EnergyCo

September 2023

Central-West Orana Renewable Energy Zone Transmission project

Technical paper 13 – Traffic and transport

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Central-West Orana Renewable Energy Zone Transmission project
Technical paper 13 – Traffic and transport

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Glossary

Project terms	
access roads	Permanent access roads to switching stations and energy hubs.
access tracks	Temporary and permanent access tracks to transmission lines.
brake/winch sites	A brake and winch site is a temporarily cleared area where plant and equipment is located for the purposes of spooling and winching a conductor into place on erected towers along a transmission line corridor. Dependent upon the angle of line deviation, the location of the brake and winch site at that angle may or may not be within the nominated transmission line easement. The brake and winch site is only required for the construction phase of the project. It does not need to be maintained for ongoing operation and/or maintenance of the transmission line.
Central-West Orana REZ (CWO REZ)	A geographic area of approximately 20,000 square kilometres centred on the regional towns of Dubbo and Dunedoo and extending west to Narromine and east beyond Mudgee and to Wellington in the south and Gilgandra in the north, that will combine renewable energy generation, storage and transmission infrastructure to deliver energy to electricity consumers
construction area	The area that would be directly impacted by construction of the project, including (but not limited to) transmission towers and lines, brake and winch sites, access roads to switching stations and energy hubs, access tracks, energy hubs, switching stations, communications infrastructure, workforce accommodation camps, construction compounds and laydown and staging areas.
construction compound	An area used as the base for construction activities, usually for the storage of plant, equipment and materials, and/or construction site offices and worker facilities. It can also comprise concrete batching plant, crushing, grinding and screening plant, testing laboratory and wastewater treatment plant.
construction routes	Roads used by construction vehicles (light and heavy).
cumulative impact	The combined impacts of the project on a matter with other relevant future projects relating to traffic and transport only.
double circuit transmission lines	A set of six conductors carried by a single tower set.
Enabling works	Activities that would be carried out before the start of substantial construction in order to make ready the key construction sites (including workforce accommodation camps and compounds), facilitate the commencement of substantial construction, manage specific features or issues and collect additional information required to finalise the final design and construction methodology.
EnergyCo	the Energy Corporation of New South Wales constituted by section 7 of the *Energy and Utilities Administration Act 1987* as the NSW Government-controlled statutory authority responsible for the delivery of NSW's REZs.

Project terms	
Energy hub/s	An energy hub is a substation where energy exported from renewable energy generators or storage is aggregated, transformed to 500 kV (where required) and exported to the transmission network. For the project, this includes Merotherie Energy Hub and Elong Elong Energy Hub.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
last – mile road section	A supply chain management or transportation planning terminology, the last mile is the last leg of a journey comprising the movement of people and goods to a final destination. The section of road between the end of a gazetted OSOM route and a nominated construction location. Vehicles carrying OSOM loads require prior approval from the relevant road authority to travel on a last mile road section.
operation area	The area that would be occupied by permanent components of the project and/or maintained, including transmission line easements, transmission lines and towers, energy hubs, switching stations, communications infrastructure, access roads to the switching stations and energy hubs, maintenance facilities and permanent access tracks to the easements.
(the) proponent	EnergyCo
(the) project	The Central-West Orana REZ Transmission project as described in the Environmental Impact Statement.
renewable energy generators	A renewable energy provider to the CWO REZ.
renewable energy generation and storage projects	The various renewable energy generation and storage projects within the CWO REZ that would be delivered by others, such as wind farms and solar farms.
Renewable Energy Zone (REZ)	A geographic area identified and declared by the NSW Government as a REZ.
study area	The study area entails the road network which will be used as construction routes, generally between construction compounds, workforce accommodation camps and works along the transmission line.
substation	A facility used to increase or decrease voltages between incoming and outgoing lines (e.g. 330 kV to 500 kV).
switching station	A facility used to connect two or more distinct transmission lines of the same designated voltage.
transmission line easement	An area surrounding and including the transmission lines which is a legal ‘right of way’ and allows for ongoing access and maintenance of the lines. Landowners can typically continue to use most of the land within transmission line easements, subject to some restrictions for safety and operational reasons.
twin transmission line	A pair of single or double circuit transmission lines running parallel.
workforce accommodation camps	Areas that would be constructed and operated during construction to house the construction workforce.

Abbreviations

Acronym	Definition
CSSI	Critical State Significant Infrastructure declared by the Minister for Planning and Public Spaces under section 5.13 of the EP&A Act
CTMP	Construction traffic management plan
DPE	(NSW) Department of Planning and Environment
DCCEEW	(Cth) Department of Climate Change, Energy, the Environment and Water
EII Act	(NSW) *Electricity Infrastructure Investment Act 2020*
EIS	Environmental Impact Statement
EP&A Act	(NSW) *Environmental Planning and Assessment Act 1979*
HV	high voltage
ICNG	Interim Construction Noise Guideline (DECC, 2009)
LGA	Local government area
NHVR	National Heavy Vehicle Regulator
NSW	New South Wales
NSW Government	The State Government of NSW
OSOM	Over Size, Over Mass (pertaining to vehicles and traffic routes)
RAV	Restricted Access Vehicles
REF	Review of Environmental Factors
REZ	means a renewable energy zone as defined in the EII Act.
Roads Act	*Roads Act 1993*
SEARs	Secretary Environmental Assessment Requirements issued in response to an SSI application
SSI	State significant infrastructure
State	the State of NSW

Executive summary

This technical paper assesses the potential impacts to traffic and transport from the construction and operation of the Central-West Orana Renewable Energy Zone Transmission project (the project) and has been prepared to support and inform the Environmental Impact Statement (EIS) for the project.

The impacts have been assessed in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment (DPE) and against the relevant legislation and guidelines as they apply to traffic and transport.

Project overview

The NSW Government is leading the development of Renewable Energy Zones (REZ) across NSW to deliver renewable energy generation and storage, supported by high voltage transmission infrastructure. Energy Corporation of NSW (EnergyCo) is proposing the construction and operation of new electricity transmission infrastructure and new Energy Hubs and switching stations required to connect new energy generation and storage projects within the Central-West Orana REZ to the existing electricity network (the project). The project is located within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter local government areas (LGAs) and extends generally north to south from Cassilis to Wollar and east to west from Cassilis to Goolma.

The project would enable 4.5 gigawatts of new network capacity to be unlocked by the mid-2020s (noting the NSW Government's proposal to amend the Central-West Orana REZ declaration to allow for a transfer capacity of six gigawatts), and enable renewable energy generators within the Central-West Orana REZ who are successful in their bids to access the new transmission infrastructure to export electricity to the rest of the network. Importantly, the development of renewable energy generation projects in the Central-West Orana REZ is the sole responsibility of private generators and subject to separate planning and environmental approvals.

Legislative and policy context

Impacts to traffic and transport from construction and operation of the project have been assessed in accordance with the relevant legislation and guidelines including:

- *Roads Act 1993* (NSW)
- NSW Heavy Vehicle Access Policy Framework
- Austroads Guide to Traffic Management and Road Design
- Traffic Control at Work Sites – Technical Manual 2022
- Road Safety Action Plan.

Methodology

The assessment of potential impacts related to traffic and transport arising from the project included the following key steps:

- undertaking a desktop and mapping analysis to identify, describe and qualitatively assess the existing conditions of the proposed construction routes
- reviewing the proposed construction activities and deriving the associated traffic generation and traffic distribution
- assessing the impacts associated with the construction activities with regards to road capacity, pavement condition, road safety, efficiency, heavy vehicle access, access to construction compounds and workforce accommodation camps, temporary access tracks, property access, stringing of transmission lines, active transport and public transport
- reviewing the operational maintenance activities and assessing the impacts associated with road capacity, pavement condition, road safety, efficiency, active transport, public transport and property access
- assessing the potential cumulative traffic impacts
- identifying recommended mitigation and management measures to minimise the impacts of the project as far as practicable.

Existing environment

The road network within the traffic and transport study area reflects the predominately rural nature of the locality. The roads in the study area comprise highways, main roads, regional roads and local roads that connect population centres, mining sites and residential properties with a network of sealed and unsealed local roads.

Potential construction impacts

Construction of the project would commence in the second half of 2024, subject to NSW Government and Commonwealth planning approvals and is estimated to take about three years to complete. Construction would peak in mid-2025 to mid-2026 and during this time up to approximately 1,800 workers would be required for the project. There would be multiple work fronts across the construction area which would generate traffic movements, for example between workforce accommodation camps, construction compounds and work sites along the transmission lines. The impacts of these movements have been assessed in this technical paper with the key outcomes summarised below:

- The impact of the predicted increase in traffic volumes generated during construction to the road network's capacity and efficiency are minor, attributed largely to already low traffic volumes and the low construction traffic volumes on each construction route with respect to spare mid-block road capacity.
- The assessment has identified that the operation of the following intersections would be impacted, and that potential changes would be required to support the increased construction traffic demand in accordance with safety considerations detailed in the Austroads guidelines.
  - investigate the upgrade of Ulan Road/Neeleys Lane intersection to achieve a short channelised right and auxiliary left turn treatments for safe access to the satellite workforce accommodation camp. The investigation would be based upon the confirmed workforce numbers to be housed at the satellite accommodation camp
  - investigate the upgrade of Ulan Road/Golden Highway intersection to provide an additional short channelised right turn.
- The project is to seek approval for Over Size Over Mass (OSOM) access. It is noted that the last mile road section to the energy hubs are currently not gazetted as approved OSOM routes. The CTMP to be prepared will ensure that OSOM movements are appropriately managed, and consultation with relevant roads authorities regarding OSOM movements will be ongoing.

- Minor impacts on rail operation and the road network would typically occur during the stringing of transmission lines. These activities are to be coordinated with the ARTC and the relevant road authority respectively during construction.
- The impacts on road condition are likely to be minor given the minor increase of heavy vehicle movements attributable to the project. Routine inspections would be needed along all nominated construction routes to ensure they are maintained to safe standard during the course of construction activity.
- Road safety impacts during construction would be predominantly associated works adjacent to public roads, the extended travel distances between accommodation camps and work areas, and short-term interruptions during the construction. These are manageable through appropriate implementation of various management plans during construction, and the impacts are therefore expected to be low.
- The project has negligible impact on the active transport network, the public transport network and accesses to affected properties.

Potential operational impacts

The potential traffic and transport impacts of the project include provision of access for continued maintenance of transmission line and substation infrastructure. These would have insignificant traffic generation during the operational and maintenance phase would have negligible impact on the efficiency of the road network within the study area.

1 Introduction

1.1 Background

New South Wales (NSW) is currently undergoing an energy sector transformation that will change how we generate and use energy. The NSW Government is leading the development of Renewable Energy Zones (REZs) across NSW to deliver renewable energy generation and storage projects, supported by transmission infrastructure. A REZ connects renewable energy generation and energy storage systems to transmission infrastructure via energy hubs, requiring the coordination of power generation, power storage and transmission infrastructure. By doing so, REZs capitalise on economies of scale to deliver cheap, reliable and clean electricity for homes, businesses and industry in NSW.

The Central-West Orana REZ was formally declared on 5 November 2021 under the *Electricity Infrastructure Investment Act 2020*. As NSW's first REZ, the Central-West Orana REZ will play a pivotal role in underpinning NSW's transition to a clean, affordable and reliable energy sector. The Central-West Orana REZ declaration (November 2021) provides for an initial intended network capacity of three gigawatts. The NSW Government is proposing to amend the declaration to increase the intended network capacity to six gigawatts, which would allow for more renewable energy from solar, wind and storage projects to be distributed through the NSW transmission network.

The proposed amendment is consistent with the NSW Network Infrastructure Strategy (EnergyCo, 2023) which identifies options to increase network capacity to 4.5 gigawatts initially under Stage 1 (which would be based on the infrastructure proposed in this assessment) and up to six gigawatts by 2038 under Stage 2 (which would require additional infrastructure beyond the scope of this assessment, and subject to separate approval). The proposed amendment also supports recent modelling by the Consumer Trustee in the draft 2023 Infrastructure Investment Objectives Report (AEMO, 2023) showing more network capacity will be needed to meet NSW's future energy needs as coal-fired power stations progressively retire.

Energy Corporation of NSW (EnergyCo), a NSW Government statutory authority, has been appointed as the Infrastructure Planner under the *Electricity Infrastructure Investment Act 2020*, and is responsible for the development and delivery of the Central-West Orana REZ. EnergyCo is responsible for coordinating REZ transmission, generation, firming and storage projects to deliver efficient, timely and coordinated investment.

EnergyCo is seeking approval for the construction and operation of new electricity transmission infrastructure and new Energy Hubs and switching stations that are required to connect energy generation and storage projects within the Central-West Orana REZ to the existing electricity network (the project).

1.2 Purpose of this paper

This technical paper assesses the potential impacts to traffic and transport from the construction and operation of the project and has been prepared to support and inform the Environmental Impact Statement (EIS).

This technical paper has been prepared to address the relevant Secretary's environmental assessment requirements (SEARs) for the project issued by the Secretary of the NSW Department of Planning and Environment (DPE) for the project on 7 October 2022, and supplementary SEARs on 2 March 2023. The SEARs relevant to the assessment of Traffic and Transport are presented in Table 1-1.

Table 1-1 SEARs relevant to this paper

Reference	Assessment requirement	Location where it is addressed
Traffic and Transport	An assessment of the potential transport impacts for all stages of the project on the capacity, condition, safety and efficiency of the local and State road network and the rail network;	Chapter 5 for assessment of construction impacts Chapter 6 for assessment of operational impacts
	A cumulative impact assessment of traffic from nearby developments;	A separate EIS chapter is prepared for Cumulative Impact Assessments
	Details of the ongoing maintenance works required to service assets, outlining the measures to maintain the road; and	Chapter 6
	Provide details of measures to mitigate and/or manage potential impacts including a schedule of all required road upgrades and any other traffic control measures, developed in consultation with the relevant road and/or rail authority.	Chapter 7

1.3 Project overview

The project comprises the construction and operation of the new electricity transmission infrastructure and new Energy Hubs and switching stations within the Central-West Orana REZ. The project would enable 4.5 gigawatts of new network capacity to be unlocked by the mid-2020s (noting the NSW Government's proposal to amend the Central-West Orana REZ declaration to allow for a transfer capacity of six gigawatts), and enable renewable energy generators within the Central-West Orana REZ who are successful in their bids to access the new transmission infrastructure to export electricity to the rest of the network. The detailed project description is provided in Chapter 3 of the EIS.

1.3.1 Features

The project would comprise the following key features:

- a new 500 kV switching station (the New Wollar Switching Station), located at Wollar to connect the project to the existing 500 kV transmission network
- around 90 kilometres of twin double circuit 500 kV transmission lines and associated infrastructure to connect to connect two energy hubs to the existing NSW transmission network via the New Wollar Switching Station
- energy hubs at Merotherie and Elong Elong (including potential battery storage at the Merotherie Energy Hub) to connect renewable energy generation projects within the Central-West Orana REZ to the 500 kV network infrastructure
- around 150 kilometres of single circuit, double circuit and twin double circuit 330 kV transmission lines, supported on towers, to connect renewable energy generation projects within the Central-West Orana REZ to the two energy hubs
- thirteen switching stations along the 330 kV network infrastructure at Cassilis, Coolah, Leadville, Merotherie, Tallawang, Dunedoo, Cobbora and Goolma, to transfer the energy generated from the renewable energy generation projects within the Central-West Orana REZ onto the project's 330 kV network infrastructure
- underground fibre optic communication cables along the 330 kV and 500 kV transmission lines between the energy hubs and switching stations
- a maintenance facility within the Merotherie Energy Hub to support the operational requirements of the project

- microwave repeater sites at locations along the alignment, as well as outside of the alignment at Botobolar, to provide a communications link between the project and the existing electricity transmission and distribution network. The Botobolar site would be subject to assessment at the submissions report stage
- establishment of new, and upgrade of existing access tracks for transmission lines, energy hubs, switching stations and other ancillary works areas within the construction area (such as temporary waterway crossings, laydown and staging areas, earthwork material sites with crushing, grinding and screening plants, concrete batching plants, brake/winch sites, site offices and workforce accommodation camps)
- property adjustment works to facilitate access to the transmission lines and switching stations. These works include the relocation of existing infrastructure on properties that are impacted by the project
- utility adjustments required for the construction of the transmission network infrastructure, along with other adjustments to existing communications, water and wastewater utilities. This includes adjustments to Transgrid's 500 kV transmission lines 5A3 (Bayswater to Mount Piper) and 5A5 (Wollar to Mount Piper) to provide a connection to the existing NSW transmission Network, including new transmission line towers along the Transgrid network along the frontage of the New Wollar Switching Station, and other locations where there is an interface with Transgrid’s network.

1.3.2 Location

The project is located in Central-West NSW within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter Local Government Areas (LGAs). It extends north to south from Cassilis to Wollar and east to west from Cassilis to Goolma. The location is shown in Figure 1-1.

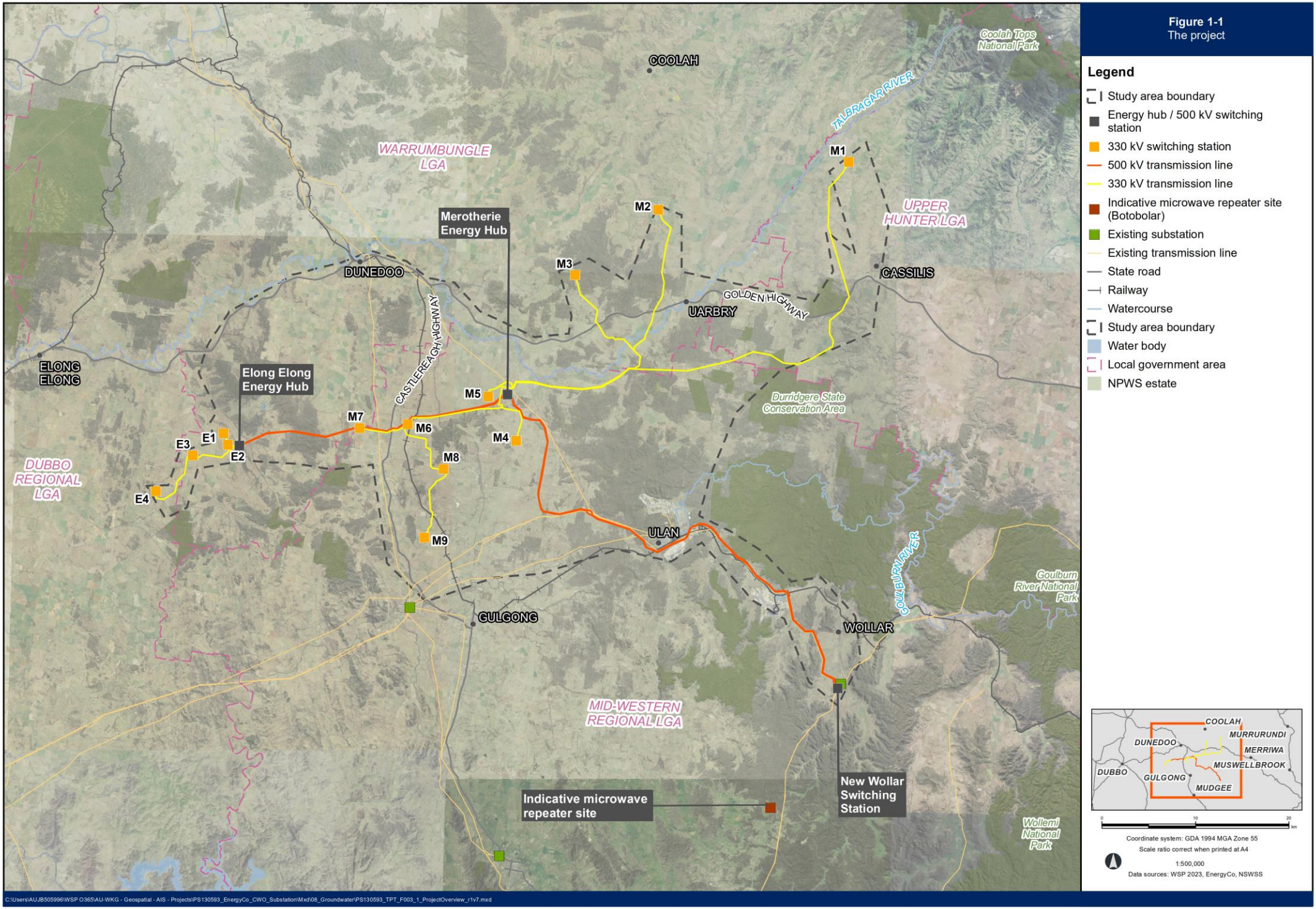

Figure 1-1
The project

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Indicative microwave repeater site (Botobolar)
- Existing substation
- Existing transmission line
- State road
- Railway
- Watercourse
- Study area boundary
- Water body
- Local government area
- NPWS estate

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:500,000
Data sources: WSP 2023, EnergyCo, NSWSS

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1.3.3 Timing

Construction of the project would commence in the second half of 2024, subject to NSW Government and Commonwealth planning approvals, and is estimated to take about four years. The project is expected to be commissioned/energised (i.e. become operational) in late 2027.

1.3.4 Construction

Key construction activities for the project would occur in the following stages:

- enabling works
- construction works associated with the transmission lines
- construction works associated with energy hubs and switching stations
- pre-commissioning and commissioning of the project
- demobilisation and rehabilitation of areas disturbed by construction activities.

Excavation and land forming works within the construction area would be required for transmission line tower construction, site preparation works at the energy hubs and switching station sites to provide level surfaces, to create trenches for drainage, earthing, communications infrastructure and electrical conduits, and to construct and upgrade access tracks.

Construction vehicle movements would comprise heavy and light vehicles transporting equipment and plant, construction materials, spoil and waste from construction facilities and workforce accommodation camp sites. There would also be additional vehicle movements associated with construction workers travelling to and from construction areas and workforce accommodation camp sites. These movements would occur daily for the duration of construction.

To support the construction of the project a number of construction compounds would be required including staging and laydown facilities, concrete batching plants, workforce accommodation camps and construction support facilities. The main construction compounds would be established as enabling work and demobilised at the completion of construction. The size of the construction workforce would vary depending on the stage of construction and associated activities. During the peak construction period, an estimated workforce of up to around 1,800 people would be required.

1.3.5 Operation

Permanent project infrastructure would be inspected by field staff and contractors on a regular basis, with other operational activities occurring in the event of an emergency (as required). Regular inspection and maintenance activities are expected to include:

- regular inspection (ground and aerial) and maintenance of electrical equipment and easements
- fault and emergency response (unplanned maintenance)
- general building, asset protection zone and landscaping maintenance
- fire detection system inspection and maintenance
- stormwater maintenance
- remote asset condition monitoring
- network infrastructure performance monitoring.

Operation of the project would require the establishment of transmission line easements. These easements would be around 60 metres for each 330 kV transmission line and 70 metres for each 500 kV transmission lines. Where network infrastructure is collocated, easement widths would increase accordingly (for example, a twin double circuit 500 kV transmission line would have an easement about 140 metres wide). Vegetation clearing would be required to some extent for the full width of the transmission line easement, depending on the vegetation types present.

1.4 Structure of the paper

The structure and content of this technical paper is as follows:

- Chapter 1 – Introduction: Provides an introduction to this technical paper (this chapter)
- Chapter 2 – Legislative and policy context: Provides an overview of the regulatory context for the assessment, including an overview of the legislation, policy and guidelines that apply to the project
- Chapter 3 – Methodology: Outlines the methodology adopted for this assessment
- Chapter 4 – Existing environment: Describes the existing environment within the traffic and transport assessment study area
- Chapter 5 – Construction assessment: Describes the potential construction impacts associated with the project
- Chapter 6 – Operational assessment: Describes the potential operational impacts associated with the project
- Chapter 7 – Recommended Management and mitigation measures: Details recommended mitigation and management measures to minimise the traffic and transport impacts
- Chapter 8 – References: Identifies the key reports and documents used to generate this technical paper.

The appendices to this paper are:

- Appendix A – Low impact local roads.

2 Legislative and policy context

Environmental planning approval for the project is required in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act). The project is also a controlled action and would therefore requires Commonwealth assessment and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Sections 5.12 and 5.13 of the EP&A Act provide for the declaration of State significant infrastructure (SSI) and Critical State significant infrastructure (CSSI). On 23 November 2020, the Minister for Planning made the Environmental Planning and Assessment Amendment (Central-West Orana Renewable Energy Zone Transmission Order) 2020. The Order declares the whole Central-West Orana REZ Transmission project to be CSSI.

This section describes the legislation and policy relevant to the assessment of traffic and transport impacts.

2.1 Legislation

2.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is administered by the NSW Department of Planning and Environment and includes provisions for the assessment of environmental impact statements (EISs).

The EP&A Act requires that an EIS be prepared according to the Planning Secretary's Environmental Assessment Requirements (SEARs), and subsequently placed on public exhibition for a period of at least 28 days. The Planning Secretary would then prepare an environmental assessment report for consideration of approval of the project by the Minster for Planning. The SEARS identify that the EIS for the project must comply with the requirements in Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. This technical paper has been developed to provide the EIS with technical assessment of the traffic and transport impacts likely to be caused by the project.

2.1.2 Roads Act 1993

The *Roads Act 1993* (Roads Act) aims to establish the rights of members of the public to pass along public roads, rights of persons who own land adjoining a public road to have access to the public road, and to establish the procedures for the opening and closing of a public road. The Roads Act also aims to provide a structure for the classification of roads, empower public agencies such as Transport for NSW as the road authorities and regulate the carrying out of various activities on public roads, including the transportation of construction materials with heavy vehicles.

This project is consistent with the *Environmental Planning and Assessment Act 1979* and *Roads Act 1993* by ensuring that the appropriate processes, approvals and measures are in place to manage the impacts to users of the public roads, property owners and the opening/closing of public roads.

Part 9 of the Roads Act nominates the requirements for undertaking works within a public road, including the requirement to obtain consent under section 138 for carrying out works in, on or over a public road (this includes the erection of structures), and the digging up or disturbance of the surface of a public road. In relation to section 138 consents, Section 5.24 of the EP&A Act lists the approvals or authorisations that cannot be refused if they are necessary for carrying out approved CSSI and are substantially consistent with the CSSI approval. A consent under section 138 of the Roads Act is one of the approvals listed under section 5.24 of the EP&A Act.

2.1.3 NSW Road Rules, 2014

The *NSW Road Rules 2014* are a framework for safe and efficient movement of traffic on NSW roads. The NSW Road Rules are a legislative instrument with the following objectives:

- to consolidate in a single instrument the road rules that are applicable in New South Wales, and
- to provide for road rules that are based on the *Australian Road Rules* so as to ensure that the road rules applicable in this State are substantially uniform with road rules applicable elsewhere in Australia, and
- to provide for other road rules to be observed in this State in relation to matters that are not otherwise dealt with in the *Australian Road Rules*.

The project would support the objectives of the legislation by ensuring recommended mitigation measures are aligned with the Road Rules.

2.2 Policy, standards and guidelines

This section outlines government plans, policies and guidelines, particularly those that identify the methods for assessing the impacts of key matters and set standards and performance criteria for evaluating the incremental and cumulative impacts of projects.

2.2.1 Austroads Guide to Traffic Management and Road Design

The Austroads *Guide to Traffic Management* comprises thirteen parts, and provides comprehensive traffic management guidance for practitioners involved in traffic engineering, road design and road safety. It recognises that the management of traffic is to be based on an understanding of road design and the capabilities and behaviour of all road users, and on the performance and characteristics of vehicles.

This guide has informed the assessment methodology for the road network performance assessment for the project. This includes intersection performance, mid-block capacity performance and management strategies to minimise the impacts of traffic and transport movements generated by the project.

Austroads *Guide to Road Design* has seven parts and provides designers with a framework that promotes efficiency in design and construction, economy and both consistency and safety for road users. This guide is referred to in this study when the assessment of road geometry is required to assess the impact of construction and operation of the project.

2.2.2 Guide to Traffic Generating Developments

Transport for NSW's Guide to Traffic Generating Developments was first released in 1991, revised in 2001 and is in the process of being further revised. It provides guidance on a number of matters related to the traffic impacts of land use developments, most notably on matters relating to traffic generation and parking. This includes policies, guidelines on traffic impact studies methodologies, traffic generation, interpretation of traffic impacts, parking requirements, access and parking area design, residential subdivision design and associated cost implications.

This guideline was considered in this study to guide the traffic impact assessment methodology, traffic generation and assessment of property accesses.

2.2.3 Traffic Control at Work Sites – Technical Manual

The *Traffic Control at Work Sites – Technical Manual 2022* is a Transport for NSW document which provides the requirements for temporary traffic management at Transport construction and maintenance work sites.

The aim is to protect the safety for all transport mode users (vehicles, pedestrians, cyclists etc.) travelling around or passing through work sites. This manual applies to all persons, including construction site staff and members of the public. It is intended to help personnel to comply with the *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2017*. It contains:

- guidance to develop, select or design Traffic Guidance Scheme (TGS) for a range of work activities
- information on how to develop a traffic management plan (TMP) and risk assessment prior to development of a TGS
- technical requirements for signs and devices used to manage traffic at work sites.

This guide refers to Australian Standards 1742 (*Manual of uniform traffic control devices*) and 1743 (*Road signs – specifications*) to have consistent application with the Australian Standards. Temporary works on public roads detailed in this technical paper consider the practices detailed in this guideline.

2.2.4 2026 Road Safety Action Plan

The 2026 Road Safety Action Plan is a framework by the NSW Government which seeks to continue the accomplishment of the Road Safety Plan 2021 with new road trauma reduction targets for 2030, setting NSW on a path towards zero road trauma by 2050.

The four elements of the Safe System approach, first used in Scandinavia, are safer people, safer roads, safer speeds and safer vehicles. This strategy highlights the need to improve the safety of all parts of the system, so that if one part fails, the other parts will protect people from being killed or seriously injured.

With all of these elements working together as a whole, the system is more forgiving of human or mechanical error and the impact of a mistake made on the road does not result in a fatality or serious injury.

The underlying principles of the Safe System approach are that:

- road safety is a shared responsibility
- the human body can only withstand limited forces in a crash before this results in a fatality or serious injury
- continuous improvements in vehicles, roads and behaviour will reduce fatalities and serious injuries.

The mitigation measures detailed in Chapter 7 of this technical paper consider the principles of Safe System approach that would provide a safe temporary road environment.

2.2.5 NSW Heavy Vehicle Access Policy Framework

The *NSW Heavy Vehicle Access Policy Framework 2018* aims to provide a framework for heavy vehicle access in NSW for roads managed by both state government and local council. As part of the project, heavy vehicles would be required to carry freight, including construction materials, to locations within the study area. This Framework provides a platform to consider areas of priority such as safety and the capacity of road infrastructure (including roads and bridges).

2.2.6 New South Wales Class 1 Load Carrying Combination (Hunter Region) Mass and Dimension Exemption Notice Operator's Guide

In July 2020, the National Heavy Vehicle Regulator (NHVR) released an Exemption Notice ('Notice') to support the oversize over mass (OSOM) vehicle movements to transport mining equipment across the Hunter Valley.

The Notice is the largest mass and dimension notice in the country, covering vehicles up to 184.5 tonnes for a combination up to 39.9 metres long, 5.9 metres wide and 5.2 metres high, travelling across the local government areas of Newcastle, Port Stephens, Singleton, Maitland, Upper Hunter and Warrumbungle.

The Notice is aimed at reducing the processes and provide certainty for the local mining and freight industry.

3 Methodology

This section outlines the methodology applied to undertake the traffic and transport assessment for the project in response to the SEARs, and in accordance with the abovementioned legislation, policy and guidelines that apply to the project.

3.1 Methodology overview

Relevant information related to the project construction methodology, workforce vehicle movements and logistics for the delivery of plant, equipment and project infrastructure has been provided by EnergyCo to assist in the completion of this assessment. This traffic and transport impact assessment aims to assess the key issues raised in the SEARs as listed in Section 1.2, within the defined study area described in Section 3.2. The methodology adopted in this technical paper can be summarised as follows:

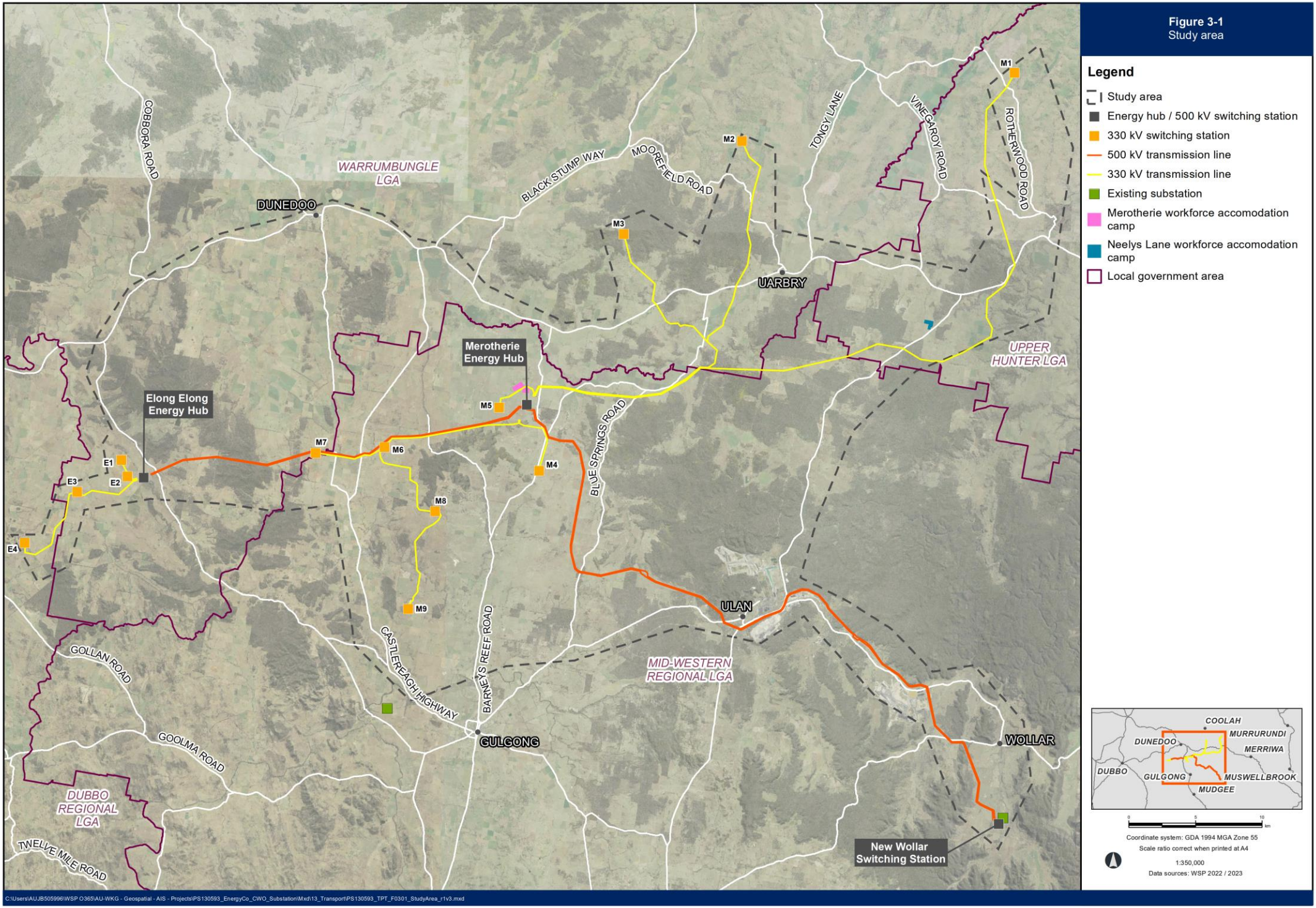
- desktop and mapping analysis to identify, describe and qualitatively assess the existing conditions of construction routes, including road classification, lane configuration, speed limit, pavement type, pedestrian/cyclist facilities, the existing heavy vehicle restrictions, crash history, traffic operating performance, and public transport provisions
- undertake data collection at the appropriate locations to understand the existing conditions and traffic demand and patterns to further assess the impact of the project
- review of the proposed construction activities and methodology to derive the expected traffic generation and traffic distribution during construction of the project
- assessment of the potential impacts associated with the construction of the project with regards to road capacity, road condition, road safety, efficiency, heavy vehicle access, access to construction compounds and workforce accommodation camps, temporary access tracks, property access, stringing of transmission lines, active transport and public transport
- review the operational activities (i.e. maintenance of transmission line, energy hubs and switching stations) and assess the potential impacts associated with road capacity, road condition, road safety, efficiency, active transport, public transport and property access
- identify mitigation and management measures to be applied to construction and operation of the project to avoid, minimise and manage the potential traffic and transport impacts of the project, as far as practicable.

3.2 Study area

The study area for this Transport and Traffic Impact Assessment (TTIA) has been identified as the transport networks that may be impacted by construction movements to and from the Energy Hubs, switching stations, access gates, construction compounds and workforce accommodation camps, or by the operation of the project (staff and maintenance movements).

As construction workforce and material origins are expected to be widely distributed across the broader region, the study area is identified as those roads and associated transport facilities (e.g. parking, active transport, heavy vehicle, public transport networks) which provide access to the construction sites, back to the nearest highway. Beyond this point, the construction traffic is expected to diminish as it is distributed across the broader network to multiple origins and represents no measurable impact.

The traffic and transport study area spans across the Warrumbungle Shire, Upper Hunter Shire, Mid-Western Regional and Dubbo Regional Council Local Government Areas (LGAs), as depicted in Figure 3-1.


COBBORA ROAD
WARRUMBUNGLE LGA
DUNEDOO
BLACK STUMP WAY
MOOREFIELD ROAD
TONGY LANE
VINEGAROY ROAD
ROTHERWOOD ROAD
M1
M2
M3
UARBRY
UPPER HUNTER LGA
Merotherie Energy Hub
Elong Elong Energy Hub
M5
M7
M6
M4
BLUE SPRINGS ROAD
E1
E2
E3
E4
M8
M9
ULAN
GOLLAN ROAD
CASTLEREAGH HIGHWAY
BARNEYS REEF ROAD
MID-WESTERN REGIONAL LGA
GULGONG
WOLLAR
GOOLMA ROAD
DUBBO REGIONAL LGA
TWELVE MILE ROAD
New Wollar Switching Station
Figure 3-1
Study area
Legend
Study area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing substation
Merotherie workforce accomodation camp
Neelys Lane workforce accomodation camp
Local government area
COOLAH
MURRURUNDI
DUNEDOO
MERRIWA
DUBBO
GULGONG
MUSWELLBROOK
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3.3 Existing conditions assessment

3.3.1 Transportation network

The existing conditions assessment involves undertaking desktop and mapping analysis to identify, describe and qualitatively assess the existing conditions of construction traffic routes, including road classification, lane configuration, speed limit, pavement type, pedestrian/cyclist facilities, the existing heavy vehicle restrictions, crash history, traffic operating performance, and public transport provisions. A number of these items are available as data sets from Transport for NSW's Open Data platform.

Traffic data were also collected to understand the existing conditions and traffic demand and patterns to further assess the impact of the project. The methodology and locations are further described in Section 3.3.2 below.

3.3.2 Data collection

Data collection consisted of a combination of intersection traffic counts and midblock surveys. The locations of data collection are depicted in Figure 3-2 and the intersection and midblock locations are described in Table 3-1 and Table 3-2, respectively. The intersection counts and midblock (automatic traffic counters) surveys were conducted to understand the current traffic demands, conditions and travel patterns.

Intersection traffic counts were undertaken on Wednesday 19 October 2022 between 6.00 am–10.00 am and 3.00 pm–7.00 pm to capture the traffic movements at key intersections listed in Table 3-1. The survey provided separated traffic counts for light and heavy vehicles. 24-hour midblock counts (Automatic Traffic Counters) were conducted at key mid-block locations between 16 and 23 October 2022 to capture traffic data including volume, speed and vehicle classifications across this period. The locations of mid-block traffic counts are listed in Table 3-2.

The survey locations were selected based on:

- potential construction routes to be used for construction of the project
- likely access points to the key construction areas, construction compounds, and workforce accommodation camps.

It is noted that the traffic count surveys were completed prior to finalisation of construction routes and study area. Therefore, there are several survey locations that are located outside of the study area. These survey locations have been listed in this section; however, are not further assessed in the construction and operational impact assessment of this technical paper. The locations of data collection are depicted in Figure 3-2 and correspond to the identification numbers listed in Table 3-1 (for intersections survey locations) and Table 3-2 (for mid-block count locations).

Figure 3-2
Traffic survey locations

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Transmission line alignment

General construction route

- Heavy vehicles and light vehicles
- Light vehicles only
- Intersection counts
- Mid-block counts

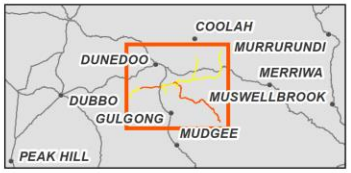

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Table 3-1 Intersection count locations

No.	Location	Suburb	LGA
I-01	Black Stump Way/Golden Highway*	Leadville	Warrumbungle
I-02	Merotherie Road/Golden Highway	Leadville	Warrumbungle
I-03	Spring Ridge Road/Golden Highway	Cobbora	Warrumbungle
I-04	Golden Highway/Ulan Road	Cassilis	Upper Hunter
I-05	Ulan Road/Ulan-Wollar Road	Ulan	Mid-Western
I-06	Ulan Road/Cope Road (Main Street)	Ulan	Mid-Western
I-07	Wollar Road/Barigan Street/Phillip Street	Wollar	Mid-Western
I-08	Cope Road/Springwood Park Road*	Cope	Mid-Western
I-09	Cope Road/Blue Springs Road	Stubbo	Mid-Western
I-10	Black Stump Way (Binnia Street)/Vinegaroy Road (Campbell Street) *	Coolah	Warrumbungle
I-11	Castlereagh Highway/Goolma Road	Gulgong	Mid-Western
I-12	Castlereagh Highway/Laheys Creek Road	Beryl	Mid-Western
I-13	Saleyards Lane/Cope Road*	Gulgong	Mid-Western
I-14	Mitchell Highway/Goolma Road*	Montefiores	Dubbo Regional
I-15	Brooklyn Road/Laheys Creek Road	Dunedoo	Warrumbungle

* site was surveyed however the location is not part of the construction route

Table 3-2 Midblock count locations

No.	Location	Road classification	LGA
H01	Golden Highway (near Spring Ridge Road, west of Dunedoo), Dunedoo	Highway	Warrumbungle
H02	Golden Highway (between Ulan Road and Merotherie Road), Uarbry	Highway	Warrumbungle
H03	Castlereagh Highway (between Golden Highway and Tucklan Road), Birriwa	Highway	Mid-Western
H04	Castlereagh Highway (north-west of Old Mill Road), Gulgong	Highway	Mid-Western
H05	Castlereagh Highway (north of Laheys Creek Road), Beryl	Highway	Mid-Western
H07	Mitchell Highway (west of Goolma Road), Montefiores*	Highway	Dubbo Regional
H08	Mitchell Highway (north of Saxa Road), Montefiores*	Highway	Dubbo Regional
H09	Castlereagh Highway (north-west of Putta Bucca Road), Mudgee*	Highway	Mid-Western
M01	Cope Road (between Blue Springs Road and Springwood Park Road), Cope	Main road	Mid-Western
M02	Cope Road (north east of Saleyards Lane), Gulgong	Main road	Mid-Western
M07	Vinegaroy Road (south of Rotherwood Road), Coolah*	Main road	Warrumbungle
M08	Ulan Road (north-east of Lue Road), Milroy*	Main road	Mid-Western

No.	Location	Road classification	LGA
M09	Black Stump Way (south of Coolah town), Coolah*	Main road	Warrumbungle
R03	Gollan Road (north of Goolma Road), Gollan*	Regional road	Dubbo Regional
L01	Tucklan Road (south of Rhodes Street), Dunedoo	Local road	Warrumbungle
L02	Henry Lawson Road (east of Canadian Lead Road), Gulgong*	Local road	Mid-Western
L03	Laheys Creek Road (west of Castlereagh Highway), Beryl	Local road	Mid-Western
L04	Barneys Reef Road, Gulgong	Local road	Mid-Western
L16	Twelve Mile Road (east of Brookfield Road), Wuuluman*	Local road	Dubbo Regional

* site was surveyed however the location is not part of the construction route

3.3.3 *Crash analysis*

Crash data was sourced from NSW Crash Data accessible from Transport for NSW's Open Data platform. The 5-year crash data available during this assessment extended from 2016 to 2020. The crash analysis completed as part of this assessment includes consideration of the available crash data for roads which form part of the project construction routes within the study area to develop an understanding of the key existing safety issues on the road network which the project may need to be aware of and manage accordingly.

Crash data was grouped by NSW Road Classifications which include Highway (Golden Highway and Castlereagh Highway), Main Road (Cope Road and Ulan Road), Regional (Wollar Road) and Local roads given the large study area extents and importance/heavy usage of these roads by the public.

3.4 Construction traffic assessment

To assess the potential traffic and transport impacts of the project during construction, this a quantitative assessment was undertaken of roads used as construction routes and intersection capacity, along with a qualitative assessment of impacts to the broader transport network.

The quantitative assessment has been completed taking into consideration the project's construction routes and forecasted construction traffic as described in Section 3.4.1 and 3.4.2 respectively.

Due to the size of the construction area and nature of construction works which are not static, the quantitative assessment involves forecasting a threshold of construction traffic movements which would represent the highest traffic demand likely to be experienced along the construction routes within the study area.

These volumes were added to the surveyed traffic demand (existing conditions) to enable a capacity assessment of the road network to be completed, assessed against the criteria discussed in Section 3.7. No background traffic growth factors were applied to the existing traffic demand, as there is minimal land use growth in the study area, with fluctuations in traffic generally attributable to activities generated by other projects in the area (reviewed through the cumulative impact assessment).

In addition to the capacity assessment described above, this technical paper also includes qualitative impact assessment of road and rail operations from stringing transmission lines, road condition, road safety, heavy vehicle routes, property access, active transport and public transport.

The forecasted potential traffic and transport impacts from construction activities for this project are discussed in Chapter 5.

3.4.1 Determination of construction routes

This technical paper has considered the construction routes likely to be used during construction within the study area.

For the purpose of this assessment the construction routes have been classified as:

- **General construction routes** – construction routes required on a regular basis to enable construction activities. This includes:
  - between the main construction compounds to the transmission line construction area
  - between the main construction compounds and workforce accommodation camps
  - between the workforce accommodation camps and the transmission line construction area
  - movement of earthworks materials between sections of the construction area, as required
  - transport of water to workforce accommodation camps, site compounds and ancillary sites.
- **OSOM construction routes** – construction routes that would be used for OSOM movements between ports to the main construction compounds for the delivery of project infrastructure and specialist transmission equipment. This was selected with consideration of existing gazetted OSOM approved routes.

The determination of project construction routes were selected in consultation with relevant stakeholders.

3.4.2 Estimation of project traffic generation

Daily construction vehicle movements have been estimated based on the indicative construction workforce, project construction activities, staging, size of site compound and the number of workforce staying at accommodation camps. Traffic movement generation and distribution to/from the construction area have been estimated based on advice from EnergyCo and typically involves the following activities:

- delivery of materials to/from external sites (e.g. ports, quarry, water source) to the construction area and workforce accommodation camp sites
- workers travelling between workforce accommodation camps and the construction area.

3.4.3 New site access assessment

The design criteria listed below were investigated for new access points.

- **Safe Intersection Sight Distance (SISD)** is the minimum sight distance which should be provided on the major road at any intersection. The calculation method for SISD is detailed in *Austroads Guide to Road Design Part 4A Unsignalised and Signalised Intersections.*
- **Minimum Gap Sight Distance (MGSD)** is based on distances corresponding to the critical acceptance gap that drivers are prepared to accept when undertaking a crossing or turning manoeuvre at intersections. The calculation method for MGSD is detailed in *Austroads Guide to Road Design Part 4A Unsignalised and Signalised Intersections.*
- **Stopping Sight Distance (SSD)** is the distance to enable a normally alert driver, travelling at the design speed on wet pavement, to perceive, react and brake to a stop before reaching a hazard on the road ahead. The calculation method for SSD is detailed in *Austroads Guide to Road Design Part 3 Geometric Design.*
- **Austroads Guidelines Intersection Requirement** – *Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management* includes a methodology to assess the need to provide basic (BA), auxiliary (AU) lane or channelised (CH) lane at a priority-controlled intersections against traffic volumes on the major and minor road.

3.5 Operational traffic assessment

The operation of the project generally involves maintenance works (i.e. maintenance of transmission lines, energy hubs and switching stations) which would be done several times in a year. During its operation, project-generated movements would be associated with maintenance and are likely to be low in volume.

Therefore, the operational traffic assessment aims to qualitatively assess the impacts associated with road capacity, road condition, road safety, efficiency, active transport, public transport and property access.

The operational impacts of the project are discussed in Chapter 6.

3.6 Cumulative traffic impact assessment

The cumulative impact assessment approach involves considering the impacts of the project together with the impacts of other relevant future projects on traffic and transport matters. Relevant projects with the potential for cumulative impacts with the project were identified through a review of publicly available information and environmental impact assessments. These have been detailed in a separate technical assessment (Appendix E) of the EIS.

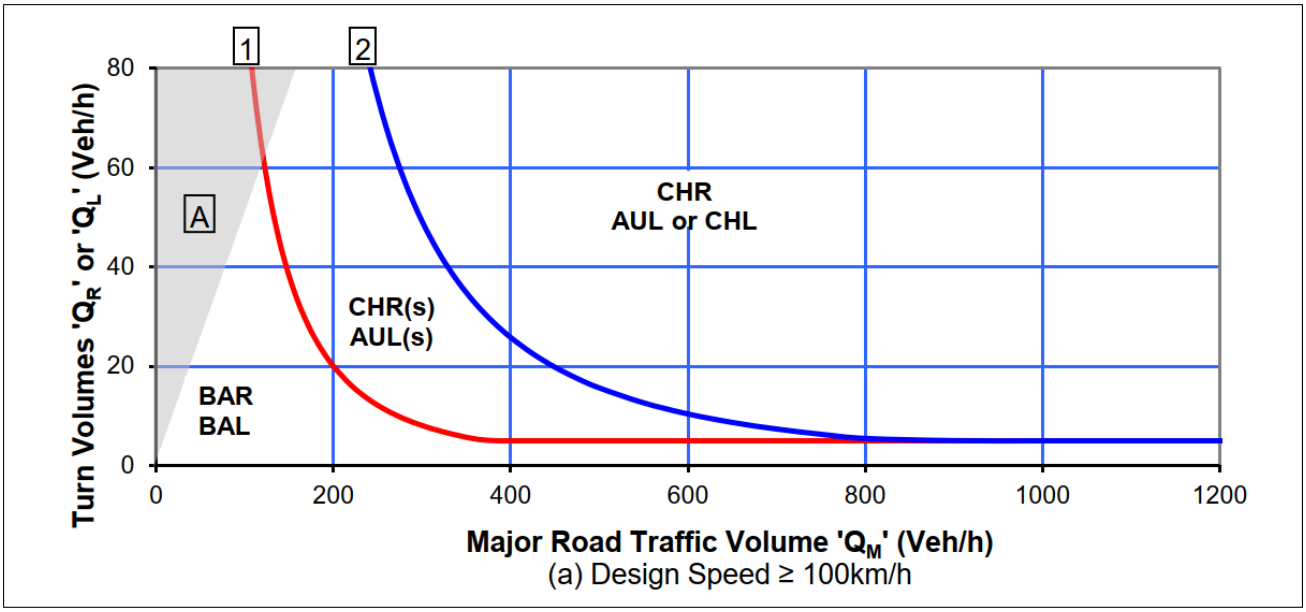
3.7 Assessment criteria

3.7.1 Intersection turn treatment warrant assessment

Quantitative assessments of key intersections have been analysed using Austroads' *intersection turn treatment warrant assessment*. Its evaluation mainly focuses on safety performance outcomes, rather than operational. This was considered as the most appropriate quantitative assessment, given almost all intersections impacted by this project are priority controlled, have low traffic demand, and are operationally observed to have minimal traffic delay and queueing.

This methodology, as described in the *Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management* assess the need for priority-controlled intersections to provide basic (BA), auxiliary (AU) lane or channelised (CH) lane as shown in Table 3-4.

The turn treatment is assessed by analysing the traffic volume demands on the minor and major roads, using the calculation in Table 3-3 and assessed against the graph shown in Figure 3-3. Curves 1 and 2 shown in the diagram are applicable for two-lane two-way roads to depict the boundary between the different treatments (basic and short/regular auxiliary or channelised lanes). For roads with four or more lanes, curve 1 becomes the boundary between a basic and regular auxiliary or channelised lane.

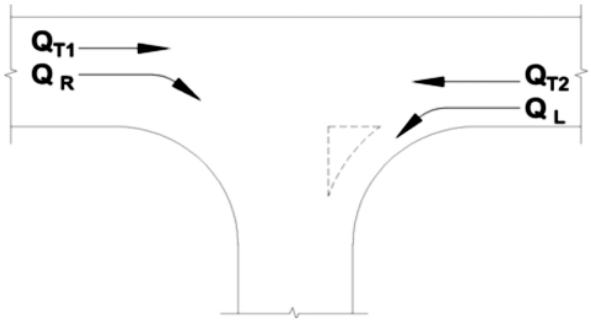


Source: *Austroads Guide to Traffic Management Part 6*

Figure 3-3 Warrants for turn treatments on major roads at unsignalised intersections

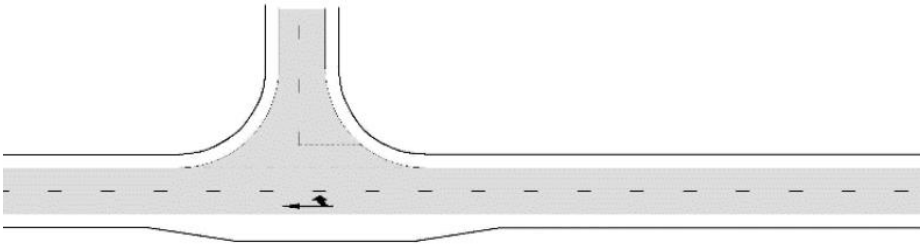
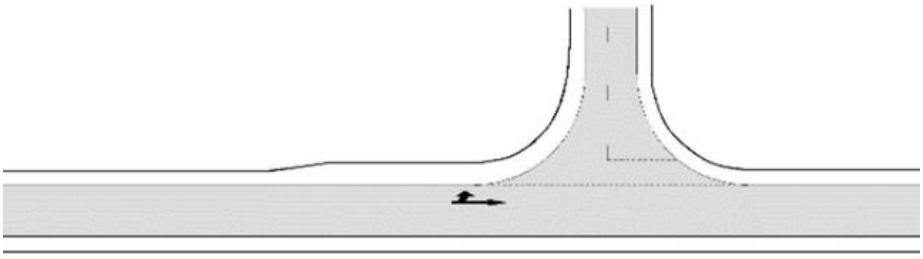
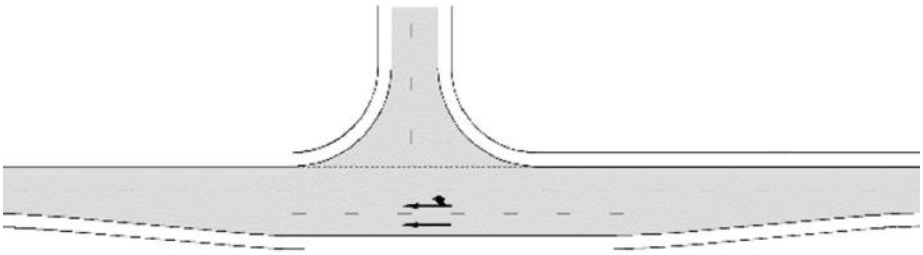
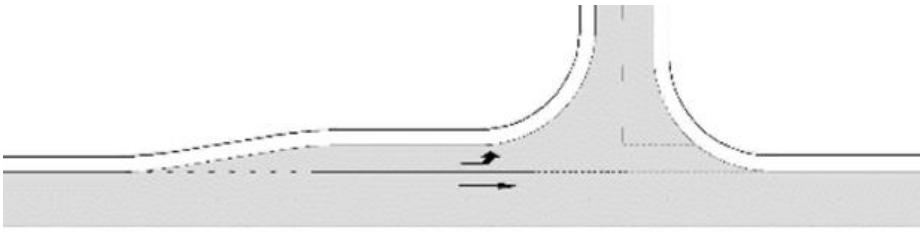
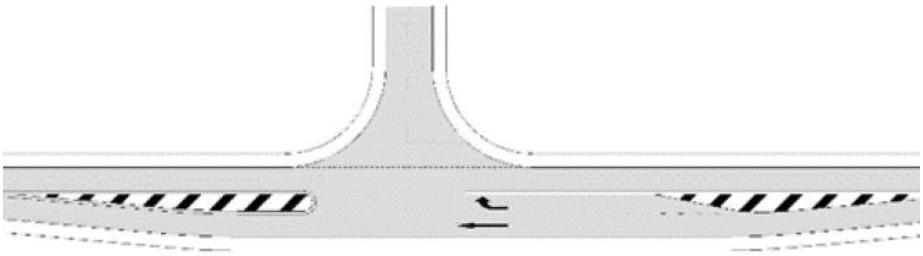
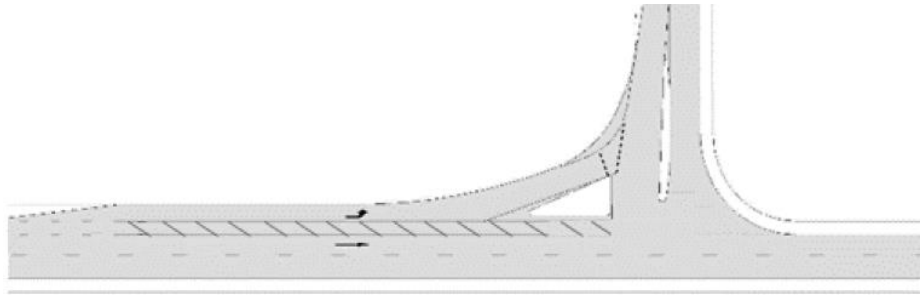
The turn treatment assessment applies to turning movements from the major road only (the road with priority). The calculation of Q_M for varying lane number scenarios are depicted in Table 3-3.

Table 3-3 Calculation of the major road traffic volume Q_M



Road type	Turn type	Splitter island	Q_M (vehicles/hour)
Two-lane two-way	Right	No	= $Q_{T1} + Q_{T2} + Q_L$
		Yes	= $Q_{T1} + Q_{T2}$
	Left	Yes or no	= Q_{T2}
Four-lane two-way	Right	No	= $0.5*Q_{T1} + Q_{T2} + Q_L$
		Yes	= $0.5*Q_{T1} + Q_{T2}$
	Left	Yes or no	= $0.5*Q_{T2}$

Table 3-4 Intersection type – rural roads

Treatment	Right turn
Basic right turn (BAR)	
Basic left turn (BAL)	
Auxiliary right turn (AUR)	
Auxiliary left turn (AUL)	
Channelised right turn (CHR)	
Channelised left turn (CHL)	

Source: Austroads Guide to Traffic Management Part 6

3.7.2 Mid-block road network performance

The level of service (LoS) adopted in the assessment of road network performance (mid-block) focuses on the volume to capacity ratio (V/C ratio) of the roads used as part of construction vehicle routes. This has been selected as the most appropriate method of assessment, with traffic volume metrics being the most accessible data consistently available throughout the study area. This LoS applies to mid-block sections of road and not intersection performance.

The level of service is classified from LoS A representing a free flow condition to LoS F representing unstable flow. The description of the various level of service are listed in Table 3-5.

Table 3-5 Level of Service criteria

Level of Service	Description
A	LoS A describes free-flow operations. Vehicles are almost completely unimpeded in their ability to manoeuvre within the traffic stream.
B	LoS B represents reasonable free-flow operations. The ability to manoeuvre within the traffic stream is only slightly restricted and the general level of physical and psychological comfort provided to drivers is still high.
C	Los C provides the flow conditions with speeds near the free-flow speed. Freedom to manoeuvre within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the drivers.
D	LoS D is the level at which speeds begin to decline slightly with increasing flows, with density increasing more quickly. Freedom to manoeuvre is seriously limited and the drivers experience reduced physical and psychological comfort levels. Performance up to Level of Service D are considered typically acceptable by Transport for NSW.
E	LoS E describes operation at or near capacity. Operations at this level are highly volatile with virtually no usable gaps within the traffic stream, leaving little room to manoeuvre within the traffic stream. The physical and psychological comfort for drivers is poor.
F	LoS F describes unstable flow.

Source: Austroads Guide to Traffic Management

Some assumptions to the traffic lane capacity have been made based on the road function in line with Austroads *Guide to Traffic Management Part 3 – Transport Study and Analysis Methods* and description of road types as detailed in *Design of Roads and Streets Movement and Place* Guideline (Transport for NSW, 2022) as follows:

- **Highway** condition presents a high-speed primary connection between cities and towns in regional areas. Typically entails traffic network which minimises traffic interruption, thus typically consist of wide lanes, road shoulder, channelised turning lanes, no parking and operating speed of 90 km/h or above – typically found in the Highway road network. The theoretical capacity has been adopted at 1,800 vehicles/hour/lane. However, it is considered conservative, as Austroads found that an 80 km/h road with uninterrupted condition can accommodate up to 2,000 vehicles/hour/lane. Highways are part of the Classified Roads in Transport for NSW's *Schedule of Classified Roads and Unclassified Regional Roads* and is operated and maintained by Transport for NSW.
- **Main road** is a secondary connection between cities and towns in regional areas. May also be described as rural arterial road (in Austroads) or rural link (in TfNSW *Design of Roads and Streets Movement and Place* guideline), where the condition presents an interrupted network typically having no parking, some access to properties and side streets. Wide travel lanes and channelised turning lanes to side streets are not necessarily found on this type of road condition. The speed of a main roads are typically moderate to high (80 km/h or above). Main Roads are part of the Classified Roads in Transport for NSW's *Schedule of Classified Roads and Unclassified Regional Roads* and is operated and maintained by Transport for NSW.

- **Regional road** – provide connections between highways or main roads to surrounding land uses. The condition is typically similar to the Main Roads, however, with narrower traffic lanes and shoulder, and poorer pavement quality. Property access and side streets are more commonly found. On-street parking activities may be observed along some sections closer to towns or more dense residential properties. The speed limit may range from low to moderate. Regional road is part of the Unclassified Roads in Transport for NSW's *Schedule of Classified Roads and Unclassified Regional Roads* operated and maintained by the local councils and is often funded in part by both the State and Local Government.
- **Local road** – predominantly have the function to provide access for local properties, and connect them to nearby Highway, Main Road or Regional road. Local road is part of the Unclassified Roads in Transport for NSW's *Schedule of Classified Roads and Unclassified Regional Roads* and is operated, maintained and funded by the local councils. The condition and capacity of the local roads in the study area are assumed to be similar to those of the regional road network.

Table 3-6 provides a measure of each level of service based on the ratio of lane volume compared to the capacity (measured in volume/hour/lane), taken from the Austroads' *Guide to Traffic Management Part 3: Transport Study and Analysis Methods*, based on road functional classification.

Table 3-6 Level of Service description for road performance (road mid-block)

LoS	Highway		Main road		Regional/local	
	V/C	Lane capacity	V/C	Lane capacity	V/C	Lane capacity
A	0.3	540	0.26	360	0.24	240
B	0.47	850	0.41	570	0.38	380
C	0.68	1,220	0.59	830	0.54	540
D	0.89	1,600	0.81	1,130	0.78	780
E	1.00	1,800	1.00	1,400	1.00	1,000
F	>1.00	>1,800	>1.00	>1,400	>1.00	>1,000

Source: *Guide to Traffic Management Part 3: Transport Study and Analysis Methods (Austroads, 2020)*

Note: *Volume to capacity ratio and maximum lane capacity (measured at LOS E) are adopted from Austroads to align with the typical road function and posted speed limit. Lane capacity is measured in vehicles/hour/lane in one direction.*

To understand the impact of additional traffic movements on roads used as part of construction vehicle routes, the following classifications have been applied in Section 5.2.1:

- Low impact: no change in LoS
- Medium impact: one level change in LoS
- High impact: two or more level change in LoS.

4 Existing environment

4.1 Road network

The road network in the study area comprise highways, main roads, regional roads and local roads that connect population centres, mining sites and residential properties with a network of sealed and unsealed local roads.

The existing condition of roads intended to provide construction access for the project are described in this section. The roads listed in this section are depicted in Figure 4-1. The approved heavy vehicle types permitted to access these roads is further discussed in Section 4.3.

To manage the extensive road network, Transport for NSW and the local Councils established an administrative framework of classified and unclassified road categories. Highway and Main Roads are managed and financed by Transport for NSW, Regional roads are typically managed by local councils and financed by both state and local governments, and Local Roads are managed and financed by Councils. The existing conditions of the road network are presented based on the categories under this administrative framework, which is known as the *NSW Schedule of Classified Roads and Unclassified Regional Roads*.

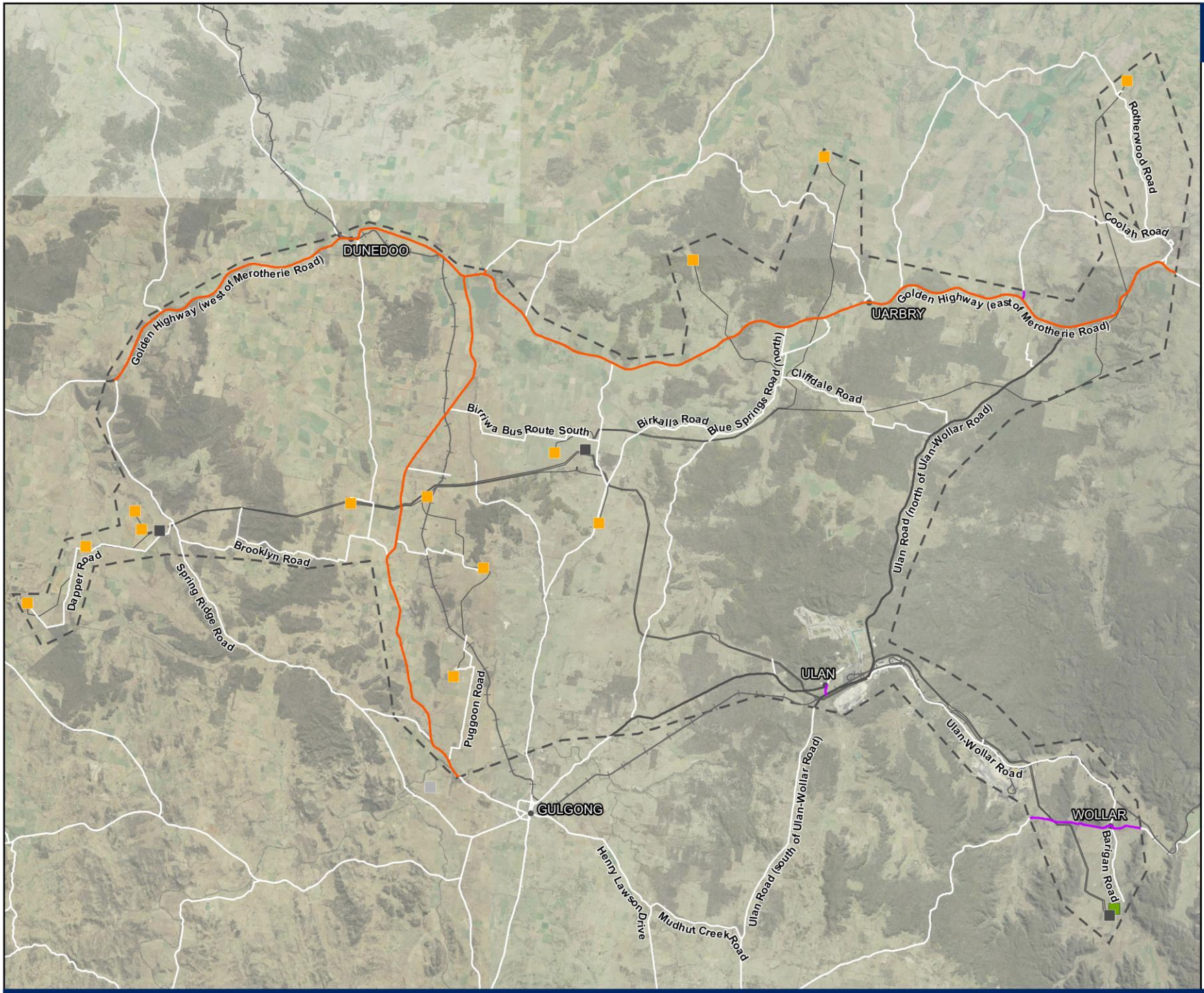


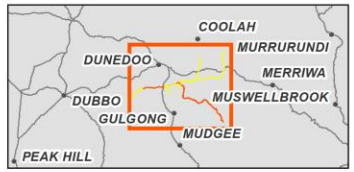
Figure 4-1
NSW Road Network Classifications for construction routes within the study area

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing substation
- Transmission line alignment
- Railway

Classifed Road Network

- Highway
- Main Road
- Regional



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4.1.1 Highway road network

The key highways within the study area include the Golden Highway and Castlereagh Highway. Highways are the primary road network which have the important role of carrying traffic and linking routes for the movement of people and goods/materials for the region. Highways form part of classified roads, operated and maintained by Transport for NSW and are typically constructed to a standard suitable to accommodate the higher traffic demand, high-speed conditions and for freight movements. These roads are typically sealed, two-lanes two-way with wide travel lanes, narrow (<2.0 metres) road shoulders, has auxiliary lanes at key intersections, large horizontal and vertical curve radii.

The speed limit on the highways are generally 100 km/h, dropping down to 80 km/h when approaching towns and further reduces to 50 or 60 km/h within town environments. When passing through towns, the highways typically have wider road width to accommodate kerbside parking and paths for walking or cycling to support the towns' activities. Other descriptions are detailed in Table 4-1.

Table 4-1 Highway road network within the study area

Road name	Description	Pavement	Configuration and speed limit
Golden Highway (B84)	The Golden Highway extends between Dubbo in the west to the New England Highway, near Singleton in the east, including around 313-kilometres within the study area. Throughout its length, it passes several towns including Denman, Merriwa, Dunedoo, Elong Elong, Ballimore and Dubbo. The Golden Highway has an important role for freight, servicing various regional towns and industries including farmland and mining. The Golden Highway is pre-approved for access by Restricted Access Vehicles (RAV) OSOM vehicles.	Sealed	Bidirectional two-lane road (one lane in each direction) Predominantly 100 km/h posted speed limit. 50 km/h within regional towns
Castlereagh Highway (B55)	Castlereagh Highway is around 790 kilometres long, extending north-south between the Carnarvon Highway near St. George in Queensland to the Great Western Highway near Lithgow in the south. Near the study area, it passes several towns including Mudgee, Gulgong and Dunedoo. It shares the same alignment with the Golden Highway (B84) for about 10 kilometres in Dunedoo.	Sealed	Bidirectional two-lane road (one lane in each direction) Predominantly 100 km/h posted speed limit. 50 km/h within regional towns

4.1.2 Main road network

There are two main roads in the study area which would be used for construction traffic as listed in Table 4-2. Main roads are classified roads which has a function support the highways by connecting smaller towns to the highway network and with each other in rural areas.

Main roads are typically sealed, bidirectional two-lane roads (one lane in each direction) with wide travel lanes, unsealed road shoulders, basic turn treatments at key intersections and less generous horizontal and vertical curve radii when compared to the highway road network.

Table 4-2 Main road network within the study area

Road name	Description	Pavement	Configuration and speed limit
Ulan Road	Approximately 72 kilometres long, providing a north-south connection between the Golden Highway in the north and Mudgee town centre. It passes through the Ulan township and surrounding coal mines nearby.	Sealed	Bidirectional two-lane road (one lane in each direction) 100 km/h posted speed limit
Cope Road	Approximately 24 kilometres long, extending between Gulgong town centre and Cope Road–Ulan Road intersection.	Sealed	Bidirectional two-lane road (one lane in each direction) 100 km/h posted speed limit

4.1.3 Regional roads

Wollar Road is the only regional road in the study area which is described in Table 4-3.

Table 4-3 Regional Road network within the study area

Road name	Description	Pavement	Configuration and speed limit
Wollar Road	Approximately 39 kilometres long, connecting the township of Wollar to Ulan Road and towards Mudgee further south.	Sealed	Bidirectional two-lane road (one lane in each direction) 100 km/h posted speed limit

4.1.4 Local roads

There are 29 local roads in the study area which are listed in Table 4-4 which would form part of the construction vehicle routes for the project. These roads would mostly be used to access the transmission construction area during construction.

The posted speed limit information included in the table below are obtained from Transport for NSW's Open Data, however their appropriateness for the road conditions have not been checked in this assessment.

Table 4-4 Local road network within the study area

Road name	Description	Pavement	Configuration and speed limit
Ancrum Street, Cassilis	A short section of local road in Cassilis town centre between Coolah Road and Uarbry Road	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 50 km/h

Road name	Description	Pavement	Configuration and speed limit
Bald Hill Road, Dunedoo	Extends east-west for around 10 kilometres between Gollan Road and Sandy Creek Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Barigan Road, Wollar	Extends south of Wollar Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Barigan Street, Wollar	A continuation of Ulan-Wollar Road which becomes the main access road in the village of Wollar	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 50 km/h
Birkalla Road, Merotherie and Bungaba	Extends for around 10 kilometres between Merotherie Road and Blue Springs Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Birriwa Bus Route South, Birriwa and Merotherie	Approximately 12 kilometres in length connecting Castlereagh Highway in Birriwa to Merotherie Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Blue Springs Road, Bungaba and Uarby	Approximately 30 kilometres in length, with a north-south alignment, connecting the Golden Highway to Cope Road	Sealed with unsealed shoulders and no line marking in the southern section. Unsealed in the northern section	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Brooklyn Road, Dunedoo	Approximately 6 kilometres in length, with an east-west alignment, connecting Lahey Creeks Road to Corishs Lane	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Cassilis Road, Cassilis	Approximately 1.5 kilometres in length, with a north-south alignment, located in the village of Cassilis. It connects the village of Cassilis to Golden Highway	Sealed with unsealed shoulders	Bidirectional two-lanes road (one lane in each direction) 100 km/h near Golden Highway. Reduces to 50 km/h near the town of Cassilis
Cliffdale Road, Turill and Uarbry	Approximately 12 kilometres in length connecting Castlereagh Highway in Blue Springs Road to Ulan Road. It has an east-west alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Coolah Road, Cassilis	Approximately 10 kilometres in length that runs in an east-west alignment. It connects the village of Cassilis to Vinegaroy Road	Unsealed/Partially Sealed	Bidirectional two-lane road (one lane in each direction) 100 km/h on rural segment. Reduces to 50 km/h near the town of Cassilis

Road name	Description	Pavement	Configuration and speed limit
Corishs Lane, Tallawang	Approximately 5 kilometres in length located in Tallawang. It links Tucklan Road to Brooklyn Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Dapper Road, Dunedoo	Approximately 13 kilometres in length linking Spring Ridge Road to Bald Hill Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Gingers Lane, Tallawang	Approximately 4 kilometres in length, running in an east-west alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Highett Road, Ulan	Approximately 1.7 kilometres in length	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Merotherie Road, Merotherie	Approximately 18 kilometres in length, running in a north-south alignment. It is located between Golden Highway and Barneys Reef Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Neeleys Lane, Turill	Approximately 4 kilometres in length connecting Golden Highway to Ulan Road. It runs in a north-south alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 50 km/h
Phillip Street, Wollar	This is a short 500 m road in the village of Wollar that connects Wollar Road to the village of Wollar	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 50 km/h
Puggoon Road, Beryl and Tallawang	Approximately 11 kilometres in length connects to Castlereagh Highway in a north-south alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Ross Crossing Road, Uarbry	Approximately 4 kilometres in length connecting Golden Highway to Blue Springs Road It is split into two sections – Ross Crossing North Road and Ross Crossing South Road	Unsealed (Access track)	Bidirectional two-lane road (one lane in each direction) Unknown speed limit
Spir Road, Orana	Approximately 1 kilometres in length that connects to Tucklan Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Spring Ridge Road, Dunedoo and Tallawang	Approximately30 kilometres connecting Golden Highway and Laheys Creek Road	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)

Road name	Description	Pavement	Configuration and speed limit
Thompsons Road, Cassilis	This is a short road in Cassilis, that is connected to Cassilis Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Trgo Close, Wilpinjong	This is a short road off Ulan-Wollar Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Tucklan Road, Orana	A 5 km section of road in Orana that connects Castlereagh Highway to Spir Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Turill Bus Route, Turill	This is a 2 km section of road off Ulan Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Ulan-Wollar Road, Ulan, Wilpinjong and Wollar	Approximately 22 kilometres in length connecting Ulan Road to the village of Wollar. It runs in a general east-west alignment	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Upper Laheys Creek Road, Dunedoo	A local road off Spring Ridge Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Whistons Lane, Tallawang	Approximately 2.5 km long road off the Castlereagh Highway	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)

4.1.5 Existing road network (mid-block) volumes and performance

The existing mid-block traffic volumes and performance of roads proposed to be used for construction routes are detailed in Table 4-5. The Level of Service has been measured for each direction of travel in the respective morning and afternoon peak hours based on the methodology detailed in Section 3.7.2.

Based on the survey results, and as expected the highways experience some of the higher traffic volumes in the study area given the function of these roads as links to connect major towns.

There are several main roads that experience higher traffic volumes include Cope Road (from 1,200–1,800 vehicles per day) and Ulan Road (approximately 9,000 vehicles per day) on weekdays. This is due to their function to provide access to the existing coal mines located near the intersections of Ulan Road and Ulan-Wollar Road within the study area.

In terms of peak hour, noting the large size of the study area, the survey found peak traffic demand varied across all sites during the day and was in response to the surrounding land use; for example, the traffic demand around the mining sites peak when shift change occur. Given the nature of construction works which are not static, this study adopted a conservative approach of assessing the respective peak traffic demand experienced by each site.

Based on the assessment in Table 4-5, it was found almost all roads were quantitatively assessed to operate at a LoS A under existing traffic conditions, with the exception of Ulan Road (just north of Mudgee), which operated at a LoS B during the traffic survey period. Ulan Road was surveyed immediately north of Mudgee, at a location which would capture traffic volumes and movements of vehicles in and out of the Mudgee city centre.

Table 4-5 Mid-block surveyed traffic data within the study area

Survey ID	Location	Road classification	ADT	Weekday daily volume			Peak hour volume (veh/hour)				Lane capacity (vph / lane)	Volume/capacity ratio and LoS			
				AWT	Vehicle classification		AM peak		PM peak			AM peak		PM peak	
					Light vehicles	Heavy vehicles	NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB
H01	Golden Highway (near Spring Ridge Road, west of Dunedoo), Dunedoo	Highway	1,282	1,341	1,028 (75.9%)	327 (24.1%)	57	52	51	61	1,800	0.03 (LoS A)	0.03 (LoS A)	0.03 (LoS A)	0.03 (LoS A)
H02	Golden Highway (between Ulan Road and Merotherie Road), Uarbry	Highway	930	918	633 (68.8%)	287 (31.2%)	54	35	39	42	1,800	0.03 (LoS A)	0.02 (LoS A)	0.02 (LoS A)	0.02 (LoS A)
H03	Castlereagh Highway (between Golden Highway and Tucklan Road), Birriwa	Highway	725	781	647 (80.6%)	156 (19.4%)	29	41	38	34	1,800	0.02 (LoS A)	0.02 (LoS A)	0.02 (LoS A)	0.02 (LoS A)
H04	Castlereagh Highway (north-west of Old Mill Road), Gulgong	Highway	1,445	1,547	1,275 (81.5%)	290 (18.5%)	52	64	65	61	1,800	0.03 (LoS A)	0.04 (LoS A)	0.04 (LoS A)	0.03 (LoS A)
H05	Castlereagh Highway (north of Laheys Creek Road), Beryl	Highway	1,000	1,048	858 (82.3%)	184 (17.7%)	31	46	44	45	1,800	0.02 (LoS A)	0.03 (LoS A)	0.02 (LoS A)	0.03 (LoS A)
H07	Mitchell Highway (west of Goolma Road), Montefiores	Highway	4,656	5,024	4,100 (81.5%)	933 (18.5%)	178	241	207	199	1,800	0.10 (LoS A)	0.13 (LoS A)	0.12 (LoS A)	0.11 (LoS A)
H08	Mitchell Highway (north of Saxa Road), Montefiores	Highway	5,411	5,728	4,464 (77.9%)	1,263 (22.1%)	192	247	278	215	1,800	0.11 (LoS A)	0.14 (LoS A)	0.15 (LoS A)	0.12 (LoS A)
H09	Castlereagh Highway (north-west of Putta Bucca Road), Mudgee	Highway	6,608	7,158	6,341 (88.3%)	840 (11.7%)	205	446	320	283	1,800	0.11 (LoS A)	0.25 (LoS A)	0.18 (LoS A)	0.16 (LoS A)
M01	Cope Road (between Blue Springs Road and Springwood Park Road), Cope	Main road	1,095	1,192	1,041 (87.8%)	144 (12.2%)	16	106	46	51	1,400	0.01 (LoS A)	0.08 (LoS A)	0.03 (LoS A)	0.04 (LoS A)
M02	Cope Road (north east of Saleyards Lane), Gulgong	Main road	1,675	1,757	1,560 (89.2%)	188 (10.8%)	96	23	66	81	1,400	0.07 (LoS A)	0.02 (LoS A)	0.05 (LoS A)	0.06 (LoS A)

Survey ID	Location	Road classification	ADT	Weekday daily volume			Peak hour volume (veh/hour)				Lane capacity (vph / lane)	Volume/capacity ratio and LoS			
				AWT	Vehicle classification		AM peak		PM peak			AM peak		PM peak	
					Light vehicles	Heavy vehicles	NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB
M07	Vinegaroy Road (south of Rotherwood Road), Coolah	Main road	327	337	302 (90.4%)	32 (9.6%)	9	19	13	18	1,400	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
M08	Ulan Road (north-east of Lue Road), Milroy	Main road	8,409	9,002	7,897 (93.7%)	649 (7.2%)	236	478	387	426	1,400	0.17 (LoS A)	0.34 (LoS B)	0.28 (LoS B)	0.30 (LoS B)
M09	Black Stump Way (south of Coolah town), Coolah	Main road	870	893	664 (72.0%)	258 (28.0%)	41	40	37	38	1,400	0.03 (LoS A)	0.03 (LoS A)	0.03 (LoS A)	0.03 (LoS A)
R03	Gollan Road (north of Goolma Road), Gollan	Regional road	603	654	489 (75.8%)	156 (24.2%)	30	22	26	25	1,000	0.03 (LoS A)	0.02 (LoS A)	0.03 (LoS A)	0.03 (LoS A)
L01	Tucklan Road (south of Rhodes Street in Dunedoo), Dunedoo	Local road	120	127	112 (92.6%)	9 (7.4%)	6	6	7	6	1,000	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
L02	Henry Lawson Road (east of Canadian Lead Road), Gulgong	Local road	676	720	633 (87.6%)	90 (12.4%)	27	34	37	31	1,000	0.03 (LoS A)	0.03 (LoS A)	0.04 (LoS A)	0.03 (LoS A)
L03	Laheys Creek Road (west of Castlereagh Highway), Beryl	Local road	159	176	165 (92.7%)	13 (7.3%)	10	7	6	10	1,000	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
L04	Barneys Reef Road, Gulgong	Local road	465	495	458 (92.9%)	35 (7.1%)	18	27	23	23	1,000	0.02 (LoS A)	0.03 (LoS A)	0.02 (LoS A)	0.02 (LoS A)
L16	Twelve Mile Road (east of Brookfield Road), Wuuluman	Local road	96	108	104 (95.4%)	5 (4.6%)	5	6	6	6	1,000	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)

NB – Northbound Traffic Movement, SB – Southbound Traffic Movement, EB – Eastbound Traffic Movement, WB – Westbound Traffic Movement

Annual Daily Traffic (ADT), Annual Weekday Traffic (AWT) and vehicle classification volumes are combined bidirectional, and is measured as vehicles per day (vpd)

Theoretical lane capacity has been estimated based on existing road feature (i.e. lane width availability of turn lanes, shoulders) which influences road capacity

Vehicles classification is based on Austroads Vehicle Classification. Light vehicles (class 1–2), small trucks (Class 3), medium trucks (class 4–5), large trucks (class 6–12)

Roads measured to have a LoS A, indicates that under existing conditions, the roads operate in free flow, meaning vehicles are able to travel almost completely unimpeded within the traffic stream. The volume to capacity ratio is far below the next Level of Service B threshold which suggests these roads performed at a stable free-flow condition and have ample spare capacity. LoS B can be found on Ulan Road just north of Mudgee, which as mentioned, would pick up traffic activities associated with Mudgee as a town centre.

Through analysis of the total peak hour and daily traffic volume, it was found that peak hour demand makes up approximately 8–10 per cent of the daily traffic volume.

There are several roads forming part of the proposed project construction routes to the workforce accommodation camp, energy hubs and switching stations where traffic count surveys were not completed as part of this assessment. These roads and associated traffic data are described in Table 4-6. The traffic data of these roads have been obtained from the intersection counts summarised in Section 4.2.

Average Daily Traffic (ADT) volumes have been estimated with the assumption that the peak hour traffic makes up for approximately ten per cent of the daily traffic, consistent with the findings of the mid-block survey data on roads as summarised in Table 4-5. Merotherie Road was inaccessible during the time of survey due to a major flooding event, which resulted in no traffic volumes recorded on the road.

It is to be noted that there are several local roads listed in Section 4.1.4 which have no available traffic data and thus not quantitatively assessed in this chapter. These roads are not expected to be heavily used during construction or operation of the project. Their main purpose for the project is to provide access to the transmission line access gates. These local roads typically consist of rural unsealed roads which provide access to the surrounding rural properties.

The peak hour volume to capacity ratio and LoS ratio have been measured using the surveyed data, which shows that these roads are operating at LoS A under existing traffic conditions with ample capacity during the AM and PM peak.

Table 4-6 Additional mid-block traffic data estimated from intersection counts

ID	Location	Road classification	ADT	Peak hour volume (veh/hour)				Lane capacity (vph/lane)	Volume/capacity ratio and LoS			
				AM peak		PM peak			AM peak		PM peak	
				NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB
M03	Ulan Road near Ulan township	Main Road	5,770	447	130	174	191	1,400	0.32 (LoS B)	0.09 (LoS A)	0.12 (LoS A)	0.14 (LoS A)
M04	Ulan Road (north of Ulan-Wollar Road)	Main Road	2,610	152	109	74	81	1,400	0.11 (LoS A)	0.08 (LoS A)	0.05 (LoS A)	0.06 (LoS A)
M05	Main Street – extension of Cope Road, Ulan	Main Road	1,360	9	127	8	89	1,000	0.01 (LoS A)	0.13 (LoS A)	0.01 (LoS A)	0.09 (LoS A)
R01	Wollar Road (west of Wollar)	Regional	170	11	6	8	7	1,000	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
L05	Spring Ridge Road, south of Golden Highway, Cobbora	Local	120	7	5	3	5	1,000	0.01 (LoS A)	0.01 (LoS A)	0.00 (LoS A)	0.01 (LoS A)
L06	Upper Laheys Creek Road, Dunedoo	Local	40	0	4	1	2	1,000	0.00 (LoS A)	0.00 (LoS A)	0.00 (LoS A)	0.00 (LoS A)
L07	Merotherie Road (south of Golden Highway), Merotherie	Local	0	0	0	0	0	1,000	0.00 (LoS A)	0.00 (LoS A)	0.00 (LoS A)	0.00 (LoS A)
L08	Barigan Street (north of Wollar), Wollar	Local	150	5	4	12	3	1,000	0.01 (LoS A)	0.00 (LoS A)	0.01 (LoS A)	0.00 (LoS A)
L09	Barigan Road (to Wollar substation), Wollar*	Local	100	5	5	5	5	1,000	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
L10	Blue Springs Road (north)	Local	180	1	11	13	5	1,000	0.00 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
L11	Blue Springs Road (south)	Local	180	1	11	13	5	1,000	0.00 (LoS A)	0.01 (LoS A)	0.01 (LoS A)	0.01 (LoS A)
L12	Ulan-Wollar Road, Ulan	Local	3,760	51	325	126	116	1,000	0.05 (LoS A)	0.33 (LoS B)	0.13 (LoS A)	0.12 (LoS A)
L13	Maitland Street (east of Barigan Street)	Local	230	14	8	18	5	1,000	0.01 (LoS A)	0.01 (LoS A)	0.02 (LoS A)	0.01 (LoS A)

*Estimated based on previous studies undertaken for Wollar Solar

4.2 Key intersection layout and volumes

This chapter captures the key intersection layout, volumes and warrant assessment against Austroads' turn treatment warrant, which assessment criteria is detailed in Section 3.7.1. These intersections were selected as they are most likely to be used by construction traffic.

The warrant assessment is used to understand if the current intersection layouts are currently suitable to provide safe operations to accommodate the existing peak hour demand at the intersection.

Its evaluation mainly focuses on safety performance outcomes, rather than operational. It is noted that the peak hours may differ from site to site, which are assessed as the worst-case scenario.

4.2.1 *Merotherie Road/Golden Highway*

Merotherie Road/Golden Highway intersection is T-intersection with priority given to the Golden Highway in the east-west direction.

Merotherie Road is currently an unsealed road with limited property accesses. The Golden Highway is sealed, and line marked.

The speed limit of both roads is 100 km/h. On the Golden Highway, left and right turn treatments into Merotherie Road are provided through basic treatments (i.e. BAL and BAR respectively).

Based on the count survey data collected at the intersection, there was no traffic entering/exiting Merotherie Road.

As such, the demand requires the intersection to have a basic left and basic right turn layout. The intersection layout is considered sufficient for its existing demand.

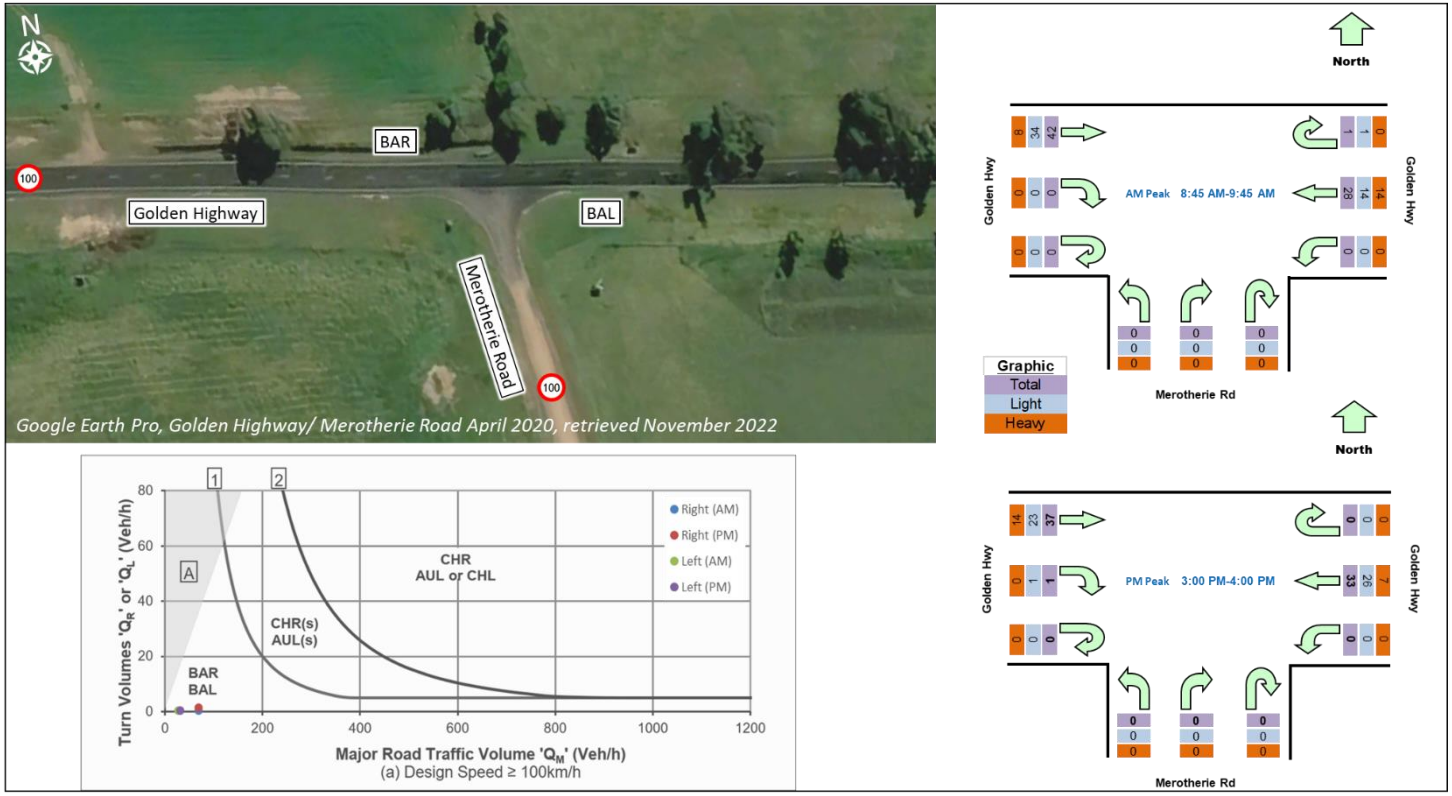


Figure 4-2 Merotherie Road/Golden Highway – layout, volumes and turn treatment assessment

4.2.2 *Spring Ridge Road/Golden Highway*

Spring Ridge Road/Golden Highway intersection is T-intersection with priority given to the Golden Highway in the east-west direction.

Approaches to the intersection are sealed and line marked.

The speed limit of both roads is 100 km/h. On the Golden Highway, left turn treatment is provided through an auxiliary left turn lane (AUL) of 85 metres long. The right turn is provided through an auxiliary right turn lane (AUR) of 125 metres long.

Based on the count collected at the intersection, the traffic demand only requires the intersection to have a basic left and basic right turn layout. Therefore, the existing provision of AUL/AUR exceed the existing traffic demand at the intersection and therefore the intersection layout is adequate.

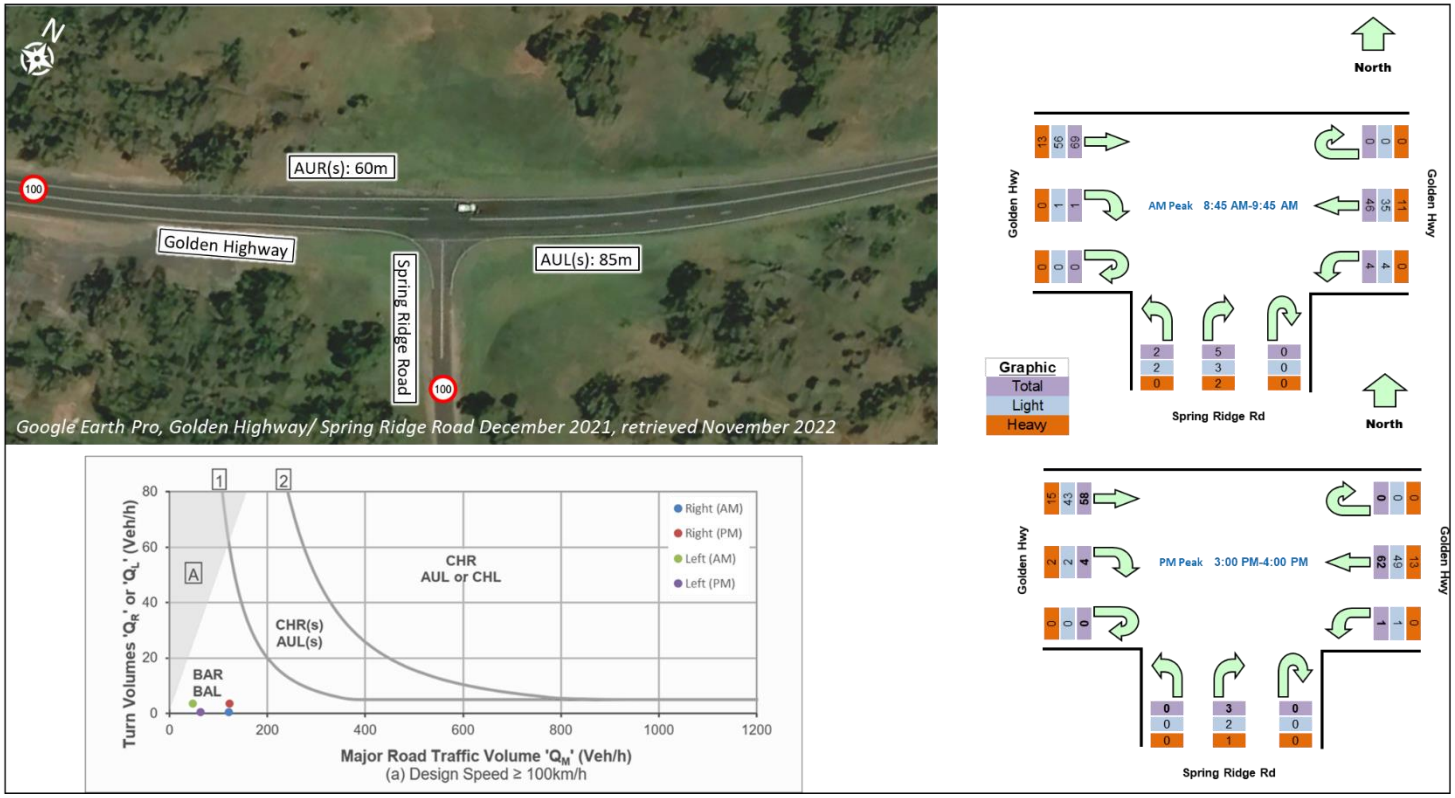


Figure 4-3 Spring Ridge Road/Golden Highway – layout, volumes and turn treatment assessment

4.2.3 Golden Highway/Ulan Road

Golden Highway/Ulan Road intersection is T-intersection with priority given to the Golden Highway in the east-west direction.

Approaches to the intersection are sealed and line marked. The approach from Ulan Road currently includes a 'rumble strip' safety treatment which consists of a set of transverse lines where the spacings are continually reduced to create a visual perception for drivers to slow down before reaching the intersection.

The speed limit of both roads is 100 km/h. On the Golden Highway, left turn treatment is provided through an auxiliary left turn lane (AUL) of about 110 metres. The right turn is provided through a basic right turn treatment (BAR).

Based on the intersection count data collected at the intersection, the traffic demand only requires the intersection to have a basic left and basic right turn layout. Therefore, the existing provision of AUL/BAR exceeds the existing traffic demand at the intersection and therefore intersection layout is adequate under existing conditions.

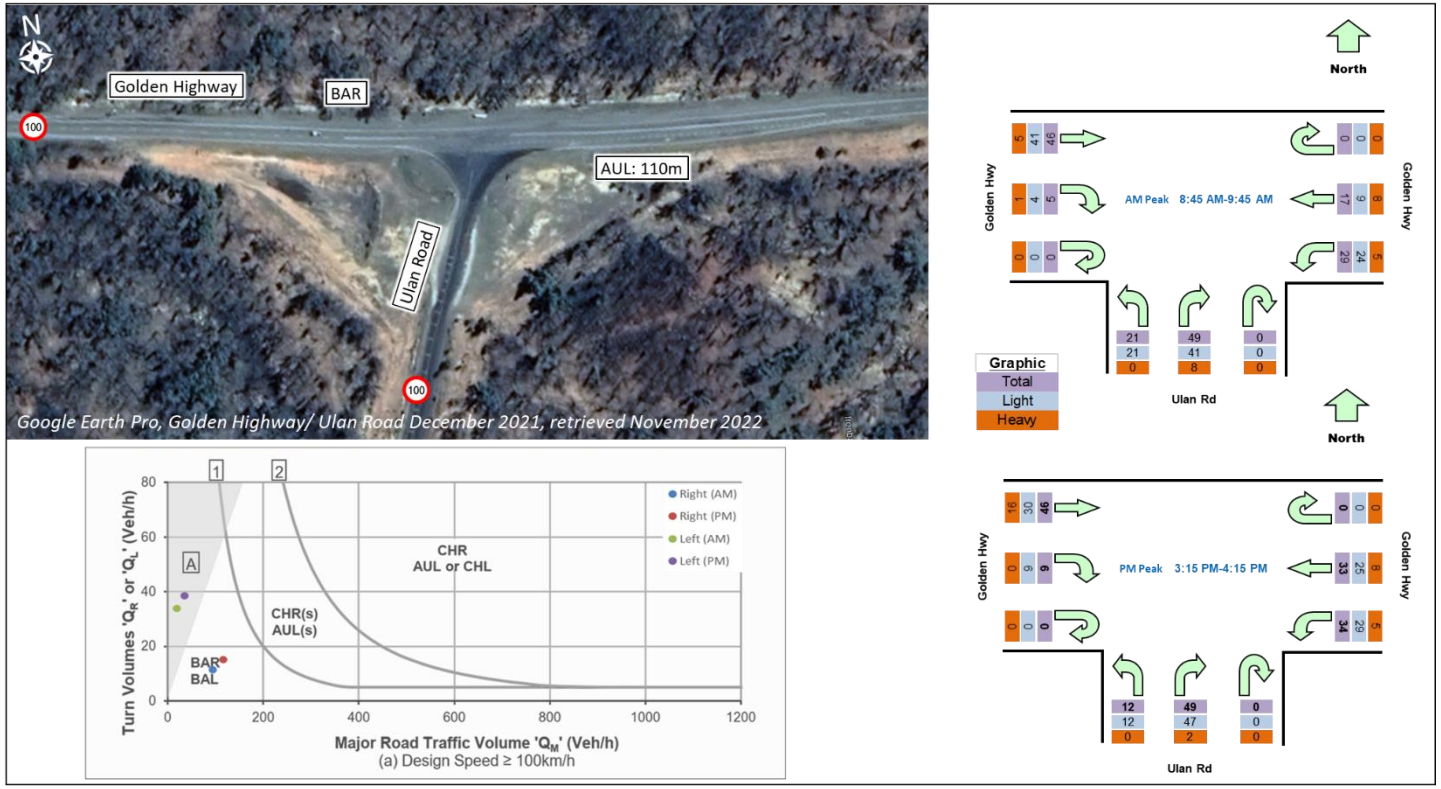


Figure 4-4 Golden Highway/Ulan Road – layout, volumes and turn treatment assessment

4.2.4 Ulan Road/Ulan-Wollar Road

Ulan Road/Ulan-Wollar Road intersection is T-intersection with priority given to Ulan Road in the east-west direction. Approaches to the intersection are sealed and line marked.

The land use nearby is rural, with three major coal mines located near the intersection.

The speed limit of both roads is 100 km/h. On Ulan Road, left turn treatment into Ulan-Wollar Road is provided through an auxiliary left turn lane (AUL) of about 125 metres long. The right turn is provided through a channelised right turn lane (CHR) of about 125 metres long.

Based on the intersection count data collected, the left turn movements only require a basic left turn treatment (BAL).

The right turn movement on Ulan Road into Ulan-Wollar Road is moderately high with 301 and 111 vehicles recorded in the respective AM and PM peak periods, and as such the plot of right turn flow (Q_R) against the major traffic flow (Q_M) are not visible on the chart. Q_M for the AM and PM peak periods were recorded at 255 and 144 vehicles respectively.

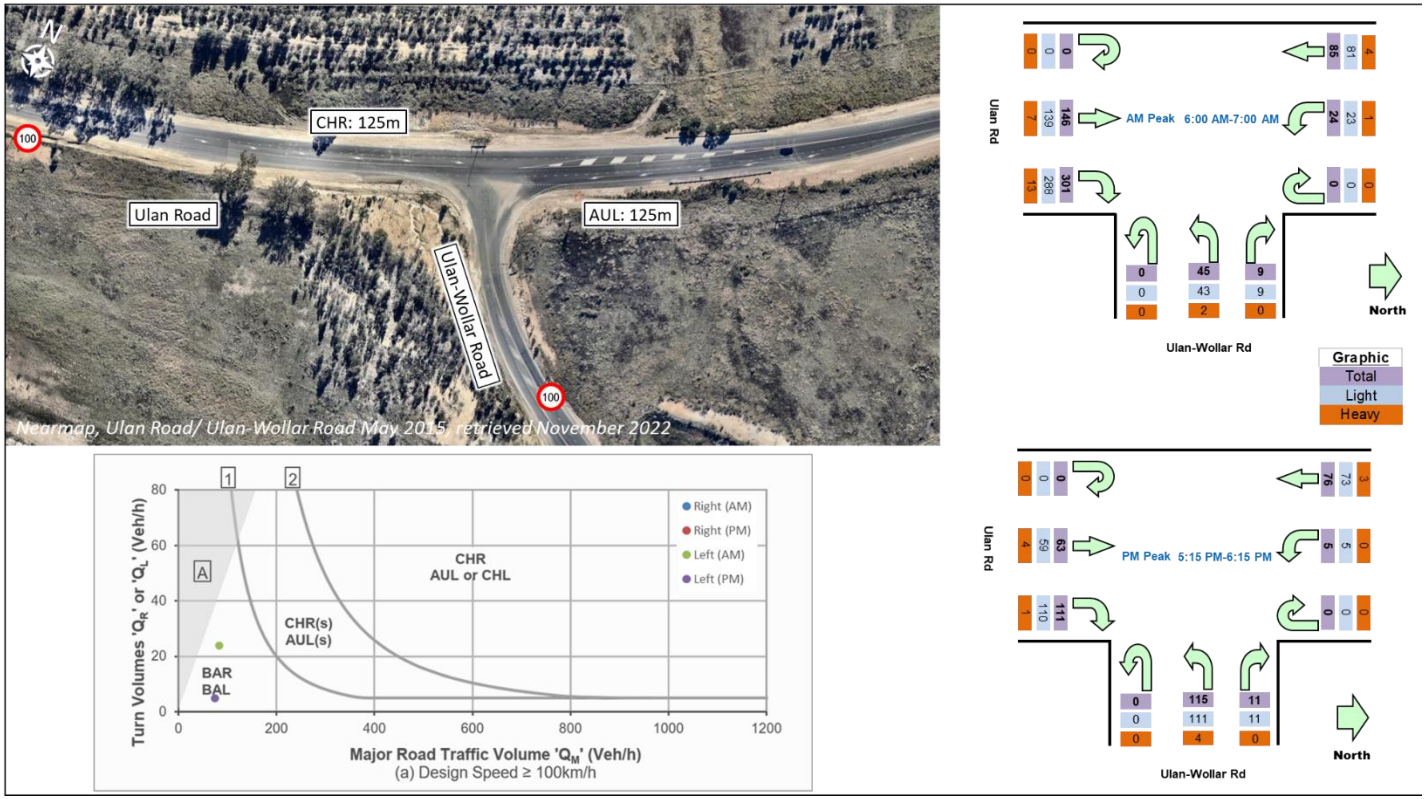


Figure 4-5 Ulan Road/Ulan-Wollar Road – layout, volumes and turn treatment assessment

Nevertheless, the intersection has provided a channelised right turn treatment which is the highest degree of design for a rural intersection. Queuing was observed to be minor at the intersection.

4.2.5 Ulan Road/Cope Road (Main Street)

Ulan Road/Cope Road (Main Street) intersection is T-intersection with priority given to the Ulan Road in the east-west direction.

Approaches to the intersection are sealed and line marked.

The speed limit of Ulan Road is 100 km/h and Cope Road is posted at 50 km/h.

On Ulan Road, left turn treatment into Cope Road is provided through a basic left turn treatment (BAL). The right turn is provided through a short channelised right turn lane of 65 metres long.

Based on the intersection count data collected, the traffic demand requires the left turn treatment to consist of an Auxiliary Left (AUL) and the right turn to consist of a full length channelised right turn (CHR) treatment.

As such, the turn treatments at the intersection are under designed for the current demand.

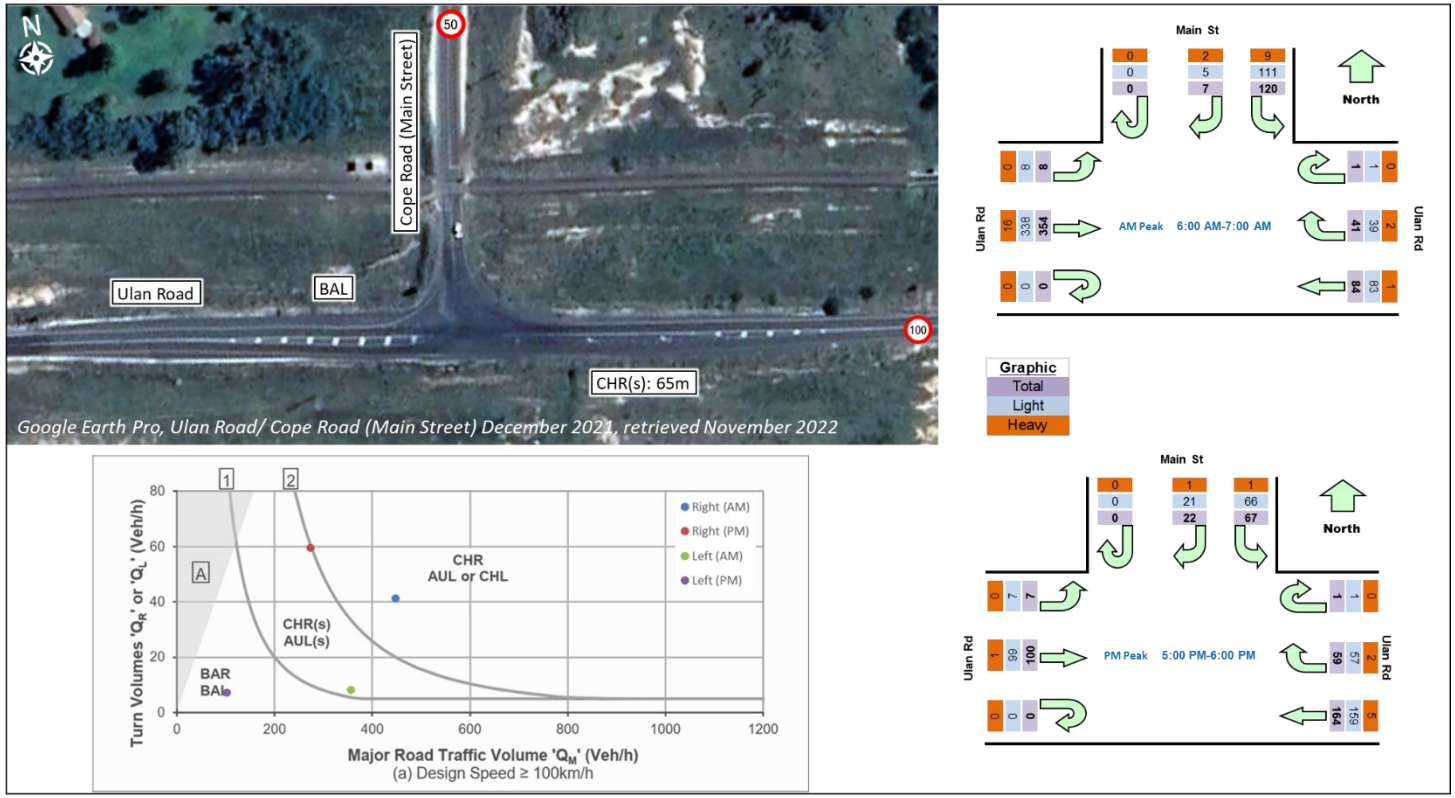


Figure 4-6 Ulan Road/Cope Road (Main Street) – layout, volumes and turn treatment assessment

4.2.6 *Wollar Road/Barigan Street/Phillip Street*

Wollar Road/Barigan Street/Phillip Street intersection currently operates as a T-intersection with priority given to the Wollar Road–Phillip Street (otherwise known as Maitland Street) in the east-west direction. Barigan Street approach in the south only provides access to several properties and functions like an access driveway.

Approaches to the intersection are sealed with no line marking. Barigan Street approach in the south is unsealed throughout.

The speed limit of both roads is 50 km/h as it is located within the township of Wollar. On the Wollar Road–Phillip Street, the left and right turn treatments are provided through basic turns (BAL/BAR respectively).

Based on the count collected at the intersection, the traffic demand requires the intersection to have a basic left and basic right turn layout. Therefore, the existing intersection layout is sufficient for the existing demand.

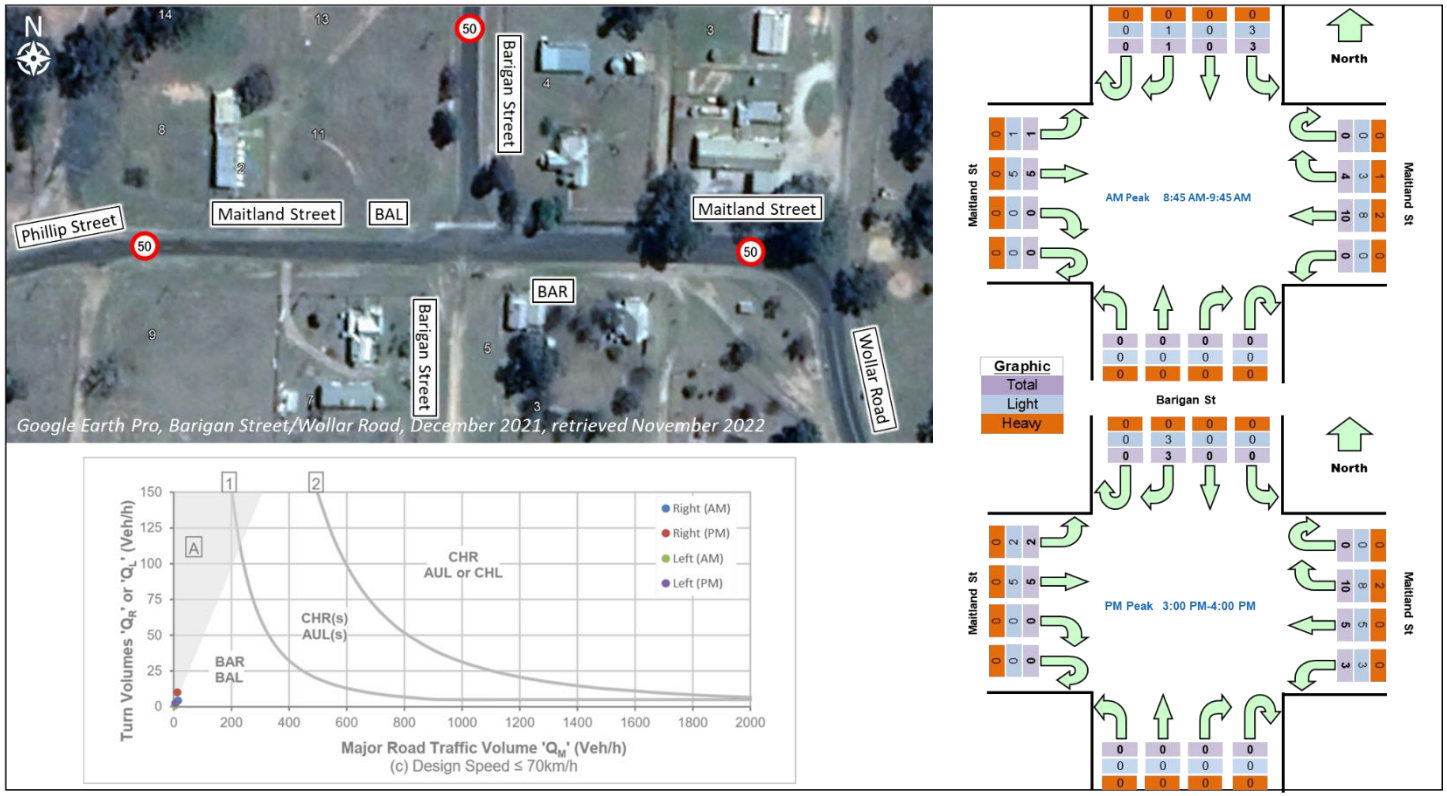


Figure 4-7 Wollar Road/Barigan Street/Barigan Road/Phillip Street – layout, volumes and turn treatment assessment

4.2.7 Cope Road/Blue Springs Road

Cope Road/Blue Springs Road intersection operates as a T-intersection with priority given to the Cope Road in the east-west direction. A property access driveway currently intersects to the south of the intersection.

The approaches to the intersection are sealed and line marked.

The speed limit of both roads are 100 km/h. On Cope Road, the left and right turn are provided through basic turn treatments (BAL and BAR respectively).

Based on the count collected at the intersection, the traffic demand only requires the intersection to have a basic left and basic right turn layout. Therefore, the existing intersection layout is sufficient for the existing demand.

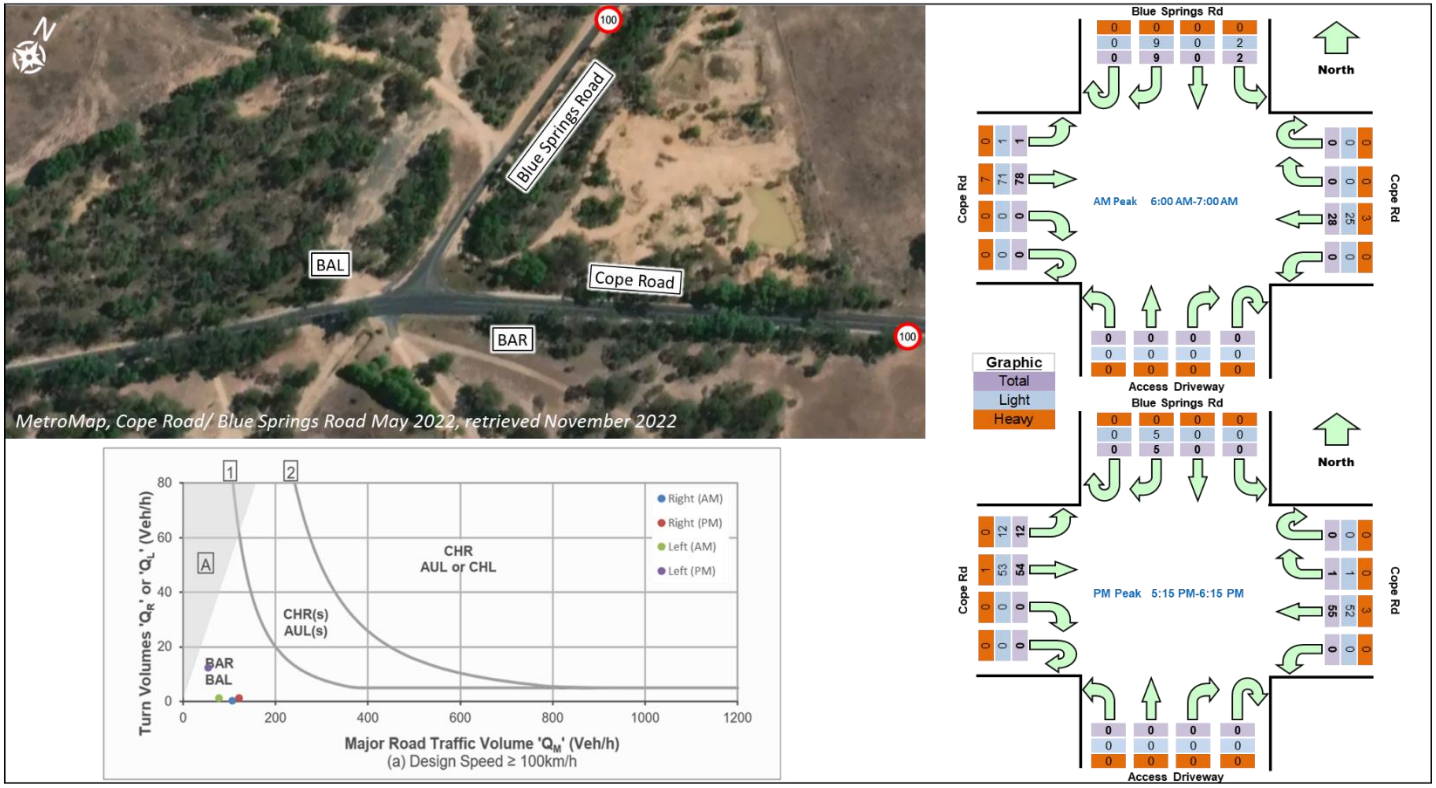


Figure 4-8 Cope Road/Blue Springs Road – layout, volumes and turn treatment assessment

4.2.8 Brooklyn Road/Laheys Creek Road

Brooklyn Road/Laheys Creek Road intersection is a T-intersection with priority given to Laheys Creek Road in the north-south direction.

Both roads are unsealed and not line marked.

The speed limit of both roads is 100 km/h with basic left and right turn treatments at the intersection.

Traffic demand at the intersection is low with only 4 cars and 3 cars recorded in the respective AM and PM peak. These volumes do no warrant intersection treatment higher than basic turn treatments.

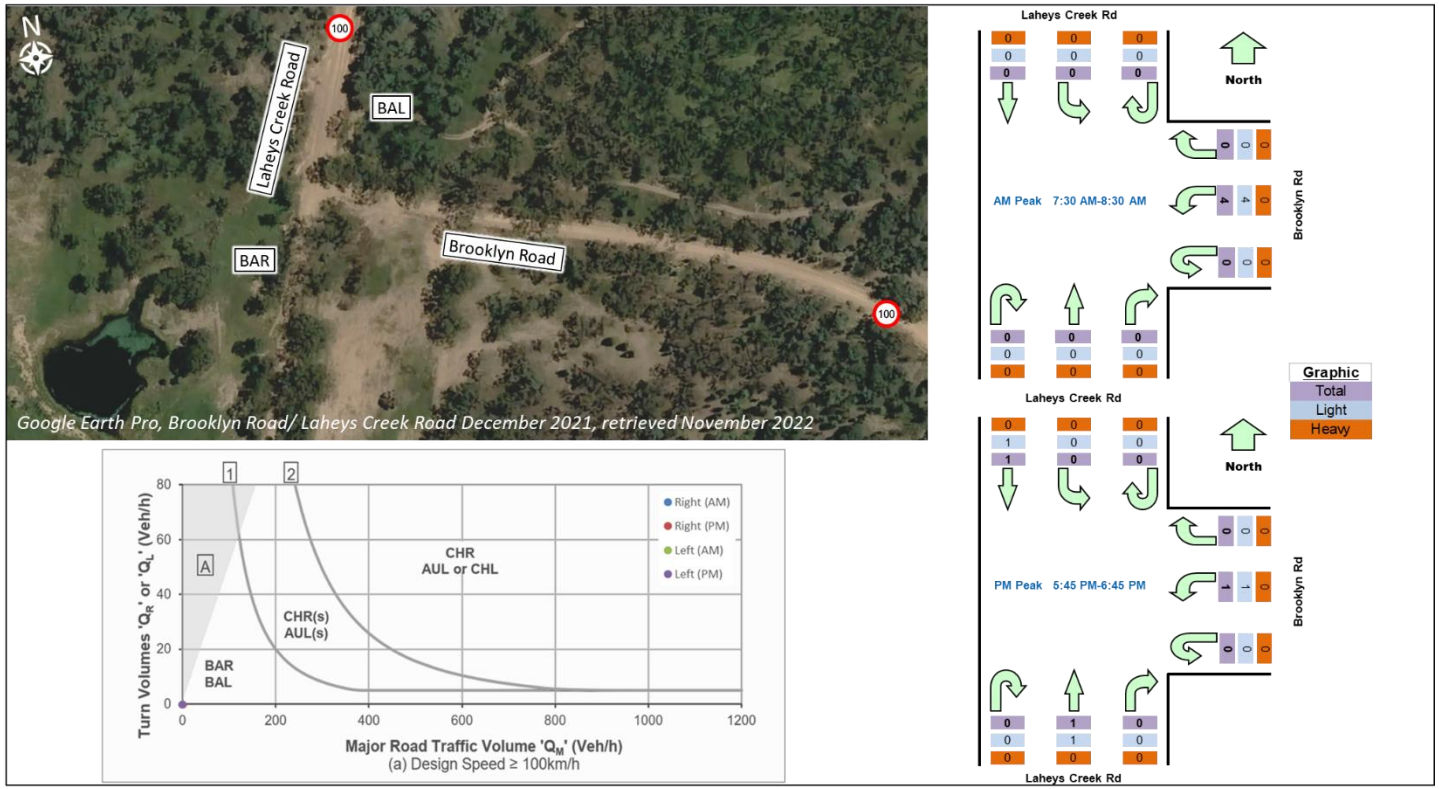


Figure 4-9 Brooklyn Road/Laheys Creek Road – layout, volumes and turn treatment assessment

4.2.9 *Castlereagh Highway/Laheys Creek Road*

Castlereagh Highway/Laheys Creek Road intersection is a T-intersection with priority given to Castlereagh Highway in the north-south direction.

The approaches to the intersection are sealed and line marked.

The speed limit of both roads is 100 km/h with basic left and right turn treatments at the intersection.

Traffic demand at the intersection is low with only 5 left turn and no right turn inbound movements into Laheys Creek Road recorded in the AM peak; and 11 left turn and 1 right turn inbound movements in the PM peak. These volumes do no warrant intersection treatment higher than basic turn treatments.

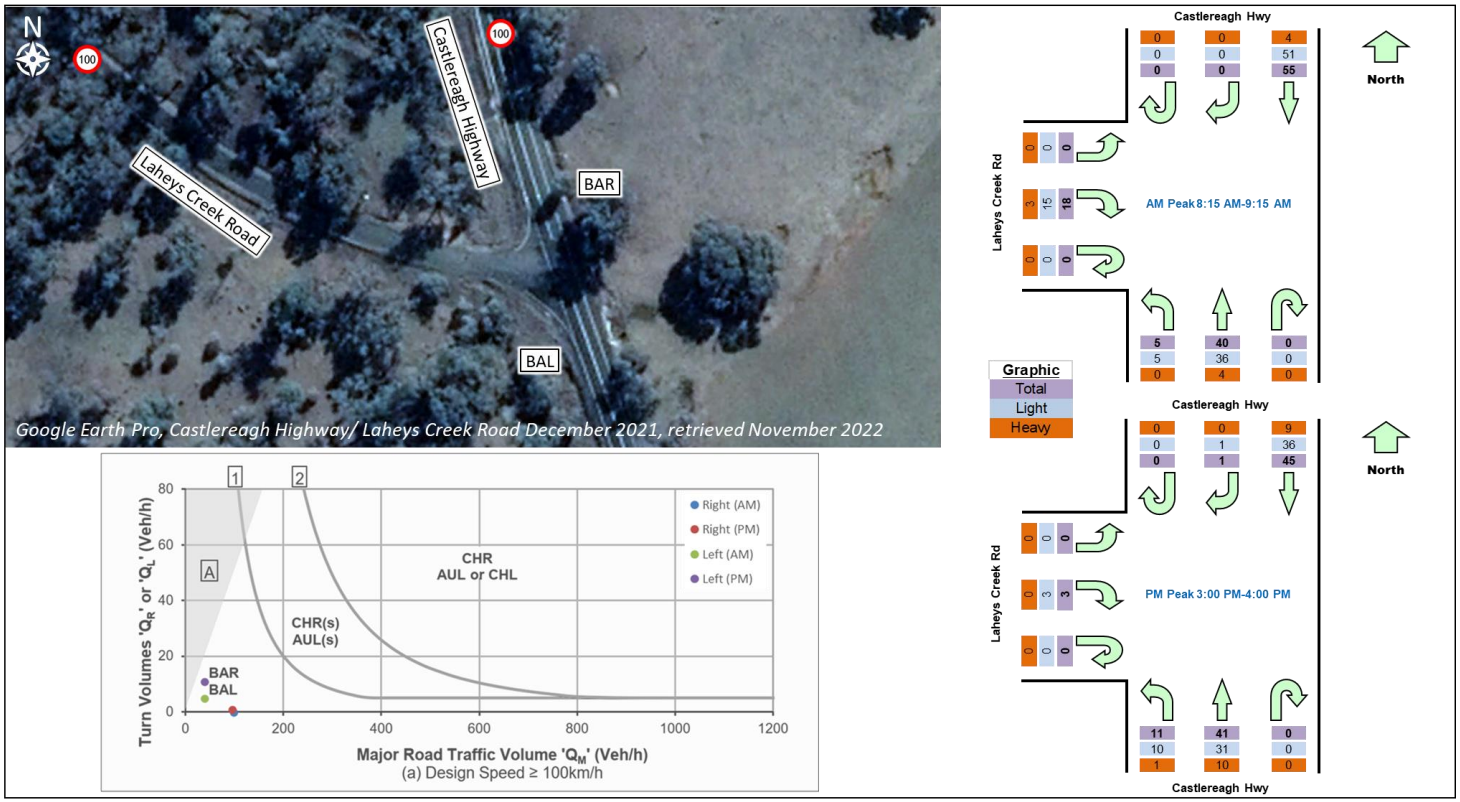


Figure 4-10 Castlereagh Highway/Laheys Creek Road – layout, volumes and turn treatment assessment

4.2.10 Black Stump Way/Golden Highway

Black Stump Way/Golden Highway intersection is T-intersection with priority given to the Golden Highway in the east-west direction. Approaches to the intersection are sealed and line marked.

The speed limit of both roads is 100 km/h. On the Golden Highway, left turn treatment is provided through an auxiliary left turn lane about 150 metres long. The right turn is provided through a channelised right turn lane of 125 metres long.

Based on the intersection count data collected, the traffic demand at the intersection only requires a basic left and basic right turn layout. Therefore the existing provision of AUL/CHR exceeds the existing demand and therefore the intersection layout is adequate under existing traffic conditions.

While in the study area, this intersection is unlikely to be used to access the construction sites. It has been included here as background information.

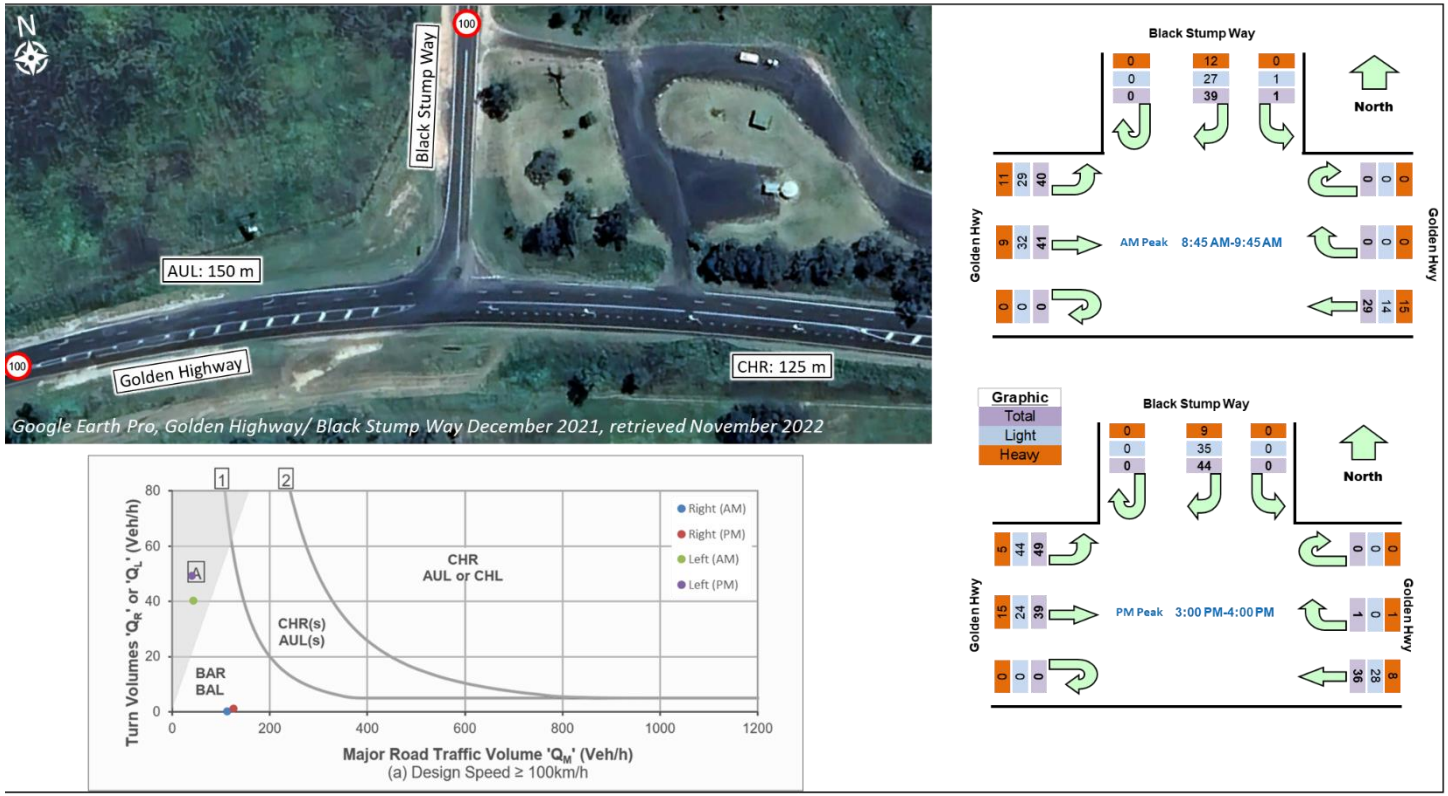


Figure 4-11 Black Stump Way/Golden Highway – layout, volumes and turn treatment assessment

4.3 Freight

4.3.1 Heavy vehicle road network restrictions

The heavy vehicle restrictions on construction routes within the study area are illustrated in Figure 4-12.

General Access Vehicles (GAV) which comply with mass and dimension requirements do not require a notice or permit to operate on the road network. Heavy vehicles other than GAV are subject to road network restrictions according to the vehicle types:

- Restricted Access Vehicles (RAV) (i.e. 19 m, 23 m and 25/26 m B-doubles)
- OSOM vehicles, which are defined as a vehicle (or vehicle combination) that exceeds any general access mass or dimension limits.

Both of the highways in the study area (Golden Highway and Castlereagh Highway) that would be utilised as construction routes for the project are part of the existing gazetted OSOM network. While approval for OSOM vehicles to travel on the road network is still required, this provides assurance that these roads are the designated route for oversize vehicles travelling through the region.

It is to be noted that the last-mile road sections to the proposed Energy Hubs locations are currently not gazetted as approved OSOM routes.

Along the construction routes, the main roads such as Cope Road and Ulan Road provide approved access for restricted access vehicles (specifically 25/26-metre-long B-Double trucks).

Most local roads along construction routes are not part of the existing approved RAV and OSOM network.

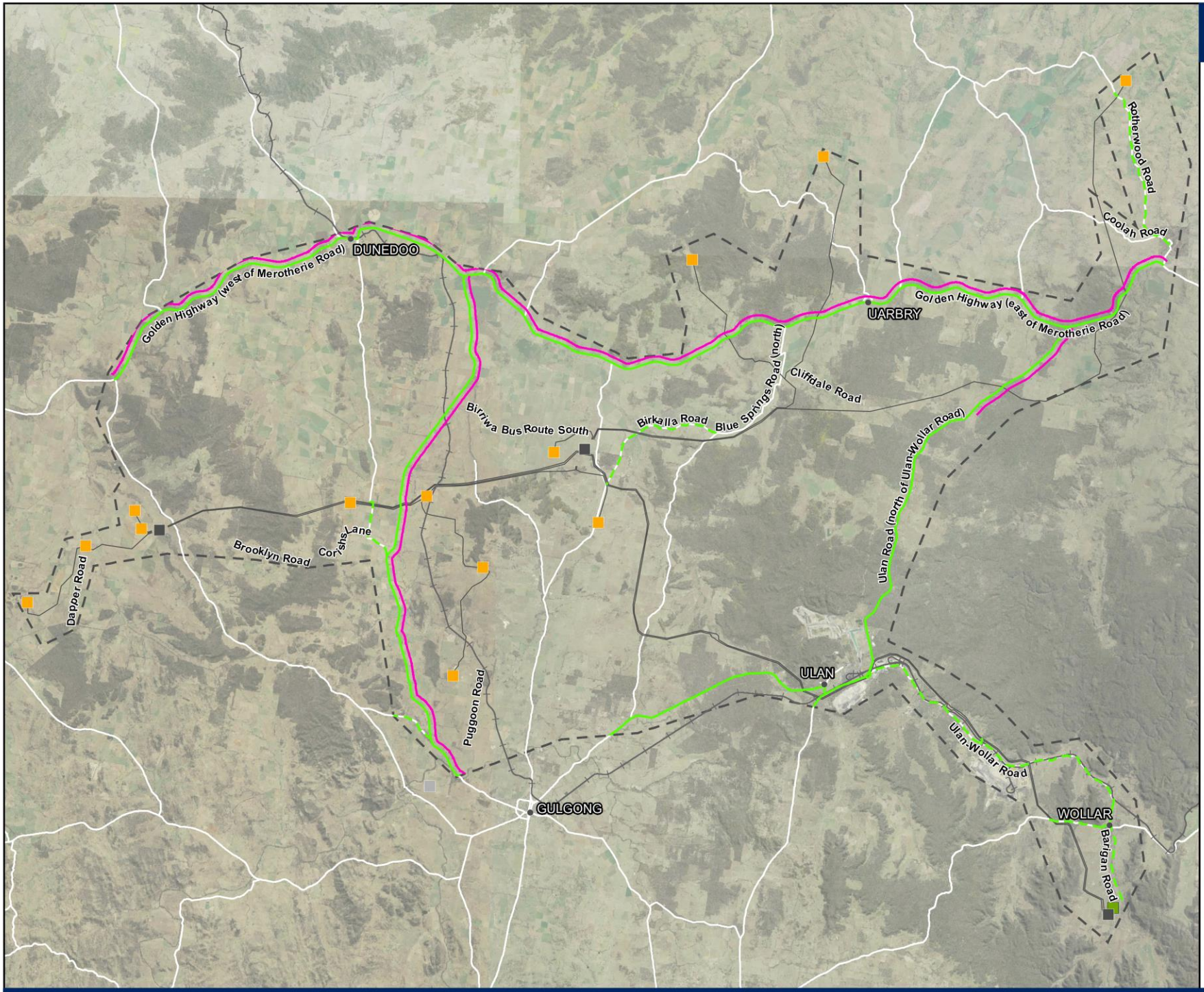
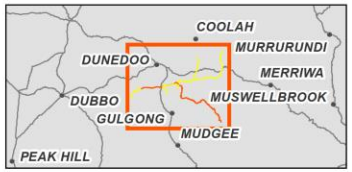


Figure 4-12
Restricted Access Vehicle and OSOM approved routes

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing substation
- Transmission line alignment
- Railway
- OSOM approved routes
- RAV approved routes
- RAV approved routes with travel conditions



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4.3.2 Regional rail lines and crossings

4.3.2.1 Regional rail services

The project crosses two active freight railway lines within the study area, both of which are managed by the ARTC:

- Sandy Hollow-Gulgong railway – a single track rail line extending between Muswellbrook and Gulgong
- Wallerawang-Gwabegar – a single track rail line extending between Gulgong and Binnaway.

4.3.2.2 Level crossings

Level crossing control falls into three categories:

- **Passive protection** – uses signs (stop or give way) to warn motorists about a level crossing.
- **Active protection** – uses either flashing lights only or flashing lights and boom gates to warn motorists that a train is approaching a level crossing.
- **Grade separation** – separating the train track and road alignment through the use of underpasses or over-bridges.

Details of rail lines and associated level crossings are available through Transport for NSW's *Public Level Crossing Finder*.

Details of level crossings in the study area that could potentially be impacted by the project are listed in Table 4-7.

Table 4-7 Existing level crossings within the study area

ID	Road name	Nearby landmark	Suburb	LGA	Control type	Controls	Track type	Rail operator	Line section
1300	Ulan-Wollar Road	Near Cumbo Creek crossing	Wilpinjong	Mid-Western Regional	Active	Boom gates and flashing lights	Single	ARTC	Ulan
1301	Ulan-Wollar Road	near Narrow Creek crossing	Wilpinjong	Mid-Western Regional	Passive	Stop signs	Single	ARTC	Ulan
1304	Cope Road	near Ulan Road intersection	Ulan	Mid-Western Regional	Active	Flashing lights	Single	ARTC	Ulan
1414	Station Street	North of Gulgong town	Gulgong	Mid-Western Regional	Active	Flashing lights	Single	ARTC	Wallerawang-Gwabegar
1421	Puggoon Road	south of Tallawang Creek	Tallawang	Mid-Western Regional	Passive	Stop signs	Single	ARTC	Wallerawang-Gwabegar
1422	Whistons Lane	near Tallawang Station	Tallawang	Mid-Western Regional	Passive	Stop signs	Single	ARTC	Wallerawang-Gwabegar
1424	Gingers Lane	East of Castlereagh Highway	Tallawang	Mid-Western Regional	Passive	Stop signs	Single	ARTC	Wallerawang-Gwabegar

ID	Road name	Nearby landmark	Suburb	LGA	Control type	Controls	Track type	Rail operator	Line section
1425	Castlereagh Highway	near Birriwa Station	Birriwa	Mid-Western Regional	Active	Flashing lights	Single	ARTC	Wallerawang-Gwabegar
1428	Golden Highway	east of Dunedoo town	Dunedoo	Warrumbungle	Active	Flashing lights	Single	ARTC	Wallerawang-Gwabegar

Source: Public Level Crossing Finder, Transport for NSW, 2022

4.4 Crash analysis

This chapter summarises the crash history along the proposed construction routes, reported by the degree of crash severity and crash location. The tables are separated according to NSW Road Classifications (highway, main road, regional and local) given the large study area and importance/heavy usage of these roads by the public.

There was a total of 63 crashes, between 2016 and 2020, along the proposed construction routes that are proposed to be used for construction vehicles, with most occurring at a mid-block location (90 per cent).

Figure 4-13 shows the recorded crashes along the proposed construction routes within the study area, where the crashes were recorded for the 5-year period between 2016 to 2020.

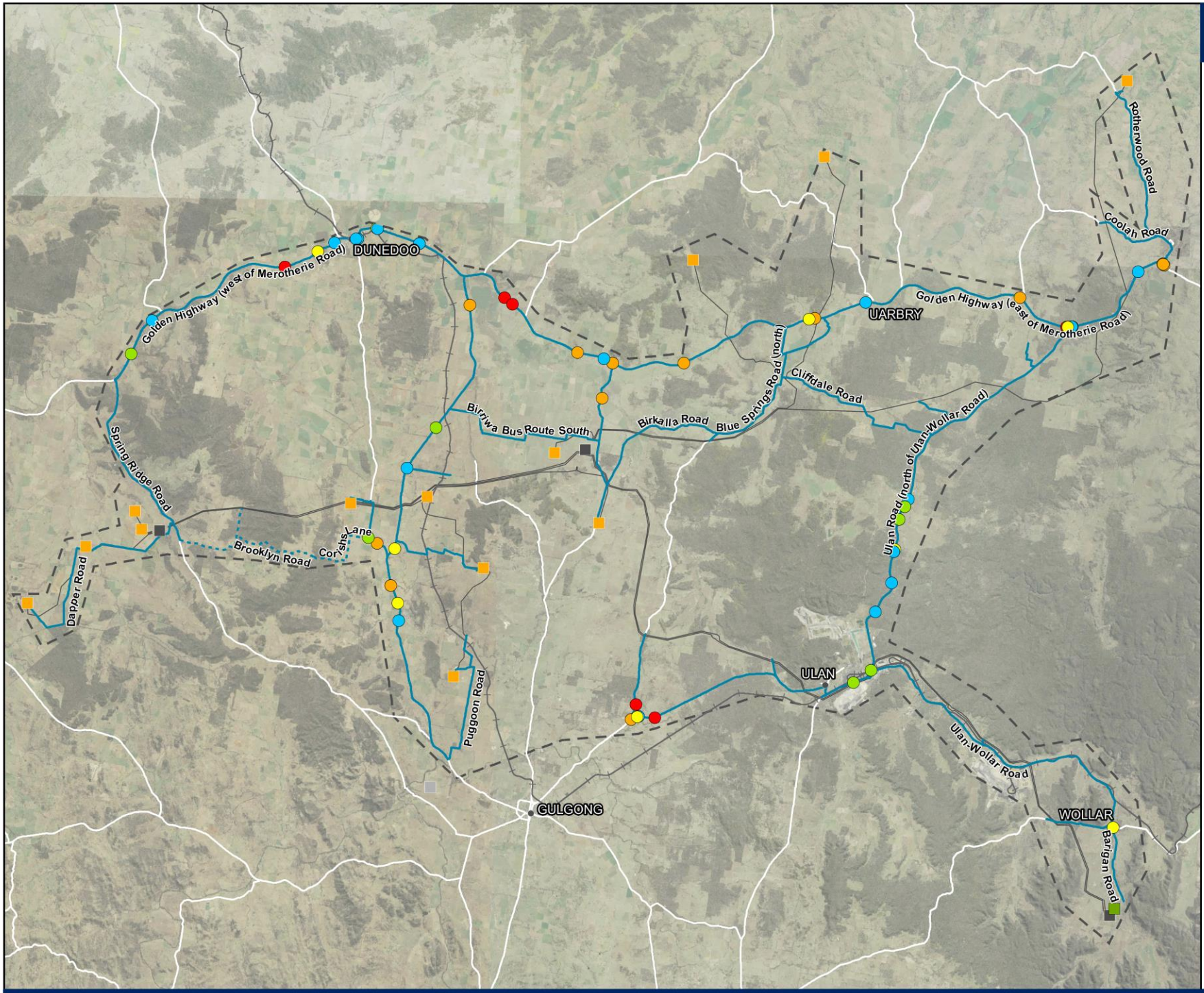

Figure 4-13
Crashes (between 2016-2020) within the study area

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing substation
- Transmission line alignment
- Railway

General construction route

- Heavy vehicles and light vehicles
- Light vehicles only

Crash Analysis

- Fatal
- Serious Injury
- Moderate Injury
- Minor/Other Injury
- Non-casualty (towaway)

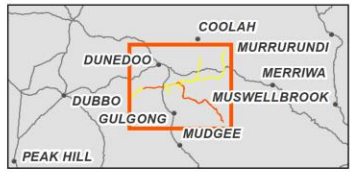

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Table 4-8 and Table 4-9 show the crashes which occurred in the study area on Golden Highway and Castlereagh Highway respectively of the proposed construction routes.

Golden Highway recorded 32 crashes with 13 crashes (41 per cent) classified as Fatal and Serious Injury (FSI) crashes, with the majority occurred mid-block (81 per cent). The most common crash types recorded were run-off and head-on crashes. In high-speed environment, these types of crashes tend to result in fatality and serious injury.

Table 4-8 Crash summary along the proposed Golden Highway construction route by degree of severity and location

Severity	Total	Pedestrian	Intersection	Head-on	Rear-ends	U-turn/ Parking	Overtaking	On-path	Off-path on straight	Off-path on curve	Others
Fatal	**4**	0	0	1	0	0	0	0	2	1	0
Serious injury	**9**	0	0	3	1	0	0	0	2	3	0
Moderate injury	**7**	0	3	1	0	0	0	1	1	1	0
Minor injury/other injury	**1**	0	0	0	0	0	1	0	0	0	0
No casualty	**11**	0	0	1	0	0	0	2	3	4	1
Total	**32**	0	3	6	1	0	1	3	8	9	1

Castlereagh Highway recorded 8 crashes with 2 crashes (25 per cent) classified as FSI crashes, with all of the crashes recorded mid-block. The most common type of crashes recorded were associated with run-off crashes.

Table 4-9 Crash summary along the proposed Castlereagh Highway construction route by degree of severity and location

Severity	Total	Pedestrian	Intersection	Head-on	Rear-ends	U-turn/ Parking	Overtaking	On-path	Off-path on straight	Off-path on curve	Others
Fatal	**0**	0	0	0	0	0	0	0	0	0	0
Serious injury	**2**	0	0	0	0	0	0	0	1	1	0
Moderate injury	**2**	0	0	0	0	0	0	0	1	1	0
Minor injury/other injury	**1**	0	0	0	0	0	0	0	1	0	0
No casualty	**3**	0	0	0	0	0	0	1	1	1	0
Total	**8**	0	0	0	0	0	0	1	4	3	0

Table 4-10 and Table 4-11 show the crashes upon Cope Road and Ulan Road (main roads) along the proposed construction routes.

Cope Road recorded 4 crashes with 50 per cent classified as FSI crashes. The most common type of crashes recorded were associated with run-off crashes.

Ulan Road recorded 11 crashes with no FSI crashes. The most common type of crashes recorded were associated with run-off crashes and loss of control on-path.

Main roads along the proposed construction routes have comparatively lower proportions of FSI crashes when compared to the highway road network. The majority of crashes on the main roads occurred at mid-block locations (87 per cent).

Table 4-10 Crash summary along the proposed Cope Road construction route by degree of severity and location

Severity	Total	Pedestrian	Intersection	Head-on	Rear-ends	U-turn/ Parking	Overtaking	On-path	Off-path on straight	Off-path on curve	Others
Fatal	**1**	0	0	0	0	0	0	0	1	0	0
Serious injury	**1**	0	0	0	0	0	0	0	1	0	0
Moderate injury	**1**	0	0	0	0	0	0	0	0	1	0
Minor injury/other injury	**0**	0	0	0	0	0	0	0	0	0	0
No casualty	**1**	0	0	0	0	0	0	0	0	1	0
Total	**4**	0	0	0	0	0	0	0	2	2	0

Table 4-11 Crash summary along the proposed Ulan Road construction route by degree of severity and location

Severity	Total	Pedestrian	Intersection	Head-on	Rear-ends	U-turn/ Parking	Overtaking	On-path	Off-path on straight	Off-path on curve	Others
Fatal	**0**	0	0	0	0	0	0	0	0	0	0
Serious injury	**0**	0	0	0	0	0	0	0	0	0	0
Moderate injury	**3**	0	2	0	0	0	0	1	0	0	0
Minor injury/other injury	**4**	0	0	0	0	0	0	3	0	0	1
No casualty	**4**	0	0	0	0	0	1	1	1	1	0
Total	**11**	0	2	0	0	0	1	5	1	1	1

Wollar Road (regional road) had one mid-block crash which resulted in moderate injuries.

Table 4-12 show the crashes upon the local roads along the proposed construction routes. These accounted for 7 crashes, with four crashes (57 per cent) classified as FSI crashes. The most common type of crashes recorded were associated with run-off and head on crashes.

Table 4-12 Crash summary along the proposed construction routes using Local Roads by degree of severity and location

Severity	Total	Pedestrian	Intersection	Head-on	Rear-ends	U-turn/ Parking	Overtaking	On-path	Off-path on straight	Off-path on curve	Others
Fatal	**1**	0	0	0	0	0	0	0	0	1	0
Serious injury	**3**	0	0	2	1	0	0	0	0	0	0
Moderate injury	**1**	0	1	0	0	0	0	0	0	0	0
Minor injury/other injury	**1**	0	0	0	0	0	0	0	1	0	0
No casualty	**1**	0	0	0	0	0	0	0	0	1	0
Total	**7**	0	1	2	1	0	0	0	1	2	0

4.5 Public transport

Coaches provide the primary public transport service between the towns in the study area. Coach services are available and travel through towns such as Gulgong, Dunedoo and Coolah. Based on the local bus service provider website (Ogden's Coach), there are no local bus services within the study area.

These coach services form part of NSW Train Link's Regional Train and Coaches Network which generally runs an infrequent return trip of one service per week and up to four services a week. The network map is shown in Figure 4-14 and the route services and frequencies are detailed in Table 4-13.

Table 4-13 Bus services within the vicinity of the project

Bus number	Route	Network and operator	Service frequency
539	Lithgow to Coonabarabran	NSW Train Link Regional trains and coaches	One service per week on Sunday only, during the evening
540	Coonabarabran to Lithgow	NSW Train Link Regional trains and coaches	One service per week on Monday only, during the afternoon
545	Lithgow to Coonabarabran	NSW Train Link Regional trains and coaches	One service per week on Monday only, during the morning
546	Coonabarabran to Lithgow	NSW Train Link Regional trains and coaches	Four services per week in total. One service per day on the following days – Tuesday/Wednesday/Thursday/Sunday during the afternoon
547	Lithgow to Coonabarabran	NSW Train Link Regional trains and coaches	Two services per week in total. One service per day on the following days –Wednesday/Friday during the morning
549	Lithgow to Coonabarabran	NSW Train Link Regional trains and coaches	One service per week on Tuesday only, during the morning
573	Lithgow to Baradine	NSW Train Link Regional trains and coaches	One service per week on Thursday only, during the morning
574	Baradine to Lithgow	NSW Train Link Regional trains and coaches	One service per week on Friday only, during the morning

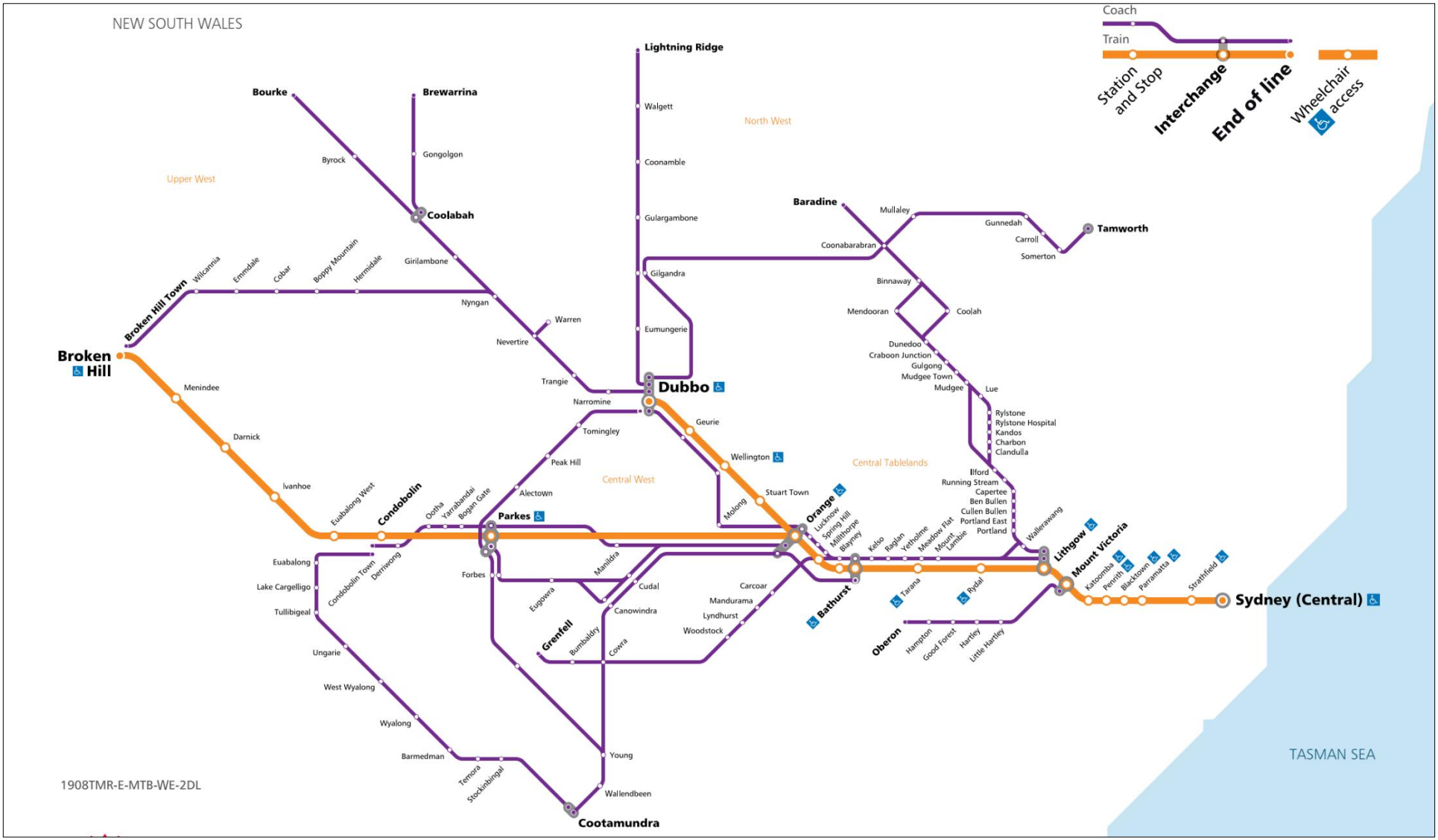


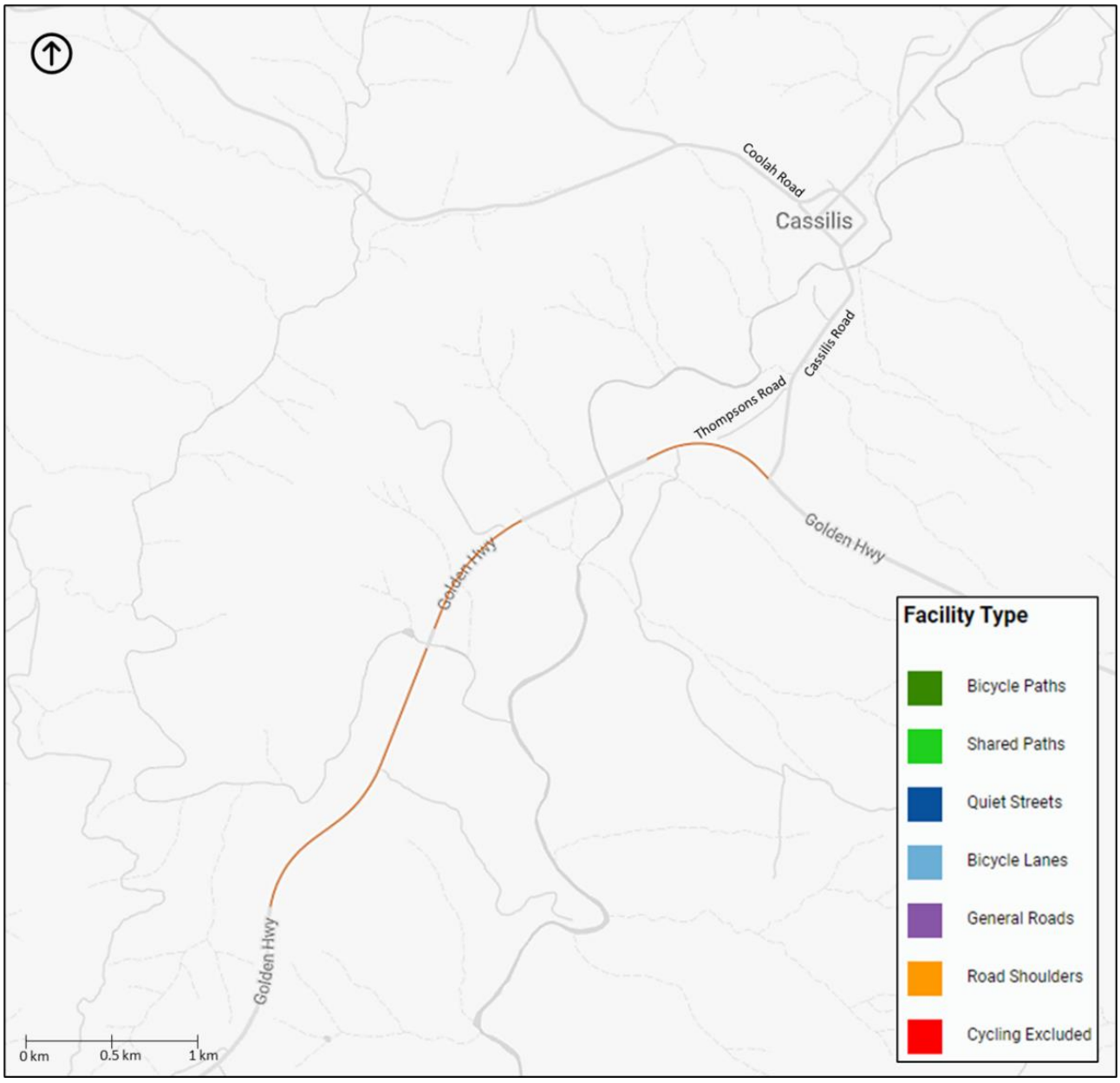
Figure 4-14 TfNSW Regional train and coaches network

4.6 Active transport

Active transport infrastructure is defined as allocated off-road or on-road facilities for pedestrian and cyclists to travel. These can be provided in a mixed traffic condition, visually separated, physically separated or segregated from the main traffic lanes or public transport corridor.

In the study area, footpath networks are typically only provided in town centres (i.e. Gulgong, Cassilis, Dunedoo, Wollar) which provide separated walking facilities from the adjacent traffic lanes. Separated walking facilities are typically not provided on the roads outside of the town centres.

Cycling facilities are much less established within the study area. A search in Transport for NSW's *Cycleway Finder* found that the only bicycle facility in the study area is located on the Golden Highway (shown on Figure 4-15), which extends approximately 4.5 kilometres west of Cassilis Road, with the link disconnected over road bridges across intersecting rivers and creeks. The facility consists of a wide shoulder on either side of the Golden Highway.



Source: Cycleway Finder Transport for NSW, 2022

Figure 4-15 Existing bicycle infrastructure on Golden Highway near the project

Despite generally having limited cycling infrastructure, the region encompass an active cycling community – the Central West Cycle (CWC) trail. The cycling group actively ride and discover suitable routes to cycle on, map and write about the routes, and provide feedback and representations to Council.

The CWC trail follows the quiet backroads in a circuit through Mudgee-Gulgong-Dunedoo-Mendooran-Ballimore-Dubbo-Geurie-Wellington-Goolma-Gulgong to Mudgee. It traverses through rural landscapes, native bush areas, villages, small towns and regional cities. The route mapped by CWC in November 2020 is depicted in Figure 4-16, noting that additional route between Gulgong and Birriwa have been discovered since (Figure 4-17).

Figure 4-16 Central West Cycle trail

Figure 4-17 Central West Cycle trail

5 Construction assessment

This chapter presents an assessment of the potential impacts that are expected to occur during construction of the project. This included an assessment of the performance of the construction routes based on the increase in construction traffic, including OSOM vehicle access, and an assessment of potential impact to road users including pedestrian and cyclists.

5.1 Construction overview

The project overview as detailed in Section 1.3 provides a summary of works proposed in this project. This section aims to discuss the proposed construction activities relevant to traffic and transport matters, which includes construction hours, construction route, major site compound locations, location of camp sites, switching station, access requirements and impact of these to the operation of the road network.

5.1.1 Workforce accommodation camp locations

To support construction of the project two workforce accommodation camps are required to house up to 1,800 workers during peak construction.

The main workforce accommodation camp would be located at the Merotherie energy hub site and would house up to approximately 1,000 workers. The workforce accommodation camp would be accessed from Merotherie Road from the Golden Highway. A satellite workforce accommodation camp would be located at 118 Neeleys Lane, Cassilis to the south of the Golden Highway. The satellite workforce accommodation camp would house up to 800 workers during peak construction.

Details of the proposed workforce accommodation camp sites, capacity and proposed access points are summarised in Table 5-1.

Table 5-1 Location of accommodation camp sites and access points

Site location	Accommodation type	Capacity	Access
Merotherie site (part of the Energy Hub site)	Main camp site	1000 workers	Access driveway on Merotherie Road
118 Neeleys Lane Cassilis	Satellite camp	800 workers	Neeleys Lane/Ulan Road intersection

Source: EnergyCo, November 2022

The location of proposed access points for the workforce accommodation camps were based on the proposed camp layout, existing access provisions and connectivity to the road network. The access layout and the composition of the access arrangements were determined utilising Austroads Design guidelines and construction standards.

The locations of these access points and their design and layout requirements have been indicated at each site as depicted in Section 5.1.6.

5.1.2 Energy hubs

Energy hubs are substations where energy exported from renewable energy generators is aggregated, transformed to 500 kV (where required) and exported to the transmission network. The significant civil and electrical works required at these sites would attract the majority of traffic movements generated from the camps throughout the construction period. Table 5-2 details the location of the Energy Hubs and associated access points required.

Table 5-2 Location of Energy Hubs and access points

Energy hub	Section of project	Access point
Elong Elong Energy Hub	Western	New access road off Spring Ridge Road to be accessed via Golden Highway
Merotherie Energy Hub	Central	Upgraded Merotherie Road via Merotherie Road/ Golden Highway intersection

Source: EnergyCo, November 2022

5.1.3 Switching stations

Switching stations are facilities used to connect two or more distinct transmission lines of the same designated voltage. Details of location, access points and connecting transmission lines are detailed in Table 5-3 and depicted in Figure 5-1. The switching station sites have smaller work area footprint and scope of works compared to the energy hubs and therefore generate considerably less traffic movements during construction.

Table 5-3 Location of switching station and access points

Switching stations	Access point	Transmission line connection
New Wollar	Existing access road for the Wollar Substation off Barigan Road. This road also provides access to the Wollar Solar Farm.	New Wollar Switching Station to Merotherie Energy Hub connection
M1	New access track off Rotherwood Road, accessible from Coolah Road in Cassilis	Cassilis connection
M2	New access track off the Golden Highway in Uarbry	Coolah connection
M3	New access track off the Golden Highway in Uarbry	Leadville connection
M4	New access track of Merotherie Road south of Birkalla Road	Merotherie south connection
M5	New access track off Birriwa Bus Route South, accessible from Merotherie Road	Merotherie west connection
M6	New access track off Gingers Lane, accessible from Castlereagh Highway (south of the Golden Highway)	Tallawang west connection
M7	New access track off Spir Road, accessible from Tucklan Road	Tallawang west connection
M8	New access track which provides a continuation of Whistons Lane. Accessible from Castlereagh Highway (south of Golden Highway)	Tallawang south connection
M9	New access track off Puggoon Road	Tallawang south connection
E1	Shared access road with the Elong Elong Energy Hub. The new access road would be constructed off Spring Ridge Road and Dapper Road north of Upper Laheys Creek Road.	Cobbora north connection
E2		Cobbora west connection
E3		Goolma connection
E4	Access via transmission line easement and/or track off Dapper Road	Goolma connection

Source: EnergyCo, November 2022

5.1.4 Transmission lines

As part of this project, approximately 90 kilometres of twin double circuit 500 kV transmission lines, 150 kilometres of single circuit, double circuit and twin double circuit 330 kV transmission lines, fibre optic communication lines and associated infrastructure (e.g. transmission towers) are proposed to be constructed.

Works associated with the transmission line generally interacts with the road network by way of vehicle access needs from the road network and short disruptions caused by stringing across the roads.

Transmission line access – access gates are proposed where the transmission line easement crosses a public road to provide access for workers and delivery of materials and machinery to undertake the construction works.

Line stringing activities – would occur over the road and rail network which would likely cause short-term disruptions requiring appropriate construction methodology to be developed, notification, traffic control and permit application, which are further discussed in Section 5.2.4.

The roads to be used for construction vehicle access to the transmission lines and the location to which stringing activities are likely to interact with the road network is detailed in Table 5-4 which are also viewable in Figure 5-1.

These construction traffic impact assessment from these activities is detailed in Section 5.2, including design consideration as per Austroads which is discussed in Section 5.2.2.3.

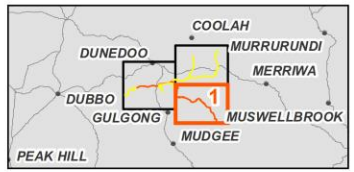
Stringing across the railway line would occur:

- along Sandy Hollow Gulgong railway line which intersects with the New Wollar Switching Station—Merotherie Energy Hub connection at three locations
- along the Wallerawang-Gwabegar railway line which intersects the Tallawang South Connection, Tallawang West Connection and Merotherie Energy Hub—Elong Elong Energy Hub connection.

Figure 5-1
Transmission line sections
Page 1 of 3

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Existing substation
- Access gate



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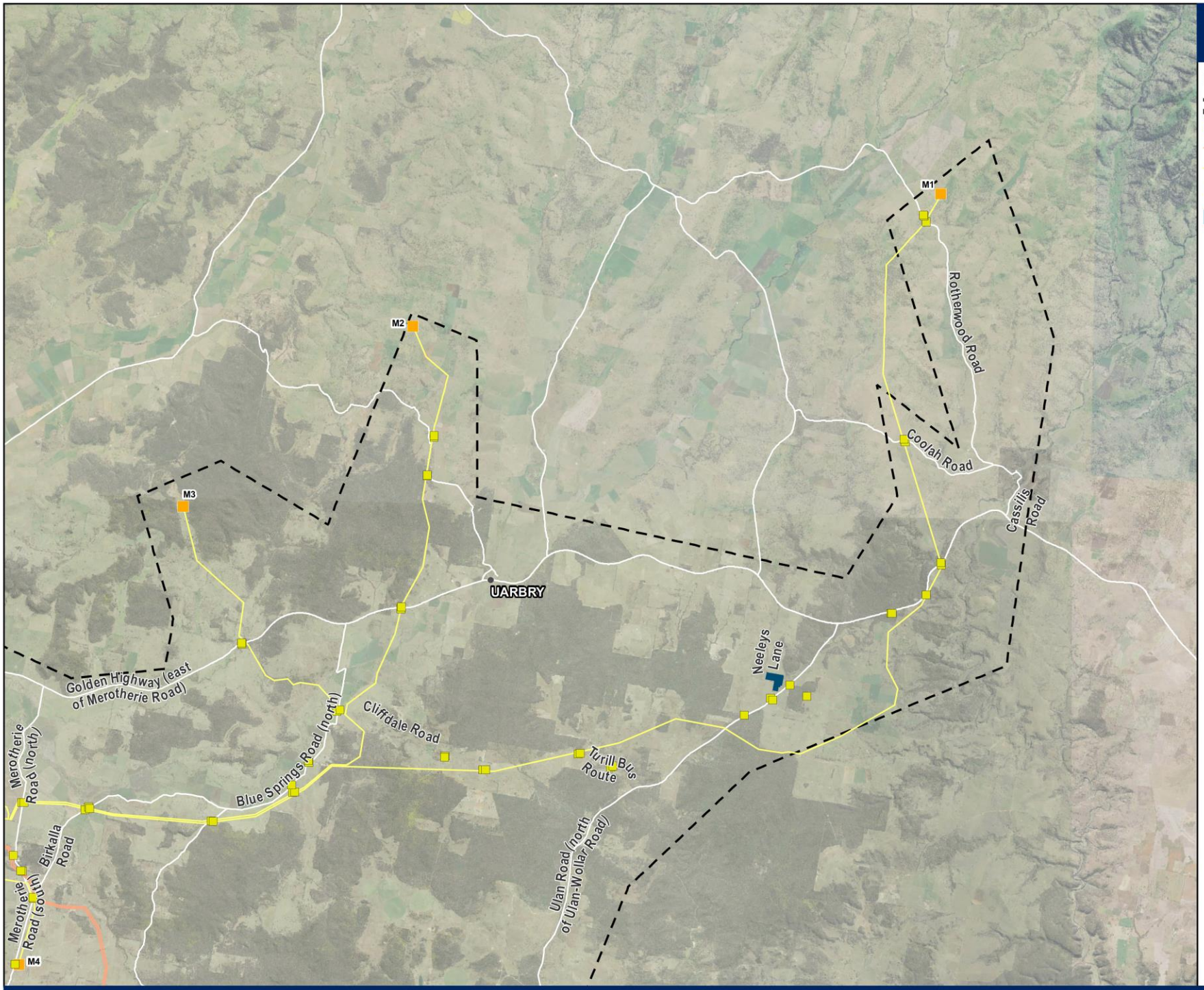
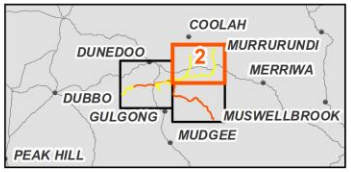


Figure 5-1
Transmission line sections
Page 2 of 3

Legend

- Study area boundary
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Access gate
- Neeleys Lane workforce accommodation camp



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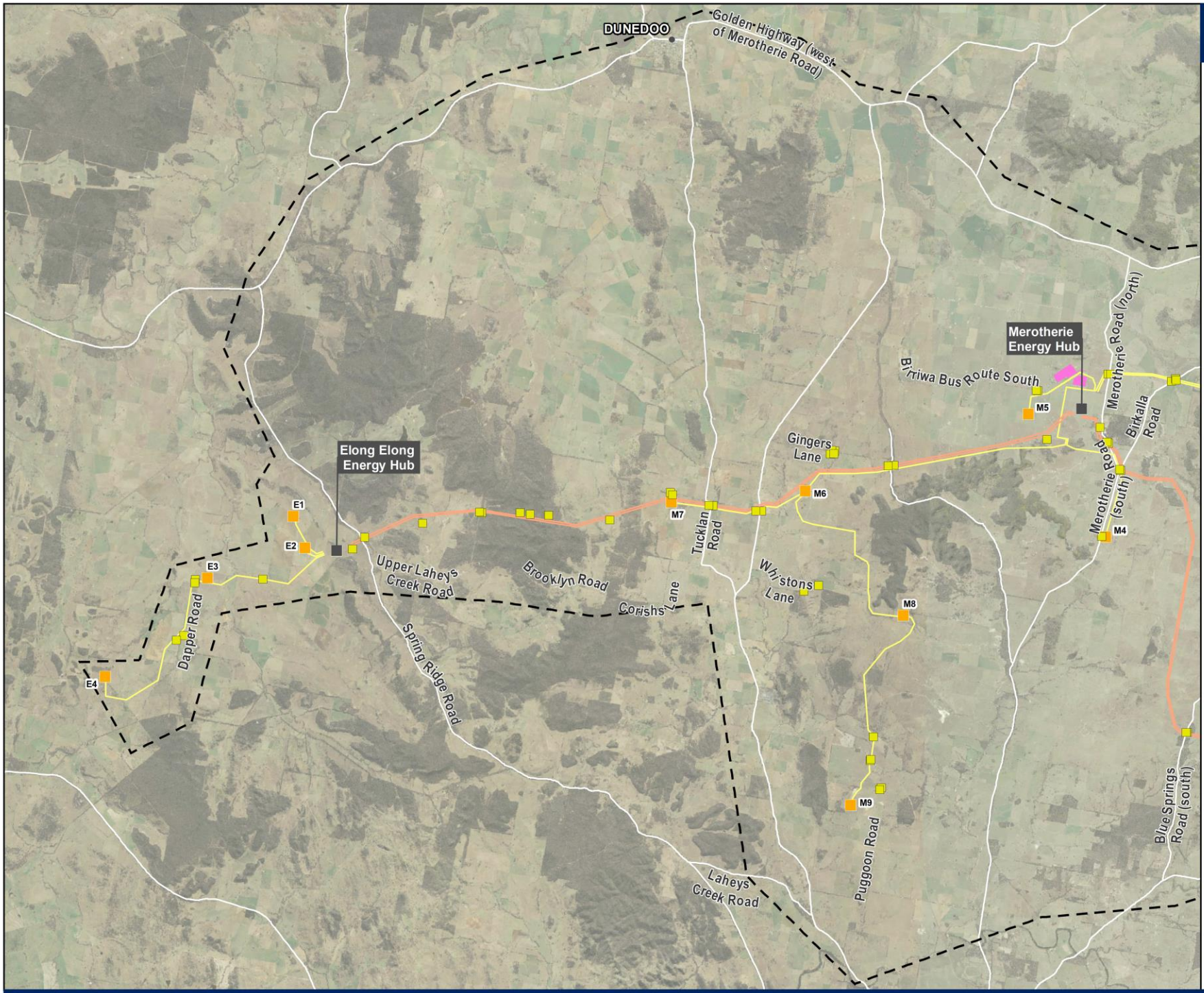

Figure 5-1
Transmission line sections
Page 3 of 3

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Access gate
- Merotherie workforce accomodation camp

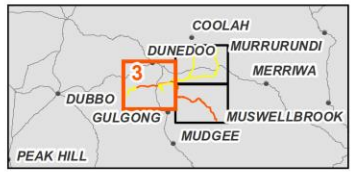

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Table 5-4 Extent of new transmission line, proposed access gate locations and interaction with road network associated with stringing activities

Transmission line	Brief description	Roads to access gates along transmission line	Stringing across road network
500 kV transmission			
New Wollar Switching Station—Merotherie Energy Hub connection Section: south-eastern and central	Extends from the new Wollar Switching Station to the Merotherie Energy Hub	— Barigan Road — Wollar Road (near Wollar township) — Ulan Wollar Road — Ulan Road — Lagoons Road — Cope Road — Main Street — Highett Road — Blue Springs Road — Birkalla Road — Merotherie Road	— Merotherie Road and Birkalla Road, near Birkalla Road intersection with Merotherie Road — Blue Springs Road north of Cope Road — Highett Road — Cope Road and Ulan Road near Ulan township — Ulan-Wollar Road — Wollar Road west of Wollar township
Merotherie Energy Hub—Elong Elong Energy Hub connection Section: Central and Western	Extends from the Merotherie Energy Hub to the Elong Elong Energy Hub	— Gingers Lane — Castlereagh Highway (south of Golden Highway) — Tucklan Road — Spir Road — Laheys Creek Road — Spring Ridge Road — Dapper Road	— Barneys Reef Road — Castlereagh Highway south of Gingers Lane — Tucklan Road — Laheys Creek Road (north of Tuckland State Forest) — Spring Ridge Road

Transmission line	Brief description	Roads to access gates along transmission line	Stringing across road network
330 kV transmission			
Cassilis connection from Merotherie Energy Hub Section: north-eastern	Extends from the Merotherie Energy Hub to Cassilis, runs parallel with the Coolah connection for a short duration, terminating at M1	— Merotherie Road — Birkalla Road — Blue Springs Road — Cliffdale Road off Blue Springs Road — Turill Bus Route — Ulan Road south of Neeleys Lane — Golden Highway south of Cassilis township — Coolah Road and Rotherwood Road (off Cassilis Road & Golden Highway)	— Birriwa Bus Route South — Merotherie Road — Birkalla Road — Blue Springs Road — Cliffdale Road — Turill Bus Route — Ulan Road south of Neeleys Lane — Golden Highway south of Cassilis township — Coolah Road — Rotherwood Road
Coolah connection from Merotherie Energy Hub Section: north-eastern	Extends from the Merotherie Energy Hub to Coolah, runs parallel with the Cassilis connection for a short duration, terminating at M2	— Merotherie Road — Birkalla Road — Cliffdale Road — Blue Springs Road — Golden Highway (east of Blue Springs Road) — Moorefield Road	— Birriwa Bus Route South — Merotherie Road — Birkalla Road — Cliffdale Road — Blue Springs Road — Golden Highway east of Blue Springs Road — Moorefield Road
Leadville connection from Merotherie Energy Hub Section: north-eastern	Extends from the Coolah connection, terminating at M3	— Blue Springs Road — Golden Highway west of Blue Springs road	— Blue Springs Road — Golden Highway west of Blue Springs Road

Transmission line	Brief description	Roads to access gates along transmission line	Stringing across road network
Merotherie south connection from Merotherie Energy Hub Section: central	Extends from the Merotherie Energy Hub to the south, south-east, terminating at M4	— Merotherie Road	— Merotherie Road
Merotherie west connection from Merotherie Energy Hub Section: central	Extends from Merotherie Energy Hub to the west of the EH, terminating at M5	— Birriwa Bus Route South	— Birriwa Bus Route South
Tallawang west connection from Merotherie Energy Hub Section: central	Extends from Merotherie Energy Hub to the west, terminating near the border of Dunedoo, terminating at M7	— Merotherie Road — Gingers Lane off Castlereagh Highway — Castlereagh Highway — Tucklan Road — Spir Road	— Barneys Reef Road — Castlereagh Highway — Tucklan Road
Tallawang south connection from Merotherie Energy Hub Section: central	Extends from the M6 switching station to the south, terminating at M9	— Gingers Lane off Castlereagh Highway — Whistons Lane off Castlereagh Highway — Puggoon Road	— Puggoon Road
Cobbora north connection from Elong Elong Energy Hub Section: western	Extends from western boundary to the north, terminating at E2	— Spring Ridge Road	— Does not interact with the road network
Cobbora west connection from Elong Elong Energy Hub Section: western	Extends to the west, terminating at E3	— Spring Ridge Road — Dapper Road off Spring Ridge Road	— Does not interact with the road network
Goolma connection from Elong Elong Energy Hub Section: western	Extends to the south-west, terminating at E4	— Dapper Road off Spring Ridge Road	— Dapper Road

Source: EnergyCo, November 2022

5.1.5 Construction routes

The proposed construction routes for the proposed energy hubs, switching stations and transmission line access gates are depicted in Figure 5-2.

General construction routes would typically use:

- General access vehicles (GAV) – classified as vehicles that comply with mass and dimension requirements. The limitation includes length (12.5 metres long for rigid vehicles, 19 metres long for articulated vehicles), height (not exceeding 4.3 metres) and width (not exceeding 2.5 metres). These vehicles do not require a permit to operate on the NSW road network and can operate on any road unless the road is sign-posted otherwise.
- Restricted access vehicles (RAV) in limited amounts. Restricted access vehicles are classified as vehicles are greater in mass and dimension than general access vehicles as described above. These vehicles are restricted to using approved roads only detailed in the Transport for NSW's Restricted Access Vehicle Map. Example of these vehicles during construction may include articulated vehicles (truck and dog or tag trailers) exceeding 19 metres long which may be needed to transfer materials or plant.

The construction of the project would also require the transportation of large and/or heavy equipment via road that would constitute OSOM movements (e.g. electrical transformers). The majority of OSOM vehicles would travel from the Port of Newcastle to the energy hubs at Elong Elong and Merotherie, and the New Wollar Switching Station. For these journeys, the vast majority of the OSOM movements would travel via the Hunter Express and Golden Highway, which are pre-approved for OSOM transport. However, for the last mile road sections between the pre-approved OSOM routes and the energy hubs and new Wollar Switching Station additional approvals would be required from the NHVR.

To assist in the facilitation of OSOM and other construction traffic movements, EnergyCo is proposing to upgrade Merotherie Road from its junction with the Golden Highway for around 7 kilometres, including a replacement bridge over Talbragar River. In addition, EnergyCo is proposing to upgrade a low point on Spring Ridge Road, just north of the intersection with Dapper Road.

EnergyCo intends to assess and determine the road and intersection upgrades under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application. However, the road and intersection upgrades are also included in the EIS so that in the event they are not determined under Division 5.1, they can be approved under the CSSI application.

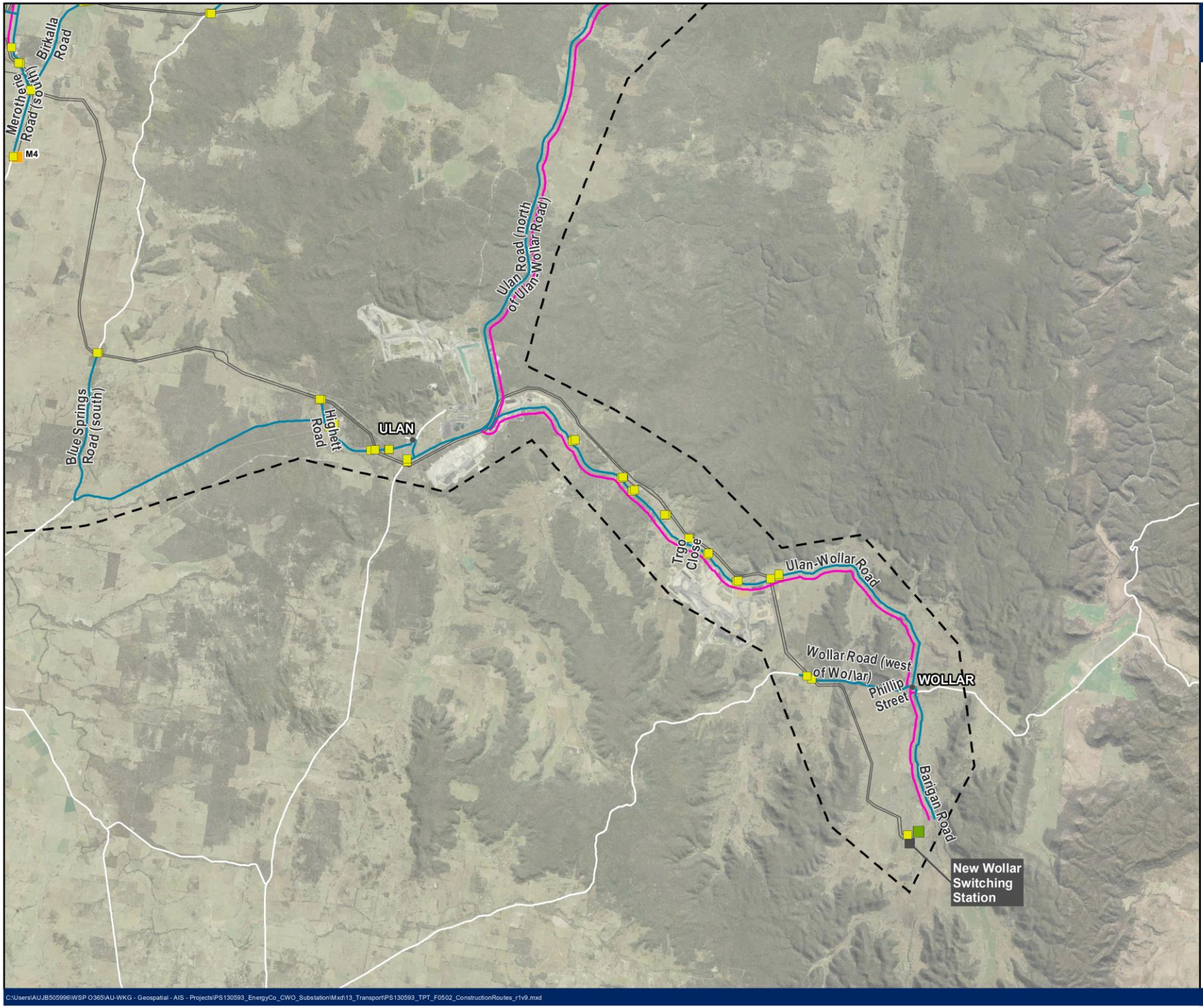


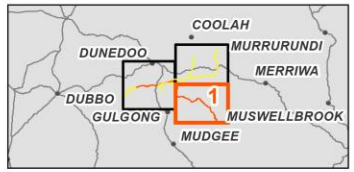
Figure 5-2
Construction routes within the traffic and transport study area

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing substation
- Indicative microwave repeater site (Botobolar)
- Access gate
- Transmission line alignment
- Merotherie workforce accomodation camp
- Neeleys Lane workforce accommodation camp
- OSOM construction route

General construction route

- General construction route (light and heavy vehicles)
- General construction route (light vehicle only)



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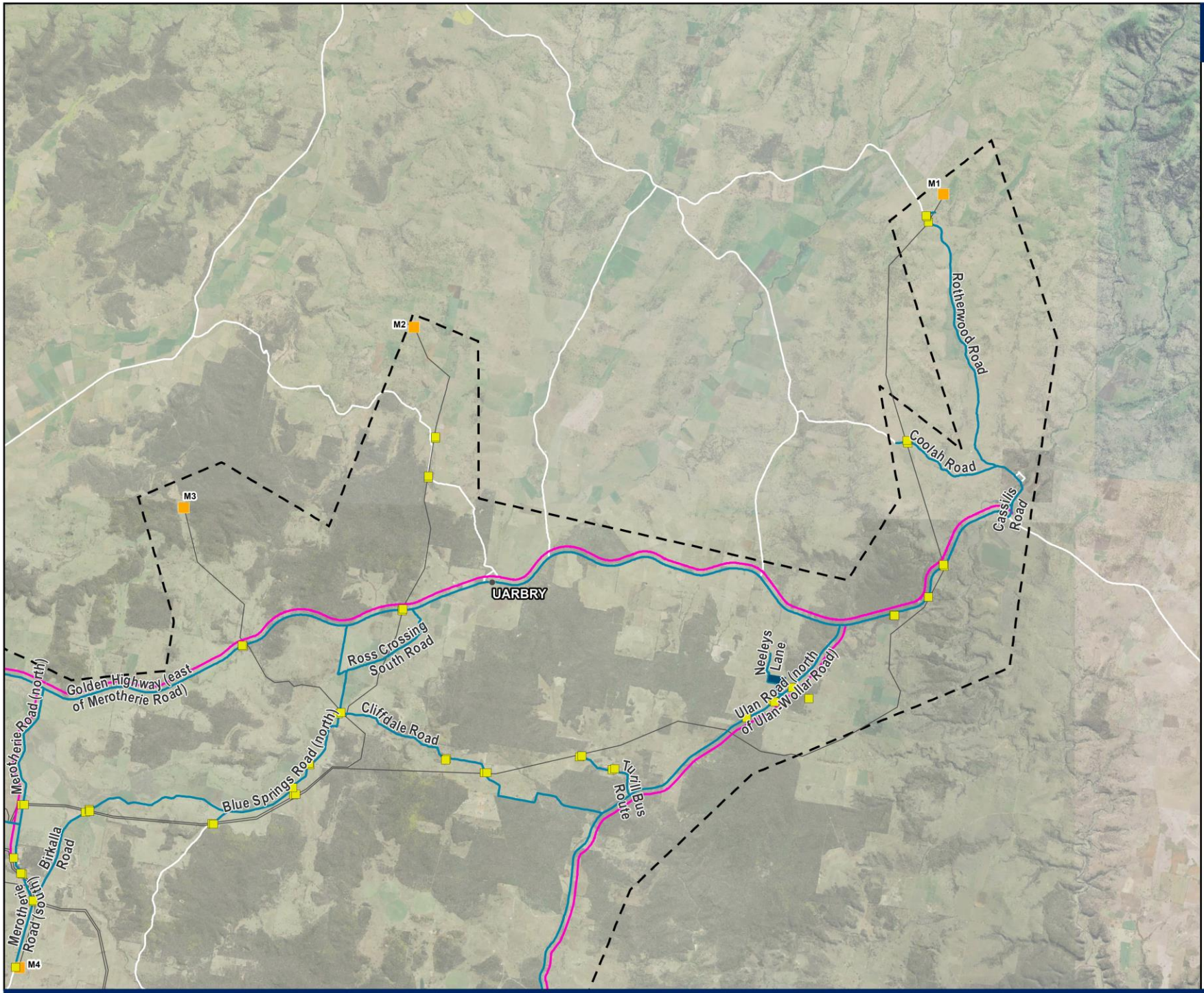

Figure 5-2
Construction routes within the traffic and transport study area

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- Study area boundary
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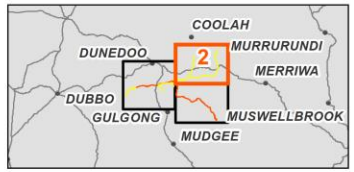
- Neeleys Lane workforce accommodation camp
- OSOM construction route

General construction route

- General construction route (light and heavy vehicles)
- General construction route (light vehicle only)



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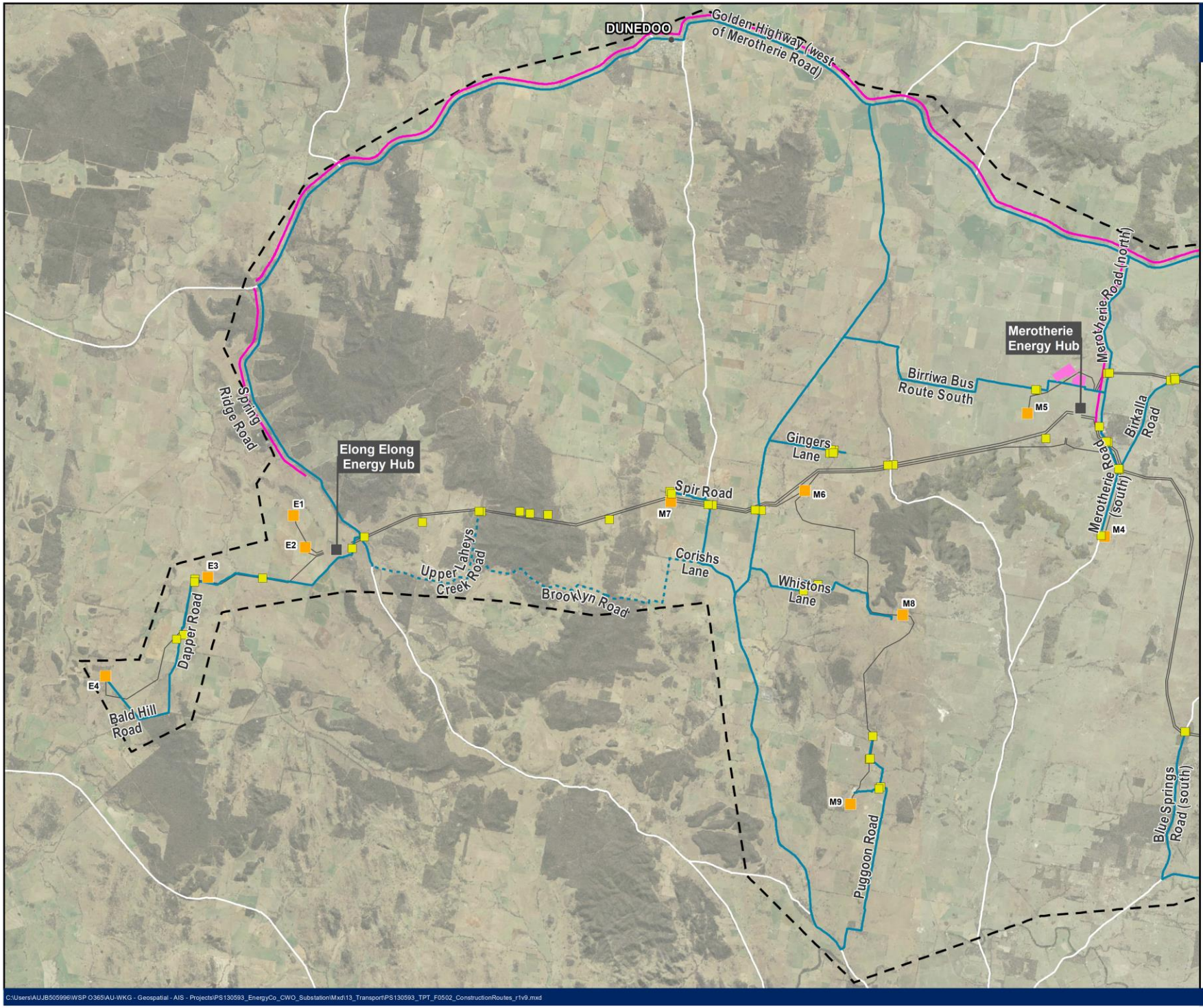


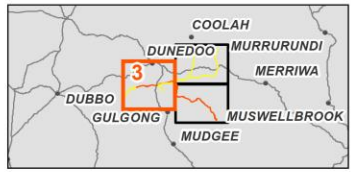
Figure 5-2
Construction routes within the traffic and transport study area

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing substation
- Indicative microwave repeater site (Botobolar)
- Access gate
- Transmission line alignment
- Merotherie workforce accomodation camp
- Neeleys Lane workforce accommodation camp
- OSOM construction route

General construction route

- General construction route (light and heavy vehicles)
- General construction route (light vehicle only)



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5.1.6 Construction traffic generation and distribution

Construction of the project would commence in the second half of 2024, subject to NSW Government and Commonwealth planning approvals, and is estimated to take about three years. The construction activities are expected to peak from mid-2025 to mid-2026 with the workforce accommodation camps to be at full capacity in this period.

Based on the construction activities scheduled in this period, EnergyCo has provided estimates of the traffic and transport movements to/from the workforce accommodation camps, energy hubs and switching stations. The estimates of traffic movements have taken into consideration:

- movements of workers which would mainly occur in the morning and afternoon peak
- material transfers distributed throughout the day
- movement of visitors and deliveries
- typical movements at switching stations and access gates along the transmission lines.

Table 5-5 highlights the maximum hourly movements generated to/from the respective sites which have been used to assess the worst-case impact of the project (i.e. peak hour during peak construction). These movements would be distributed on the construction routes depicted in Figure 5-2.

Table 5-5 Traffic and transport peak-hour combined traffic movement estimates two-way combined

Site	Light vehicle (traffic movements per hour)	Heavy vehicle (traffic movements per hour)	Total (traffic movements per hour)
Merotherie Energy Hub and Camp (main camp site)	40	30	70
Neeleys Lane Camp (satellite camp site)	32	24	56
New Wollar switching station	4	20	24
Elong Elong Energy Hub	4	20	24
Switching stations (typical)	12	1	13
Access gate (typical)	12	20	32

These estimates are considered the worst-case scenario as the estimates provided in Table 5-5 would:

- represent the maximum hourly traffic movements estimated for each site (i.e. peak hour during peak construction)
- assume that the typical traffic volumes required for works at switching stations and access gates are equally applied throughout the study area. In reality, construction activities for the switching stations and transmission line would be completed progressively throughout the construction phase (i.e. not concurrently) and associated traffic movements would only be needed where and when the construction works take place.

Figure 5-3 represents the upper threshold (rounded up to nearest 25 vehicles/hour) of peak hour traffic movements distributed throughout the road network in the study area generated/attracted by the project.

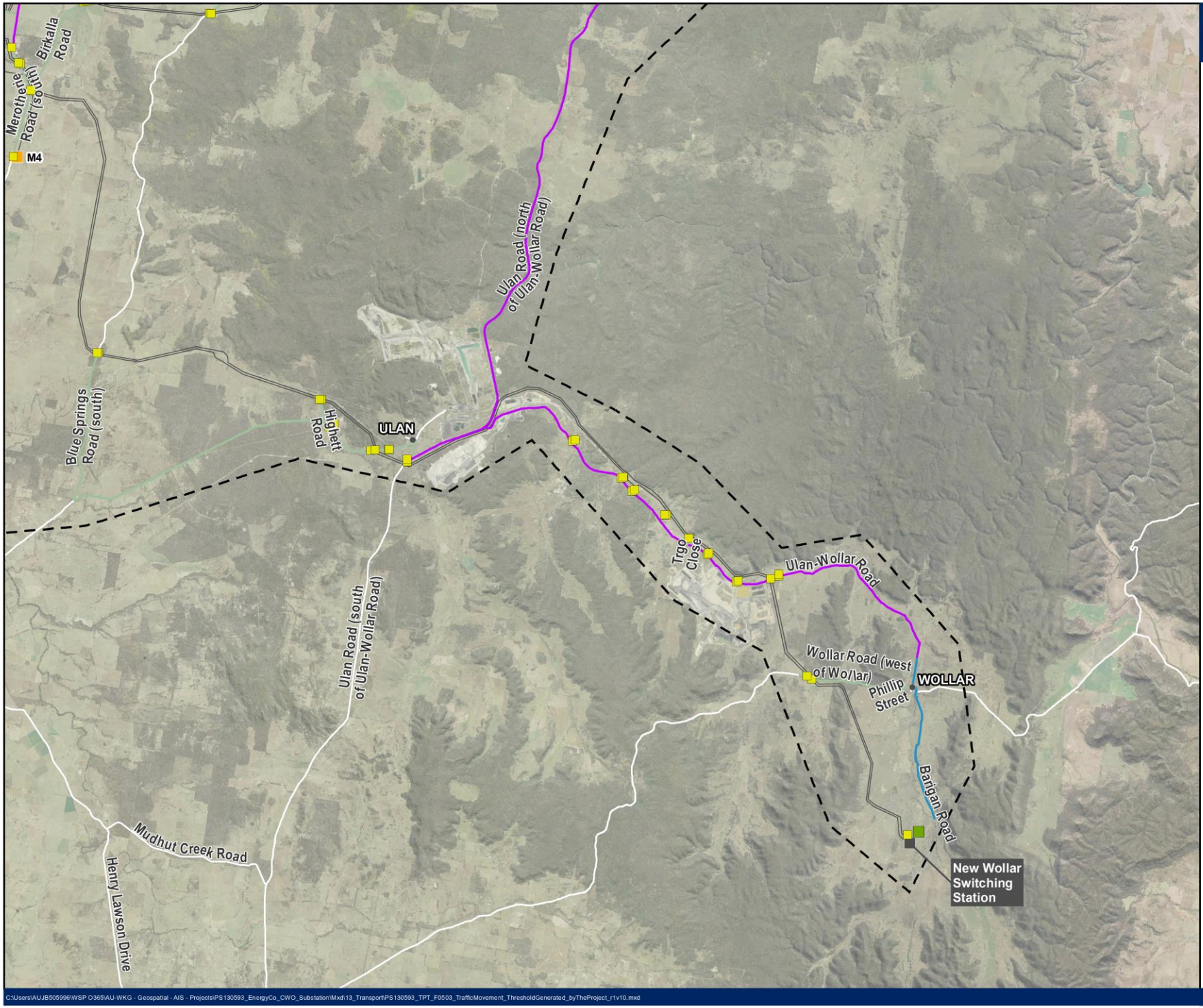


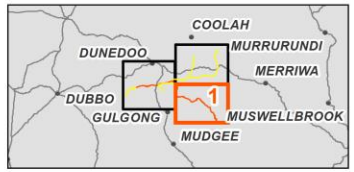
Figure 5-3
Traffic movement threshold generated by the project in peak construction period

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing substation
- Access gate
- Transmission line alignment

Traffic movement threshold (vehicle movement per hour)

- 25
- 50
- 75



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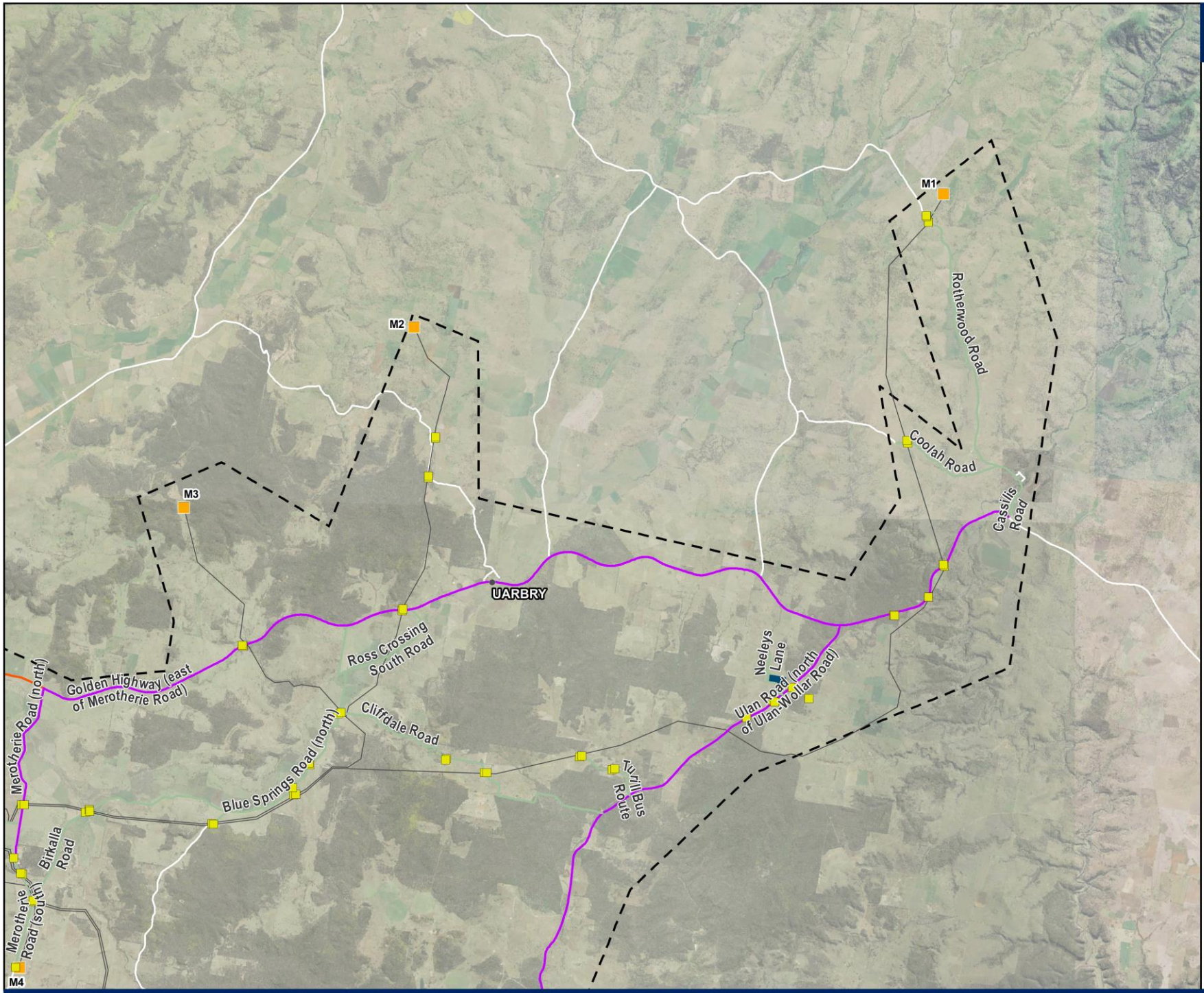


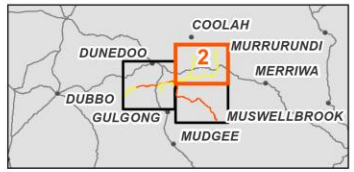
Figure 5-3
Traffic movement threshold generated by the project in peak construction period

Legend

- Study area boundary
- 330 kV switching station
- Access gate
- Transmission line alignment
- Neeleys Lane workforce accommodation camp

Traffic movement threshold (vehicle movement per hour)

- 50
- 75
- 100



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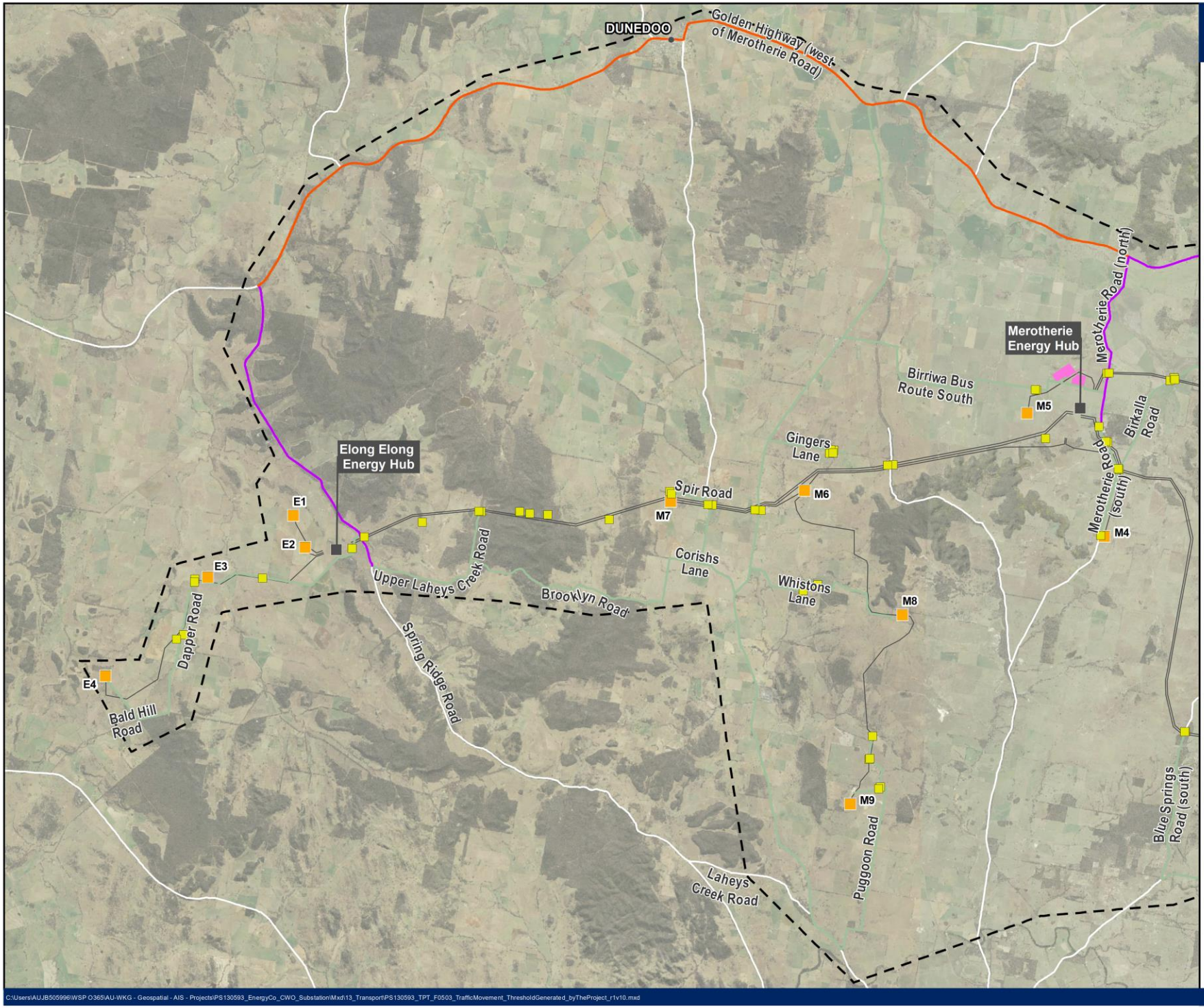


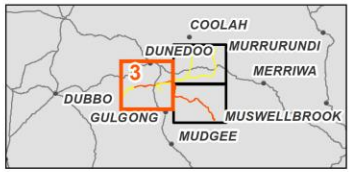
Figure 5-3
Traffic movement threshold generated by the project in peak construction period

Legend

- Study area boundary
- Energy hub / 500 kV switching station
- 330 kV switching station
- Access gate
- Transmission line alignment
- Merotherie workforce accomodation camp

Traffic movement threshold (vehicle movement per hour)

- 50
- 75
- 100



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5.2 Construction impact assessment

5.2.1 Impacts on road capacity and efficiency

No background traffic growth has been applied in the assessment to reflect the conditions observed at several Transport for NSW's traffic count stations available in the region.

Table 5-6 provides a comparison of traffic performance under existing traffic conditions with those forecasted during construction. This assessment has been completed for the construction routes to be used for access between the workforce accommodation camps, and energy hubs and switching stations.

For the purpose of the assessment, traffic movements at the workforce accommodation account for 10:90 inbound to outbound ratio in the morning peak. Movements at the work area (energy hubs/switching stations) account of 90:10 inbound to outbound ratio in the morning peak. The reverse is used for movements in the afternoon peak periods.

There are several local roads that form part of the construction routes that have not been quantitatively assessed, given that they would primarily function to provide access to the transmission lines' access gates only – a list of these roads have been included in Appendix A. Construction vehicle utilising the transmission line access gates would typically be limited to 32 vehicles per hour (12 light vehicles and 20 heavy vehicles) during the peak period. These low additional demands (an arrival of approximately one vehicle every two minutes) are not likely to adversely impact the performance and capacity of the road network. These roads would be subject to the routine road condition inspection discussed in Section 5.2.6.

With the addition of forecasted construction traffic, the impact to the road network's capacity and efficiency would be minor, with almost all construction routes in the study area continuing to operate at the same LoS as they do under existing conditions. This result can be attributed to the already low traffic volumes and the low construction traffic on each construction route with respect to the spare road capacity.

One road which would experience reduced level of service from LoS B (existing) to LoS C (during construction) is on Ulan-Wollar Road in the eastbound direction. This road is highly utilised by workers travelling to the existing mine sites in the morning peak. Despite the reduced level of service, traffic would still operate a near free flowing conditions, although drivers would be required to exercise more care and vigilance when making lane changes.

It is evident that based on the Level of Service, the project would not adversely affect the road capacity performance of any construction routes.

Table 5-6 Road performance analysis during construction

ID	Location	Road classification	Lane capacity (vph/ lane)	Traffic volume (current) Volume/Capacity ratio (Level of Service)				Construction peak-hour movement threshold (vph)	Project peak hour movement				Traffic volume with project Volume/Capacity ratio (Level of Service)			
				AM peak hour		PM peak hour			AM peak hour		PM peak hour		AM peak hour		PM peak hour	
				NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
H01	Golden Highway (near Spring Ridge Road, west of Dunedoo), Dunedoo	Highway	1,800	57 vph 0.03 (LoS A)	52 vph 0.03 (LoS A)	51 vph 0.03 (LoS A)	61 vph 0.03 (LoS A)	100	90	10	10	90	147 vph 0.08 (LOS A)	62 vph 0.03 (LOS A)	61 vph 0.03 (LOS A)	151 vph 0.08 (LOS A)
H02	Golden Highway (between Ulan Road and Merotherie Road), Uarbry)	Highway	1,800	54 vph 0.03 (LoS A)	35 vph 0.02 (LoS A)	39 vph 0.02 (LoS A)	42 vph 0.02 (LoS A)	75	68	7	7	68	122 vph 0.07 (LOS A)	42 vph 0.02 (LOS A)	46 vph 0.03 (LOS A)	110 vph 0.06 (LOS A)
H03	Castlereagh Highway (between Golden Highway and Tucklan Road), Birriwa	Highway	1,800	29 vph 0.02 (LoS A)	41 vph 0.02 (LoS A)	38 vph 0.02 (LoS A)	34 vph 0.02 (LoS A)	50	5	45	45	5	34 vph 0.02 (LoS A)	86 vph 0.05 (LoS A)	83 vph 0.05 (LoS A)	39 vph 0.02 (LoS A)
H05	Castlereagh Highway (north of Laheys Creek Road), Beryl	Highway	1,800	31 vph 0.02 (LoS A)	46 vph 0.03 (LoS A)	44 vph 0.02 (LoS A)	45 vph 0.03 (LoS A)	50	5	45	45	5	36 vph 0.02 (LOS A)	91 vph 0.05 (LOS A)	89 vph 0.05 (LOS A)	50 vph 0.03 (LOS A)
M01	Cope Road (between Blue Springs Road and Springwood Park Road), Cope	Main Road	1,400	16 vph 0.01 (LoS A)	106 vph 0.08 (LoS A)	46 vph 0.03 (LoS A)	51 vph 0.04 (LoS A)	50	45	5	5	45	61 vph 0.04 (LOS A)	111 vph 0.08 (LOS A)	51 vph 0.04 (LOS A)	96 vph 0.07 (LOS A)
M03	Ulan Road near Ulan township	Main Road	1,400	447 vph 0.32 (LoS B)	130 vph 0.09 (LoS A)	174 vph 0.12 (LoS A)	191 vph 0.14 (LoS A)	75	8	67	67	8	455 vph 0.33 (LOS B)	197 vph 0.14 (LOS A)	241 vph 0.17 (LOS A)	199 vph 0.14 (LOS A)
M04	Ulan Road (north of Ulan-Wollar Road)	Main Road	1,400	152 vph 0.11 (LoS A)	109 vph 0.08 (LoS A)	74 vph 0.05 (LoS A)	81 vph 0.06 (LoS A)	75	8	67	67	8	160 vph 0.11 (LOS A)	176 vph 0.13 (LOS A)	141 vph 0.10 (LOS A)	89 vph 0.06 (LOS A)

ID	Location	Road classification	Lane capacity (vph/ lane)	Traffic volume (current) Volume/Capacity ratio (Level of Service)				Construction peak-hour movement threshold (vph)	Project peak hour movement				Traffic volume with project Volume/Capacity ratio (Level of Service)			
				AM peak hour		PM peak hour			AM peak hour		PM peak hour		AM peak hour		PM peak hour	
				NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
M05	Main Street – extension of Cope Road, Ulan	Main Road	1,000	9 vph 0.01 (LoS A)	127 vph 0.13 (LoS A)	8 vph 0.01 (LoS A)	89 vph 0.09 (LoS A)	50	45	5	5	45	54 vph 0.05 (LoS A)	132 vph 0.13 (LoS A)	13 vph 0.01 (LoS A)	134 vph 0.13 (LoS A)
R01	Wollar Road (west of Wollar)	Regional	1,000	11 vph 0.01 (LoS A)	6 vph 0.01 (LoS A)	8 vph 0.01 (LoS A)	7 vph 0.01 (LoS A)	50	45	5	5	45	56 vph 0.06 (LoS A)	11 vph 0.01 (LoS A)	13 vph 0.01 (LoS A)	52 vph 0.05 (LoS A)
L01	Tucklan Road (south of Rhodes Street in Dunedoo), Dunedoo	Local	1,000	6 vph 0.01 (LoS A)	6 vph 0.01 (LoS A)	7 vph 0.01 (LoS A)	6 vph 0.01 (LoS A)	50	45	5	5	45	51 vph 0.05 (LoS A)	11 vph 0.01 (LoS A)	12 vph 0.01 (LoS A)	51 vph 0.05 (LoS A)
L05	Spring Ridge Road, south of Golden Highway	Local	1,000	7 vph 0.01 (LoS A)	5 vph 0.01 (LoS A)	3 vph 0.00 (LoS A)	5 vph 0.01 (LoS A)	75	8	67	67	8	15 vph 0.02 (LOS A)	72 vph 0.07 (LOS A)	70 vph 0.07 (LOS A)	13 vph 0.01 (LOS A)
L06	Upper Laheys Creek Road	Local	1,000	0 vph 0.00 (LoS A)	4 vph 0.00 (LoS A)	1 vph 0.00 (LoS A)	2 vph 0.00 (LoS A)	50	5	45	45	5	5 vph 0.01 (LOS A)	49 vph 0.05 (LOS A)	46 vph 0.05 (LOS A)	7 vph 0.01 (LOS A)
L07	Merotherie Road (south of Golden Highway)	Local	1,000	0 vph 0.00 (LoS A)	0 vph 0.00 (LoS A)	0 vph 0.00 (LoS A)	0 vph 0.00 (LoS A)	75	8	67	67	8	8 vph 0.01 (LOS A)	67 vph 0.07 (LOS A)	67 vph 0.07 (LOS A)	8 vph 0.01 (LOS A)
L08	Barigan Street (north of Wollar)	Local	1,000	5 vph 0.01 (LoS A)	4 vph 0.00 (LoS A)	12 vph 0.01 (LoS A)	3 vph 0.00 (LoS A)	25	3	22	22	3	8 vph 0.01 (LOS A)	26 vph 0.03 (LOS A)	34 vph 0.03 (LOS A)	6 vph 0.01 (LOS A)
L09	Barigan Road (to Wollar substation)	Local	1,000	5 vph 0.01 (LoS A)	5 vph 0.01 (LoS A)	5 vph 0.01 (LoS A)	5 vph 0.01 (LoS A)	25	3	22	22	3	8 vph 0.01 (LOS A)	27 vph 0.03 (LOS A)	27 vph 0.03 (LOS A)	8 vph 0.01 (LOS A)

ID	Location	Road classification	Lane capacity (vph/ lane)	Traffic volume (current) Volume/Capacity ratio (Level of Service)				Construction peak-hour movement threshold (vph)	Project peak hour movement				Traffic volume with project Volume/Capacity ratio (Level of Service)			
				AM peak hour		PM peak hour			AM peak hour		PM peak hour		AM peak hour		PM peak hour	
				NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
L10	Blue Springs Road (north)	Local	1,000	1 vph 0.00 (LoS A)	11 vph 0.01 (LoS A)	13 vph 0.01 (LoS A)	5 vph 0.01 (LoS A)	50	45	5	5	45	46 vph 0.05 (LOS A)	16 vph 0.02 (LOS A)	18 vph 0.02 (LOS A)	50 vph 0.05 (LOS A)
L11	Blue Springs Road (south)	Local	1,000	1 vph 0.00 (LoS A)	11 vph 0.01 (LoS A)	13 vph 0.01 (LoS A)	5 vph 0.01 (LoS A)	50	45	5	5	45	46 vph 0.05 (LOS A)	16 vph 0.02 (LOS A)	18 vph 0.02 (LOS A)	50 vph 0.05 (LOS A)
L12	Ulan-Wollar Road	Local	1,000	51 vph 0.05 (LoS A)	325 vph 0.33 (LoS B)	126 vph 0.13 (LoS A)	116 vph 0.12 (LoS A)	75	8	67	67	8	59 vph 0.06 (LOS A)	392 vph 0.39 (LOS C)	193 vph 0.19 (LOS A)	124 vph 0.12 (LOS A)
L13	Maitland Street (east of Barigan Street)	Local	1,000	14 vph 0.01 (LoS A)	8 vph 0.01 (LoS A)	18 vph 0.02 (LoS A)	5 vph 0.01 (LoS A)	25	3	22	22	3	17 vph 0.02 (LoS A)	30 vph 0.03 (LoS A)	40 vph 0.04 (LoS A)	8 vph 0.01 (LoS A)

NB – Northbound Traffic Movement, SB – Southbound Traffic Movement, EB – Eastbound Traffic Movement, WB – Westbound Traffic Movement

5.2.2 *Intersection operation and safety*

This chapter assesses the impact of the project at key intersections, particularly access to construction compounds, workforce accommodation camps and access gates along the transmission lines.

5.2.2.1 Access to construction compounds and accommodation camp sites

The intersections that would provide access to construction compounds and accommodation camps are listed in Table 5-7.

Based on the assessments below, upgrades to relevant intersections on Merotherie Road, Spring Ridge Road and other intersections would be required to ensure safe construction access. It is to be noted that these upgrade works would be completed as part of a separate works package and Review of Environmental Factor (REF) process carried out by EnergyCo. EnergyCo intends to assess and determine the road and intersection upgrades under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application. However, the road and intersection upgrades are also included in the EIS so that in the event they are not determined under Division 5.1, they can be approved under the CSSI application.

The capacity assessment of these intersections has assumed that the road upgrades proposed to be delivered under the separate works package have been completed prior to the CSSI determination.

Table 5-7 Intersections to be used to provide access to construction compounds and accommodation camp sites

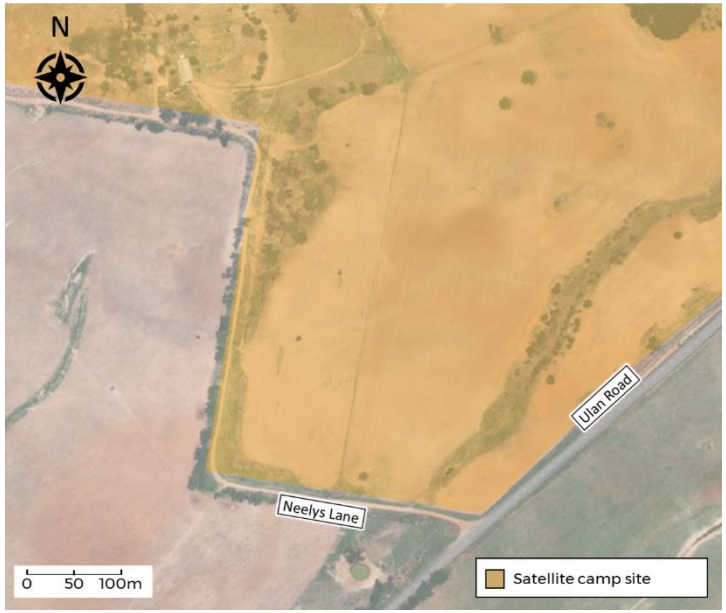
Intersection	Assessment table
Satellite construction camp (118 Neeleys Lane, Cassilis) – Neeleys Lane and Ulan Road	Table 5-8
Merotherie Energy Hub and main construction camp – Access Road and Merotherie Road intersection	Table 5-9
Merotherie Energy Hub and main construction camp – Merotherie Road and Golden Highway intersection	Table 5-10
Elong Elong Energy Hub –Spring Ridge Road and Dapper Road intersection	Table 5-11
Elong Elong Energy Hub – Intersection of Golden Highway and Spring Ridge Road	Table 5-12
New Wollar Switching Station and Energy Hub – Access Road and Barigan Road intersection	Table 5-13
New Wollar Switching Station and Energy Hub – intersection of Wollar Road/Barigan Street/ Phillip Street	Table 5-14
New Wollar Switching Station and Energy Hub – intersection of Ulan Road and Ulan-Wollar Road	Table 5-15

The potential design criteria required for these intersections are discussed in Chapter 3, which includes investigation into:

- Safe Intersection Sight Distance (SISD)
- Minimum Gap Sight Distance (MGSD)
- Stopping Sight Distance (SSD).

The Austroads intersection treatment warrant assessment have been included for intersections which are subjected to quantitative assessment only.

Table 5-8 Satellite construction camp (118 Neeleys Lane, Cassilis) – Neeleys Lane and Ulan Road

	**Description**	Satellite workforce accommodation camp access via Neeleys Lane. It is located adjacent to Ulan Road, approximately 3.5 km south of the Golden Highway. At the peak of construction, this camp site would provide accommodation for up to 800 workers.	
	Existing vehicle type access permit	Ulan Road near the site is approved for 25/26 metres B-Double (RAV) and OSOM vehicles.	
	Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
	Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle (km/h) is 100 km/h. MGSD required is 111–139 m.	
	Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD required is: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD required is: 191 m. Assumes no grade correction applied.

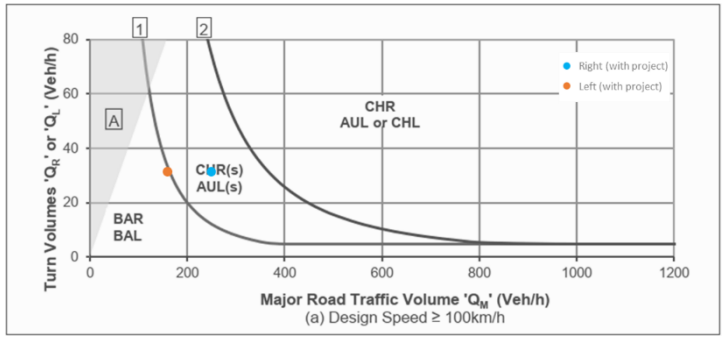
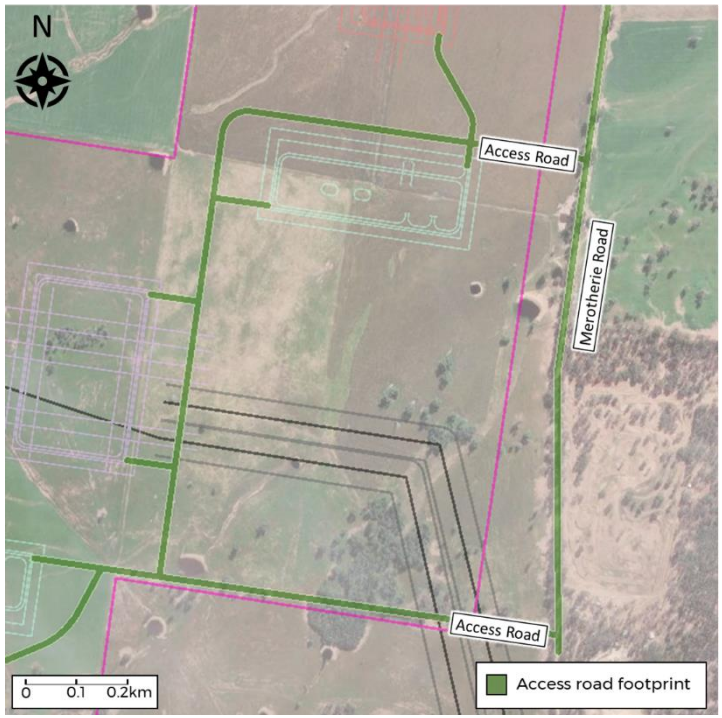
	The Neeleys Lane satellite workforce accommodation camp would generate 56 traffic movements (32 light vehicles and 24 heavy vehicles) at its peak. Construction traffic would enter/exit Neeleys Lane assuming 50:50 (north:south) traffic distribution corresponding to the location of the work area. Ulan Road is currently moderately trafficked with a total of 261 and 155 bidirectional traffic in the respective AM and PM peak periods. In the worst-case scenario (AM peak) 152 vehicles travel northbound and 109 vehicles southbound. The intersection currently has a basic left and right turn treatment. Using the construction turn volumes 'Q_R' or 'Q_L' of approximately 30 vehicles per hour in either direction, the preferred treatment option was found to be short Channelised Right Turn (CHRs) and short Auxiliary Left Turn (AULs). The intersection of Neeleys Lane and Ulan Road would need to be upgraded to CHR(s)/AUL(s) to provide a safe access for workers entering/exiting the satellite workforce accommodation camp site. This recommendation will be reviewed in the detailed construction planning stage, subject to the determination of finalised workforce numbers. EnergyCo intends to assess and determine the intersection works under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application.

Table 5-9 Merotherie Energy Hub and main construction camp – Access Road and Merotherie Road intersection

<table>
<tr><td rowspan="5"> 
</td><td>Description</td><td colspan="2">During construction, the Merotherie Energy Hub would be used for site compound, ancillary site and laydown area. The Merotherie accommodation camp will also be constructed adjacent to the Energy Hub. Merotherie Road between the Golden Highway and access road would be used as the main access point to these sites.</td></tr>
<tr><td>Existing vehicle type access permit</td><td colspan="2">Merotherie Road near the energy hub is approved for general access vehicle only.</td></tr>
<tr><td>Safe Intersection Sight Distance (SISD)</td><td colspan="2">3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed.
SISD required is 248 m, assumes no grade correction applied.</td></tr>
<tr><td>Minimum Gap Sight Distance (MGSD)</td><td colspan="2">4.0–5.0 seconds critical gap acceptance time for left and right turning movements.
85th percentile of approaching vehicle (km/h) is 100 km/h.
MGSD required is 111–139 m.</td></tr>
<tr><td>Stopping Sight Distance (SSD)</td><td>Cars: 2.0 seconds reaction time, 100 km/h design speed.
SSD required is: 165 m (desirable) Assumes no grade correction applied.</td><td>Trucks: 2.0 seconds reaction time, 100 km/h operating speed.
SSD required is: 191 m. Assumes no grade correction applied.</td></tr>
</table>

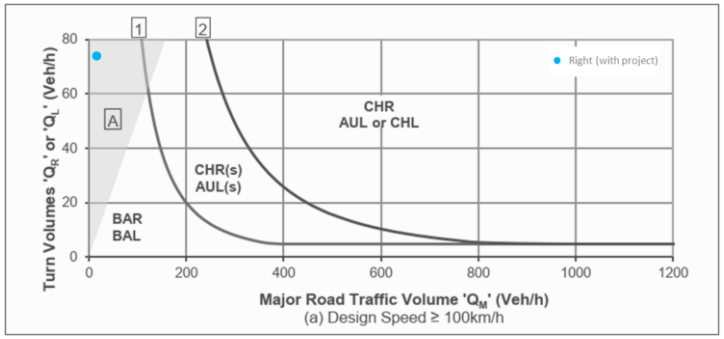
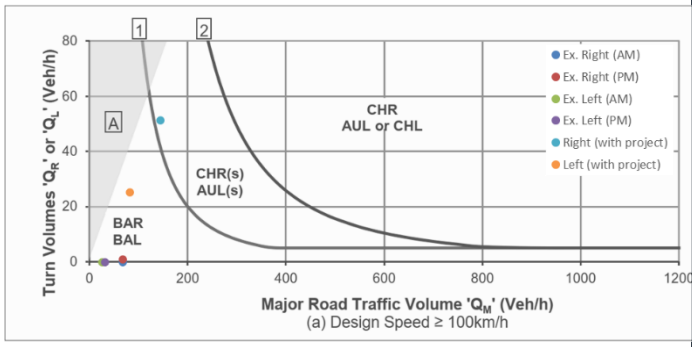
	Construction activities at the Merotherie Energy Hub would generate 45 traffic movements (30 light vehicles and 15 heavy vehicles) at its peak. An additional 32 traffic movements (30 light vehicles and 2 heavy vehicles) are needed for access to the transmission lines. Construction traffic would enter/exit the site from Merotherie Road, to connect to the Golden Highway. Merotherie Road is currently lowly trafficked with minimal vehicles recorded. The capacity assessment of this intersection indicate that it would need to have a basic left turn (BAL) and basic right turn (BAR) to be constructed. EnergyCo intends to assess and determine the intersection works under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application. However, the road and intersection upgrades are also included in the EIS so that in the event they are not determined under Division 5.1, they can be approved under the CSSI application.

Table 5-10 Merotherie Energy Hub and accommodation camp – Merotherie Road and Golden Highway intersection

Description	During construction, the Merotherie Energy Hub site would be used for site compound, ancillary site and laydown area. The Merotherie accommodation camp will also be constructed adjacent to the Energy Hub. Merotherie Road/ Golden Highway intersection would be used as the key access point to/from these sites.	
Existing vehicle type access permit	Merotherie Road south of the Golden Highway is approved for general access vehicle only. Golden Highway is approved for 25/26 metres B-Double (RAV) and OSOM vehicles.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle (km/h) is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD required is: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD required is: 191 m. Assumes no grade correction applied.

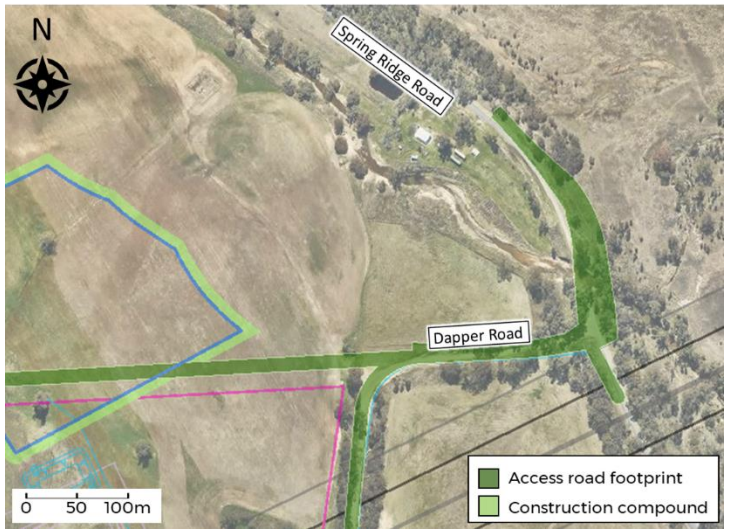


The Merotherie Energy Hub and the main construction camp would generate approximately 75 traffic movements which includes traffic demand into/out of transmission lines and switching stations work sites.

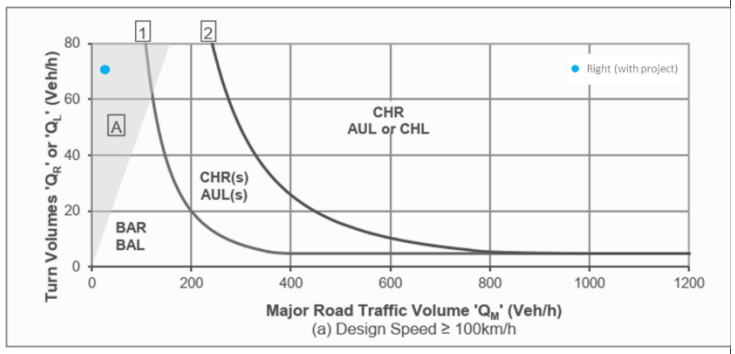
During construction, right turn movements into Merotherie Road (Q_R) is estimated to increase by 50 vehicles per hour, and the left turn (Q_L) would increase by 25 vehicles per hour.

The capacity assessment of this intersection indicate that it would need to have at least a basic left turn (BAL) and to be upgraded to a short channelised right turn (CHRs). EnergyCo intends to assess and determine the intersection works under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application. However, the road and intersection upgrades are also included in the EIS so that in the event they are not determined under Division 5.1, they can be approved under the CSSI application.

Table 5-11 Elong Elong Energy Hub – Dapper Road and Spring Ridge Road intersection



Description	During construction, the Elong Elong Energy Hub would be used for site compound, ancillary site and laydown area. Spring Ridge Road between the Golden Highway and Dapper Road would be used as an access point for this site. Part of Spring Ridge Road and Dapper Road would be upgraded as part of the separate works package.	
Existing vehicle type access permit	General access vehicle on Spring Ridge Road and Dapper Road.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle (km/h) is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD required is: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD required is: 191 m. Assumes no grade correction applied.



Elong Elong Energy Hub would generate 24 traffic movements (4 light vehicles and 20 heavy vehicles) at its peak. An additional 32 traffic movements (30 light vehicles and 2 heavy vehicles) and 13 traffic movements (12 light and 1 heavy vehicles) are needed for access to the transmission lines and switching station work sites respectively. Construction traffic would enter the site from the south (via the Dapper Road).

Spring Ridge Road is currently lightly trafficked with a total of 12 and 8 vehicles recorded in both directions in the respective AM and PM peak periods.

During construction, right turn movements into Dapper Road (Q_R) is estimated to increase by 70 vehicles per hour. The capacity assessment of this intersection indicate that it would need to be upgraded to a basic left turn (BAL) and basic right turn (BAR). EnergyCo intends to assess and determine the intersection works under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application. However, the road and intersection upgrades are also included in the EIS so that in the event they are not determined under Division 5.1, they can be approved under the CSSI application.

Table 5-12 Elong Elong Energy Hub – Intersection of Golden Highway and Spring Ridge Road

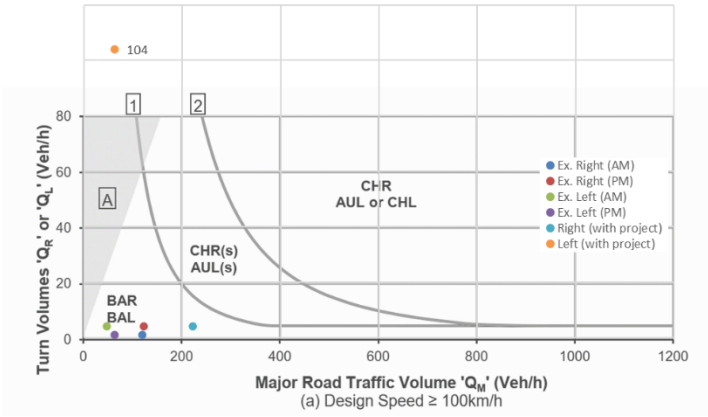
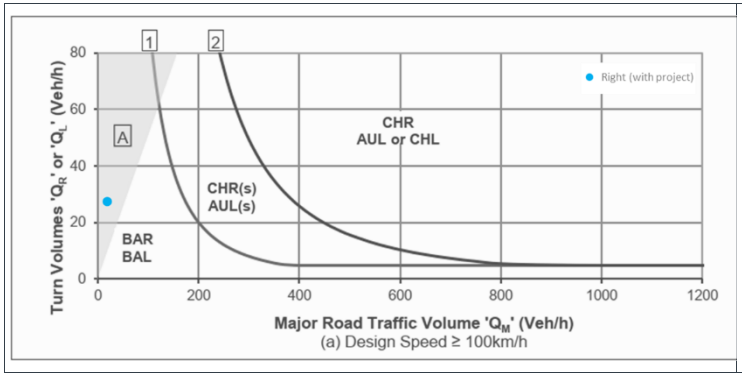
<table>
<tr><td rowspan="5"> 
</td><td>Description</td><td colspan="2">During construction, the Elong Elong Energy Hub would be used for site compound, ancillary site and laydown area. Spring Ridge Road/ Golden Highway would be used as the main access point for this site.</td></tr>
<tr><td>Existing vehicle type access permit</td><td colspan="2">General access vehicle on Spring Ridge Road.
Golden Highway is approved for 25/26 metres B-double (RAV) and OSOM vehicles.</td></tr>
<tr><td>Safe Intersection Sight Distance (SISD)</td><td colspan="2">3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed.
SISD required is 248 m, assumes no grade correction applied.</td></tr>
<tr><td>Minimum Gap Sight Distance (MGSD)</td><td colspan="2">4.0–5.0 seconds critical gap acceptance time for left and right turning movements.
85th percentile of approaching vehicle (km/h) is 100 km/h.
MGSD required is 111–139 m.</td></tr>
<tr><td>Stopping Sight Distance (SSD)</td><td>Cars: 2.0 seconds reaction time, 100 km/h design speed.
SSD required is: 165 m (desirable) Assumes no grade correction applied.</td><td>Trucks: 2.0 seconds reaction time, 100 km/h operating speed.
SSD required is: 191 m. Assumes no grade correction applied.</td></tr>
<tr><td colspan="2"> 
</td><td colspan="2">Elong Elong Energy Hub would generate 24 traffic movements (4 light vehicles and 20 heavy vehicles) at its peak. Additional 32 traffic movements (30 light vehicles and 2 heavy vehicles) and 13 traffic movements (12 light and 1 heavy vehicles) are needed for access to the transmission lines and switching station work sites respectively. Construction traffic would mainly enter the site from Golden Highway east approach corresponding to the location of the camps.
The Q_M under the existing condition on the Golden Highway at Spring Ridge Road accounts for approximately 120 vehicles for the right turn and 46–62 for the left turn calculations. During construction, left turn movements into Spring Ridge Road (Q_L) is estimated to increase by 100 vehicles per hour in addition to the existing traffic volumes on Spring Ridge Road. The capacity assessment of this intersection indicate that it would need to have a basic left turn (BAL) and basic right turn (BAR). The existing configuration of the intersection is therefore sufficient and no upgrade is required.</td></tr>
</table>

Table 5-13 New Wollar Switching Station – Access Road and Barigan Road intersection

Description	During construction, new Wollar switching station would be used for as a site compound, ancillary site and laydown area. Access to the switching station is via Barigan Road which has recently been upgraded and utilised by the Wollar Solar Project. Barigan Road is part of future public road works to facilitate access to energy hubs and switching stations, including intersection upgrades. Barigan Road is a 100 km/h road according to Transport for NSW's speed zone data. The intersection turn treatment consists of a basic left and right.	
Existing vehicle type access permit	Barigan Road is approved for 25/26 metres B-double (RAV). B-doubles speed limit is restricted at 60 km/h only.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle (km/h) is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD required is: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD required is: 191 m. Assumes no grade correction applied.



New Wollar Switching Station would generate 24 traffic movements (4 light vehicles and 20 heavy vehicles) at its peak. Access to the site would likely be via Ulan Road, Ulan-Wollar Road through to Wollar township and onto Barigan Road.

Barigan Road is currently lightly trafficked with approximately 10 vehicles estimated in both directions in the respective AM and PM peak periods.

Using the construction turn volumes 'Q_R' or 'Q_L' of 24 vehicles per hour in either direction, the preferred treatment option is the Basic Right Turn (BAR) and the Basic Left Turn (BAL), which currently exists at the intersection.

Table 5-14 New Wollar Switching Station and Energy Hub – intersection of Wollar Road/Barigan Street/Phillip Street

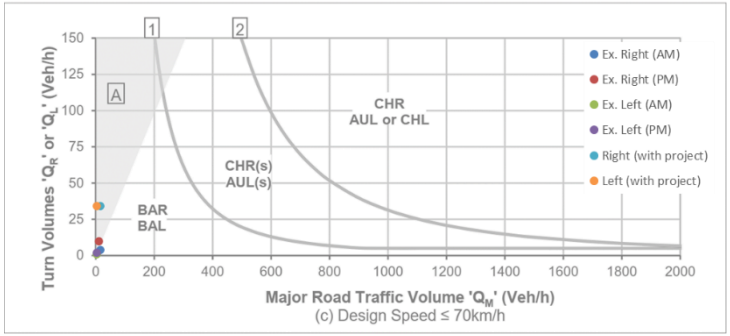
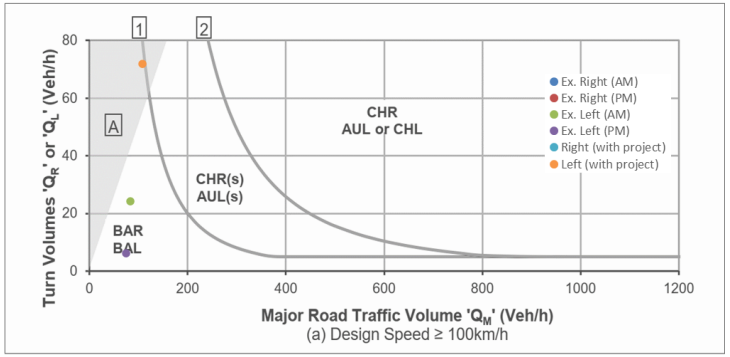
<table>
<tr><td rowspan="5"> 
</td><td>Description</td><td colspan="2">Access to the switching station would be via Barigan Street (north approach) and Wollar Road (east approach) of the intersection. Access gates are also proposed on Phillip Street (west approach).</td></tr>
<tr><td>Existing vehicle type access permit</td><td colspan="2">Both Barigan Street and Wollar Road are approved for 25/26 metres B-Doubles (RAV). Travel conditions apply for both roads with B-Double trips permitted only outside of the school hours on Barigan Street; a B-Double speed limit apply for the full length of Wollar Road (80 km/h) and Barigan Road (60 km/h) towards the switching station. The speed limit at the intersection however is limited to 50 km/h.</td></tr>
<tr><td>Safe Intersection Sight Distance (SISD)</td><td colspan="2">3.0 seconds observation time, 2.0 seconds reaction time, 50 km/h design speed.
SISD required is 97 m, assumes no grade correction applied.</td></tr>
<tr><td>Minimum Gap Sight Distance (MGSD)</td><td colspan="2">4.0–5.0 seconds critical gap acceptance time for left and right turning movements.
85th percentile of approaching vehicle (km/h) is 50 km/h.
MGSD required is 55–69 m.</td></tr>
<tr><td>Stopping Sight Distance (SSD)</td><td>Cars: 2.0 seconds reaction time, 50 km/h design speed. SSD: 55 m (desirable) Assumes no grade correction applied.</td><td>Trucks: 2.0 seconds reaction time, 50 km/h operating speed. SSD: 62 m. Assumes no grade correction applied.</td></tr>
<tr><td> 
</td><td colspan="3">New Wollar Switching Station would generate 24 traffic movements (4 light vehicles and 20 heavy vehicles) and the access gates would generate by 32 traffic movements (12 light vehicles and 20 heavy vehicles) at its peak. Construction traffic would travel through this intersection to the site, from either the main camp at Merotherie or the satellite camp at Neeleys Lane.
The demand of traffic movements into Barigan Street would increase with workers traveling between the satellite camp to the switching station and transmission line access gates. The right turn into Barigan Street is estimated to increase by 24 vehicles, while the left turn would increase by 32 vehicles.
Taking the above increases into consideration, the preferred treatment option at the intersection is a Basic Right Turn (BAR) and Basic Left Turn (BAL), which currently exists at the intersection, as such the layout at the intersection would not be impacted by the project.</td></tr>
</table>

Table 5-15 New Wollar Switching Station and Energy Hub – intersection of Ulan Road and Ulan-Wollar Road

Description	Access to the switching station would be via Ulan and Ulan Road-Wollar Road intersection, therefore the impact of this intersection is included here for assessment.	
Existing vehicle type access permit	Both Ulan Road and Ulan-Wollar Road are approved for 25/26 metres B-Doubles (RAV). Travel speed limit of 80 km/h apply on Ulan-Wollar Road for RAV. OSOM vehicles is approved on Ulan Road for 8.4 km south of the Golden Highway only.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle (km/h) is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD required is: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD required is: 191 m. Assumes no grade correction applied.



New Wollar Switching Station would generate 24 traffic movements (4 light vehicles and 20 heavy vehicles) at its peak. Construction traffic would travel through this intersection to the site, from either the main camp at Merotherie or the satellite camp at Neeleys Lane.

The demand of left and right turn movements into Ulan-Wollar Road would increase with workers traveling between the satellite camp to compound, switching stations and access gates. The left turn is estimated to increase by 50 vehicles and the right turn to increase by 25 vehicles.

Taking the above increases into consideration, the left turn treatment was found to require an auxiliary left turn treatment (AUL) and the right turn treatment to require channelised right (CHR) treatment, being the highest order of turn treatments for rural intersections. As such, the intersection treatment currently exists at the intersection would not be impacted due to the project.

5.2.2.2 Other intersections along proposed construction routes

This chapter assesses intersections on the proposed construction routes which would experience increases in traffic demand during construction. These include:

- Golden Highway and Ulan Road: movements between camps, new Wollar switching station and transmission line towards the east of the construction area
- Ulan Road and Cope Road (Main Street): movements between camps and transmission line towards the east of the construction area
- Cope Road and Blue Springs Road: movements between camps and transmission line towards the east of the construction area
- Brooklyn Road and Laheys Creek Road: movements along the transmission line east of Spring Ridge Road
- Castlereagh Highway and Laheys Creek Road: movements to access the gates and switching stations off Puggoon Road.

These assessments are detailed in Table 5-16 to Table 5-18, which includes discussion on:

- existing treatment at the intersection
- potential additional traffic volumes generated by the construction activities
- assessment using Austroads intersection treatment warrant for priority-controlled intersections, or intersection modelling for roundabout controlled intersection at Castlereagh Highway/Goolma Road
- impacts of additional traffic to the intersection.

Table 5-16 Intersection of Golden Highway and Ulan Road

Description	Golden Highway/Ulan Road intersection is T-intersection with priority given to the Golden Highway in the east-west direction. 110 metres auxiliary left turn lane (AUL) and a basic right turn treatment (BAR) have been provided on the Golden Highway at the intersection.	
Existing vehicle type access permit	Both Ulan Road and the Golden Highway are approved for 25/26 metres B-Doubles (RAV). OSOM vehicles is approved on Ulan Road for 8.4 km south of the Golden Highway only.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD: 191 m. Assumes no grade correction applied.

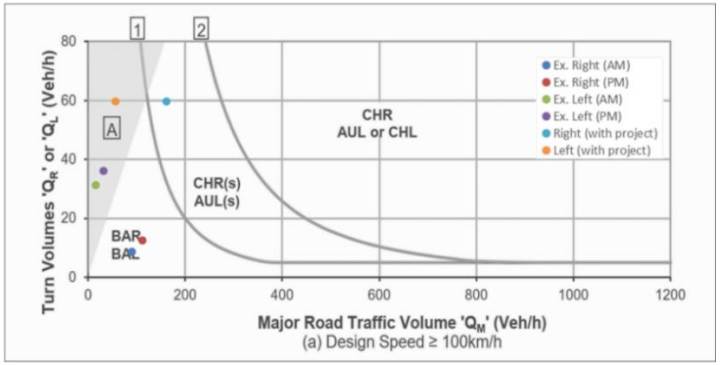
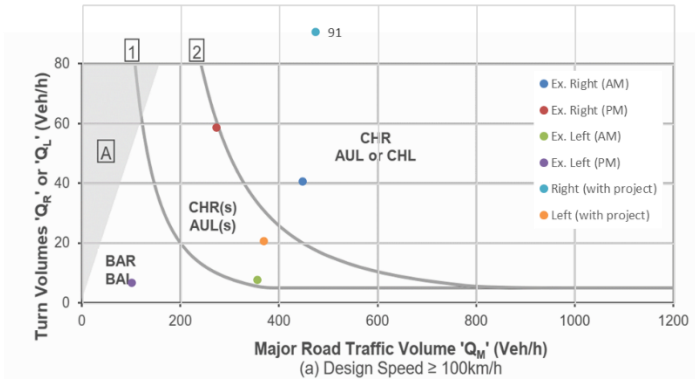
	Construction vehicle movements at this intersection would largely be associated with movements to and from the Neeleys Lane workforce accommodation camp, new Wollar switching station, and access gates along the transmission line in the south-eastern section of the construction area. The intersection is estimated to experience an addition of up to 75 vehicle movements on the Golden Highway and 75 vehicle movements turning into/out of Ulan Road in the peak hours during construction. The increase of traffic movements due to construction would result in the intersection to consist of short channelised right turn (CHRs) and basic left turn (BAL) treatments to support safe operations of the intersection. The need for BAL for the left turn treatment would be satisfactorily provided with the existing AUL treatment. The need for a short channelised right turn treatment would require an upgrade to the intersection from its currently layout of a basic right turn treatment. This will be reviewed in the detailed construction planning stage, subject to the determination of finalised workforce numbers. EnergyCo intends to assess and determine the intersection works under Division 5.1 of the *Environmental Planning and Assessment Act 1979* to allow these time critical works to be determined and commence construction prior to the determination of the CSSI application. However, the road and intersection upgrades are also included in the EIS so that in the event they are not determined under Division 5.1, they can be approved under the CSSI application.

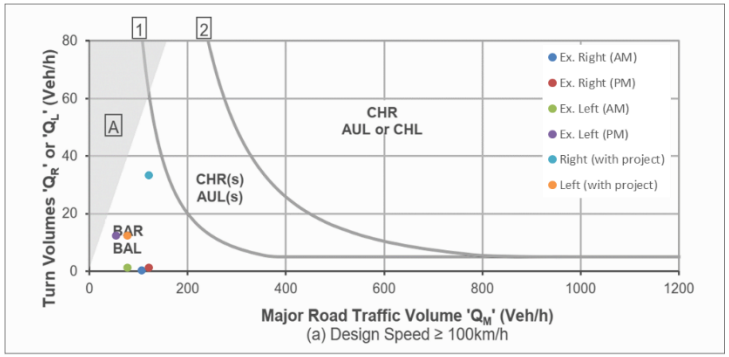
Table 5-17 Intersection of Ulan Road and Cope Road (Main Street)



Description	Ulan Road/Cope Road (Main Street) intersection is T-intersection with priority given to the Ulan Road in the east-west direction. Basic left turn treatment (BAL) and a 65 metres short channelised right turn lane have been provided on Ulan Road. Based on the count collected at the intersection, the traffic demand requires the left turn treatment to consist of an Auxiliary Left (AUL) and the right turn requires a full length channelised right turn (CHR). As such, both turn treatment at the intersection are currently under designed for the current demand.	
Existing vehicle type access permit	Both Ulan Road and the Cope Road are approved for 25/26 metres B-Doubles (RAV).	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD: 191 m. Assumes no grade correction applied.
Construction vehicle movements at this intersection would largely be associated with movements between the workforce accommodation camp and access gates along the transmission line which are accessed off Cope Road. This is estimated to generate a minor addition of up to 50 vehicle movements per hour. No upgrades to this intersection are proposed. The increase of traffic movements during construction would maintain the need for the intersection to consist of a channelised right turn (CHR) treatment and short auxiliary left turn (AUL) treatment, as per the findings of the existing conditions. The impact of the project to this intersection is considered minor as Cope Road would mainly be used to access the gates along the 500 kV transmission line easement between Merotherie Energy Hub and new Wollar switching station, which is not a major generator traffic movements for the project. It is recommended for the project to minimise construction vehicle movements to this intersection during peak hours.		

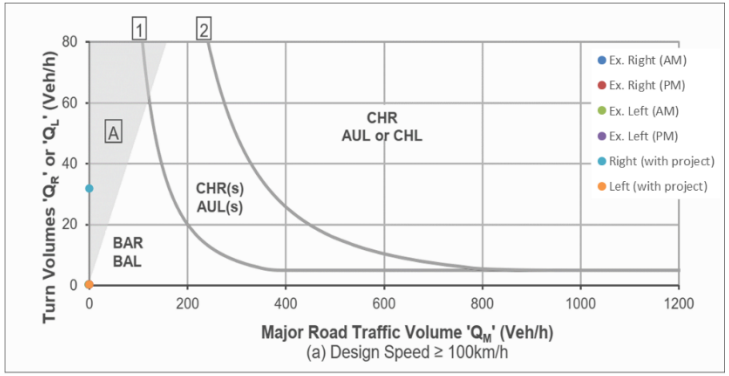
Table 5-18 Intersection of Cope Road and Blue Springs Road

MetroMap, Cope Road/ Blue Springs Road May 2022, retrieved November 2022



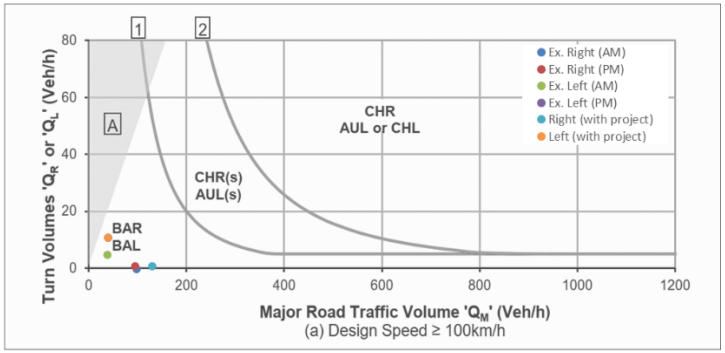
Description	Cope Road/Blue Springs Road intersection operates as a T-intersection with priority given to the Cope Road in the east-west direction. A property access driveway currently intersects to the south of the intersection. On Cope Road, the left and right turn are provided through basic turn treatments (BAL and BAR respectively), which are sufficient for the existing demand at the intersection.	
Existing vehicle type access permit	Both Cope Road and Blue Springs Road are approved for 25/26 metres B-Doubles (RAV). A travel condition exist on Blue Springs Road with access to Cope Road restricted to right in, right out and left in only. B-double speed limit of 80 km/hr speed limit applies on sealed section and 60km/hr on unsealed section. Access is permitted outside school bus operation hours.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD: 191 m. Assumes no grade correction applied.
Construction vehicle movements at this intersection would largely be associated with movements to and from the access gates along the transmission line which are accessed off Cope Road and Blue Springs Road of up to 50 vehicles per hour at the peak periods of construction. The increase of traffic movements due to construction would result in the intersection requiring basic right turn (BAR) and basic left turn (BAL) treatments, which currently exist at the intersection. As such, the existing intersection treatments would not be impacted due to the project.		

Table 5-19 Intersection of Brooklyn Road and Laheys Creek Road



Description	Brooklyn Road/Laheys Creek Road intersection is a T-intersection with priority given to Laheys Creek Road in the north-south direction. Both roads are unsealed and not line marked. The speed limit of both roads is 100 km/h with basic left and right turn treatments at the intersection. Traffic demand at the intersection is low with only 4 cars and 3 cars recorded in the respective AM and PM peak. These volumes do no warrant intersection treatment higher than basic turn treatments.	
Existing vehicle type access permit	No restricted access vehicle permitted to travel on both roads. Roads are permitted for General Access only.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD: 191 m. Assumes no grade correction applied.
Construction vehicle movements at this intersection would largely be associated with light vehicle movements to and from the access gates along the transmission line which are accessed off Springs Ridge Road. Access gates typically require up to 50 vehicles per hour at the peak periods of construction. The increase of traffic movements due to construction would result in the intersection requiring basic right turn (BAR) and basic left turn (BAL) treatments, which currently exist at the intersection. As such, the existing intersection treatments would not be impacted due to the project.		

Table 5-20 Intersection of Castlereagh Highway and Laheys Creek Road



Description	Castlereagh Highway/Laheys Creek Road intersection is a T-intersection with priority given to Castlereagh Highway in the north-south direction. The approaches to the intersection are sealed and line marked. The speed limit of both roads is 100 km/h with basic left and right turn treatments at the intersection. Traffic demand at the intersection is low with only 5 left turn and no right turn inbound movements into Laheys Creek Road recorded in the AM peak; and 11 left turn and 1 right turn inbound movements in the PM peak. These volumes do no warrant intersection treatment higher than basic turn treatments.	
Existing vehicle type access permit	Both Castlereagh Highway and Laheys Creek Road are approved for 25/26 metres B-Doubles (RAV). A travel condition currently exist on Laheys Creek road with a B-Doubles speed limit of 80 km/h.	
Safe Intersection Sight Distance (SISD)	3.0 seconds observation time, 2.0 seconds reaction time, 100 km/h design speed. SISD required is 248 m, assumes no grade correction applied.	
Minimum Gap Sight Distance (MGSD)	4.0–5.0 seconds critical gap acceptance time for left and right turning movements. 85th percentile of approaching vehicle is 100 km/h. MGSD required is 111–139 m.	
Stopping Sight Distance (SSD)	Cars: 2.0 seconds reaction time, 100 km/h design speed. SSD: 165 m (desirable) Assumes no grade correction applied.	Trucks: 2.0 seconds reaction time, 100 km/h operating speed. SSD: 191 m. Assumes no grade correction applied.
Construction vehicle movements at this intersection would largely be associated with light vehicle movements on Castlereagh Highway to access the gates off Puggoon Road to enter/exit M9 Switching Station. Access gates typically require up to 50 vehicles per hour at the peak periods of construction. The increase of traffic movements due to construction would result in the intersection requiring basic right turn (BAR) and basic left turn (BAL) treatments, which currently exist at the intersection. As such, the existing intersection treatments would not be impacted due to the project.		

5.2.2.3 Construction access to transmission lines

As described in Section 5.1.4, the construction of the transmission lines would be provided through locked access gates located along the transmission line. Where the location of the construction area is offset from the road network, access tracks would be provided between the road network and the construction area. The traffic demand to these access gates would generally be low with up to 32 vehicles per hour generally needed at their peak construction period.

The location of temporary access tracks was determined and considered by EnergyCo and their suitability for use based on topography, minimise impact to surrounding properties and proximity to a public road.

The establishment of temporary access tracks would enable safe access of construction machinery and materials to each transmission line structure site. They would generally be unsealed and of sufficient width to accommodate two-way traffic access to the site and be constructed to follow the natural contour of the land as far as practicable to minimise the amount of cut and fill and soil disturbance.

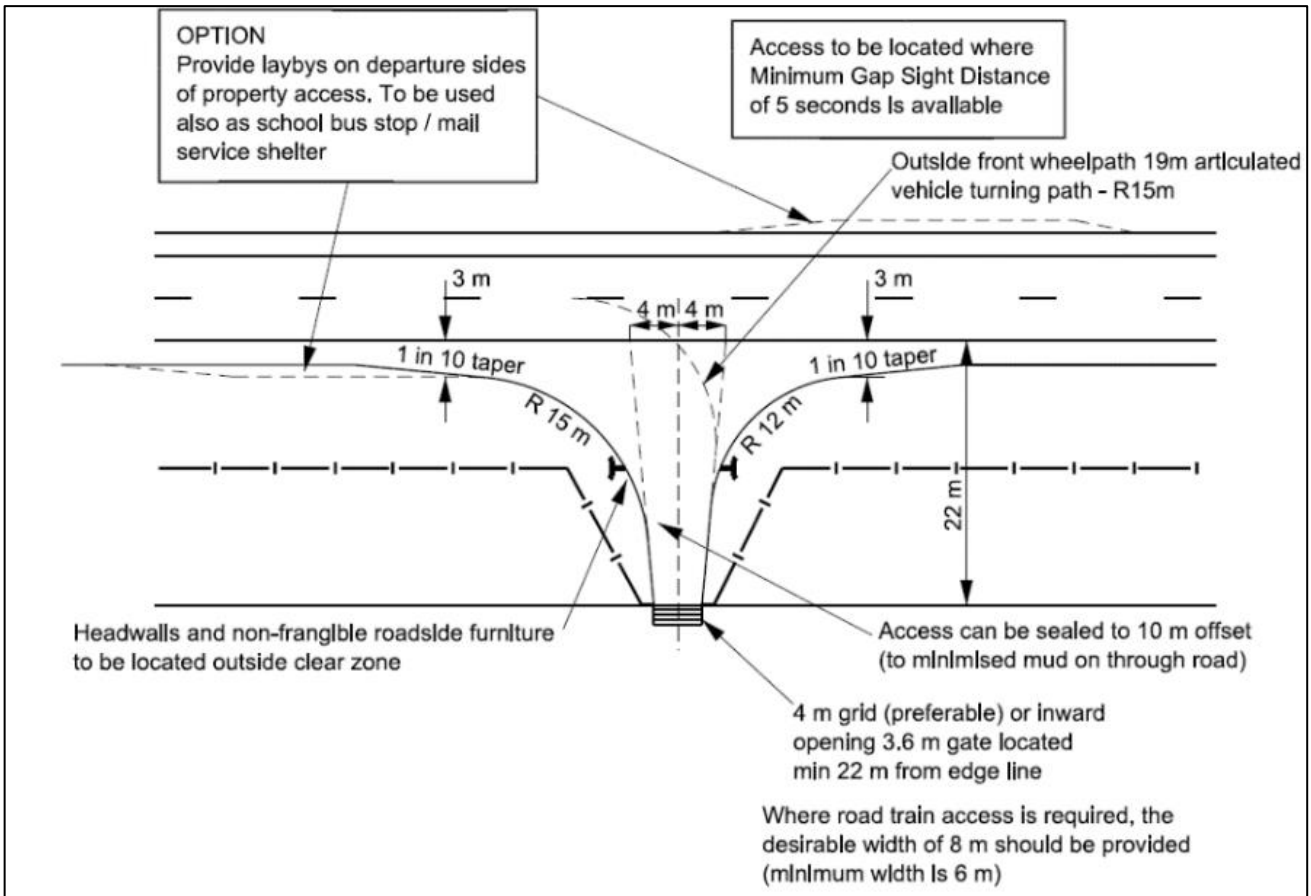
Temporary access tracks would be beneficial in terms of providing a direct access to the proposed work areas. It would provide the following features to improve traffic management:

- appropriate wayfinding for drivers of construction vehicles and workers to the site
- appropriate temporary road and intersection design, which is safe, adequately delineated and suitable for all-weather conditions to accommodate the different types of construction vehicles
- a consolidation of accesses to different sites which would minimise disturbance to the surrounding environment, including the abutting roads.

The design for access point of the tracks would correspond to the road types where it is located. These are detailed in Table 5-21.

Table 5-21 Design consideration of access tracks intersection

Intersecting road type	Design consideration
Highway or main road	— New access points at nominated locations. The access road is to be designed in accordance with *Austroads Guide to Road Design*. As a minimum, the design of the access driveway is to consider an articulated vehicle as shown in Figure 5-4. — Line marking and signage at access points to support the traffic management requirements.
Sealed local or regional roads	— Upgrades to allow access for long vehicles e.g. semi-trailers. An example of the minimum requirements for a rural intersection off a minor road is depicted in Figure 5-5. — Line marking and signage at access points to support the traffic management requirements. — Potential use of road plates, propping or similar over culverts.
Unsealed local roads	— Improvements to existing roads at new access points which may include importing or stabilising material. — Upgrades to allow access for long vehicles e.g. semi-trailers. An example of the minimum requirements for a rural intersection off a minor road is depicted in Figure 5-5. — Line marking and signage at access points to support the traffic management requirements. — Potential use of road plates, propping or similar over culverts.

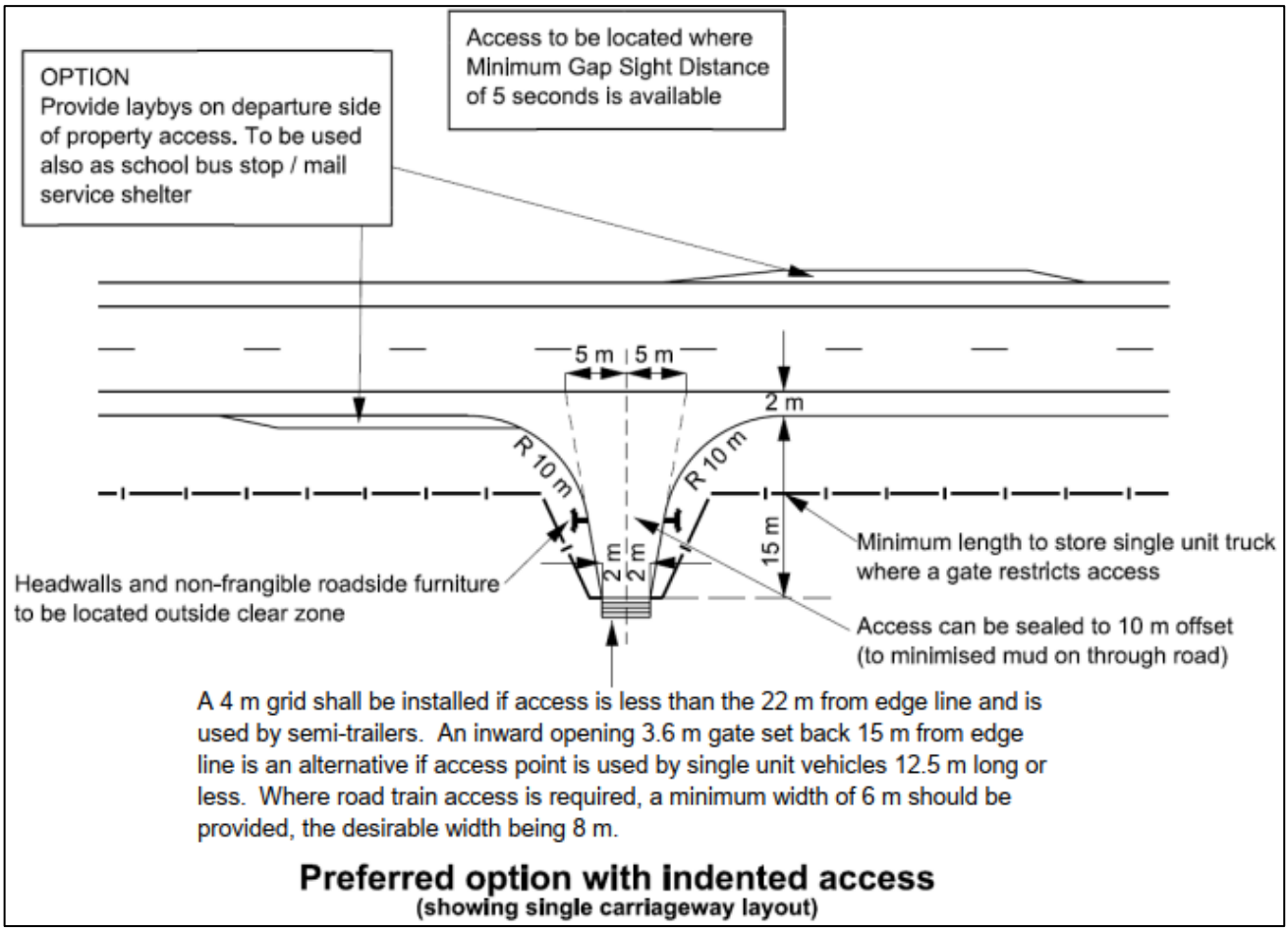


Note: Minimum requirement for a single carriageway with design AADT < 2000 or minimum requirement for dual carriageway left-in–left-out access for single unit truck. Where AADT > 1000 and access is required for a semi-trailer then use the layout.

Source: Department of Main Roads (2006)[7].

Source: Austroads Guide to Road Design Part 4: Intersections and Crossings

Figure 5-4 Example of rural property access designed for articulated vehicles



Source: *Austroads Guide to Road Design Part 4: Intersections and Crossings*

Figure 5-5 Example of rural property access layout – preferred option with indented access

5.2.3 *Impacts to approved restricted access vehicle routes*

The project would require OSOM routes to the energy hubs. Appropriate travel permits would be required for OSOM vehicles to travel on any part of the road network. This is to be sought from the National Heavy Vehicle Regulator (NHVR), and once approved, the travel conditions would be actioned accordingly.

As discussed in Section 4.3, for most part, the nominated construction route for OSOM vehicles are currently OSOM and RAV approved. There are however several last-mile road sections to the location of energy hubs that are currently not gazetted for OSOM or RAV access. For these roads, the project would need to appropriately assess the routes and seek approval from the NHVR in order to utilise OSOM vehicles to transport materials for the project. These road sections include:

- Spring Ridge Road between the Golden Highway and Elong Elong Energy Hub access point
- Merotherie Road between the Golden Highway and Merotherie Energy Hub access point
- Ulan Road, Ulan-Wollar Road, Barigan Street, Wollar Road and Barigan Road to access the New Wollar switching point. It is to be noted that this route has been approved for RAV (up to 25/26 metres B-double) and has previously been used by other projects (e.g. Wollar Solar Farm) to access the site for construction.

5.2.4 Impacts during stringing of transmission lines across roads

The stringing of transmission lines would occur over roads at locations mentioned in Section 5.1.4.

This would likely be done with localised, short-term closures outside of the peak periods. Where this is not possible, considerations would be made to use temporary hurdles, if reasonable and feasible. Temporary hurdles are vertical structures used to support new conductors being strung across existing transmission lines, major roads, rail lines or other infrastructure. The potential need for use of hurdles would be determined by a risk assessment. for relevant locations.

During stringing works, traffic controls would be implemented to safely manage traffic passing the work area. This may entail short-term full road closure, localised traffic controls (stop/go) being implemented, and/or reduction in speed limit.

Road Occupancy Licence(s) would be sought for all temporary lane or road closures (as required). Any road closures that would result in a substantial impact (e.g. short-term full road closure and/or long-term temporary lane/road closures) would be assessed on a case-by-case basis, and approval sought from the relevant road authority and consulted with emergency services, land owners and other relevant stakeholders. Where feasible, temporary lane closures are to be planned outside of the traffic peak periods to minimise impact to the road network.

5.2.5 Impacts on rail

As described in Section 5.1.4, the stringing of transmission lines over railway tracks (lines) would occur at three locations along Ulan railway track and at three locations along the Wallerawang-Gwabegar railway track.

Where possible, stringing across the rail network would occur during a full or local track possession. Hurdles may be required if string is done on a local possession.

Impacts to rail lines due to transmission line stringing works across the railway tracks would be limited and undertaken with prior consultation with the ARTC. These activities are likely to be undertaken during rail maintenance periods or during rail possessions and therefore would not impact rail services.

Track possessions would be sought for all temporary works that required access to the rail corridor. Any works traversing rail corridors would be assessed on a case-by-case basis, and prior approval sought from ARTC.

5.2.6 Impacts on road condition

Pavement fatigue generally occurs as a result of repeated heavy vehicle traffic movements. The corresponding contribution of light vehicles movements on road pavement condition is negligible. As discussed in Section 5.1.6 and 5.2.1, the project would only generate a minor increase of heavy vehicle movements utilising these construction routes. The impacts of this additional heavy vehicle movements would likely be minor and depend on the existing pavement condition and remaining life of the pavement.

The construction contractor would be required to undertake road pre-condition survey to record the pavement condition along the construction routes. This would be undertaken to confirm the existing condition of the road pavement along the construction routes.

Routine inspections and maintenance would be completed along all nominated routes to ensure that construction routes, access tracks, construction compound and workforce accommodation camp accesses are maintained to safe standard during construction, in consultation with the relevant road authority.

5.2.7 Impacts on road safety

A number of factors can contribute to crashes, including vehicle design, speed of operation, road design, weather, road environment, driving skills, and driver behaviours.

One of the key challenges of this project for road safety is that the construction area is extensive and frequently interacts with the road network. There are several key items which may impact road safety:

- **Road network efficiency**: As demonstrated in Section 5.2.1, the traffic increase associated with the construction activities is low, and that the road network capacity on the proposed construction routes would not be adversely impacted. The unchanged road efficiency would unlikely result in increased vehicle overtaking, sudden speed reductions, or lane changing and hence would unlikely increase crashes. The impact to road network efficiency during construction is therefore considered to be low.
- **Multiple construction site locations and associated access points on the road network**: The construction area is spread out across the project with vehicle access required at construction compounds, workforce accommodation camps and along the transmission lines. This increases interaction with the road network and also risks associated with traffic movements into/out of the construction sites. As such, appropriate traffic management, intersection treatments, signs and line marking are to be implemented at vehicle accesses to minimise this impact. The impact to construction site locations and associated access points during construction is therefore considered to be low.
- **Driver fatigue**: The issue of travel fatigue may be present for drivers extended driving tasks. As such, effective fatigue management must be implemented for drivers to minimise road safety issues associated with fatigue. The impact to driver fatigue during construction is therefore considered to be moderate.
- **Road conditions**: As discussed in Section 5.2.6, the increase in traffic demand due to the construction activities are envisaged to not have an adverse impact on the condition of the road network. To further minimise this impact, routine inspections and maintenance would be completed along all nominated routes to ensure that construction routes, access tracks and construction compound and workforce accommodation camp accesses are maintained to safe standard during the course of construction activity. The impact to road conditions during construction is therefore considered to be low.
- **OSOM haulage**: Transfer of materials from port to compound would be undertaken on designated travel route. Appropriate approval and procedure to use OSOM vehicles on the road network as guided by the NHVR and Transport for NSW would be implemented by the project to minimise road safety impacts associated with OSOM haulage activities. The impact to OSOM haulage during construction is therefore considered to be low.

5.2.8 Impacts on active transport

As discussed in Section 4.6, there is currently limited active transport facilities within the study area. The project is not expected to impact these facilities, as for most parts the works would be undertaken along the transmission line, at energy hubs and switching stations which have limited interaction with the existing active transport facilities.

However, the Central West Cycle (CWC) trail, an active local cycling group, currently has a cycling route which are on the proposed construction routes for this project. This route is known as the Gulgong to Dunedoo route and passes through sections of Barneys Reef Road, Merotherie Road and Birriwa Bus Route South. Merotherie Road and Birriwa Bus Route South in particular would be actively used by construction traffic with the Merotherie Energy Hub and main camp site located off these roads.

To minimise the impact of the project to the CWC's current cycling route between Gulgong to Dunedoo, the project would actively liaise with the cycling group and relevant councils (Mid-Western Regional and Warrumbungle Shire) of the activities that would be occurring on the affected routes. This may include provision of suitable road condition for cycling, separation of cycling route through the construction site wherever practicable, and consideration of traffic measures to manage safe movement for cyclists. Where absolutely necessary, temporary alternative access arrangements may need to be provided during a high-risk construction activities following consultation with affected stakeholders and relevant councils.

5.2.9 Impacts on public transport

Similar to the active transport, the construction activities would have limited interactions with the existing public transport services.

The additional traffic movement generated over the construction phase of the project is expected to have a negligible impact on the public transport network in the traffic and transport study area.

5.2.10 Impacts to property access and emergency services

The project is not expected to significantly impact access to properties during construction. Where temporary partial road closures are needed, the construction contractors would consult and/or notify the affected property owners, relevant road authority and emergency services of any changes to the road network. This would entail an appropriate traffic management to be prepared and, where necessary, temporary alternative access to be provided.

6 Operational assessment

This chapter presents an assessment of the potential impacts that are expected to occur during operation of the project. The operation of transmission and substation lines are typically infrequent and require a minimal workforce.

Key potential operational impacts relating to traffic and transport include provision of access for continued maintenance of transmission line and substation infrastructure. These would have insignificant traffic generation during the operational and maintenance phase would have negligible impact on the efficiency of the road network in the study area.

6.1 Ongoing maintenance activities

The new substation and transmission lines would be inspected by field staff and contractors on a regular basis, with other operational activities occurring in the event of an emergency (as required). Likely maintenance activities would include:

- regular inspection (ground and aerial) and maintenance of electrical equipment
- general building, asset protection zone and general landscaping maintenance
- fire detection system inspection and maintenance
- fence repair
- stormwater and drainage infrastructure maintenance.

6.1.1 Transmission line maintenance

Regular maintenance activities would be required for the transmission lines during its operation. Likely maintenance activities would include:

- regular inspection and maintenance of transmission lines, towers and poles including:
  - an annual fly over as part of seasonal bushfire prevention surveys
- routine infrastructure inspection on a six-yearly cycle for towers. This would typically involve two to three maintenance crew driving a light vehicle from public roads to the easement utilising access tracks, then along the easement inspecting each transmission line tower in turn. Towers would be inspected both from the ground and by personnel climbing the tower
- routine/planned line maintenance using a light vehicle(s), an elevated work platform and a medium sized truck with up to around five to ten personnel to rectify any defects found from routine inspections. Generally, this would occur within the same three to six-year maintenance cycles as the routine infrastructure inspection
- ad hoc fault and emergency fly over(s) to assess infrastructure condition should an unplanned outage occur (for example through a weather event or other failure of infrastructure). This maintenance would occur as required. The amount of maintenance and/or crew required for repair of any damaged infrastructure would depend on the extent of repairs required
- vegetation removal required to maintain appropriate clearances between ground vegetation and transmission lines. Vegetation below the transmission lines would require ongoing maintenance throughout the operation to ensure electrical safety clearances and protection zones are maintained. The required clearance of vegetation within the corridor would be undertaken in accordance with EnergyCo maintenance requirements (refer to section below).

6.1.2 Proposed substation and switching station operation and maintenance

The proposed substation and switching stations would not accommodate full-time staff or contractors. Maintenance work would typically include ad-hoc attendance (up to three times a week) of one or two switching operators to undertake planned and unplanned operations and maintenance. It is expected that these activities would only require light vehicles and/or small to medium plant (depending on the works required). Any waste generated during operation would be minimal and disposed of on an 'as need' basis by the attending maintenance personnel.

Additional maintenance activities at the substation sites would typically include:

- routine substation infrastructure inspection (such as transformers and other electrical plant and equipment) throughout the year by around two to three personnel
- routine/planned substation maintenance of equipment, property and switchyard areas on a scheduled basis. This would typically be monthly and undertaken by around three to five maintenance personnel
- ad hoc fault and emergency works for repair of any damaged infrastructure (for example through a weather event or other failure of infrastructure). This maintenance would occur as required. The amount of maintenance and/or crew required to access for repair of any damaged infrastructure would depend on the extent of repairs required.

Equipment for the substation is expected to have a service life of around 50 years. Maintenance would be regularly undertaken for the different infrastructure components and plant items such as transformers. These components would be replaced/refurbished towards the end of their serviceable life, allowing the service life of the substation to be extended.

6.2 Ongoing maintenance works vehicle volumes, access, routes and scheduling

6.2.1 Maintenance works workforce size

The maintenance workforce typically consists of three to five personnel for routine inspections and maintenance. Some less frequent inspections would require up to ten personnel.

6.2.2 Traffic generation from maintenance works

Routine maintenance activities appear to only require a light vehicle or sometimes a light truck with a small group of crews and required equipment. Staff are likely to carpool when travelling between the works site and the office. The daily movement number can be as low as ten vehicle movements.

6.2.3 Site maintenance access and road access

Access to the proposed easement for operational purposes would preferentially use existing public and private roads and tracks, although access tracks created for construction may be retained during operation of the project to provide safe access. Access easements may be required to provide EnergyCo with access from the nearest public road to the easement. These access easements would be negotiated with landholders as necessary. EnergyCo may install locked and signed access gates to enable access to the easement should a landholder not have a suitable existing gate nearby.

For maintenance access routes that are not part of the approved RAV, Road Train and OSOM network but require such vehicle access, EnergyCo would be required to apply for a heavy vehicle access permit to be issued by the NHVR.

6.3 Operational impact assessment

6.3.1 Impacts on the road capacity and efficiency

The proposed activities required during operation as described in Section 6.1 would be carried out at routine intervals but infrequently. The traffic generation is during the operational and maintenance phase is insignificant.

Overall, the insignificant traffic generation during the operational and maintenance phase would have negligible impact on the efficiency of the road network in the study area.

6.3.2 Impacts on intersection operation

The negligible traffic movements associated with the maintenance activities would not affect the intersection capacity.

6.3.3 Impacts on road condition

The low traffic movements and minimal heavy vehicles involved in the maintenance activities are not anticipated to have a noticeable impact on the road pavement condition.

6.3.4 Impacts on road safety

Due to the low magnitude, the additional light vehicle traffic generated over the operational and maintenance phase of the project is expected to have a negligible impact on road safety in the traffic and transport study area.

6.3.5 Impacts on active transport

Most maintenance and operational activities are anticipated to occur near the transmission line, substations and the associated assets which may involve direct travel from staff's office/home to the site. These activities would have limited interactions with a wider road network including the existing active transport facilities.

The additional light vehicle traffic generated over the operational and maintenance phase of the project is expected to have a negligible impact on the active transport network in the traffic and transport study area.

6.3.6 Impacts on public transport

Similar to the active transport, the maintenance activities would have limited interactions with a wider road network including the existing public transport services.

The additional light vehicle traffic generated over the operational and maintenance phase of the project is expected to have a negligible impact on the public transport network in the traffic and transport study area.

6.3.7 Impacts to property access and emergency services

Access to properties for residents (including for emergency vehicle access and egress) is expected to be maintained throughout the operational and maintenance phase. Should there be a requirement for a short-term restriction for a particular property, prior consultation with the affected party would be undertaken.

7 Management and mitigation measures

7.1 Environmental management framework

A Construction Traffic Management Plan (CTMP) would be prepared and implemented as part of the Construction Environmental Management Plan (CEMP) by the engaged contractor as part of the works. The CTMP would include:

- confirmation of construction routes
- measures to maintain access to local roads and properties
- site specific traffic control measures (including signage) to manage and regulate traffic movement
- measures to maintain pedestrian and cyclist access
- requirements and methods to consult and inform the local community of impacts on the local road network
- obtain relevant approvals for any potential works in the road corridor and access by restricted access vehicles or over-sized vehicles required for the project
- access to construction sites including entry and exit locations and measures to prevent construction vehicles queueing on public roads
- a response plan for any construction traffic incident
- consideration of other developments that may be under construction to minimise cumulative impacts.

This would be prepared in consultation with stakeholders to identify the necessary mitigations and response strategies to potential delays and disruptions that may arise due to the proposal.

7.2 Mitigation measures

The proposed mitigation measures are discussed in Table 7-1.

As many of the roads are likely to be trafficked for a relatively short period (relative to a roads' design life), an approach of maintaining and locally mitigating impacts would form the best strategy, as opposed to improving and upgrading roads ahead of time. The exception to this is where proposed access points are to be installed. Each access point would be designed based on road type, condition, existing speed, existing traffic and predicted construction movements and where appropriate, would meet the relevant road design standards.

Roads would be used in the accordance with permitted use or otherwise agreed or granted by the relevant road authority. With the exception of the identified access point/intersection modifications, no road upgrades outside of the remaining existing road footprint are proposed.

Table 7-1 Mitigation measures

Ref	Impact type	Identified mitigation measure	Timing	Applicable location (s)
T1	Intersection and access point upgrades	As part of the detailed design process, an evaluation of the potential need for upgrades to the following intersections will be undertaken as detailed below: — Intersection of Ulan Road /Neeleys Lane: Investigate and confirm if short channelised right and/or auxiliary left turn treatments (or suitable alternative) are required for safe access to the satellite workforce accommodation camp. — Intersection of Golden Highway/Ulan Road: Investigate and confirm if a new short channelised right turn treatment (or suitable alternative) is required to provide safer intersection operation and to accommodate additional increases in traffic demand during construction. Where the need for intersection upgrades are required, these will be designed and constructed in accordance with Austroads Guidelines, relevant applicable standards and consider the appropriate design vehicles.	Detailed design	Intersections and access points to construction sites
T2	Road and traffic management	Traffic control plans will be prepared in consultation with the relevant road authorities. The plans will be implemented by licenced traffic management contractors. Necessary road occupancy licences and road related work approvals will be obtained prior to the commencement of relevant works (including site access and access tracks).	Construction	Construction Routes, Access Tracks, Construction Compound and Workforce Accommodation Camp Accesses
T3	Road safety – design related	All accesses will be designed to accommodate the required construction vehicle(s) requiring access, and in accordance with relevant Austroads guidelines (where applicable). Road safety audits and routine inspections will be completed on a regular basis.	Construction	Construction Routes, Access Tracks, Construction Compound and Workforce Accommodation Camp Accesses

Ref	Impact type	Identified mitigation measure	Timing	Applicable location (s)
T4	Road safety – driver related	The following road safety measures will be implemented with regard to driver management during construction: — A Driver Code of Conduct will be developed and implemented. The code will define acceptable driver behaviour for proposal personnel to promote road safety and ensure that the impacts of construction-related vehicle movements on local roads and the local community are minimised. — In-vehicle monitoring systems (IVMS) will be installed in relevant vehicles to monitor load limits and fatigue management. — A Driver Fatigue Management Plan will be developed and implemented as part of the Construction Environmental Management Plan, and will incorporate appropriate measures to manage driver fatigue risks, including, but not limited to: — planning of regular breaks — mapping locations of driver rest areas along the proposed construction routes.	Construction	Construction Routes, Access Tracks, Construction Compound and Workforce Accommodation Camp Accesses
T5	Rail safety	Early and ongoing consultation with the ARTC will be undertaken for works which will cross over existing rail lines. Relevant works will only proceed following receipt of applicable approvals/permits, including accreditations for workers requiring access within the rail corridor to undertake construction activities.	Construction	Where the transmission line requires access to rail corridor over railway tracks on select railway lines.
T6	Access track condition	Access tracks used for construction sites, construction compounds and workforce accommodation camps will be maintained to safe standard.	Construction	All areas affected by construction including Construction Routes, Access Tracks, Construction Compound and Workforce Accommodation Camp Accesses

Ref	Impact type	Identified mitigation measure	Timing	Applicable location (s)
T7	Road condition	Pre-construction road dilapidation surveys and routine inspections will be completed along all nominated construction routes on local roads. Where rectification works are required due to project impacts, consultation with the appropriate road authority will be undertaken to confirm the scope of the work required.	Pre-construction Construction	Local roads
T8	Temporary lane closures or temporary road closures	Road Occupancy Licence(s) will be sought for all temporary lane closures (as required). Where road closures are likely to result in a significant traffic impact (e.g. short-term full road closure and long-term temporary lane/road closures), prior consultation will be undertaken with potentially affected stakeholders (e.g. landowners, emergency services, transport services) and relevant approval(s) obtained from the relevant roads authority. Where feasible, temporary road closures will be planned to occur outside of the traffic peak periods to minimise impacts to the road network.	Construction	All roads that intersect with the transmission line alignment (for stringing of transmission lines) or on Construction Routes.
T9	Access to properties	Access to properties will be maintained throughout construction where feasible. Where that is not feasible, temporary alternative access arrangements will be provided following consultation with affected landowners and in accordance with the requirements of the pre-construction and construction Communication and Engagement Plan (as detailed in mitigation measure SI5). Disruptions to property access and traffic will be notified to landowners at least five days prior and in accordance with the relevant community consultation processes outlined in the Constructions Environmental Management Plan.	Construction	All areas affected by construction
T10	Pedestrian and cyclist access	The project will actively consult with local bicycle groups, such as Central West Cycle (CWC) during construction, particularly regarding construction routes proposed on CWC's cycling route between Gulgong to Dunedoo. Safe pedestrian and cyclist access will be maintained where the project interacts with existing pedestrian or bicycle facilities. Where this is not feasible, temporary alternative access arrangements will be provided following consultation with affected stakeholders and the relevant roads authority.	Construction	All areas affected by construction.

Ref	Impact type	Identified mitigation measure	Timing	Applicable location (s)
T11	Heavy vehicles using road network	A Vehicle Movement Plan will be prepared which identifies the construction vehicle route(s) (including OSOM routes) to be used during construction. The Vehicle Movement Plan will also include details of activities of adjoining land uses and awareness of public safety measures (e.g. entering urban areas from the highways) to provide guidance to drivers of construction vehicles travelling to and from project locations. Ongoing consultation will be undertaken with Transport for NSW regarding the use of State roads for OSOM vehicle routes.	Construction	All roads that intersect with the transmission lines alignment or on construction routes.
T12	Access Tracks Maintenance and Safety	The following maintenance and safety measures will be implemented at relevant locations along each of the access tracks, construction compounds and workforce accommodation camp access: — appropriate line marking and signage at access points — wheel cleaning facility as required at access points/intersections — signage to indicate trucks turning — potential use of road plates, propping (or similar) over culverts where required — improvements to existing roads at new access points which may include importing or stabilising material if required.	Construction	Access Tracks, Construction Compound and Workforce Accommodation Camp Accesses

8 References

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Appendix A

Low impact local roads

Table A-1 lists the local roads that form part of the construction routes which are likely to have low usage and required provide access to the transmission lines' access gates only.

Construction vehicle utilising the transmission line access gates would typically be limited to 32 vehicles per hour (12 light vehicles and 20 heavy vehicles) during the peak period. These low additional demands (an arrival of approximately one vehicle every two minutes) are not likely to adversely impact the performance and capacity of the road network. The condition of these roads would be subject to the routine road condition inspection during construction.

Table A-1 Local roads proposed to be used for access to transmission line access gates

Road name	Description	Pavement	Configuration and speed limit
Ancrum Street, Cassilis	A short section of local road in Cassilis town centre between Coolah Road and Uarbry Road	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 50 km/h
Bald Hill Road, Dunedoo	Extends east-west for around 10 kilometres between Gollan Road and Sandy Creek Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Birkalla Road, Merotherie and Bungaba	Extends for around 10 kilometres between Merotherie Road and Blue Springs Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Brooklyn Road, Dunedoo	Approximately 6 kilometres in length, with an east-west alignment, connecting Lahey Creeks Road to Corishs Lane	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Cassilis Road, Cassilis	Approximately 1.5 kilometres in length, with a north-south alignment, located in the village of Cassilis. It connects the village of Cassilis to Golden Highway	Sealed with unsealed shoulders	Bidirectional two-lanes road (one lane in each direction) 100 km/h near Golden Highway. Reduces to 50 km/h near the town of Cassilis
Cliffdale Road, Turill and Uarbry	Approximately 12 kilometres in length connecting Castlereagh Highway in Blue Springs Road to Ulan Road. It has an east-west alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Coolah Road, Cassilis	Approximately 10 kilometres in length that runs in an east-west alignment. It connects the village of Cassilis to Vinegaroy Road	Unsealed/Partially Sealed	Bidirectional two-lane road (one lane in each direction) 100 km/h on rural segment. Reduces to 50 km/h near the town of Cassilis
Corishs Lane, Tallawang	Approximately 5 kilometres in length located in Tallawang. It links Tucklan Road to Brooklyn Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Gingers Lane, Tallawang	Approximately 4 kilometres in length, running in an east-west alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)

Road name	Description	Pavement	Configuration and speed limit
Highett Road, Ulan	Approximately 1.7 kilometres in length	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Phillip Street, Wollar	This is a short 500 m road in the village of Wollar that connects Wollar Road to the village of Wollar	Sealed with unsealed shoulders and no line marking	Bidirectional two-lane road (one lane in each direction) 50 km/h
Puggoon Road, Beryl and Tallawang	Approximately 11 kilometres in length connects to Castlereagh Highway in a north-south alignment	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Ross Crossing Road, Uarbry	Approximately 4 kilometres in length connecting Golden Highway to Blue Springs Road It is split into two sections – Ross Crossing North Road and Ross Crossing South Road	Unsealed (Access track)	Bidirectional two-lane road (one lane in each direction) Unknown speed limit
Spir Road, Orana	Approximately 1 kilometres in length that connects to Tucklan Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Thompsons Road, Cassilis	This is a short road in Cassilis, that is connected to Cassillis Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Trgo Close, Wilpinjong	This is a short road off Ulan-Wollar Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Turill Bus Route, Turill	This is a 2 km section of road off Ulan Road	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)
Whistons Lane, Tallawang	Approximately 2.5 km long road off the Castlereagh Highway	Unsealed	Bidirectional two-lane road (one lane in each direction) 100 km/h (rural speed limit)

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