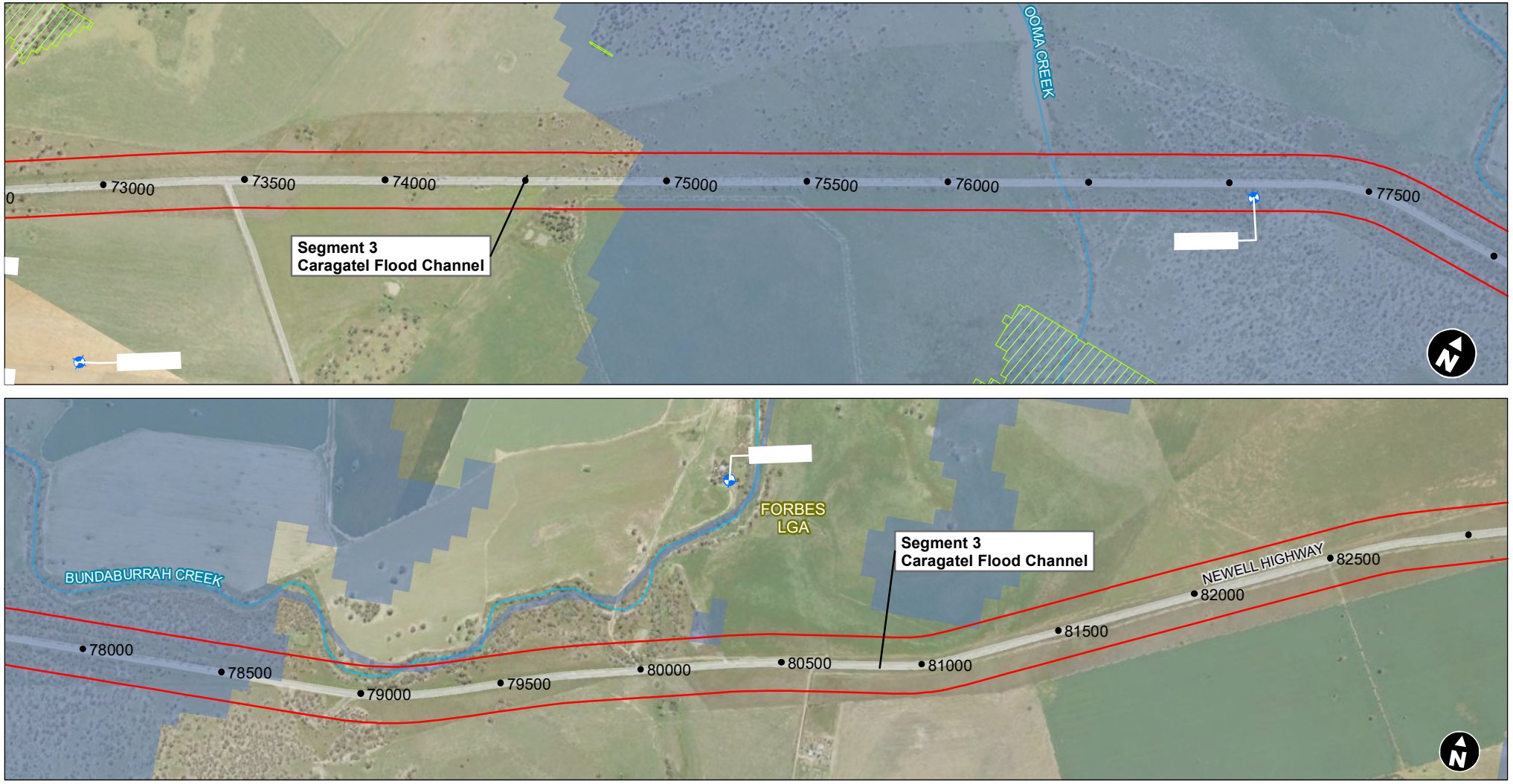

Legend

- Study area
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

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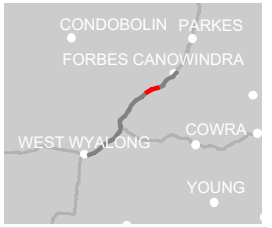

Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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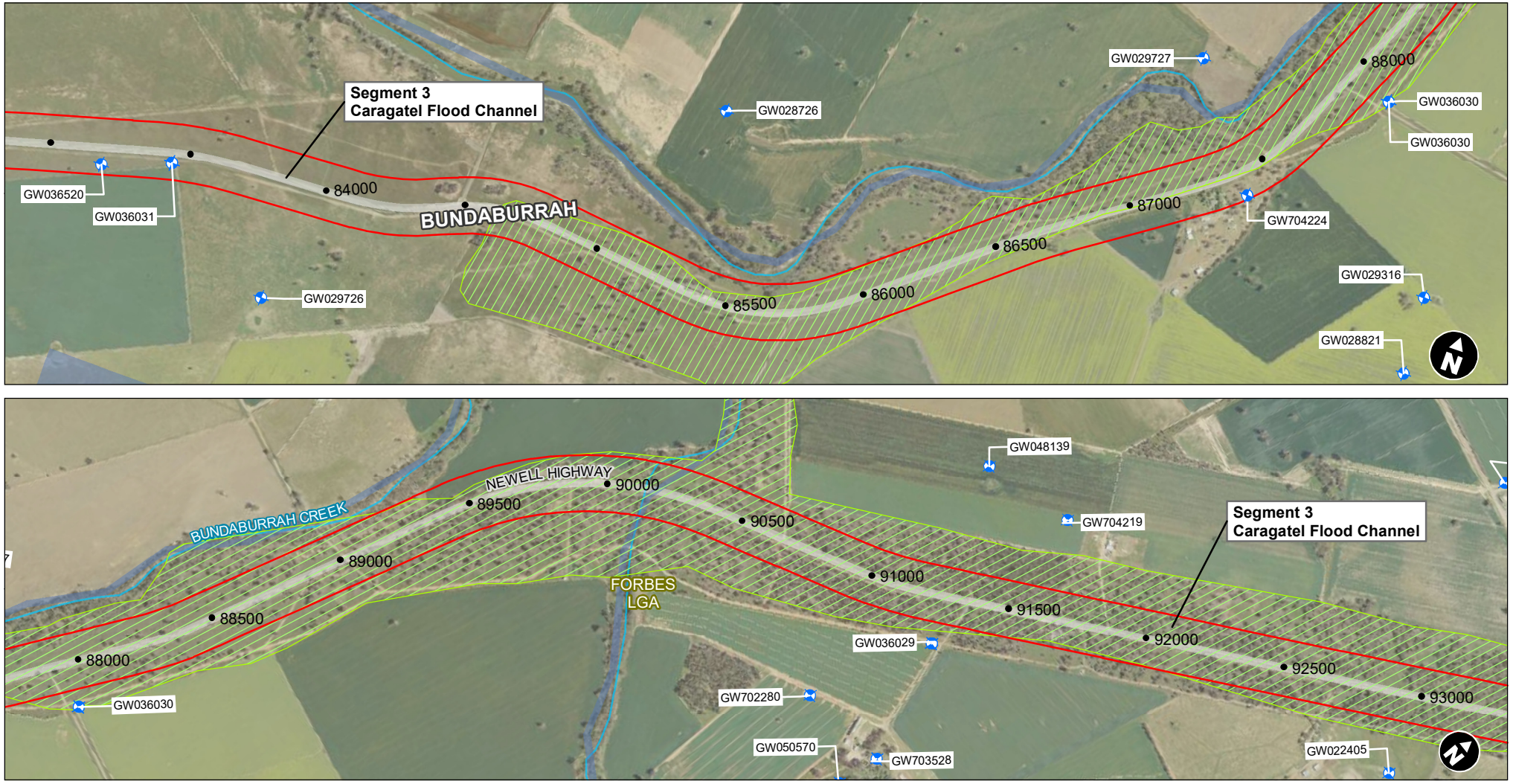
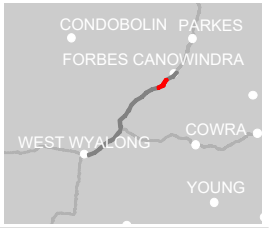


Legend

- Study area
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4



Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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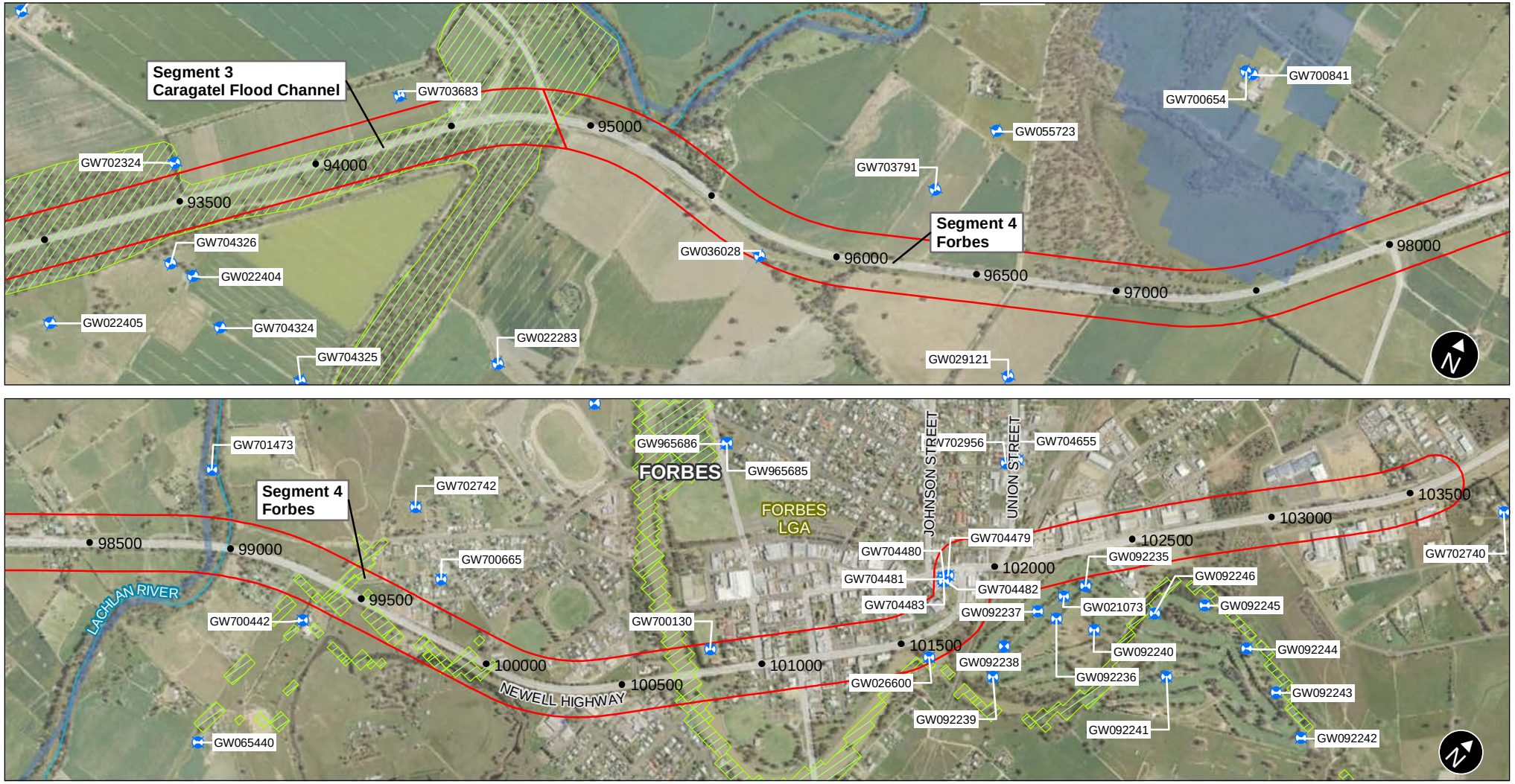
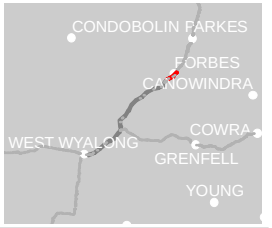


Legend

- Study area
- Local Government Area
- Groundwater bore
- Terrestrial groundwater dependent ecosystems
- Aquatic groundwater dependent ecosystems
- Waterway

0 500 1000 m

1:20,000 at A4



Data sources

Jacobs 2020
Geoscience Autralia 2020
NSW Spatial Services 2020
BOM 2021

GDA94 MGA55

Figure 5-3 Groundwater bores, GDEs

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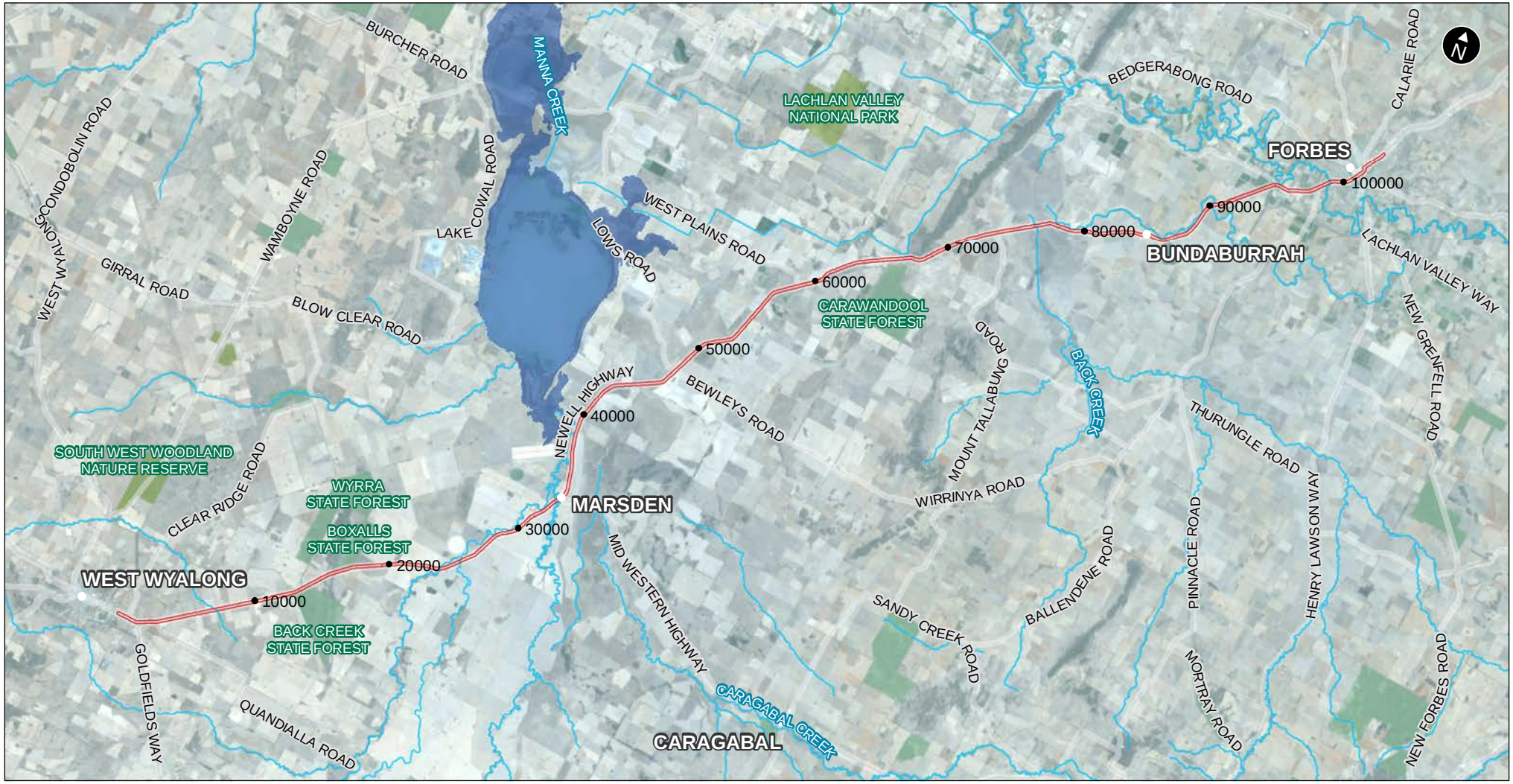
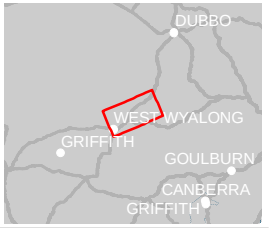


Study area
Lake Cowal/Wilbertroy Wetlands
National Park
State Forest
Waterway

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2020
NSW Spatial Services 2020
DPIE 2021
GDA94 MGA55

Figure 5-4 Nationally important wetlands

Date: 17/02/2021 Path: \\jacobs.com\ANZ\IE\Projects\04_Eastern\IS340100\22 Spatial\GIS\Directory\Templates\Figures\IS340100_GIS_F008_Welands_r1.mxd
Created by : HK | QA by : XX

Field survey

The rapid survey, involving stopping and surveying next to the highway identified the following features within the study area:

- Four threatened fauna species were observed next to the study area:
  - Glossy-black Cockatoo (*Calyptorhynchus lathami*) (listed as vulnerable under the BC Act)
  - Brown Treecreeper (*Climacteris picumnus victoriae*) (listed as vulnerable under the BC Act)
  - Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) (listed as vulnerable under the BC Act)
  - Blue-billed Duck (*Oxyura australis*) (listed as vulnerable under the BC Act).
- The rapid assessment identified that:
  - Most vegetation is disturbed, primarily by missing and modified structural layers and varying invasion of exotic groundcover, including *Avena* sp. (Oats) and *Brassica napus* (Canola)
  - Populations of threatened flora species occur in disturbed roadside vegetation, e.g. *Austrostipa metatoris* (A spear-grass) *Austrostipa wakoolica* (A spear-grass)*, Dichanthium setosum* (Bluegrass)
  - Some communities have been inaccurately mapped, such as some areas of Weeping Myall Woodland (listed under the BC Act and EPBC Act). Additionally, areas that appear to be co-dominated by *Eucalyptus populnea* (Poplar Box) may meet the listing criteria and condition threshold for EPBC Act listed Poplar Box Grassy Woodland on Alluvial Plains (Endangered) TEC, which has not been mapped
  - Areas mapped as native grassland (in particular PCT 45 and PCT 250) are commonly dominated by exotic species
  - Native groundcover species and planted/regrowth/remnant woody native vegetation was identified in areas mapped as 'Not native' vegetation. Therefore, the extent of some PCTs within the study area may be larger than suggested by regional vegetation mapping
  - A moderate to high abundance of hollows were observed in areas containing large trees, particularly *Eucalyptus camaldulensis* (River Red Gum) along riparian corridors, which may offer suitable habitat for hollow-dependent fauna. Riparian corridors also offer wildlife corridors. A group of Brown Treecreepers (listed as vulnerable under the BC Act) were observed in River Red Gum Woodland around Bland Creek
  - Moderate to high quality woodland vegetation may provide habitat for threatened terrestrial plant species, such as *Acacia ausfeldii (*Ausfeld's Wattle) (listed as vulnerable under the BC Act)
  - Creeks and dams may provide wetland and wader habitat for bird species. The Blue-billed Duck was identified adjacent to the study area in Barmedman Creek during surveys. Roadside low-lying swales/drains containing standing water present suitable habitat for amphibian species, including Sloane's Froglet (listed as vulnerable under the BC Act and endangered under the EPBC Act). Aquatic areas may also provide suitable habitat for threatened wetland plant species, such as *Eleocharis obicis* (Spike-Rush) (listed as vulnerable under the BC Act and EPBC Act)
  - A moderate to high abundance of mistletoes were observed in some areas, particularly in Weeping Myall, which would provide foraging habitat for a range of nectarivorous species
  - Surveys did not identify any areas of high-quality rocky outcrops. The rocky escarpment just north of Carawandool State Forest and north of the study area may provide rocky outcrops and rocky overhang habitat for reptile and bat species
  - A large number of medium-sized stick nests were observed, most likely belonging to the Australian Raven. No large stick nests potentially belonging to a threatened raptor species were identified.

  A field study was undertaken on 8 September 2020 by AREA Environmental Consultants & Communication (AREA) along the highway near Gullifer's Road. *Swainsona murrayana* (Slender

Darling Pea*)* been recorded adjacent to the highway in segment 3 near Gullifer's Road, refer **Figure 5-2** which is located about 20 km south of the Forbes township on the highway.

5.2.3 Summary of findings

Desktop review

A summary of the desktop review assessment findings is provided below. This summary provides a broad-scale distribution of key ecological attributes that may occur in the study area.

Key ecological attributes and potential biodiversity constraints to consider include:

- The potential presence of at least seven EPBC Act and nine BC Act TECs listed as endangered and/or critically endangered
- Potential presence of derived grasslands associated with a TEC (e.g. White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grassland) that may not be identified by vegetation mapping and will need to be ground-truthed by detailed floristic assessment
- Some communities have been inaccurately mapped, such as some areas of Weeping Myall Woodland (listed under the BC Act and EPBC Act). Additionally, areas that appear to be co-dominated by Eucalyptus populnea (Poplar Box) may meet the listing criteria and condition threshold for EPBC Act listed Poplar Box Grassy Woodland on Alluvial Plains (Endangered) TEC, which has not been mapped
- Potential habitat and presence of threatened flora and fauna listed under the EPBC Act and BC Act within the study area including the Glossy-black Cockatoo (*Calyptorhynchus lathami)*, Brown Treecreeper (*Climacteris picumnus victoriae*), Grey-crowned Babbler *(Pomatostomus temporalis temporalis*) and Blue-billed Duck (*Oxyura australis*) which have been confirmed in the study area
- Populations of threatened flora species occur in disturbed roadside vegetation, e.g. *Austrostipa metatoris* (A spear-grass) *Austrostipa wakoolica* (A spear-grass)*,* and the *Swainsona murrayana* (Slender Darling Pea)
- Potential bats roosting habitat in man-made structures such as culverts*.*

Key potential impacts on the ecological attributes identified as potentially present within the study area include:

- Clearing of endangered and critically endangered ecological communities
- Clearing of habitat for EPBC Act and BC Act listed threatened flora and fauna species
- Direct clearance of EPBC Act and BC Act listed threatened flora species
- Increased habitat fragmentation and edge effects through the widening of the highway corridor
- Potential indirect impact to KFH and waterways that are habitat for threatened fish species
- Potential for weed invasion, including listed priority weeds, and spread into adjacent sensitive habitats such as areas of TECs
- Introduction of pathogens as *Phytophthora cinnamomi* (dieback) and *Uredo rangelii* (Myrtle Rust) into the environment.

5.2.4 Recommendations

Biodiversity issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-8**.

Table 5-8 Summary of recommendations – biodiversity

Issue	Recommendation	Timing
Impacts to biodiversity	Impacts on identified TECs, threatened plant species, threatened fauna habitat and wildlife connectivity should be addressed. This will require specialist ecological advice and should, in priority order, seek to avoid, minimise and then manage impacts. The assessment should be in accordance with the *Biodiversity Assessment Guidelines, EIA-N06 (Transport, 2020).*	Detailed environmental assessment
Impacts to biodiversity	A biodiversity assessment should be undertaken during the detailed environmental assessment stage of the proposal development consistent with the requirements of the BC Act and EPBC Act. This should include as a minimum: • Field survey and other investigations to verify biodiversity values present • Assessment of impact significance for affected endangered ecological communities with reference to environmental assessment requirements • Assessment of impact significance for affected TECs with reference to relevant Commonwealth guidelines • Assessment of impact significance on threatened species with a moderate or higher likelihood of occurrence in the study area • Consideration of fauna connectivity and potential mitigation measures • Offset requirements in accordance with relevant assessment pathway. Impact assessment on threatened flora and fauna and wildlife connectivity with a moderate or higher likelihood of occurrence in the study area should be further assessed during design development, construction planning and construction. The assessment should be in accordance with the *Biodiversity Assessment Guidelines, EIA-N06 (Transport, 2020).*	Detailed environmental assessment
Impacts to biodiversity	Apply the 'avoid, minimise, mitigate and offset' hierarchy during further design development, specifically in relation to threatened communities and species.	Design development and detailed environmental assessment
Impacts to KFH	Consultation with DPI (Fisheries) will be carried if any impacts are expected on KFH. Specific consideration will need to be given to potential impacts on fish habitat and fish passage during detailed environmental investigation.	Design development and detailed environmental assessment
Opportunity	**Recommendation**	**Timing**

Issue	Recommendation	Timing
Reduce impacts to biodiversity	Seek to reduce the proposal's footprint in valuable and sensitive biodiversity areas, where possible.	Design development

5.3 Aboriginal heritage

This section identifies the Aboriginal heritage values of the study area and constraints to be managed during further stages of the proposal. This section is based on the results of desktop review and is summarised below.

5.3.1 Methodology

A desktop review was used to identify Aboriginal heritage within the study area. It included:

- An extensive search of the Heritage NSW AHIMS was carried out on 31 August 2020 with a 100 m search area either side of the existing road centre line
- A search of the Australian Heritage Database and State Heritage Register (SHR) was carried out on 9 July 2020 with a one km buffer of the study area.
- A review of previous archaeological assessments within the wider region.

The results from these searches are summarised below and contained in **Appendix B**. The aboriginal heritage assessment for the proposal is summarised below.

5.3.2 Existing environment

Historical background

The proposal is located in the Riverina region and the central west region. The Riverina region and the central west region was occupied by Aboriginals of the district more than 30,000 years ago. The Wiradjuri people travelled to the high-altitude regions of the South Eastern Highlands and Australian Alps bioregions for an annual feast of bogong moths.

The Wiradjuri people lived near the Lachlan, Macquarie and Murrumbidgee rivers, "people of the three rivers". They mostly moved in small groups, staying close to the river flats and waterways through the seasons. The Wiradjuri people cover one of the largest tribal areas in NSW from Nyngan to Albury and from Hay to Bathurst (Forbes Shire Council, 2020).

Search of heritage registers and databases

A desktop search SHR did not identify any Aboriginal heritage places or items in the proposal area (refer to **Appendix A**).

A search of Aboriginal objects, sites, and places registered on the AHIMS identified 13 records within the study area as shown in grey in **Table 5-9**. Another three registered sites are located outside the 100 m search area either side of the existing road centre line and also described in **Table 5-9** (not shaded). **Figure 1-2** shows the location of AHIMS sites.

Table 5-9 Summary of Aboriginal sites within the study area and 100 m either side of the existing road centre line of the highway

AHIMS ID	Site name	Site features	Segment	Location in or next to the study area
43-4-0067	Glenroy-IF2	Artefact of a single silcrete flake located within the flat landform in a ploughed field. It is located 7.4 km northeast of Wyalong, 70 m north of the highway and 940 m east of Gagies Creek. Recorded 12/11/2018.	Segment 1	Within the study area
43-5-0040	Open artefact scatter	The site is an artefact scatter located adjacent to and on the western side of the highway. There are six known artefacts within the ploughed area of 15-20 cm, however the artefacts scatter area could larger. Artefacts included five quartz and one volcanic flake. Filed 5/2/1999.	Segment 2	Within the study area
43-5-0051	Kywong – isolated find	The isolated find of a grey chert flake with secondary flaking is located in a track exposure 10 m wide on the western side of the highway. Filed October 1997.	Segment 2	Within the study area
43-5-0050	Burcher Road Artefact scatter	The site is located 50 m south of the easement centre line, on the western side of the highway and the artefact scatter consists of two flakes. Field October 1997.	Segment 2	Within the study area
43-5-0048	Baverts Road	Artefact	Segment 3	Within the study area
43-5-0049	Specks Gap Artefact scatter	The site is an artefact scatter located in an irrigation channel at Specks Gap on the western side of the highway. Five artefacts were noted in the area of 200 m x 30 m. The general site has been disturbed by vegetation clearance, vehicle use, and the construction of a large irrigation channel. Four flakes and one backed blade. Filed 15/6/1999.	Segment 3	Within the study area
43-5-0058	Gooburthery Hill 1 – Scarred Tree	The probably scarred tree is located on the western side of the highway at a low gradient northwest facing slope of Gooburthery Hill. The tree is in good health and the trunk is hollow.	Segment 3	Within the study area
43-5-0052	Gooburthery Hill 2 – Scarred Tree	The probable scarred tree is 15 m tall and is located on the northern basal slopes of Gooburthery Hill and on the western side of the highway.	Segment 3	Within the study area

AHIMS ID	Site name	Site features	Segment	Location in or next to the study area
43-2-0030	Bundaburrah Creek 3 - Artefact scatter.	The site includes an artefact scatter on the southern bank of Bundaburrah Creek. Located about 300 m west of Garema Road and the highway. Artefacts are scattered across an area of 170 x 240 m between the creek and a road layby off the highway. Artefacts included flakes, flaked pieces, cores and one backed blade.	Segment 3	Within the study area
43-4-0012	Bundaburrah Creek 2 – Scarred Tree	The possible Aboriginal scarred tree is about 18 m tall is located on the southern bank of Bundaburrah Creek, on the northwest of the easement centre line of the highway.	Segment 3	Within the study area
43-4-0013	Bundaburrah Creek 1 – Scarred Tree	The possible Aboriginal scarred tree is about 10-15 m tall is located on the southern bank of Bundaburrah Creek, on the western side of the highway.	Segment 3	Within the study area
43-2-0020	Scarred Tree	The scarred tree is alive with a height of 2.03 m x 0.5 m in width located near Bundaburrah Creek. Filed 19/8/1993.	Segment 3	About 10 m south of the study area
43-5-0010	Scarred Tree	A large trunk of an old tree which may have been struck by lightning a fine blackened scar is on the eastern side of the tree trunk. Trunk with scar is dead however 3 new tree trunks have grown from original trunk. The original scar surface is missing. Located 300m from Bundaburrah Creek, 6 km fro0m Forbes and south of the highway. Filed 2/9/1992.	Segment 3	About 50 m south of the study area
43-5-0008	Scar Tree 3	The scarred tree is located about 900 m east of Bundaburrah Creek and 150 m south of the highway and 50 m north of the boundary line. Scarred tree filed 7/9/1992.	Segment 3	About 50 m south of the study area
43-2-0059	Forbes Scar Tree	Modified Tree (Carved or Scarred).	Segment 4	Within the study area
43-2-0032	Jemalong scar tree	Listed 18 October 1999. The scar tree is located 25 m from the highway the dead scar tree is under threat from natural attraction and removal in vehicle carpark.	Segment 4	Within the study area

Landform

In general, the landform is flat, and vegetation has been cleared within the study area. Mature trees are located on either side of the study area provides an indication that the natural landform has not been heavily disturbed in these locations. Furthermore, the study area crosses several water ways, a landform

which is an indication of potential archaeological sites. This indicates that the study area has the potential to contain Aboriginal objects.

Previous archaeological investigation

Wyalong Solar Farm "Glenroy and Glenee" 1409 Newell Highway, Wyalong NSW (OzArk, 2018) is located adjacent north of the study area. In 2018 OzArk carried out a survey of the land in West Wyalong for the proposed solar farm. This study was based on data within the AHIMS register for the wind farm site, existing resources and a field survey. The topography of the solar farm is low lying and has no specific change in elevation of landform. OzArk stated that the topographic nature of the solar farm area would have encouraged past Aboriginal land use and easy movement through the landscape. Aboriginal land use in the area would have been encouraged through features, including low lying landform and the close water sources.

The following site predictions were made for the study area:

- Site types may include scar trees, open campsites, isolated finds
- Creeks may have been transit corridors for movement through country, and occupation would be likely to have been more intense around creeks due to the resources they provide
- Small hills or flat land near creek confluences may have potentially contained campsites.

Carved trees associated with burial grounds and other ceremonial places may be recorded in the wider region and are a common class of heritage item in the region.

5.3.3 Summary of findings

The desktop review indicated that the study area is potentially located within a sensitive landscape. The previous archaeological assessment near the proposal demonstrated that sensitive landforms are present, such as river flats, creeks, and slopes next to creeks.

Thirteen AHIMS sites were identified in the study area, with another three sites located next to the study area. As the AHIMS search results may not be representative of all the Aboriginal sites in the area but rather a demonstration of where archaeological assessments have been conducted, there would be potential for more Aboriginal sites to be present within the study area.

5.3.4 Recommendations

Aboriginal heritage values that will need to be considered during the design development and environmental assessment phases of the proposal are outlined in **Table 5-10**.

Table 5-10 Summary of recommendations – Aboriginal heritage

Issue	Recommendation	Timing
Aboriginal heritage assessment	A PACHCI Stage 1 assessment and a Stage 2 PACHCI assessment is recommended. The aim of a Stage 2 PACHCI is to carry out further assessment and a survey with specific Aboriginal stakeholders to assess the proposal's potential to harm Aboriginal cultural heritage, and to determine whether formal Aboriginal community consultation and a cultural heritage assessment report is required.	Detailed Environmental assessment

5.4 Water quality, hydrogeology and hydrology

Potential constraints within the study area related to water quality, hydrogeology and hydrology are presented in this section. This section also summarises the findings of the *West Wyalong to Forbes Flood Immunity – Preliminary Flooding Report* (Jacobs, 2021) provided in **Appendix C**.

5.4.1 Methodology

Potential surface water quality, hydrogeological, groundwater quality and hydrology constraints within the study area were identified based on a desktop review of publicly accessible information, including scientific literature, previous reports and relevant historic data, applicable legislation, and online databases. Information sources included:

- Minview – Rivers (DPIE, 2019)
- *Directory of Important Wetlands in Australia* (DoAWE, 2021)
- *NSW Water Quality and River Flow Objectives – Lachlan River Catchment* (DECCW, 2006)
- *Basin Plan 2012* (MDBA, 2012)
- *Australian and New Zealand National Water Quality Guidelines for Fresh and Marine Water Quality* (ANZG, 2018)
- *Guidelines for Managing Risks in Recreational Water (NHMRC, 2008) Water resources and management overview – Lachlan catchment* (Green, et al, 2011)
- Water Management (General) Regulation 2018 hydroline spatial data 1.0 (DPIE, 2021)
- *Water quality technical report for the Lachlan surface water resource plan area (SW10)* (DPIE, 2020a)
- Key Fish Habitat Mapping (DPI Fisheries, 2020b)
- *Strahler stream classification - Hypsometric (area-altitude) analysis of erosional topography* (Strahler, 1952b)
- WaterNSW-registered groundwater (supply) bores, real time data (WaterNSW, 2021)
- BoM Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology, 2021)
- Atlas of Australian Acid Sulphate Soils (CSIRO, 2021)
- *Hydrogeological Landscapes of New South Wales and the Australian Capital Territory* (DPIE, 2016)
- BoM rainfall data (BoM, 2018)
- NSW Landuse 2017 (DPIE, 2017).

The methodology for the flooding assessment included:

- Identification of legislation and policy framework applicable to the flooding assessment
- Review of available information, including:
    - Relevant previous reports and anecdotal information on flooding from previous flood studies to identify the historic nature of flooding of the highway
    - Topographic data
    - Rainfall data
    - Streamflow.
- Defining the existing flood immunity of the highway from a review of the available information

- Identifying potential works and measures required to achieve targeted flood immunity for the highway on the basis of a desktop assessment
- Recommendations for the highway upgrade.

5.4.2 Existing environment

Catchment overview

On a regional scale, the proposal is located in the Lachlan River Catchment in NSW, which drains a total area of about 90,000 km^2. The Lachlan River begins in the Great Dividing Range near Gunning and flows generally west for approximately 1,400 km to its junction with the Murrumbidgee River near Oxley (Green, et al, 2011).

The study area is located within the 'middle sub-catchment' of the Lachlan River Catchment. The landscape of the Lachlan Catchment varies from east to west as it flows from the headwaters and tablelands, through the slopes of the middle catchment, to the flat, western plains. The middle catchment, where the study area is located, is characterised by an undulating landscape which has been extensively cleared but with pockets of remnant vegetation remaining (Green, et al, 2011). The Lachlan River Catchment and the study area are displayed on **Figure 5-5**.

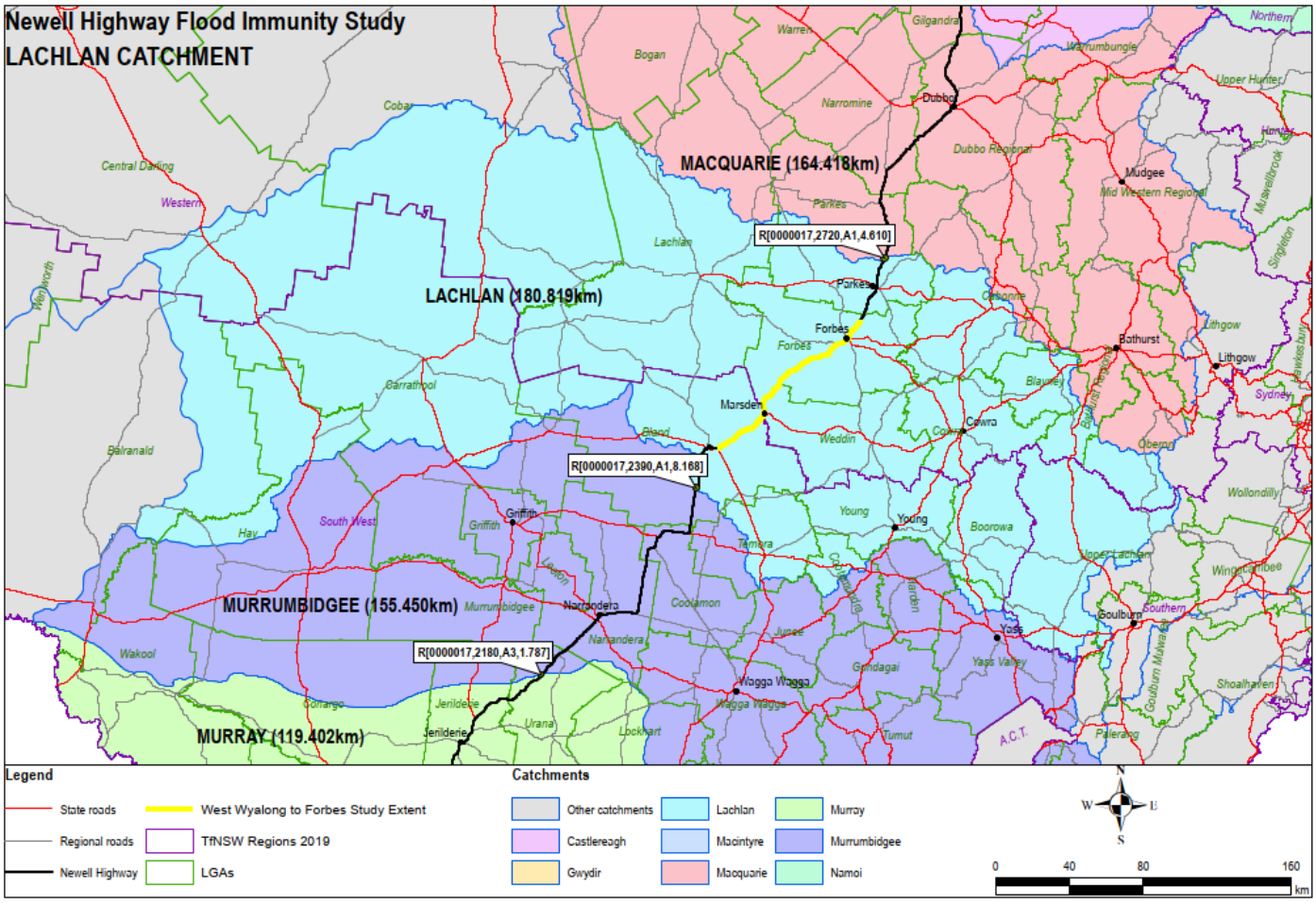


Figure 5-5 Lachlan River Catchment (Source: Perrens Consultants, 2001)

Waterways and hydrological features

The study area generally follows the existing highway alignment which intersects mapped waterways at 23 locations (some of which may be the same waterway intersected more than once), refer to **Figure 1-2**. The waterways within and in proximity to the study area range from minor first order streams to eighth order major waterways (Strahler, 1952b). Minor streams and drainage channels are usually ephemeral or intermittent in nature, while major waterways are perennial. Of the waterways intersected, only seven are named, these are Gagies Creek (5th order), Barmedman Creek (6th order), Warralonga Cowal (3rd order), Bland Creek (7th order), Ooma Creek (6th order), Bundaburrah Creek (2nd order) and Lachlan River (8th order). Six of the waterways crossed by the study area are mapped as KFH by NSW Fisheries (DPI, 2007) (refer to **Section 5.2.2** for further discussion on aquatic habitat).

As outlined in **Section 5.2.2**, Lake Cowal/Wilbertroy Wetlands is located near the study area and is considered wetlands of national significance. Lake Cowal/ Wilbertroy Wetlands form the terminal drainage of Bland Creek sub-catchment, which has an area upstream of the lake of 400,000 ha, refer to **Figure 5-4**. Inundation of the lake occurs as a result of flood flow from the Lachlan River crossing the floodplain or from flooding in the local catchment. To fill from the river, the system requires very large floods that usually occur from the two 'breaks' that are located along the Lachlan River west of Jemalong Range. This usually occurs when flow exceeds about 15,000 megalitres per day (ML/day) at Jemalong Weir (Green, et al, 2011).

Water quality and river flow objectives

The NSW water quality and river flow objectives are the agreed long-term goals for NSW's surface water, as determined by the Department of the Environment, Climate Change and Water in 2006 (DECCW, 2006).

The Water Quality Objectives (WQOs) set out the community's values and uses (ie. Healthy aquatic ecosystem, water suitable for recreation or drinking water etc) for our waterways (rivers, creeks, lakes and estuaries), and a range of relevant water quality indicators to assess whether the current condition of the waterway supports these values and uses. The River Flow Objectives (RFOs) are the agreed high-level goals for surface water flow management. They identify the key elements of the flow regime that protect river health and water quality for ecosystems and human uses.

The study area falls within the middle portion of the Lachlan River Catchment (DECCW, 2006). Waterways within this section of the catchment are mainly categorised as "uncontrolled streams", however Lachlan River is categorised as a "major regulated river" and at the study area crossing location at Forbes it is additionally categorised as "waterways affected by urban development". Waterways within and in proximity of the urban centre of West Wyalong are also categorised as "waterways affected by urban development". WQOs that are assigned to each waterway category identified in the study area are outlined in **Table 5-11**.

Table 5-11 Water quality objectives for waterway categories in the study area

Category	Water quality objective										
	Aquatic ecosystems	Visual amenity	Secondary contact recreation	Primary contact recreation	Livestock water supply	Irrigation water supply	Homestead water supply	Drinking water at point of supply- disinfection only	Drinking water at point of supply – clarification and disinfection	Drinking water at point of supply – groundwater	Aquatic foods (cooked)
Uncontrolled streams – streams or waterbodies that are not in estuaries or other categories. Largely natural flow patterns.	X	X	X	X	X	X	X	X	X		X
Major regulated rivers – rivers which have large dams supplying irrigation water (and usually town and industrial water) for substantial distances downstream	X	X	X	X	X	X	X	X	X	X	X
Waterways affected by urban development – waterways within urban areas that are often substantially modified and generally carry poor quality stormwater	X	X	X	X							

Default guideline values (DGVs) for water quality indicators relevant to each WQO are provided in the *Australian and New Zealand National Water Quality Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) (referred to herein as the ANZG (2018) Water Quality Guidelines) and the *Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008). However because the Lachlan River Catchment forms part of the broader Murray-Darling Basin, a suite of water quality targets for indicators of turbidity, total phosphorus (TP), total nitrogen (TN), dissolved oxygen (DO), electrical conductivity (EC) and pH have been outlined in Schedule 11 of the *Basin Plan 2012* (MDBA, 2012) which can be used in lieu of the ANZG (2018) *Water Quality Guideline DGVs*. Any indicator not included in the *Basin Plan 2012* (MDBA, 2012) continues to utilise DGVs outlined in the ANZG (2018) *Water Quality Guidelines*.

RFOs for the waterway categories of “uncontrolled streams” and “waterways affected by urban development” are outlined in **Table 5-12**. In 1999, when the RFOs were published, no RFOs were recommended for “major regulated rivers” as flow rules were already in place. Several Water Sharing Plans (WSPs) for both surface and groundwater have been in place in the catchment since 2004. Surface water sharing plans in force in the Lachlan catchment include:

- Lachlan Regulated River Water Source 2016
- Lachlan Unregulated and Alluvial Water Sources 2020
- Belubula Regulated River Water Sources 2012.

Groundwater WSPs are discussed further in the following section.

Table 5-12 River flow objectives nominated for waterway categories within the study area

Category	River Flow Objective								
	Protect pools in dry times	Protect natural low flows	Mimic natural drying in temporary waterways	Maintain natural flow variability	Maintain natural rates of change in water levels	Minimise effects of weirs and other structures	Manage groundwater for ecosystems	Maintain wetland and floodplain inundation	Protect important rises in water levels
Uncontrolled streams - streams or waterbodies that are not in estuaries or other categories. Largely natural flow patterns.	X	X				X	X	X	X
Waterways affected by urban development – waterways within urban areas that are often substantially modified and generally carry poor quality stormwater	X	X	X	X	X	X			

Existing water quality

Publicly available water quality data for waterways within proximity of the proposal was limited and dated, with water quality summary statistics reported in the *Water quality technical report for the Lachlan surface water resource plan area (SW10)* (DPIE, 2020a) from a routine monitoring site on Lachlan River at Forbes as part of the State Water Quality Assessment Monitoring Program. The report summarised data collected monthly between July 2010 to June 2015 for parameters including nutrients (TN and TP), total suspended solids (TSS), DO, pH, EC and turbidity, which were compared against the Basin Plan 2012 water quality targets (MDBA, 2012). Results of the routine monitoring program indicated that water quality in the Lachlan River at Forbes between those years was poor, with median DO below the lower limit of 90% saturation, and median concentrations of TN, TP and turbidity exceeding the Basin Plan 2012 targets of 0.25 milligrams per litre (mg/L), 0.02 mg/L and 20 Nephelometric Turbidity Units (NTU), respectively. However, median pH remained within the Basin Plan target range of 7.0 – 8.0 and EC was below the median EC 'End-of-Valley' target of 460 micro siemens per centimetre (µS/cm) (as described in Schedule B, Appendix 1 of the Commonwealth Water Act (2007)).

The data indicates that the Lachlan River at Forbes has historically not met the Basin Plan 2012 water quality targets or the NSW WQOs, however no contemporary data was publicly available for review to determine current water quality. No water quality data was publicly available for other waterways within the study area.

Groundwater

The geology within the study area is dominated by alluvium and alluvial floodplain/channel deposits, with colluvial plains and shallow slope environments.

A review of WaterNSW-registered groundwater bores (WaterNSW, 2021) identified 286 groundwater bores within two km of the study area, refer **Figure 5-3**. The reported purpose of majority of these bores is water

supply (including for stock, irrigation and domestic use), with the remainder used predominantly for exploration and monitoring. Bores ranged from a depth of around two m to 160 m. Available data indicate that most bores are constructed within alluvial soils and have standing water levels typically shallower than 10 m below ground surface. Reported groundwater salinity in these bores typically ranges between 500 and 2500mg/L, rendering it suitable for stock and moderately salt-sensitive to salt-tolerant crops, and consistent with the majority of land use along the alignment being grazing and cropping (DPIE, 2017).

There are GDEs within the study area as discussed in **Section 5.4.2** and shown on **Figure 5-3**.

As described in **Section 5.7.2** and shown **Figure 5-8** much of the study area is mapped high to very high salinity hazard a, indicating that there is potential for generating sodic and saline groundwater in the region.

Flooding

History of flooding

Several major flood events have occurred in the study area, including in 1950, 1952, 1956, 1973, 1974, 1975, 1990, 1993, 1996, 1998, 2010, 2012, 2016 and 2021. During the 1952, 1974, 1990, 1993, 2012, 2016 and 2021 flood events, the highway between West Wyalong and Forbes was impassable.

The 1990 flood resulted in nearly two weeks of flooding, with flood peaks in the Lachlan River maintained for one week compared to its usual duration of around half a day. During this flood event, the highway was closed for six weeks between Marsden and Forbes. Flood water in the area was described as slow moving, however high velocity flows were reported on the highway in Dowling Street, Forbes. The flood event which occurred in 2016 resulted in the closure of the highway for a total of 43 days. During this event about 20 km of the highway was flooded between West Wyalong and Forbes.

Intense rainfall occurred on 23 March 2021 and a section of the highway at Specks Gap was overtopped resulting in pavement damage.

The flooding behaviour for each section of the study area has been summarised as follows:

- West Wyalong: Flooding in this section of the highway occurs due to rainfall runoff generated from the catchment area of a tributary of Yiddah Creek and the catchment area of Gagies Creek. Both water courses have relatively smaller catchments and hence the duration of inundation would be expected to be short
- Marsden: Flooding in this section of the highway is dominated by Bland Creek and its tributaries which traverse along the highway or crossed by the highway. Bland Creek discharges into Lake Cowal/Wilbertroy Wetlands which is located near the study area and is considered wetlands of national significance. Inundation of the lake occurs as a result of flood flow from the Lachlan River crossing the floodplain or from flooding in the local catchment. For the flood plain to fill from the river, the system requires very large floods that usually occur from the two ‘breaks’ that are located along the Lachlan River west of Jemalong Range. This usually occurs when flow exceeds about 15,000 ML/day at Jemalong Weir (Green, et al, 2011)
- Caragatel flood channel: Flood behaviour in this section of the highway is dominated by flooding from the catchment area of Ooma Creek, backwater flooding from Caragatel Lagoon, and flooding in Bundaburrah Creek
- Forbes: Flooding in this section of the highway is dominated by flooding in the Lachlan River and Lake Forbes. The section of the highway located east of the Lachlan Valley Way intersection is subject to flooding from the main channel of the Lachlan River. Sections of the highway located on the southern and northern side of Fitzgerald Bridge are subject to flooding during major flood events
- Lake Forbes: Lake Forbes has a catchment area of approximately 250 square km. Major flooding in Lake Forbes is dominated by breakout flows from the Lachlan River upstream of Forbes. The size of the flood, existing works and vegetation on the floodplain govern the distribution of flood flow between the

Lachlan River and Lake Forbes upstream of Forbes. A major breakout of Lake Forbes is located about 800 m north of where the highway crosses Lake Forbes.

Existing flood immunity

The existing flooding immunity along the highway is summarised below for each section of the study area:

- West Wyalong: The preliminary flood map for Wyalong and West Wyalong provided by Bland Shire Council (Bland Shire Council, n.d) shows that the highway is overtopped in the 1% annual exceedance probability event (AEP) event east of the intersection with Emu Road and east of the intersection with Goldfields Way due to flooding in an unnamed tributary of Yiddah Creek. This section of highway would be expected to have a higher flood immunity than the remaining three sections of the highway

  The preliminary assessment indicates that the section of the highway at Gagies Creek may have flood immunity in a 10% AEP event

- Marsden: Flooding in Bland Creek and its tributaries overtopped 11 sections of the highway during the 2016 flood event. The overall length of overtopping of the highway was 4.56 km, the length of overtopping varying from 300 m to 800 m. Flood levels in ten flooded sections of the highway located north of Bland Creek varied between 207.3 m Australian height datum (AHD) and 207.6 m AHD implying that the floodplain in the vicinity of the highway is flat and wide and impacted by backwater flooding

  A number of sections of the highway were also flooded during the 1990 and 1993 major flood events of. The major flood event of 1993 occurred in Bland Creek and its tributary catchments when the Lachlan River in Forbes was not in flood. However, in the case of the major flood event of August 1990, three minor flood events occurred in the Lachlan River in April, June and July 1990 prior to the major flood event

  Flood modelling carried out (WMAwater, 2019) for this section of the highway showed that two sections of the highway would be overtopped in the 50% AEP event

- Caragatel flood channel: A small section of the highway near Specks Gap was overtopped on 23 March 2021 due to intense rainfall. The frequency of the intense rainfall event is expected to be similar or larger than a 5% AEP event

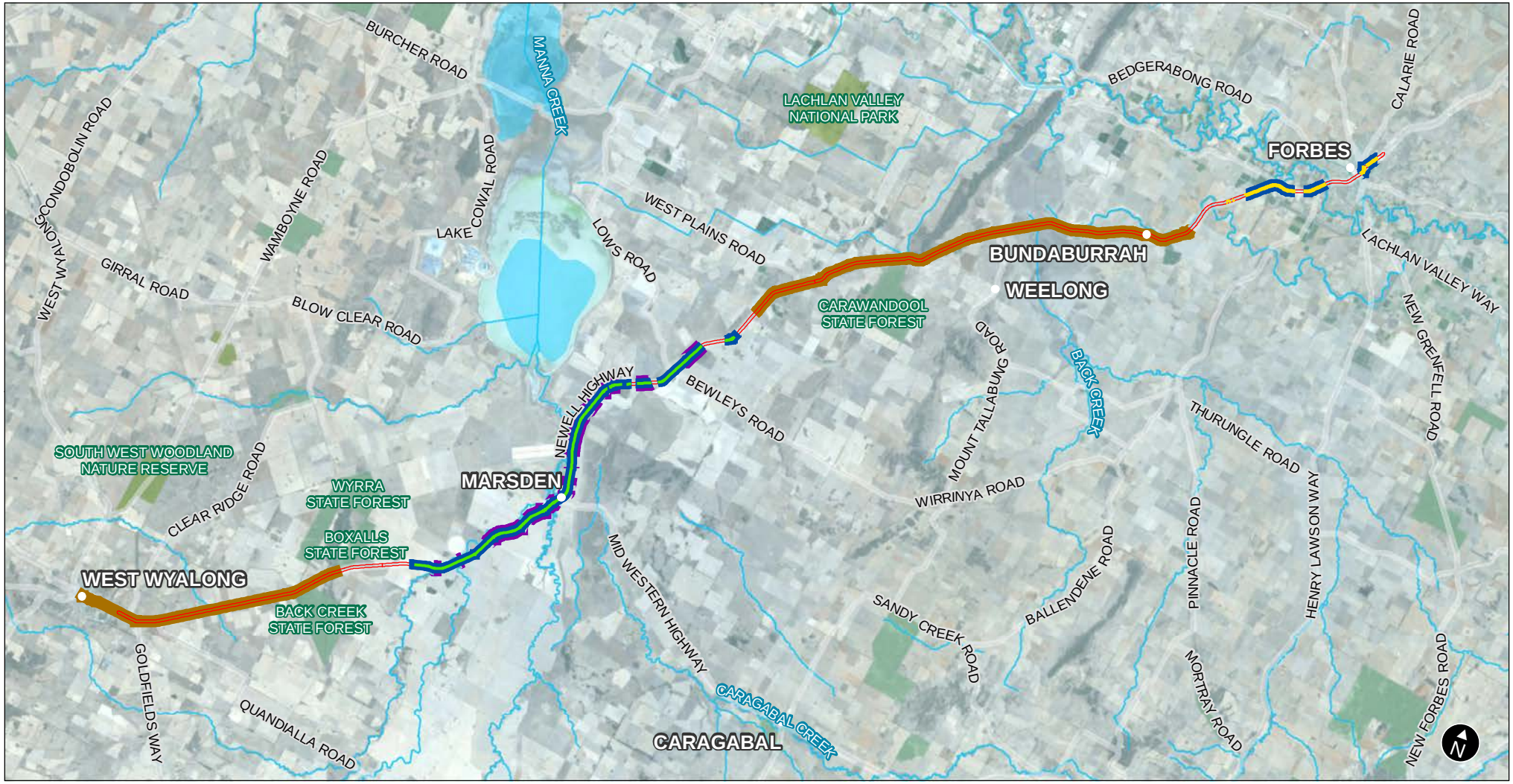
  A 4.44 km section of the highway was flooded during the 2016 major flood event for a period of 37 days. This section of the highway was also flooded during the 1990 major flood event. The 1990 major flood level was 0.15 m higher than the 2016 major flood event. However, the AEP of the smallest flood event which overtops this section of the highway is undefined. No historic records are available on Bundaburrah Creek overtopping the highway. The section of the highway in the vicinity of Bundaburrah Creek is immune to flooding in the 5% AEP event if the section of the highway was not overtopped during the major flood events of 1990 and 2016.

- Forbes: The Lachlan River flooded a section of the highway east of the intersection with Lachlan Valley Way during major flood events. In addition, sections of the highway located both north and south of Fitzgerald Bridge were flooded during major flood events. The breakout of Lake Forbes overtopped the highway during flood events of 1952, 1974, 1990, 2012 and 2016.

  This section of the highway is expected to be immune to flooding in the 10% AEP event.

On the basis of the available data, existing flood immunity has been defined for the Marsden and Forbes segments of the highway. The Marsden segment of the highway at is flooded at two locations in the 50 % AEP. The Forbes segment of the highway is immune to flooding from flooding in the Lachlan River and Lake Forbes in the 10% AEP event.

The sections of the highway subject to flooding is shown on **Figure 5-6**.



Legend

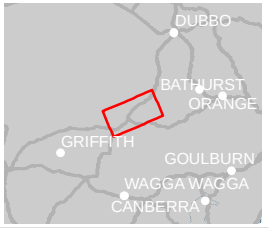
- Study area
- Waterway
- State Forest
- National Park

Flooding on Newell Highway

- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- No flooding information available

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2021
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GDA94 MGA55

Figure 5-6 Sections of Newell Highway subject to flooding

Date: 12/03/2021 Path: \\jacobs.com\ANZ\IE\Projects\04_Eastern\IS340100\22 Spatial\GIS\Directory\Templates\Figures\IS340100_GIS_F009_FloodConstraints_r1v3.mxd
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5.4.3 Summary of findings

Surface water quality

The desktop review indicated that the study area traverses several waterways, wetlands and floodplain environments which are likely to be highly sensitive aquatic ecosystems, important for use in irrigation, water supply or for recreational purposes. Available water quality data for the Lachlan River near the urban centre of Forbes indicated that the water quality is generally poor and likely a result of impacts from existing activities including damming of the river, agricultural practices and nearby development. For other waterways in the study area, however, there was insufficient data available to adequately assess existing water quality against relevant guidelines (ANZG, 2018; NHMRC, 2008; MDBA, 2012). In order to determine the existing condition of the waterways, if WQOs are being met and if the proposal will have any impact on achieving WQOs, additional data will need to be obtained or collected.

Key potential impacts to surface water quality of waterways within the study area may include:

- Erosion of exposed soils and subsequent sedimentation of downstream receivers
- Changes to the hydrological regime and surface runoff leading to potential erosion and sedimentation of waterways
- Potential changes to water quality in sensitive aquatic ecosystems that are key fish habitat and predicted habitat for threatened fish species.

Groundwater

The desktop review indicated that groundwater is used in the study area for stock, irrigation and domestic use. The proposal traverses several potential GDEs, a zone of potential acid sulfate soils, and soils with potential for generating sodic and saline groundwater.

Modifications to the highway, including increasing the highway height (using new embankments), changes to drainage, and landscaping, additional foundations, and the construction of these elements, have the potential to alter the surface water and groundwater flow regimes. The relatively shallow groundwater system is a potentially sensitive resource that could be impacted by the proposal.

Key potential impacts to groundwater due to these modifications may include:

- Permanent changes to the hydrogeological flow regime or groundwater availability, potentially leading to reduced/increased baseflow to waterways and/or reduced groundwater recharge, and subsequent impact to sensitive GDEs, aquatic ecosystems and/or groundwater (supply) bore users
- Changes to groundwater availability during construction due to construction dewatering, potentially leading to reduced/increased baseflow to waterways and/or reduced groundwater recharge, and subsequent impact to sensitive GDEs, aquatic ecosystems and/or groundwater (supply) bore users
- Potential changes to groundwater quality due to, for example, disturbance of saline or acid sulfate soils, or interaction with contaminated sites (as relevant).

Hydrology

The desktop review indicated that the study area falls within a significant wetland and floodplain environment connected by several major and minor waterways with variable flows and hydrological characteristics, ranging from major, regulated waterways to minor, intermittent or ephemeral streams. Apart from the Lachlan River, which is highly regulated, the majority of waterways in the study area are considered to be mostly natural therefore there is a key objective to protect natural flow variability as well as to maintain wetland environments and floodplain inundation (DECCW, 2006). Most of the existing

highway alignment is unlikely to significantly disrupt natural flows, therefore existing conditions are considered likely to be achieving the nominated RFOs.

Impacts to waterway hydrology include:

- Potential changes to the hydrological regime and quantity of surface runoff which may lead to erosion and sedimentation or scour of waterways, and subsequent impacts to river geomorphology
- Potential changes to flow paths which could cause alteration of wetting and drying processes within natural waterways. This may cause subsequent impacts to aquatic ecosystem function such as disruption of spawning cues and species migration.

Flooding

Flood prone areas of the highway were identified by reviewing historical data of the submerged sections of the highway in a high volume rainfall event over a six week period in 2016 between West Wyalong to Forbes. In addition, the available information (such as flood study reports, flood modelling data, aerial photographs, imagery, topographic data, rainfall data, stream gauge data etc) on flood behaviour along the highway were reviewed in an attempt to define the existing flood immunity for the highway.

Due to gaps in the available information and inconsistency between observed and modelled flood behavior along the highway, it would be necessary to undertake a detailed flooding assessment to identify feasible options to improve flood immunity for the highway. In addition, improvement of flood immunity for the highway has the potential to have adverse impacts on flood levels, duration of flooding, flood velocity, scour and erosion, and provide a flood hazard. Hence it is recommended that a detailed flooding assessment be carried out during development of concept design for the proposal. The recommendations for each section are summarised below:

- West Wyalong: Limited information is available on the existing flood behaviour for this section of the highway. Hence, it would be necessary to carry out a detailed flooding assessment to define the frequency, duration and extent of flooding for the highway. The flooding assessment would also need to define the extent of the upgrade required to achieve the desired flood immunity for the highway
- Marsden: The available flood study for Marsden (WMAwater, 2019) requires updating with good quality LiDAR data. Calibration and verification against observed flood events of the flood model is required to allow confidence on flood behaviour for design flood events. The updated model should be used to define the existing flood behaviour and to assess flooding impacts for a range of upgrade options to assist in the selection of the preferred upgrade option
- Caragatel flood channel: A flooding assessment is required to identify and assess potential upgrade options for about 4.5 km section of the highway at Caragatel Bridge. Major waterway crossings need to be provided at this location to address debris blockage and to manage duration of inundation within acceptable limit for any upgrade option of the highway at Caragatel Bridge.
- A flooding assessment is also required to define the existing flood immunity and to identify feasible upgrade options for the highway at Bundaburrah Creek. Extend the flood model for Forbes to include the section of Bundaburrah Creek which is crossed by the highway.
- Forbes: The flood model for Forbes needs to be refined to update flood behaviour along the highway prior to identification and assessment of any upgrade options for four sections of the highway which were flooded during the flood event of September 2016. The updated flood model should be used in the identification and assessment of flooding impacts for the selected options. Any upgrade option for the highway should ensure that no adverse change in the distribution of flood flows between the Lachlan River, Lake Forbes and Bundaburrah Creek in Forbes.

Potential impact of the proposal

During construction the following activities may have the potential to affect surface water hydrology and flooding:

- Culvert and bridge works including construction of piers and temporary crane pads (if required)
- Relocation of a drainage channels
- Earthworks for road widening and raising, intersection and access upgrades
- Construction of retaining walls
- Excavation for drainage trenches, channels and temporary sediment and permanent water quality basins
- Installation of new drainage pits, pipes and culverts
- Culverts and other drainage works, including temporary waterway crossings
- Vegetation clearance
- Cleaning of existing pipes and culverts
- Temporary access roads
- Construction compounds and ancillary facilities
- Temporary stockpiles.

Impacts of the proposed construction works on surface water hydrology and flooding should be assessed during development of concept design for the proposal.

While the potential impacts to hydrology and flooding during operation of the proposal would relate to the raising of the highway embankment, encroachment of the floodplain due to construction of new bridges and culverts, increase in impervious surface through the widening of the road, a change in surface flow paths associated within drainage lines across the proposal and the changes in stormwater discharge due to the frequency and intensity of the storm events. The proposal has the potential to impact on flood levels, flow velocities, scour and erosion, flood hazard, flow distribution and duration of inundation.

It is expected that the concept design for the proposal will be developed to avoid adverse impacts on hydrology and flooding.

5.4.4 Recommendations

Water quality and hydrology issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-13**.

Table 5-13 Summary of recommendations – water quality, flooding and hydrology

Issue	Recommendation	Timing
Flooding	Further design development and detailed environmental assessment for the proposal should assess potential flooding impacts during construction and operation including consideration of the *NSW Government's Floodplain Development Manual* (Department of Natural Resources, 2005), *Practical Consideration of Climate Change – Flood risk management guideline* (DECC, 2007) and *Australian Rainfall and Runoff:*	Design development and detailed environmental assessment

Issue	Recommendation	Timing
	A guide to flood estimation (Commonwealth of Australia (Geoscience Australia 2016).	
Flooding	A detailed flooding assessment to identify feasible options to improve flood immunity for the highway should be carried out. A detailed flooding assessment should be carried out during development of concept design for the proposal.	Design development and detailed environmental assessment
Flooding	Assess impacts of the proposed construction works on surface water hydrology and flooding during development of the proposals concept design.	Design development and detailed environmental assessment
Flooding – surface water and groundwater	Consider impacts on groundwater and surface water flow including flood routes during the environmental assessment process.	Design development and detailed environmental assessment
Hydrology	Identification of potential impacts on stormwater quantity, change in stormwater runoff (increase or decrease) and geomorphic sensitivity of downstream waters.	Design development and detailed environmental assessment
Surface water quality	Identification of sensitive receiving waterways, assessment of existing water quality against numerical criteria for relevant water quality indicators (ANZG, 2018; NHMRC, 2008; MDBA, 2012), and determination of whether relevant WQOs are currently being met, and whether they are likely to be achieved during construction and operation.	Design development and detailed environmental assessment
Groundwater resource	Detailed identification and assessment of potential environmental impacts associated with groundwater resources, including potential loss of groundwater availability to groundwater users and ecosystems during construction and operation.	Design development and detailed environmental assessment
Groundwater quality	Consider potential impacts on groundwater quality, including due to disturbance of saline or acid sulfate soils, during construction and operation.	Design development and detailed environmental assessment

5.5 Socio-economic, land use and property

This section outlines the likely land use, property and socio-economic issues within the study area.

5.5.1 Methodology

The following section provides an outline of the socio-economic land use and property constraints located within the study area, based on a desktop review of the following resources:

- Land use zoning under the Bland, Weddin and Forbes LEPs
- Publicly available information from the DPIE's Major Project Register
- Australian Bureau of Statistics (ABS)
- The Bland, Weddin and Forbes LEPs, community profiles and maps.

5.5.2 Existing environment

The study area is located within the Bland LGA in the Riverina region (DoAWE, 2020a) and the central west region which includes the Weddin and Forbes LGAs. These LGAs cover a total area of about 16,690 km^2 (including waterways).

The Central West region of NSW is located west of Sydney and the Great Dividing Range, extending from Lithgow into the plains areas surrounding Condobolin and West Wyalong. The region comprises the 11 local government areas of Bathurst, Blayney, Cabonne, Cowra, Forbes, Lachlan, Lithgow, Oberon, Orange, Parkes and Weddin (DoAWE, 2020b). The central west region covers a total area of around 70,300 km^2 and about 211,200 people live in the central west (ABS, 2019).

A Labour Force Survey undertaken in May 2020 by the ABS indicates that around 111,500 people were employed in the Central West region. The largest employment sector is Agriculture, forestry and fishing with 18,200 people employed. This sector represents 16 per cent of the region's workforce. Health care and social assistance was the second largest employment sector with 15,000 people employed in the sector, followed by 12,300 people employed in retail trade. Other important employment sectors in the region were education and training; construction; and manufacturing. (DoAWE, 2020).

The proposal's northern section includes Weddin and Forbes LGAs and is located in the Central West region and is identified within the Central West and Orana Regional Plan 2036 (DoAWE, 2020c). This plan is a 20 year blueprint for the future of the Central West and Orana region. This region had the largest gross regional product contributor of $2.5 billion from mining in 2011, while the second largest gross regional product contributor in the area was $1.3 billion from agriculture, forestry and fishing.

The southern section of the proposal is within the Bland LGA. The LGA which includes West Wyalong and Wyalong, and is located in the Riverina Murray region, identified in the Riverina Murray Regional Plan 2036 (DoAWE, 2020a). The Riverina Murray is recognised as one of Australia's quality agricultural areas and is well-connected export conduit to Melbourne and ports in NSW.

The route is generally straight and flat, with slight undulating hills in some segments of the highway. The highway is constrained by freight movements, flooding and safety is a concern for sharing the highway with tourists and caravans.

Population and demography

The proposal is located within the Bland, Weddin and Forbes LGAs. The ABS 2016 census (ABS 2016) for the Bland, Weddin and Forbes LGAs was reviewed and has been summarised as follows:

- Bland Shire has an estimated resident population of 5,955 in the 2016 ABS census. The median age is 43, with the main industries of employment being grain-sheep or grain beef cattle farming, gold ore mining, other grain growing, sheep farming and local government administration, (Bland Shire Council, 2011)
- Weddin Shire has an estimated resident population of 3,664 in the 2016 ABS census. The median age is 51, with the main industries of employment being grain-sheep or grain-beef cattle farming, sheep

farming, other grain growing, local government administration and hospitals (except psychiatric hospitals), (Weddin Shire Council, 2011)

- Forbes Shire is estimated to have a resident population of 9,587 in 2016 ABS census. The median age is 43, with the main industries of employment being secondary education, supermarket and grocery stores, primary education, sheep farming and aged care residential services, (Forbes Shire Council, 2013).

Land use and property

Land use patterns within the study area (as indicated by a review of Bland, Weddin and Forbes LEPs land zoning) are as summarised below:

- Undeveloped parcels of undulating land and agricultural lots are generally located outside the town centres (West Wyalong and Forbes) of the study area.
- Forbes and West Wyalong towns within the study area consists of residential and developed land
- The area west and east of the highway is generally vegetated with juvenile to mature trees along the sides of the highway.
- Residential receivers scattered throughout the study area and more concentrated in the far south of the study area in segment 1 and in the far northern end in segment 4 of the study area.
- Recreational receivers who are accessing the study area for walking tracks along the highway within town centres.
- Non-residential receivers, including industry and businesses in segments 1 and 4, such as food chain restaurants, supermarkets and petrol stations.

The southern end of segment 1 and north end of segment 4 as shown on **Figure 1-2** are located in low-density residential areas of West Wyalong and Forbes, while the majority of receivers between the township of West Wyalong and Forbes are located more than 100 m from the study area.

There are several parcels of land currently gazetted Crown Land along the edge of the highway near Marden, Bundaburrah and Forbes (refer to **Figure 1-2**). The study area includes parcels of crown land that may be subsequent to Native Title. The study area is located on Wiradjuri Land as described in **Section 5.3.2**.

There are also several private properties access along the highway and agriculture land within the study area. Local businesses are located in the Forbes and West Wyalong town centres. Tourism/ walking tracks are accessed from West Wyalong and Forbes town centres. No walking tracks are accessed between the town centres.

Approved and future developments

There are currently a number of projects and proposals within 15 km of the study area, these include:

- Wyalong Solar Farm
- West Wyalong Solar Farm
- Daroobalgie Solar Farm
- Cowal Gold Operations Underground Development
- Jemalong Solar Farm
- Jemalong Solar Thermal Plant
- Inland Rail Stockinbingal to Parkes (through Forbes).

These may have the potential to interact with the proposal and are discussed and considered further in **Section 5.11**.

Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being.

The social infrastructure within the study area includes:

- Local bus services operate in both West Wyalong and Forbes town centres. The closest public bus service stop to the study area is about 950 m south of the study area at Forbes Hospital, Elgin Street in the north and a coach bus stop about 2.8 km south west of the study area in Church Street, West Wyalong
- The public bus service route from West Wyalong to Forbes includes roads that connect West Wyalong to Temora, Cootamundra, Young, Grenfell to Forbes
- There are a number of informal school bus stops along the highway
- The highway is used by a number of long distance coaches that service the towns in central western NSW from major capital cities and larger regional centres
- The closest train station is West Wyalong and is about 1.6 km south of the study area.
- There are nine vehicle rest areas located along the highway within the study area, as shown on **Figure 1-2**.
- There are no designated pedestrian or cycling paths provided along the highway from West Wyalong to Forbes.

Community values

Community values are those elements considered to be important to quality of life and wellbeing. They include physical elements, such as parks, buildings and landscapes, and social elements, such as a sense of belonging and community identity.

Community values likely to be important to people who work, live, study and visit the study area can be broadly categorised as:

- Local character and natural values of the study area, which forms a primary point of entry for motorists into West Wyalong to Forbes – the highway's route travelling through the creeks either side of the study area and offers views of woodland that extend throughout the existing highway alignment
- Local amenity and sense of place
- Employment and residential growth supported by local access and connectivity
- Community safety
- Liveability and access to social and community support.

Utilities

There would be potential for utilities to be present along the highway corridor. A dial before you dig was carried out and the following listed utilities may be impacted by the proposal:

- APA Group gas – Central West Pipeline
- Essential Energy
- Jemena Gas Country

- NBN
- Nextgen
- Telstra NSW.

Additional utility surveys will be required during the detailed environmental assessment to confirm the utilities present.

5.5.3 Summary of issues

The proposal may require the acquisition of Crown land. This will be confirmed during the design development of the proposal.

Other potential land use, property and socio-economic issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal include:

- Impacts on productive agricultural land next to the highway
- Impacts to ecological and environmental values next to and within the road corridor (see the biodiversity impacts in **Section 5.2**)
- The timing of the proposal may coincide with other major projects currently proposed within the region placing an increase in demand and completion for construction labour (see cumulative impacts in **Section 5.11**)
- Impacts to local and regional utilities
- Constructability issues relating to the availability of suitable sites for construction compounds and stockpiles
- Temporary disruptions to access and connectivity within and through the study area during construction and the effects that such disruptions will have on access to private property, local businesses, social infrastructure and the broader West Wyalong and Forbes region
- Construction impacts on traffic and highway use with greater impacts likely during peak tourism, harvest seasons and during Forbes Inland rail construction
- Adverse effects on existing local amenity and community values of the study area due to construction noise, dust and changes in the study area's landscape character and visual amenity (as discussed in **Sections 5.6**, **Section 5.9**, and **Section 5.10** respectively).

Notwithstanding the above constraints, the proposal has the potential for both local and wider regional benefits in the medium to longer term through reduced traffic congestion, improved access and connectivity, and improved safety for motorists.

The following additional potential socio-economic constraints and opportunities are discussed in the relevant sections of this PEI:

- Traffic, transport and access (refer to **Section 5.1**)
- Noise and vibration (refer to **Section 5.6**)
- Landscape character and visual impacts (refer to **Section 5.9**)
- Air quality (refer to **Section 5.10**).

Stakeholder and community consultation and involvement will be carried out during the design development and detailed environmental assessment phases of the proposal (refer to **Chapter 4**).

5.5.4 Recommendations

Socio-economic issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-14**.

Table 5-14 Summary of recommendations – socio-economic, land use and property

Issue	Recommendation	Timing
Socio economics	A general socio-economic assessment should be carried out in accordance with the *Transport Environmental Impact Practice Note: Socio-economic Assessment (EIA N-05).*	Detailed environmental assessment
Socio economics	Investigate measures to address construction socio-economic impacts in any future proposal environmental management documentation.	Detailed environmental assessment
Consultation	Consultation should be carried out with local councils, stakeholders and other major proposal proponents within the vicinity of the study area to reduce and manage the cumulative socio-economic impacts of the proposal.	Design development and detailed environmental assessment
Suitable locations for construction compounds	Consider identifying sufficient suitable locations for construction compounds in order to ensure that the appropriate assessment and approvals can be achieved in a timely manner.	Design development and detailed environmental assessment
Opportunity	**Recommendation**	**Timing**
Reduce the impacts of property	Opportunities to minimise the proposal's impact on public and private property will need to be investigated during the design development phase, with the objective of containing the proposal within the existing road corridor wherever possible.	Design development

5.6 Noise and vibration

Potential noise and vibration constraints within the study area and noise and vibration criteria for construction and operational activities are presented in this section.

5.6.1 Methodology

A preliminary noise and vibration investigation was carried out with consideration to the following guidelines:

- *Noise Mitigation Guidelines* (NMG) (Roads and Maritime, 2015)
- *Noise Criteria Guideline* (NCG) (Roads and Maritime, 2015)
- *Noise Model Validation Guideline* (NMVG) (Roads and Maritime, 2018)
- *Construction and Noise Vibration Guideline* (CNVG) (Roads and Maritime, 2016).

Sensitive receivers were identified by reviewing aerial photography and identifying receivers within or next to the study area.

5.6.2 Existing environment

Background and ambient noise and vibration

There is no existing background noise data available for the study area. The study area is dominated by low ambient noise levels found in rural and low residential areas. The main source of background noise would be from farming activities (including operation of grain storage and handling facilities), and road traffic, including heavy vehicle freight on the highway in both directions.

Other noise sources would be associated with rail operations at the southern and northern end of the study area in West Wyalong and Forbes. Noise levels would be higher around West Wyalong and Forbes, where there are increased activities including commercial/industrial operations.

Sensitive receivers in the study area include:

- Residential receivers, scattered throughout the study area and more concentrated in the far south of the study area in segment 1 and in the far northern end in segment 4 of the study area
- Recreational receivers who are accessing the study area for walking tracks along the highway
- Non-residential receivers, including industry and businesses in segments 1 and 4, such as food chain restaurants, supermarkets and petrol stations.

Segment 1 and 4 are located in residential areas of West Wyalong and Forbes, as shown on **Figure 1-2**.

5.6.3 Summary of findings

Potential construction impacts include operation of plant and machinery and associated noise and vibration emissions on nearby receivers.

The main sources of vibration would be due to rolling and/or compacting. Sensitive receivers within 20 m of these works may pose a constraint.

5.6.4 Recommendations

Noise and vibration issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-15**.

Table 5-15 Summary of recommendations – noise and vibration

Issue	Recommendation	Timing
Noise	Further detailed environmental assessment for the proposal should assess potential noise and vibration impacts in accordance with the NMG, NCG, NMVG and CNVG.	Detailed environmental assessment

Issue	Recommendation	Timing
Further noise and vibration assessment	Consider carrying out a monitoring survey at representative locations along the proposal to fully quantify the existing level of noise impact and provide a baseline of the noise environment for the study area.	Detailed environmental assessment
Noise and vibration	Investigate measures to address construction noise and vibration impacts in any future proposal environmental management documentation.	Pre-construction and during construction

5.7 Topography, geology, soils and contamination

Potential constraints within the study area related to local topography, geology, soils and contamination are presented in this section.

5.7.1 Methodology

Potential constraints were identified based on a desktop review of the following resources:

- Geological sheets
- Soil Landscapes Sheets
- DPIE NSW Planning Portal (on 25 September 2020)
- The NSW EPA Contaminated Land Public Record (on 25 September 2020)
- The EPA's List of NSW contaminated sites notified to EPA (search carried out on 25 September 2020)
- Sharing and Enabling Environmental Data (SEED) salinity mapping (on 25 September 2020) (DPIE, 2020b)
- Resource and Conservation Division, Planning New South Wales 2002 Development of Conservation Criteria for Brigalow Belt Southern Region
- Bland LEP 2011
- Weddin LEP 2011
- Forbes LEP 2013.

5.7.2 Existing environment

Topography and geology

The characteristic landforms of the Lower Slopes IBRA encompass on undulating plains and isolated peaks set in wide valleys at the peaks of the Riverina alluvial fans. Rock types vary across the bioregion, which is also affected by topographic and rainfall gradients that decrease toward the west. (DFSI, 2020). These physical differences have an impact on the nature of the soils and vegetation found across the bioregion.

The study area lies in the eastern part of the Lachlan Fold Belt. The Lachlan Fold Belt consists of a complex series of Cambrian to Early Carboniferous sedimentary and volcanic rocks. The proposal extends from the south at West Wyalong where there is presence of alluvium and manna conglomerate transitioning to a section of Weddin sandstone south of Bundaburrah and alluvial channel deposits – meander plain facies in the north at Forbes. Wide valleys filled with Quaternary alluvium and occasional lakes are the dominant landscape form (DPIE, 2016). The regional geology is shown on **Figure 5-7**.

The topography of the study area is between 205 to 265 m above sea level. The hills in the area rise between 15 m and 30 m above the surrounding country near the study area.

Soils

Soils vary greatly across this topography, as does the microclimate and aspect, so it is necessary to differentiate areas of hill tops and plateau from slopes and valley floors, as follows:

- West Wyalong to Marsden is dominated by alluvium and alluvial floodplain deposits and Carawandool volcanics – flow banded rhyolite near the Boxalls State Forest
- Marsden to Bundaburrah consists of rock units of alluvial floodplain deposits, floodplain deposits - swamp facies, Weddin Sandstone and Mixed colluvial, alluvial and aeolian deposits
- Bundaburrah to Forbes transverses the alluvium, alluvial channel deposits - meander-plain facies and alluvial floodplain deposits.

In general, these soil types within the study area are considered moderately erodible.

Acid sulfate soils

Acid sulfate soils (ASS) are the common name given to naturally occurring sediments and soils containing iron sulphides (principally iron sulphide or iron sulfide or their precursors). The exposure of the sulphide in these soils to oxygen by drainage or excavation leads to the generation of sulphuric acid. Areas of ASS can typically be found in low lying and flat locations which are often swampy or prone to flooding (ASSMAC 1998).

ASS mapping by Commonwealth Scientific and Industrial Research Organisation (CSIRO) (CSIRO 2021) indicates that there is an extremely low to low probability of occurrence of ASS within majority of the study area. The ASS risk within the study area is “low probability” in segment 1, “extremely low probability” in segment 2, “extremely low probability” to “low probability” in segment 3, and in segment 3 the probability varies between “extremely low” to “high probability” of ASS. The exception of about 150 m of potentially high probability of occurrence of ASS near Caragatel Lagoon / Ooma Creek located in segment 3 refer **Figure 5-8**.

Salinity

Salinity is the degree to which water contains dissolved salts. Dryland salinity typically occurs in non-irrigated areas. The salinity risk within the study area is “high” in segment 1, 2 and 4, predominately “high in segment 3 with some sections of the segment classified as “low” to “moderate”, refer **Figure 5-8**.

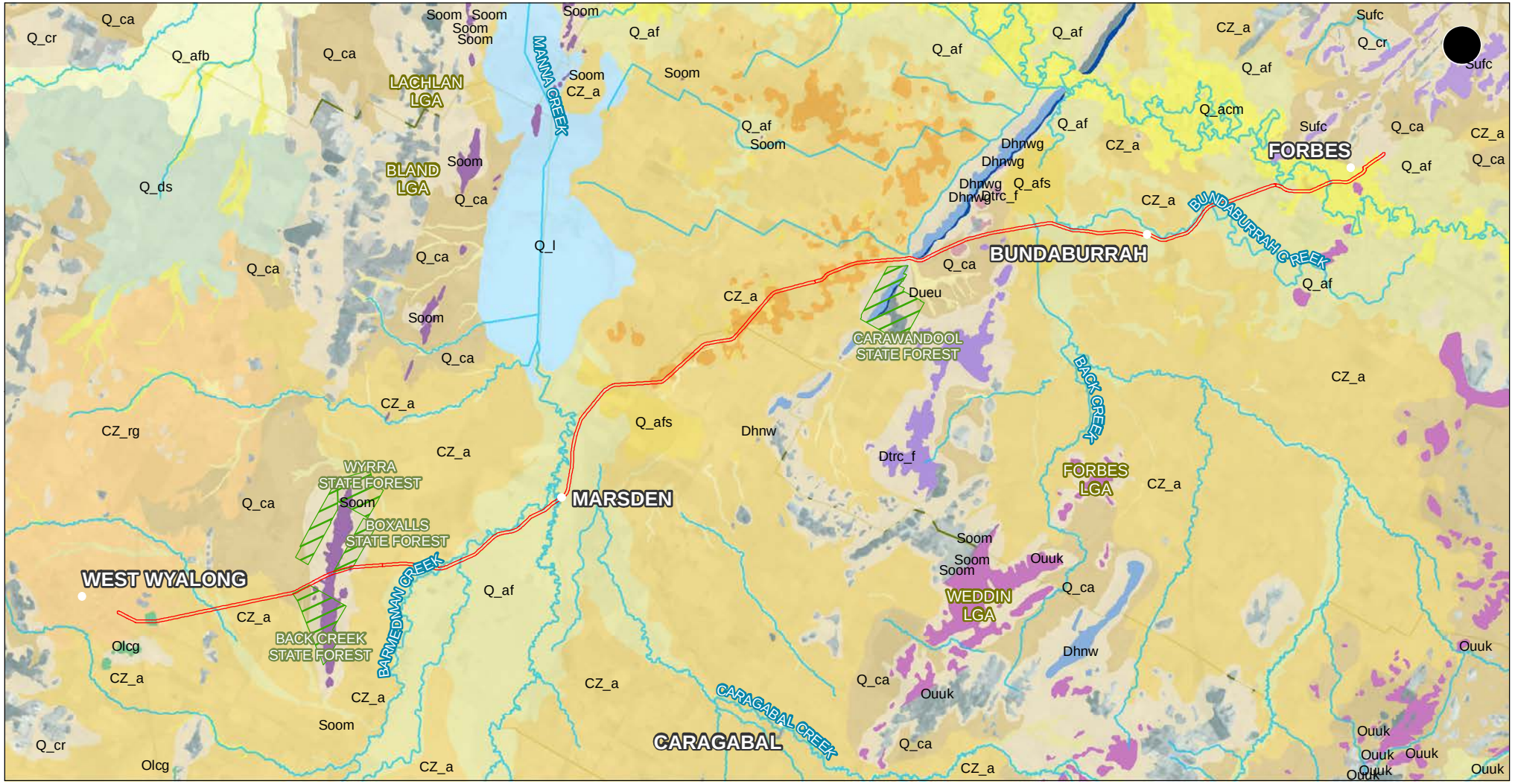
Contamination

The EPA’s database (Contaminated Land Public Record and the List of NSW contaminated sites notified to EPA) search identified no registered contaminated sites within the study area.

Notwithstanding the above, current and former land uses within the study area may have resulted in the contamination of soils and/or groundwater underlying the area. Potential contamination sources / environmental risks identified within the study area comprise the following:

- Herbicides and pesticides historically used on nearby properties and during the maintenance of the existing road corridor
- Exhaust particulates and hydrocarbons released from motor vehicles using the existing road network
- Spills and leaks of hydrocarbons and other potentially hazardous materials from motor vehicles using the existing road network and the large amount of crashes of both light and heavy vehicles
- Unlawfully dumped waste
- Potential for contamination as a result of the construction of the existing highway.

The potential for contamination to occur within the study area (outside of those sites already registered on the EPA's database) was not addressed as part of this PEI and will need to be considered during the environmental assessment phase of the proposal.



Study area
Local Government Area
State Forest
Waterway

Rock units

- Alluvium (CZ_a)
- Residual deposits - granite-derived (CZ_rg)
- Alluvium (Q_a)
- Alluvial channel deposits - meander-plain facies (Q_acm)
- Alluvial floodplain deposits (Q_af)
- Alluvial floodplain deposits - swamp facies (Q_afs)
- Mixed colluvial, alluvial and aeolian deposits (Q_ca)
- Colluvial and residual deposits (Q_cr)
- Source-bordering dunes (Q_dds)
- Claypan and lacustrine deposits (Q_l)
- Weddin Sandstone (Dhnw)
- Cloghnan Shale Member (Dhnwg)
- Carawandool Volcanics - flow banded rhyolite (Dtrc_f)
- Bundaburrah Granodiorite (Dueu)
- Manna Conglomerate (Soom)
- Cotton Formation (Sufc)
- Gidginbung Volcanics (Olcg)
- Kirribilli Formation (Ouuk)

0 5 10 km

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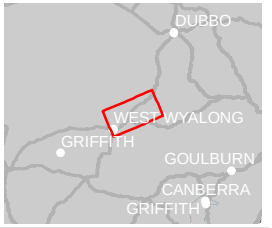
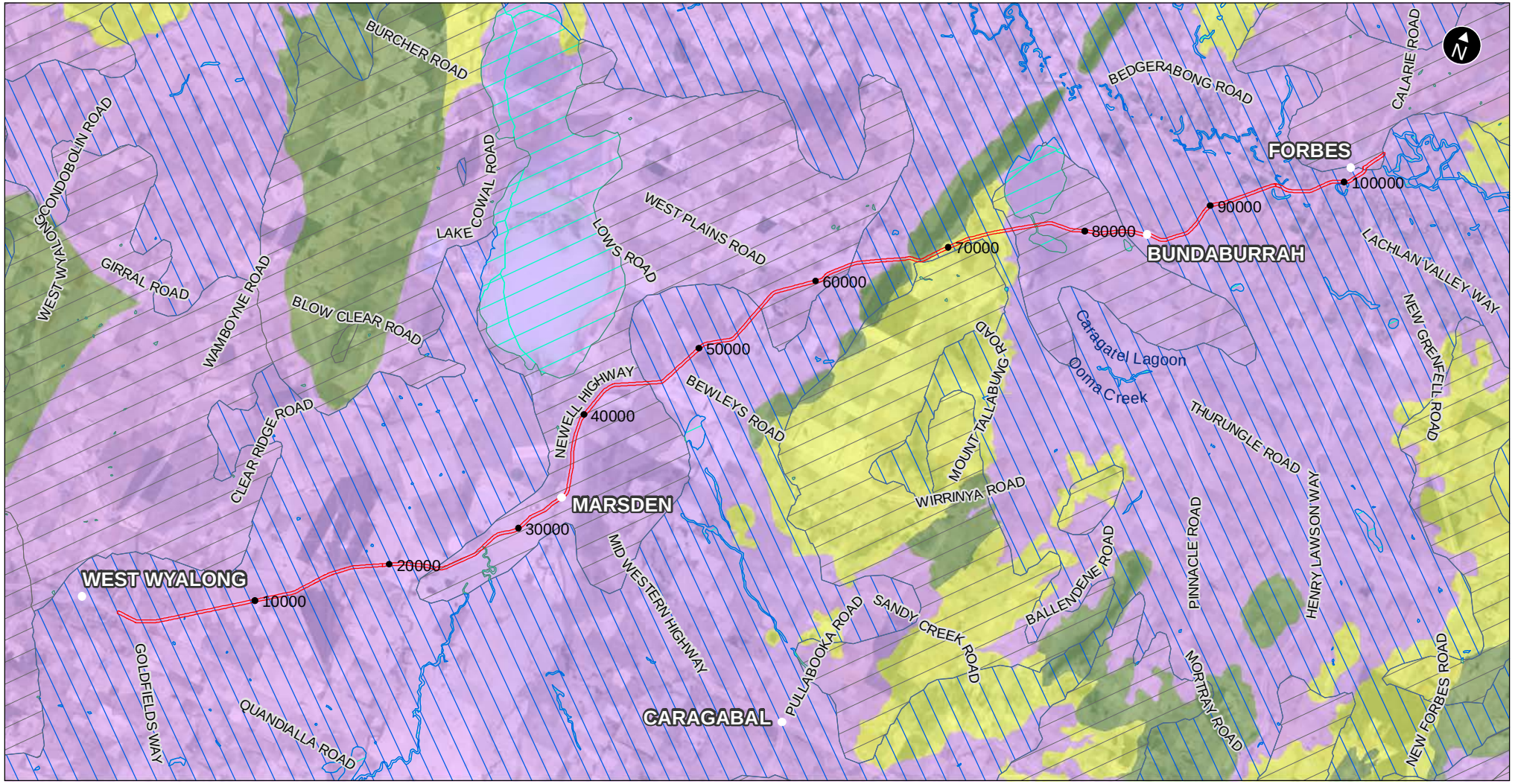


Data sources

Jacobs 2020
NSW Spatial Services 2020
GDA94 MGA55

Figure 5-7 Geology

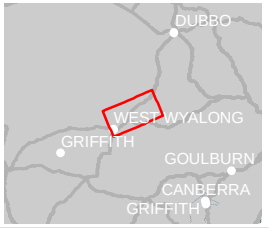


Study area

Potential salinity	Acid sulfate soil
Low	Extremely low probability
Moderate	Low probability
High	High probability

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2020
NSW Spatial Services 2020
DPIE 2021
GDA94 MGA55

Figure 5-8 Acid sulfate soil and potential salinity

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5.7.3 Summary of findings

The study area has a generally flat to slightly undulating plain. The soils in the area are highly erodible and soil erosion will need to be managed during construction. These conditions could also present issues with sediment and dust control during construction.

The erosion and dust issues will need to be considered during the design development and environmental assessment phases of the proposal.

ASS and contaminated land are not anticipated to be major constraints within the study area. However, the risk of encountering contaminated materials will need to be considered further during the environmental assessment phase of the proposal.

5.7.4 Recommendations

Topography, geology, soils and contamination issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-16**.

Table 5-16 Summary of recommendations – topography, geology, soils and contamination

Issue	Recommendation	Timing
Geology and soils	Geotechnical investigations and assessment, and preliminary site assessments should be undertaken to support further design development.	Design development and detailed environmental assessment
Erosion and sediment control	Develop constructability and earthworks design early in the design development phase to enable appropriate assessment of potential impacts to allow consideration of the slope and extreme erodibility of the study area.	Design development and detailed environmental assessment
Erosion and sediment control	Prepare an erosion and sediment management report in accordance with Transport guidelines to inform the design development and the environmental assessment.	Design development and detailed environmental assessment
Erosion and sediment control	Investigate appropriate soil, erosion, dust and sediment control measures in any future environmental management documentation as relevant.	Design detailed development, pre-construction

5.8 Non-Aboriginal heritage

Potential non-Aboriginal heritage constraints located within and near the study area based on a desktop review are presented in this section.

5.8.1 Methodology

A non-Aboriginal heritage desktop review was carried out to identify if any listed historical heritage items. The following heritage registers and local planning instruments were reviewed on 25 September 2020:

- SHR and State Heritage Inventory
- Australian Heritage Places Inventory
- Australian Heritage Database (including Commonwealth and National heritage lists)
- Register of National Estate (non-statutory list)
- Transport's section 170 Register
- ARTC section 170 Register
- Bland LEP 2011
- Weddin LEP 2011
- Forbes LEP 2013.

5.8.2 Existing environment

The heritage searches identified 22 heritage items within the study area highlighted grey, one state heritage listed, and 22 local heritage listed items in **Table 5-17**. Forbes Railway Station Group is listed under the SHR and the Forbes local heritage register. Three heritage items were identified in the searches next to the study area as detailed in **Table 5-17** (not shaded) and show in **Figure 1-2**.

Table 5-17 Heritage listed items within the study area

Heritage item	ID	Register	LGA	Segment	Location
Residence, Wyalong House ID: 7314	I41	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.
Watterson Store (former)	139	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.
Courthouse & Lock-up Group	I37	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.
Top Town Tavern	I40	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.

Heritage item	ID	Register	LGA	Segment	Location
School of Arts (former)	I38	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.
Council Chambers (former)	I36	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.
Post Office (former)	Bland I35	Local	Bland LGA	Segment 1 – West Wyalong	Within the study area.
Jemalong Range Fossils	I129	Local Crown Reserve	Forbes LGA	Segment 3 - Caragatel Flood Channel	About 50 m north of the study area.
Heterodendron oleifolium (Western Rosewood)	I147	Local	Forbes LGA	Segment 3 - Caragatel Flood Channel	Within the study area.
Graves	I11	Local	Forbes LGA	Segment 3 - Caragatel Flood Channel	Within the study area.
Squatter's Arms Inn remnant	I87	Local	Forbes LGA	Segment 4 - Forbes	Within the study area.
Forbes business Heritage Conservation Area	1414	Local	Forbes LGA	Segment 4 - Forbes	Within the study area.
Forbes Court House, fence and grounds and Police buildings	I115	Local	Forbes LGA	Segment 4 - Forbes	Within the study area.
Victoria Square Park including bandstand and fountain	I53	Local	Forbes LGA	Segment 4 - Forbes	Within the study area.
Forbes Railway Station Group	Forbes I84 State 01145	State	Forbes LGA	Segment 4 - Forbes	Within the study area.
Forbes Post Office	State 01414	State	Forbes LGA	Segment 4 - Forbes	About 100 m north of the study area.
South Lead mullock heap No 1	I57	Local	Forbes LGA	Segment 4 - Forbes	Within the study area.

Heritage item	ID	Register	LGA	Segment	Location
Lake Forbes ID: 19006	I122	Local	Forbes LGA	Segment 4 - Forbes	Within study area. Proposal crosses Lake Forbes.
Wunderlich House	I109	Local	Forbes LGA	Segment 4 - Forbes	Within study area.
Fire Station	I111	Local	Forbes LGA	Segment 4 - Forbes	Within study area.
Johnny Wood's crossing	I116	Local	Forbes LGA	Segment 4 - Forbes	Within study area.
Bathurst Road Crossing No 2	I17	Local	Forbes LGA	Segment 4 - Forbes	Within study area.
Forbes Public School infants - schoolhouse and teacher's vested residence (former)	I23	Local	Forbes LGA	Segment 4 - Forbes	About 30m north of the study area.
Lands Office (former) including flood markings	I24	Local	Forbes LGA	Segment 4 - Forbes	Within study area.
Vandenberg Hotel	I37	Local	Forbes LGA	Segment 4 - Forbes	Within study area.

5.8.3 Summary of findings

Potential non-Aboriginal heritage issues for the proposal would primarily be associated impacts to the heritage listed items detailed in **Table 5-17**. These impacts could include:

- Adverse changes to the visual outlook of heritage items due to the establishment of additional road infrastructure
- Direct impacts to the 22 heritage items within the study area and potential indirect impacts on heritage items next to the study area.

5.8.4 Recommendations

Recommendations for non-Aboriginal heritage issues to be considered during the design development and detailed environmental assessment phases of the proposal are in **Table 5-18**.

Table 5-18 Summary of recommendations – non-Aboriginal heritage

Issue	Recommendation	Timing
Non-Aboriginal heritage assessment	• Consider the potential for both registered and previously unrecorded non-Aboriginal heritage items and archaeological relics to be directly and/or indirectly impacted by the proposal • Carry out further non-Aboriginal heritage assessment including detailed research, a comprehensive field survey, a significance assessment and an impact assessment.	Detailed environmental assessment
Non-Aboriginal heritage impacts	Seek to minimise impact on the listed heritage items in **Table 5-7** through the design process of the proposal.	Design development

5.9 Landscape character and visual

Potential landscape character and visual constraints within the study area are presented in this section.

5.9.1 Methodology

The visual catchment was considered by reference to local land use plans and aerial imagery.

5.9.2 Existing environment

The landscape setting and visual setting within the study area is strongly influenced by an existing highway, surrounded by vegetation and sections of State forests. State forest surrounds the study area in segment 1 (Back Creek State Forest and Boxalls State Forest) and segment 3 (Carawandool State Forest) as shown on **Figure 1-2**.

The experience of motorists travelling along the highway as it passes through the study area is dominated by juvenile to mature vegetation and agricultural land.

5.9.3 Summary of findings

The study area has high scenic values due to State Forests located next to the highway in segment 1 and segment 3.

The following general issues associated with landscape character and visual amenity have the potential to occur as a result of the proposal:

- Removal of vegetation especially within areas with greater visual sensitivity such as roadside vegetation along creek lines or within predominately cleared agricultural environments
- Temporary ground disturbance
- Alterations to the current highway surface
- Alteration of existing intersection and rural access roads.

5.9.4 Recommendations

Landscape character and visual impact issues will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-19**.

Table 5-19 Summary of recommendations – Landscape character and visual

Issue	Recommendation	Timing
Urban design	Develop, review and refine urban design objectives and principles that complement the built and natural character of the area.	Design development
Visual impacts	Following release of the preferred options report, if deemed necessary carry out a landscape character and visual impact assessment of the proposed concept design in accordance with *Environmental Impact Assessment Practice Note EIA-N04 "Guideline for landscape character and visual impact assessment*" (Transport, 2020).	Detailed environmental assessment

5.10 Air quality and climate change

Potential air quality and climate change factors and constraints within the study area are presented in this section.

5.10.1 Methodology

Potential constraints were identified based on a desktop review of the following resources:

- Commonwealth Department of the Environment and Energy's National Pollution Inventory (NPI) database (search carried out on 25 September 2020)
- Identification of sensitive receivers using cadastral information and aerial imagery
- BoM climate data (viewed on 25 September 2020)
- Publicly available information from the Bland, Weddin, and Forbes Council website.

5.10.2 Existing Environment

Sensitive receivers

Residential receivers are scattered throughout the study area, and more concentrated in the far south of the study area in segment 1 and in the far northern end of the study area in segment 4. The northern and southern extent of the study area is located next to low-density residential areas of West Wyalong and Forbes as shown in **Figure 1-2**. The sensitive receivers comprise of a mix of residential and businesses between West Wyalong and Forbes.

Ambient air quality

Air quality in the study area is characteristic of an inland rural area, where the main local influences on air quality are agricultural activities, mining, dust, woodfires and road traffic.

No air quality monitoring was carried out during the preparation of this PEI. The proposal falls within the South-West Slopes region.

The DPIE EES Annual Air Quality Statement 2020 is released, however the South West Slopes bioregion did not have information provided in the report. The Air Quality Statement of 2019 is utilised as data is available for the region.

The DPIE EES Annual NSW Annual Air Quality Statement 2019 was reviewed and summarised as follows:

- Widespread smoke and dust storms significantly affected air quality levels throughout the State, particularly during the bushfire emergency period from late October 2019.
- The Air Quality Index (AQI) was in the 'very good' or good' category for 64 per cent of the time for the South-west Slopes, as shown in **Figure 5-9**. The 'very good' to 'fair' AQI categories represent the amount of time air quality met relevant standards.
- The annual average South West Slopes PM10 levels:
  - Met the national standard
  - Were higher across NSW in 2019 compared with 2018, due to the impacts of the bushfires in 2019 and the continuing intense drought conditions.
- South West Slopes had 20 hazardous days in total including:
  - Eight days due to dust storms including one day in January, two days in February, one day in March, one day in September, one day in October and two days in November
  - Seven hazardous days due to bushfires in December
  - Five hazardous days due to a combination of smoke from bushfires and dust storms including one in November and four in December.
- During 2019, annual average PM10 levels met the national standard located within the South-west Slopes region. The PM2.5 fine particle pollution recorded less than 20 days above which are divided into exceptional and non-exceptional events. Exceptional events are those related to bushfires, hazard reduction burns and continental-scale dust storms. These are not counted towards the National Environment Protection Measures (NEPM) goal of 'no days above the particle standards in a year'.
- In the South-west Slopes, the station typically records high PM10 annual averages, particularly during drought affected years due to windblown dust.

There is no information available in the Annual 2019 report for ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide pollution in South-West Slopes region.

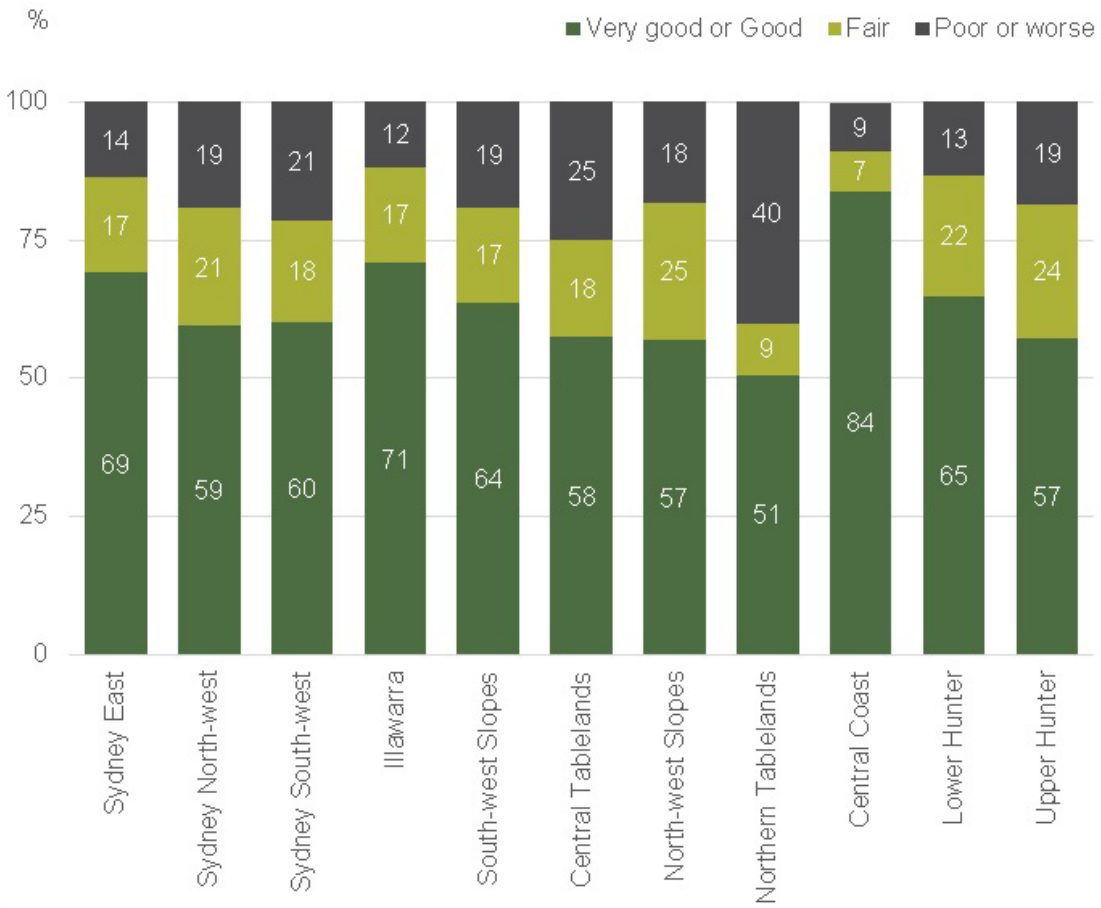

Figure 5-9 2019 Air Quality Index categories as a percentage of time in each region in NSW (NSW Annual Air Quality Statement 2019)

Regional emission sources

A search of the NPI database indicated that four industrial facilities reported air emissions from within the Forbes LGA during the 2018-2019 reporting period. These industrial facilities are located outside the study area to the north and include the Daroobalgie Waste Management Facility, Forbes Depot, Oilsplus Daroobalgie Depot and Kaloola Piggery. The closest being the Forbes Depot located about 450 m north of the study area.

Other emission sources that would be likely to influence the ambient air quality within the study area comprise:

- Exhaust emissions from vehicles using the road network
- Particulate emissions (dust) from wind erosion from exposed areas
- Wood smoke from domestic combustion heaters.

Given the large number of vehicles that currently operate on the highway, vehicle exhaust emissions would be likely to make a substantial contribution to the local air quality of the study area.

Climate

The climate of the study area is characterised by hot summers and mild to cool winters. Climate data obtained from the BoM (viewed on 25 September 2020) for the nearest monitoring station, Forbes Airport (station 065103), is summarised in **Table 5-20**. The data set ranges from year 1995 to 2020.

Table 5-20 Climate data Forbes Airport AWS (automatic weather station)

Data (units)	Average monthly minimum	Average monthly maximum	Average annual
Rainfall (mm)	28.7 mm (April)	52.3 mm (December)	479.9 mm
Mean temperature (degrees Celsius)	2.5 Degrees Celsius (July)	34.6 Degrees Celsius (January)	Min: 9.7 Max: 24.5
Mean 9am wind speed (km/h)	10.4 km/h (May)	18.7 km/h (January)	14.5 km/h
Mean 3pm wind speed (km/h)	15.2 km/hr (May)	20 km/h (December)	17.7 km/h

Source: BoM (2020)

5.10.3 Summary of findings

Potential air quality issues during the construction of the proposal will primarily be associated with the generation of particulate (dust) from dust generating activities (eg excavation, vegetation clearing and wind erosion from unsealed surfaces and stockpiles) and gaseous emissions from the combustion of diesel and petrol fuel in construction plant, vehicles and equipment.

Dust emissions may be an issue during construction of the proposal due to the extent of earthworks required. Dust emissions during construction could result in reduced local air quality and dust deposition at nearby sensitive receivers and, in extreme cases, could affect human health.

The potential for surrounding sensitive receivers particularly at the northern end of the proposal to be adversely affected by the proposal will need to be considered during the detailed environmental assessment phase.

5.10.4 Recommendations

Air quality issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-21**.

Table 5-21 Summary of recommendations – air quality

Issue	Recommendation	Timing
Air Quality	A further air quality assessment during detailed environmental assessment will be carried out and include: • Air pollution sources • Quality management are in accordance to relevant guidelines • Methodology to manage adverse climatic weather conditions such as high winds • Methodology to rehabilitate exposed surfaces progressively.	Detailed environmental assessment

Issue	Recommendation	Timing
Climate change	Identify sources of greenhouse gas emissions associated with the construction, operation and ongoing works of the proposal.	Detailed environmental assessment
Opportunity	**Recommendation**	**Timing**
Climate change	Identify opportunities to reduce the greenhouse gas emissions associated with the proposal.	Design development and environmental assessment

5.11 Cumulative impacts

This section identifies any major projects occurring in the vicinity of the study area and assess the cumulative impact that may result.

5.11.1 Methodology

Projects and proposals in the study area were identified based on a search of the following data sources carried out in September 2020:

- DPIE's online major projects database
- Proponent websites
- Local council websites / Development Application (DA) tracking databases.

5.11.2 Existing environment

The projects and proposals near and within the study area that are under way now or are likely to commence during the proposals scheduled construction timeframe, which have the potential to have cumulative impacts are summarised in **Table 5-22**.

Table 5-22 Other projects, developments and proposals near and within the study area

Project	Description
Wyalong Solar Farm	The State Significant Development (SSD) construction and operation project would include a 100 megawatts (MW) capacity utility-scale solar farm and storage compound at about 8 km north east of the township of West Wyalong, NSW. The proposal is situated on an area north and next to the highway, between Wyalong and Back Creek.
West Wyalong Solar Farm	The project would include construction and operation of a 90 MW solar photovoltaic facility with battery storage. The project is located about 8 km north of the highway.

Project	Description
Daroobalgie Solar Farm	Daroobalgie Solar Farm is an electricity generation (solar) project about 11 km north east of Forbes. The project would involve the installation of solar panels generating about 100 MW. This project is currently at 'Prepare EIS' stage.
Cowal Gold Operations Underground Development	Expansion of the existing mining operations to include a new underground mine, including extension of mine life from 2032 to 2037, extracting and processing up to 27 million tonnes of ore and additional production of about 1.4 million ounces of gold. The project also includes the development of the ancillary surface infrastructure including modifications to existing processing plant and a paste fill plant for stope void backfill; and developing a box-cut entry from the ancillary surface infrastructure to the underground mine. This project is currently at 'Prepare EIS' stage.
Jemalong Solar Farm	The Jemalong 50 MW Solar Farm is located 26 km south west of Forbes. The project was approved in 2018 and has undergone two modifications including changes to subdivision plan and expanded development footprint. The modification 3, currently at 'Determination' stage. The project proposes to change two sections of the approved 66 kV transmission line from underground to overhead and increase in the approved height of the inverter stations by 0.5 m.
Jemalong Solar Thermal Plant	Jemalong Solar Thermal Plant is a 30 MW Concentrating Solar Thermal Power Plant project about 36 km west of Forbes and accessed by: Lachlan Valley Way to the north. The project would involve the installation of solar panels generating about 30 MW. This project is currently at 'Withdrawn' stage.

5.11.3 Summary of findings

The following projects and proposals could result in cumulative impacts with the proposal and will require consideration as part of the future planning stages:

- Wyalong Solar Farm
- West Wyalong Solar Farm
- Daroobalgie Solar Farm
- Cowal Gold Operations Underground Development.

The remaining projects and proposals identified in **Table 5-22** are not considered an issue due to their location from the current proposal, the size the projects, or current development stage.

Although the Wyalong Solar Farm project is located next to the proposal, it will still need to be considered during the planning and assessment process for the current proposal.

The Stockinbingal to Parkes Inland Rail proposal is proposed to traverse the Forbes area by extending from the towns of Stockinbingal to Parkes. This section of Inland Rail is expected to begin construction in 2022 to 2025 (Stockinbingal to Parkes Inland Rail Factsheet October 2020). Based on current timelines and assurance requirements for West Wyalong to Forbes (WW2F) Flood proposal, this will start construction in June 2025 and therefore is not expected to have cumulative impacts with the proposal. The rest of the Inland Rail alignment does not appear to impact where the proposal is located.

Generally, the following issues require consideration:

- The timing of the proposal may coincide with other major projects currently proposed within the region placing an increase in local accommodation and demand competition for construction labour, and construction materials including water
- Workers relocating or non-resident workforce to the region to pursue employment opportunities have the potential to place excessive demand on regional facilities
- The timing of the proposal may coincide with other major projects and result in cumulative construction impacts such as traffic delays, and amenity issues relating to construction noise and dust
- Cumulative loss and fragmentation of native vegetation and associated habitats during construction and potential increase in risk of fauna mortality through wildlife-vehicle collisions
- Potential for cumulative amenity impacts and construction fatigue. Potential cumulative benefits would also arise through opportunities for business and workers associated with multiple projects
- There may be insufficient capacity at smaller local facilities and construction waste may need to be transported to larger regional facilities.

5.11.4 Recommendations

Cumulative issues that will need to be considered during the design development and detailed environmental assessment phases of the proposal are outlined in **Table 5-23**.

Table 5-23 Summary of recommendations – cumulative

Issue	Recommendation	Timing
Cumulative impact	A further assessment of the cumulative impacts will be carried out in the detailed environmental assessment. The detailed assessment will include, but not be limited to further review of existing or future projects near the proposal which construction has the potential to occur over a similar stage.	Detailed environmental assessment
Wyalong Solar Farm	The Wyalong Solar Farm project is located 8 km north of the study area, and as a result will need to be considered during the planning and assessment process for the current proposal.	Design development and environmental assessment

6. Conclusion

Transport has started planning for flood proofing and immunity solutions for the combined length of 105 km of the highway between West Wyalong and Forbes.

The information and recommendations in this PEI would be used to inform the options investigations and design process for the proposal with an aim to avoid or minimise environmental and social impacts wherever possible.

Once a preferred option has been identified and a concept design developed, a detailed environmental assessment would be prepared. This detailed environmental assessment would detail environmental safeguards and management measures to be implemented.

Based on the PEI the following are considered key environmental issues:

- Disruption and management of traffic and transport on the highway, including heavy and light vehicle movements
- Potential to disrupt access to and from rural/residential properties, and agricultural/commercial land
- Parts of the highway are located within the road reserve while other parts are located out the road reserve corridor. Some of the parts of the highway that are outside of road reserve are within crown land.
- Threats to registered outstanding biodiversity values in the locality and specific ecological values, primarily due to the indicative vegetation distribution map detailing the potential presence of seven listed communities under the EPBC Act and nine TECs listed under the BC Act within the locality.
- Threats to ecological values, primarily due to potential presence of derived native grasslands associated with a threatened ecological community (e.g. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered Community) that may not be identified in the indicative regional vegetation mapping.
- Potential habitat and presence of threatened flora and fauna listed under the EPBC Act and BC Act within the study area including the Glossy-black Cockatoo *(Calyptorhynchus lathami*), Brown Treecreeper (*Climacteris picumnus victoriae*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) and Blue-billed Duck (Oxyura australis) which have been confirmed in the study area.
- Impacts to populations of threatened flora species occur in disturbed roadside vegetation, e.g. *Austrostipa metatoris* (A spear-grass) *Austrostipa wakoolica* (A spear-grass)*, Dichanthium setosum* (Bluegrass) and the *Swainsona murrayana* (Slender Darling Pea)
- Key potential impacts on the ecological attributes identified as potentially present within the study area include:
  - Clearing of endangered and critically endangered ecological communities
  - Clearing of habitat for EPBC Act and BC Act listed threatened flora and fauna species
  - Direct clearance of EPBC Act and BC Act listed threatened flora species
  - Increased habitat fragmentation and edge effects through the widening of the highway corridor
  - Potential indirect impact to KFH and waterways that are habitat for threatened fish species
  - Potential for weed invasion, including listed priority weeds, and spread into adjacent sensitive habitats such as areas of TECs
  - Introduction of introduction of pathogens as *Phytophthora cinnamomi* (dieback) and *Uredo rangelii* (Myrtle Rust) into the environment
- Potential impact on connectivity corridors for wildlife including clearing and changes to vegetated reserves associated with Crown Land located next to the existing highway, vegetated riparian corridors, vegetated road reserves, isolated patches of woodlands within farmland and paddock trees.

- Parts of the highway are located within the road reserve and some parts are located out the road reserve corridor. Some of the part of the highway that are outside of road reserve are contained within crown land, Should Transport choose to establish a road reserve corridor, strip acquisition of private and publicly owned land would be required. The proposal contains several landforms and resource zones which have the potential to contain Aboriginal archaeological sites
- Sixteen Aboriginal items recorded on the AHIMS are located in and near the study area
- Potential direct impacts on 22 local heritage items along the study area between West Wyalong and Forbes, including the Forbes Railway Station Group which is listed as a State Heritage Item
- Management of potential soil erosion
- Water quality and hydrology, due to potential indirect impacts to ephemeral waterbodies
- Management of flooding risk to and from the proposal as Sections of the study area where the highway is located are subject to flooding. In major flood events the highway may become impassable between West Wyalong and Forbes
- Noise and vibration issues to local rural/residential land uses
- Disruptions to landscape character and visual amenity
- Socio-economic impacts due to an influx of workers placing pressure on local infrastructure and competition for construction labour and materials
- Cumulative issues to the local community and environment due to other major projects in the region.

6.1 Summary of recommendations

The identified issues will need to be considered further during design development and detailed environmental assessment in order to avoid, minimise and mitigate impacts to the extent possible. Where necessary, specialist advice and investigations will need to inform the assessment process. **Table 6-1** summarises recommendations and **Table 6-2** summarises the opportunities for future phases of proposal development.

Table 6-1 Summary of recommendations

Issue	Recommendation	Timing
Traffic		
Impacts to road users during construction	Consider the need for construction staging within design development to ensure access for heavy vehicles is maintained. Construction staging would also consider any other road upgrades (including safety works) occurring simultaneously along the highway.	Design development
Traffic assessment	Carry out a traffic assessment and traffic modelling to estimate the proposals effect on surrounding road network performance.	Design development
	Include consideration of the construction traffic impacts on the surrounding road network in the traffic assessment.	Design development

Issue	Recommendation	Timing
Cumulative impact	Consultation with ARTC regarding the proposed inland rail project in Forbes to ensure cumulative traffic and transport impacts are understood and assessed.	Design development
Property and landowner access	Any change requirements to local access arrangements will be confirmed during detailed design and in consultation with the local road authority and any affected landowners.	Design development
Biodiversity		
Impacts to biodiversity	Impacts on identified TECs, threatened plant species, threatened fauna habitat and wildlife connectivity should be addressed. This will require specialist ecological advice and should, in priority order, seek to avoid, minimise and then manage impacts. The assessment should be in accordance with the *Biodiversity Assessment Guidelines, EIA-N06 (Transport, 2020).*	Detailed environmental assessment
Impacts to biodiversity	A biodiversity assessment should be undertaken during the detailed environmental assessment stage of the proposal development consistent with the requirements of the BC Act and EPBC Act. This should include as a minimum: • Field survey and other investigations to verify biodiversity values present • Assessment of impact significance for affected endangered ecological communities with reference to environmental assessment requirements • Assessment of impact significance for affected TECs with reference to relevant Commonwealth guidelines • Assessment of impact significance on threatened species with a moderate or higher likelihood of occurrence in the study area • Consideration of fauna connectivity and potential mitigation measures • Offset requirements in accordance with relevant assessment pathway. Impact assessment on threatened flora and fauna and wildlife connectivity with a moderate or higher likelihood of occurrence in the study area should be further assessed during design development, construction planning and construction. The assessment should be in accordance with *the Biodiversity Assessment Guidelines, EIA-N06 (Transport, 2020).*	Design development and detailed environmental assessment
Impacts to biodiversity	Apply the 'avoid, minimise, mitigate and offset' hierarchy during further design development, specifically in relation to threatened communities and species.	Design development and detailed environmental assessment

Issue	Recommendation	Timing
Impacts to KFH	Consultation with DPI (Fisheries) will be carried if any impacts are expected on KFH. Specific consideration will need to be given to potential impacts on fish habitat and fish passage during detailed environmental investigation.	Design development and detailed environmental assessment
Aboriginal heritage		
Aboriginal heritage assessment	A PACHCI Stage 1 assessment and a Stage 2 PACHCI assessment is recommended. The aim of a Stage 2 PACHCI is to carry out further assessment and a survey with specific Aboriginal stakeholders to assess the proposal's potential to harm Aboriginal cultural heritage, and to determine whether formal Aboriginal community consultation and a cultural heritage assessment report is required.	Detailed Environmental assessment
Water quality, flooding and hydrology		
Flooding	Further design development and detailed environmental assessment for the proposal should assess potential flooding impacts during construction and operation including consideration of the *NSW Government's Floodplain Development Manual* (Department of Natural Resources, 2005), *Practical Consideration of Climate Change - Flood risk management guideline* (DECC, 2007) and *Australian Rainfall and Runoff: A guide to flood estimation (Commonwealth of Australia* (Geoscience Australia 2016*).*	Design development and detailed environmental assessment
Flooding	A detailed flooding assessment to identify feasible options to improve flood immunity for the highway should be carried out. A detailed flooding assessment should be carried out during development of concept design for the proposal.	Design development and detailed environmental assessment
Flooding	Assess impacts of the proposed construction works on surface water hydrology and flooding during development of the proposals concept design.	Design development and detailed environmental assessment
Flooding – surface water and groundwater	Consider impacts on groundwater and surface water flow including flood routes during the environmental assessment process.	Design development and detailed environmental assessment
Hydrology	Identification of potential impacts on stormwater quantity, change in stormwater runoff (increase or decrease) and geomorphic sensitivity of downstream waters.	Design development and detailed environmental assessment

Issue	Recommendation	Timing
Surface water quality	Identification of sensitive receiving waterways, assessment of existing water quality against numerical criteria for relevant water quality indicators (ANZG, 2018; NHMRC, 2008; MDBA, 2012), and determination of whether relevant WQOs currently being met, and whether they are likely to be achieved during construction and operation.	Design development and detailed environmental assessment
Groundwater resource	Detailed identification and assessment of potential environmental impacts associated with groundwater resources, including potential loss of groundwater availability to groundwater users and ecosystems during construction and operation.	Design development and detailed environmental assessment
Groundwater quality	Consider potential impacts on groundwater quality, including due to disturbance of saline or acid sulfate soils, during construction and operation.	Design development and detailed environmental assessment
Socio-economic, land use and property		
Socio economics	A general socio-economic assessment should be carried out in accordance with the *Transport Environmental Impact Practice Note: Socio-economic Assessment (EIA N-05).*	Detailed environmental assessment
Socio economics	Investigate measures to address construction socio-economic impacts in any future proposal environmental management documentation.	Detailed environmental assessment
Consultation	Consultation should be carried out with local councils, stakeholders and other major proposal proponents within the vicinity of the study area to reduce and manage the cumulative socio-economic impacts of the proposal.	Detailed environmental assessment
Suitable locations for construction compounds	Consider identifying sufficient suitable locations for construction compounds in order to ensure that the appropriate assessment and approvals can be achieved in a timely manner.	Design development and detailed environmental assessment
Noise and vibration		
Noise	Further detailed environmental assessment for the proposal should assess potential noise and vibration impacts in accordance with the NMG, NCG, NMVG and CNVG.	Detailed environmental assessment
Further noise and vibration assessment	Consider carrying out a monitoring survey at representative locations along the proposal to fully quantify the existing level of noise impact and provide a baseline of the noise environment for the study area.	Detailed environmental assessment

Issue	Recommendation	Timing
Noise and vibration	Investigate measures to address construction noise and vibration impacts in any future proposal environmental management documentation.	Detailed environmental assessment
Topography, geology, soils and contamination		
Geology and soils	Geotechnical investigations and assessment, and preliminary site assessments should be undertaken to support further design development.	Design development and detailed environmental assessment
Erosion and sediment control	Develop constructability and earthworks design early in the design development phase to enable appropriate assessment of potential impacts to allow consideration of the slope and extreme erodibility of the study area.	Design development and detailed environmental assessment
Erosion and sediment control	Prepare an erosion and sediment management report in accordance with Transport guidelines to inform the design development and the environmental assessment.	Design development and detailed environmental assessment
Erosion and sediment control	Investigate appropriate soil, erosion, dust and sediment control measures in any future environmental management documentation as relevant.	Design development and detailed environmental assessment
Non-Aboriginal heritage		
Non-Aboriginal heritage assessment	• Consider the potential for both registered and previously unrecorded non-Aboriginal heritage items and archaeological relics to be directly and/or indirectly impacted by the proposal • Carry out further non-Aboriginal heritage assessment including detailed research, a comprehensive field survey, a significance assessment and an impact assessment.	Detailed environmental assessment
Non-Aboriginal heritage impacts	Seek to minimise impact on the listed heritage items in **Table 5-7** through the design process of the proposal.	Design development
Landscape character and visual		
Urban design	Develop, review and refine urban design objectives and principles that complement the built and natural character of the area.	Design development

Issue	Recommendation	Timing
Visual impacts	Following release of the preferred options report, if deemed necessary carry out a landscape character and visual impact assessment of the proposed concept design in accordance with *Environmental Impact Assessment Practice Note EIA-N04 "Guideline for landscape character and visual impact assessment"* (Transport, 2020).	Detailed environmental assessment
Air quality		
Air Quality	A further air quality assessment during detailed environmental assessment will be carried out and include: • Air pollution sources • Quality management are in accordance to relevant guidelines • Methodology to manage adverse climatic weather conditions such as high winds • Methodology to rehabilitate exposed surfaces progressively	Detailed environmental assessment
Climate change	Identify sources of greenhouse gas emissions associated with the construction, operation and ongoing works of the proposal.	Detailed environmental assessment
Cumulative		
Cumulative impact	A further assessment of the cumulative impacts will be carried out in the detailed environmental assessment. The detailed assessment will include, but not be limited to further review of existing or future projects near the proposal which construction has the potential to occur over a similar stage.	Detailed environmental assessment
Wyalong Solar Farm	The Wyalong Solar Farm project is located 8 km north of the study area, and as a result will need to be considered during the planning and assessment process for the current proposal.	Design development and environmental assessment

Table 6-2 Summary of opportunities

Opportunity	Recommendation	Timing
Traffic		
Improved road safety	Investigation of the opportunity to improve the local road intersections with the highway (in areas flooded in 2016).	Design development
Bus stops	Investigation of the opportunity for wider areas for school bus pick and drop off areas.	Design development

Opportunity	Recommendation	Timing
Road reserve	Consider the need for creating a road reserve for the highway	Design development
Biodiversity		
Reduce impacts to biodiversity	Seek to reduce the proposal's footprint in valuable and sensitive biodiversity areas, where possible.	Design development
Socio-economic, land use and property		
Reduce the impacts of property	Opportunities to minimise the proposal's impact on public and private property will need to be investigated during the design development phase, with the objective of containing the proposal within the existing road corridor wherever possible.	Design development
Air quality		
Climate change	Identify opportunities to reduce the greenhouse gas emissions associated with the proposal.	Design development and environmental assessment

7. Certification

This PEI provides a true and fair review of the proposal in relation to environment issues and opportunities present.

Samantha Bourke

Environmental Planner

Jacobs

Date: 29 June 2021

I have examined this PEI and accept it on behalf of Transport.

Stephen Howlett

Project Development Manager

Regional Infrastructure Development, Infrastructure & Place

Date:

8. References

ABS 2019, Statistics, people population. Regional population by age and sex *https://www.abs.gov.au/statistics/people/population/regional-population-age-and-sex/latest-release* [Accessed 1 February 2021].

ABS 2016, Census 2016. *QuickStats General Community Profile*, Australian Bureau of Statistics, Canberra.

ASSMAC, 1998 Acid Sulfate Soils Management Advisory Committee*, Acid Sulfate Soils Assessment Guidelines*, August 1998.

AMBS Ecology & Heritage 2017. *Cowal Gold Operations Processing Rate Modification - Flora and Fauna Survey Report.* Consultancy report to Evolution Mining (Cowal) Pty Limited.

ANZG, 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand governments and Australian state and territory governments. Canberra ACT, Australia, 2018. Available at: *www.waterquality.gov.au/anz-guidelines*. Accessed January 2021.

Bland Shire Council, 2011. *Bland Local Environmental Plan.*

Bland Shire Council*, n.d. Wyalong/West Wyalong Flood Study, s.l.: s.n.*

BoM, 2020. Bureau of Meteorology, *Climate Data Online*, *http://www.bom.gov.au/climate/data/*

BoM, 2021. *Groundwater Dependent Ecosystems (GDE) Atlas*, Australian Government's Bureau of Meteorology (on 5 September 2020), available at *http://www.bom.gov.au/water/groundwater/gde/*

BoM, 2018. Bureau of Meteorology NSW, Rainfall data *http://www.bom.gov.au/water/designRainfalls/pmp/*

CSIRO (2021), Atlas of Australian Acid Sulphate Soils, available at *https://data.csiro.au/dap/landingpage?execution=e1s2&_eventId=viewDescription.*

DECC, 2008. *Descriptions for NSW (Mitchell) Landscapes Version 2 (2002)*, Department of Environment and Climate Change, Sydney NSW.

DFSI, 2020. NSW Department of Finance, Services and Innovation, Spatial Services. NSW topographic maps and aerial photographs.

DPI, 2006. Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River. Primefact 145, pp. 1-4.

DPI Water, 2017 Department of Primary Industries (Water). Available at *http://www.water.nsw.gov.au/water-management/catchments* **[**Accessed January 2021].

DPI Fisheries, 2020a. Department of Primary Industries Fisheries, *Key Fish Habitat Maps*. Available at *https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps*. Accessed January 2021.

DPI Fisheries, 2020b. Department of Primary Industries Fisheries *spatial data portal NSW, https://www.dpi.nsw.gov.au/about-us/research-development/spatial-data-portal* [Accessed January 2021].

DPIE, 2017, Department of Planning, Industry and Environment, *New South Wales Landuse*, available at *https://datasets.seed.nsw.gov.au/dataset/5a5e08fd-6ed5-497a-9403-3356f5e229c0*

DPIE, 2016, Department of Planning, Industry and Environment *Hydrogeological Landscapes of New South Wales and the Australian Capital Territory*, available at *https://datasets.seed.nsw.gov.au/dataset/8bb2763b-6be0-4385-904c-9d1e388bc085*

DPIE, 2019. Department of Planning Industry and the Environment, *Minview – Rivers*. Available at: *https://minview.geoscience.nsw.gov.au/#/?lon=150.8689&lat=-33.79028&z=14&bm=bm1&l=wa1:y:100* **[**Accessed January 2021].

DPIE EES BioNet, 2021. Department of Environment Industry and the Environment - Environment Energy and Science, *BioNet Vegetation Classification* [Online]. NSW, *https://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx*

DPIE, 2021. Water Management (General) Regulation 2018 hydroline spatial data 1.0, Available at *https://trade.maps.arcgis.com/apps/webappviewer/index.html?id=07b967fd0bdc4b0099fc5be45b6d1392* Accessed January 2021.

DPIE, 2020a. *Water quality technical report for the Lachlan surface water resource plan area (SW10),* February 2020.

DPIE, 2020b. *The Central Resource for Sharing and Enabling Environmental Data in NSW Online database*, *https://www.seed.nsw.gov.au/*

DLWC, 2002, Department of Land and Water Conservation *NSW State Groundwater Dependent Ecosystems Policy*, April 2002.

DoAWE 2020.Bioregion overview, *South Western Slopes Bioregion https://www.environment.nsw.gov.au/bioregions/NSWSouthWesternSlopesBioregion.htm*

DoAWE, 2020a. *About my region – Riverina New South Wales*, Department of Agriculture, Water and the *Environment https://www.agriculture.gov.au/abares/research-topics/aboutmyregion/nsw-riverina*

DoAWE, 2020b. *About my region –Central West New South Wales*, *https://www.agriculture.gov.au/abares/research-topics/aboutmyregion/nsw-central*

DoAWE, 2020c. Central West and Orana Regional Plan 2036*. https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/Central-West-AND-Orana*

DoAWE, 2021. *Australian Wetlands database: Directory of Important Wetlands – Lake Cowal/Wilbertroy Wetlands*. Available at *http://www.environment.gov.au/cgi-bin/wetlands/report.pl* [Accessed online January 2021].

DEC 2004, Department of Environment and Conservation, State of New South Wales, *Australian and New Zealand Environment and Conservation Council Guidelines and Water Quality Objectives in NSW*

DECCW, 2006. Department of Environment, Climate Change and Water, 2006, *NSW Water Quality and River Flow Objectives – Hunter River.*

DECCW, 2010*. Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*, Sydney.

Ecolink, 2019. Wyalong Solar Farm*, Biodiversity Development Assessment Report, NSW.*

Forbes Shire Council, 2013. *Forbes Local Environmental Plan.*

Forbes Advocate, October 29 2020. [Online] Available at: *https://www.forbesadvocate.com.au/story/6988821/planning-for-newell-highway-flood-proofing-begins/* [Accessed 25 February 2021].

Green, D., Petrovic, J., Moss. P., and Burrell. M., 2011. *Water resources and management overview: Lachlan catchment,* NSW Office of Water, Sydney.

Infrastructure NSW, 2017. *NSW State Infrastructure Strategy 2018-2038,* Sydney NSW.

Jacobs, 2021. *West Wyalong to Forbes Flood Immunity – Preliminary Flooding report*

MDBA, 2012. *Basin Plan: Schedule 11 – Target values for target application zones*, Basin Plan 2012 made under subparagraph 44(3)(b)(i) of the *Water Act 2007.*

Narrabri Courier, 2020. Upgrade for the Newell Highway. Available at: *https://narrabricourier.com.au/2020/09/09/upgrade-for-the-newell-highway/* [Accessed 25 February 2021].

NHMRC, 2008. *Guidelines for Managing Risks in Recreational Water,* Australian Government.

NPWS, 2003. *The Bioregions of New South Wales: their biodiversity, conservation and history*. NSW National Parks and Wildlife Service.

OzArk, 2018. Wyalong Solar Farm - “Glenroy and Glenee” 1409 Newell Highway, Wyalong NSW, Aboriginal and Historic Cultural Heritage Assessment Report October 2018 *https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-9564%2120190304T035941.760%20GMT*

Strahler, A.N., 1952a. *Dynamic Basis of Geomorphology*. Geological Society of America Bulletin, vol.63, pp. 923-938.

Strahler, A.N., 1952b. *Hypsometric (area-altitude) analysis of erosional topography.* Bull. Geol. Soc. Am., vol.63, pp. 1117-1142.Thackway, R. & Cresswell, I. D, 1995. *An Interim Biogeographic Regionalisation of Australia,* Canberra, Australian Nature Conservation Agency.

Transport, 2015. *Newell Highway Corridor Strategy,* Sydney NSW.

Transport, 2012*. NSW Long Term Transport Master Plan,* Sydney NSW.

WaterNSW (2021), Water Insights Real-Time Water Data. Available at https://realtimedata.waternsw.com.au/

Weddin Shire Council, 2011. *Weddin Local Environmental Plan 2011*

Terms and acronyms used in this PEI

<table>
<tr><th>Term / Acronym</th><th>Description</th></tr>
<tr><td>Annual Exceedance Probability (AEP)</td><td>The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (AR&R, 2016).
<table>
<tr><th>Frequency Descriptor</th><th>EY</th><th>AEP (%)</th><th>AEP (1 in x)</th><th>ARI</th></tr>
<tr><td rowspan="9">Very frequent</td><td>12</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>99.75</td><td>1.002</td><td>0.17</td></tr>
<tr><td>4</td><td>98.17</td><td>1.02</td><td>0.25</td></tr>
<tr><td>3</td><td>95.02</td><td>1.05</td><td>0.33</td></tr>
<tr><td>2</td><td>86.47</td><td>1.16</td><td>0.50</td></tr>
<tr><td>1</td><td>63.2</td><td>1.58</td><td>1.00</td></tr>
<tr><td rowspan="5">Frequent</td><td>0.69</td><td>50.00</td><td>2</td><td>1.44</td></tr>
<tr><td>0.5</td><td>39.35</td><td>2.54</td><td>2.00</td></tr>
<tr><td>0.22</td><td>20.00</td><td>5</td><td>4.48</td></tr>
<tr><td>0.2</td><td>18.13</td><td>5.52</td><td>5.00</td></tr>
<tr><td>0.11</td><td>10.00</td><td>10.00</td><td>9.49</td></tr>
<tr><td rowspan="3">Infrequent</td><td>0.05</td><td>5.00</td><td>20</td><td>20.0</td></tr>
<tr><td>0.02</td><td>2.00</td><td>50</td><td>50.0</td></tr>
<tr><td>0.01</td><td>1.00</td><td>100</td><td>100</td></tr>
<tr><td rowspan="4">Rare</td><td>0.005</td><td>0.50</td><td>200</td><td>200</td></tr>
<tr><td>0.002</td><td>0.20</td><td>500</td><td>500</td></tr>
<tr><td>0.001</td><td>0.10</td><td>1000</td><td>1000</td></tr>
<tr><td>0.0005</td><td>0.05</td><td>2000</td><td>2000</td></tr>
<tr><td rowspan="5">Extremely Rare</td><td>0.0002</td><td>0.02</td><td>5000</td><td>5000</td></tr>
<tr><td></td><td></td><td rowspan="4">↓</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Extreme</td><td></td><td></td><td>PMP</td><td></td></tr>
</table>
</td></tr>
<tr><td>ABS</td><td>Australian Bureau of Statistics</td></tr>
<tr><td>ACT</td><td>Australian Capital Territory</td></tr>
<tr><td>AHD</td><td>Australian height datum</td></tr>
<tr><td>AHIMS</td><td>Aboriginal Heritage Information Management System (AHIMS) Web Services</td></tr>
</table>

Term / Acronym	Description
AHIP	Aboriginal Heritage Impact Permits
ANZG	Australian and New Zealand National Water Quality Guidelines
AQI	Air Quality Index
AREA	AREA Environmental Consultants & Communication
ARI	Average recurrence interval
ARTC	Australian Rail Track Corporation
ASS	Acid sulfate soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
AWS	Automatic weather station
BC Act	*Biodiversity Conservation Act, 2016* (NSW)
BDAR	*Biodiversity Development Assessment Report*
BoM	Bureau of Meteorology
CNVG	*Construction Noise and Vibration Guideline* (Roads and Maritime, 2016)
CSEP	Community and Stakeholder Engagement Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water
DFSI	NSW Department of Finance, Services and Innovation, Spatial Services
DLWC	Department of Land and Water Conservation
DPI	Department of Primary Industries
DPIE	Department of Planning Industry and Environment
DO	dissolved oxygen
DoAWE	Department of Agriculture, Water and Environment
DGVs	Default guideline values
EC	electrical conductivity
EEC	Endangered Ecological Communities

Term / Acronym	Description
EES	Environment, Energy and Science
EIA	Environmental impact assessment
EIS	Environmental impact statement
EPA	NSW Environment Protection Authority
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.
EPL	Environment protection licence
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
Flood immunity	Flood immunity is defined as one lane - each way (both north and south bound lanes) dry and trafficable for all vehicles
Flood passable	Flood passable is defined as one way – one lane trafficable for all vehicles under traffic management
Flood proof	The term flood proof is defined as no closure required during a defined flood event
FM Act	Fisheries Management Act 1994
Future Transport Strategy	Future Transport Strategy 2056
GDE	Groundwater dependent ecosystems
GIS	geographic information system
HPV	Higher Productivity Vehicles
IBRA	Interim Biogeographic Regionalisation for Australia
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
KFH	Key Fish Habitat
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument in NSW
LGA	Local Government Area

Term / Acronym	Description
LTTMP	NSW Long Term Transport Master Plan
mg/L	milligrams per litre
MDBA	Murray-Darling Basin Authority
µS/cm	Microsiemens Per Centimetre. A unit in the category of Electric conductivity. It is also known as microsiemens per centimetre, microsiemens/centimetre.
MNES	Matters of national environmental significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999
NBN	NBN Co Limited
NCG	*Noise Criteria Guideline* (Roads and Maritime, 2015)
NEPM	National Environment Protection Measures
NHMRC	National Health and Medical Research Council
NMG	*Noise Mitigation Guidelines* (Roads and Maritime, 2015)
NMVG	*Noise Model Validation Guideline* (Roads and Maritime, 2018)
NPI	National Pollution Inventory
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NPWS	National Parks and Wildlife Services
NRMA	National Roads and Motorists' Association Limited
NSW	New South Wales
NTU	Nephelometric Turbidity Units
OEH	Office of Environment and Heritage (now rebranded to DPIE EES)
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime, 2011)
PCT	Plant community type
PEI	Preliminary Environmental Investigation
pH	potential hydrogen
PMST	EPBC Protected Matters Search Tool
POEO Act	*Protection of the Environment Operations Act 1997*
RFOs	River Flow Objectives
RNP	NSW Road Noise Policy

Term / Acronym	Description
ROL	Road Occupancy Licence
Roads and Maritime	NSW Roads and Maritime Services
WQO	Water Quality Objectives
SEED	Sharing and Enabling Environmental Data
SEPP	State Environmental Planning Policy. A type of planning instrument in NSW
SHR	State Heritage Register
SIPs	Services and Infrastructure Plans
SIS	Species impact statement
km^2	square kilometres
SRD	State and Regional Development 2011
SSD	*State Significant Development*
SSI	State Significant Infrastructure
TEC	Threatened ecological communities
Transport	Transport for New South Wales
TN	total nitrogen
TP	total phosphorus
TSR	Travelling Stock Reserves
TSS	total suspended solids
VIS	Vegetation Information System
WSPs	Water Sharing Plans
WQO	Water Quality Objectives

Appendix A Desktop review

Australian Bureau of Statistics

2016 Census QuickStats

Australia | New South Wales | Local Government Areas

Bland (A)

Code LGA10800 (LGA)

People	**5,955**
Male	49.9%
Female	50.1%
Median age	43
Families	**1,494**
Average children per family	
for families with children	2.1
for all families	0.7
All private dwellings	**2,914**
Average people per household	2.4
Median weekly household income	$1,100
Median monthly mortgage repayments	$1,000
Median weekly rent	$150
Average motor vehicles per dwelling	2

People — demographics & education

People tables are based on a person's place of usual residence on Census night

People *Persons count based on place of usual residence on Census night*	**Bland (A)**	**%**	**Australia**	**%**
Male	2,971	49.9	11,546,638	49.3
Female	2,988	50.1	11,855,248	50.7
Aboriginal and/or Torres Strait Islander people	262	4.4	649,171	2.8

In the 2016 Census, there were 5,955 people in Bland (A) (Local Government Areas). Of these 49.9% were male and 50.1% were female. Aboriginal and/or Torres Strait Islander people made up 4.4% of the population.

Age	Bland (A)	%	Australia	%
Median age	43	--	38	--
0-4 years	351	5.9	1,464,779	6.3
5-9 years	459	7.7	1,502,646	6.4
10-14 years	415	7.0	1,397,183	6.0
15-19 years	333	5.6	1,421,595	6.1
20-24 years	267	4.5	1,566,793	6.7
25-29 years	271	4.6	1,664,602	7.1
30-34 years	319	5.4	1,703,847	7.3
35-39 years	318	5.3	1,561,679	6.7
40-44 years	361	6.1	1,583,257	6.8
45-49 years	325	5.5	1,581,455	6.8
50-54 years	385	6.5	1,523,551	6.5
55-59 years	468	7.9	1,454,332	6.2
60-64 years	393	6.6	1,299,397	5.6
65-69 years	363	6.1	1,188,999	5.1
70-74 years	264	4.4	887,716	3.8
75-79 years	249	4.2	652,657	2.8
80-84 years	194	3.3	460,549	2.0
85 years and over	211	3.5	486,842	2.1

The median age of people in Bland (A) (Local Government Areas) was 43 years. Children aged 0 - 14 years made up 20.6% of the population and people aged 65 years and over made up 21.5% of the population.

Registered marital status *People aged 15 years and over*	Bland (A)	%	Australia	%
Married	2,546	53.9	9,148,218	48.1
Separated	149	3.2	608,059	3.2
Divorced	327	6.9	1,626,890	8.5
Widowed	403	8.5	985,204	5.2
Never married	1,300	27.5	6,668,910	35.0

Of people in Bland (A) (Local Government Areas) aged 15 years and over, 53.9% were married and 10.1% were either divorced or separated.

Social marital status *People aged 15 years and over*	Bland (A)	%	Australia	%
Registered marriage	2,086	53.4	8,001,141	47.7
De facto marriage	349	8.9	1,751,731	10.4
Not married	1,473	37.7	7,024,973	41.9

In Bland (A) (Local Government Areas), of people aged 15 years and over, 53.4% of people were in a registered marriage and 8.9% were in a de facto marriage.

Education	Bland (A)	%	Australia	%
Preschool	102	5.3	347,621	4.8
Primary - Government	455	23.5	1,314,787	18.2
Primary - Catholic	111	5.7	380,604	5.3
Primary - other non Government	3	0.2	231,490	3.2
Secondary - Government	296	15.3	827,505	11.5
Secondary - Catholic	33	1.7	338,384	4.7
Secondary - other non Government	17	0.9	280,618	3.9
Technical or further education institution				

	86	4.4	424,869	5.9
University or tertiary institution	71	3.7	1,160,626	16.1
Other	19	1.0	198,383	2.8
Not stated	742	38.3	1,707,023	23.7

In Bland (A) (Local Government Areas), 32.6% of people were attending an educational institution. Of these, 29.6% were in primary school, 17.8% in secondary school and 8.1% in a tertiary or technical institution.

Level of highest educational attainment *People aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Bachelor Degree level and above	399	8.5	4,181,406	22.0
Advanced Diploma and Diploma level	250	5.3	1,687,893	8.9
Certificate level IV	109	2.3	551,767	2.9
Certificate level III	731	15.5	2,442,203	12.8
Year 12	477	10.1	2,994,097	15.7
Year 11	211	4.5	941,531	4.9
Year 10	950	20.1	2,054,331	10.8
Certificate level II	4	0.1	13,454	0.1
Certificate level I	0	0.0	2,176	0.0
Year 9 or below	614	13.0	1,529,897	8.0
No educational attainment	7	0.1	145,844	0.8
Not stated	850	18.0	1,974,794	10.4

Of people aged 15 and over in Bland (A) (Local Government Areas), 10.1% reported having completed Year 12 as their highest level of educational attainment, 17.8% had completed a Certificate III or IV and 5.3% had completed an Advanced Diploma or Diploma.

2011 benchmarks are not available for this data item.

People — cultural & language diversity

Ancestry, top responses	**Bland (A)**	**%**	**Australia**	**%**
Australian	2,673	34.3	7,298,243	23.3
English	2,380	30.5	7,852,224	25.0
Irish	643	8.2	2,388,058	7.6
Scottish	623	8.0	2,023,470	6.4
German	313	4.0	982,226	3.1

The most common ancestries in Bland (A) (Local Government Areas) were Australian 34.3%, English 30.5%, Irish 8.2%, Scottish 8.0% and German 4.0%.

Respondents had the option of reporting up to two ancestries on their Census form, and this is captured by the Ancestry Multi Response (ANCP) variable used in this table. Therefore, the total responses count will not equal the persons count for this area. Calculated percentages represent a proportion of all responses from people in Bland (A) (Local Government Areas) (including those who did not state an ancestry).

Country of birth	**Bland (A)**	**%**	**Australia**	**%**
Australia	4,890	82.2	15,614,835	66.7
Other top responses				

England	73	1.2	907,570	3.9
New Zealand	32	0.5	518,466	2.2
Papua New Guinea	25	0.4	28,800	0.1
Philippines	20	0.3	232,386	1.0
South Africa	20	0.3	162,449	0.7

In Bland (A) (Local Government Areas), 82.2% of people were born in Australia. The most common countries of birth were England 1.2%, New Zealand 0.5%, Papua New Guinea 0.4%, Philippines 0.3% and South Africa 0.3%.

Country of birth of father and/or mother, stated responses	Bland (A)	%	Australia	%
Both parents born overseas	361	6.1	8,051,196	34.4
Father only born overseas	179	3.0	1,488,092	6.4
Mother only born overseas	120	2.0	1,094,591	4.7
Both parents born in Australia	4,549	76.4	11,070,538	47.3

In Bland (A) (Local Government Areas), 76.4% of people had both parents born in Australia and 6.1% of people had both parents born overseas.

Country of birth of father, stated responses	Bland (A)	%	Australia	%
Australia	4,709	79.4	12,231,150	52.3
England	156	2.6	1,403,096	6.0
New Zealand	46	0.8	617,331	2.6
Scotland	26	0.4	276,038	1.2
Papua New Guinea	22	0.4	28,460	0.1

In Bland (A) (Local Government Areas), the most common countries of birth for male parents were Australia 79.4%, England 2.6%, New Zealand 0.8%, Scotland 0.4% and Papua New Guinea 0.4%.

Country of birth of mother, stated responses	Bland (A)	%	Australia	%
Australia	4,757	80.2	12,643,365	54.0
England	143	2.4	1,302,147	5.6
New Zealand	52	0.9	608,329	2.6
South Africa	27	0.5	193,412	0.8
Papua New Guinea	24	0.4	34,128	0.1

In Bland (A) (Local Government Areas), the most common countries of birth for female parents were Australia 80.2%, England 2.4%, New Zealand 0.9%, South Africa 0.5% and Papua New Guinea 0.4%.

Religious affiliation, top responses	Bland (A)	%	Australia	%
Catholic	1,545	26.0	5,291,834	22.6
Anglican	1,484	24.9	3,101,185	13.3
No Religion, so described	824	13.8	6,933,708	29.6
Not stated	770	12.9	2,238,735	9.6
Presbyterian and Reformed	406	6.8	526,689	2.3

The most common responses for religion in Bland (A) (Local Government Areas) were Catholic 26.0%, Anglican 24.9%, No Religion, so described 13.8%, Not stated 12.9% and Presbyterian and Reformed 6.8%. In Bland (A) (Local Government Areas), Christianity was the largest religious group

reported overall (83.0%) (this figure excludes not stated responses).

Language, top responses (other than English)	Bland (A)	%	Australia	%
Cantonese	21	0.4	280,943	1.2
Tagalog	15	0.3	111,273	0.5
Tok Pisin (Neomelanesian)	13	0.2	3,741	0.0
Arabic	8	0.1	321,728	1.4
Malayalam	7	0.1	53,206	0.2
English only spoken at home	5,108	86.2	17,020,417	72.7
Households where a non English language is spoken	69	2.8	1,971,011	22.2

In Bland (A) (Local Government Areas), 86.2% of people only spoke English at home. Other languages spoken at home included Cantonese 0.4%, Tagalog 0.3%, Tok Pisin (Neomelanesian) 0.2%, Arabic 0.1% and Malayalam 0.1%.

People — employment

Employment *People who reported being in the labour force, aged 15 years and over*	Bland (A)	%	Australia	%
Worked full-time	1,609	61.0	6,623,065	57.7
Worked part-time	764	29.0	3,491,503	30.4
Away from work	168	6.4	569,276	5.0
Unemployed	95	3.6	787,452	6.9

There were 2,636 people who reported being in the labour force in the week before Census night in Bland (A) (Local Government Areas). Of these 61.0% were employed full time, 29.0% were employed part-time and 3.6% were unemployed.

The ABS Labour Force Survey provides the official estimates of Australia's unemployment rate. More information about Census and labour force status is provided in Understanding the Census and Census Data.

Employment - hours worked *Employed people aged 15 years and over*	Bland (A)	%	Australia	%
1-15 hours per week	283	11.2	1,218,823	11.4
16-24 hours per week	217	8.6	1,079,236	10.1
25-34 hours per week	260	10.3	1,193,445	11.2
35-39 hours per week	329	13.0	2,031,263	19.0
40 hours or more per week	1,279	50.5	4,591,801	43.0

Of employed people in Bland (A) (Local Government Areas), 11.2% worked 1 to 15 hours, 8.6% worked 16 to 24 hours and 50.5% worked 40 hours or more.

Occupation *Employed people aged 15 years and over*	Bland (A)	%	Australia	%
Managers	701	27.5	1,390,047	13.0
Technicians and Trades Workers	352	13.8	1,447,414	13.5
Labourers	306	12.0	1,011,520	9.5
Machinery Operators and Drivers	276	10.8	670,106	6.3
Professionals	268	10.5	2,370,966	22.2
Clerical and Administrative Workers	240	9.4	1,449,681	13.6

Community and Personal Service Workers	191	7.5	1,157,003	10.8
Sales Workers	159	6.2	1,000,955	9.4

The most common occupations in Bland (A) (Local Government Areas) included Managers 27.5%, Technicians and Trades Workers 13.8%, Labourers 12.0%, Machinery Operators and Drivers 10.8%, and Professionals 10.5%.

Industry of employment, top responses *Employed people aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Grain-Sheep or Grain-Beef Cattle Farming	225	9.1	15,056	0.1
Gold Ore Mining	183	7.4	20,141	0.2
Other Grain Growing	181	7.3	19,053	0.2
Sheep Farming (Specialised)	99	4.0	18,197	0.2
Local Government Administration	96	3.9	142,724	1.3

Of the employed people in Bland (A) (Local Government Areas), 9.1% worked in Grain-Sheep or Grain-Beef Cattle Farming. Other major industries of employment included Gold Ore Mining 7.4%, Other Grain Growing 7.3%, Sheep Farming (Specialised) 4.0% and Local Government Administration 3.9%.

Median weekly incomes *People aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Personal	580	--	662	--
Family	1,360	--	1,734	--
Household	1,100	--	1,438	--

The median weekly personal income for people aged 15 years and over in Bland (A) (Local Government Areas) was $580.

Travel to work, top responses *Employed people aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Car, as driver	1,349	53.1	6,574,571	61.5
Worked at home	388	15.3	503,582	4.7
Walked only	154	6.1	370,427	3.5
Car, as passenger	152	6.0	489,922	4.6
Bus	61	2.4	323,201	3.0
People who travelled to work by public transport	78	3.1	1,225,668	11.5
People who travelled to work by car as driver or passenger	1,535	60.2	7,305,271	68.4

In Bland (A) (Local Government Areas), on the day of the Census, the most common methods of travel to work for employed people were: Car, as driver 53.1%, Worked at home 15.3% and Walked only 6.1%. Other common responses were Car, as passenger 6.0% and Bus 2.4%. On the day, 3.1% of employed people used public transport (train, bus, ferry, tram/light rail) as at least one of their methods of travel to work and 60.2% used car (either as driver or as passenger).

Unpaid work *People aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Did unpaid domestic work (last week)	3,054	64.6	13,143,914	69.0
Cared for child/children (last two weeks)	1,257	26.6	5,259,400	27.6
Provided unpaid assistance to a person with a disability (last two weeks)	581	12.3	2,145,203	11.3
Did voluntary work through an organisation or group (last 12				

months)	1,458	30.9	3,620,726	19.0

In Bland (A) (Local Government Areas), of people aged 15 years and over, 64.6% did unpaid domestic work in the week before the Census. During the two weeks before the Census, 26.6% provided care for children and 12.3% assisted family members or others due to a disability, long term illness or problems related to old age. In the year before the Census, 30.9% of people did voluntary work through an organisation or a group.

Unpaid domestic work, number of hours *People aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Less than 5 hours per week	861	18.2	4,298,593	22.6
5 to 14 hours per week	1,068	22.6	4,944,578	26.0
15 to 29 hours per week	558	11.8	2,189,776	11.5
30 hours or more per week	568	12.0	1,710,970	9.0

Of people who did unpaid domestic work in the week before the Census in Bland (A) (Local Government Areas), 22.6% worked 5 to 14 hours, 11.8% worked 15 to 29 hours and 12.0% worked 30 hours or more.

Families — family composition

Family composition	**Bland (A)**	**%**	**Australia**	**%**
Couple family without children	687	46.0	2,291,987	37.8
Couple family with children	558	37.4	2,716,224	44.7
One parent family	227	15.2	959,543	15.8
Other family	20	1.3	102,559	1.7

Of the families in Bland (A) (Local Government Areas), 37.4% were couple families with children, 46.0% were couple families without children and 15.2% were one parent families.

Single (or lone) parents *Proportion of the total single (or lone) parent population*	**Bland (A)**	**%**	**Australia**	**%**
Male	--	26.8	--	18.2
Female	--	73.2	--	81.8

In Bland (A) (Local Government Areas), 26.8% of single parents were male and 73.2% were female.

Families — employment status of couple families

Employment status of parents in couple families *Labour force, parents or partners aged 15 years and over*	**Bland (A)**	**%**	**Australia**	**%**
Both employed, worked full-time	292	23.6	1,084,006	21.6
Both employed, worked part-time	44	3.6	203,596	4.1
One employed full-time, one part-time	297	24.0	1,086,460	21.7
One employed full-time, other not working	138	11.1	749,886	15.0
One employed part-time, other not working	67	5.4	302,037	6.0
Both not working	250	20.2	1,006,697	20.1
Other (includes away from work)	78	6.3	264,145	5.3
Labour force status not stated (by one or both parents in a couple family)	72	5.8	311,381	6.2

In Bland (A) (Local Government Areas), of couple families with children, 23.6% had both partners employed full-time, 3.6% had both employed part-

time and 24.0% had one employed full-time and the other part-time.

The ABS Labour Force Survey provides the official estimates of Australia's unemployment rate. More information about Census and labour force status is provided in Understanding the Census and Census Data.

Dwellings — dwelling structure

Dwelling tables exclude visitor only and other non-classifiable households

Dwelling count	Bland (A)	%	Australia	%
Occupied private dwellings	2,180	82.8	8,286,073	88.8
Unoccupied private dwellings	453	17.2	1,039,874	11.2

In Bland (A) (Local Government Areas), 82.8% of private dwellings were occupied and 17.2% were unoccupied.

Dwelling structure *Occupied private dwellings*	Bland (A)	%	Australia	%
Separate house	2,066	94.8	6,041,788	72.9
Semi-detached, row or terrace house, townhouse etc	9	0.4	1,055,016	12.7
Flat or apartment	56	2.6	1,087,434	13.1
Other dwelling	13	0.6	64,425	0.8

Of occupied private dwellings in Bland (A) (Local Government Areas), 94.8% were separate houses, 0.4% were semi-detached, row or terrace houses, townhouses etc, 2.6% were flat or apartments and 0.6% were other dwellings.

Number of bedrooms *Occupied private dwellings*	Bland (A)	%	Australia	%
None (includes bedsitters)	9	0.4	39,769	0.5
1 bedroom	58	2.7	411,252	5.0
2 bedrooms	271	12.4	1,562,759	18.9
3 bedrooms	982	44.9	3,403,190	41.1
4 or more bedrooms	773	35.4	2,670,758	32.2
Number of bedrooms not stated	92	4.2	198,351	2.4
Average number of bedrooms per dwelling	3.2	--	3.1	--
Average number of people per household	2.4	--	2.6	--

In Bland (A) (Local Government Areas), of occupied private dwellings 2.7% had 1 bedroom, 12.4% had 2 bedrooms and 44.9% had 3 bedrooms. The average number of bedrooms per occupied private dwelling was 3.2. The average household size was 2.4 people.

Tenure *Occupied private dwellings*	Bland (A)	%	Australia	%
Owned outright	1,015	46.5	2,565,695	31.0
Owned with a mortgage	565	25.9	2,855,222	34.5
Rented	492	22.5	2,561,302	30.9
Other tenure type	16	0.7	78,994	1.0
Tenure type not stated	94	4.3	224,869	2.7

Of occupied private dwellings in Bland (A) (Local Government Areas), 46.5% were owned outright,

25.9% were owned with a mortgage and 22.5% were rented.

Dwellings — household composition

Household composition	Bland (A)	%	Australia	%
Family households	1,486	68.3	5,907,625	71.3
Single (or lone) person households	664	30.5	2,023,542	24.4
Group households	25	1.1	354,917	4.3

In Bland (A) (Local Government Areas), of all households, 68.3% were family households, 30.5% were single person households and 1.1% were group households.

Household income	Bland (A)	%	Australia	%
Less than $650 gross weekly income	--	26.4	--	20.0
More than $3000 gross weekly income	--	9.7	--	16.4

In Bland (A) (Local Government Areas), 26.4% of households had a weekly household income of less than $650 and 9.7% of households had a weekly income of more than $3000.

Dwellings — mortgage & rent

Proportions are calculated using all tenure types for occupied private dwellings. This excludes visitor only and other non-classifiable households.

Rent weekly payments	Bland (A)	%	Australia	%
Median rent	150	--	335	--
Households where rent payments are less than 30% of household income	--	96.7	--	88.5
Households with rent payments greater than or equal to 30% of household income	--	3.3	--	11.5

The number of households where rent payments were 30% or more of an imputed income measure are expressed in this table as a proportion of the total number of households in an area (including those households which were not renting, and excluding the small proportion of visitor-only and other non-classifiable households). The nature of the income imputation means that the reported proportion may significantly overstate the true proportion.

Mortgage monthly repayments	Bland (A)	%	Australia	%
Median mortgage repayments	1,000	--	1,755	--
Households where mortgage repayments are less than 30% of household income	--	97.1	--	92.8
Households with mortgage repayments greater than or equal to 30% of household income	--	2.9	--	7.2

The number of households where mortgage repayments were 30% or more of an imputed income measure are expressed in this table as a proportion of the total number of households in an area (including those households which were renting, and excluding the small proportion of visitor only and other non-classifiable households). The nature of the income imputation means that the reported proportion may significantly overstate the true proportion.

Dwellings — number of motor vehicles

Number of registered motor vehicles	Bland (A)	%	Australia	%
None	100	4.6	623,829	7.5
1 motor vehicle	687	31.5	2,881,485	34.8
2 motor vehicles	760	34.9	2,999,184	36.2
3 or more vehicles	518	23.8	1,496,382	18.1
Number of motor vehicles not stated	115	5.3	285,197	3.4

In Bland (A) (Local Government Areas), 31.5% of occupied private dwellings had one registered motor vehicle garaged or parked at their address, 34.9% had two registered motor vehicles and 23.8% had three or more registered motor vehicles.

Dwellings — internet connection

Dwelling internet connection	Bland (A)	%	Australia	%
Internet not accessed from dwelling	561	25.7	1,172,415	14.1
Internet accessed from dwelling	1,519	69.6	6,892,165	83.2
Not stated	104	4.8	221,494	2.7

In Bland (A) (Local Government Areas), 69.6% of households had at least one person access the internet from the dwelling. This could have been through a desktop/laptop computer, mobile or smart phone, tablet, music or video player, gaming console, smart TV or any other device.

People characteristics - Aboriginal and/or Torres Strait Islander peoples

People characteristics *Count based on place of usual residence on Census night.*	Bland (A)	%	Australia	%
Male	128	47.9	322,171	49.6
Female	139	52.1	326,996	50.4
Median age	20	--	23	--

In Bland (A) (Local Government Areas), 47.9% of Aboriginal and/or Torres Strait Islander people were male and 52.1% were female. The median age was 20 years.

Dwelling characteristics - Aboriginal and/or Torres Strait Islander households

Dwelling tables exclude visitor only and other non-classifiable households

Dwelling characteristics *Occupied private dwellings where at least one person was Aboriginal and/or Torres Strait Islander*	Bland (A)	%	Australia	%
Average number of people per household	3	--	3.2	--
Average number of persons per bedroom	0.9	--	1	--
Median weekly household income	1,092	--	1,203	--

There has been change in methodology used to calculate the average number of persons per bedroom. To compare the time series for average number of persons per bedroom please refer to Understanding the Census and Census Data

In Bland (A) (Local Government Areas), for dwellings occupied by Aboriginal and/or Torres Strait Islander people, the average household size was 3 persons, with 0.9 persons per bedroom. The median household income was $1,092.

Mortgage and rent ***Occupied private dwellings where at least one person was Aboriginal and/or Torres Strait Islander***	**Bland (A)**	**%**	**Australia**	**%**
Median weekly rent	160	--	250	--
Median monthly mortgage repayments	872	--	1,660	--

In Bland (A) (Local Government Areas), for dwellings occupied by Aboriginal and/or Torres Strait Islander people, the median weekly rent was $160 and the median monthly mortgage repayment was $872.

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Small random adjustments have been made to all cell values to protect the confidentiality of data. These adjustments may cause the sum of rows or columns to differ by small amounts from the table totals. For further information, go to the User Guide for QuickStats.

Data reported for Australia and Other Territories now includes Norfolk Island, following an amendment to the *Acts Interpretation Act, 1901*. Because Norfolk Island has not previously been included in the Census, any 2011 benchmarks will not include Norfolk Island.

The information contained in this QuickStat has been produced by the Australian Bureau of Statistics | It contains data from the 2016 Census of Population & Housing held on 9 August 2016 | Release date of this QuickStat was 23 October 2017 | Some values may have been adjusted to avoid release of confidential data | These adjustments may have a significant impact on the calculated percentages in QuickStats | For more information refer to Introduced Random Error in the 2016 Census Dictionary. For further enquiries contact the ABS National Information and Referral Service on 1300 135 070 | www.abs.gov.au/census

This page last updated 19 September 2020

Australian Bureau of Statistics

2016 Census QuickStats

Australia | New South Wales | Local Government Areas

Forbes (A)

Code LGA12900 (LGA)

People	**9,587**
Male	50.1%
Female	49.9%
Median age	42
Families	**2,414**
Average children per family	
for families with children	2
for all families	0.7
All private dwellings	**4,370**
Average people per household	2.4
Median weekly household income	$1,069
Median monthly mortgage repayments	$1,148
Median weekly rent	$180
Average motor vehicles per dwelling	1.9

People — demographics & education

People tables are based on a person's place of usual residence on Census night

People *Persons count based on place of usual residence on Census night*	**Forbes (A)**	**%**	**Australia**	**%**
Male	4,806	50.1	11,546,638	49.3
Female	4,784	49.9	11,855,248	50.7
Aboriginal and/or Torres Strait Islander people	1,062	11.1	649,171	2.8

In the 2016 Census, there were 9,587 people in Forbes (A) (Local Government Areas). Of these 50.1% were male and 49.9% were female. Aboriginal and/or Torres Strait Islander people made up 11.1% of the population.

Age	Forbes (A)	%	Australia	%
Median age	42	--	38	--
0-4 years	628	6.5	1,464,779	6.3
5-9 years	672	7.0	1,502,646	6.4
10-14 years	650	6.8	1,397,183	6.0
15-19 years	631	6.6	1,421,595	6.1
20-24 years	481	5.0	1,566,793	6.7
25-29 years	513	5.3	1,664,602	7.1
30-34 years	484	5.0	1,703,847	7.3
35-39 years	477	5.0	1,561,679	6.7
40-44 years	503	5.2	1,583,257	6.8
45-49 years	579	6.0	1,581,455	6.8
50-54 years	661	6.9	1,523,551	6.5
55-59 years	606	6.3	1,454,332	6.2
60-64 years	614	6.4	1,299,397	5.6
65-69 years	630	6.6	1,188,999	5.1
70-74 years	497	5.2	887,716	3.8
75-79 years	408	4.3	652,657	2.8
80-84 years	302	3.1	460,549	2.0
85 years and over	254	2.6	486,842	2.1

The median age of people in Forbes (A) (Local Government Areas) was 42 years. Children aged 0 - 14 years made up 20.3% of the population and people aged 65 years and over made up 21.8% of the population.

Registered marital status *People aged 15 years and over*	Forbes (A)	%	Australia	%
Married	3,715	48.6	9,148,218	48.1
Separated	305	4.0	608,059	3.2
Divorced	617	8.1	1,626,890	8.5
Widowed	584	7.6	985,204	5.2
Never married	2,424	31.7	6,668,910	35.0

Of people in Forbes (A) (Local Government Areas) aged 15 years and over, 48.6% were married and 12.0% were either divorced or separated.

Social marital status *People aged 15 years and over*	Forbes (A)	%	Australia	%
Registered marriage	3,217	49.9	8,001,141	47.7
De facto marriage	654	10.1	1,751,731	10.4
Not married	2,579	40.0	7,024,973	41.9

In Forbes (A) (Local Government Areas), of people aged 15 years and over, 49.9% of people were in a registered marriage and 10.1% were in a de facto marriage.

Education	Forbes (A)	%	Australia	%
Preschool	214	7.2	347,621	4.8
Primary - Government	539	18.1	1,314,787	18.2
Primary - Catholic	270	9.1	380,604	5.3
Primary - other non Government	18	0.6	231,490	3.2
Secondary - Government	280	9.4	827,505	11.5
Secondary - Catholic	359	12.0	338,384	4.7
Secondary - other non Government	33	1.1	280,618	3.9

Technical or further education institution	169	5.7	424,869	5.9
University or tertiary institution	127	4.3	1,160,626	16.1
Other	27	0.9	198,383	2.8
Not stated	947	31.7	1,707,023	23.7

In Forbes (A) (Local Government Areas), 31.1% of people were attending an educational institution. Of these, 27.8% were in primary school, 22.5% in secondary school and 9.9% in a tertiary or technical institution.

Level of highest educational attainment *People aged 15 years and over*	**Forbes (A)**	**%**	**Australia**	**%**
Bachelor Degree level and above	754	9.9	4,181,406	22.0
Advanced Diploma and Diploma level	513	6.7	1,687,893	8.9
Certificate level IV	222	2.9	551,767	2.9
Certificate level III	1,170	15.3	2,442,203	12.8
Year 12	870	11.4	2,994,097	15.7
Year 11	315	4.1	941,531	4.9
Year 10	1,325	17.3	2,054,331	10.8
Certificate level II	6	0.1	13,454	0.1
Certificate level I	0	0.0	2,176	0.0
Year 9 or below	1,062	13.9	1,529,897	8.0
No educational attainment	26	0.3	145,844	0.8
Not stated	1,163	15.2	1,974,794	10.4

Of people aged 15 and over in Forbes (A) (Local Government Areas), 11.4% reported having completed Year 12 as their highest level of educational attainment, 18.2% had completed a Certificate III or IV and 6.7% had completed an Advanced Diploma or Diploma.

2011 benchmarks are not available for this data item.

People — cultural & language diversity

Ancestry, top responses	**Forbes (A)**	**%**	**Australia**	**%**
Australian	4,766	37.8	7,298,243	23.3
English	3,871	30.7	7,852,224	25.0
Irish	1,203	9.5	2,388,058	7.6
Scottish	771	6.1	2,023,470	6.4
German	338	2.7	982,226	3.1

The most common ancestries in Forbes (A) (Local Government Areas) were Australian 37.8%, English 30.7%, Irish 9.5%, Scottish 6.1% and German 2.7%.

Respondents had the option of reporting up to two ancestries on their Census form, and this is captured by the Ancestry Multi Response (ANCP) variable used in this table. Therefore, the total responses count will not equal the persons count for this area. Calculated percentages represent a proportion of all responses from people in Forbes (A) (Local Government Areas) (including those who did not state an ancestry).

Country of birth	**Forbes (A)**	**%**	**Australia**	**%**
Australia	8,216	85.8	15,614,835	66.7
Other top responses				

England	92	1.0	907,570	3.9
New Zealand	55	0.6	518,466	2.2
Philippines	35	0.4	232,386	1.0
India	21	0.2	455,389	1.9
Italy	19	0.2	174,042	0.7

In Forbes (A) (Local Government Areas), 85.8% of people were born in Australia. The most common countries of birth were England 1.0%, New Zealand 0.6%, Philippines 0.4%, India 0.2% and Italy 0.2%.

Country of birth of father and/or mother, stated responses	Forbes (A)	%	Australia	%
Both parents born overseas	473	4.9	8,051,196	34.4
Father only born overseas	274	2.9	1,488,092	6.4
Mother only born overseas	202	2.1	1,094,591	4.7
Both parents born in Australia	7,691	80.2	11,070,538	47.3

In Forbes (A) (Local Government Areas), 80.2% of people had both parents born in Australia and 4.9% of people had both parents born overseas.

Country of birth of father, stated responses	Forbes (A)	%	Australia	%
Australia	7,972	83.3	12,231,150	52.3
England	198	2.1	1,403,096	6.0
New Zealand	76	0.8	617,331	2.6
Scotland	52	0.5	276,038	1.2
Italy	44	0.5	470,138	2.0

In Forbes (A) (Local Government Areas), the most common countries of birth for male parents were Australia 83.3%, England 2.1%, New Zealand 0.8%, Scotland 0.5% and Italy 0.5%.

Country of birth of mother, stated responses	Forbes (A)	%	Australia	%
Australia	8,019	83.6	12,643,365	54.0
England	185	1.9	1,302,147	5.6
New Zealand	68	0.7	608,329	2.6
Philippines	41	0.4	325,049	1.4
Italy	37	0.4	395,775	1.7

In Forbes (A) (Local Government Areas), the most common countries of birth for female parents were Australia 83.6%, England 1.9%, New Zealand 0.7%, Philippines 0.4% and Italy 0.4%.

Religious affiliation, top responses	Forbes (A)	%	Australia	%
Catholic	3,293	34.4	5,291,834	22.6
Anglican	2,372	24.8	3,101,185	13.3
No Religion, so described	1,478	15.4	6,933,708	29.6
Not stated	991	10.3	2,238,735	9.6
Uniting Church	461	4.8	870,183	3.7

The most common responses for religion in Forbes (A) (Local Government Areas) were Catholic 34.4%, Anglican 24.8%, No Religion, so described 15.4%, Not stated 10.3% and Uniting Church 4.8%. In Forbes (A) (Local Government Areas), Christianity was the largest religious group reported overall (81.7%) (this figure excludes not stated responses).

Language, top responses (other than English)	Forbes (A)	%	Australia	%
Italian	26	0.3	271,597	1.2
Wiradjuri	15	0.2	457	0.0
Cantonese	14	0.1	280,943	1.2
Malayalam	12	0.1	53,206	0.2
Afrikaans	9	0.1	43,741	0.2
English only spoken at home	8,538	89.0	17,020,417	72.7
Households where a non English language is spoken	114	3.0	1,971,011	22.2

In Forbes (A) (Local Government Areas), 89.0% of people only spoke English at home. Other languages spoken at home included Italian 0.3%, Wiradjuri 0.2%, Cantonese 0.1%, Malayalam 0.1% and Afrikaans 0.1%.

People — employment

Employment *People who reported being in the labour force, aged 15 years and over*	Forbes (A)	%	Australia	%
Worked full-time	2,493	59.8	6,623,065	57.7
Worked part-time	1,177	28.2	3,491,503	30.4
Away from work	272	6.5	569,276	5.0
Unemployed	225	5.4	787,452	6.9

There were 4,167 people who reported being in the labour force in the week before Census night in Forbes (A) (Local Government Areas). Of these 59.8% were employed full time, 28.2% were employed part-time and 5.4% were unemployed.

The ABS Labour Force Survey provides the official estimates of Australia's unemployment rate. More information about Census and labour force status is provided in Understanding the Census and Census Data.

Employment - hours worked *Employed people aged 15 years and over*	Forbes (A)	%	Australia	%
1-15 hours per week	369	9.4	1,218,823	11.4
16-24 hours per week	337	8.5	1,079,236	10.1
25-34 hours per week	468	11.9	1,193,445	11.2
35-39 hours per week	644	16.3	2,031,263	19.0
40 hours or more per week	1,851	46.9	4,591,801	43.0

Of employed people in Forbes (A) (Local Government Areas), 9.4% worked 1 to 15 hours, 8.5% worked 16 to 24 hours and 46.9% worked 40 hours or more.

Occupation *Employed people aged 15 years and over*	Forbes (A)	%	Australia	%
Managers	758	19.2	1,390,047	13.0
Professionals	560	14.2	2,370,966	22.2
Technicians and Trades Workers	549	13.9	1,447,414	13.5
Labourers	508	12.9	1,011,520	9.5
Clerical and Administrative Workers	398	10.1	1,449,681	13.6
Community and Personal Service Workers	382	9.7	1,157,003	10.8
Sales Workers	379	9.6	1,000,955	9.4
Machinery Operators and Drivers	322	8.2	670,106	6.3

The most common occupations in Forbes (A) (Local Government Areas) included Managers 19.2%, Professionals 14.2%, Technicians and Trades Workers 13.9%, Labourers 12.9%, and Clerical and Administrative Workers 10.1%.

Industry of employment, top responses *Employed people aged 15 years and over*	**Forbes (A)**	**%**	**Australia**	**%**
Secondary Education	163	4.2	177,487	1.7
Supermarket and Grocery Stores	154	4.0	254,275	2.4
Primary Education	144	3.7	231,198	2.2
Sheep Farming (Specialised)	129	3.3	18,197	0.2
Aged Care Residential Services	117	3.0	211,621	2.0

Of the employed people in Forbes (A) (Local Government Areas), 4.2% worked in Secondary Education. Other major industries of employment included Supermarket and Grocery Stores 4.0%, Primary Education 3.7%, Sheep Farming (Specialised) 3.3% and Aged Care Residential Services 3.0%.

Median weekly incomes *People aged 15 years and over*	**Forbes (A)**	**%**	**Australia**	**%**
Personal	571	--	662	--
Family	1,326	--	1,734	--
Household	1,069	--	1,438	--

The median weekly personal income for people aged 15 years and over in Forbes (A) (Local Government Areas) was $571.

Travel to work, top responses *Employed people aged 15 years and over*	**Forbes (A)**	**%**	**Australia**	**%**
Car, as driver	2,602	66.3	6,574,571	61.5
Worked at home	376	9.6	503,582	4.7
Car, as passenger	198	5.0	489,922	4.6
Walked only	178	4.5	370,427	3.5
Truck	64	1.6	85,892	0.8
People who travelled to work by public transport	32	0.8	1,225,668	11.5
People who travelled to work by car as driver or passenger	2,834	71.8	7,305,271	68.4

In Forbes (A) (Local Government Areas), on the day of the Census, the most common methods of travel to work for employed people were: Car, as driver 66.3%, Worked at home 9.6% and Car, as passenger 5.0%. Other common responses were Walked only 4.5% and Truck 1.6%. On the day, 0.8% of employed people used public transport (train, bus, ferry, tram/light rail) as at least one of their methods of travel to work and 71.8% used car (either as driver or as passenger).

Unpaid work *People aged 15 years and over*	**Forbes (A)**	**%**	**Australia**	**%**
Did unpaid domestic work (last week)	5,012	65.6	13,143,914	69.0
Cared for child/children (last two weeks)	1,960	25.7	5,259,400	27.6
Provided unpaid assistance to a person with a disability (last two weeks)	918	12.0	2,145,203	11.3
Did voluntary work through an organisation or group (last 12 months)	1,917	25.1	3,620,726	19.0

In Forbes (A) (Local Government Areas), of people aged 15 years and over, 65.6% did unpaid domestic work in the week before the Census. During the two weeks before the Census, 25.7% provided care for children and 12.0% assisted family members or others due to a disability, long term illness or problems related to old age. In the year before the Census, 25.1% of people did voluntary work through an organisation or a group.

Unpaid domestic work, number of hours *People aged 15 years and over*	Forbes (A)	%	Australia	%
Less than 5 hours per week	1,395	18.3	4,298,593	22.6
5 to 14 hours per week	1,834	24.0	4,944,578	26.0
15 to 29 hours per week	934	12.2	2,189,776	11.5
30 hours or more per week	852	11.1	1,710,970	9.0

Of people who did unpaid domestic work in the week before the Census in Forbes (A) (Local Government Areas), 24.0% worked 5 to 14 hours, 12.2% worked 15 to 29 hours and 11.1% worked 30 hours or more.

Families — family composition

Family composition	Forbes (A)	%	Australia	%
Couple family without children	1,072	44.4	2,291,987	37.8
Couple family with children	896	37.1	2,716,224	44.7
One parent family	408	16.9	959,543	15.8
Other family	41	1.7	102,559	1.7

Of the families in Forbes (A) (Local Government Areas), 37.1% were couple families with children, 44.4% were couple families without children and 16.9% were one parent families.

Single (or lone) parents *Proportion of the total single (or lone) parent population*	Forbes (A)	%	Australia	%
Male	--	20.8	--	18.2
Female	--	79.2	--	81.8

In Forbes (A) (Local Government Areas), 20.8% of single parents were male and 79.2% were female.

Families — employment status of couple families

Employment status of parents in couple families *Labour force, parents or partners aged 15 years and over*	Forbes (A)	%	Australia	%
Both employed, worked full-time	444	22.5	1,084,006	21.6
Both employed, worked part-time	65	3.3	203,596	4.1
One employed full-time, one part-time	438	22.2	1,086,460	21.7
One employed full-time, other not working	238	12.1	749,886	15.0
One employed part-time, other not working	117	5.9	302,037	6.0
Both not working	467	23.7	1,006,697	20.1
Other (includes away from work)	110	5.6	264,145	5.3
Labour force status not stated (by one or both parents in a couple family)	95	4.8	311,381	6.2

In Forbes (A) (Local Government Areas), of couple families with children, 22.5% had both partners employed full-time, 3.3% had both employed part-time and 22.2% had one employed full-time and the other part-time.

The ABS Labour Force Survey provides the official estimates of Australia's unemployment rate. More information about Census and labour force status is provided in Understanding the Census and Census Data.

Dwellings — dwelling structure

Dwelling tables exclude visitor only and other non-classifiable households

Dwelling count	Forbes (A)	%	Australia	%
Occupied private dwellings	3,503	86.8	8,286,073	88.8
Unoccupied private dwellings	532	13.2	1,039,874	11.2

In Forbes (A) (Local Government Areas), 86.8% of private dwellings were occupied and 13.2% were unoccupied.

Dwelling structure *Occupied private dwellings*	Forbes (A)	%	Australia	%
Separate house	3,171	90.5	6,041,788	72.9
Semi-detached, row or terrace house, townhouse etc	119	3.4	1,055,016	12.7
Flat or apartment	139	4.0	1,087,434	13.1
Other dwelling	59	1.7	64,425	0.8

Of occupied private dwellings in Forbes (A) (Local Government Areas), 90.5% were separate houses, 3.4% were semi-detached, row or terrace houses, townhouses etc, 4.0% were flat or apartments and 1.7% were other dwellings.

Number of bedrooms *Occupied private dwellings*	Forbes (A)	%	Australia	%
None (includes bedsitters)	15	0.4	39,769	0.5
1 bedroom	97	2.8	411,252	5.0
2 bedrooms	581	16.6	1,562,759	18.9
3 bedrooms	1,568	44.9	3,403,190	41.1
4 or more bedrooms	1,125	32.2	2,670,758	32.2
Number of bedrooms not stated	105	3.0	198,351	2.4
Average number of bedrooms per dwelling	3.1	--	3.1	--
Average number of people per household	2.4	--	2.6	--

In Forbes (A) (Local Government Areas), of occupied private dwellings 2.8% had 1 bedroom, 16.6% had 2 bedrooms and 44.9% had 3 bedrooms. The average number of bedrooms per occupied private dwelling was 3.1. The average household size was 2.4 people.

Tenure *Occupied private dwellings*	Forbes (A)	%	Australia	%
Owned outright	1,324	37.9	2,565,695	31.0
Owned with a mortgage	1,050	30.1	2,855,222	34.5
Rented	972	27.8	2,561,302	30.9
Other tenure type	26	0.7	78,994	1.0
Tenure type not stated	122	3.5	224,869	2.7

Of occupied private dwellings in Forbes (A) (Local Government Areas), 37.9% were owned outright, 30.1% were owned with a mortgage and 27.8% were rented.

Dwellings — household composition

Household composition	Forbes (A)	%	Australia	%
Family households	2,379	68.1	5,907,625	71.3
Single (or lone) person households	1,034	29.6	2,023,542	24.4
Group households	80	2.3	354,917	4.3

In Forbes (A) (Local Government Areas), of all households, 68.1% were family households, 29.6% were single person households and 2.3% were group households.

Household income	Forbes (A)	%	Australia	%
Less than $650 gross weekly income	--	26.5	--	20.0
More than $3000 gross weekly income	--	7.7	--	16.4

In Forbes (A) (Local Government Areas), 26.5% of households had a weekly household income of less than $650 and 7.7% of households had a weekly income of more than $3000.

Dwellings — mortgage & rent

Proportions are calculated using all tenure types for occupied private dwellings. This excludes visitor only and other non-classifiable households.

Rent weekly payments	Forbes (A)	%	Australia	%
Median rent	180	--	335	--
Households where rent payments are less than 30% of household income	--	92.3	--	88.5
Households with rent payments greater than or equal to 30% of household income	--	7.7	--	11.5

The number of households where rent payments were 30% or more of an imputed income measure are expressed in this table as a proportion of the total number of households in an area (including those households which were not renting, and excluding the small proportion of visitor-only and other non-classifiable households). The nature of the income imputation means that the reported proportion may significantly overstate the true proportion.

Mortgage monthly repayments	Forbes (A)	%	Australia	%
Median mortgage repayments	1,148	--	1,755	--
Households where mortgage repayments are less than 30% of household income	--	95.5	--	92.8
Households with mortgage repayments greater than or equal to 30% of household income	--	4.5	--	7.2

The number of households where mortgage repayments were 30% or more of an imputed income measure are expressed in this table as a proportion of the total number of households in an area (including those households which were renting, and excluding the small proportion of visitor only and other non-classifiable households). The nature of the income imputation means that the reported proportion may significantly overstate the true proportion.

Dwellings — number of motor vehicles

Number of registered motor vehicles	Forbes (A)	%	Australia	%

None	200	5.7	623,829	7.5
1 motor vehicle	1,091	31.2	2,881,485	34.8
2 motor vehicles	1,296	37.0	2,999,184	36.2
3 or more vehicles	743	21.2	1,496,382	18.1
Number of motor vehicles not stated	171	4.9	285,197	3.4

In Forbes (A) (Local Government Areas), 31.2% of occupied private dwellings had one registered motor vehicle garaged or parked at their address, 37.0% had two registered motor vehicles and 21.2% had three or more registered motor vehicles.

Dwellings — internet connection

Dwelling internet connection	Forbes (A)	%	Australia	%
Internet not accessed from dwelling	925	26.5	1,172,415	14.1
Internet accessed from dwelling	2,444	69.9	6,892,165	83.2
Not stated	128	3.7	221,494	2.7

In Forbes (A) (Local Government Areas), 69.9% of households had at least one person access the internet from the dwelling. This could have been through a desktop/laptop computer, mobile or smart phone, tablet, music or video player, gaming console, smart TV or any other device.

People characteristics - Aboriginal and/or Torres Strait Islander peoples

People characteristics *Count based on place of usual residence on Census night.*	Forbes (A)	%	Australia	%
Male	508	47.8	322,171	49.6
Female	555	52.2	326,996	50.4
Median age	21	--	23	--

In Forbes (A) (Local Government Areas), 47.8% of Aboriginal and/or Torres Strait Islander people were male and 52.2% were female. The median age was 21 years.

Dwelling characteristics - Aboriginal and/or Torres Strait Islander households

Dwelling tables exclude visitor only and other non-classifiable households

Dwelling characteristics *Occupied private dwellings where at least one person was Aboriginal and/or Torres Strait Islander*	Forbes (A)	%	Australia	%
Average number of people per household	3	--	3.2	--
Average number of persons per bedroom	0.9	--	1	--
Median weekly household income	1,032	--	1,203	--

There has been change in methodology used to calculate the average number of persons per bedroom. To compare the time series for average number of persons per bedroom please refer to Understanding the Census and Census Data

In Forbes (A) (Local Government Areas), for dwellings occupied by Aboriginal and/or Torres Strait Islander people, the average household size was 3 persons, with 0.9 persons per bedroom. The median household income was $1,032.

Mortgage and rent *Occupied private dwellings where at least one person was Aboriginal and/or Torres Strait Islander*	Forbes (A)	%	Australia	%
Median weekly rent	180	--	250	--
Median monthly mortgage repayments	1,083	--	1,660	--

In Forbes (A) (Local Government Areas), for dwellings occupied by Aboriginal and/or Torres Strait Islander people, the median weekly rent was $180 and the median monthly mortgage repayment was $1,083.

LATEST ISSUE Released at 11:30 AM (AEST) 23/10/2017

Small random adjustments have been made to all cell values to protect the confidentiality of data. These adjustments may cause the sum of rows or columns to differ by small amounts from the table totals. For further information, go to the User Guide for QuickStats.

Data reported for Australia and Other Territories now includes Norfolk Island, following an amendment to the *Acts Interpretation Act, 1901*. Because Norfolk Island has not previously been included in the Census, any 2011 benchmarks will not include Norfolk Island.

The information contained in this QuickStat has been produced by the Australian Bureau of Statistics | It contains data from the 2016 Census of Population & Housing held on 9 August 2016 | Release date of this QuickStat was 23 October 2017 | Some values may have been adjusted to avoid release of confidential data | These adjustments may have a significant impact on the calculated percentages in QuickStats | For more information refer to Introduced Random Error in the 2016 Census Dictionary. For further enquiries contact the ABS National Information and Referral Service on 1300 135 070 | www.abs.gov.au/census

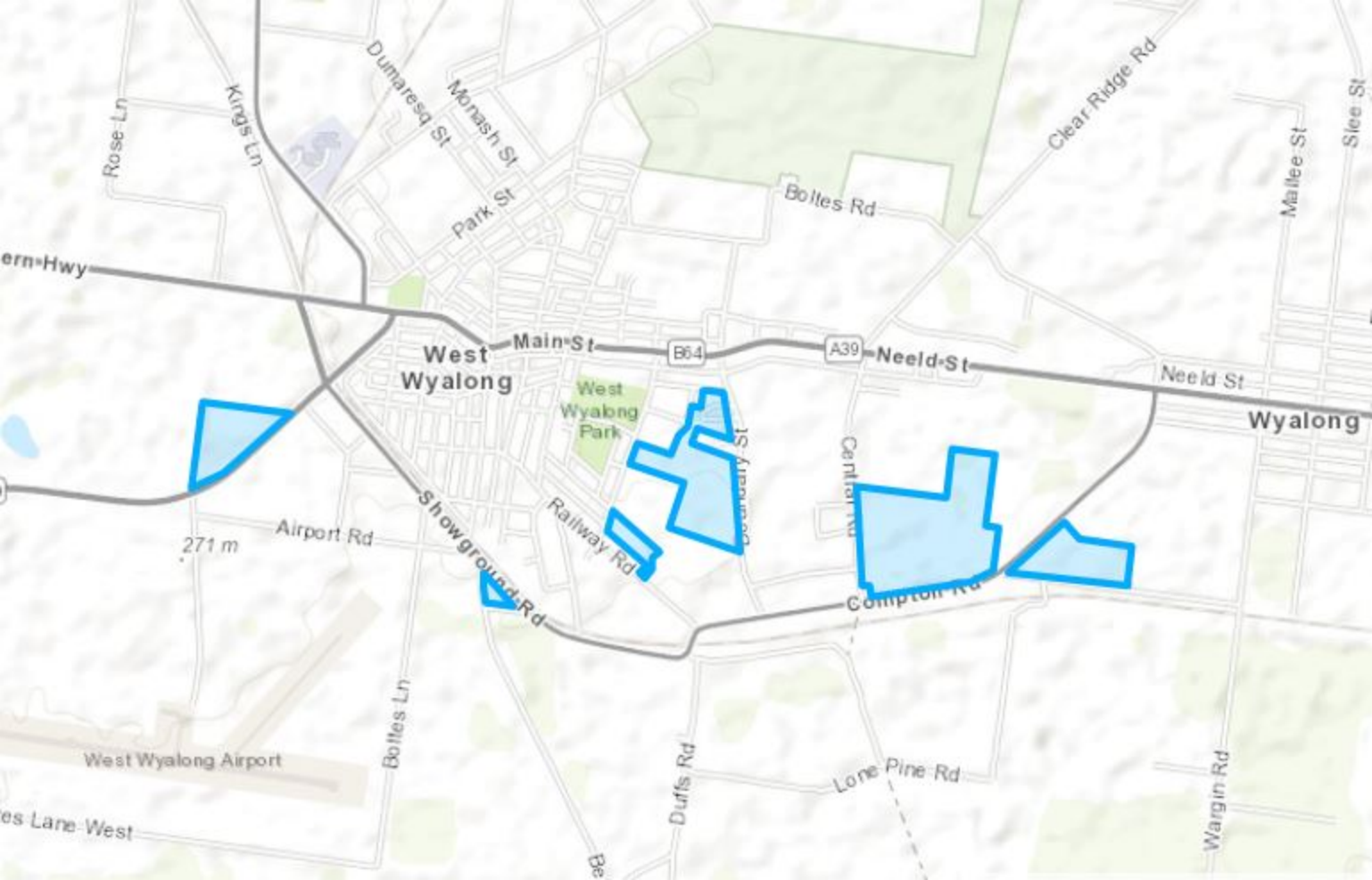
This page last updated 19 September 2020

Search Results

7 results found.

Barmedman Mining Area and Mineral Pool Nobbys Rd	Barmedman, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Buddigower Nature Reserve (1977 boundary)	Buddigower via West Wyalong, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Lake Cowal Burcher Marsden Rd	Burcher, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
The Charcoal Tank Nature Reserve Newell Hwy	Wyalong South via West Wyalng, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
West Wyalong General Cemetery Clear Ridge Rd	Wyalong, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Wyalong Central Station Building (former) Cootamundra Lake Cargelligo Railway Line	Wyalong, NSW, Australia	(Destroyed) Register of the National Estate (Non-statutory archive)
Wyalong Courthouse Neeld St	Wyalong, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)

Report Produced: Fri Sep 25 02:30:20 2020


Rose Ln
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Showground Rd
Railway Rd
Airport Rd
271 m
Compton Rd
Bolles Ln
West Wyalong Airport
Duffs Rd
Lone Pine Rd
Wargin Rd
es Lane West

Section 170 Heritage and Conservation Register

October 2019

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Registry Contact

Heritage@ARTC.com.au

Version Control

Updates, items added or removed from the S.170 shall be reflected here

Version	Change	Date
1.0	2019 register review and document creation	11 October 2019

Register

- Numbers in the SHR (State Heritage Register) or SHI (State Heritage Inventory) columns are the official reference numbers registered by the Office of Environment and Heritage
- Items with a Conservation Management Plan (CMP) are marked with “YES”
- Click on the SHI number to be directed to the items inventory page

ITEM NAME	LOCATION	SUBURB	LEP	SHR	SHI	CMP
ALBURY (LAVINGTON) GATEHOUSE	Dallinger Street, Lavington, NSW 2641	Albury	Albury City		4282613	
ALBURY RAILWAY PRECINCT	Railway Place (Off Young Street), Albury, NSW 2640	Albury	Albury City	1073	4280274	
ALBURY, MURRAY RIVER UNDERBRIDGE	648.465km, Main Southern Railway Line, Albury, NSW 2640	Albury	Albury City	1020	4280312	
ALLANDALE, ANVIL CREEK UNDERBRIDGE	207.776km, Northern Railway Line, Allandale To Greta, NSW	Allandale	Cessnock		4281615	
ARDGLEN RAILWAY TUNNEL	362.330km, Northern Railway Line, Ardglen, NSW 2338	Ardglen	Upper Hunter	1021	4280220	
BETHUNGRA SPIRAL RAILWAY INFRASTRUCTURE	450 to 455km, Main Southern Line, Bethungra, NSW 2590	Bethungra	Junee	1026	4280304	

BINALONG RAILWAY PRECINCT	Wellington Street, Binalong, NSW 2584	Binalong	Yass Valley		4280259	
BINNAWAY RAILWAY PRECINCT	George Street, Binnaway, NSW 2395	Binnaway	Warrumbungle		4280021	
BOGAN GATE RAILWAY STATION	Station Street, Bogan Gate, NSW 2876	Bogan Gate	Parkes		4280356	
BOMEN RAILWAY STATION	Dampier Street, Bomen, NSW 2650	Bomen	Wagga Wagga	1093	4280278	
BONVILLE, BONVILLE CREEK UNDERBRIDGE	596.868km North Coast Railway, Bonville, NSW 2441	Bonville	Coffs Harbour		4281629	
BOWNING RAILWAY PRECINCT	Bowning, NSW 2582	Bowning	Yass Valley	1096	4280269	YES
BOWRAL, GIB RAILWAY TUNNELS	134.627 Main Southern Line, Bowral, NSW	Bowral	Wingecarribee		4281696	
BRANXTON, BLACK CREEK UNDERBRIDGE	217.175km, Main Northern Railway, Branxton, NSW 2335	Branxton	Cessnock		4280446	
BROKEN HILL RAILWAY PRECINCT	Crystal Street, Broken Hill, NSW 2880	Broken Hill	Broken Hill	1101	4280348	
BUNDANOON RAILWAY PRECINCT	Railway Avenue, Bundanoon, NSW 2578	Bundanoon	Wingecarribee	1104	4280255	

CAMBERWELL GLENNIES CREEK UNDERBRIDGE	252.613kms Main Northern Railway, Camberwell, NSW 2330	Camberwell	Singleton		4281689	
CAMURRA, GWYDIR RIVER UNDERBRIDGE	676.220km Moree To Mungindi Railway, Camurra, NSW 2400	Camurra	Moree Plains		4281693	
CARRICK, WOLLONDILLY RIVER UNDERBRIDGE NO 1	205.556km Main Southern Railway, Carrick, NSW 2580	Carrick	Goulburn Mulwaree		4281677	
CASINO RAILWAY PRECINCT AND LOCOMOTIVE DEPOT	Canterbury Street, Casino, NSW 2470	Casino	Richmond Valley	1111	4280172	YES
CASINO, RICHMOND RIVER UNDERBRIDGE	804.430km North Coast Railway, Casino, NSW 2470	Casino	Richmond Valley		4280246	
CONDOBOLIN RAILWAY PRECINCT	Condobolin, NSW 2877	Condobolin	Lachlan		4280360	
COOTAMUNDRA RAILWAY PRECINCT	Hovell Street, Cootamundra, NSW 2590	Cootamundra	Cootamundra	1118	4280261	
COOTAMUNDRA WEST RAILWAY STATION	Cootamundra West, NSW 2590	Cootamundra West	Cootamundra	1119	4280306	

COUGAL TO BORDER LOOP, RAILWAY SPIRAL AND LANDSCAPE	railway location (kms):869.381-875.100 Border Loop, North Coast Railway, Cougal, NSW 2474	Cougal - Border Loop	Kyogle	1027	4280245
CULCAIRN RAILWAY PRECINCT	Melville Street, Culcairn, NSW 2660	Culcairn	Greater Hume		4280282
DEMONDRILLE, RAILWAY RELICS	Young Road, Demondrille, NSW 2587	Demondrille	Harden	1128	4281687
DUBBO RAILWAY PRECINCT	Dubbo, NSW 2830	Dubbo	Dubbo	1130	4280342
DUBBO, MACQUARIE RIVER UNDERBRIDGE MACQUARIE RIVER UNDERBRIDGE	Dubbo-Narromine Railway, Dubbo, NSW 2830	Dubbo	Dubbo	1032	4280389
DUNEDOO RAILWAY PRECINCT	Whiteley Street, Dunedoo, NSW 2844	Dunedoo	Warrumbungle	1134	4280184
DUNGOG, WILLIAMS RIVER UNDERBRIDGE	245.835km North Coast Railway, Dungog, NSW 2420	Dungog	Dungog		4281618
EAST MAITLAND RAILWAY PRECINCT	John Street, East Maitland, NSW 2323	East Maitland	Maitland	1135	4280006

EAST MAITLAND, WILLIAM STREET FOOTBRIDGE	188.696km Main Northern Railway, East Maitland, NSW 2323	East Maitland	Maitland		4280517
FISH RIVER WATER SUPPLY LOCATION	270.650km Main Southern Railway, Fish River, NSW 2581	Fish River	Upper Lachlan		4280307
FORBES RAILWAY STATION	Lewis Street, Forbes, NSW 2871	Forbes	Forbes	1145	4280343
GEROGERY GATEKEEPER'S RESIDENCE	Main Street, Gerogery, NSW 2642	Gerogery	Greater Hume	1148	4280275
GOULBURN MULWAREE RIVER UNDERBRIDGE	223.020km Main Southern Railway, Goulburn, NSW 2580	Goulburn	Goulburn Mulwaree	1035	4280319
GOULBURN RAILWAY PRECINCT	Sloane Street, Goulburn, NSW 2580	Goulburn	Goulburn Mulwaree	1152	4280291
GOULBURN ROUNDHOUSE/ LOCOMOTIVE DEPOT	Braidwood Road, Goulburn, NSW 2580	Goulburn	Goulburn Mulwaree	1152	4281706
GRAFTON RAILWAY VIADUCTS	Kent, Clarence, Villiers, Duke, Prince, Queen & Mary Streets, Grafton, NSW 2460	Grafton	Clarence Valley		4280699

GRAFTON, CLARENCE RIVER UNDERBRIDGE	696.143km North Coast Railway, Grafton, NSW 2460	Grafton	Clarence Valley	1036	4280237
GRAFTON, POUND STREET (WEST) UNDERBRIDGE	698.533km North Coast Railway Pound Street, Grafton, NSW 2420	Grafton	Clarence Valley		4281660
GULGONG RAILWAY STATION	Railway Street, Gulgong, NSW 2852	Gulgong	Mid-Western Regional	1158	4280178
GUNNING RAILWAY PRECINCT	Grovenor Street, Gunning, NSW 2581	Gunning	Upper Lachlan		4280268
GUNNING, GUNNING CREEK (MEADOW CREEK) UNDERBRIDGE	277.735km Main Southern Line, Gunning, NSW 2581	Gunning	Upper Lachlan		4281680
HARDEN RAILWAY PRECINCT	Station Street, Harden, NSW 2587	Harden	Harden	1165	4280270
HENTY RAILWAY PRECINCT	Railway Parade, Henty, NSW 2658	Henty	Greater Hume	1169	4280285
IVANHOE RAILWAY PRECINCT	Ivanhoe, NSW 2878	Ivanhoe	Central Darling		4280794
JOPPA JUNCTION, RUN O' WATERS CREEK UNDERBRIDGE	230.425km Main Southern Railway, Joppa Junction, NSW 2580	Joppa Junction	Goulburn Mulwaree		4280395

JUNEE RAILWAY PRECINCT	Main Street, Junee, NSW 2680	Junee	Junee	1173	4280760
KEMPSEY, MACLEAY RIVER UNDERBRIDGE	505.355km North Coast Railway, Kempsey, NSW 2440	Kempsey	Kempsey	1041	4280240
KENDALL, CAMDEN HAVEN RIVER UNDERBRIDGE	433.363km North Coast Railway, Kendall, NSW 2439	Kendall	Port Macquarie-Hastings		4281627
KYOGLE, FAWCETTS CREEK UNDERBRIDGE	834.040km North Coast Railway, Kyogle, NSW 2474	Kyogle	Kyogle		4281664
LANSDOWNE, LANSDOWNE RIVER UNDERBRIDGE	394.772km North Coast Railway, Lansdowne, NSW 2430	Lansdowne	Greater Taree		4281625
MACKSVILLE, NAMBUCCA RIVER UNDERBRIDGE	553.490km North Coast Railway, Macksville, NSW 2447	Macksville	Nambucca		4281635
MAITLAND RAILWAY PRECINCT	Railway Street, Maitland, NSW 2320	Maitland	Maitland	1185	4280012
MARULAN RAILWAY PRECINCT	Thoroughfare Street, Marulan, NSW 2579	Marulan	Goulburn Mulwaree	1188	4280257
MENANGLE NEPEAN RIVER UNDERBRIDGE	64.333km Main Southern Railway, Menangle, NSW 2571	Menangle	Wollondilly	1047	4280315

MENANGLE RAILWAY STATION	Stevens Road, Menangle, NSW 2571	Menangle	Wollondilly	1191	4280267
MENINDEE DARLING RIVER UNDERBRIDGE	1005.846Km Parkes To Broken Hill Railway, Menindee, NSW 2879	Menindee	Central Darling		4280365
MITTAGONG RAILWAY PRECINCT	Station Street, Mittagong, NSW 2575	Mittagong	Wingecarribee	1195	4280288
MOREE, MEHI RIVER BRIDGE	Railway Location, Mungindi Line 663.34 Kms, , NSW 2400	Moree	Moree Plains		4281692
MOSS VALE RAIL UNDERBRIDGE (ARGYLE ST)	Argyle Street, Moss Vale, NSW 2577	Moss Vale	Wingecarribee	1049	4280314
MOSS VALE RAILWAY PRECINCT	Lackey Road, Moss Vale, NSW 2577	Moss Vale	Wingecarribee	1200	4280253
MOUNT GEORGE, MANNING RIVER UNDERBRIDGE	339.954km North Coast Railway, Mount George, NSW 2424	Mt George	Greater Taree	1264	4280242
MOUNT MURRAY RAILWAY STATION	Mount Murray, NSW 2577	Mount Murray	Wingecarribee	1202	4280151
MURRAYS FLATS BOXERS CREEK UNDERBRIDGE	214.124Km Main Southern Railway, Murrays Flats, NSW 2580	Murrays Flats	Goulburn Mulwaree		4281679

MURRAYS FLATS, WOLLONDILLY RIVER NO 2 UNDERBRIDGE	(213.418km) Main Southern Railway, Murrays Flats, NSW 2580	Murrays Flats	Goulburn Mulwaree		4281678
MUSWELLBROOK HUNTER RIVER UNDERBRIDGE	Railway Locations, Ulan Line, 289.304 & 327.079 Kms, , NSW 2333	Muswellbrook	Muswellbrook		4281690
MUSWELLBROOK RAILWAY PRECINCT	Market Street, Muswellbrook, NSW 2333	Muswellbrook	Muswellbrook	1208	4280182
NARROMINE FOOTBRIDGE	At Level Crossing North of Station, Narromine, NSW 2821	Narromine	Narromine		4280597
NARROMINE RAILWAY STATION	Narromine, NSW 2821	Narromine	Narromine		4280209
OAKHAMPTON, HUNTER RIVER UNDERBRIDGE	199.657km North Coast Railway, Oakhampton, NSW 2320	Oakhampton	Maitland		4281617
OLD CASINO RAILWAY STATION	Near Kent Street; Casino To Murwillumbah Line, Casino, NSW 2470	Old Casino	Richmond Valley	1216	4280217
PATERSON RAILWAY PRECINCT	Railway Street, Paterson, NSW 2421	Paterson	Dungog		4280211
PATERSON, PATERSON RIVER UNDERBRIDGE	213.732km North Coast Railway, Paterson, NSW 2421	Paterson	Dungog		4280241

PICTON PEDESTRIAN OVERBRIDGE	86.000km Main Southern Railway, Picton, NSW 2571	Picton	Wollondilly		4280622
PICTON RAILWAY DEVIATION WORKS	85.500 to 88.000km Main Southern Railway, Picton, NSW 2571	Picton	Wollondilly	1224	4280323
PICTON RAILWAY PRECINCT	Picton, NSW 2571	Picton	Wollondilly	1224	4280271
PICTON STONEQUARRY CREEK UNDERBRIDGE	85.391km Main Southern Railway, Picton, NSW 2571	Picton	Wollondilly	1051	4280413
PICTON, ANTILL STREET UNDERBRIDGE	88.133km Main Southern Railway, Picton, NSW 2571	Picton	Wollondilly		4281670
PICTON, ARGYLE STREET UNDERBRIDGE	86.160km Main Southern Railway, Picton, NSW 2571	Picton	Wollondilly		4281671
PREMER RAILWAY STATION	Premer, NSW 2381	Premer	Warrumbungle		4280195
RALEIGH, BELLINGER RIVER NORTH ARM UNDERBRIDGE	587.823km North Coast Railway, Raleigh, NSW 2454	Raleigh	Bellingen		4281628
ROBERTSON RAILWAY PRECINCT	Robertson, NSW 2577	Robertson	Wingecarribee		4280147

SANDGATE, IRONBARK CREEK UNDERBRIDGES	172.311km Sandgate To Hexham Railway, Sandgate, NSW 2304	Sandgate	Newcastle		4280457
SAWTELL, BOAMBEE CREEK UNDERBRIDGE	601.432km North Coast Railway, Sawtell, NSW 2441	Sawtell	Coffs Harbour		4281648
SCONE RAILWAY PRECINCT	Susan Street, Scone, NSW 2337	Scone	Upper Hunter	1242	4280173
SINGLETON HUNTER RIVER UNDERBRIDGE	Main Northern Railway, Singleton, NSW 2330	Singleton	Singleton		4280716
SINGLETON RAILWAY PRECINCT	Munro Lane, Singleton, NSW 2330	Singleton	Singleton		4280212
STROUD ROAD, KARUAH RIVER UNDERBRIDGE	266.155km North Coast Railway, Stroud Road, NSW 2415	Stroud Road	Great Lakes		4281619
TALLONG RAILWAY PRECINCT AND WATER SUPPLY FACILITIES	Railway Parade, Tallong, NSW 2579	Tallong	Goulburn Mulwaree	1259	4280793
TALLONG, BARBERS CREEK UNDERBRIDGE	187.849km Main Southern Rly, Tallong, NSW	Tallong	Goulburn Mulwaree		4281675
TAREE RAILWAY PRECINCT	Olympia Street, Taree, NSW 2430	Taree	Greater Taree		4280196

TELEGRAPH POINT, WILSON RIVER UNDERBRIDGE	472.000km North Coast Railway, Telegraph Point, NSW 2441	Telegraph Point	Port Macquarie-Hastings		4281632
THE ROCK RAILWAY PRECINCT	Railway Street, The Rock, NSW 2655	The Rock	Lockhart	1268	4280256
URUNGA, BELLINGER RIVER SOUTH UNDERBRIDGE	581.890km North Coast Railway, Urunga, NSW 2455	Urunga	Bellingen		4281636
WAGGA WAGGA (521.7 KM) FOOTBRIDGE	521.7km Cassidy Pde & Brookong Ave, Wagga Wagga, NSW 2650	Wagga Wagga	Wagga Wagga		4280661
WAGGA WAGGA RAILWAY PRECINCT	Station Place, Wagga Wagga, NSW 2650	Wagga Wagga	Wagga Wagga	1279	4280250
WAGGA WAGGA VIADUCTS	Across Murrumbidgee Flood Plain, Wagga Wagga, NSW 2650	Wagga Wagga	Wagga Wagga		4280713
WAGGA WAGGA, TARCUTTA STREET UNDERBRIDGE	520.157km Main Southern Railway, Wagga Wagga, NSW 2650	Wagga Wagga	Wagga Wagga		4280721
WARATAH, STYX RIVER UNDERBRIDGE	164.475km Northern Railway Line, Waratah, NSW 2298	Waratah	Newcastle		4280456

WARATAH, UPFOLD STREET PEDESTRIAN FOOTBRIDGE	165.345km Upfold Street, Mayfield, NSW 2298	Waratah	Newcastle		4280667	
WAUCHOPE STATION MASTER'S RESIDENCE	59 Randall Street, Wauchope, NSW 2446	Wauchope	Port Macquarie-Hastings	1283	4280197	
WAUCHOPE, HASTINGS RIVER UNDERBRIDGE	455.363km North Coast Railway, Wauchope, NSW 2446	Wauchope	Port Macquarie-Hastings	1283	4281631	
WERRIS CREEK RAILWAY PRECINCT	Single Street, Werris Creek, NSW 2341	Werris Creek	Liverpool Plains	1285	4280177	YES
YASS JUNCTION RAILWAY PRECINCT	Faulder Avenue, Yass Junction, NSW 2582	Yass Junction	Yass Valley	1291	4280252	
YASS JUNCTION, BANGO CREEK UNDERBRIDGE	318.760km Main Southern Line, Yass, NSW 2582	Yass Junction	Yass Valley		4281682	

Search for NSW Heritage

Return to search page where you can refine/broaden your search.

Statutory listed items

Information and items listed in the State Heritage Inventory come from a number of sources. This means that there may be several entries for the same heritage item in the database. For clarity, the search results have been divided into three sections.

- **Section 1 -** contains Aboriginal Places declared by the **Minister for the Environment** under the National Parks and Wildlife Act. This information is provided by Heritage NSW.
- **Section 2 -** contains heritage items listed by the **Heritage Council of NSW** under the Heritage Act. This includes listing on the State Heritage Register, an Interim Heritage Order or protected under section 136 of the Heritage Act. This information is provided by Heritage NSW.
- **Section 3 -** contains items listed by **local councils** on Local Environmental Plans under the Environmental Planning and Assessment Act and **State government agencies** under s.170 of the Heritage Act. This information is provided by local councils and State government agencies.

Section 1. Aboriginal Places listed under the National Parks and Wildlife Act.

Your search did not return any matching results.

Section 2. Items listed under the Heritage Act.

Your search did not return any matching results.

Section 3. Items listed by Local Government and State Agencies.

Your search returned 54 records.

Item name ▲	Address	Suburb	LGA	Information source
Bank of New South Wales (former)	142-146 Main Street	West Wyalong	Bland	LGOV
Barmedman General Cemetery	Goldfields Way	Barmedman	Bland	LGOV
Barmedman Hotel	78-80 Queen Street	Barmedman	Bland	LGOV
Barmedman Station buildings - homestead, kitchen, stables, sheds, woolshed	Williams Crossing Road	Barmedman	Bland	LGOV
Bland Community Centre	172 Main Street	West Wyalong	Bland	LGOV
Buildings - Butcher Shop	185 Main Street	West Wyalong	Bland	LGOV
Buildings - Roundabout Bakery	187 Main Street	West Wyalong	Bland	LGOV
Bygoo Station Group	40 Sprys Lane	Bygoo	Bland	LGOV
CBC Bank (former)	141 Main Street	West Wyalong	Bland	LGOV
Commercial and Retail Building	935 & 97-99 Main Street	West Wyalong	Bland	LGOV
Council Chambers (former)	68 Neeld Street	Wyalong	Bland	LGOV
Courthouse and Lock-up Group and constable's quarters	69 Neeld Street	Wyalong	Bland	LGOV
Cowal West Group comprising homestead, quarters, shed and stables	Lake Cowal Road	Lake Cowal	Bland	LGOV
Flour mill (former)	106 Railway Road	West Wyalong	Bland	LGOV
Globe Hotel	149 Main Street	West Wyalong	Bland	LGOV
Grenfell Hill	138 Slee Street	Wyalong	Bland	LGOV
Helyars Dry Cleaners	176 Main Street	West Wyalong	Bland	LGOV
Herridge Brick Kilns (former)	24 Clear Ridge Road	West Wyalong	Bland	LGOV
Item		Blank	Bland	LGOV
John Meagher & Co (former)	70 Queen Street	Barmedman	Bland	LGOV
John Meagher & Co (former)	98-106 Main Street	West Wyalong	Bland	LGOV
John Souden Jewellers (former)	148 Main Street	West Wyalong	Bland	LGOV
Linley	138 Slee Street	Wyalong	Bland	LGOV
Lone Grave of Anne Woodhouse	3147 Merrengreen Road	Calleen	Bland	LGOV
Lone Graves of Wisman and Kerner	362 Williams Crossing Road	Bland	Bland	LGOV

Masonic Pioneer Lodge (former)	31 Mallee Street	Wyalong	Bland	LGOV
Medical Hall	131 Main Street	West Wyalong	Bland	LGOV
Morangarell General Cemetery	Barmedman - Morangarell Road	Morangarell	Bland	LGOV
Popes Creek Bridge	Mid Western Highway	57.4 km west of West Wyalong	Bland	SGOV
Post Office (former)	64 Neeld Street	Wyalong	Bland	LGOV
Post Office Hotel	96 Main Street	West Wyalong	Bland	LGOV
Queensland Hotel	76 Queen Street	Barmedman	Bland	LGOV
Royal Hotel	Ariah Street	Mirrool	Bland	LGOV
Rural Chambers (former)	110 Main Street	West Wyalong	Bland	LGOV
School of Arts (former)	70 Neeld Street	Wyalong	Bland	LGOV
Shops and Garage	63-69 Queen Street	Barmedman	Bland	LGOV
Shops and garage	66-68 Queen Street	Barmedman	Bland	LGOV
Soudens Homestead Store	133 Main Street	West Wyalong	Bland	LGOV
St Barnabas' Anglican Church	6 Court Street	West Wyalong	Bland	LGOV
Tallimba Police Station and Official Residence	Main Street	Tallimba	Bland	SGOV
Tattersall's Hotel	83-87 Main Street	West Wyalong	Bland	LGOV
Thom's Corner	143-147 Main Street	West Wyalong	Bland	LGOV
Top Town Tavern	74-76 Neeld Street	West Wyalong	Bland	LGOV
Watterson Store (former)	71 Neeld Street	Wyalong	Bland	LGOV
Weethalle Police Station and Official Residence	Cow Street and Railway Street	Weethalle	Bland	SGOV
Weethalle Railway Station	Railway Street	Weethalle	Bland	SGOV
West Wyalong Court House and Residence	Court Street	West Wyalong	Bland	SGOV
West Wyalong Fire Station	Court Street	West Wyalong	Bland	SGOV
West Wyalong General Cemetery	240 Clear Ridge Road	Wyalong	Bland	LGOV
West Wyalong Police Station	34 Church Street	West Wyalong	Bland	SGOV
West Wyalong Showground Pavilions: Fine Arts, Sheep, Cattle, Poultry	By Pass Road	West Wyalong	Bland	LGOV
White Tank Hotel	203 Main Street	West Wyalong	Bland	LGOV
Wyalong Courthouse	Neeld Street and Slee Street	Wyalong	Bland	SGOV
Wyalong House	83 Neeld Street	Wyalong	Bland	LGOV

There was a total of 54 records matching your search criteria.

Key:

LGA = Local Government Area

GAZ= NSW Government Gazette (statutory listings prior to 1997), HGA = Heritage Grant Application, HS = Heritage Study, LGOV = Local Government, SGOV = State Government Agency.

Note: While Heritage NSW seeks to keep the Inventory up to date, it is reliant on State agencies and local councils to provide their data. Always check with the relevant State agency or local council for the most up-to-date information.

Return to search page where you can refine/broaden your search.

Statutory listed items

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Section 1. Aboriginal Places listed under the National Parks and Wildlife Act.

Your search returned 1 record.

Aboriginal place name	Local government area	Local Aboriginal Land Council	Latitude	Longitude	Gazettal date and page numbers	Comments
Kings Grave	Lachlan	West Wyalong	-33.0690862934	146.7890236	07/11/2007 p. 7013	

Section 2. Items listed under the Heritage Act.

Your search did not return any matching results.

Section 3. Items listed by Local Government and State Agencies.

Your search returned 26 records.

Item name	Address	Suburb	LGA	Information source
Bank of New South Wales (former)	142-146 Main Street	West Wyalong	Bland	LGOV
Bland Community Centre	172 Main Street	West Wyalong	Bland	LGOV
Buildings - Butcher Shop	185 Main Street	West Wyalong	Bland	LGOV
Buildings - Roundabout Bakery	187 Main Street	West Wyalong	Bland	LGOV
CBC Bank (former)	141 Main Street	West Wyalong	Bland	LGOV
Commercial and Retail Building	935 & 97-99 Main Street	West Wyalong	Bland	LGOV
Flour mill (former)	106 Railway Road	West Wyalong	Bland	LGOV
Globe Hotel	149 Main Street	West Wyalong	Bland	LGOV
Helyars Dry Cleaners	176 Main Street	West Wyalong	Bland	LGOV

Herridge Brick Kilns (former)	24 Clear Ridge Road	West Wyalong	Bland	LGOV
John Meagher & Co (former)	98-106 Main Street	West Wyalong	Bland	LGOV
John Souden Jewellers (former)	148 Main Street	West Wyalong	Bland	LGOV
Medical Hall	131 Main Street	West Wyalong	Bland	LGOV
Popes Creek Bridge	Mid Western Highway	57.4 km west of West Wyalong	Bland	SGOV
Post Office Hotel	96 Main Street	West Wyalong	Bland	LGOV
Rural Chambers (former)	110 Main Street	West Wyalong	Bland	LGOV
Soudens Homestead Store	133 Main Street	West Wyalong	Bland	LGOV
St Barnabas' Anglican Church	6 Court Street	West Wyalong	Bland	LGOV
Tattersall's Hotel	83-87 Main Street	West Wyalong	Bland	LGOV
Thom's Corner	143-147 Main Street	West Wyalong	Bland	LGOV
Top Town Tavern	74-76 Neeld Street	West Wyalong	Bland	LGOV
West Wyalong Court House and Residence	Court Street	West Wyalong	Bland	SGOV
West Wyalong Fire Station	Court Street	West Wyalong	Bland	SGOV
West Wyalong Police Station	34 Church Street	West Wyalong	Bland	SGOV
West Wyalong Showground Pavilions: Fine Arts, Sheep, Cattle, Poultry	By Pass Road	West Wyalong	Bland	LGOV
White Tank Hotel	203 Main Street	West Wyalong	Bland	LGOV

There was a total of 27 records matching your search criteria.

Key:

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GAZ= NSW Government Gazette (statutory listings prior to 1997), HGA = Heritage Grant Application, HS = Heritage Study, LGOV = Local Government, SGOV = State Government Agency.

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Home Contaminated land Record of notices

Search results

Your search for:LGA: WEDDIN SHIRE COUNCIL

Matched 1 notice relating to 1 site.

Search Again

Refine Search

Suburb	Address	Site Name	Notices related to this site
GRENFELL	Corner Gooloogong Road & Bourke STREET	Grenfell Gasworks	1 former

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Home Contaminated land Record of notices

Search results

Your search for:Suburb: FORBES

Matched 2 notices relating to 1 site.

Search Again
Refine Search

Suburb	Address	Site Name	Notices related to this site
FORBES	24-26 Union STREET	Former Gasworks	2 former

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25 September 2020

Site and notice details

Your search for: Suburb: FORBES 2 notices on 1 site were matched.
Return to list of search results

Search Again Refine Search

Area No: 3096

The information below was correct at the time the notices were issued.

Site: Former Gasworks
Address: 24-26 Union STREET, FORBES
LGA: FORBES

Owner: Forbes Shire Council
Lot 1-9 SP 37775

Notices relating to this site (0 current and 2 former)

(Map) where available, maps show the part of the site affected by the notice
*notice matched search criteria

Notice recipient	Notice type & number	Status	Date
Forbes Shire Council	EHC Act Revocation Notice * 564	Former	Issued 02 Feb 2010
Forbes Council	Section 36 EHC Act Order * 444	Former	Issued 28 Apr 1997 Revoked 02 Feb 2010

25 September 2020

Home Contaminated land Record of notices

Search results

Your search for:LGA: FORBES SHIRE COUNCIL

Matched 14 notices relating to 2 sites.

Search Again

Refine Search

Suburb	Address	Site Name	Notices related to this site
CAMELLIA	39 Grand AVENUE	Former Asciano Properties	8 current and 4 former
FORBES	24-26 Union STREET	Former Gasworks	2 former

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25 September 2020

Home Contaminated land Record of notices

Site and notice details

Your search for: LGA: FORBES SHIRE COUNCIL 14 notices on 2 sites were matched.
Return to list of search results Search Again Refine Search

Area No: 3020

The information below was correct at the time the notices were issued.

Site: Former Asciano Properties
Address: 39 Grand AVENUE, CAMELLIA
LGA: CITY OF PARRAMATTA

Owner: Camellia Linx Pty Ltd (Camellia Lynx)
Lot 2 DP 539890 Lot 2 DP 615549

Notices relating to this site (8 current and 4 former)

(Map) where available, maps show the part of the site affected by the notice
*notice matched search criteria

Notice recipient	Notice type & number	Status	Date
Camellia Linx Pty Ltd	Approved Voluntary Management Proposal 20171708	Current	Issued 17 Jan 2018
Asciano Properties Operations Pty Ltd	Amendment or Repeal of Order or Notice 20154428	Current	Issued 21 Aug 2015
Asciano Properties Operations Pty Ltd	Amendment or Repeal of Order or Notice 20144419	Current	Issued 05 May 2014
Asciano Properties Operations Pty Ltd	Amendment or Repeal of Order or Notice 20134440	Current	Issued 13 Dec 2013
Asciano Properties Operations Pty Ltd	Amendment or Repeal of Order or Notice 20134401	Current	Issued 19 Feb 2013
Asciano Properties Operations Pty Ltd	Approved Voluntary Management Proposal 20121719	Current	Issued 13 Sep 2012 Amended 21 Aug 2015
Not Applicable	Declaration of Remediation Site 21116 Map	Current	Issued 08 May 2009
Not Applicable	Declaration of Investigation Area 15033	Current	Issued 14 Dec 2005
Asciano Properties Operations Pty Ltd	Amendment or Repeal of Order or Notice 20124421	Former	Issued 13 Sep 2012
Asciano Properties Operations Pty Ltd	Approved Voluntary Management Proposal 20091707	Former	Issued 19 Dec 2009 Completed 13 Sep 2012
Asciano Limited	Site Audit Statements 0503-1402-R	Issued	Issued 22 Jul 2014
Fogerty Holdings Pty Ltd	Section 35 EHC Act Order 143	Not in force	Issued 20 Sep 1989 Invalid 10 May 2006

25 September 2020

Home Contaminated land Record of notices

Search results

Your search for:LGA: WEDDIN SHIRE COUNCIL

Matched 1 notice relating to 1 site.

Search Again

Refine Search

Suburb	Address	Site Name	Notices related to this site
GRENFELL	Corner Gooloogong Road & Bourke STREET	Grenfell Gasworks	1 former

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25 September 2020

Search results

Your search for:Suburb: WEST WYALONG

Search Again
Refine Search

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... more search tips

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register.POEO public register

25 September 2020

Search results

Your search for:Suburb: WYALONG

Search Again
Refine Search

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See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register.POEO public register

25 September 2020

Australian Government
Bureau of Meteorology

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Site information

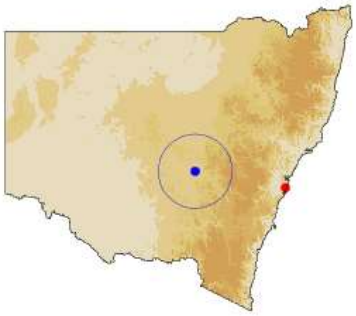
Site name: FORBES AIRPORT AWS
Site number: 065103
Latitude: 33.36 °S **Longitude:** 147.92 °E
Elevation: 230 m
Commenced: 1995 **Status:** Open
Latest available data: 24 Sep 2020

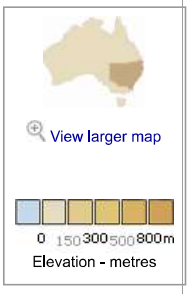
Additional information

Additional site information

Nearest alternative sites

1. 065016 FORBES (CAMP STREET) (8.6km)
2. 065026 PARKES (MACARTHUR STREET) (33.2km)
3. 065068 PARKES AIRPORT AWS (39.5km)





View: Main statistics / All available | Period: 30 year period not available | Text size: Normal / Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	34.6	32.8	29.4	24.7	19.4	15.5	14.7	16.5	20.6	25.1	29.1	31.9	24.5	25	1995 2020
Mean minimum temperature (°C)	18.4	17.6	14.4	9.6	5.5	3.7	2.5	2.6	5.2	8.7	12.7	15.4	9.7	25	1995 2020
Rainfall															
Mean rainfall (mm)	28.9	49.4	50.2	28.7	32.4	49.8	38.6	33.5	39.1	39.1	45.5	52.3	479.9	23	1995 2020
Decile 5 (median) rainfall (mm)	25.2	44.4	38.6	18.2	29.0	49.4	41.8	25.0	30.7	31.4	36.0	34.4	443.0	25	1995 2020
Mean number of days of rain ≥ 1 mm	4.0	4.4	4.2	3.1	4.0	6.0	5.5	5.2	5.2	4.5	4.8	4.8	55.7	24	1995 2020
Other daily elements															
Mean daily sunshine (hours)															
Mean number of clear days															
Mean number of cloudy days															
9 am conditions															
Mean 9am temperature (°C)	24.5	23.0	19.6	16.9	11.8	8.4	7.3	9.3	13.8	17.7	20.5	22.9	16.3	15	1995 2010
Mean 9am relative humidity (%)	47	55	59	61	76	90	91	81	70	55	50	45	65	15	1995 2010
Mean 9am wind speed (km/h)	18.7	16.5	13.8	12.4	10.4	10.9	10.6	13.2	15.1	16.7	17.4	18.1	14.5	15	1995 2010
3 pm conditions															
Mean 3pm temperature (°C)	32.3	30.9	27.9	23.5	18.7	14.7	13.7	15.4	19.4	23.2	27.3	29.9	23.1	15	1995 2010
Mean 3pm relative humidity (%)	25	31	31	36	46	61	60	51	45	36	29	24	40	15	1995 2010
Mean 3pm wind speed (km/h)	18.4	17.4	16.8	15.7	15.2	16.2	16.2	18.0	19.1	19.6	19.8	20.0	17.7	15	1995 2010

red = highest value blue = lowest value

Product IDCJCM0028 Prepared at Thu 24 Sep 2020 01:29:00 AM EST

Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

Related Links

- This page URL: http://www.bom.gov.au/climate/averages/tables/cw_065103.shtml
- About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
- Bureau of Meteorology website: http://www.bom.gov.au

Page created: Thu 24 Sep 2020 01:29:00 AM EST

This page was created at **on**

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

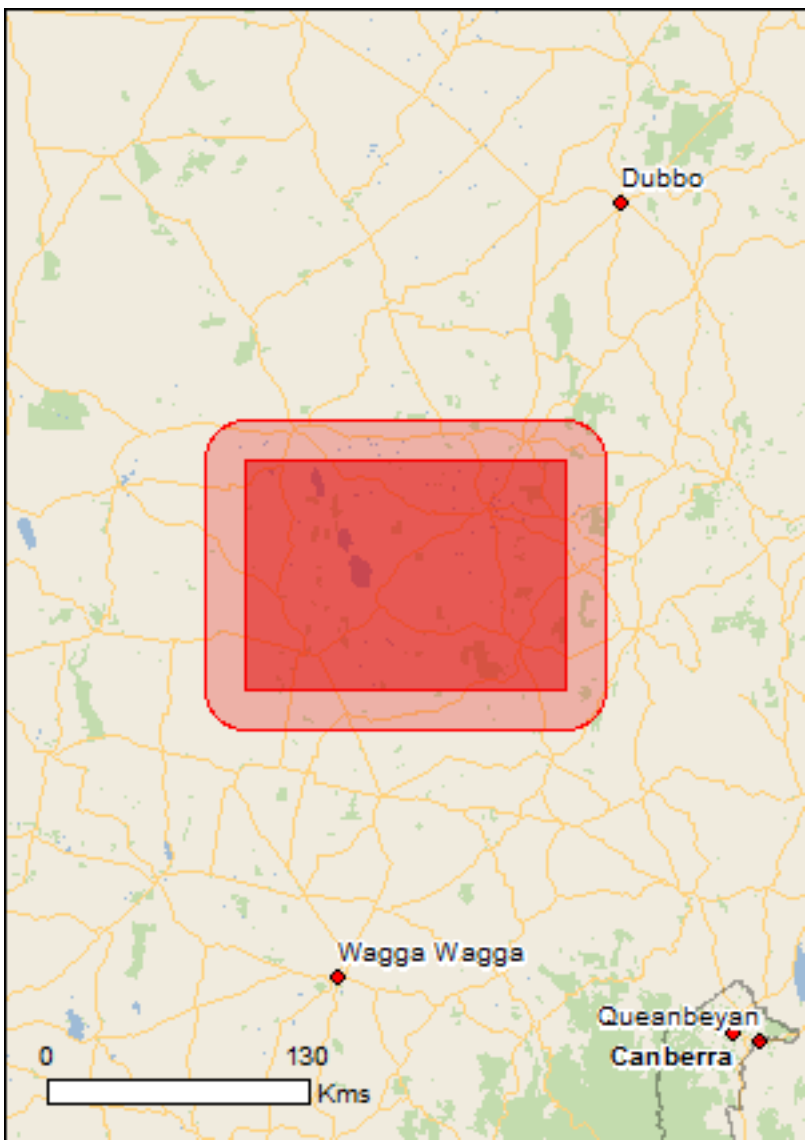
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

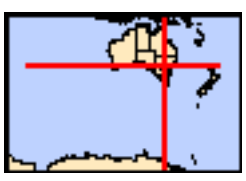
Report created: 13/08/20 14:31:03

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	40
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	12
Commonwealth Heritage Places:	1
Listed Marine Species:	22
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	11
Regional Forest Agreements:	None
Invasive Species:	36
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	500 - 600km upstream
Hattah-kulkyne lakes	300 - 400km upstream
Riverland	500 - 600km upstream
The coorong, and lakes alexandrina and albert wetland	600 - 700km upstream

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Falco hypoleucos		
Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor		
Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Limosa lapponica baueri		
Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri		
Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pedionomus torquatus		
Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Extinct within area
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Breeding known to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Fish		
Galaxias rostratus		
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Macquaria australasica		
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Insects		
Synemon plana		
Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may

Name	Status	Type of Presence
		occur within area
Plants		
Ammobium craspedioides Yass Daisy [20758]	Vulnerable	Species or species habitat may occur within area
Androcalva procumbens [87153]	Vulnerable	Species or species habitat may occur within area
Austrostipa metatoris [66704]	Vulnerable	Species or species habitat known to occur within area
Austrostipa wakoolica [66623]	Endangered	Species or species habitat known to occur within area
Eleocharis obicis a spike rush [15320]	Vulnerable	Species or species habitat known to occur within area
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat likely to occur within area
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat likely to occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Airservices Australia
Commonwealth Land - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation
Commonwealth Land - Commonwealth Scientific & Industrial Research Organisation
Commonwealth Land - Commonwealth Trading Bank of Australia

Name
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - BOGAN GATE STORES DEPOT
Defence - PARKES TRAINING DEPOT ; PARKES ACS LAND

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Forbes Post Office	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bendick Murrell	NSW
Buddigower	NSW
Conimbla	NSW
Dananbilla	NSW
Eugowra	NSW
Goobang	NSW
Lachlan Valley	NSW
Nangar	NSW
South West Woodland	NSW
The Charcoal Tank	NSW
Weddin Mountains	NSW

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Lake Cowal/Wilbertroy Wetlands	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.21106 146.93627,-33.21106 148.359,-34.05715 148.359,-34.05715 146.93627,-33.21106 146.93627

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
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-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B Community and stakeholder engagement plan

Newell Highway West Wyalong to Forbes Flood Immunity – Preliminary Environmental Investigation

Community and stakeholder engagement plan

April 2021 | Version: 0.2

Objective references

Objective ID		**Objective File ID**	
Objective Document location			

Version history

Version	Author	Date	Details
0.1	Olivia Fusca	28/08/2020	Draft
0.2	Samantha Bourke	12/04/2021	Addressing client comments

Distribution and approval

For Approval			
Title	**Name**	**Signature**	**Date**

For Information			
Title	**Name**	**Signature**	**Date**

Confidentiality

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Author:	Olivia Fusca – Communications and Stakeholder Engagement Consultantf
Date:	April 2021
Version:	0.2
Reference:	Reference
Division:	Division
Review date:	April 2021

Glossary / Definitions

Term / Acronym	Description
ARI	Average recurrence interval
Flood immunity	Flood immunity is defined as one lane - each way (both northbound and southbound lanes) dry and trafficable for all vehicles.
Flood passable	Flood passable is defined as one way – one lane (~3m wide) over the crown of the road trafficable for all vehicles under traffic management
IAP2	International Association of Public Participation Spectrum
Mail blasts	Email blasts are single email message that is sent to an entire email list, a large segment of an email list, or many email lists all at once to target all contacts in mailing lists.
PEI	Preliminary Environmental Investigation
TfNSW	Transport for NSW
KPIs	Key Performance Indicators
WW2F	West Wyalong to Forbes project

1. Introduction and context

1.1 Purpose

This community and stakeholder engagement plan has been developed for the Preliminary Environmental Investigation (PEI) stage of the Newell Highway West Wyalong to Forbes Flood Immunity (WW2F) project.

It aims to describe the communication and consultation approach and activities for the PEI stage of the WW2F and keep key stakeholders and the community informed during the project.

1.2 Project background

The Newell Highway is a major interstate freight corridor, with its total length covering 1,059 kilometres from Victoria to Queensland and serves as a link to regional centres in Western NSW.

The Newell Highway is prone to flooding and has a history of road closures during periods of heavy rain in the Lachlan Catchment. This section of the Newell Highway between Forbes and West Wyalong is particularly susceptible to flooding by the Bland Creek causeway system at Marsden.

Heavy rainfall in September 2016 flooded about 20 kilometres of the Newell Highway between Forbes and West Wyalong over 17 separate locations, resulting in a 43-day road closure. Flooded sections were located in clusters around Marsden, the Caragatel Flood Channel, and Forbes.

Detours during flooding events have been further hampered by the flooding and subsequent closure of key alternate routes, adding substantial distances to travel within the region. Up to 400 heavy vehicles per day were diverted to either the official diversion route (250 kilometres - Parkes-Eugowra Road) or via Sydney or Broken Hill.

In March 2019 the Coalition Government announced it would spend $200 million flood proofing the Newell Highway between Forbes and West Wyalong. This project aims to deliver on that promise as well as prioritising further flood immunity initiatives for the Newell Highway.

The PEI is written on behalf of Transport for NSW to inform a flood immunity solution for the Newell Highway between Compton Road, West Wyalong and Hereford Street, Forbes.

1.3 Project area profile

- The Newell Highway is a national highway that forms a primary freight and passenger transport link between Victoria and Queensland, and between regional centres in western NSW. It provides access between key regional primary industries and export markets and supports regional tourism, with caravans being a major road user
- The project is located in the Forbes Shire, Weddin Shire and Bland Shire Councils and within the Orange and Cootamundra State Electorates
- West Wyalong, to the south of the project area, has a population of around 2,600 and is next to the town of Wyalong, which is also within the project area
- Forbes, to the north of the project area, has a population of 8,400. Both towns have origins in the gold rush era.

Refer to **Appendix A** for project location map.

1.4 Project objectives

The primary objective of the proposal is to provide increased flood immunity along the highway between West Wyalong and Forbes by:

- Achieving a minimum flood passable level of service for an equivalent 2016 flood event
- Achieving a minimum flood immunity of 1 in 20 year annual recurrence intervals
- Assessing options for flood immunity and flood passable for up to a one in 50 year flood event.

1.5 Project milestones

Table 1 Project milestones

Milestone	Date
Inception meeting/handover	September 2019
Signed brief handover	November 2019
Project inception meeting	February 2020
Submission of Strategic Business Case	September 2021
Submission of final business case	December 2022
Review of Environmental Factors Display	March 2023
Detailed design completion	December 2023
Request for construction tender	October 2024
Construction tender awarded	November 2024
Start of work	June 2025
End of work	December 2027

2. Communication and engagement objectives

Throughout the project lifecycle, the aim of community engagement will be to foster an open, two-way communicative relationship between TfNSW and its stakeholders.

The key objectives of the project will be to:

- Keep the local community and other key stakeholders regularly informed of project progress
- Provide the community and stakeholders with regular and targeted information to build awareness about the WW2F project
- Provide clear information about what we are seeking feedback on, when and why
- Ensure community and stakeholder feedback is continuously fed into communication and engagement
- Be transparent in all that we do
- Encourage participation from communities and other stakeholders
- Listen to feedback, investigate suggestions and report back
- Engage in a manner that is collaborative, innovative, adaptive and sustainable
- Increase stakeholder understanding of the WW2F and its objectives
- Ensure that project information is distributed in an effective and timely manner
- Respond to stakeholder and community enquiries and complaints in a timely, respectful way.

1.1 Stakeholder analysis

Stakeholders, including the local community, have been identified as those who may have an interest or influence in the WW2F project. Potential issues relating to these stakeholders have also been identified.

A detailed stakeholder list is available at **Appendix B**.

1.2 Key messages

The project is at the PEI stage therefore the key messages for the project are limited. However, these key messages will be updated as the project progresses.

Key messages for the project include:

- Transport for NSW is carrying out investigation work on Newell Highway between West Wyalong and Forbes to help inform future work in the area
- We will be in touch with you to discuss this work as it progresses.

1.3 Communication approach

Our communication approach for the Newell Highway WW2F project will focus on communication and engagement during the PEI phase of the project.

TfNSW will engage with the community and stakeholders at the ‘inform’ and ‘Consult’ level of the International Association of Public Participation Spectrum (IAP2). A range of consultation and communication tools will be used to inform and receive input from stakeholders and the community throughout the project, which may change as the project progresses.

1.4 Communication and engagement tools and techniques

The following communication and engagement tools and techniques will be used during the PEI stage of the project. These tools and techniques include:

- Media release and postcard announcing the project
- Project notifications and project updates for nearby residents, businesses and stakeholders
- Door-knocking nearby residents and businesses
- Meetings and briefings for stakeholders, businesses and residents (as required)
- Site inductions, training and tool box sessions
- Letters, emails and target correspondence
- Project updates on the TfNSW website
- Social media
- Email blasts
- Consultation Manager database.

These tools are explored further under communication activities (refer **Section 1.6**).

1.5 Communication protocols

All stakeholder contact relating to the project, including complaints, will be collected, documented and stored in the Consultation Manager database. This includes incoming and outgoing correspondence, submissions and any corresponding actions taken. Internal TfNSW stakeholders and stakeholders other than the community will be first directed to the Project Manager then to the Senior Project Development Manager in their absence.

We will set up and manage the project specific phone number and email, as well as a Consultation Manager database to record community/stakeholder contact.

Complaints Management

A complaints management system will be established for the project – typically Consultation Manager. This will include:

- Date and time of complaint
- Method of communication
- Full name, address and contact details of complainant
- Nature of the complaint and issues raised
- Names of people involved throughout
- Action taken and details of the resolution, including response times.

We will respond to verbal community and stakeholder enquiries within 24 hours and written enquiries within five days. We will update the database within 24 hours of contact and produce monthly reports.

Media and Government

Only TfNSW can address the media and provide statements. If any other party is contacted by the media regarding the project, they must refer all enquiries to the TfNSW media unit or offer to pass their contact details onto the TfNSW media unit.

1.6 Evaluation

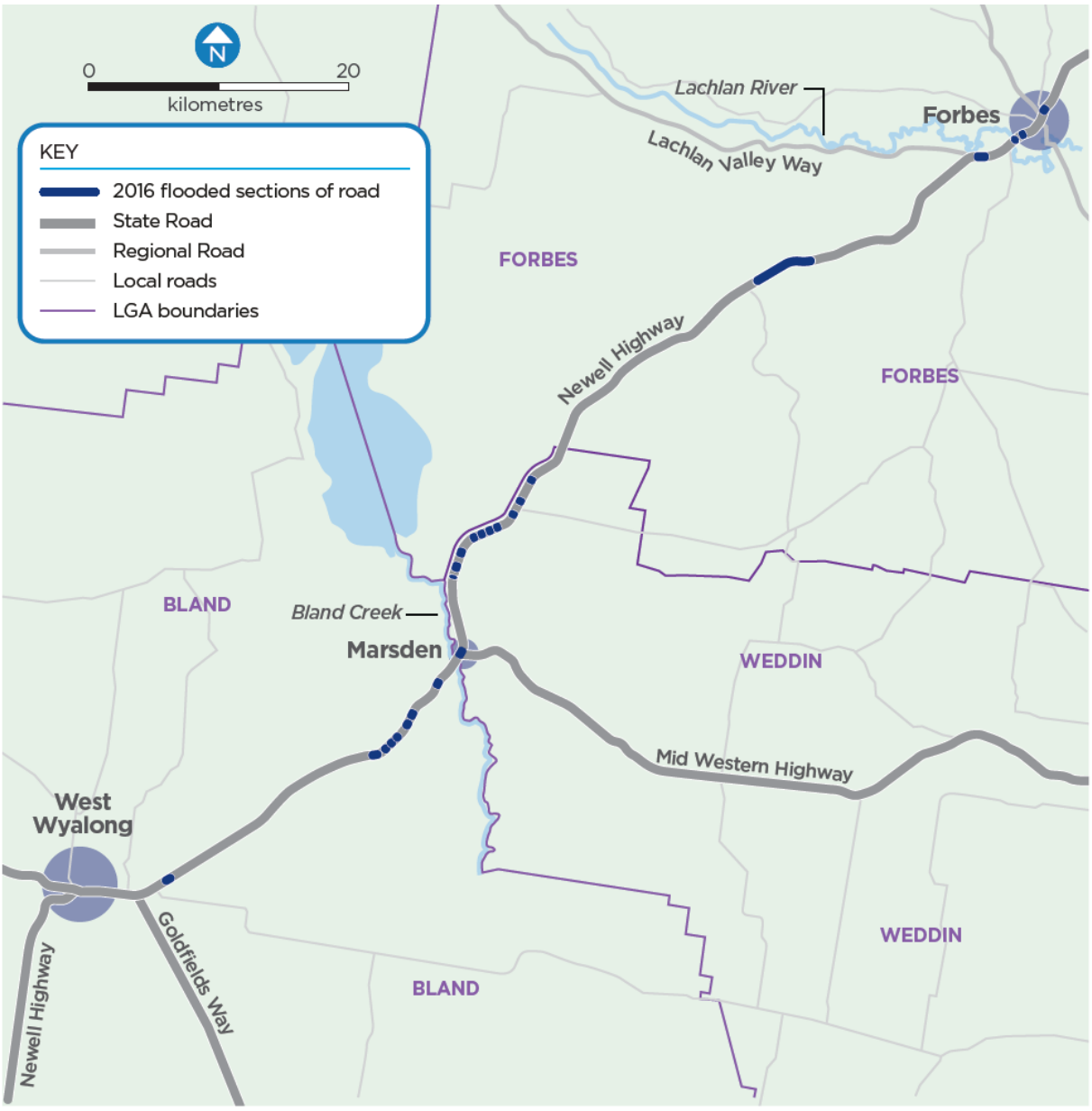
Monitoring and evaluation will include:

- Regular review of complaints and enquiries received to identify emerging trends and unresolved issues
- Review of initial response time to complaints and timing of response letter to assess compliance
- Regular review of all communication materials
- Reviewing timing of notifications
- Monitoring of the media (traditional and social)

Refer to the engagement toolkit for more information on evaluation methods and mechanisms including Key Performance Indicators (KPIs).

Appendix A – Project Area

Map of 2016 flooded sections of road between Forbes and West Wyalong.



Appendix B – Stakeholder List

Stakeholder group	Stakeholder	Interest
Federal Government	The Hon. Michael McCormack – Member for Riverina	Potential funding
State Government	Mr Phillip Donato – Member for Orange	Impacts to constituents
	Ms Steph Cook – Member for Cootamundra	Project benefits
		Project funding
Local Government	Forbes Shire Council	Impacts to constituents
	Bland Shire Council	Impacts to Council assets
	Weddin Shire Council	Community concerns
Government agencies	NSW Department of Primary Industries	Impacts to freight movement
	NSW Department of Planning, Industry and Environment	Environmental assessment
	NSW Environment Protection Agency	Land use implications
	Department of Regional NSW	Impact on surrounding towns, motorists and freight
Emergency services	NSW Ambulance	Safety considerations during planning, design and delivery, particularly during bushfire and flooding seasons
	NSW Police Force	Access during construction
	NSW Fire & Rescue	
	NSW Rural Fire Services	
	State Emergency Services	
Utilities	Ausgrid	Ongoing energy reliability
	Water NSW	Effects on services (if any) during construction
	Residents/landowners living on Newell Highway	Potential property adjustments/acquisitions

Stakeholder group	Stakeholder	Interest
Local community		Safety considerations during design phase Construction impacts – noise, access, fatigue
	Local businesses between West Wyalong and Forbes along the highway	Potential property adjustments/acquisitions Safety considerations during design phase Construction impacts – noise, access, fatigue Impacts to trade during/after construction
Interest groups	Local Aboriginal Land Councils – West Wyalong (Wiradjuri people)	Preservation of Aboriginal artefacts and land Adequate consultation and involvement in the project
	Central West Lachlan Landcare	Preservation of surrounding flora and fauna Consideration of design options
	Road Freight NSW	Consideration of design options – increased safety via additional lighting, overtaking lanes or extra-wide lanes Construction impacts – traffic control and flow, effects on delivery times Construction fatigue
	Riverina Local Land Services	Impacts on local communities Land use implications
	Bland Shire Community Reference Group	Involvement in consultation stages Consideration of design options
Wider community	Residents and businesses in surrounding communities of West Wyalong, Wyalong and Forbes Local tourist and caravan parks	Construction fatigue Impacts to flora and fauna Consideration of design options Impacts to tourism/trade during construction
	Local motorists	Impacts/upgrades to rest stops within project area

Stakeholder group	Stakeholder	Interest
Road users	Tourists/caravan users Freight drivers & freight industry	Consideration of design options – Possibility of additional safety measures beyond the scope of flood immunity, for example adding an overtaking lane or additional lighting
	National Heavy Vehicle Regulator	Consideration of design options Impacts to heavy vehicle industry during construction
Local media	West Wyalong Advocate Forbes Advocate Forbes Community Radio West Wyalong Community Radio Regional television – 7Prime, WIN Channel	General community sentiment – backlash or support Project benefits

Appendix C Preliminary flooding report

West Wyalong to Forbes Flood Immunity

Preliminary flooding report

Rev 1

29 June 2021

Transport for NSW

Client Reference

West Wyalong to Forbes Flood Immunity

Project No:	IS340100
Document Title:	Preliminary flooding report
Document No.:	Rev 1
Revision:	
Document Status:	
Date:	25/06/2021
Client Name:	Transport for NSW
Client No:	Client Reference
Project Manager:	Tina-Maria Donovan
Author:	Jorja Vernon and Akhter Hossain
File Name:	IS340100 WW2F_Flooding report REV1v2 20210630

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Document history and status

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Rev 1	25/06/2021	Addressing client comments	Jorja Vernon	T.Donovan	Akhter Hossain	T.Donovan

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Appendix A. Long section profiles along the Newell Highway

Executive Summary

The Newell Highway (the highway) between West Wyalong and Forbes was impacted by flooding several times over the last seventy years due to flooding in Bland Creek, Ooma Creek/ Caragatel Lagoon, the Lachlan River and Lake Forbes. The highway was impassable during flood events of 2016, 2012, 1993, 1990, 1974 and 1952. During the flood event of September 2016, the highway was closed for 43 days due to flooding in the Lachlan River and Bland Creek. In total, about 20 kilometres (km) of the highway was impacted by flooding in September 2016.

Transport for NSW (Transport) has started planning for potential flood proofing and immunity solutions for the highway). This proposal is focussed on addressing areas on the highway and seeks to develop an appropriate flood immunity solution for the West Wyalong to Forbes section of the highway.

Flood prone areas of the highway were identified by reviewing historical data of the submerged sections of the highway in a high-volume rainfall event in September 2016 between West Wyalong to Forbes, including but not limited to the areas of West Wyalong, Marsden, Caragatel Flood Channel and Forbes. In addition, the available information (e.g. flood study reports, flood modelling data, aerial photographs, imagery, topographic data, rainfall data, stream gauge data etc) on flood behaviour along the highway has been reviewed in an attempt to define the existing flood immunity for the highway.

On the basis of the available data, existing flood immunity has been defined for the Marsden and Forbes segments of the highway. The Marsden segment of the highway at is flooded at two locations in the 50 per cent (%) annual exceedance probability event (AEP). The Forbes segment of the highway is immune to flooding from flooding in the Lachlan River and Lake Forbes in the 10% AEP event.

There are gaps in the available information and inconsistency between observed and modelled flood behaviour along the highway. It is necessary to undertake a detailed flooding assessment to identify feasible options to improve flood immunity for the highway. In addition, improvement of flood immunity for the highway has the potential to have adverse impacts on flood levels, duration of flooding, flood velocity, scour and erosion, and flood hazard. Hence it is recommended that a detailed flooding assessment should be undertaken during development of concept design for the proposal.

Limitations

The sole purpose of this report and the associated services performed by Jacobs was to provide a flooding assessment in accordance with the scope of services set out in the contract between Jacobs and Transport for NSW (the Client). That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from public domain and the Client (if any). The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the proposal and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs' Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 The proposal

Transport for NSW (Transport) has started planning for potential flood proofing and immunity solutions for the Newell Highway (the highway) between Compton Road, West Wyalong to Hereford Street, Forbes (the proposal).

The proposal forms part of the Newell Highway Corridor Strategy (Transport, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the highway. The proposal would be funded under the Newell Highway Package of Works.

This proposal is focussed on addressing areas on the highway and seeks to develop an appropriate flood immunity solution for the West Wyalong to Forbes section of the highway. Flood prone areas of the highway were identified by reviewing historical data of the submerged sections of the highway in a high-volume rainfall event over a six week period in 2016 between West Wyalong to Forbes, including but not limited to the areas of Marsden, Caragatel Flood Channel, Forbes and West Wyalong.

Key features of the proposal include:

- Increasing the height of the highway to meet the flood immunity objectives
- Pavement, bridge and drainage improvements to allow water to pass freely under the highway
- Tie ins at the northern and southern extents
- Ancillary works including safety barriers, signage, line marking, landscaping and environmental protection works as required
- Temporary ancillary facilities including site compounds and stockpile sites.

The proposal is expected to be delivered in segments with a combined length of about 105 kilometres (km). The following four segments have been used in the PEI for reporting purposes as described in **Table 1-1** and shown on **Figure 1-1**.

Table 1-1 Segments for the PEI

Segment number	Locality	Location coordinates north of West Wyalong to Forbes
1	West Wyalong	The segment starts at Compton Road intersection of the West Wyalong Bypass and extends 1,900 metres (m) to the start of segment 2.
2	Marsden	Segment starts about 2 km north of Boxalls State Forest on the highway and ends about 1 km north of the West Plains Road on the highway.
3	Caragatel Flood Channel	Segment starts about 1 km north of the West Plains Road on the highway and ends at the Lachlan Valley Way intersection in Forbes.
4	Forbes	The segment starts from the Lachlan Valley Way intersection in Forbes and ends on the highway intersecting Hereford Street in Forbes.

1.1.1 Definitions

The following terms are used in the Flooding report:

- The 'proposal' and 'the highway' refers to the proposed flood immunity solutions to the Newell Highway between West Wyalong and Forbes as shown on **Figure 1-1.**

- The 'study area' includes all the segments to be upgraded as part of the proposal and applies a 100 m buffer from the centre of the highway
- 'The locality' encompasses the area in a 10 km radius of the study area
- 'Flood immunity' is defined as one lane - each way (both north and south bound lanes) dry and trafficable for all vehicles
- 'Flood passable' is defined as one way – one lane trafficable for all vehicles under traffic management
- 'Flood proof' is the term flood proof is defined as no closure required during a defined flood event.

1.2 Location of the proposal

The proposal is located in the Central West of NSW, and traverses the Bland, Weddin and Forbes Local Government Areas (LGA). The locality of the proposal is shown on **Figure 1-1**.

1.3 Purpose of the report

This PEI has been prepared by Jacobs on behalf of Transport. The purpose of the flooding report is to:

- Identify potential environmental, social and planning issues and opportunities for the proposal
- Provide recommendations to inform future stages of proposal development
- Integrate environmental, economic, and social outcomes into decision making
- Assist in applying the principles of Ecologically Sustainable Development (ESD).

The information and recommendations in this flood study will be used to inform the options investigations and ongoing design process that addresses the need and objectives of the proposal, with an aim to avoid or minimise environmental and social impacts wherever possible.

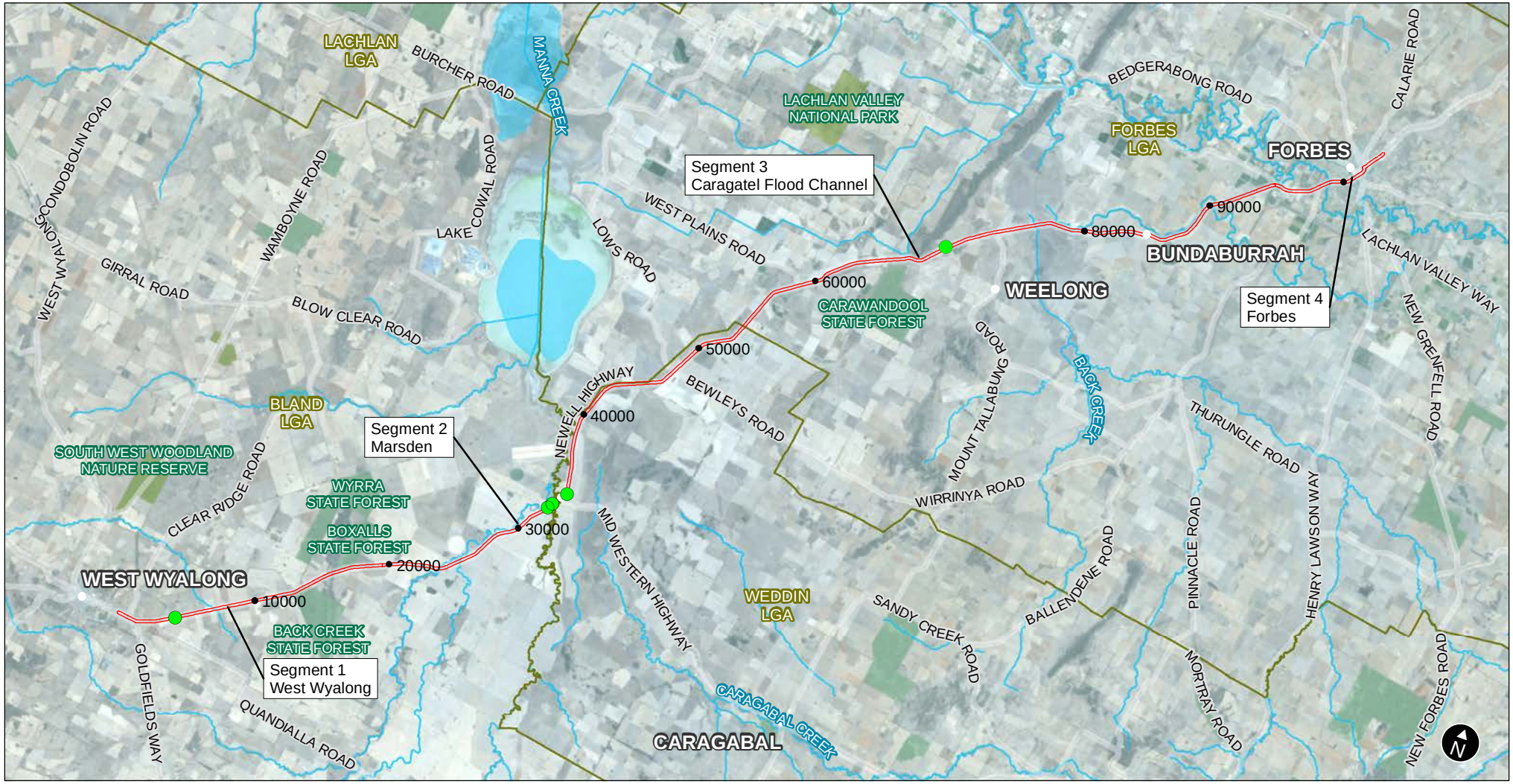
Once a preferred option has been identified and a concept design developed, a detailed environmental impact assessment would be prepared and would detail environmental safeguards and management measures that would be implemented.

1.4 Report structure

Section	Description
Section 1	Introduction
Section 2	Outlines legislative and policy context relevant to surface water and groundwater
Section 3	Presents the methodology for the assessment
Section 4	Presents an overview of the catchment
Section 5	Presents a review of available information
Section 6	Provides the flooding assessment results and potential constraints
Section 7	Conclusion

1.5 Purpose of this report

The purpose of this report is to provide hydrology and input into Newell Highway - West Wyalong to Forbes Flood Immunity Project Preliminary Environmental Investigation (PEI). Since specific upgrade projects in the study area are yet to be defined in detail, the desktop assessment outlined in this report aims to provide a general overview of the existing hydrology and flooding constraints in the study area.

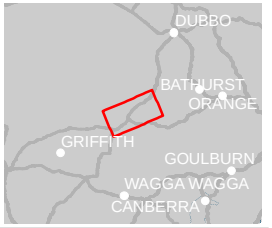


Legend

- Study area
- Local Government Area
- State Forest
- National Park
- Waterway
- Rest area

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2020
NSW Spatial Services 2020
GDA94 MGA55

Figure 1-1 Location of the proposal

2. Legislation and policy framework

2.1 NSW State legislation

2.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for proposal assessment and approval in NSW. One of its key aims is to encourage the 'proper management, development and conservation' of natural and artificial resources, as well as facilitating 'ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the Environmental Planning and Assessment Regulation 2000. The EP&A Act and the Regulation include provisions to ensure that the potential environmental impacts of a development are considered in the decision-making process prior to proceeding to construction.

Part 4 of the EP&A Act provides for the control of development that requires development consent from a consent authority. Depending on the circumstances of the proposal, the consent authority may be the local Council or the Minister for Planning. Schedule 3 of the EP&A Regulation outlines development types which are declared to be designated development. Most areas of the proposal are not identified in Schedule 3 as designated development.

2.1.2 Water Management Act 2000 and Water Act 1912

The *Water Management Act 2000* (WM Act) and the *Water Act 1912* are the two key pieces of legislation for the management of water in NSW and contain provisions for the licensing of water access and use.

The WM Act and the *Water Act 1912* are administered by the NSW Department of Planning, Industry and Environment (Water) (DPIE (Water)), with Water NSW as the regulator and DPIE (Water) as the policy maker. The *Water Act 1912* is being progressively phased out and replaced by the WM Act.

In general, the WM Act governs the issue of water access licences (WALs) and approvals for those water sources (rivers, lakes, estuaries and groundwater) in NSW where Water Sharing Plans (WSPs) have commenced. The WSPs for the proposal have commenced and water management for the proposal is therefore generally governed under the WM Act.

It is noted that Transport, as a roads authority, under Schedule 4 1(2) of the Water Management Regulation 2018 (WM Reg), are exempt from the requirement to hold a WAL in relation to take of groundwater or surface water associated with road construction and road maintenance.

2.1.3 Biodiversity Conservation Act 2016

The purpose of the *Biodiversity Conservation Act 2016* (BC Act) is to maintain a healthy, productive and resilient environment for the greatest wellbeing of the community, now and into the future, consistent with the principles of ecologically sustainable development (described in the *Protection of the Environment Administration Act 1991* (NSW) and Section 516A of the EPBC Act).

Schedule 4 of the BC Act lists key threatening processes and includes reference to the potential alteration of existing flow regimes which are applicable to this assessment:

2.2 Relevant guidelines and policies

2.2.1 NSW Floodplain Development Manual and Flood Prone Land Policy

The NSW Flood Prone Land Policy is produced within Section 1.1 of the *Floodplain Development Manual* (NSW Government, 2005). The manual highlights the requirements consistent with the *Water Act 1912* to manage the risks resulting from natural hazards. Its purpose is to reduce the impact of flooding on individual owners and occupiers of flood-prone property and to reduce private and public losses resulting from floods. The manual "*promotes the use of a merit approach which balances social, economic, environmental and flood risk parameters to determine whether particular development or use of the floodplain is appropriate and sustainable*". This policy also recognises the benefits of the use, occupation and development of flood prone land.

The proposal recognises existing users of the floodplain and the existing flooding risks that apply to these users. Consideration has been made in the design development of the proposal to minimise impacts as a result of the proposal and hence not increase private and public losses resulting from floods. In doing so, the proposal is being carried out in compliance with the provisions in the Floodplain Development Manual and the NSW Flood Prone Land Policy.

2.2.2 Flood Planning Guideline

On 31 January 2007 the NSW Planning Minister announced a guideline for development control on floodplains (the "Flood Planning Guideline"). An overview of the Flood Planning Guideline and associated changes to the EP&A Act and Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) was issued by the then Department of Planning in a Planning Circular dated 31 January 2007 (Reference PS 07-003). The Flood Planning Guideline issued by the Minister in effect relates to a package of directions and changes to the EPA Act, EP&A Regulation and *Floodplain Development Manual* (DIPNR, 2005).

This Flood Planning Guideline confirms that unless there are "exceptional circumstances", councils are to adopt the 100 year flood (i.e. 1% AEP flood) as the flood planning level for residential development, with the exception of some sensitive forms of residential development such as seniors living housing. The Flood Planning Guideline does provide that controls on residential development above the 100 year flood may be imposed subject to an "exceptional circumstance" justification being agreed to by the Department of Natural Resources and the Department of Planning (both now incorporated into the Department of Planning, Industry and Environment (DPIE)) prior to the exhibition of a draft local environmental plan or draft development control plan.

DPIE are currently proposing to provide an updated Flood Prone Land Package to provide land use planning advice to councils, however this has not yet been implemented at the time of finalising this report.

2.2.3 NSW Climate Change Policy Framework

The *NSW Climate Change Policy Framework* (OEH, 2016) summarises how the NSW Government intends to support the reduction of emissions to reduce the effects of climate change, and measures to adapt to the risks associated with climate change.

One of the policy directions is to reduce risks and damage to public and private assets in NSW arising from climate change. This needs to be considered in the design and assessment of the proposal by considering projections for future climate when carrying out the flooding assessment for the proposal.

2.2.4 Bland Local Environmental Plan 2011

The Bland LEP sets out environmental regulations for the Bland local government area (LGA). Clause 6.7 of Part 6 of the LEP outlines the considerations to made for land at or below the flood planning level, which is defined as the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

The LEP states that: "Development consent must not be granted to develop on land which this clause applies unless the consent authority is satisfied that the development –

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding."

The flooding impact assessment must take into consideration this clause.

2.2.5 Bland Shire Development Control Plan 2012

The Bland Shire DCP provides additional details on controls for various types of development in the Bland LGA which supplement or expand on the controls within the LEP, however no additional controls for flooding are detailed in the Bland Shire DCP.

2.2.6 Weddin Local Environmental Plan 2011

The Weddin LEP sets out rules and regulations for the Weddin LGA. Clause 6.5 of Part 6 of the LEP sets out provisions for the land that is shown as 'Flood planning area' on the Weddin Flood Planning Map and other land at or below the flood planning level, whereby the flood planning level is the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

Identical to the Bland LEP, the Weddin LEP states that: "Development consent must not be granted to develop on land which this clause applies unless the consent authority is satisfied that the development –

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding."

2.2.7 Weddin Shire Council Development Control Plan 2014

Chapter 4 of the Weddin Shire Council DCP details the Flood Policy applicable to the Weddin LGA. The Flood Policy was prepared to provide specific controls to guide development of land in flood prone areas, particularly bordering the Emu Creek system at Grenfell.

2.2.8 Forbes Local Environmental Plan 2013

Forbes LEP sets out rules and regulations for the Forbes LGA. Clause 7.2 of Part 7 of the Forbes LEP outlines the flood planning provisions for the land that is shown as 'Flood planning area' on the Forbes Flood Planning Map and other land at or below the flood planning level, whereby the flood planning level is the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

Identical to the other LEPs, the Forbes LEP states that: "Development consent must not be granted to develop on land which this clause applies unless the consent authority is satisfied that the development –

(a) is compatible with the flood hazard of the land, and

(b) will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding."

2.2.9 Forbes Shire Council Development Control Plan 2013 (V2)

Chapter 4 of the Forbes DCP addresses the flooding plan which applies to the whole of the Forbes LGA. The DCP provides general provisions relating to all floodplains and specific provisions to individual floodplains. The controls which apply to the proposed development depends on the land use category of the development, as well as what floodplain and what part of the floodplain the land is located within. The proposal is located across a number of flood risk category areas including "High hazard floodway" across and on the banks of Lachlan River and "High hazard flood fringe" in the area classified as the Rural Flood Precinct which is the flood prone land outside the Forbes Township Floodplain. All other areas within the study area are classified as "Low hazard flood fringe".

Chapter 4 outlines performance criteria for development applications. The performance criteria which are relevant to this proposal are provided in **Table 2-1**.

Table 2-1 Relevant performance criteria

Control type	Performance Criteria
General controls	▪ The proposed development should not result in any increased risk to human life ▪ The proposal should only be permitted where effective warning time and reliable access is available for the evacuation of an area potentially affect by floods. Evacuation should be consistent with any relevant flood evacuation strategy where in existence ▪ Development should not detrimentally increase the potential flood affectation on other development or properties ▪ Development should not result in significant impacts upon the amenity of an area by way of unacceptable properties, privacy impacts or by being incompatible with the streetscape or character of the locality ▪ Proposed development must be consistent with ESD principles.
Fencing	▪ Fencing is to be constructed in a manner which does not affect the flow of floods so as to detrimentally increase flood affection on surrounding land

Control type	Performance Criteria
	▪ Ability to be certified by a suitable qualified engineer, that the proposed fencing is adequately constructed so as to withstand the forces of floodwaters, or collapse or open in a controlled manner to prevent the undesirable impediment of floodwaters. Prescriptive controls: ▪ Fencing within a floodway or high hazard FRP must be designed so as any panels are easily removed prior to a flood event. Solid type fencing will not generally be permitted in a floodway ▪ Council will require a DA for all fences located in high hazard floodway, high hazard storage and high hazard flood fringe FRPs unless otherwise stated by exempt and complying development provisions.
Special considerations	▪ The proposal does not have a significant detrimental impact on: - Water quality - Native bushland vegetation - Riparian vegetation - Wetland, lakes or other waterbodies - Aquatic and terrestrial ecosystems - Indigenous flora and fauna or - Fluvial geomorphology. ▪ Development pursed to mitigate the potential impact of flooding must be undertaken in a manner which minimises the impact upon the amenity and character of the locality ▪ The proposal must not constrain the orderly and efficient utilisation of waterways for multiple purposes ▪ The proposal must not adversely impact upon the recreational, ecological, aesthetic or utilitarian use of the waterway corridors, and where possible, should provide for their enhancement, in accordance with ESD principles.

The flood plan in the Forbes DCP also outlines what information is required to accompany an application. For large scale developments, particularly where an existing catchment-based flood study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required.

2.2.10 Floodplain Management Plan

The NSW Government's Flood Prone Land Policy (refer to **Section 2.2.1**) aims to provide solutions to existing flooding problems and ensure that new development within flood prone areas is compatible with the prevailing flood risk and does not create additional flooding problems in other areas. Under the policy, the rural flood risk within the state for areas west of the Great Dividing Range is managed by the NSW Government. These management provisions are set out in Part 8 of the *Water Act 1912*, under which the Lachlan River Gooloogong to Jemalong Gap Floodplain Management Plan (FMP) prepared by the Department of Environment, Climate Change and Water NSW (2011).

The FMP, including the FMP floodway network, forms the basis for determining whether flood control works on the floodplain will be granted approval under Part 8 of the Water Act. It also details the approval process and assessment criteria for proposed and existing works. The FMP floodway network is designed to convey floodwaters to environmentally important areas (EIAs) within the FMP floodplain and downstream floodplains. EIAs are areas that have important environmental and/or cultural features that rely on inundation by floodwaters to sustain essential ecological processes.

About 25 km of the highway traverses the area of the Lachlan River Gooloogong to Jemalong Gap FMP. The following criteria identified in the FMP will apply to any proposed upgrade of the highway located within the high level floodways associated with Ooma Creek (Caragatel Lagoon), Bundaburrah Creek, Lachlan River and Lake Forbes:

- *The works do not cause an increase of greater than 100 mm in flood levels for floods larger than the 15 year ARI design flood*
- *The works do not cause any significant redistribution of peak flood flows for floods larger than the 15 year ARI design flood (i.e. more than a 5% redistribution of flow)*
- *The works do not cause any significant increase in floodway velocities. Velocities should be of an order that is below the threshold of erosion for the potential land usage*
- *The works do not block, impede or divert the flooding regimes in flood dependent ecosystems within the FMP high level floodway network.*

3. Methodology

The flooding assessment has involved the following items:

- Identification of legislation and policy framework applicable to the flooding assessment. Refer to **Section 2**.
- Review of available information, including the following:
  - Available relevant reports
  - Anecdotal information on flooding from previous flood studies to identify the historic nature of flooding of the highway.
  - Topographic data
  - Rainfall data
  - Streamflow (WaterNSW)
- Defining the existing flood immunity of the highway though a review of the available information
- Identifying potential works and measures required to achieve targeted flood immunity for the highway on the basis of a desktop assessment
- Recommend further investigations to develop concept design for upgrade of the highway.

4. Catchment overview

4.1 Lachlan River catchment

On a regional scale, the study area is located in the Lachlan River catchment in NSW, which drains a total area of about 90,000 square km. The Lachlan River begins in the Great Dividing Range near Gunning and flows generally west for approximately 1,400 km to its junction with the Murrumbidgee River near Oxley (Green, et al, 2011).

More locally, the study area is located within the 'middle sub-catchment' of the Lachlan River catchment. The landscape of the Lachlan Catchment varies from east to west as it flows from the headwaters and tablelands, through the slopes of the middle catchment, to the flat, western plains. The middle catchment is characterised by an undulating landscape which has been extensively cleared but with pockets of remnant vegetation remaining (Green, et al, 2011). The Lachlan catchment and flood study extent are displayed on **Figure 4-1**.

4.2 History of flooding

Several significant flood events have occurred in the study area, including in 1950, 1952, 1956, 1973, 1974, 1975, 1990, 1993, 1996, 1998, 2010, 2012 and 2016. The August 1990 flood resulted in nearly two weeks of flooding, with flood peaks in the Lachlan River maintained for one week compared to its usual duration of around half a day. During this flood event, the highway was closed for six weeks between Marsden and Forbes. Flood water in the area was described as slow moving, however high velocity flows were reported on the highway in Dowling Street and Forbes. The flood event which occurred in September 2016 resulted in the closure of the highway for a total of 43 days Intense rainfall occurred on 23 March 2021 and a section of the highway at Specks Gap was overtopped resulting in pavement damage. The 2021 and 2016 flooding locations are shown on **Figure 4-2**.

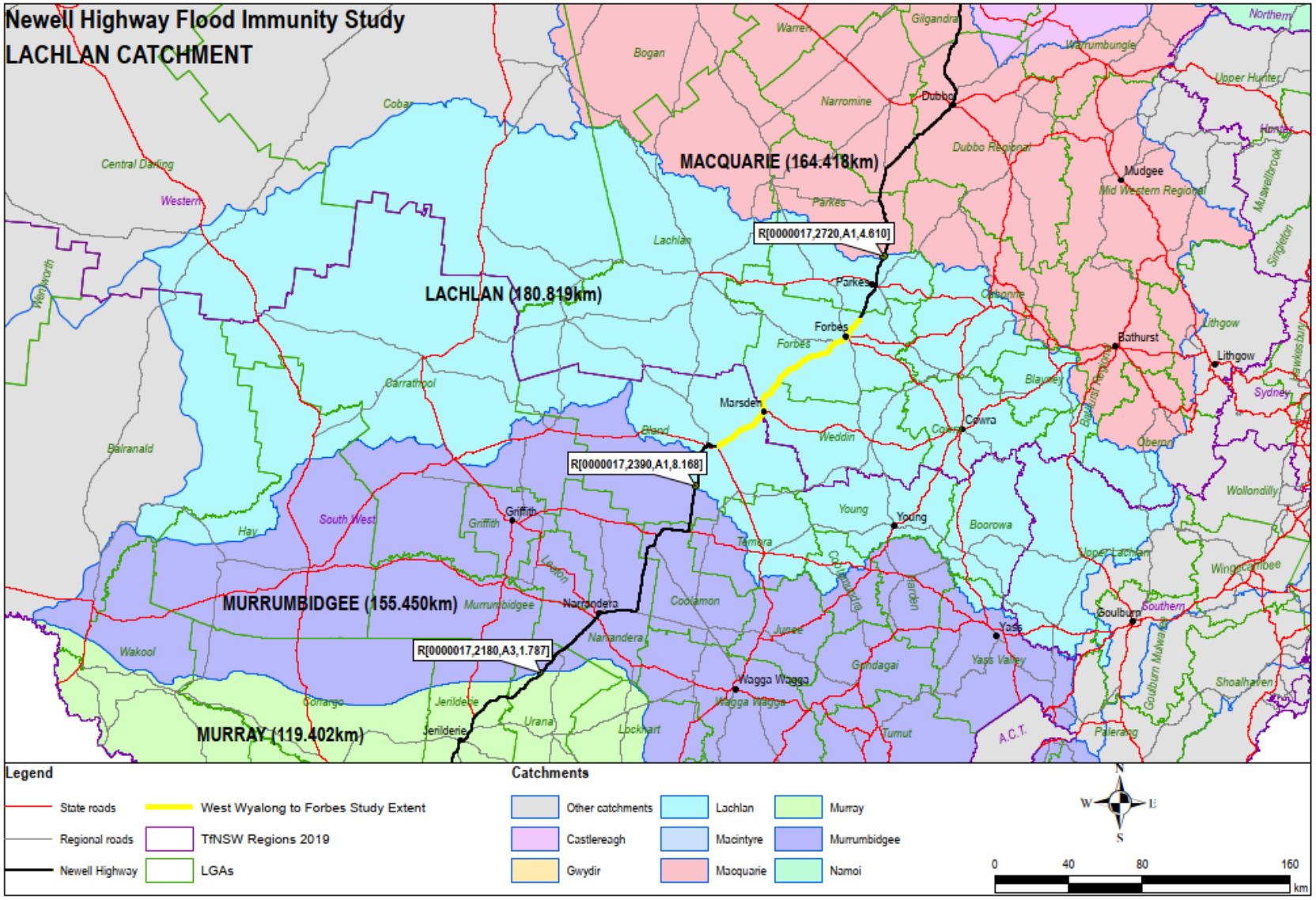


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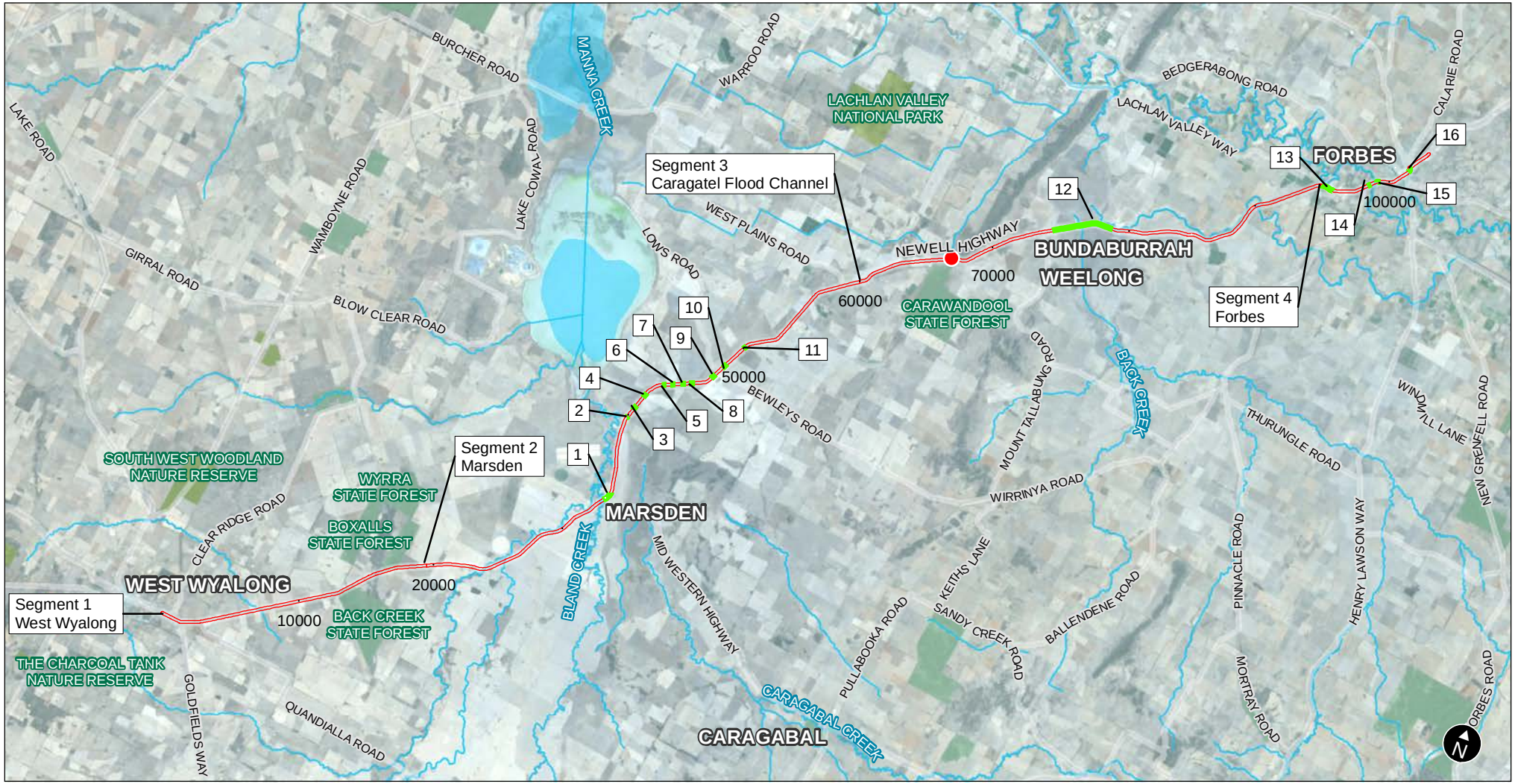
Figure 4-1 Lachlan Catchment - Newell Highway Flood Immunity Study

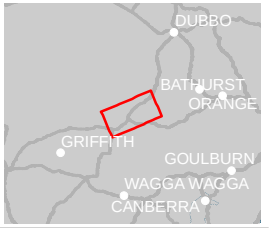


Legend

- Study area
- State Forest
- National Park
- Waterway
- Section of the Newell Highway flooded in March 2021
- Sections of the Newell Highway flooded in September 2016

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2020
Department Finance, Services and Innovation Dec 2020

GDA94 MGA55

Figure 4.2 Historic Information on Flooding

Date: 27/05/2021 Path: \\jacobs.com\ANZ\IE\Projects\04_Eastern\IS340100\22 Spatial\GIS\Directory\Templates\Figures\IS340100_GIS_F012_HistoricFlooding_r2v1.mxd
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4.3 Waterways and hydrological features

The study area generally follows the existing highway alignment which intersects mapped waterways at 23 locations (some of which may be the same waterway intersected more than once) as shown in **Figure 4-3**.

Table 4-1 provides a list of waterways which are traversed by the alignment.

Table 4-1 Waterways traversed by the highway (order from west to east)

Waterway	Approximate Chainage (m)	Catchment Area at the highway (km^2)	Notes
Tributary of Yiddah Creek	1,750	15	The highway crosses the waterway east of the Goldfields Way intersection. Due to the smaller size of the contributing catchment, intense rainfall is likely to be the dominating factor for overtopping of the highway. The highway is expected to be closed off for a short period of time.
Gagies Creek	7,160	185	The main channel of Gagies Creek bifurcates into two channels approximately 4 km north of the highway. The secondary channel crosses the highway approximately 400 m east of the main channel. Distribution of flood flows between the two channels upstream of the highway governs the nature of flooding on the highway in the vicinity of the two channels.
Back Creek	12,700	45	The creek crosses the highway and runs south east and joins Barmedman Creek approximately 12 km downstream. Flood behaviour on the highway is expected to be impacted by rainfall runoff generated from the catchment area located upstream of the highway.
Barmedman Creek	23,600	1,700	Stream traverses highway alignment, then runs north approximately parallel to the highway for 9 km within 500 m west of the existing highway. Flooding on the highway is expected to be dominated by flood levels in Barmedman Creek.
Warralonga Cowal	25200	90	Joins Barmedman Creek approximately 250 m downstream of the highway. Flood behaviour on the highway is expected to be impacted by backwater flooding.
Tributary of Barmedman Creek	32,200	40	Joins Barmedman Creek approximately 200 m downstream of the highway. Flood behaviour on the highway is expected to be dominated by flooding in the main channel of Barmedman Creek.
Bland Creek	33250	8,950	The creek traverses highway alignment, then runs north approximately parallel to the highway for 7 km within 500 m west of the existing highway. Flooding on the highway is dominated by catchment runoff and flood level in Lake Cowal.

Waterway	Approximate Chainage (m)	Catchment Area at the highway (km^2)	Notes
Unnamed tributary of Bland Creek	67,000	40	Rainfall runoff generated from the upstream catchment is the main source of flooding in this area. However, during major flood events, similar to the flood event of August 1990, in the Lachlan River, floodwaters may breakout to join Lake Cowal.
Ooma Creek	76,400	1,400	Flood behaviour is influenced by catchment runoff, backwater flooding from Caragatel Lagoon and flood flow in Bundaburrah Creek. Debris blockage of the cross drainage structure is a known issue at this location.
Tributary of Bundaburrah Creek	79,000	33	The unnamed tributary joins Bundaburrah Creek approximately 50 m downstream of the highway. Flood behaviour on the highway is expected to be dominated by backwater flooding from Bundaburrah Creek.
Bundaburrah Creek	90,100	A flood runner of the Lachlan River	Stream traverses highway alignment, then runs south-west approximately parallel to the highway for 11 km. Flood behaviour is dictated by the distribution of flood flow upstream of Forbes between the Lachlan River, Lake Forbes and floodways located in Cumbijowa Forest.
Unnamed tributary of the Lachlan River	95,300	12	The unnamed tributary joins the Lachlan River approximately 100 m downstream of the highway. Flood behaviour on the highway is expected to be dominated by backwater flooding from the Lachlan River.
Lachlan River	99,000	19,000	The Lachlan River crosses the highway and then runs south-west approximately parallel to the highway for approximately 3.5 km. Flood behaviour is dictated by outflow from Wyangala Dam, rainfall runoff generated from the catchment areas downstream of Wyangala Dam and distribution of flood flows upstream of Forbes between the Lachlan River, Lake Forbes and Bundaburrah Creek.
Lake Forbes	100,700	250	Breakouts from the Lachlan River approximately 15 km upstream of the township Forbes are considered to be the major source of flooding in Lake Forbes. Lake Forbes runs north to south for a distance of approximately 3 km along the eastern side of the highway prior to crossing the highway. A major breakout of Lake Forbes is located approximately 800 m north of the crossing. This breakout operates during major flood events in the Lachlan River.

4.3.1 West Wyalong

Flooding in this section of the highway occurs due to rainfall runoff generated from the catchment area of a tributary of Yiddah Creek and the catchment area of Gagies Creek. Both water courses have relatively smaller catchments and hence the duration of inundation is expected to be short.

4.3.2 Marsden

Flooding in this section of the highway is dominated by Bland Creek and its tributaries which traverse along the highway or crossed by the highway. Bland Creek discharges into Lake Cowal/Wilbertroy Wetlands which is located near the study area and is considered wetlands of national significance. Inundation of the lake occurs as a result of flood flow from the Lachlan River crossing the floodplain or from flooding in the local catchment. To fill from the river, the system requires very large floods that usually occur from the two 'breaks' that are located along the Lachlan River west of Jemalong Range. This usually occurs when flow exceeds about 15,000 ML/day at Jemalong Weir (Green, et al, 2011).

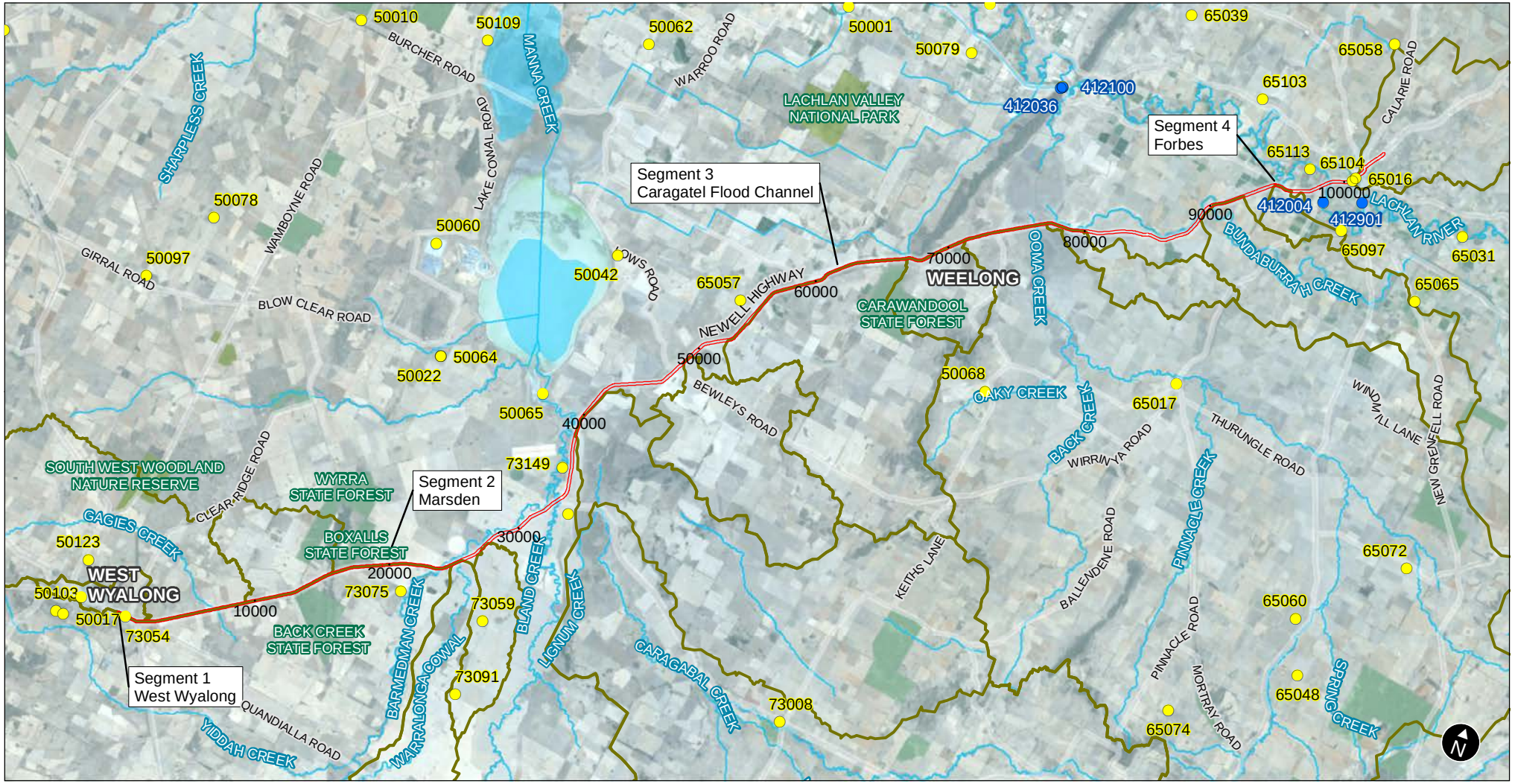
4.3.3 Caragatel flood channel

Flood behaviour in this section of the highway is dominated by flooding from the catchment area of Ooma Creek, backwater flooding from Caragatel Lagoon, and flooding in Bundaburrah Creek.

4.3.4 Forbes

Flooding in this section of the highway is dominated by flooding in the Lachlan River and Lake Forbes. The section of the highway located east of the Lachlan Valley Way intersection is subject to flooding from the main channel of the Lachlan River. Sections of the highway located on the southern and northern side of Fitzgerald Bridge are subject to flooding during major flood events.

Lake Forbes has a catchment area of approximately 250 square km. However, major flooding in Lake Forbes is dominated by breakout flows from the Lachlan River upstream of Forbes. The size of the flood, existing works and vegetation on the floodplain govern the distribution of flood flow between the Lachlan River and Lake Forbes upstream of Forbes. A major breakout of Lake Forbes is located approximately 800 m north where the highway crosses Lake Forbes.

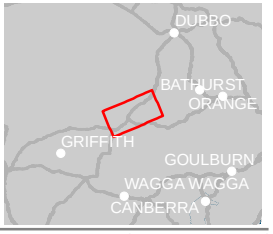


Legend

- Study area
- Major catchments
- State Forest
- National Park
- Waterway
- Stream gauges
- Rain gauges

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2020
Department Finance, Services and Innovation Dec 2020

GDA94 MGA55

Figure 4-3 Major waterways crossing Newell Highway

5. Review of available information

A review of available information was undertaken to determine what previous assessments have been conducted, identify anecdotal data from these studies, and to understand data provided by Transport. Existing flood models have been reviewed to determine if extension of these models will be sufficient for the purposes of this study or if the development of a new model would be required.

5.1 Previous studies and reports

5.1.1 Flood Study of the Newell Highway within the Lachlan Catchment

Description

In 2001, Perrens Consultants was engaged by Roads and Traffic Authority (RTA) (now Transport for NSW) to investigate a range of issues associated with the flooding of the Newell highway between West Wyalong and Parkes, as well as two alternative routes within the catchment of the Lachlan River (Perrens, 2001).

The study identified flood prone locations along the highway and alternative routes from discussions with stakeholders. Twelve flood prone areas were identified on the highway between West Wyalong to Parkes. A flood analysis was carried out at flood prone locations to construct a relationship between flood depth and flood frequency. A range of methodologies were used to arrive at the depth-frequency relationships and depended on the availability of data. Methods included:

- Use of results of existing studies (referred to as method "A" in **Table 5-1**)
- Use of hydrologic/hydraulic modelling (referred to as method "B" in **Table 5-1**)
- Use of a frequency distribution approach (referred to as method "C" in **Table 5-1**)
- Use of a more approximate method based on anecdotal evidence (referred to as method "D" in **Table 5-1**).

Based on local experience as well as international and Australian technical literature, the following 'Flood Conditions' were adopted for the assessment of the onset of road damage, or the need to close the road for safety reasons or the risk of mechanical damage to vehicles:

- Commencement of pavement damage
  - Flood level higher than 200mm below road verge
- Open to light vehicles
  - Flood level less than 300mm above road verge
  - Flooded length is less than 300m in a well-marked causeway
- Open to heavy vehicles
  - Flood level less than 400mm above road verge
  - Flooded length is less than 300m in a well-marked causeway.

Flood depth and flood frequency relationship at flood prone sites

Table 5-1 provides a summary of methodologies used and subsequent results from the analysis for the highway flood prone locations identified in the study area (Perrens, 2001).

Table 5-1 Summary of depth-frequency analysis results and methodology

Location	Floodway	Flooding type*	Calculation method	Estimate Average Recurrence Interval (ARI) years		
				Condition 1 – 200mm below road	Condition 3 – 300mm above road	Condition 4 – 400mm above road
West Wyalong to Booberoi Hills	3 – 2 10 – 4/5	II II	A	1.9 1.4	>100 >100	>100 >100
Booberoi Hill to Marsden		I		3.3	12	16
Marsden to Bewley Road	1 -11	I	D	1.4	7	13
Specks Gap		II	D	1.1	50	120
Caragatel		I	C	4.8	15	20
South of Bundaburrah Creek		I	D	14.5	33	40
Birdwood		I	C	4.5	16	22
Greens Road		I	A	1.5	>100	>100
Warrul Road		I	A	2.5	>100	>100
Dowling Street			A	8	14	16
Forbes Heavy Bypass			A	10	13	14
Tichborne			B	14	19	21

* Type I = Mainstream flooding from the Lachlan River or Bland Creek, long duration flooding (7 – 10 days or longer), Type II = Local flooding from smaller creeks, short duration (1 – 2 days)

The depth-frequency relationships derived for each flood prone location were utilised to guide design of improvements for the highway and alternate route roads. The improvements included the dimensions for additional culverts, length of road to be raised, the required road levels and velocities for the design of scour protection. A summary of the results for highway is provided in **Table 5-2** and **Table 5-3**. **Table 5-2** lists the total length of road to be upgraded for each flood condition and design frequency. **Table 5-3** contains the total lengths of culvert upgrading required for each route, in conjunction with the road upgrading. Culvert sizes are not included in the table, but are based on heights on 375 mm, 900 mm, 1,200 mm and 3,600 mm.

Table 5-2 Combined pavement upgrade lengths (km) for flood prone areas on Newell Highway in nominated flood conditions and flood frequencies

Flood immunity	Condition 1	Condition 3	Condition 4
10 year ARI	12.5	5.2	5.0
20 year ARI	14.6	11.5	5.3
50 year ARI	23.2	14.2	12.7
100 year ARI	23.8	16.2	14.4

Table 5-3 Combined culvert upgrade lengths (km) for flood prone areas on Newell Highway in nominated flood conditions and flood frequencies

Flood immunity	Condition 1	Condition 3	Condition 4
10 year ARI	1.8	0.4	0.3
20 year ARI	2.8	1.4	0.4
50 year ARI	4.7	2.0	1.9
100 year ARI	6.4	2.9	2.5

5.1.2 Newell Highway 2016 Flood Summary Report

Description

This report was prepared by Roads and Maritime Services (Roads and Maritime) to summarise the location and extent of flood conditions on the highway between Marsden and Forbes during the flood events between September and November 2016.

- Marsden - dominated by flooding in the catchment areas of Bland Creek and its tributaries
- Caragatel flood channel – dominated by flooding in the catchment area of Ooma Creek, backwater flooding from Caragatel Lagoon, and flooding in Bundaburrah Creek which is a flood runner of the Lachlan River
- Forbes – dominated by flooding in the Lachlan River and Lake Forbes.

Identification of flooded sections of the Newell Highway

Four types of data were used in the study to determine the extent of flooding at various locations along the study corridor over the length of 43 days closure. The data included aerial imagery, dashcam videos, photographs captured from ground and road inspections carried out by surveillance officers.

Roads and Maritime contracted AAM Group to provide aerial photography of the highway between West Wyalong and Parkes to provide a visual baseline of the flood conditions. This flight was flown on 8 October 2016, two weeks after the highway was closed to traffic. The flight produced imagery with 10 cm resolution along the study corridor in 38 5 km wide tiles. The aerial imagery was used to identify flooded sections at the time when the imagery was taken.

Another source of information which was used to determine the extent of flooding was a number of dashcam videos taken at various times and locations. The location of flooding from these videos was determined either through GPS tagging in the video or through identification of distinctive objects in the video and determining their location in GIPSICAM.

A third source of information used to identify locations of spot flooding were photos taken during the flood event. A total of six photos were used to identify locations of additional flooding in and around Forbes. These photos identified flooding at three different locations at different times during the flood event.

A number of surveillance officers carried out regular inspections of the road condition and flood levels during the flood event of September 2016.

Once all of the locations from the various sources had been compiled and duplicates of locations removed a total of 16 flood locations were determined between Marsden and Forbes. Details on the flooded sections are provided in **Table 5-4**. Eleven flooded sections of the highway covering a total length of 4.56 km were flooded in Marsden. One section of the highway, approximately 4.44 km long, was flooded in Caragatel Flood Channel section. Three sections of the highway representing a total length of 1.52 km were flooded south of Forbes and a 0.34 km section of the highway was flooded north of Forbes. In total, 10.52 km of the highway was flooded between Marsden and Forbes during the flood event of September 2016.

Estimation of flood depth

A number of different methods were used to estimate the depth of flood waters for each of the different means of identification of flood locations. The different means of depth estimation were visual approximation of depth of flooding for videos and ground photos. Surveillance officers measured flood depths during road inspections. In addition, flood depths for all flood locations were estimated by the use of topographical contours surveyed in a digital terrain model (DTM). These contours were determined by LiDAR captured on 23 November 2016. Estimated flood depths varied from 100 mm to 800 mm depending on the topography as shown in **Table 5-4**. A review of flood depth, flood level and the available terrain data for Flood Crossing 15 (F) shows that the flood level of 239.6 m AHD (refer to **Table 5-4**) for this Flood Crossing is inconsistent. Long section profiles along the highway presented in **Appendix A** confirms this inconsistency.

Duration of flooding

The duration of flooding at the individual flood locations was more difficult to determine as flood conditions at some locations fluctuated throughout the flood event. Some flood locations, particularly around Forbes, closed the highway at different times. Hence the overall flood duration was determined from the closure dates announced by the Traffic Management Centre and Roads and Maritime. The highway was closed between 21 September 2016 and 4 November 2016 as shown in **Table 5-4**.

Flood frequency

The study assigned an average recurrence interval (ARI) of 1:50 to both 1990 and 2016 flood events based on flooding in Forbes. However, it is to be noted that the stream gauge at Cottons Weir recorded lower gauge height for the flood event of 2016 (refer to **Table 5-8**).

Table 5-4 Details on location, length, depth and duration of flooding during the flood event of September 2016

Flood Crossing[1]	Chainage (intersection of Camp and Sheriff Streets in Forbes)	Length (km)	Max Depth (mm)	Flood Level (m AHD)	First Date Flooded	Earliest Date Clear
1 (M)	67.68 to 66.88km south of Forbes	0.80	800	208.6	26/09/2016	2/11/2016
2 (M)	61.38 to 61.22km south of Forbes	0.16	300	207.3	22/09/2016	24/10/2016
3 (M)	60.78 to 60.33km south of Forbes	0.45	500	207.4	22/09/2016	24/10/2016
4 (M)	59.58 to 59.15km south of Forbes	0.43	400	207.4	22/09/2016	24/10/2016
5 (M)	57.91 to 57.60km south of Forbes	0.31	500	207.3	22/09/2016	30/10/2016
6 (M)	57.32 to 56.93km south of Forbes	0.38	500	207.3	22/09/2016	27/10/2016
7 (M)	56.58 to 56.15km south of Forbes	0.42	800	207.3	22/09/2016	24/10/2016
8 (M)	55.99 to 55.57km south of Forbes	0.44	800	207.3	22/09/2016	27/10/2016
9 (M)	54.29 to 53.85km south of Forbes	0.45	600	207.4	22/09/2016	24/10/2016
10 (M)	53.21 to 52.79km south of Forbes	0.42	300	207.6	28/09/2016	20/10/2016
11 (M)	51.23 to 50.93km south of Forbes	0.30	300	207.4	26/09/2016	2/11/2016
12 (CFC)	26.80 to 22.35km south of Forbes	4.44	300	225.6	26/09/2016	7/10/2016
13 (F)	6.18 to 5.26km south of Forbes	0.92	200	234.3	28/09/2016	8/10/2016
14 (F)	2.79 to 2.50km south of Forbes	0.29	200	235.7	28/09/2016	8/10/2016
15 (F)	2.06 to 1.75km south of Forbes	0.31	100	239.6	28/09/2016	8/10/2016
16 (F)	0.38 to 0.72km north of Forbes	0.34	150	236.7	28/09/2016	8/10/2016

[1] (M) – Marsden; (CFC) Caragatel Flood Channel; (F) - Forbes

Strategic cost estimates

Strategic cost estimates were prepared to upgrade flooded sections of the highway to 1:10, 1:50 and 1:100 year ARI events based on cost estimates prepared as part of the 2001 Flood Study (Perrens, 2001).

5.1.3 Newell Highway Flood Investigations – Marsden

Description

In 2019, WMAwater was engaged by Roads and Maritime (RMS) to investigate flood impacts to the highway between the townships of Forbes and West Wyalong, specifically the area around Marsden (RMS, 2019). The study area includes several floodway segments which are currently subjected to prolonged inundation periods during and post flood events. The study investigated the impact to the floodway segments and potential mitigation measures. The study area predominately drains to Lake Cowal but due to the flat nature of the surrounding floodplain, the area is prone to becoming waterlogged for long periods.

A WBNM hydrology model and a two dimensional (2D) TUFLOW hydraulic model of the Marsden study area were developed to investigate flood immunity to the highway at floodway locations during various rainfall events. The report also presents aerial imagery of the 1993 and 2016 flood events in the study area. The flood behaviour depicted in the 1993 aerial image is suggested to reflect the predicted behaviour indicated by the hydraulic model. The 2016 image also demonstrates the inundated floodplain environment post rainfall which broadly agrees with the modelled flood behaviour leading confidence to the modelling. The photos are reproduced in **Figure 5-1** and **Figure 5-2.**

Figure 5-1 1993 event aerial photo (Source RMS, 2019)

Figure 5-2 2016 flood airborne photography (Source RMS, 2019)

Flood modelling

The TUFLOW 2D flood hydraulic model, developed by WMAwater for the highway near Marsden was not available to this study. The model was not calibrated and no recorded gauge data was available in the areas. This meant that the exact frequency of overtopping was uncertain, but the modelling undertaken was determined to be suitable for relative impact assessment. Additionally, the flood behaviour depicted in the aerial photography (refer to **Figure 5-1** and **Figure 5-2**) was determined to broadly reflect the model outputs which provided confidence of the model reliability.

The model data is summarised in **Table 5-5**.

Table 5-5 Hydraulic model data for highway flood study near Marsden

Item	Supplied by	Description
Point Cloud Data	RMS	Detailed LiDAR data of highway and up to ±150m either side of highway. Average point separation: 0.4m Estimated accuracy of <0.3m vertical <0.05m horizontal (68% confidence level)
Detailed Aerial Imagery	RMS	Detailed aerial imagery tiles for areas including between Marsden and Tichborne
Hydraulic structure data	RMS	Details of culvert and bridge data provided as logged inspection data or design drawings
Additional survey	RMS	Survey data taken 2016 beginning approximately 830m north of the Mid Western Highway / highway intersection. Extending for approximately 9km.

Peak water levels and depths at key locations

The modelled peak water levels and depths from the report are summarised in **Table 5-6**. Observed flood levels for the flood event of September 2016 are generally 0.3 m higher than peak water levels for the 10% AEP at all but location E where the observed flood level is similar to the peak water level for the 10% AEP event.

Table 5-6 Peak water levels and depths at key locations identified for the Marsden flood study and observed flood levels for the flood event of September 2016

Location [1]	Peak Depth (m)			Peak Water Level (m AHD)			Observed Flood Level - September 2016 Flood (m AHD) and Location[2]
	50% AEP	20% AEP	10% AEP	50% AEP	20% AEP	10% AEP	
A	-	0.25	0.35	-	206.96	207.07	207.3 (5)
B	-	0.25	0.33	-	206.92	207.01	207.3 (6)
C	0.05	0.32	0.41	206.68	206.83	206.92	207.3 (7)
D	0.19	0.45	0.52	206.56	206.81	206.90	207.3 (8)
E	-	0.15	0.23	-	207.22	207.29	207.3 (2)
F	-	0.26	0.36	-	207.02	207.14	207.4 (3)

Location [1]	Peak Depth (m)			Peak Water Level (m AHD)			Observed Flood Level - September 2016 Flood (m AHD) and Location[2]
	50% AEP	20% AEP	10% AEP	50% AEP	20% AEP	10% AEP	
G	-	0.10	0.20	-	206.99	207.11	207.4 (4)
H	-	0.22	0.32	-	206.64	207.04	207.4 (9)

[1]Refer to **Figure 1-1** of WMAwater, 2019 for location of identified sites A to H.
[2]Refer to **Table 5-4** for flood levels and **Figure 4-2** for location (2) to (9).

The flood modelling results indicate that there is significant overtopping and prolonged inundation of the highway at several locations within the study area under existing conditions. Overtopping of the highway varies from 1.9m deep in the 50% AEP event and up to 2.5m deep in the 10% AEP event. Furthermore, the length of inundation duration (i.e. time the road is cut) increases with flood magnitude. Modelled peak flow rates over the roadway of 25.7m^3/s to 151.2m^3/s occur for the 50% AEP to 10% AEP events respectively.

An option was considered where 12 x 600 mm reinforced concrete pipes were installed at chainage 61.53 km. The option made limited improvement to inundation times and water levels in the area. Overall, given the minimal effect of the option on flood levels and the significant cost of construction the option was not considered viable. The study strongly recommends that more accurate LiDAR be flown in the area prior to the investigation of any future roadway improvement options.

5.1.4 Forbes Flood Study

Forbes Shire Council has been updating the flood study for Forbes. The recent flood study report has not been published so was not available to this study however data from the recent study has been provided by Council. Forbes Shire Council provided TUFLOW flood modelling results for Forbes based on the recent study. In particular, the following information was available to this study:

- Flood photographs for the flood event of September 2016
- Historic flood events of June 1952, September 1974, August 1990, December 2010, March 2012 and September 2016 – modelled peak flood depths and levels
- Design flood events of 2 year, 5 year, 10 year, 20 year, 100 year and 500 year average recurrence interval (ARI) – modelled peak flood depths and levels.

The information provided by Forbes Shire Council has been compared with the sections of the highway flooded in September 2016 (refer to **Section 5.1.2**). The comparison shows that in general, the Forbes Flood Study model overestimates the section of the highway flooded during historic flood events and design flood events. In total, a 1.86 km long section of the highway was overtopped in Forbes during the flood event of September 2016 (refer to **Table 5-4** for flooded sections 13 to 16). However, the Forbes Flood Study model estimates that approximately 6.97 km and 7.59 km sections of the highway are flooded in the 10% and 5% AEP event respectively. The flood model for Forbes needs to be update prior to using the flood model for assessing any upgrade options for the highway.

5.1.5 Wyalong and West Wyalong Flood Study

Wyalong and West Wyalong Flood study is currently being carried out by Lyall & Associates for Bland Shire Council (https://www.blandshire.nsw.gov.au/Environment/Wyalong-West-Wyalong-Flood-Study). The study will investigate the overland flow flood behaviour and flood patterns within the Wyalong/West Wyalong catchment

study area. The study has involved consideration of local flood history, collected available flood data and the development of hydrologic and hydraulic models to determine the full range of flood behaviour.

The report was not available for review and the data for this assessment has not been made available for use in this assessment. Preliminary flood mapping for the 1% AEP event shows overtopping of the highway west of the intersection with Compton Road, east of the intersection with Emu Road and east of the intersection with Goldfields Way.

5.1.6 Caragatel Bridge, Flood Impact Assessment for Flooding in Ooma Creek

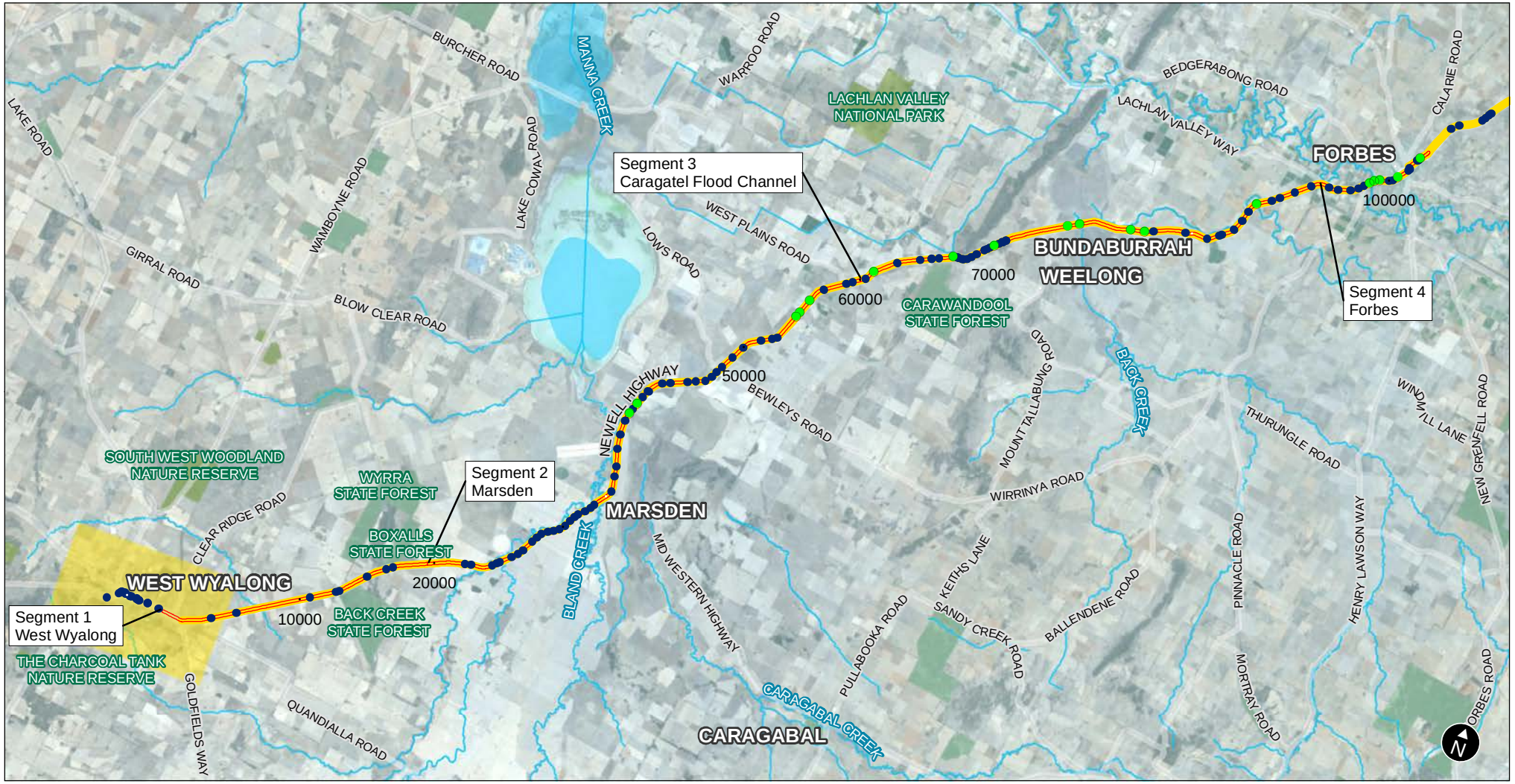
Sinclair Knight Merz (SKM) was engaged by the Roads and Transport Authority (RTA) in 2003 to undertake a flood impact assessment for the proposed upgrade of Caragatel Bridge located on the highway 24.8 km south-west of Forbes (SKM, 2003). The upgrade was proposed both to improve the structural condition of the bridge and to provide increased flood immunity.

SKM undertook both at-site flood frequency analysis and a detailed hydrological modelling for the catchment area of Ooma Creek. A hydraulic assessment was undertaken to define flood behaviour at Caragatel Bridge for a range of inflows in Ooma Creek, initial water levels in Caragatel/Bundaburrah Lagoon and debris blockage at the bridge. The observed 1990 flood level at Caragatel Bridge was 225.75 m Australian Height Datum (AHD) and the modelled flood level was 226.0 m AHD. The 1990 flood is estimated as having an AEP of approximately a five per cent (%) event.

Calculations carried out by SKM show that raising the bridge by 0.5 metres (m) and lengthening it to 134 m provides adequate waterway area and elevation for Ooma Creek floods (1% AEP event), Lachlan floods (approximately for the 5% AEP event) and the risk of blockage.

5.2 Topographic data

Transport engaged AAM Pty Limited for production and supply of aerial photography and a digital elevation model (DEM) for a 135 km section of the highway between West Wyalong and Parkes. The area of capture followed the existing centreline of the highway with a corridor width of 300 m. The point cloud data and 0.5 m contours were produced from aerial LiDAR data captured on 28 November and 23 December 2016. The extent of the LiDAR data is shown in **Figure 5-3**. One metre DEM for West Wyalong and Forbes are available from ELVIS (https://elevation.fsdf.org.au).

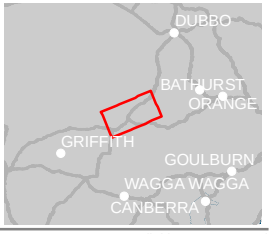


Legend

- Study area
- State Forest
- National Park
- Waterway
- Extent of Lidar data
- Location of culverts
- Location of bridges

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2020
Department Finance, Services and Innovation Dec 2020

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Figure 5-3 Available data

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5.3 Rainfall data

There are 41 available rain gauges located in the vicinity of the study area shown on **Figure 4-3 and Figure 5-3.** Eight rain gauges which are currently in operation. Details on the availability of data for the eight open gauging stations are provided in **Table 5-7**. Two of the eight open gauging stations are automatic.

Table 5-7 Rainfall gauges currently in operation within or near the study area

Gauge number	Gauge Name	Year Started	Automatic gauge	No. of times one day rainfall exceeded 80 mm	No. of times one day rainfall exceeded 100 mm
50010	Burcher Post Office	1937	N	4	1
50017	West Wyalong Airport AWS	1999	Y	1	-
65039	Forbes (Muddy Water)	1969	N	2	-
65072	Garema (Forest Lodge)	1971	N	7	1
65103	Forbes Airport AWS	1995	Y	1	-
65113	Forbes (Bimbimbi)	2004	N	2	-
73054	Wyalong Post Office	1895	N	12	4
73149	Wyalong (Marsden (Minoru))	1997	N	2	1

Table 5-7 shows that the rain gauge No. 73054 has the longest length of records and the gauge recorded 100mm or more rainfall in one day on four occasions. The same gauge recorded 80 mm or more rainfall in one day on twelve occasions. The rain gauge No. 65072 was commissioned in 1971 and in the last 49 years the gauge recorded 100mm or more rainfall in one day once and the gauge recorded 80 mm or more rainfall in one day on seven occasions.

Rain gauges shown in **Table 5-7** recoded rainfall depths between 110 mm and 165 mm during the month of September 2016 and during the month of March 2012 the gauges recorded rainfall depths between 120 mm and 188 mm. However, on 23 March 2021 the rain gauges recorded rainfall depths between 65 mm and 101 mm. This means that an intense rainfall event occurred on 23 March 2021.

5.4 Stream gauging data

Available stream gauges in the vicinity of the study area are shown in **Figure 4-3** which shows that a few stream gauges are available in the vicinity of the study area. Two stream gauges relevant to the study area are located on the Lachlan River in the vicinity of Forbes and details on the gauges area provided below. WaterNSW often measures flood flows in the Lachlan River, Lake Forbes and other flood runners including Bundaburrah Creek at the highway in the vicinity of Forbes.

5.4.1 Lachlan River at Forbes Iron Bridge

Lachlan River levels have been recorded on a regular basis since 1893 when readings commenced at the Forbes Iron Bridge gauge and then daily records ceased in 1944. However, the gauge has been continued for flood warning purposes by the NSW State Emergency Services. Historic gauge heights for this station are shown in **Table 5-8**. The highest gauge height (10.8 m) was recorded during the 1952 flood at this gauge. Within the available period of records, the 10 m gauged height was exceeded more than 25 times. During major flood events, flood heights recorded at this gauging site are most likely to be influenced by flows in Lake Forbes, Bundaburrah Creek and major breakouts within the township of Forbes and the southern breakouts between Red Bend and Cottons Weir. The most recent major flood event recorded at the gauge is the flood event of September 2016 and the maximum height recorded at the gauge during March 2021 is 3.66 m.

5.4.2 Lachlan River at Cottons Weir

This gauge is located approximately 3 km downstream of Iron Bridge gauge and 1.5 km upstream of Fitzgerald Bridge along the highway. Records commenced at this gauge in 1939 and continue to the present. A telemetering system was installed in 1978. Historic gauge heights for this station are shown in **Table 5-8**. The most recent major flood event recorded at the gauge is the flood event of September 2016. Unlike the Forbes Iron Bridge gauge, the recoded gauge height at Cottons Weir gauge for the flood event of September 2016 is significantly lower than gauge heights of September 1974 and August 1990. It is to be noted that the gauge recorded a maximum gauge height of 1.07 m during March 2021.

Table 5-8 Historic stream gauge heights in the Lachlan River in Forbes

Flood Event	Lachlan River at Forbes Iron Bridge (GS 412901)	Lachlan River at Cottons Weir (GS 412004)
September 2016	10.65	7.17
March 2012	10.55	7.04
December 2010	10.16	6.29
August 1990	10.64	7.31
September 1974	10.62	7.30
June 1952	10.80	-

5.5 Data for cross drainage

Transport provided information on bridges and culverts along the highway within the study area. Location of the available bridges and culverts are shown in **Figure 5-3**.

6. Assessment

6.1 Frequency of flooding

6.1.1 West Wyalong

No stream gauges are located within the catchment areas of Yiddah Creek or Gagies Creek (refer to **Figure 4-3**). In addition, no information is available on overtopping for this section of the highway during historic flood events (refer to **Figure 4-2**).

6.1.2 Marsden

Flooding in this section of the highway is dominated by Bland Creek and its tributaries which have large catchment areas. The highway traverses flat floodplains of Bland Creek and its tributaries and crosses Bland Creek and its tributaries. However, no stream gauges are located within the catchment area of Bland Creek (refer to **Figure 4-3**). Hence, it is not possible to define frequency and duration of overtopping of the highway using recorded stream records.

The flood modelling results (WMAwater, 2019) indicate significant overtopping and prolonged inundation of the highway at several locations within the study area under existing conditions.

6.1.3 Caragatel flood channel

Flood behaviour in this section of the highway is dominated by flooding from the catchment area of Ooma Creek, backwater flooding from Caragatel/ Bundaburrah Lagoon, and flooding in Bundaburrah Creek. There are no stream gauges in the vicinity of the highway (refer to **Figure 4-3**) which can be used to define the frequency and duration of inundation of the highway.

The section of the highway in the vicinity of Caragatel Bridge was flooded during the flood events of September 2016 and August 1990. The observed 1990 flood level at Caragatel Bridge was 225.75 m Australian Height Datum (AHD) which is similar to a 5% AEP event (SKM, 2003). The observed flood level at Caragatel Bridge during the flood event of September 2016 was 225.6 m AHD as shown in **Table 5-4**. Hence the flood event of August 1990 was larger than the flood event of September 2016. The AEP of the flood event which results in just overtopping of the section of the highway away from Caragatel Bridge is unknown.

There are no stream gauges on Bundaburrah Creek in the vicinity of the highway. Moreover, no information is available on overtopping of the highway due to historic flooding in Bundaburrah Creek.

6.1.4 Forbes

The flood behaviour around Forbes is complex as the floodplain surrounding Forbes behaves differently during different flood events. As a result, the distribution of flood flow between the Lachlan River, Lake Forbes and Bundaburrah Creek also varies for each flood event. Gauge heights recorded at the two stream gauges in the Lachlan River in Forbes are not consistent as shown in **Table 5-8**. Hence, it is problematic to define a consistent flood frequency for Forbes based on gauge heights recorded at the two gauges.

6.2 Existing flood immunity

6.2.1 West Wyalong

A preliminary flood map for Wyalong and West Wyalong (refer to **Section 5.1.5**) shows that the highway is overtopped in the 1% AEP event east of the intersection with Emu Road and east of the intersection with Goldfields Way due to flooding in an unnamed tributary of Yiddah Creek. It is expected that this section of highway would have the higher flood immunity than the remaining three sections of the highway.

A preliminary assessment indicates that the section of the highway at Gagies Creek may have flood immunity in the 10% AEP event.

6.2.2 Marsden

Flooding in Bland Creek and its tributaries overtopped 11 sections of the highway during the flood event of 2016. The overall length of overtopping of the highway was 4.56 km and the length of overtopping of the highway varied between 300 m and 800 m. Flood levels in ten flooded sections of the highway located north of Bland Creek varied between 207.3 m AHD and 207.6 m AHD implying that the floodplain in the vicinity of the highway is flat and wide and impacted by backwater flooding.

A number of sections of the highway were also flooded during the flood events of September 1993 and August 1990. The flood event of September 1993 occurred in Bland Creek and its tributary catchments when the Lachlan River in Forbes was not in flood. However, in the case of the flood event of August 1990, three minor flood events occurred in the Lachlan River in April, June and July 1990 prior to the major flood event in August 1990.

Flood modelling undertaken (WMAwater, 2019) for this section of the highway shows that two sections of the highway are overtopped in the 50% AEP event (refer to **Table 5-5**). Segments of the highway subject to flooding during different flood events are shown on **Figure 6-1** based on flood modelling undertaken by WMAwater, 2019.

6.2.3 Caragatel flood channel

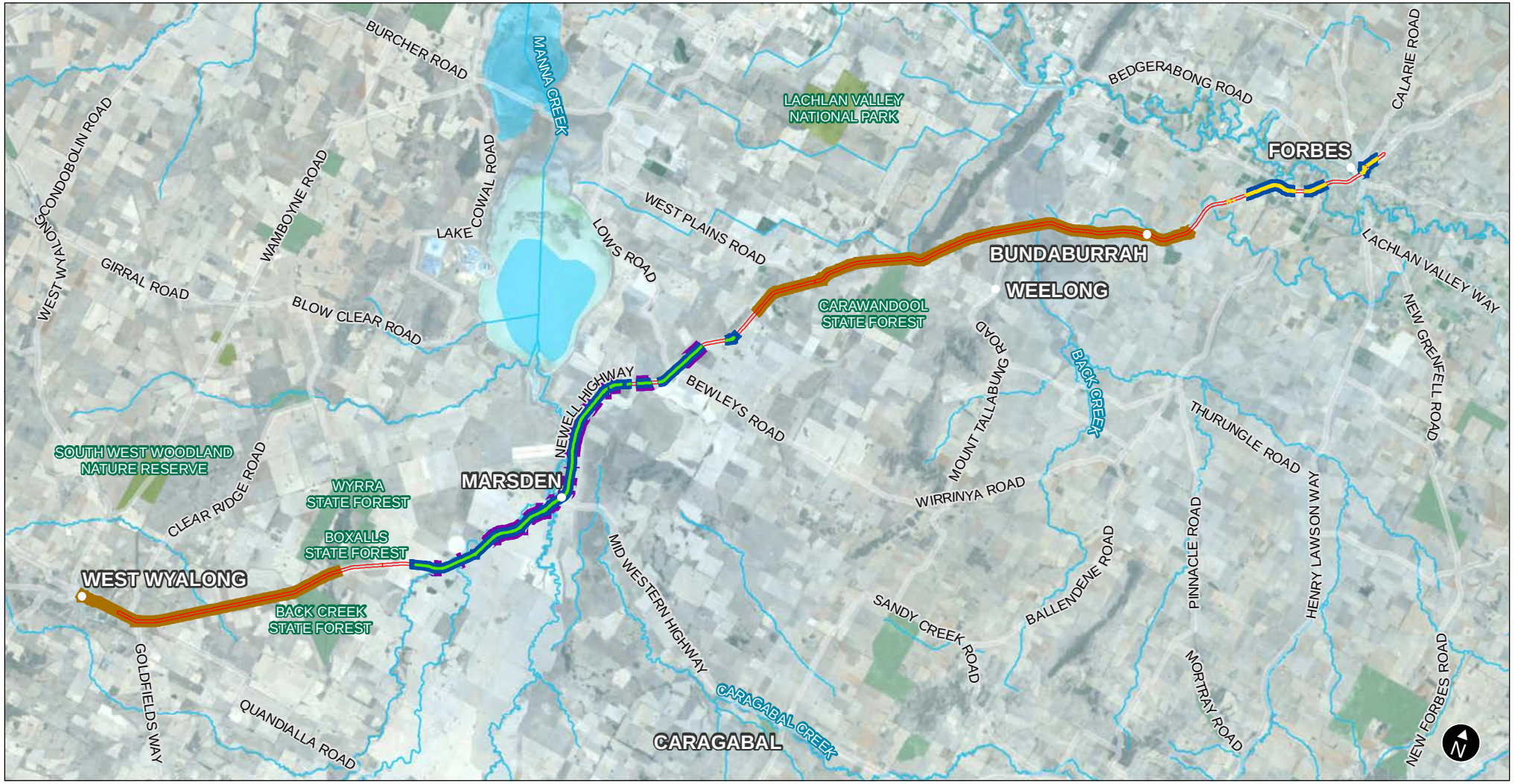
A small section of the highway near Specks Gap was overtopped on 23 March 2021 due to intense rainfall. The frequency of the intense rainfall event is expected to be similar or larger than a 5% AEP event.

A 4.44 km section of the highway was flooded during the flood event of September 2016 for a period of 37 days. This section of the highway was also flooded during the flood event of August 1990. The flood level of August 1990 was 0.15 m higher than the flood event of September 2016. However, the AEP of the smallest flood event which overtops this section of the highway is undefined. No historic records are available on Bundaburrah Creek overtopping the highway. The section of the highway in the vicinity of Bundaburrah Creek is immune to flooding in the 5% AEP event if the section of the highway was not overtopped during the flood events of August 1990 and September 2016.

6.2.4 Forbes

The Lachlan River flooded a section of the highway east of the intersection with Lachlan Valley Way during major flood events. In addition, sections of the highway located both north and south of Fitzgerald Bridge were flooded during major flood events. The breakout of Lake Forbes overtopped the highway during major flood events of 1952, 1974, 1990, 2012 and 2016.

This section of the highway is immune to flooding in the 10% AEP event on the basis of the flood modelling results provided by Forbes Shire Council as shown on **Figure 6-1**.



Legend

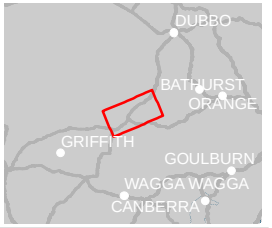
- Study area
- Waterway
- State Forest
- National Park

Flooding on Newell Highway

- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- No flooding information available

0 5 10 km

1:400,000 at A4



Data sources

Jacobs 2021
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Figure 6-1 Sections of Newell Highway subject to flooding

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6.3 Duration of flooding

6.3.1 West Wyalong

Both Yiddah Creek and Gagies Creek have smaller catchment areas hence any overtopping of the highway due to flooding of both creeks is expected to result from intense storm event only and the duration of inundation is expected to be short. Information on the frequency and duration of inundation of the highway due to flooding in Yiddah Creek is expected to be available from the final flood study report for Wyalong and West Wyalong.

6.3.2 Marsden

The section of the highway was flooded up to 37 days during the flood event of September 2016. The duration of inundation is expected to be relatively shorter for smaller flood events. Detailed flood modelling with better quality LiDAR data needs to be undertaken to confirm the duration of inundation for a range of historic and design flood events.

6.3.3 Caragatel flood channel

The duration of overtopping of the highway near Specks Gap due to intense rainfall is expected to be short.

The section of the highway at Caragatel Bridge was flooded for a period of 11 days during the flood event of September 2016. The duration of inundation is expected to be longer for flood events larger than the flood event of September 2016.

Additional flood modelling needs to be undertaken to define the duration of inundation of the highway due to flooding in Bundaburrah Creek.

6.3.4 Forbes

Four sections of the highway in Forbes were cut-off for a period of 10 days during the flood event of September 2016. The duration of inundation is expected to be longer for flood events larger than the flood event of September 2016. The flood model for Forbes needs to be refined to address duration of overtopping of the highway for historic flood events.

6.4 Potential upgrade options

6.4.1 West Wyalong

Limited information is available on the existing flood behaviour for this section of the highway. Hence, it would be necessary to undertake a detailed flooding assessment to define the frequency, duration and extent of flooding for the highway. The flooding assessment would also define the extent of the upgrade required to achieve the desired flood immunity for the highway.

6.4.2 Marsden

The section of the highway traverses the flat floodplain of Bland Creek and its tributary catchment. The available flood study for Marsden (WMAwater, 2019) needs to be updated with good quality LiDAR data. The flood model needs to be calibrated and verified against observed flood events to have confidence on flood behaviour for design flood events. The updated model should be used to define the existing flood behaviour and to assess flooding impacts for a range of upgrade options to assist in the selection of the preferred upgrade option.

6.4.3 Caragatel flood channel

A flooding assessment is required to identify and assess potential upgrade options for approximately 4.5 km section of the highway at Caragatel Bridge. Major waterway crossings need to be provided at this location to address debris blockage and to manage duration of inundation within acceptable limit for any upgrade option of the highway at Caragatel Bridge.

A flooding assessment is also required to define the existing flood immunity and to identify feasible upgrade options for the highway at Bundaburrah Creek. The flood model for Forbes could be extended to include the section of Bundaburrah Creek which is crossed by the highway.

6.4.4 Forbes

The flood model for Forbes needs to be refined to update flood behaviour along the highway prior to identification and assessment of any upgrade options for four sections of the highway which were flooded during the flood event of September 2016. The updated flood model should be used in the identification and assessment of flooding impacts for the selected options. Any upgrade option for the highway would ensure that no adverse change in the distribution of flood flows between the Lachlan River, Lake Forbes and Bundaburrah Creek in Forbes.

6.5 Construction impacts

Activities that have the potential to affect surface water hydrology and flooding during construction of the proposed upgrade may include:

- Culvert/ bridge works including construction of piers and temporary crane pads
- Relocation of a drainage channels
- Earthworks for road widening and raising, intersection and access upgrades
- Construction of retaining walls
- Excavation for drainage trenches, channels and temporary sediment and permanent water quality basins
- Installation of new drainage pits, pipes and culverts
- Vegetation clearance
- Cleaning of existing pipes and culverts
- Temporary access roads
- Construction compounds and ancillary facilities
- Temporary stockpiles
- Culverts and other drainage works, including temporary waterway crossings.

Impacts of the proposed construction works on surface water hydrology and flooding should be assessed during development of concept design for upgrade of the highway.

6.6 Operational impacts

The potential impacts to hydrology and flooding during operation of the proposal relate to the raising of the highway embankment, encroachment of the floodplain due to construction of new bridges and culverts, increase in impervious surface from introduction of the widening of the road, a change in surface flow paths associated within drainage lines across the proposal and the changes in stormwater discharge due to the frequency and intensity of the storm events. The proposal has the potential to impact on flood levels, flow velocities, scour and erosion, flood hazard, flow distribution and duration of inundation.

The concept design for the proposal will be developed to avoid adverse impacts on hydrology and flooding.

6.7 Mitigation measures

Mitigation measures will be identified and assessed during development of the concept design to address adverse impacts to hydrology and flooding. Management measures will be identified to address residual impacts on hydrology and flooding during construction and operation of the proposal.

7. Conclusion

The highway between West Wyalong and Forbes was impassable during flood events of 1952, 1974, 1990, 1993, 2012, 2016 and 2021. During the flood events of September 2016, the highway was closed for 43 days due to flooding in the Lachlan River and Bland Creek. In total, about 20 km of the highway was impacted by flooding in September 2016. Transport has started planning for potential flood proofing and immunity solutions for the highway between Compton Road, West Wyalong to Hereford Street, Forbes (the proposal). This proposal is focussed on addressing areas on the highway and seeks to develop an appropriate flood immunity solution for the West Wyalong to Forbes section of the highway.

Flood prone areas of the highway were identified by reviewing historical data of the submerged sections of the highway in a high volume rainfall event in September 2016 between West Wyalong to Forbes, including but not limited to the areas of West Wyalong, Marsden, Caragatel Flood Channel and Forbes. In addition, the available information (e.g. flood study reports, flood modelling data, aerial photographs, imagery, topographic data, rainfall data , stream gauge data etc) on flood behaviour along the highway has been reviewed in an attempt to define the existing flood immunity for the highway.

Due to gaps in the available information and inconsistency between observed and modelled flood behaviour along the highway, it is necessary to undertake a detailed flooding assessment to identify feasible options to improve flood immunity for the highway. In addition, improvement of flood immunity for the highway has the potential to have adverse impacts on flood levels, duration of flooding, flood velocity, scour and erosion, and flood hazard. Hence it is recommended that a detailed flooding assessment should be undertaken during development of concept design for the proposal.

8. References

Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) *Guidelines for Fresh and Marine Water Quality.*

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019. *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia.

Department of Environment, Climate Change and Water, 2011. *Lachlan River Gooloogong to Jemalong Gap Floodplain Management Plan.*

Green, D., Petrovic, J., Moss. P., and Burrell. M., 2011, *Water resources and management overview: Lachlan catchment,* NSW Office of Water, Sydney.

NSW Government, 2005. *Floodplain Development Manual: The management of flood liable land.*

Office of Environment and Heritage, 2014. *Framework for Biodiversity Assessment: NSW Biodiversity Offsets Policy for Major Projects*, Office of Environment and Heritage, Sydney.

Office of Environment and Heritage, 2016. *NSW Climate Change Policy Framework.*

Perrens Consultants, 2001. *Flood Study of the Newell Highway within the Lachlan Catchment.*

Roads and Maritime Services, 2016. *Newell Highway 2016 Flood Summary Report.*

Sinclair Knight Merz, 2003. Caragatel Bridge, *Flood Impact Assessment for Flooding in Ooma Creek.*

WMAwater, 2019, *Newell Highway Flood Investigations – Marsden.*

9. Terms and acronyms

<table>
<tr><th>Term / Acronym</th><th>Description</th></tr>
<tr><td>Annual Exceedance Probability (AEP)</td><td>The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (AR&R, 2016).
<table>
<tr><th>Frequency Descriptor</th><th>EY</th><th>AEP (%)</th><th>AEP (1 in x)</th><th>ARI</th></tr>
<tr><td rowspan="9">Very frequent</td><td>12</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>99.75</td><td>1.002</td><td>0.17</td></tr>
<tr><td>4</td><td>98.17</td><td>1.02</td><td>0.25</td></tr>
<tr><td>3</td><td>95.02</td><td>1.05</td><td>0.33</td></tr>
<tr><td>2</td><td>86.47</td><td>1.16</td><td>0.50</td></tr>
<tr><td>1</td><td>63.2</td><td>1.58</td><td>1.00</td></tr>
<tr><td rowspan="5">Frequent</td><td>0.69</td><td>50.00</td><td>2</td><td>1.44</td></tr>
<tr><td>0.5</td><td>39.35</td><td>2.54</td><td>2.00</td></tr>
<tr><td>0.22</td><td>20.00</td><td>5</td><td>4.48</td></tr>
<tr><td>0.2</td><td>18.13</td><td>5.52</td><td>5.00</td></tr>
<tr><td>0.11</td><td>10.00</td><td>10.00</td><td>9.49</td></tr>
<tr><td rowspan="3">Infrequent</td><td>0.05</td><td>5.00</td><td>20</td><td>20.0</td></tr>
<tr><td>0.02</td><td>2.00</td><td>50</td><td>50.0</td></tr>
<tr><td>0.01</td><td>1.00</td><td>100</td><td>100</td></tr>
<tr><td rowspan="3">Rare</td><td>0.005</td><td>0.50</td><td>200</td><td>200</td></tr>
<tr><td>0.002</td><td>0.20</td><td>500</td><td>500</td></tr>
<tr><td>0.001</td><td>0.10</td><td>1000</td><td>1000</td></tr>
<tr><td rowspan="5">Extremely Rare</td><td>0.0005</td><td>0.05</td><td>2000</td><td>2000</td></tr>
<tr><td>0.0002</td><td>0.02</td><td>5000</td><td>5000</td></tr>
<tr><td></td><td></td><td rowspan="4">↓</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Extreme</td><td></td><td></td><td>PMP</td><td></td></tr>
</table>
</td></tr>
<tr><td>AHD</td><td>Australian height datum</td></tr>
<tr><td>ANZECC</td><td>Australian and New Zealand Environment and Conservation Council</td></tr>
<tr><td>ARI</td><td>Annual recurrence interval</td></tr>
<tr><td>Average Recurrence Interval (ARI)</td><td>The long-term average number of years between the occurrences of a flood as big as or larger than the selected event. For example, floods with a discharge as great as or greater than the</td></tr>
</table>

Term / Acronym	Description
	20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
ARR	Australian Rainfall and Runoff
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
CEMP	Construction Environment Management Plan
CSWMP	Construction Soils and Water Management Plan
DCP	Development Control Plan
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCP	Erosion and Sediment Control Plan
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood fringe areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
Floodplain risk management options	The measures that might be possible for the management of particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
FM Act	Fisheries Management Act 1994
FMP	Flood Management Plan
LEP	Local Environment Plan
LGA	Local government authority
NPW Act	*National Parks and Wildlife Act 1974*
OEH	Office of Environment and Heritage
OSOM	Over size over mass
PMF	Probable maximum flood
POEO Act	*Protection of the Environment Operations Act 1997*

Term / Acronym	Description
SES	State Emergency Services
Transport	Transport for New South Wales
WM Act	*Water Management Act 2000*

Appendix A. Long section profiles along the Newell Highway

Figure 9-1: Long Section Profiles - West Wyalong

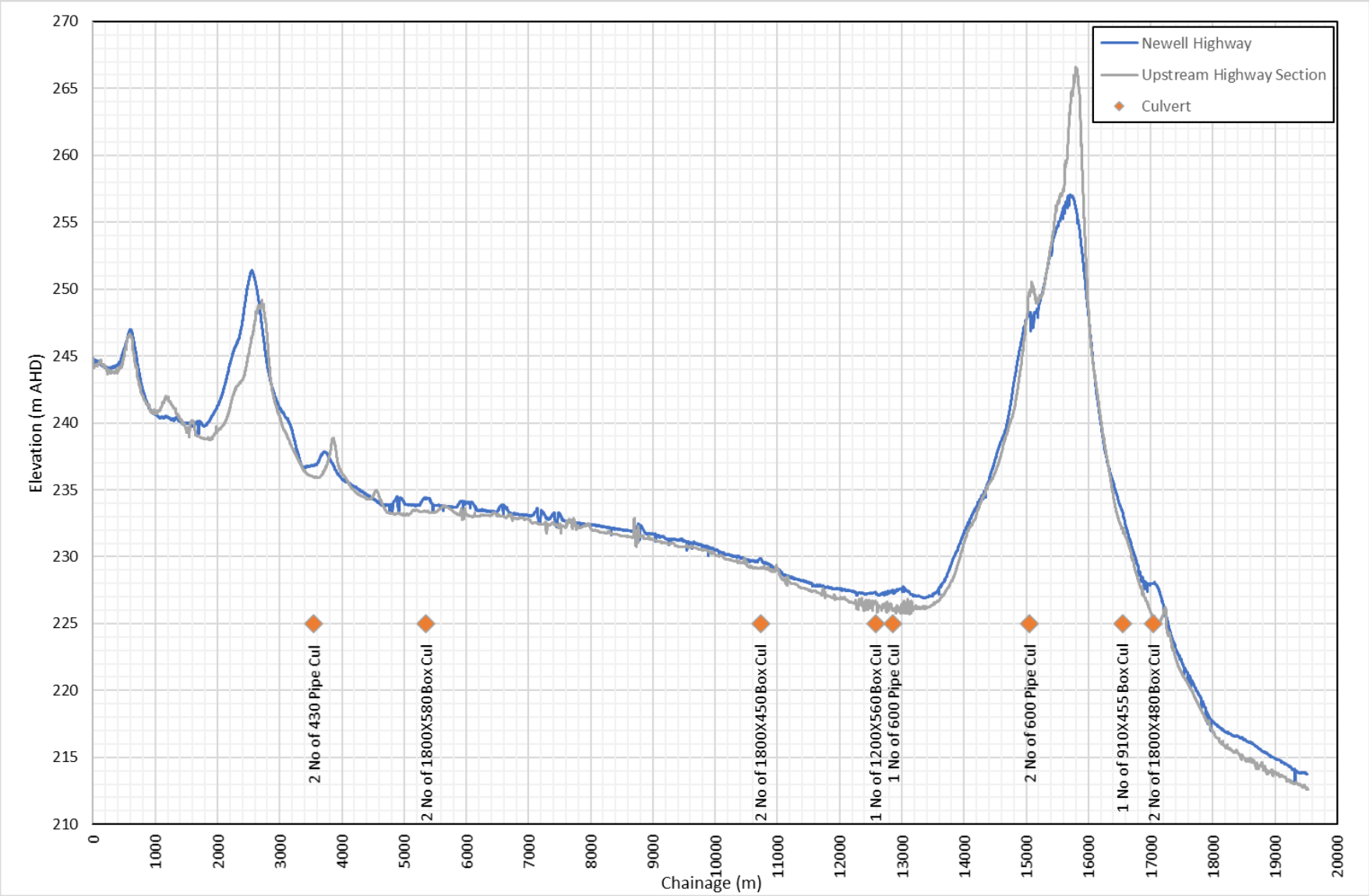


Figure 9-2: Long Section Profiles - Marsden

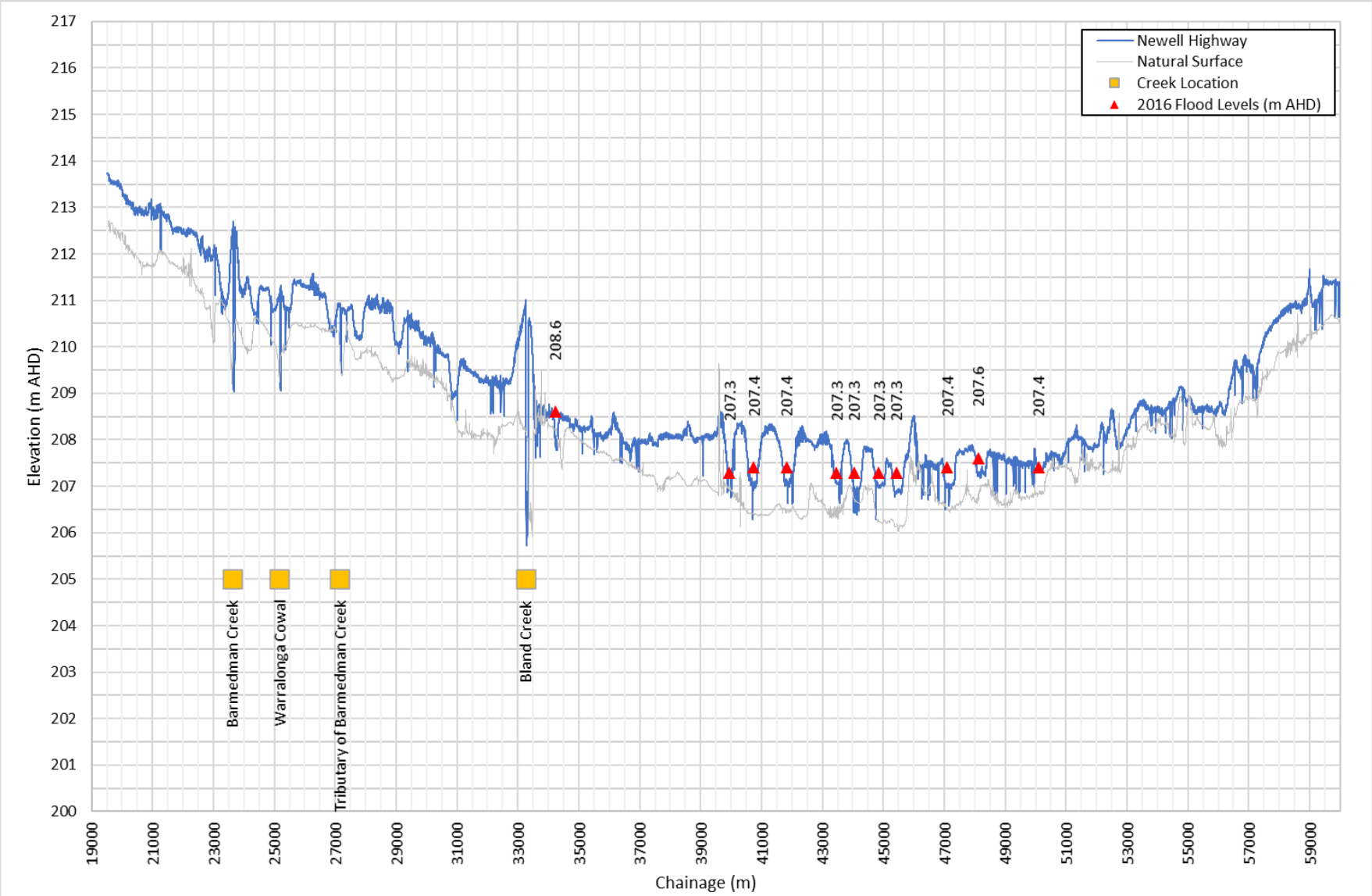


Figure 9-3: Long Section Profiles - Caragatel Flood Channel

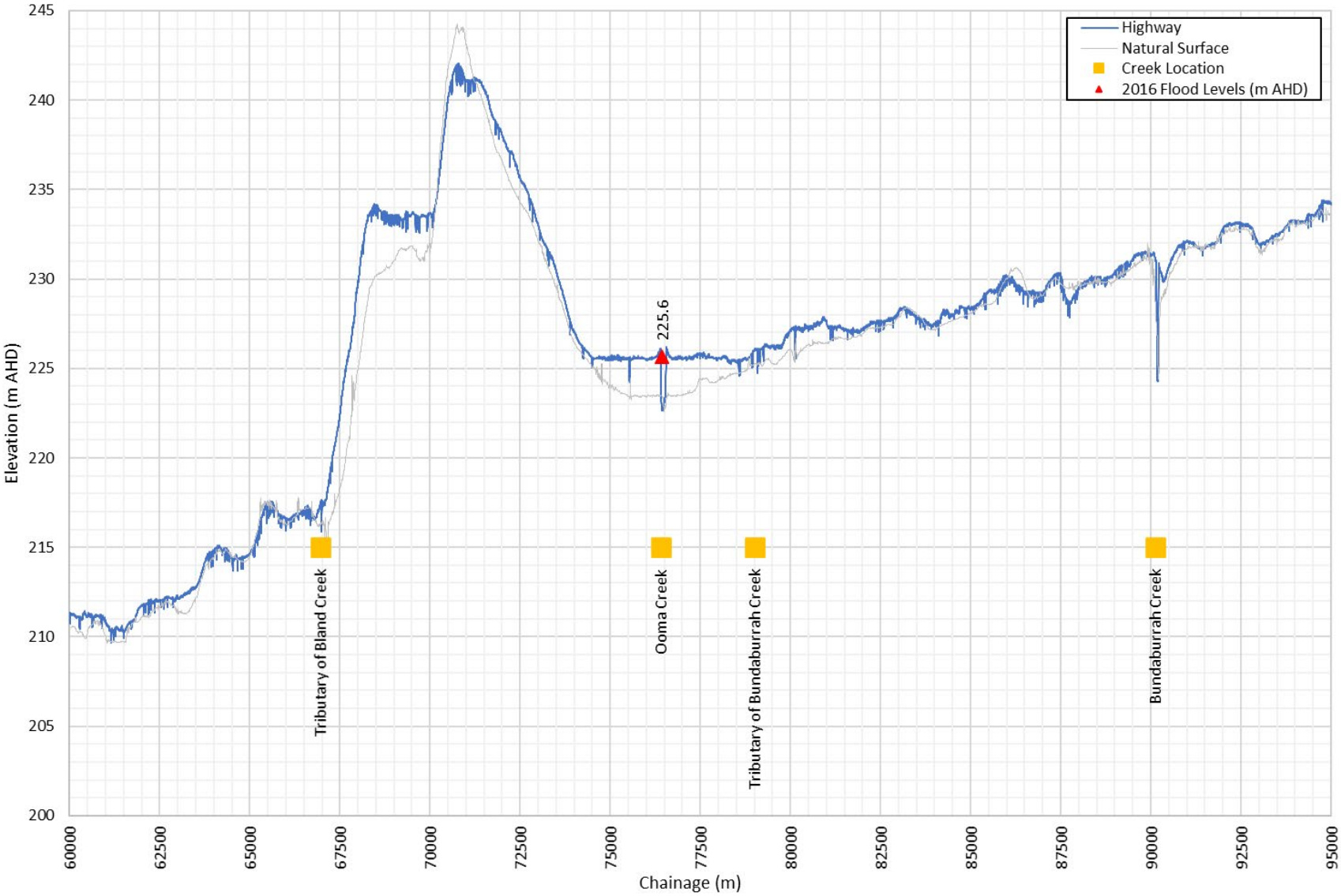
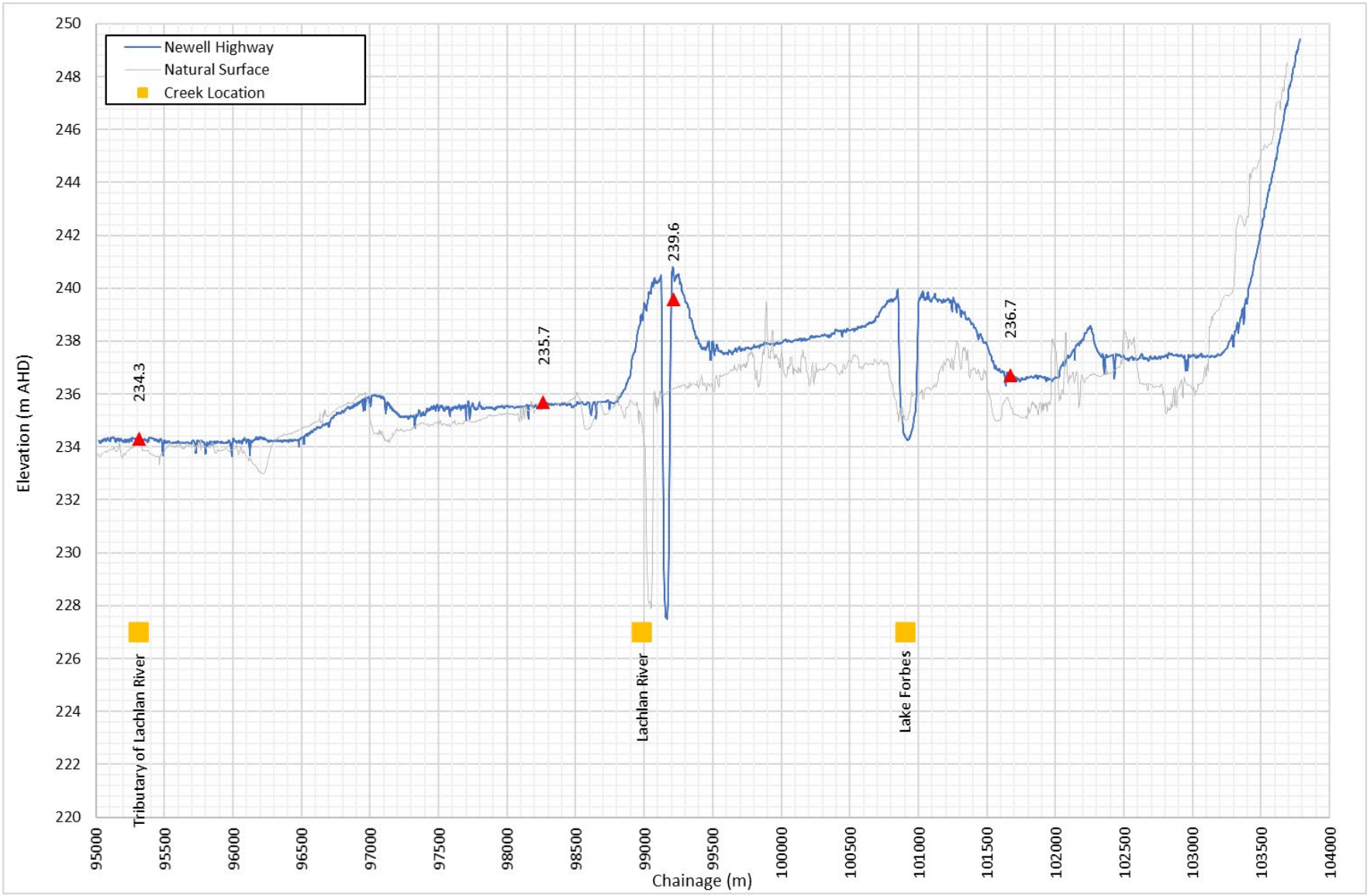


Figure 9-4: Long Section Profiles - Forbes



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