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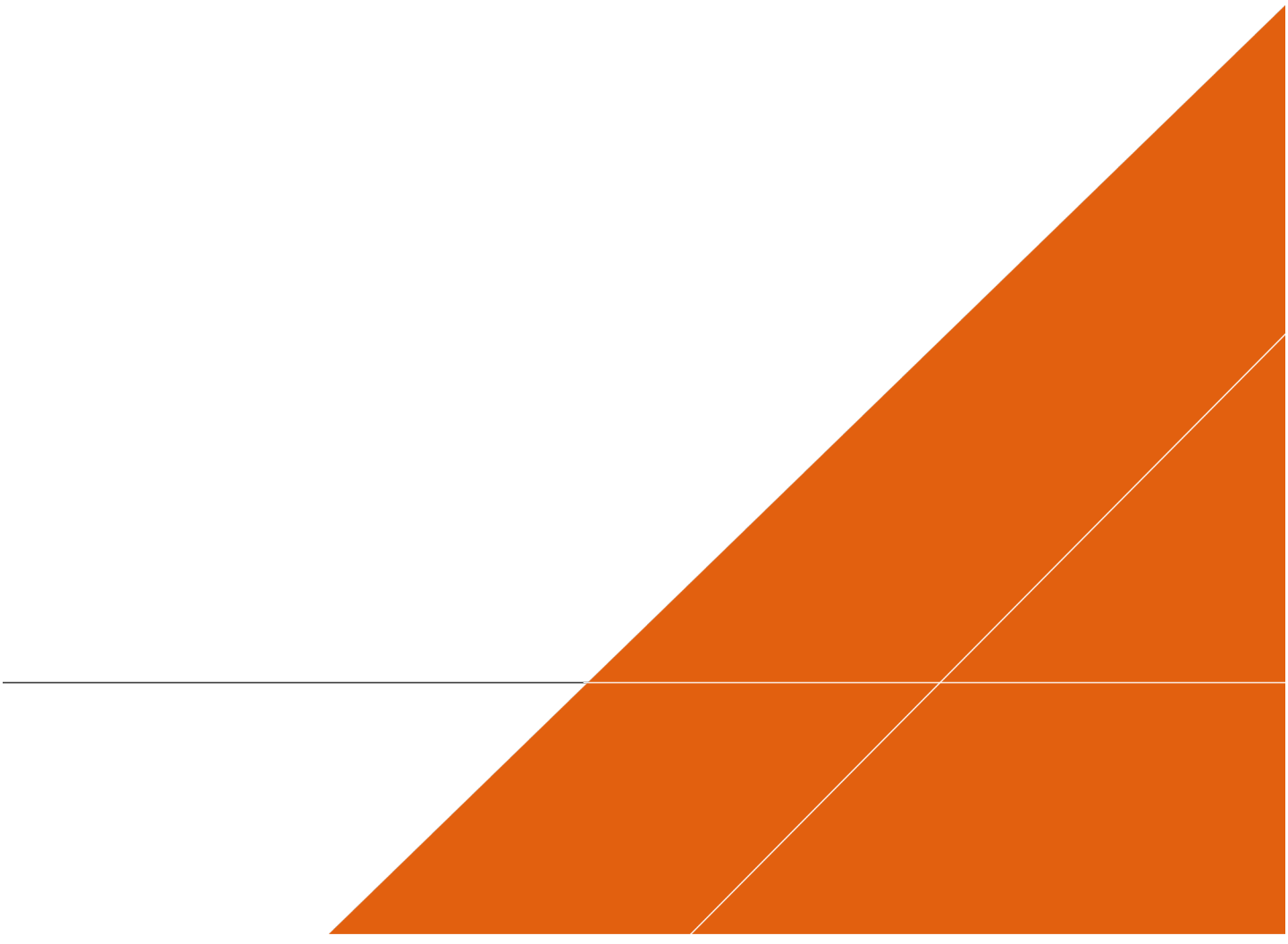
WALLERAWANG BATTERY ENERGY STORAGE SYSTEM

Transport Impact Assessment Report

04 MAY 2022



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WALLERAWANG BATTERY ENERGY STORAGE SYSTEM

TRANSPORT IMPACT ASSESSMENT

Final Report

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Report No	Report Number
Date	4/05/2022
Revision Text	07

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	18/06/2021	Draft	HJ	NV
02	23/06/2021	Draft	HJ	NV
03	30/06/2021	Final Report	HJ	NV
04	06/10/2021	Final addressing TfNSW comments	MY	NV
05	28/10/2021	Updated to address DPIE comments	HT	HT
06	10/01/2022	Updated to address DPIE comments	HT/PR	HT
07	04/05/2022	Final Report - RtS	MY/CL	NV

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ABBREVIATIONS

Abbreviation	Definition
LSBS	Large-scale battery storage
AS	Australian Standards
BAL	Basic Left Turn
BAR	Basic Right Turn
BESS	Battery Energy Storage System
GML	General Mass Limit
HML	Higher Mass Limit
LGA	Local Government Area
MW	Megawatt
MWh	Megawatt hours
pcu	Passenger Car Units
RMS	Roads and Maritime Services
SEAR's	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SISD	Safe Intersection Sight Distance
SRD	State and Regional Development
SSD	State Significant Development
TIA	Transport Impact Assessment
TMP	Traffic Management Plan

EXECUTIVE SUMMARY

Greenspot Wallerawang Pty Ltd (Greenspot) (the Proponent) is seeking development consent for the construction, operation and maintenance of a Battery Energy Storage System (BESS) within the buffer lands of the decommissioned Wallerawang Power Station site. The BESS will be up to 500 Megawatt (MW) and would provide up to 1,000 Megawatt hours (MWh) (two hours capacity at maximum discharge rate). The last operational coal fired units at the old Wallerawang Power Station were units 7 and 8, to reflect the legacy of the Wallerawang Power Station and acknowledge the long-term role the Power Station played in the NSW energy sector, the battery will be known as the 'Wallerawang 9 Battery' (the Project).

This report acts as a Transport Impact Assessment (TIA) which evaluated the impact of the proposed Project's construction and operational stage generated traffic on the surrounding road network.

It is considered that the impact of the construction generated traffic on the operational performance of intersections and road links would be minimal and only account for 2 additional heavy vehicles during AM and PM peak hours.

During operation of the Proposal, the estimated workforce would consist of a small number of workers (i.e. approximately 5 staff). In a worst-case scenario if all workers travel alone, this will equate to 5 (two way) vehicle trips per day. It is expected that there may be some irregular heavy vehicle movements during the operational stage such as replacing of transformers etc. This would however constitute very low vehicle volumes. It is considered that operational generated traffic would be negligible from a traffic engineering or transport planning perspective.

Turn warrants assessments of the proposed access to the Project Site have been conducted. These assessments indicate that basic left turn (BAL) and basic right turn (BAR) treatments would be sufficient for the access to accommodate the construction stage turn movement volumes. These would be based on Rural access requirements outlined in *Austroads Guide to Road Design Part 4 Intersections and Crossings*. However, the Project Site access would have to be formalised in order to accommodate for the B-Double, which is the largest design vehicle expected to use the access during construction (for regular use). Formalising the access would also require minor pavement widening to allow for lateral movements of vehicles when decelerating into the access.

Desktop based sight distance analysis of the access to the Project Site was conducted and it was found that vegetation clearance would be required in order to meet the minimum sight distance requirements for Safe Intersection Sight Distance. This would be required for the south to north approach along Castlereagh Highway. The extent of vegetation clearance or maintenance should be determined during detail design stage of formalising the access. Sufficient Safe Intersection Sight Distance is considered available for the north to south movement along Castlereagh Highway. It is considered from desktop analysis that sufficient minimum gap sight distance would be available along the northern approach of Castlereagh Highway, however it is perceived that available minimum gap sight distance is less than the minimum required minimum gap sight distance along the southern approach of Castlereagh Highway. It is proposed that vegetation clearance be conducted in order to remove any sight line obstructions within the sight envelope which may occur along the road verge. The extent of vegetation clearance or maintenance thereof should be determined during the detailed design stage of the access.

This TIA provides mitigation measures for the transport of oversize over mass vehicles in Section 4.3.3. The use of such vehicles should be addressed in a comprehensive Construction Traffic Management Plan (CTMP) with appropriate permits applied for with TfNSW as nominated by the contractor.

In response to comments raised by TfNSW (letter dated 18 March 2022 and subsequent consultation), a sensitivity test was conducted to examine the required intersection treatment for the worst-case scenario for construction traffic arriving at the access intersection between 6am to 7am (one hour) prior to the start of the shift at 7am. An intersection turn warrant assessment was conducted for the access intersection for the period from 6am to 7am.

Based on the mandated approach routes and expected peak hour traffic volumes in the period from 6am to 7am, the turn warrants assessment shows that an auxiliary left turn lane (AUL) treatment and basic right turn (BAR) treatment

would be sufficient for the access to accommodate the construction stage turn movement volumes. An AUL(S) (short left-turn treatment AUL) has been adopted to avoid impact to the neighbouring intersection south of the access intersection. Predominantly, light vehicles will be accessing the intersection and the provided storage of 85 metres (excluding the taper) is more than adequate to cater for the expected demand from 6am to 7am.

To minimise the impact of construction traffic at the access intersection during the 6am to 7am period, workers from the north will be mandated to come from the south (i.e. via Main Street and Barton Avenue through the town of Wallerawang) to access the site. This worst case scenario assumes all 100 site workers arriving during the 6am to 7am window a total of 100 trips per hour coming from the south to the access intersection. The mandate will be enforceable with camera monitoring, heavy penalties, emphasised at Toolbox sessions with workers and included in the Construction Traffic Management Plan. A maximum additional travel time of 10 minutes is expected with the proposed alternative travel route for workers from the north which is not a significant impost. This arrangement will significantly enhance traffic safety at the access intersection during the 12 to 24-month construction period.

1 INTRODUCTION

1.1 Project overview

Greenspot Wallerawang Pty Ltd (Greenspot) (the Proponent) is seeking development consent for the construction, operation and maintenance of a Battery Energy Storage System (BESS) within the buffer lands of the decommissioned Wallerawang Power Station site. The BESS will be up to 500 MW and would provide up to 1,000 MWh of battery storage capacity (two hours capacity at maximum discharge rate). To reflect the legacy of the Wallerawang Power Station and acknowledge the long-term role the Power Station played in the NSW energy sector, the battery will be known as the **'Wallerawang 9 Battery'** (the Project).

The Project is considered to meet the definition of State Significant Development (SSD) under Clause 8 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). The Project would be for electricity generating works (above $30 million Capital Investment Value (CIV)) on land where this use is permitted with development consent under Clause 34 of the *State Environmental Planning Policy (Infrastructure)* (ISEPP).

The Proponent is seeking SSD approval for the Project under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 Project background

The Project would involve construction and operation of a large-scale BESS at Wallerawang, NSW. The Project also includes the construction and operation of ancillary infrastructure to support the operation of the BESS.

Key features of the Project include:

- Large-scale BESS including battery enclosures, inverters and transformers
- 33/330 kV switchyard
- Transmission line connection between the BESS and the nearby TransGrid Wallerawang 330 kV Substation
- Ancillary elements including site access from the Castlereagh Highway, internal access roads and parking, site office and amenities, stormwater and fire management infrastructure, utilities, signage, fencing, security systems and landscaping.

The new power supply connection from the BESS to the Wallerawang 330 kV substation would be established on land owned by Greenspot and TransGrid and no other third-party easements would be required.

Table 1-1 Project Overview specifications

Project Component	Details
Application Lots	• Lot 3, DP 1018958 (BESS facility and office) • Lot 4, DP 1016725 (BESS facility) • Lot 3, DP 1181412 (Transmission connection line, Lake Wallace and Coxs River, west of the Project Site) • Lot 3, DP 1226927 (Includes the access road) • Lot 4, DP 1226927 (Includes the access road) • Lot 91, DP1043967 (TransGrid 330 kV Substation) • Castlereagh Highway (east of the Project Site).
Zoning	The Project is located on land zoned as a combination of IN3 Heavy Industrial, SP2 (Infrastructure) Electricity generating works and RU1 Primary Production.

Project Component	Details
Project footprint	• Total footprint – approximately 22 ha • BESS, switchyard, ancillary development - approximately 18 ha • Overhead transmission line - approximately 3.6 ha • Access road to the BESS facility, office and amenities – approximately 0.5 ha
Access	Access to the Project Site would be via the access road off the Castlereagh Highway
Construction	
BESS facility and components	Depending on the final detailed design, the BESS facility could comprise: • Up to 2013 battery enclosures housing lithium-ion type battery cells, associated control systems and HVAC (heating, ventilation and air conditioning) units (numbers indicative only and subject to change in final design) • Up to 372 power inverters (numbers indicative only and subject to change in final design) • 86 MV transformers (numbers indicative only and subject to change in final design) • Medium voltage (MV) switch rooms containing MV switchgear.
33/330 kV Switchyard	• Switchyard (33/330 kV) including up to four high voltage (HV) transformers and HV switchgear and associated control building.
Overhead transmission line connection	• Approximately 600 m transmission line including cabling infrastructure from the TransGrid Wallerawang 330 kV Substation to the BESS switchyard • Alteration to Wallerawang 330 kV substation (bay changes for connection) • Construction of foundations to support new overhead transmission line towers • Installation of towers which would be craned (in sections) onto the footings and secured with holding down bolts.
Ancillary elements	• access road off the Castlereagh Highway • Permanent site office, staff amenities and car park • Signage at site entrances and within the Project Site for the purposes of way finding, safety and building identification. • Perimeter and internal lighting of the Project Site • Stormwater drainage and management measures • Two 20,000 litre water tanks for fire suppression • On-site security system including but not limited to, closed circuit television (CCTV) and an integrated telecommunication system • Connections to telecommunications infrastructure • 330 kV back fed for supply to the Project • Rainwater capture in rainwater tanks • Contained on-site sewage system
Activities	Construction of the Project is expected to comprise: • Site establishment • Trenching • Installation of footings for the BESS • Delivery, installation and fit out of the BESS • Delivery installation and fit out of the switchyard

Project Component	Details
	• Construction of ancillary elements • Installation of permanent fencing and security systems • Testing and commissioning • Removal of construction equipment and materials and rehabilitation of construction areas (where applicable).
Program	Expected commencement of construction in Quarter 3/Quarter 4 of 2022 and would continue for approximately 12-24 months.
Hours	• 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • No works on Sundays or public holidays Some work outside of these hours (e.g. oversize deliveries, emergencies) as required.
Workforce	Up to approximately 100 full-time equivalents will be required for construction during the project peak
Operation	
Capacity	The BESS would have a capacity of up to 500 MW and up to 1000 MWh of battery storage (two hours duration at maximum discharge)
Life of BESS	The estimated life of the initial BESS equipment is 15-20 years. It is expected that replacement of the batteries would be undertaken extending the life of the BESS to 30-40 years
Workforce	Up to five operational personnel, some of which may be located off-site and work remotely. In addition to this, maintenance staff would be on-site periodically.
Operational hours	24 hours, 7 days a week.

The indicative layout of the BESS including the key features is shown on Figure 1-1.

Figure 1-1 Proposed EIS operational layout

1.3 Key terms

Table 1-2 provides a summary of the key terms used within this report.

Table 1-2 Key terms

Term	Definition
BESS	Battery Energy Storage System facility that includes battery enclosures, inverters and transformers located on the Project Site
Construction area	The area of the Project Site, which is to be utilised for construction works, namely areas to be disturbed during the construction of the Project
Forestry area	The area of the Project Site which is subject to a Pine Plantation Deed (between Greenspot and Forestry Corporation of NSW) and is to be harvested by Forestry Corporation of NSW. The harvesting of this area would be undertaken under a separate approval (to the extent required) and would involve tree removal only. Removal of stumps or any residual vegetation and earthworks for the development of the built form of the Project would be undertaken in this area.
Greenspot 2845 Activity Hub	Former Wallerawang Power Station and buffer lands including Lake Wallace, comprising approximately 613 hectares (ha) acquired by Greenspot from EnergyAustralia in September 2020.
Operational area	The area of the Project Site which is to be used for the operation of the Project
The Proponent	The entity seeking approval is Greenspot Wallerawang Pty Ltd
Project	The Wallerawang 9 Battery (subject of this EIS) comprising the BESS, overhead transmission line and ancillary infrastructure.
Project Site	Within the buffer lands of the decommissioned Wallerawang Power Station, located at 1 Main Street, Wallerawang NSW. The area where the Project would be located incorporates the following lots: Lot 3, DP 1018958, Lot 4, DP 1016725, Lot 3, DP 1181412, Lot 3, DP 1226927, Lot 4, DP 1226927.
Project switchyard	33/330 kV switchyard to be constructed for the purposes of the Project on the Project Site, connecting via the proposed overhead transmission line, to the existing TransGrid Wallerawang Substation.
Wallerawang Power Station site	The former Wallerawang Power Station site (not including the buffer lands) on which the main Power Station activities have been historically located.
Wallerawang Substation	Existing TransGrid Wallerawang 330 kV Substation located on Lot 91, DP 1043967.

1.4 Project Site

The Project Site is located in the buffer lands of the former Wallerawang Power Station and is closely linked to this historic land use. The Wallerawang Power Station was a thermal coal power station that commenced operation in the 1950s, supplying electricity to the NSW residential and business market. The power station initially consisted of 4 x 30 MW units but was upgraded in 1961 with an additional 2 x 60 MW units and again in 1976 and 1980, when 2 x 500 MW units were installed.

The power station was owned and run by Energy Australia up until 2014 when it was closed, citing ongoing lower energy demand and Wallerawang's higher operating costs caused by age and inefficiency. The power station was

subsequently acquired by Greenspot in September 2020 with the aim of repurposing the site. The acquisition included the former Wallerawang Power Station and buffer lands, comprising approximately 613 ha.

To facilitate repurposing, Greenspot has engaged a leading contractor to undertake a decommissioning, demolition and rehabilitation (DDR) program (under DA 015/19) on the Wallerawang Power Station site. The DDR project commenced in May 2021 and is expected to take approximately 18 months to complete. Under current plans, key infrastructure including the turbine hall and administration building structures, the small chimney stack from the former A and B station, the cooling tower and the coal dome (dry storage area) will be retained by Greenspot to play a role in the future development.

Greenspot believes the rejuvenated site will attract energy and water intensive businesses (e.g., in the industrial, manufacturing and agribusiness sectors), serving to generate sustainable economic activity and helping to create long term employment growth in the Lithgow area and the NSW Central-West region more broadly. The generation of such economic activity will inevitably lead to increased demand for housing and amenity and, in this regard, Greenspot proposes that parts of the site will also lend themselves to commercial, recreational, residential and other complementary uses. Repurposing of the power station and buffer lands is proposed to be undertaken as part of a Master Plan for the site known as the Greenspot 2845 Activity Hub.

Greenspot has recognised that providing a stable, reliable and cost-effective energy source for the future redevelopment of the site would contribute to the reduction in the cost of supplying electricity to consumers who are operating within the 'Greenspot 2845 Activity Hub'. As such, the Proponent is seeking development consent for the construction, operation and maintenance of a BESS - the Project.

In addition to supporting and enabling the future Greenspot 2845 Activity Hub, the Project is considered critical in supporting the NSW Government's Electricity Strategy for a reliable, affordable and sustainable electricity future that supports a growing economy. BESS facilities, such as the Project, would provide enabling infrastructure for expanding the renewable energy industry in NSW, particularly in the Central-West Orana Renewable Energy Zone (REZ), and is considered a critical element of the transformation of the NSW energy sector.

1.4.1 Project Location

The Project Site is about 70 kilometres west of Penrith in the Central Tablelands, about 115 kilometres west of the Sydney Central Business District (CBD) and north-east of the township of Wallerawang in the Lithgow LGA.

The Project is located immediately south of Wallerawang Power Station site and 320 metres east of the TransGrid Wallerawang 330 kV Substation at its closest point. The Project would require up to 22 hectares of land within the Project Site.

1.5 Study objectives

The objective of this Transport Impact Assessment (TIA) is to estimate, evaluate and mitigate the expected impact resulting from the construction and operational stage of the Proposal on the surrounding road network. The assessment has been undertaken in accordance with the Secretary's Environmental Assessment Requirements (SEARs). Relevant SEARS and where they have been addressed in this TIA are shown in Table 1-3.

Table 1-3 SEARs and report reference

Requirement	Section reference
The EIS must address the following specific matters:	
Transport – including:	

Requirement	Section reference
• an assessment of the peak and average traffic generation, including over-dimensional vehicles and construction worker transportation;	Section 4.1 Construction phase impact assessment Section 4.2 Operational phase impact assessment
• an assessment of the likely transport impacts to the site access route (including, but not limited to, Castlereagh Highway), site access point(s), any Crown land, particularly in relation to the capacity and condition of the roads, road safety and intersection performance;	Section 4
• a cumulative impact assessment of traffic from nearby developments; and	Section 2.2 Surrounding land use
• provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from heavy vehicle and over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authority;	Section 5

1.6 Relevant legislation, policy and guidelines

To assess the proposed transport impacts and arrangements, the proposal has been assessed against the following legislation, policies and guidelines:

- *Transport Administration Act 1988*
- *Road Transport Act of 2013*
- *Guide to Traffic Generating Developments* (Roads and Maritime Services [Roads and Maritime, formerly Roads and Traffic Authority], Version 2.2, October 2002)
- *AS/NZ 2890.1: Off-street car parking*
- *AS/NZ 2890.2: Off-street commercial vehicle facilities*
- *Department of Transport and Main Roads Road Planning and Design Manual: Chapter 5 Traffic Parameters and Human Factors*, August 2004
- *Department of Transport and Main Roads Road Planning and Design Manual: Chapter 13 Intersections at Grade*, October 2006
- *Austroads Guide to Road Design Part 4a: Unsignalised and Signalised Intersections* (Austroads, 2009)
- *Highway Capacity Manual*, 2010 (HCM2010)
- *Guide to Traffic Management Part 3: Traffic Studies and Analysis and Highway Capacity Manual* (Austroads, 2016)
- *Transport for NSW Traffic Control at Work Sites Technical Manual Issue 6, 2020*
- *Austroads Guide to Temporary Traffic Management Part 9*
- *Austroads Guide to Temporary Traffic Management Part 3.*

1.7 Report structure

The remainder of this report is structured as follows:

- **Section 2 Existing conditions** assesses the existing traffic, public and active transport networks within the Project Site

- **Section 3 Development details** provides an overview of the preliminary construction plan including staging, the preliminary operational plan relating to the maintenance of the Proposal, and documents traffic generation assumptions and forecast volumes
- **Section 4 Impact assessment** assesses the impacts of additional construction traffic vehicles accessing the proposed compound areas during the construction phase
- **Section 5 Conclusions** presents the overall traffic impact assessment conclusions.

2 EXISTING ENVIRONMENT

2.1 External road network

The key roads within the external network surrounding the Project Site are summarised in Table 2-1.

Table 2-1 Key roads within the Proposal site network

Road link name	Number of lanes per direction	Divided (D) / undivided (U)	Posted speed (km/h)
Castlereagh Highway	1	U	100
Great Western Highway	2	D	110
Wolgan Road	1	U	50
Main Street	1	U	50

2.2 Surrounding land use

The area surrounding the Project Site includes a mix of industrial, buffer areas, rural land uses, some residential, as well as several abandoned open cut mines and operating underground coal mines.

Other development and businesses located near the Project Site are also shown on Figure 2-2and include:

- Wallerawang Power Station site, owned by Greenspot, located immediately north of the Main Western Railway Line
- Goodearth Landscape and Building Supplies, 600 metres south
- Centennial Coal Springvale Coal Mine site, 750 metres east
- Black Gold Motel, about 1.1 km north-west
- Wallerawang Power Station Ash Repository and associated lands, owned and operated by Generator Property Management Pty Ltd, about 1.2 km north
- Industrial and commercial businesses along Main Street, Wallerawang, about 1.2 km north-west
- Approximately six residential receivers located on Springvale Lane, 150 metres south-east of the Project Site at its closest point (ie at the intersection of the existing access road and Castlereagh Highway).

The nearest residential receivers (Springvale Lane residents) are located about 650 metres south-east of the nearest BESS enclosure. It was found that there is no significant planned development in close proximity of the Project Site which would have a cumulative impact on the surrounding road network and modes of transport.

2.3 Bus services

Lithgow Buslines currently service the Wallerawang area travelling to and from Lithgow. The bus services make use of the following roads:

- Barton Avenue
- Lyon Parade
- Hume Avenue
- Lidsdale Street

- Commens Street
- Pipers Flat Road
- Main Street
- Great Western Highway.

The majority of these roads would not coincide with the routes to be used for construction of the Project with the exception of the Main Street and the Great Western Highway.

The following key bus routes running along the Great Western Highway have the potential to be impacted by the Project:

- Route 600 – Portland to Lithgow via Wallerawang
- Route 636 – Lithgow to Bathurst via Wallerawang.

There are no bus services that utilise the Castlereagh Highway in the area of the Project. Figure 2-1 shows the public bus routes within the vicinity of the Project Site and surrounding area.

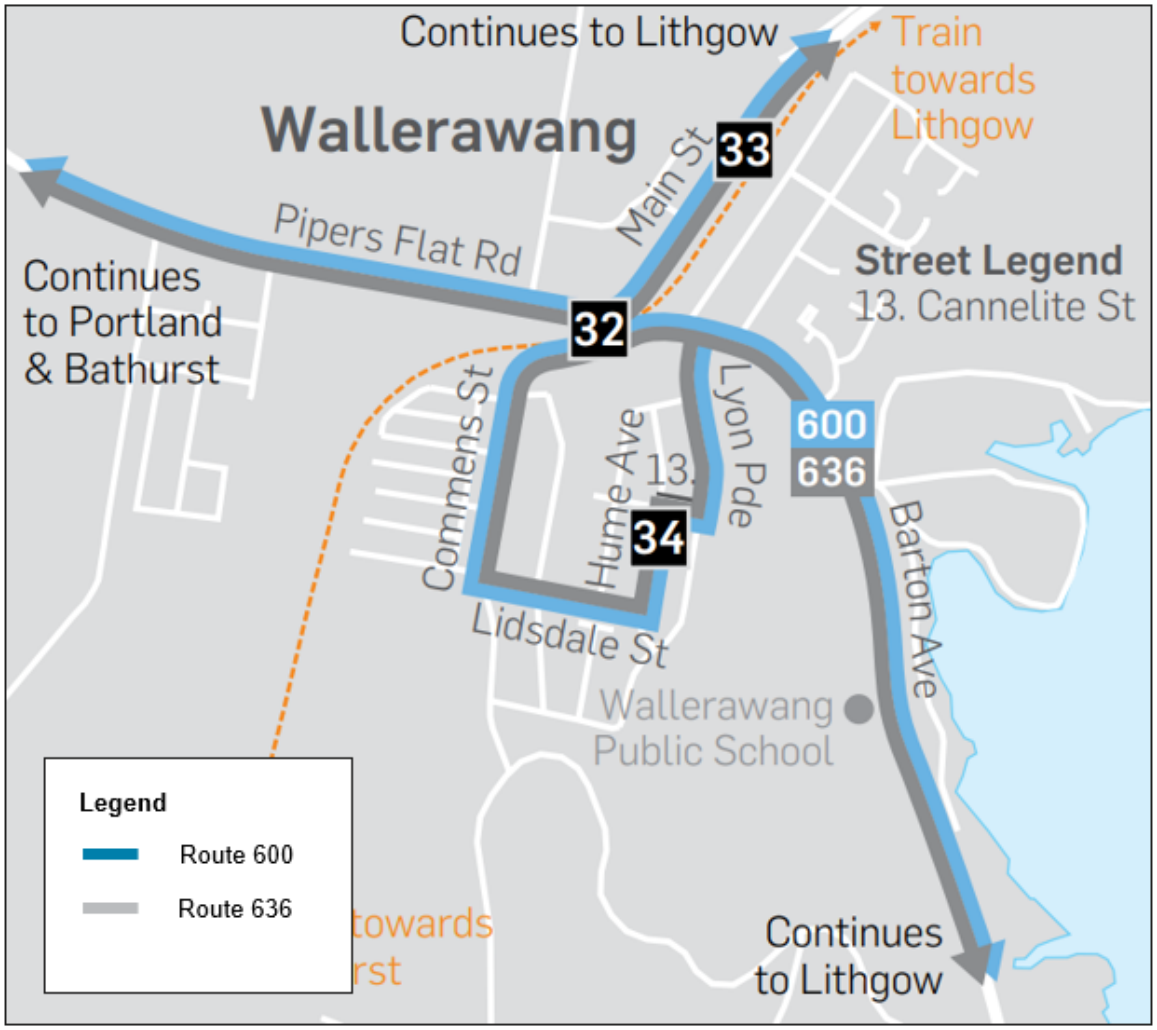


Figure 2-1 Bus routes servicing Wallerawang

Source: Transport for NSW bus timetables, valid from 22 July 2019, accessed 3 June 2021

Table 2-2 summarises the frequency of public bus services within the Wallerawang surrounding area.

Table 2-2 Public bus frequencies within the Wallerawang surrounding area

Bus service	Weekday frequency (per direction)	Relevant roads
Route 600	• 13 services from 6am – 10am • 9 services from 3pm – 6pm	Barton Avenue, Lyon Parade, Hume Avenue, Lidsdale Street, Commens Street, Pipers Flat Road, Main Street, Great Western Highway
Route 636	• 3 services from 6am – 10am • 2 services from 3pm – 6pm	Barton Avenue, Lyon Parade, Hume Avenue, Lidsdale Street, Commens Street, Pipers Flat Road, Main Street, Great Western Highway

Source: Transport for NSW bus timetables, valid from 22 July 2019, accessed 3 June 2021

2.4 Cycling network

There are no cycle paths along Castlereagh Highway or Great Western Highway. The Project is not anticipated to impact on the local cycling network. Figure 2-2 shows cycle paths within Wallerawang and the surrounding area.

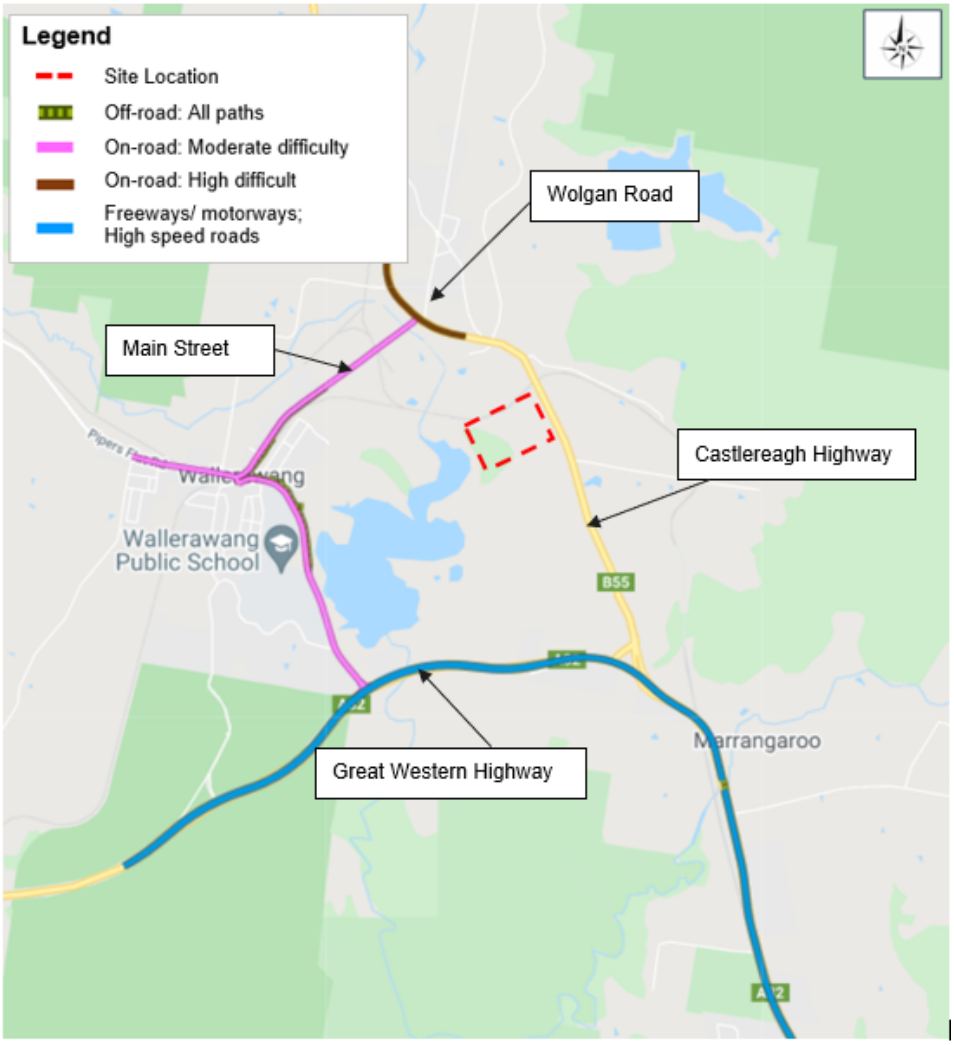


Figure 2-2 Cycle paths in Wallerawang and the surrounding area

Source: Roads and Maritime Services Cycleway Finder, last updated 8 June 2018, accessed 3 June 2021

2.5 Pedestrian infrastructure

No formal pedestrian footpaths are provided along Castlereagh Highway or the Great Western Highway, which would be the main roads used by construction vehicles during the construction stage of the Project.

2.6 Heavy vehicle routes

Within Wallerawang and the surrounding area, Great Western Highway and Castlereagh Highway are designated heavy vehicle routes for B-double up to 26 metres long under General Mass Limit (GML) and Higher Mass Limit (HML) conditions. Figure 2-3 shows the restricted access vehicle map within Wallerawang and the surrounding area.

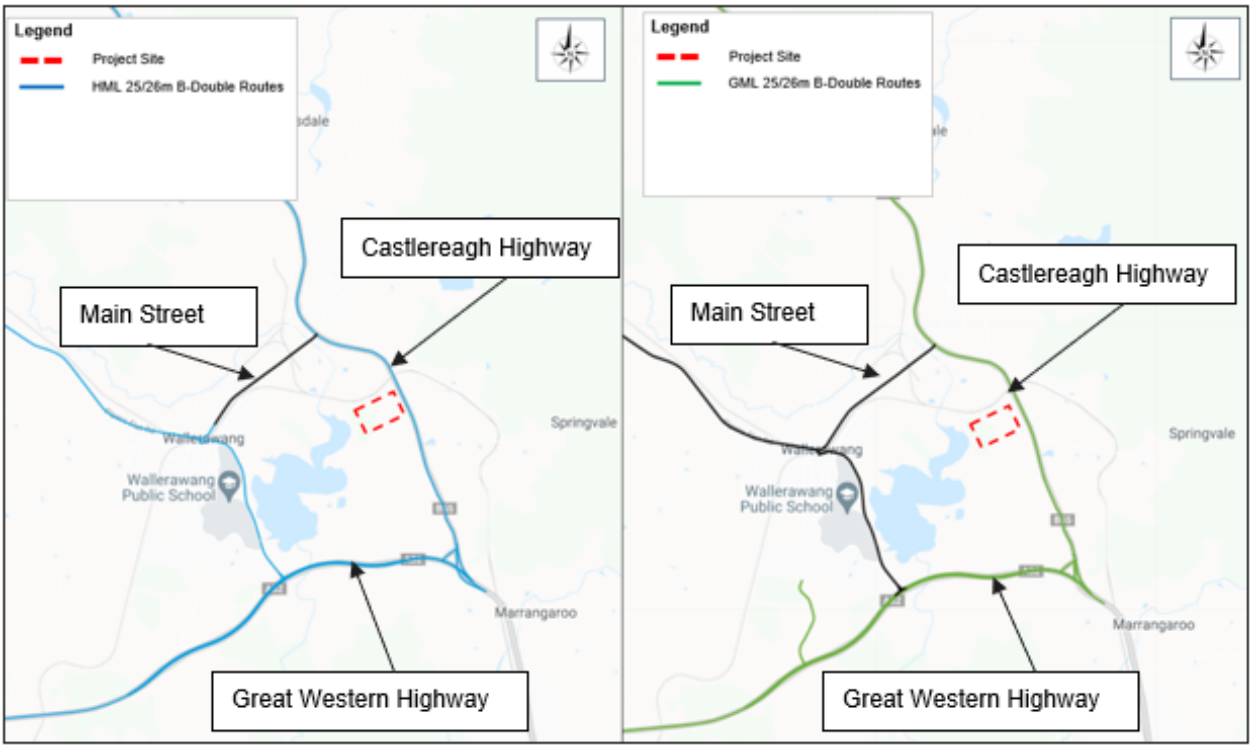


Figure 2-3 Restricted access vehicle map

Source: Roads and Maritime Services Restricted Access Vehicles Map, valid as of 25 July 2019, accessed 3 June 2021

2.7 Existing traffic conditions

2.7.1 Traffic data collection

To establish existing traffic conditions, a traffic survey was conducted on Tuesday 30 March 2021. The survey recorded turn movement volumes at the following key intersections.:

- I-1: Castlereagh Highway / Great Western Highway
- I-2: Castlereagh Highway / Wolgan Road
- I-3: Castlereagh Highway / Main Street.

Figure 2-4 shows the locations of the key intersections where traffic surveys were conducted.

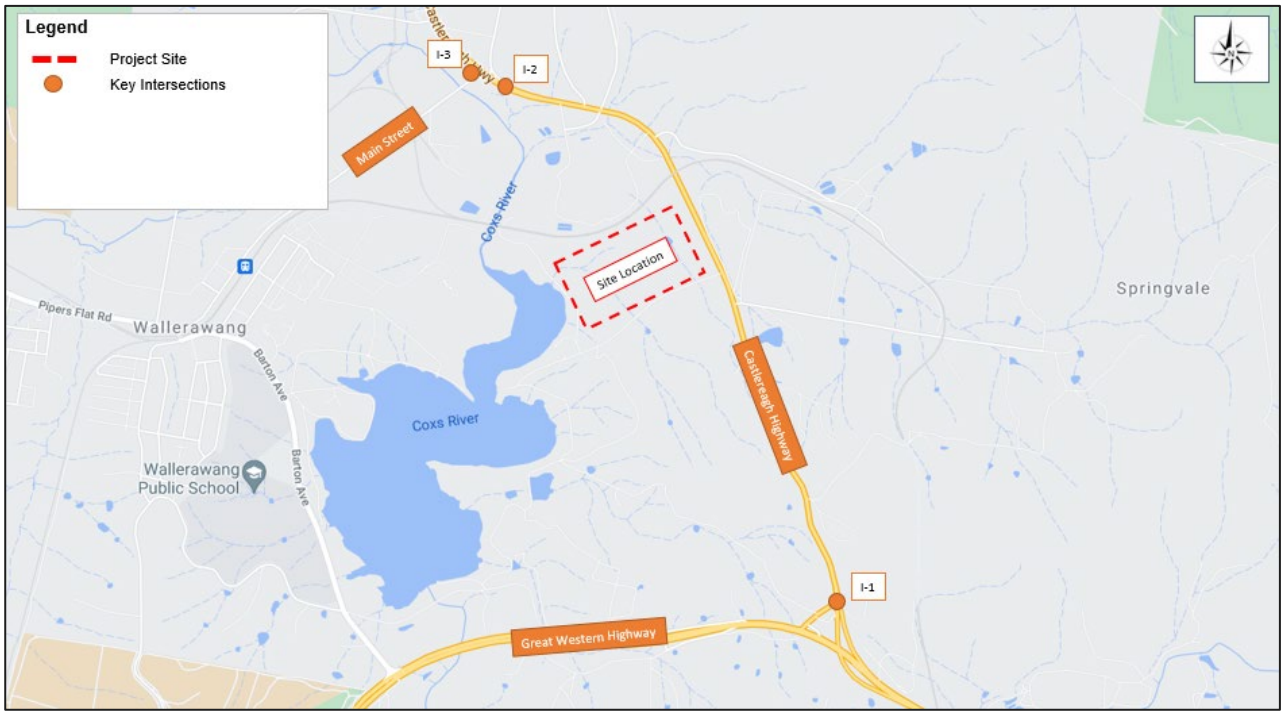


Figure 2-4 Traffic survey locations

2.7.2 Intersection traffic flows

Based on the traffic survey, background peak hours on the road network surrounding the Project Site occurred at 7:45 – 8:45 for the AM peak hour and 15:15 – 16:15 for the PM peak hour.

Peak hour traffic volumes (including traffic flow diagrams) based on the traffic survey of the key intersections are provided in full in Appendix A. Figure 2-5 shows the base year (2021) AM peak hour turn movement volumes at each of the key intersections. Figure 2-6 shows the base year (2021) PM peak hour turn movement volumes at each of the key intersections.

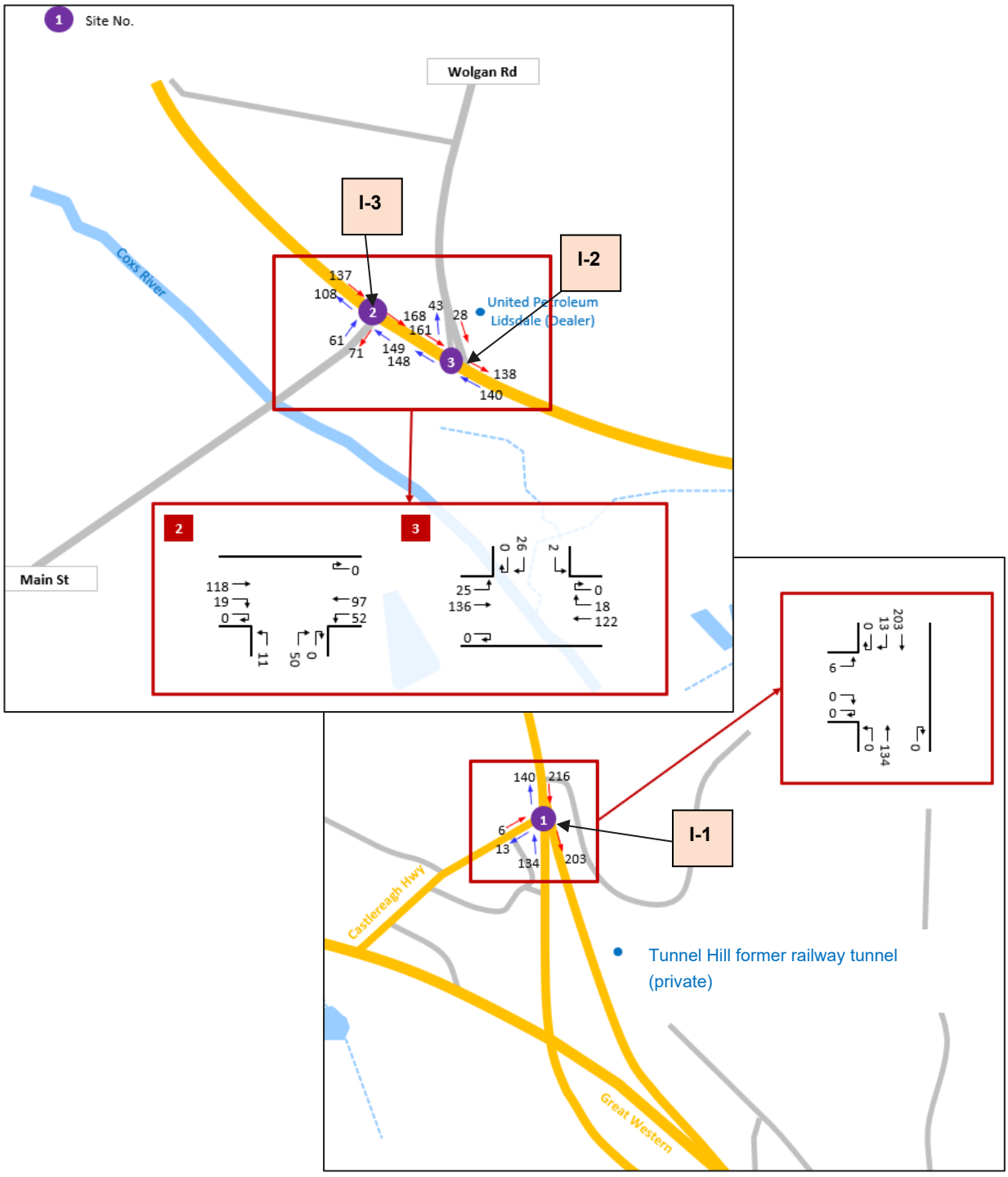


Figure 2-5 Base Year 2021 AM Peak Hour Traffic Volumes

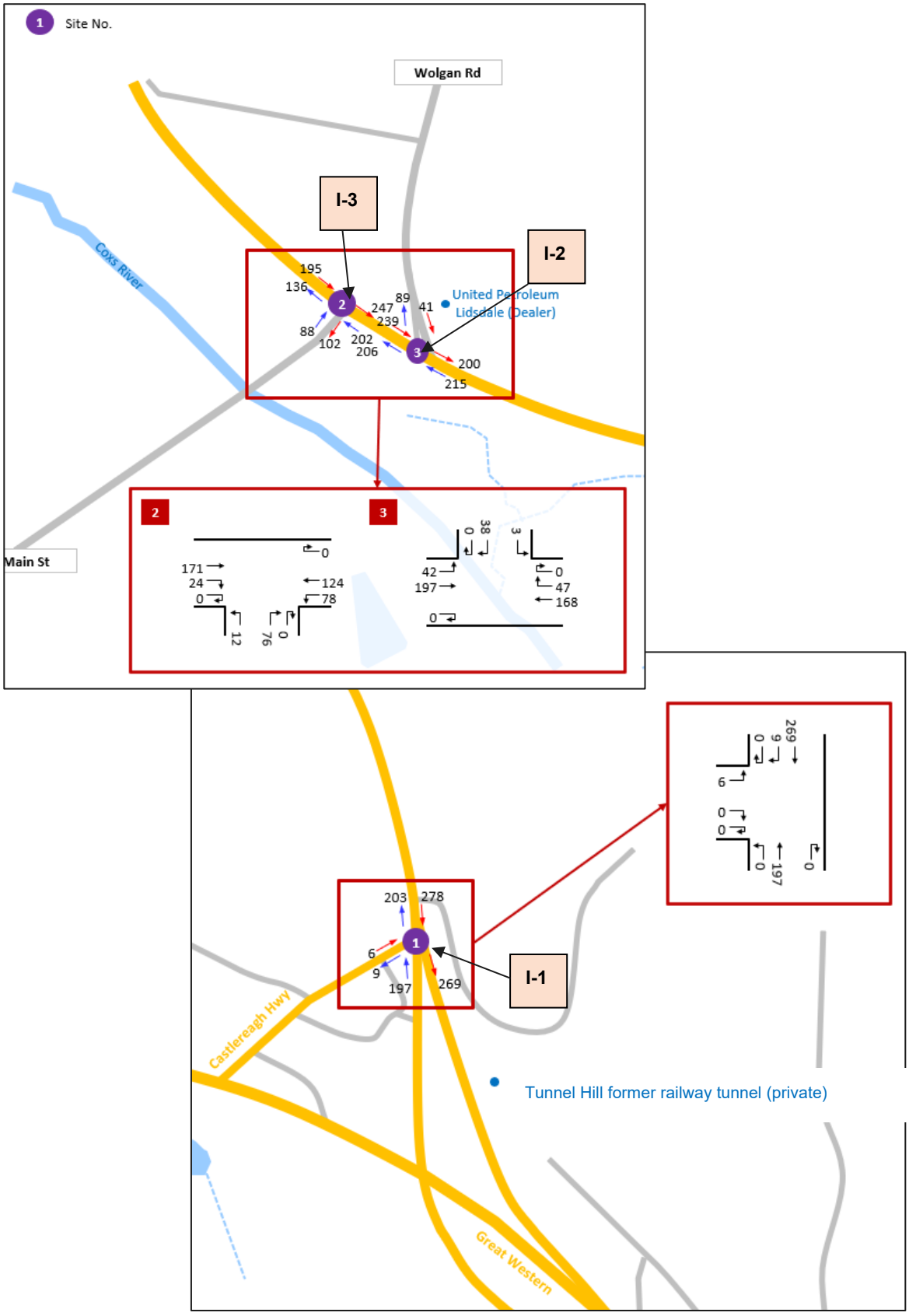


Figure 2-6 Base Year 2021 PM Peak Hour Traffic Volumes

2.7.3 Background traffic growth

A compounded 3.7% annual traffic growth rate has been adopted for the purpose of this TIA and subsequent analysis in Section 4.2 to project future year background traffic volumes. The traffic growth rate is based on information obtained from Traffic Volume Viewer for Station 99084 as illustrated in Figure 2-7. The traffic growth rates were based on data obtained from year 2008 to 2012.

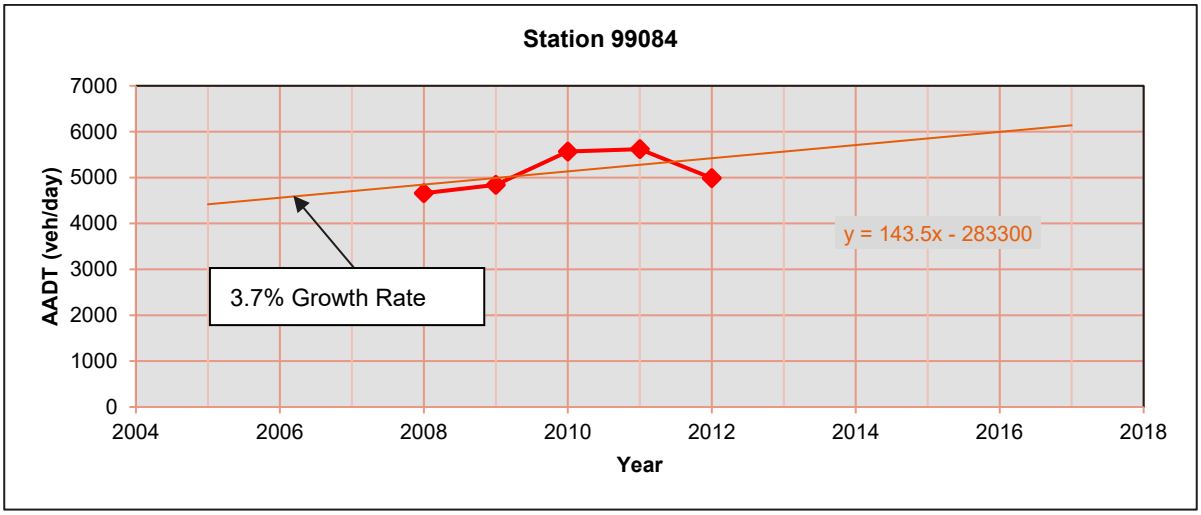


Figure 2-7 Background Traffic Growth

TfNSW provided classified traffic count data over a two-week period from the 25 May to 7 June 2021 on the Castlereagh Highway approximately 600 metres north of the Great Western Highway interchange. The recent 2021 counts showed an average daily traffic volume of 5,420 vehicles per day on the highway. This is equivalent to a historical traffic growth rate of 0.93% p.a. since 2012 (with 4,988 vehicles per day) or 1.2% p.a. since 2008 (with 4,659 vehicle per day) based on the latest TfNSW traffic data. The traffic growth based on the 2021 traffic data results in a traffic growth rate that is much lower than the assumed traffic growth rate of 3.7% adopted for the TIA and is deemed reasonable and conservative.

3 DEVELOPMENT DETAILS

3.1 Development layout

The Project would be developed on the Wallerawang Power Station buffer lands acquired by Greenspot in 2020 (the Project Site). The western half of the Project Site is zoned as SP2 Infrastructure and the eastern half IN3 Heavy Industrial under the Lithgow Local Environmental Plan (LEP) 2014. The development layout is illustrated in Section 1, Figure 1-1**.**

3.2 Construction

This section details construction activities required to facilitate the Project.

3.2.1 Site preparation

The trees (not stumps) located within the Forestry area are scheduled to be harvested in early 2022 by Forestry Corporation of NSW. Harvesting of this plantation will be conducted under a separate approval process (to the extent required).

Site establishment works and preparation for construction would include:

- Clearing of vegetation and grubbing to remove tree stumps within the forestry area.
- Civil works for site leveling within the BESS area, 330 kV switchyard and ancillary areas. The site is anticipated to have a neutral cut and fill volume.
- Installation of temporary environmental controls such as water management infrastructure.
- Establishment of a temporary construction compound within the construction footprint including demountable offices and amenities, storage sheds (shipping containers) and fabrication area.
- Establishment of a laydown area for materials such as cable drums, fill, gravel, road base, etc.
- Construction of access tracks and fencing.
- Surveying and investigation of onsite conditions to implement the final design on-site.

Formalisation of the site entrance off Castlereagh Highway would also be undertaken during the site preparation phase. This would comprise widening of the mouth of the intersection and upgrading / paving the entry of the access road for around 40 metres to prevent tracking of gravel onto the highway.

3.2.2 Construction stages

Following completion of the site establishment and preparation works construction of the Project would commence and is anticipated to include:

- Trenching and installation of cable from the battery to 33/330 kV switchyard.
- Installation of footings for battery enclosures, inverters, switch rooms and transformers, including pilings and concrete.
- Delivery, installation and fit out of the BESS including battery modules, inverters and MV transformers. BESS components are largely prefabricated and will be lifted directly into place from the delivery vehicle.
- Delivery, installation and fit out of transformers and switchgear for 33/330 kV switchyard.

- Construction of ancillary elements including, offices and amenities, installation of services, water and sewage management, fire systems and signage.
- Installation of permanent fencing and security systems.
- Testing and commissioning.
- Removal of construction equipment and materials and rehabilitation of construction areas (where applicable).

3.2.3 Construction program

Construction would begin as soon as practicable after all regulatory approvals are obtained and would take about 12 to 24 months to complete. The peak construction period would last between nine and 15 months.

The Project assumes that the entire 500 MW BESS would be constructed within a single continuous construction period. However, the Project may be staged as necessary to meet market conditions. Potential staging could be:

- Stage 1 – Consisting of 250 MW / 500 MWh with construction commencing as soon as practicable after all regulatory approvals are obtained
- Stage 2 – Consisting of 100 MW / 200 MWh with construction commencing in 2024
- Stage 3 – Consisting of 150 MW / 300 MWh with construction commencing in 2026.

Note that the above stages are indicative only. Staging activities would be limited to the BESS facility. The final built form of the 33/330 kV switchyard, the transmission line and the ancillary facilities would be constructed as part of Stage 1 in all staging scenarios.

The construction of each stage of the battery would take between 10 – 12 months and comprise construction of BESS footings, delivery, installation and fit out of BESS and, testing and commissioning. A worst-case scenario of the full capacity BESS being constructed in one stage has been assumed. For the purposes of this TIA, a construction program of start date 2022 and completion date 2024 is used.

3.2.4 Construction hours

Construction works would generally be undertaken during standard daytime construction working hours, being:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturdays
- No works on Sundays or public holidays.

Notwithstanding this, deliveries using oversize vehicles may need to be undertaken outside of these hours. Key stakeholders would be informed prior to out of hours activities.

In addition to the above, outside of hours works may also include:

- Emergency work to avoid the loss of lives, property and/or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or consideration of worker safety does not allow work within standard construction hours
- Public infrastructure works that shorten the length of the project and are supported by noise-sensitive receivers
- Construction works where it can be demonstrated and justified that these works are required to be undertaken outside of standard construction hours

3.2.5 Construction compounds

A temporary compound would be required to support construction of the Project. The compound is anticipated to be established east of the BESS pad.

It is anticipated that the compound area would contain the following:

- Site office and amenities
- Staff parking areas
- Fabrication area
- Equipment and vehicle storage areas
- Laydown areas for construction materials (e.g. cable drums, fittings, gravel road base)
- Stockpiling of excavated materials and soil
- Bunded fuel storage areas.

The construction compound would be temporary in nature and removed / decommissioned at the completion of construction. Where the construction compound is not situated within the footprint of the operational area it would be rehabilitated to the pre-construction standard upon completion of the works.

In the event that other compounds are required, the following site selection criteria would be applied to their location:

- Access to the local road network
- Relatively level land
- Greater than 50 metres from a watercourse
- Greater than 50 metres from threatened species and endangered ecological communities
- Greater than 100 metres from a residential dwelling
- No requirement to remove any native vegetation beyond that otherwise being undertaken for the Project
- No requirement to undertake any significant ground disturbing works
- No impact on any heritage items (Indigenous or non-Indigenous)
- Not unreasonably affect the land use of adjacent properties.

Consideration of all of the above factors would be undertaken prior to the establishment of any additional construction compound or stockpiles for the purpose of the Project.

3.2.6 Construction plant and equipment

The plant and equipment that are likely to be used during the construction of the Project are summarised in Table 3-1.

Table 3-1 Construction plant and equipment

Activity	Equipment	
Earthworks	• Front end loaders • Dump trucks • Road trucks	• Graders • Compactors • Water trucks

Activity	Equipment	
	• Excavators	
Trenching / construction of BESS / fit out / drainage and utilities	• Concrete trucks • Elevated work platforms • Cranes • Concrete saws and grinders • Compactors and rollers • Scrapers • Backhoe	• Bobcats • Telehandlers • Forklifts • Twin-cab utes • Cable laying machine and/or cable winch • Generators • Welders.

3.2.7 Construction traffic

3.2.7.1 Construction traffic movements

Vehicles associated with construction works would include light vehicles (workers travelling to and from the Project Site at the start and finish of shifts) and heavy vehicles delivering / removing construction materials and battery components.

The construction contractor may provide communal transport for transport construction workers to the Project construction site each day for safety and convenience. This procedure would be detailed in the Construction Environmental Management Plan (CEMP).

Heavy vehicles would deliver equipment and battery components and would also be used for the removal of waste material resulting from construction activities. Over Size Over Mass (OSOM) vehicles would also be required for the delivery of transformers and switchgear during construction (up to 36 metres).

The majority of construction and delivery traffic would be approach from the south, predominantly coming from Lithgow, Bathurst and Sydney (Port Kembla or Port Botany). Construction traffic movements based on worst case scenario are anticipated to comprise:

- Up to 100 two-way light vehicle movements per day (total of 100 light vehicle movements per day in both directions), associated with workers coming to site.
- Up to 20 two-way heavy vehicle movements per day (total of 20 heavy vehicle movements per day in both directions), associated with transport of equipment, and materials including batteries.
- Up to 36 OSOM movements across the construction period.

Heavy vehicle movements associated with the transport of equipment and materials including batteries would predominantly be from the south. Battery components could be brought in from Port Kembla or Port Botany using the Great Western Highway through the Blue Mountains. Only semi-trailers (19m) are allowed on the Great Western Highway through the Blue Mountains. A potential transport route from Port Kembla to the project site is shown in Figure 3-1.

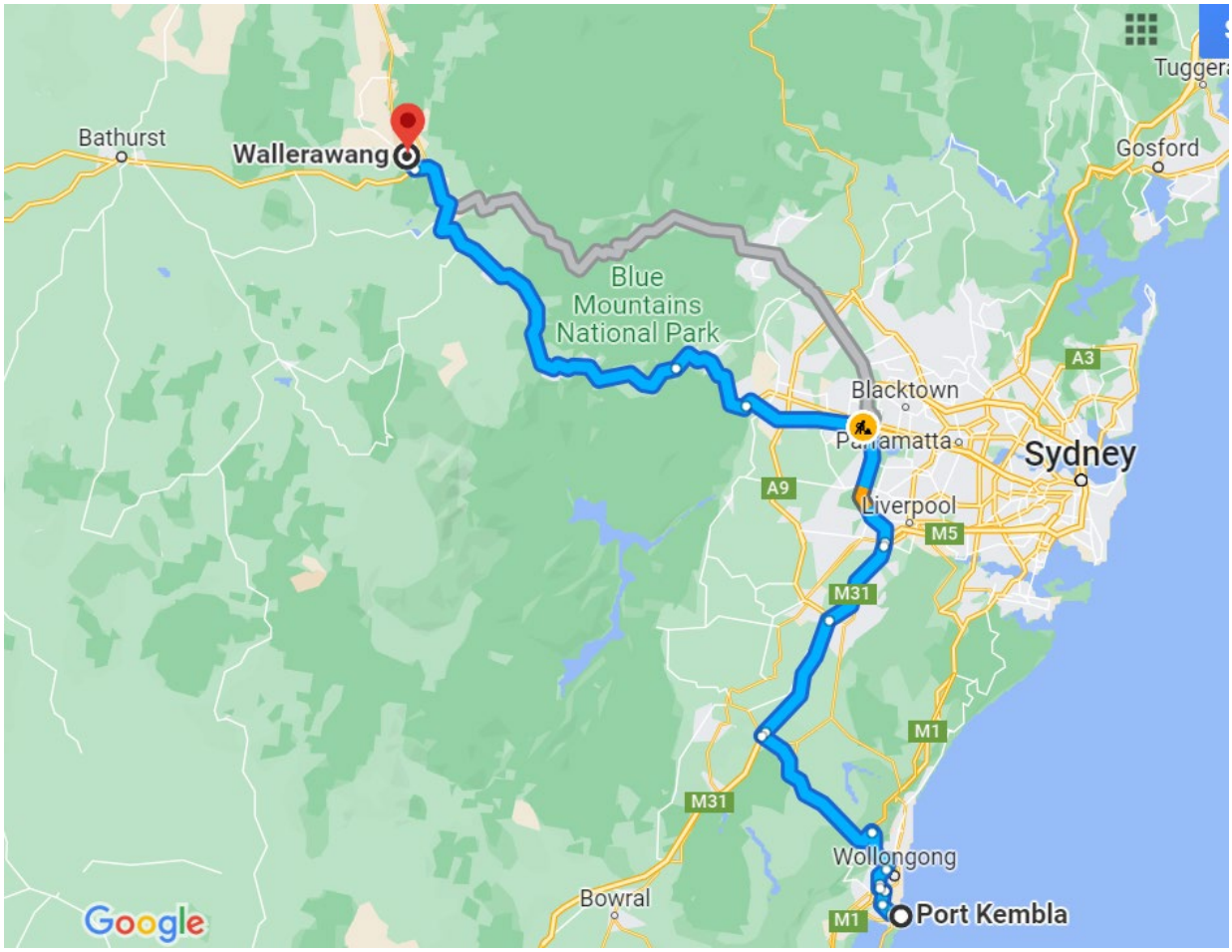


Figure 3-1 Potential transport route from Port Kembla to the project site (Source: Google Maps)

OSOM movements would be scheduled outside of peak periods where feasible and may occur outside of standard construction hours. To assess the worst-case scenario, the OSOM movements were assumed to be required for:

- 12 MV transformer deliveries over the construction period during standard construction hours.
- 20 MV switchgear deliveries over the construction period during standard construction hours.
- Up to four HV transformer deliveries.

These movements would be undertaken in accordance with applicable licences and permits. The proposed haulage routes would be addressed in a comprehensive Construction Traffic Management Plan with appropriate permits applied for with TfNSW as nominated by the contractor in the subsequent stages of the project.

3.2.8 Construction workforce

It is anticipated that up to 100 personnel a day would be required during the peak construction periods of the Project. The construction workforce would include (but not be limited to) the following:

- Tradespeople and construction personnel
- Sub-contractor construction personnel
- Engineers
- Functional and administrative staff.

The workforce required for the construction stages would be drawn from the surrounding population including Wallerawang, Lidsdale, Cullen Bullen, Capertee in the north, Bathurst in the west and Lithgow in the south. It is also worth noting that the majority of accommodation facilities are located to the south, so any non-local workers who are on site are significantly more likely to travel from the south.

Based on this and on the population distribution shown below in Table 3-2, it is envisaged that the bulk (95%) of the workforce will come from the south and 5% from the north.

Table 3-2 Population of Surrounding Towns (Source: Australian Bureau of Statistics)

Nearby towns north of project site	Population (*)	Percentage (%)
Wallerawang	1,980	
Capertee	145	
Cullen Bullen	279	
Lidsdale	429	
Sub-total A	***2,833***	***5%***
Nearby towns south of project site	Population (*)	Percentage (%)
Bathurst LGA	41,300	
Lithgow LGA (minus Sub total A)	18,257	
Sub-total B	***59,557***	***95%***
Grand Total	**62,390**	**100%**

Note: (*) Australian Bureau of Statistics

3.3 Operation

The Project would be operational 24 hours, seven days a week. The Project would generally be managed and monitored remotely with the exception of site maintenance. Ongoing operation would require up to five operational personnel.

During operations, activities on site would generally comprise:

- Storage of electricity and changing from and discharging to the broader electricity grid as required to meet the strategic objectives of the Project.
- Routine inspections.
- Repair and maintenance of the Project Site including fencing, roads, water infrastructure and environmental controls. Management of vegetation and pests would also be undertaken.
- Repair and maintenance of Project infrastructure such as battery enclosures, inverters, transformers, cables and substations.
- Ongoing security monitoring.

3.3.1 BESS replacement and decommissioning

The BESS units have a design life of 15-20 years. Remaining operational infrastructure has a design life of 30-40 years. It is expected that with improved technology, the battery units would be upgraded and be maintained to extend the

life of the BESS. Any wholescale repowering would seek to make use of the existing foundations, connections and switchyard and would generally comprise swapping out and recommissioning BESS containers.

If a battery unit faults and is beyond repair, the unit would be removed and recycled for materials, where practicable. In the case of a full decommissioning of the BESS, the Project Site would be repurposed for other industrial uses as determined by the Proponent.

3.4 Project traffic generation

3.4.1 Construction traffic generation

As mentioned in Section 3.2.7 construction traffic movements based on worst case scenario are anticipated to comprise:

- Up to 100 two-way light vehicle movements per direction per day associated with workers coming to site.
- 20 two-way heavy vehicle movements per day per direction, associated with transport of equipment, and materials including batteries.
- 36 OSOM movements each way across the construction period.

Light vehicle movements would be associated with workers travelling to and from the Project Site and would occur about an hour before / leading up to the start of each shift at 7 am. As such, light vehicle volumes would traverse the road network outside of background peak hour conditions.

Heavy vehicle movements associated with the transport of equipment, materials and batteries would be uniformly distributed across the shift periods. This would entail two heavy vehicle trips per hour which is envisaged to coincide with background peak hour conditions. The majority of construction and delivery traffic would approach from the south, predominantly coming from Lithgow, Bathurst and Sydney (Port Kembla or Port Botany).

It is considered that the impact of the construction generated traffic on the operational performance of intersections and road links would be minimal and only account for two additional heavy vehicle trips during background AM and PM peak hours.

3.4.2 Operational traffic generation

During operation of the Proposal (i.e. following the completion of the construction stage), the estimated workforce would consist of a small number of workers (i.e. approximately 5 staff). In a worst-case scenario if all workers travel alone, this will equate to 5 (two way) vehicle trips per day. It is expected that there may be some irregular heavy vehicle movements during the operational stage such as replacing of transformers, etc. This would however constitute very low vehicle volumes. It is considered that operational generated traffic would be negligible from a traffic engineering or transport planning perspective.

3.5 Vehicle access

This section of the report describes the access which are to be used during both construction and operational stages of the Project.

3.5.1 Construction access

Access to and egress from the Wallerawang BESS site during construction would use the unnamed access road from Castlereagh Highway. The site entrance off Castlereagh Highway would be formalised during the site preparation phase to accommodate construction traffic generated by the Project.

This would comprise widening of the mouth of the intersection and upgrading / paving the entry to the access road and up to around 40 metres into the site to prevent tracking of gravel onto the highway. The location of the access which would be used during the construction phase is shown in Figure 3-2.

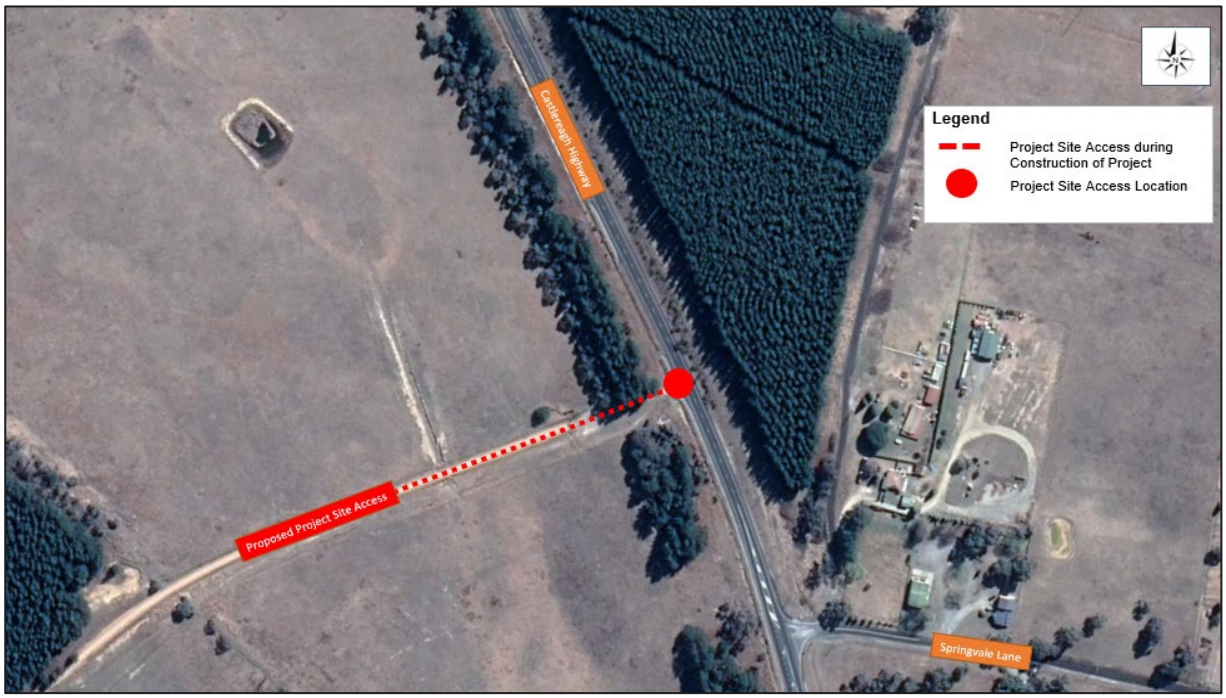


Figure 3-2 Access to Project Site During Construction Phase

Detail on the proposed construction access and how the design has been determined is provided in Section 4.1 of this TIA.

3.5.2 Operational access

The unnamed access road from Castlereagh Highway used during the construction phase would also be used as the main operational entry point for vehicles (refer to Section 8 of this EIS). The access location shown in Figure 3-3 provides details of the proposed site access to be used during the operational phase.

Figure 3-3 Access to Project Site During Operational Phase

The access of the Project Site to Castlereagh Highway would remain priority controlled which features relatively low volumes of through and turning vehicles during the operational phase. Table 3-3 provides details regarding the proposed site access.

Table 3-3 Site Access Details

Access No.	Co-Ordinates / Approximate Chainage	Location	Access Type	Description of access requirements during construction
1	33°24'28.47"S 150° 5'49.82"E	Castlereagh Highway, 195m north of Springvale Lane	Permanent Access	Delivery of construction materials and workforce movements, including Over Size Over Mass vehicles. Workforce movements during operational stage

3.6 Parking provision

Temporary staff parking would be provided on site during the construction stage. Parking opportunities would be recorded within a detailed Construction Traffic Management Plan which also designates parking locations to be used during the construction stage.

Formal parking locations to accommodate the operational stage maintenance workforce are assumed to be provided in line with relevant planning scheme standards as well as design requirements contained in Australian Standards 2890.1: *Off-streetcar parking provision* (AS2890.1) and Australian Standards 2890.2: *Off-street commercial vehicle facilities* (AS2890.2).

4 IMPACT ASSESSMENT

This section of the report describes the impact assessment and associated findings of both the construction and operational phases of the Project, on the surrounding road network and other modes of transport.

4.1 Construction phase

The impact assessment evaluates the following items during the construction phase of the Project:

- Impact on intersections
- Impact on road link capacity (Castlereagh Highway)
- Access and frontage analysis.

4.1.1 Construction phase intersection impact assessment

Generally, unsignalised intersections with minor roads with relatively low volumes of through and turning vehicles are not capacity constrained and detailed analysis of capacity is not warranted as indicated in the R*oad Planning and Design Manual Chapter 5, Traffic Parameters and Human Factors, 2004* guideline. As a guide, for a cross intersection with a two-lane, two-way road, capacity analysis is not considered to be warranted when the maximum hourly volumes are below:

- Major road 400 vehicles per hour, minor road 250 vehicles per hour
- Major road 500 vehicles per hour, minor road 200 vehicles per hour
- Major road 650 vehicles per hour, minor road 100 vehicles per hour.

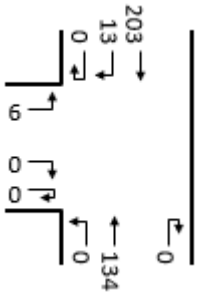
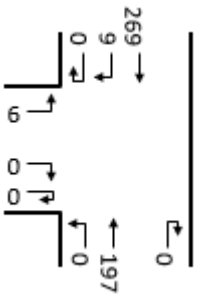
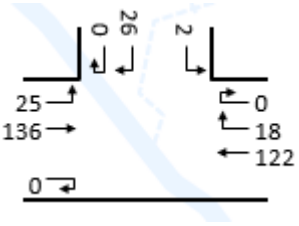
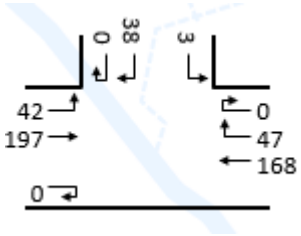
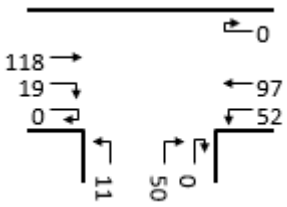
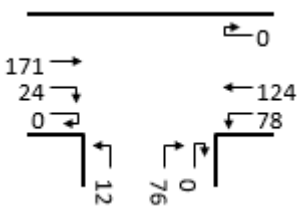
The traffic survey data (as described in Section 2.7.3) indicated that background peak hours occurred during 7:45 – 8:45 for the AM peak hour and 15:15 – 16:15 for the PM peak hour.

Comparison between the threshold volumes and the peak hourly volumes at the key intersections have been carried out which have been assessed for the following scenarios:

- Base Year 2021 AM and PM peak hour traffic conditions
- Construction Year 2022 AM and PM peak hour traffic conditions
- Construction Year 2023 AM and PM peak hour traffic conditions
- Construction Year 2024 AM and PM peak hour traffic conditions

Peak hour turning movement traffic volumes as recorded for base year 2021 at the key intersections are indicated in Table 4-1 below.

Table 4-1 Base Year 2021 Peak Hour Turn Movement Volumes

Intersection	Location	AM Peak Volumes (Base Year 2021)	PM Peak Volumes (Base Year 2021)
Castlereagh Highway / Great Western Highway			
Castlereagh Highway / Wolgan Road			
Castlereagh Highway / Main Street			

The expected construction generated volumes of two heavy vehicle movements during both AM and PM peak hours is considered to be negligible and would not have an impact on road network performance. A warrant criteria assessment of base year 2021 traffic conditions has been carried out as indicated in Table 4-2.

Table 4-2 Warrant Criteria Assessment – Intersection capacity of base year 2021 conditions

Intersection	Major Road Volume	Minor Road Volume	Warrant Criteria Achieved (Y/N)
Castlereagh Highway / Great Western Highway	AM Peak Hour: 350 veh/h PM Peak Hour: 475 veh/h	AM Peak Hour: 6 veh/h PM Peak Hour: 6 veh/h	Y
Castlereagh Highway / Wolgan Road	AM Peak Hour: 301 veh/h PM Peak Hour: 454 veh/h	AM Peak Hour: 28 veh/h PM Peak Hour: 41 veh/h	Y
Castlereagh Highway / Main Street	AM Peak Hour: 286 veh/h PM Peak Hour: 397 veh/h	AM Peak Hour: 61 veh/h PM Peak Hour: 88 veh/h	Y

It was found that all intersections meet the warrant criteria as indicated in Table 4-2, and that detailed capacity analyses of the intersections at base year 2021 conditions would not be required.

A warrant assessment has also been carried out for background traffic during construction year 2022 and year 2023 to coincide with the envisaged construction schedule. The traffic growth rate of 3.7% have been used as previously indicated to Project future year volumes. The warrant assessment results for year 2022 of construction is illustrated in Table 4-3.

Table 4-3 Warrant Criteria Assessment – Intersection capacity of construction year 2022 conditions

Intersection	Major Road Volume	Minor Road Volume	Warrant Criteria Achieved (Y/N)
Castlereagh Highway / Great Western Highway	AM Peak Hour: 360 veh/h PM Peak Hour: 489 veh/h	AM Peak Hour: 6 veh/h PM Peak Hour: 6 veh/h	Y
Castlereagh Highway / Wolgan Road	AM Peak Hour: 310 veh/h PM Peak Hour: 468 veh/h	AM Peak Hour: 29 veh/h PM Peak Hour: 42 veh/h	Y
Castlereagh Highway / Main Street	AM Peak Hour: 294 veh/h PM Peak Hour: 409 veh/h	AM Peak Hour: 62 veh/h PM Peak Hour: 90 veh/h	Y

It was found that all intersections meet the warrant criteria as indicated in Table 4-3, and that detailed capacity analyses of the intersections at construction year 2022 conditions would not be required, even with an additional two heavy vehicle volumes generated by the construction phase in year 2022. The warrant assessment results for year 2023 of construction are shown in Table 4-4.

Table 4-4 Warrant Criteria Assessment – Intersection capacity of construction year 2023 conditions

Intersection	Major Road Volume	Minor Road Volume	Warrant Criteria Achieved (Y/N)
Castlereagh Highway / Great Western Highway	AM Peak Hour: 371 veh/h PM Peak Hour: 503 veh/h	AM Peak Hour: 6 veh/h PM Peak Hour: 6 veh/h	Y
Castlereagh Highway / Wolgan Road	AM Peak Hour: 319 veh/h PM Peak Hour: 481 veh/h	AM Peak Hour: 29 veh/h PM Peak Hour: 43 veh/h	Y
Castlereagh Highway / Main Street	AM Peak Hour: 303 veh/h PM Peak Hour: 420 veh/h	AM Peak Hour: 64 veh/h PM Peak Hour: 93 veh/h	Y

It was found that all intersections meet the warrant criteria as indicated in Table 4-4, and that detailed capacity analyses of the intersections at construction year 2023 conditions would not be required, even with an additional two heavy vehicle volumes generated by the construction phase in year 2023.

The warrant assessment results for year 2024 of construction are shown in Table 4-5.

Table 4-5 Warrant Criteria Assessment – Intersection capacity of construction year 2024 conditions

Intersection	Major Road Volume	Minor Road Volume	Warrant Criteria Achieved (Y/N)
Castlereagh Highway / Great Western Highway	AM Peak Hour: 382 veh/h PM Peak Hour: 519 veh/h	AM Peak Hour: 7 veh/h PM Peak Hour: 7 veh/h	Y
Castlereagh Highway / Wolgan Road	AM Peak Hour: 328 veh/h PM Peak Hour: 519 veh/h	AM Peak Hour: 31 veh/h PM Peak Hour: 45 veh/h	Y

Intersection	Major Road Volume	Minor Road Volume	Warrant Criteria Achieved (Y/N)
Castlereagh Highway / Main Street	AM Peak Hour: 312 veh/h PM Peak Hour: 433 veh/h	AM Peak Hour: 66 veh/h PM Peak Hour: 96 veh/h	Y

It was found that all intersections meet the warrant criteria as indicated in Table 4-5, and that detailed capacity analyses of the intersections at construction year 2024 conditions would not be required, even with an additional two heavy vehicle volumes generated by the construction phase in year 2024.

4.1.2 Construction phase road link capacity impact analysis

A road link capacity impact analysis has been undertaken of Castlereagh Highway. The typical roadway capacity of a two-lane highway is 1700 passenger car units per hour (pcu/h/direction) according to Austroads Guide to Traffic Management Part 3, Traffic Analysis (Austroads, 2020). As such the existing volume to capacity ratio under base year 2021 conditions are:

- Volume to capacity ratio of 0.20 (350/1700) during the AM peak hour
- Volume to capacity ratio of 0.27 (475/1700) during the PM peak hour

There is a surplus of 80% roadway capacity remaining during base year 2021 AM peak hour conditions and 73% of roadway capacity remaining during base year 2021 PM peak hour conditions. An assessment of the impact on road capacity during construction year 2022, construction year 2023 and construction year 2024 is shown in Table 4-6.

Table 4-6 Construction Phase Road Link Capacity Impact

Construction Year	AM Peak Hour	PM Peak Hour	Spare Capacity (%)
2022	Volume to Capacity Ratio: 0.21	Volume to Capacity Ratio: 0.28	AM Peak Hour - 79% PM Peak Hour - 72%
2023	Volume to Capacity Ratio: 0.21	Volume to Capacity Ratio: 0.29	AM Peak Hour - 79% PM Peak Hour - 71%
2024	Volume to Capacity Ratio: 0.22	Volume to Capacity Ratio: 0.30	AM Peak Hour - 78% PM Peak Hour - 70%

It is considered that there would not be any impact on roadway capacity of Castlereagh Highway during the construction phase of the Project.

4.1.3 Access and frontage

The access and frontage analysis evaluates the proposed access by means of a turn warrant assessment, absorption capacity, vehicle delay assessment and sight distance assessment.

4.1.3.1 Turn lane warrant assessment

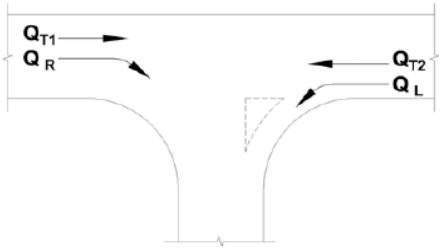
An assessment has been undertaken of the appropriate treatments for the access proposed for construction vehicles, based upon the provisions of *Austroads Guide to Road Design - Part 4A: Unsignalised and Signalised Intersections, Section 4.8 (Warrants for BA, AU and CH Turn Treatments)*. The turning movement volumes for the Project Site access shown in Appendix A have been used as the basis of this assessment, with figures recording the results of this assessment shown in Appendix B. The turn lane warrant assessment was carried out for the following scenarios:

- Construction Year 2022 AM and PM peak hour traffic conditions
- Construction Year 2023 AM and PM peak hour traffic conditions
- Construction Year 2024 AM and PM peak hour traffic conditions.

A summary of the turn lane warrant analysis for the design horizons 2022, 2023 and 2024 are indicated through Table 4-7 to Table 4-12, respectively.

Table 4-7 Turn Lane Warrant Assessment –Construction year 2022 AM Peak hour conditions

Q_{T1}=	393		Q_{T2}=	145	Splitter Island?	No
Q_R=	0		Q_L=	2	Speed Limit?	>=100km/h



	Q_M	Q_R/Q_L
Right	540	0
Left	145	2

Right Turn Treatment Required	BAR
Left Turn Treatment Required	BAL

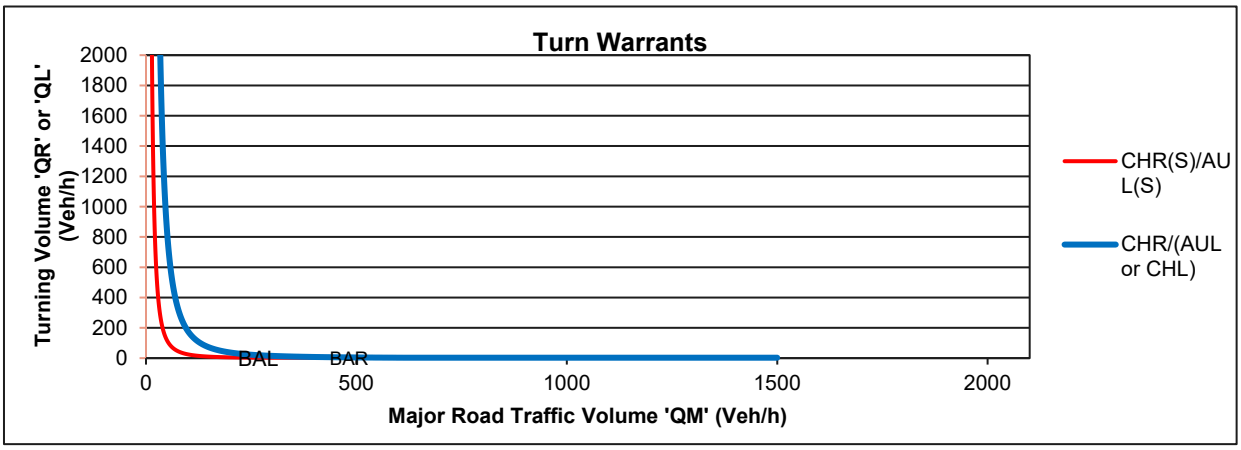
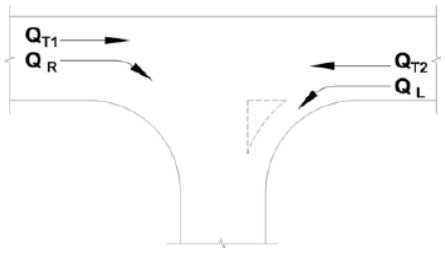


Table 4-8 Turn Lane Warrant Assessment –Construction year 2022 PM Peak hour conditions

Q_{T1}=	288		Q_{T2}=	211	Splitter Island?	No
Q_R=	0		Q_L=	2	Speed Limit?	>=100km/h



	Q_M	Q_R/Q_L
Right	501	0
Left	211	2

Right Turn Treatment Required	BAR
Left Turn Treatment Required	BAL

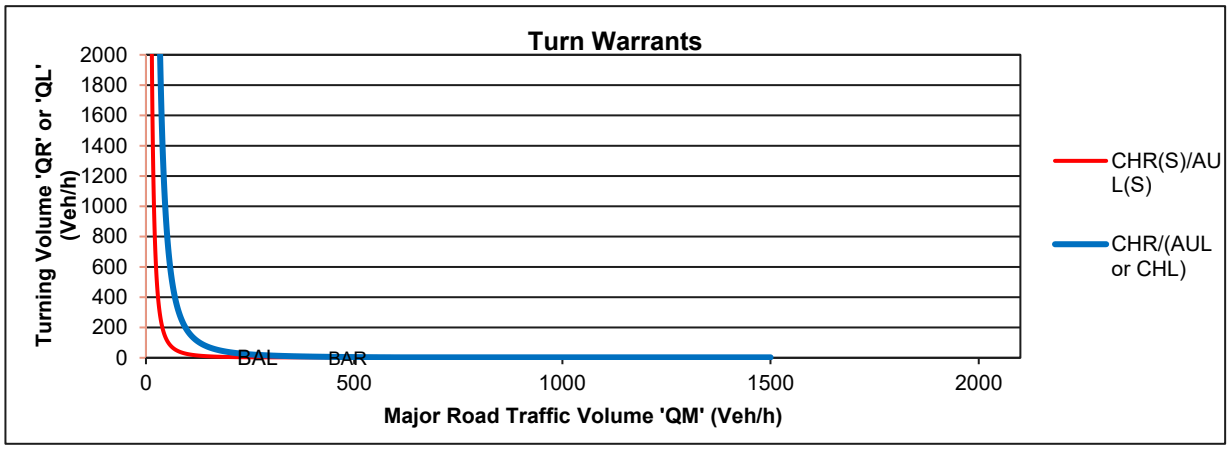
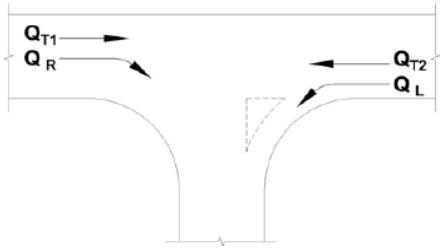


Table 4-9 Turn Lane Warrant Assessment –Construction year 2023 AM Peak hour conditions

Q_{T1}=	232		Q_{T2}=	151	Splitter Island?	No
Q_R=	0		Q_L=	2	Speed Limit?	>=100km/h



	Q_M	Q_R/Q_L
Right	385	0
Left	151	2

Right Turn Treatment Required	BAR
Left Turn Treatment Required	BAL

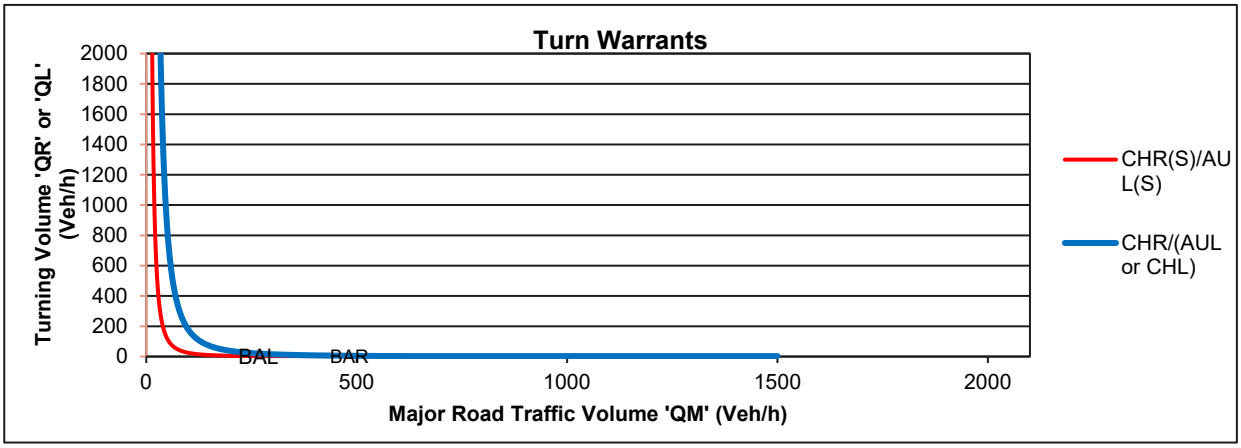
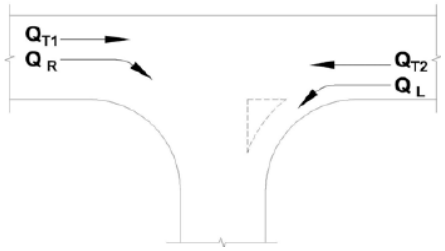


Table 4-10 Turn Lane Warrant Assessment –Construction year 2023 PM Peak hour conditions

Q_{T1}=	299	Q_{T2}=	218	Splitter Island?	No
Q_R=	0	Q_L=	2	Speed Limit?	>=100km/h



	Q_M	Q_R/Q_L
Right	519	0
Left	218	2

Right Turn Treatment Required	BAR
Left Turn Treatment Required	BAL

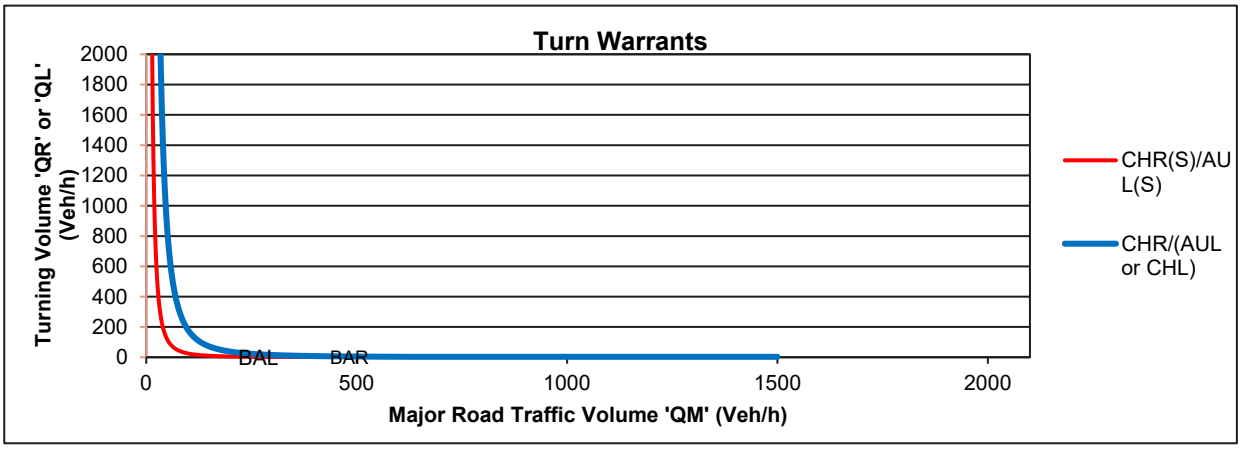
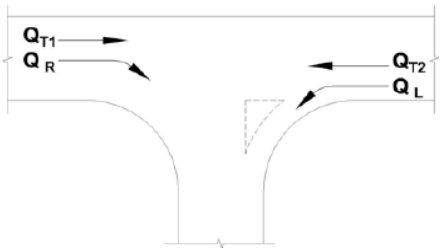


Table 4-11 Turn Lane Warrant Assessment –Construction year 2024 AM Peak hour conditions

Q_{T1}=	241	Q_{T2}=	156	Splitter Island?	No
Q_R=	0	Q_L=	2	Speed Limit?	>=100km/h



	Q_M	Q_R/Q_L
Right	399	0
Left	156	2

Right Turn Treatment Required	BAR
Left Turn Treatment Required	BAL

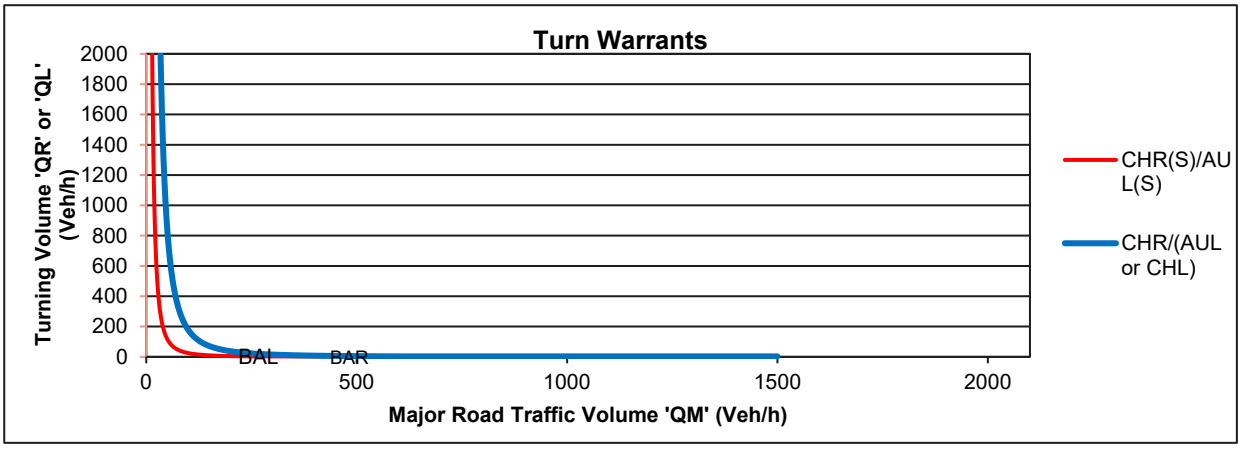
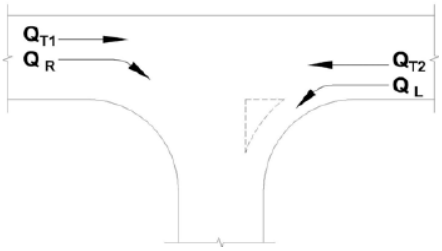


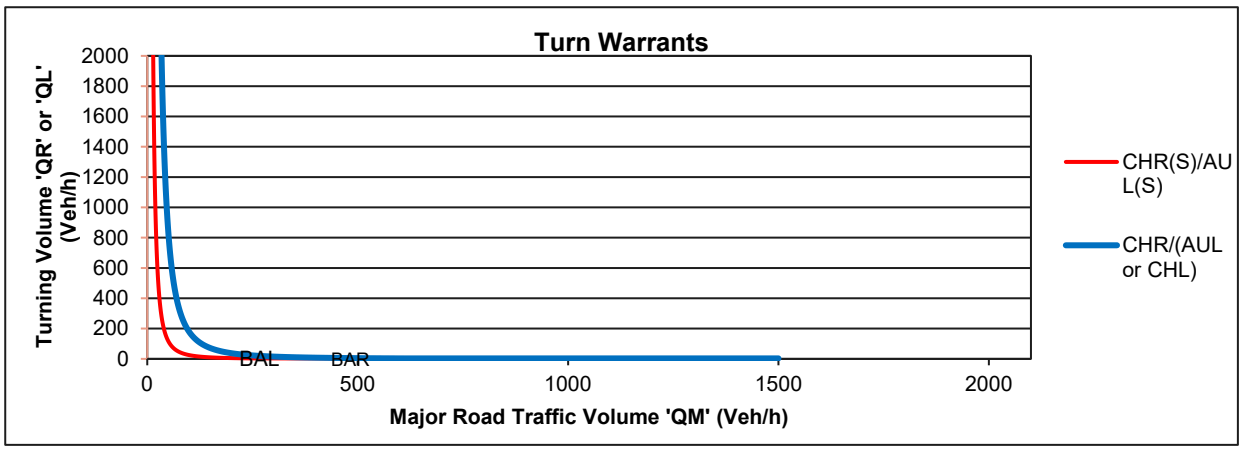
Table 4-12 Turn Lane Warrant Assessment –Construction year 2024 PM Peak hour conditions

Q_{T1}=	310	Q_{T2}=	226	Splitter Island?	No
Q_R=	0	Q_L=	2	Speed Limit?	>=100km/h



	Q_M	Q_R/Q_L
Right	538	0
Left	226	2

Right Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Based on the expected peak hour traffic volumes, the turn warrants assessment shows that a basic left turn (BAL) treatment and basic right turn (BAR) treatment would be sufficient for the access to accommodate the construction stage turn movement volumes.

Figure 4-1 shows the turn treatment requirements for rural accesses.

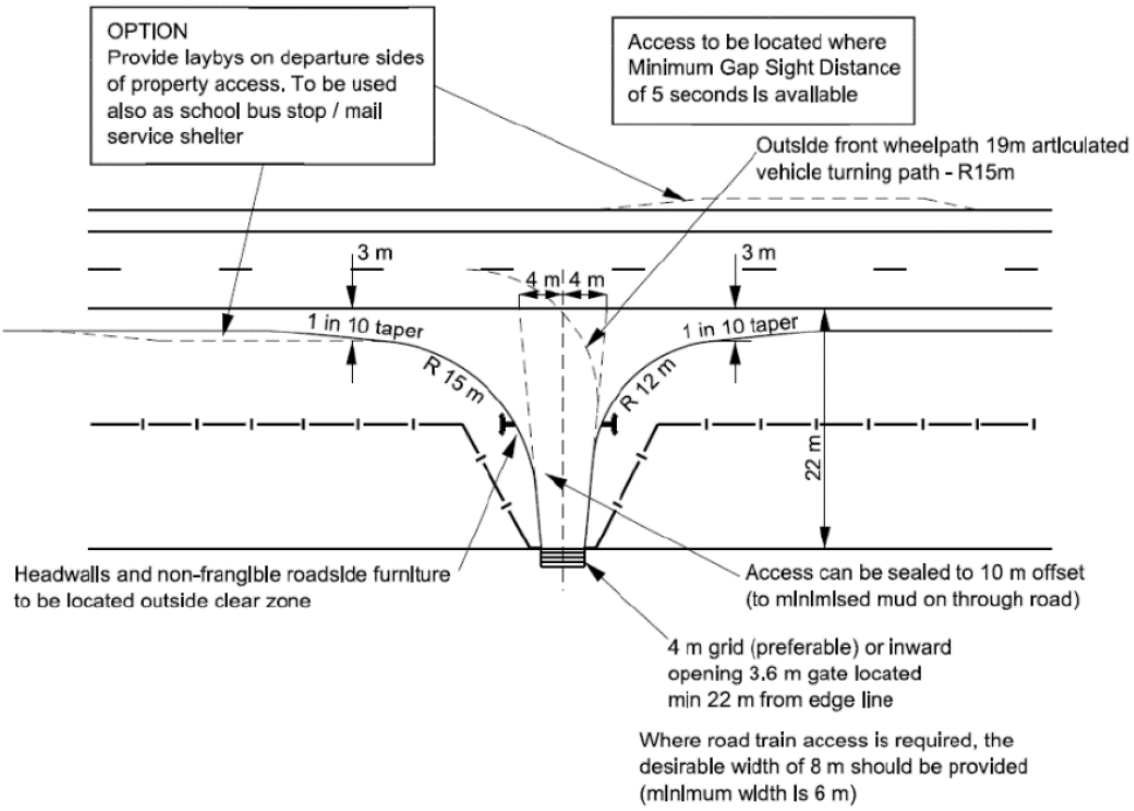


Figure 4-1 Rural access requirements

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

4.1.3.2 Proposed access layout

At the time of preparing the EIS, it was determined that dedicated turn lanes for the access during the construction phase are not required. However, the Project Site access would be formalised to accommodate for the largest design vehicle expected to use the access during construction (for regular use) which is considered to be a B-Double.

Formalising the access would also require minor pavement widening to allow for lateral movements of vehicles when decelerating into the access.

The proposed layout and pavement widening extents confirmed in the EIS incorporating Austroads Guide to Road Design (AGRD) Part 4 requirements, are indicated in Figure 4-2 and Appendix C.

Based on the proposed layout, a vehicle swept path assessment was carried out to determine whether the largest regular design vehicle (B-Double – 26 metres) would be contained within the configuration. The vehicle swept path is shown in Figure 4-3. A vehicle swept path assessment was also carried out for 36.2 metre A-Double OSOM vehicle and is shown in Figure 4-4.

As shown, the proposed layout of the access would be sufficient to accommodate the required design vehicle turn path requirements for both the B-doubles and the OSOM vehicles.

Following consultation with TfNSW during the response to submission phase, it was agreed that further sensitivity testing was undertaken to examine the required intersection treatment for the worst-case scenario. This testing resulted in a minor amendment to the proposed intersection layout. Details of this sensitivity testing is provided in Section 4.1.5 and the minor layout changes are shown in Figure 4-12.

Figure 4-2 Proposed EIS Access Arrangement

Figure 4-3 B-Double Vehicle Swept Path

Figure 4-4 OSOM 36 metre Vehicle Swept Path

4.1.3.3 Absorption capacity assessment

An absorption capacity assessment was conducted to calculate the average delay expected to be experienced by construction vehicles entering Castlereagh Highway from the proposed access. Absorption capacity in vehicles per hour can be defined as the maximum number of minor stream vehicles that can cross or enter the major stream flow for a single lane random flow. The equation[1] is:

$$C = \frac{(3600 \times qp) \times \exp(-qp \times ta)}{1 - (\exp(-qp \times tf))}$$

Where:

C = Absorption capacity (veh/h)
Cp = Practical absorption capacity (veh/h)
qp = Major stream flow (veh/sec)
tf = Follow-up headway (s)
ta = Critical gap (s)

As described previously in the report, the majority of construction and delivery traffic would be coming from the south, predominantly from Lithgow, Bathurst and Sydney. As such it was assumed that all peak hour construction vehicles (two during the AM peak and two during the PM peak) would enter the through a left turn movement from Castlereagh Highway and exit the access through a right turn movement to Castlereagh Highway. As the left turn movement is unobstructed, it would only be the right turn movement which would experience an impact on delay as construction vehicles would access and exit to the south. The analysis was done for the following scenarios:

- Scenario 1 - Construction Year 2022 AM and PM Peak Hours
- Scenario 2 - Construction Year 2023 AM and PM Peak Hours
- Scenario 3 - Construction Year 2024 AM and PM Peak Hours.

Table 4-13 shows the practical absorption capacity of the Project Site access, based on major stream traffic volumes, critical gap acceptance and follow-up headway parameters for Scenario 1.

Table 4-13 Scenario 1 practical absorption capacity

Construction Year 2022 Access AM Peak Hour Absorption Capacity Analyses		
Units		Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.10
Critical Gap Acceptance Required (s)	ta	5
Follow-up Headway (s)	tf	3
Constant	e	2.7183
Equation	qpe^(-qpta)	217.1
Equation	1-e^-qptf	0.3
Absorption Capacity (C)		846
Absorption Capacity (Cp)		677
Demand flow (veh/h)		2

[1] *Traffic Engineering & Management* (Ogden, K.W & Taylor, S.Y, 1996 - Section 5.1, p422 Department of Civil Engineering, Monash University) as well as in the *Road Planning and Design Manual* (Department of Transport and Main Roads, October 2006).

Construction Year 2022 Access AM Peak Hour Absorption Capacity Analyses Construction Year 2022 Access PM Peak Hour Absorption Capacity Analyses		
Units		Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.13
Critical Gap Acceptance Required (s)	ta	5
Follow-up Headway (s)	tf	3
Constant	e	2.7183
Equation	qpe^(-qpta)	246.6
Equation	1-e^-qptf	0.3
Absorption Capacity (C)		747
Absorption Capacity (Cp)		597
Demand flow (veh/h)		2

As shown in Table 4-13 the proposed accesses would allow for sufficient absorption capacity to accommodate for the construction phase traffic demand during both AM and PM peak hours in the construction year 2022 scenario.

Table 4-14 shows the practical absorption capacity of the accesses, based on major stream traffic volumes, critical gap acceptance and follow-up headway parameters for Scenario 2.

Table 4-14 Scenario 2 practical absorption capacity

Construction Year 2023 Access AM Peak Hour Absorption Capacity Analyses		
Units		Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.11
Critical Gap Acceptance Required (s)	ta	5
Follow-up Headway (s)	tf	3
Constant	e	2.7183
Equation	qpe^(-qpta)	226.6
Equation	1-e^-qptf	0.3
Absorption Capacity (C)		819
Absorption Capacity (Cp)		655
Demand flow (veh/h)		2
Construction Year 2023 Access PM Peak Hour Absorption Capacity Analyses		
Units		Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.15
Critical Gap Acceptance Required (s)	ta	5
Follow-up Headway (s)	tf	3
Constant	e	2.7183
Equation	qpe^(-qpta)	253.2

Construction Year 2023 Access AM Peak Hour Absorption Capacity Analyses		
Equation	1-e^-qptf	0.4
Absorption Capacity (C)		715
Absorption Capacity (Cp)		572
Demand flow (veh/h)		2

As shown in Table 4-14 the proposed accesses would allow for sufficient absorption capacity to accommodate for the construction traffic demand during both AM and PM peak hours of the construction year 2023 scenario.

Table 4-15 shows the practical absorption capacity of the accesses, based on major stream traffic volumes, critical gap acceptance and follow-up headway parameters for Scenario 3.

Table 4-15 Scenario 3 practical absorption capacity

Construction Year 2024 Access AM Peak Hour Absorption Capacity Analyses		
Units		Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.11
Critical Gap Acceptance Required (s)	ta	5
Follow-up Headway (s)	tf	3
Constant	e	2.7183
Equation	qpe^(-qpta)	226.6
Equation	1-e^-qptf	0.3
Absorption Capacity (C)		819
Absorption Capacity (Cp)		655
Demand flow (veh/h)		2
Construction Year 2024 Access PM Peak Hour Absorption Capacity Analyses		
Units		Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.15
Critical Gap Acceptance Required (s)	ta	5
Follow-up Headway (s)	tf	3
Constant	e	2.7183
Equation	qpe^(-qpta)	253.2
Equation	1-e^-qptf	0.4
Absorption Capacity (C)		715
Absorption Capacity (Cp)		572
Demand flow (veh/h)		2

As shown in Table 4-15 the proposed accesses would allow for sufficient absorption capacity to accommodate for the construction traffic demand during both AM and PM peak hours of the construction year 2024 scenario.

4.1.3.4 Vehicle delay assessment

The average vehicle delay to be expected at the accesses for the ingress and egress movements were calculated based on the equations contained and adopted from the *Road Planning and Design Manual* (Department of Transport and Main Roads, October 2006). This is a universal industry accepted analysis procedure within the traffic engineering industry, used to calculate absorption capacity and average delay of an access. This represents the average delay which the minor movement would experience in order to enter or cross a major movement flow.

The equation can be found as:

$$Wm = \frac{(qpe^{qptf}\,(e^{qpta} - qpta - 1) + qme^{qpta}\,(e^{qptf} - qptf - 1))}{qp(qpe^{qptf} - qme^{qpta}\,(e^{qptf} - 1)}$$

Where:

Wm = Average dealy to minor stream vehicles (sec)
qp = Major stream flow rate (veh/s)
qm = Minor stream flow rate (veh/s)
tf = Follow-up Headway (s)
ta = Critical Gap (s)

Similar to Section 4.2.3, the analysis was done for the following scenarios:

- Scenario 1 - Construction Year 2022 AM and PM Peak Hours
- Scenario 2 - Construction Year 2023 AM and PM Peak Hours
- Scenario 3 - Construction Year 2024 AM and PM Peak Hours

Table 4-16 shows the expected average delays to be experienced by construction vehicles at each access for construction year 2022, Scenario 1.

Table 4-16 Scenario 1 vehicle delay assessment

Construction Year 2022 Analysis Results		
Units	AM Peak Hour Access Delay	PM Peak Hour Access Delay
	Right Turn Delay	Right Turn Delay
Minor stream flow (veh/h) Qm	2	2
Major stream flow (veh/h)Qp	356	481
Major stream flow (veh/s) qp	0.10	0.13
Minor stream flow (veh/s) qm	0.00	0.00
Critical Gap Acceptance Required (s) ta	5	5
Follow-up Headway (s) tf	3	3
Constants (e)	2.7183	2.7183
Wm (sec)	1.5	2.1

The access analysis results indicate that the construction traffic vehicles would experience insignificant levels of vehicle delay in order to enter the major stream traffic flow. The accesses would operate within acceptable levels of vehicle delay.

Table 4-17 shows the expected average delays to be experienced by construction vehicles at each access for final construction year 2023, Scenario 2.

Table 4-17 Scenario 2 vehicle delay assessment

Construction Year 2023 Analysis Results		
Units	AM Peak Hour Access Delay	PM Peak Hour Access Delay
	Right Turn Delay	Right Turn Delay
Minor stream flow (veh/h) Qm	2	2
Major stream flow (veh/h)Qp	389	526
Major stream flow (veh/s) qp	0.11	0.15
Minor stream flow (veh/s) qm	0.00	0.00
Critical Gap Acceptance Required (s) ta	5	5
Follow-up Headway (s) tf	3	3
Constants (e)	2.7183	2.7183
Wm (sec)	1.6	2.4

The access analysis results indicate that the construction traffic vehicles would experience insignificant levels of vehicle delay to enter the major stream traffic flow even at the final construction year of 2023, Scenario 2. The accesses would operate within acceptable levels of vehicle delay.

Table 4-18 shows the expected average delays to be experienced by construction vehicles at each access for final construction year 2024, Scenario 3.

Table 4-18 Scenario 3 vehicle delay assessment

Construction Year 2024 Analysis Results		
Units	AM Peak Hour Access Delay	PM Peak Hour Access Delay
	Right Turn Delay	Right Turn Delay
Minor stream flow (veh/h) Qm	2	2
Major stream flow (veh/h)Qp	389	526
Major stream flow (veh/s) qp	0.11	0.15
Minor stream flow (veh/s) qm	0.00	0.00
Critical Gap Acceptance Required (s) ta	5	5
Follow-up Headway (s) tf	3	3
Constants (e)	2.7183	2.7183
Wm (sec)	1.7	2.5

The access analysis results indicate that the construction traffic vehicles would experience insignificant levels of vehicle delay in order to enter the major stream traffic flow even at the final construction year of 2024, Scenario 3. The accesses would operate within acceptable levels of vehicle delay.

4.1.3.5 Gap acceptance probability

To determine the likelihood and probability of critical gaps available to allow for sufficient absorption capacity to prevail, a gap acceptance probability analysis was carried out. This is based on a negative poison exponential distribution. Similar to the previous analyses, the following scenarios were investigated:

- Scenario 1 - Construction Year 2022 AM and PM Peak Hours
- Scenario 2 - Construction Year 2023 AM and PM Peak Hours
- Scenario 3 - Construction Year 2024 AM and PM Peak Hours.

The gap acceptance probability analysis for the base year 2021 AM Peak hour conditions is provided in Table 4-19 and the PM peak hour conditions in Table 4-20.

Table 4-19 Construction Year 2022 AM peak hour gap acceptance probability analysis

Headway Distribution Analysis - Poisson Distribution (Construction Year 2022 AM Peak)			
Variable Inputs			
Unit of time	hour		
Arrival rate	356	vehicles per hour	
	0.098888889	vehicles per second	
Critical headway gaps required	5	seconds	
Outputs			
$P(n) = qt^{(n)}$ e-qt/n!	Probability of (n) vehicles arriving at time (t)	1	30.2%
		2	7.5%
		3	2.5%
$P(h>t) = e\text{-}qt$	Probability that no vehicles arrive at time (t)	61%	
$P(h<t) = 1\text{-}e\text{-}qt$	Cumulative probability of headways (s)	75%	14
		85%	19
		95%	31
Number of headways > 5 sec	0.61	217.1	

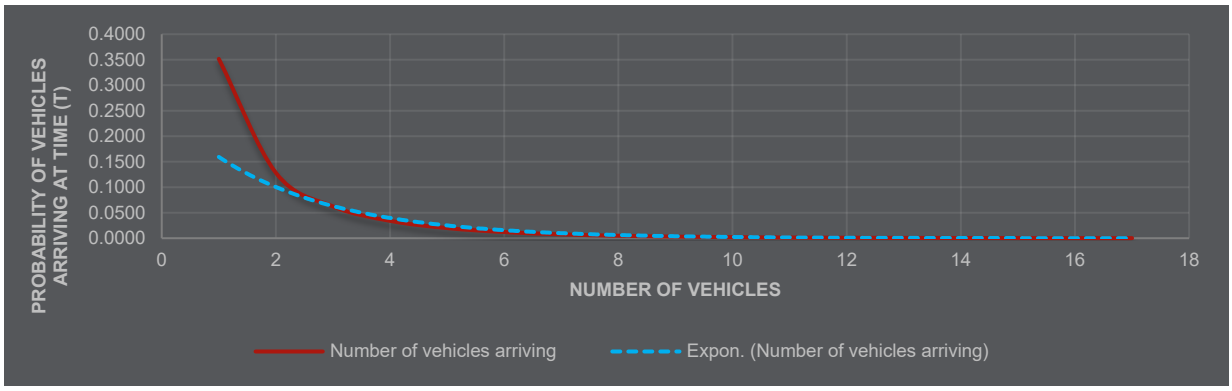
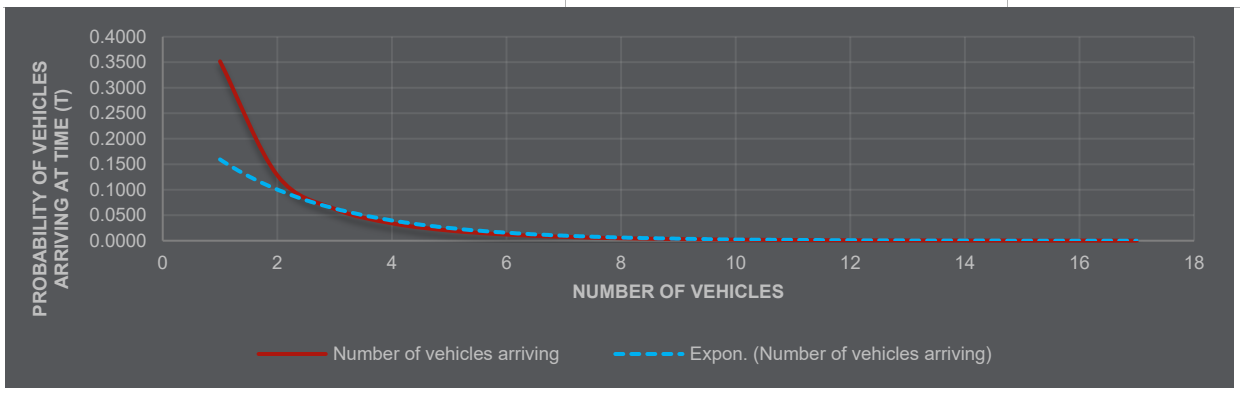


Table 4-20 Construction Year 2022 PM peak hour gap acceptance probability analysis

Headway Distribution Analysis - Poisson Distribution (Construction Year 2022 PM Peak)			
Variable Inputs			
Unit of time	hour		
Arrival rate	481	vehicles per hour	
	0.133611111	vehicles per second	
Critical headway gaps required	5	seconds	
Outputs			
$P(n) = qt^{(n)}$ e-qt/n!	Probability of (n) vehicles arriving at time (t)	1	34.3%
		2	11.4%
		3	5.1%
$P(h>t) = e\text{-}qt$	Probability that no vehicles arrive at time (t)	51%	
$P(h<t) = 1\text{-}e\text{-}qt$	Cumulative probability of headways (s)	75%	10
		85%	14
		95%	22
Number of headways > 5 sec	0.51	246.6	



The probability analysis indicates that there would occur acceptable likelihoods (probabilities) that gaps more than the required critical gaps would occur within the major stream of flow to allow right turn heavy vehicles to enter at construction year 2022 conditions at both AM and PM peak hours. The gap acceptance probability analysis for the final construction year 2023 AM peak hour scenario is provided in Table 4-21 and the PM peak hour in Table 4-22.

Table 4-21 Construction Year 2023 AM peak hour gap acceptance probability analysis

Headway Distribution Analysis - Poisson Distribution (Construction Year 2023 AM Peak)			
Variable Inputs			
Unit of time	hour		
Arrival rate	389	vehicles per hour	
	0.108055556	vehicles per second	
Critical headway gaps required	5	seconds	
Outputs			
$P(n) = qt^{(n)}$ e-qt/n!	Probability of (n) vehicles arriving at time (t)	1	31.5%
		2	8.5%
		3	3.1%
$P(h>t) = e\text{-}qt$	Probability that no vehicles arrive at time (t)	58%	
$P(h<t) = 1\text{-}e\text{-}qt$	Cumulative probability of headways (s)	75%	13
		85%	18
		95%	28
Number of headways > 5 sec	0.58	226.6	

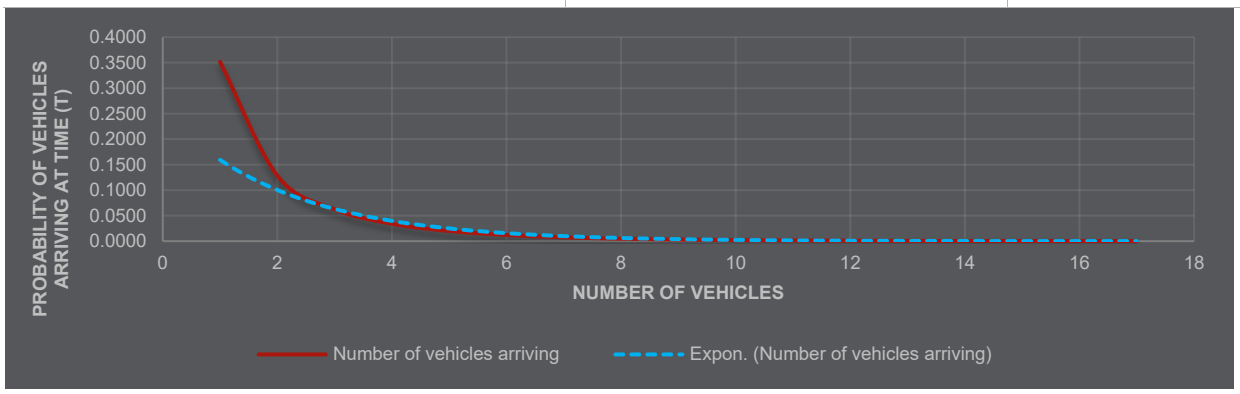
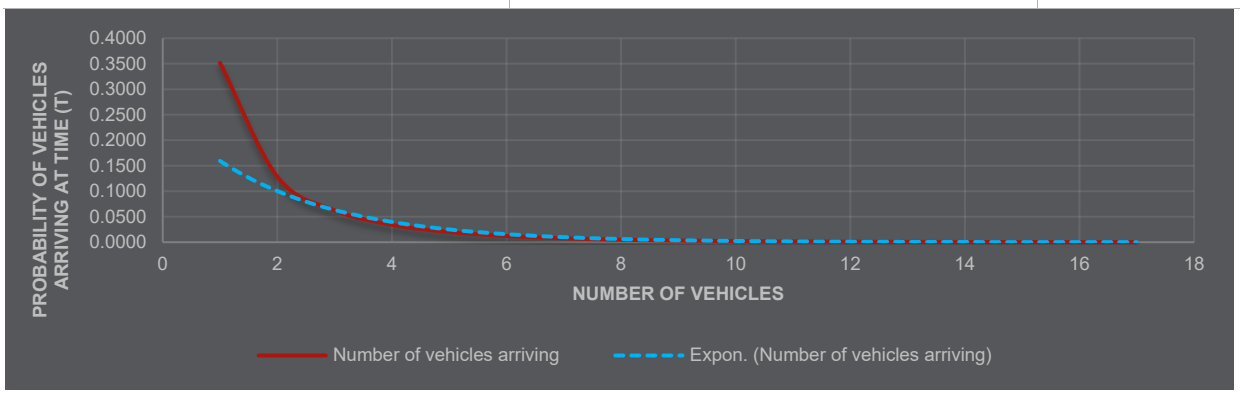


Table 4-22 Construction Year 2023 PM peak hour gap acceptance probability analysis

Headway Distribution Analysis - Poisson Distribution (Base Year 2023 PM Peak)		
Variable Inputs		
Unit of time	hour	
Arrival rate	525	vehicles per hour
	0.145833333	vehicles per second
Critical headway gaps required	5	seconds

Headway Distribution Analysis - Poisson Distribution (Base Year 2023 PM Peak)			
Outputs			
$P(n) = qt^{(n)}$ e-qt/n!	Probability of (n) vehicles arriving at time (t)	1	35.2%
		2	12.8%
		3	6.2%
P(h>t) = e-qt	Probability that no vehicles arrive at time (t)	48%	
P(h<t) = 1-e-qt	Cumulative probability of headways (s)	75%	10
		85%	13
		95%	21
Number of headways > 5 sec	0.48	253.2	



The probability analysis indicates that there would be an 85% cumulative probability that gaps in the traffic stream would be 18 seconds during the AM peak hour and 13 seconds during the PM peak hour. There would also be a 58% probability that no vehicles would arrive within the critical gap acceptance time of 5 seconds during the AM peak hour and 48% during the PM peak hour. The gap acceptance probability analysis for the final construction year 2024 AM peak hour scenario is provided in Table 4-23 and the PM peak hour in Table 4-24.

Table 4-23 Construction Year 2024 AM peak hour gap acceptance probability analysis

Headway Distribution Analysis - Poisson Distribution (Construction Year 2024 AM Peak)			
Variable Inputs			
Unit of time	hour		
Arrival rate	389	vehicles per hour	
	0.108055556	vehicles per second	
Critical headway gaps required	5	seconds	
Outputs			
$P(n) = qt^{(n)}$ e-qt/n!	Probability of (n) vehicles arriving at time (t)	1	31.5%
		2	8.5%
		3	3.1%
P(h>t) = e-qt		58%	

Headway Distribution Analysis - Poisson Distribution (Construction Year 2024 AM Peak)			
	Probability that no vehicles arrive at time (t)		
P(h<t) = 1-e-qt	Cumulative probability of headways (s)	75%	13
		85%	18
		95%	28
Number of headways > 5 sec	0.58	226.6	

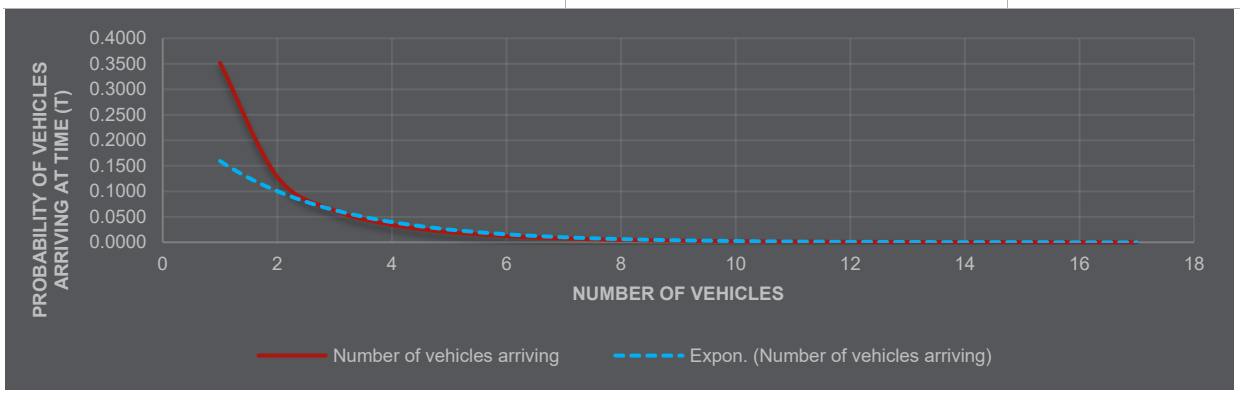
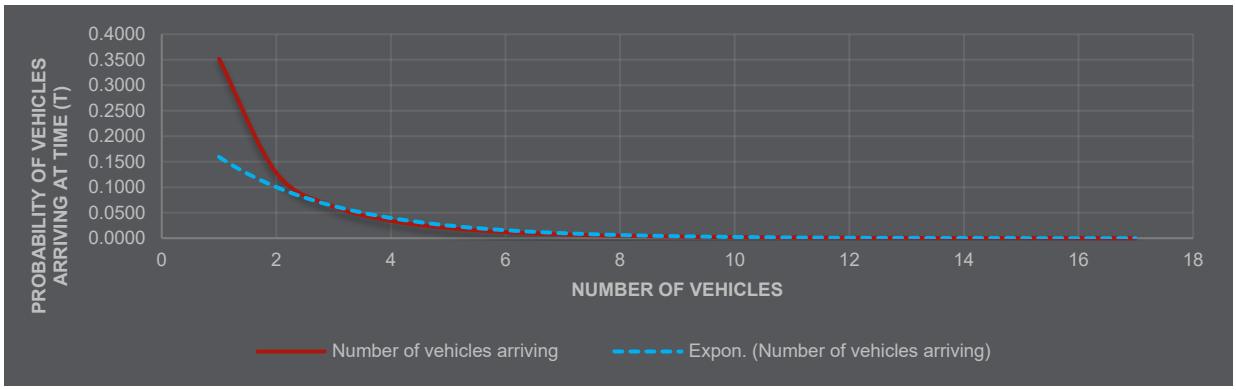


Table 4-24 Construction Year 2023 PM peak hour gap acceptance probability analysis

Headway Distribution Analysis - Poisson Distribution (Base Year 2024 PM Peak)			
Variable Inputs			
Unit of time	hour		
Arrival rate	525	vehicles per hour	
	0.145833333	vehicles per second	
Critical headway gaps required	5	seconds	
Outputs			
$P(n) = qt^{(n)}$ e-qt/n!	Probability of (n) vehicles arriving at time (t)	1	35.2%
		2	12.8%
		3	6.2%
P(h>t) = e-qt	Probability that no vehicles arrive at time (t)	48%	
P(h<t) = 1-e-qt	Cumulative probability of headways (s)	75%	10
		85%	13
		95%	21
Number of headways > 5 sec	0.48	253.2	



There would be acceptable likelihoods (probabilities) that gaps more than the required critical gaps would occur within the major stream of flow to allow right turn heavy vehicles to enter at future construction year 2024 conditions at both AM and PM peak hours.

In conclusion, the proposed access and its proposed layout would provide for sufficient operational performance.

4.1.3.6 Sight distance assessment

Safe intersection sight distance

Safe Intersection Sight Distance (SISD) is the minimum sight distance which should be available along the major road at any intersection. An evaluation of the available SISD was done for the proposed access location. The SISD assessment was based on the provisions of *Austroads Guide to Road Design - Part 4A: Unsignalised and Signalised Intersections.* The existing longitudinal grade (vertical alignment) of the major road was measured in Google Earth along each of the compound accesses. SISD was measured as indicated in Figure 4-5 for the site access.

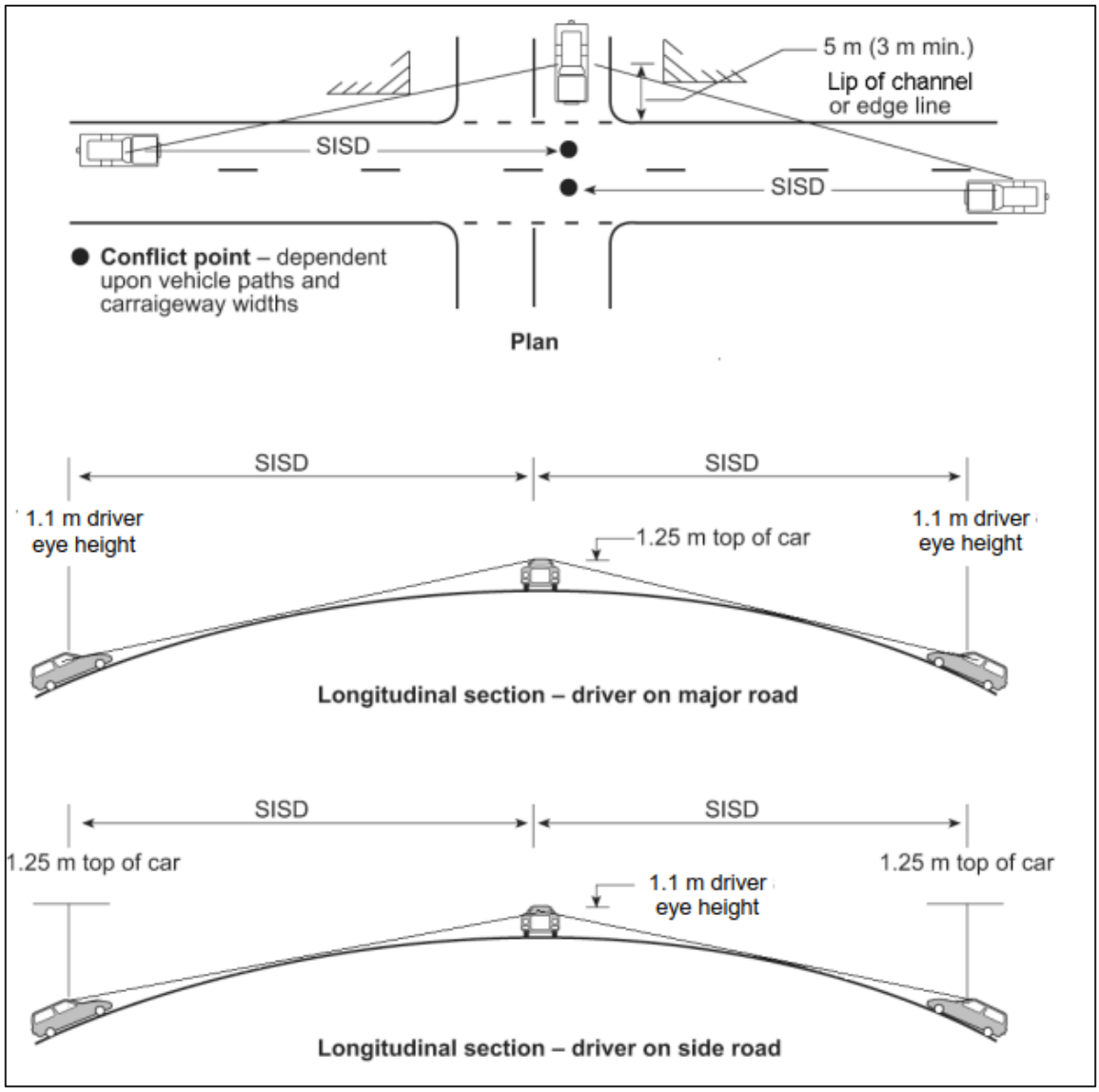


Figure 4-5 Concept of Safe Intersection Sight Distance (SISD)

Visibility of the site access is available for both directions of travel. The required SISD was determined based on the following equation:

$$SISD = \frac{DT \times V}{3.6} + \frac{V^2}{254\,(d + 0.01 \times a)}$$

Where:

SISD = safe intersection sight distance (m)

DT = decision time (sec) = observation time (3 sec) + reaction time (sec) – refer to AGRD Part 3 (Austroads 2016b) for a guide to values

V = operating (85th percentile) speed (km/h)

d = coefficient of deceleration – refer to Table 3.3 and AGRD Part 3 for a guide to values

a = longitudinal grade in % (in direction of travel: positive for uphill grade, negative for downhill grade) which should be available.

The SISD assessment was performed and the sight distance requirements provided in Table 4-25.

Table 4-25 Safe Intersection Sight Distance Requirements

Parameter	Direction of Travel	
	To proposed access from South	To proposed access from North
Ot	3	3
Rt	2.5	2.5
Dt	5.5	5.5
V	100	100
d	0.29	0.29
a	-3.827751196	1.923076923
SISD Required	**309**	**280**

Figure 4-6 shows the sight distances and longitudinal grades at the access.

Figure 4-6 Access sight distances and longitudinal grades

Based on a desktop assessment, it was found that vegetation clearance would be required to meet the minimum sight distance requirements for SISD. This would be required for the south to north approach along Castlereagh Highway. The extent of vegetation clearance or maintenance would be determined during detail design. Sufficient SISD is considered available for the north to south movement along Castlereagh Highway.

Minimum gap acceptance sight distance

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 MGSD required for the driver of an entering vehicle is to see a vehicle in the conflicting stream to safely commence the desired manoeuvre. The concept of MGSD is illustrated in Figure 4-7.

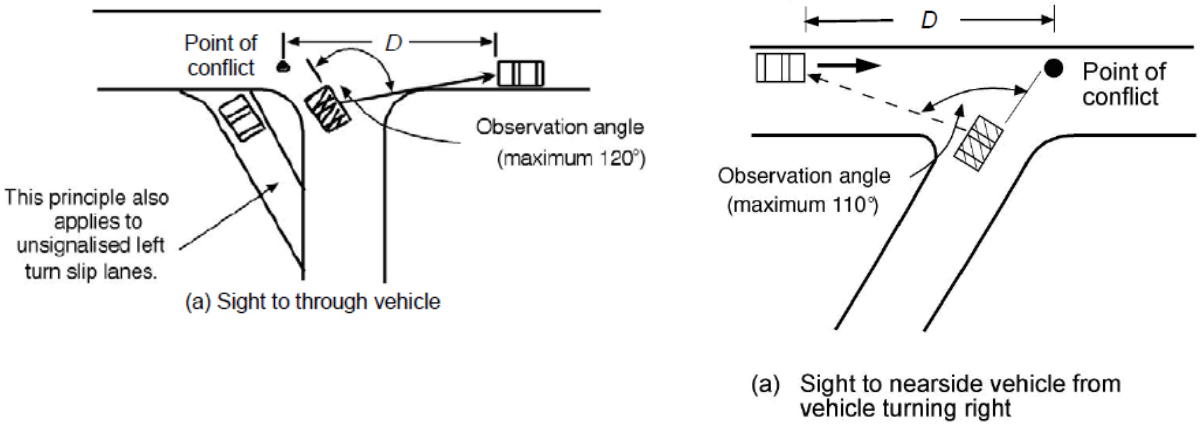


Figure 4-7 Minimum gap sight distance

Based on the provision of the Austroads Guide to Road Design - Part 4A: Unsignalised and Signalised Intersections, the following minimum gaps sight distances are required for the access as indicated in Figure 4-8.

Critical gap acceptance time (t_a) (secs)	85th percentile speed of approaching vehicle (km/h)										
	10	20	30	40	50	60	70	80	90	100	110
4	11	22	33	44	55	67	78	89	100	111	122
5	14	28	42	55	69	83	97	111	125	139	153
6	17	33	50	67	83	100	117	133	150	167	183
7	19	39	58	78	97	117	136	155	175	194	214
8	22	44	67	89	111	133	155	178	200	222	244
9	25	50	75	100	125	150	175	200	225	250	275
10	28	56	83	111	139	167	194	222	250	278	305

Figure 4-8 Minimum gap sight distance requirements

Source: Austroads Guide to Road Design - Part 4A: Unsignalised and Signalised Intersections

A minimum gap sight distance of 139m is required for both left and right turn movements from the access. Figure 4-9 shows the desktop based MGSD which is available.

Figure 4-9 Desktop evaluation of MGSD

Source: Google Earth, 2021

It is considered from desktop analysis that sufficient MGSD would be available along the northern approach of Castlereagh Highway, however it is perceived that available MGSD is less than the minimum required MGSD along the southern approach of Castlereagh Highway. It is proposed that vegetation clearance be conducted in order to remove any sight line obstructions within the sight envelope which may occur along the road verge. The extent of vegetation clearance or maintenance thereof should be determined during the design stage of the access.

4.1.4 Construction phase impact summary

The impact assessment findings indicate that the function and operational performance of the surrounding road network would not be impacted by the proposed Project and the expected construction traffic generated vehicle volumes. Adequate intersection and road link capacity would prevail. It is proposed that vegetation clearance be

conducted in order to remove any sight line obstructions within the sight envelope which may occur along the road verge. The extent of vegetation clearance or maintenance thereof should be determined during the detailed design stage of the access.

4.1.5 Sensitivity Testing

In response to comments raised by TfNSW (letter dated 18 March 2022 and subsequent consultation), a sensitivity test was conducted to examine the required intersection treatment for the worst-case scenario for construction traffic arriving at the site between 6am to 7am (one hour) prior to the start of the shift at 7am. An intersection turn warrant assessment was conducted for the access intersection for the period from 6am to 7am using the following dataset:

- 7-day traffic counts from 25 May 2021 to 7 June 2021 on the Castlereagh Highway (HW18) north of the Great Western Highway (HW5), Marrangaroo provided by TfNSW (refer to Figure 4-10). It should be noted that the traffic counts were outside the COVID-19 lockdown period
- Construction traffic volumes: Based on the workforce population distribution of 95% south and 5% north, it is estimated that 95 trips per hour will come from the south and 5 trips per hour will come from the north. However, to minimise the impact of construction traffic at the access intersection during the 6am to 7am period, workers from the north will be mandated to come from the south (i.e., via Main Street and Barton Avenue through the town of Wallerawang) to access the site (refer to Figure 4-11). This results in a total of 100 trips per hours coming from the south to the access intersection. This would be mandated and would be monitored through the installation of a camera at the intersection, enforceable with heavy penalties, emphasised at Toolbox sessions with workers and included in the construction traffic management plan. There would also be relevant signage located along Castlereagh Highway during this period. A maximum travel time of 10 minutes is expected with the proposed alternative travel route for workers from the north which is not a significant impost. It is also expected that the number of vehicles using this alternative travel route would be low in the worst case scenario, which further impact assessment on route is not warranted. This arrangement will significantly enhance traffic safety at the access intersection during the 12 to 24-month construction period.

Figure 4-10 Location of traffic count site (Source: TfNSW)

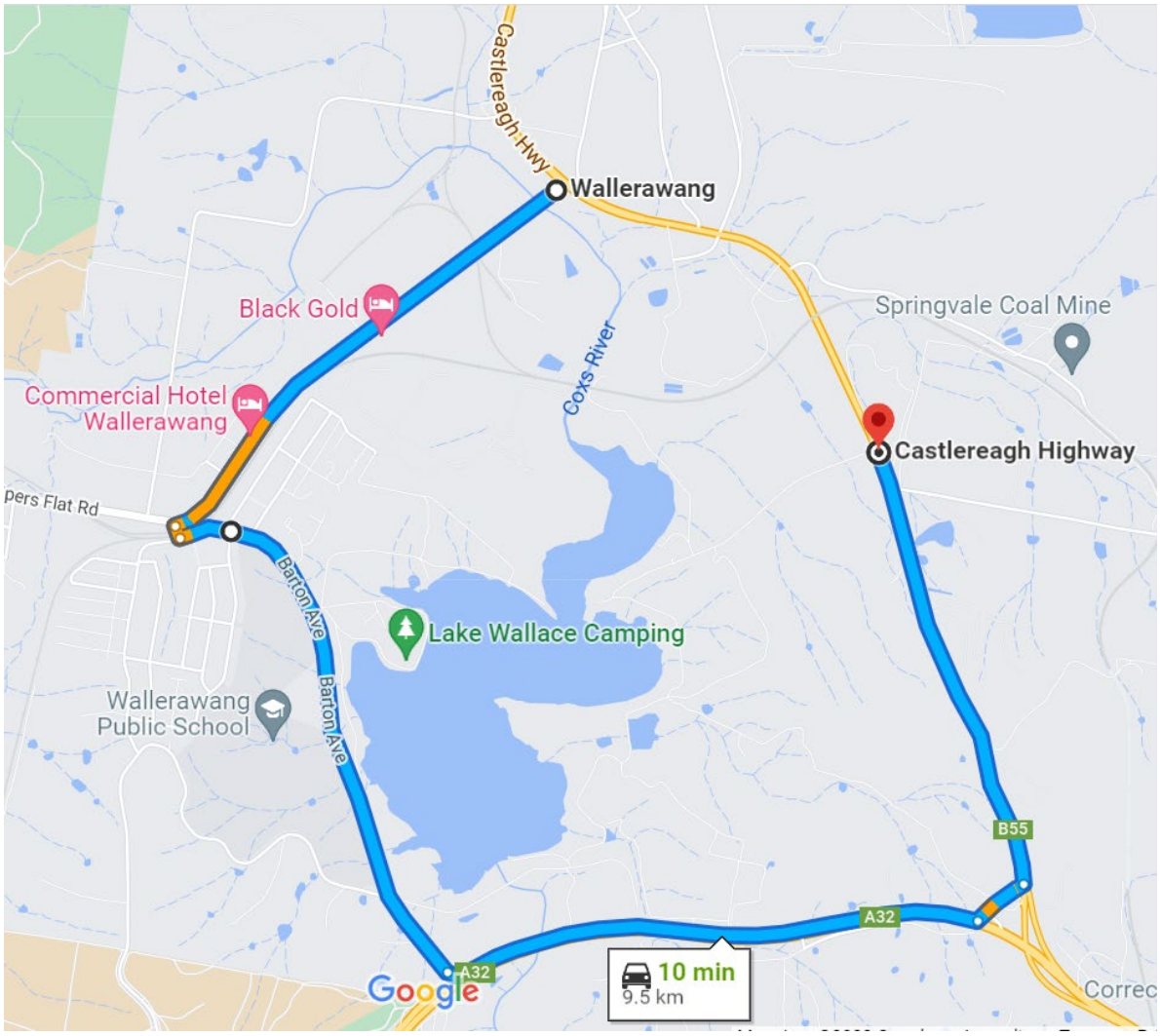


Figure 4-11 Proposed construction worker travel route from the north (Source: Google Maps)

The turn lane warrant assessment was carried out for the following scenarios:

- Construction Year 2022 6am to 7am traffic conditions
- Construction Year 2023 6am to 7 am traffic conditions
- Construction Year 2024 6am to 7 am traffic conditions

A summary of the turn lane warrant analysis for the design horizons 2022, 2023 and 2024 are indicated through Table 4-26 to Table 4-28, respectively.

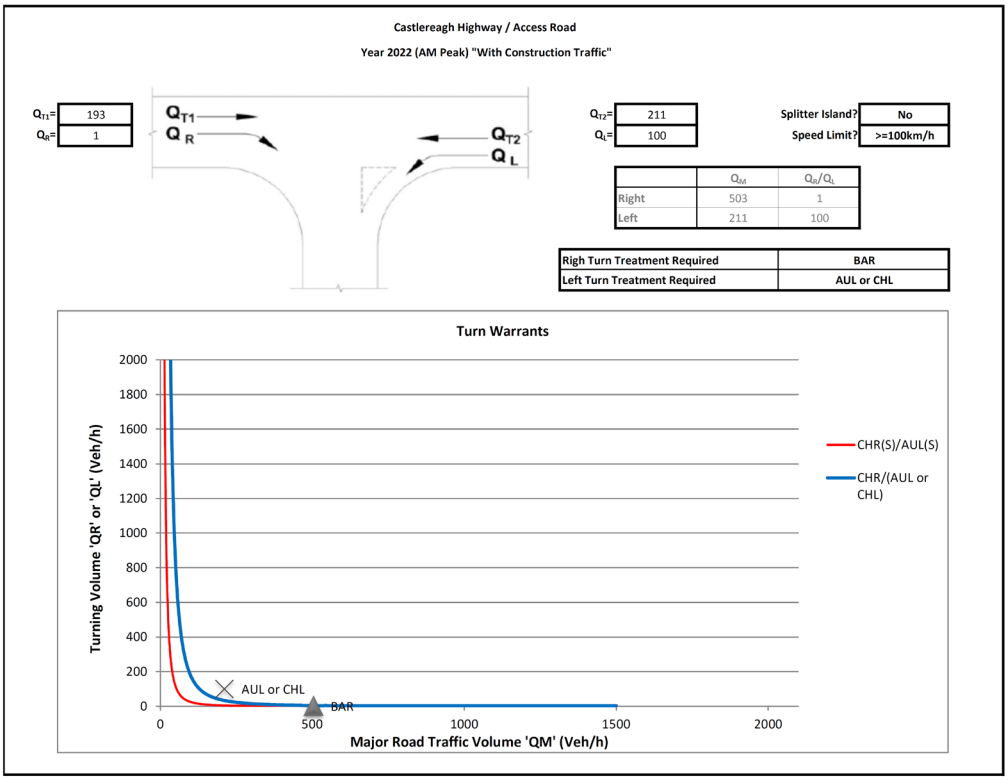


Table 4-26 Turn Lane Warrant Assessment –Construction year 2022 – 6am to 7am

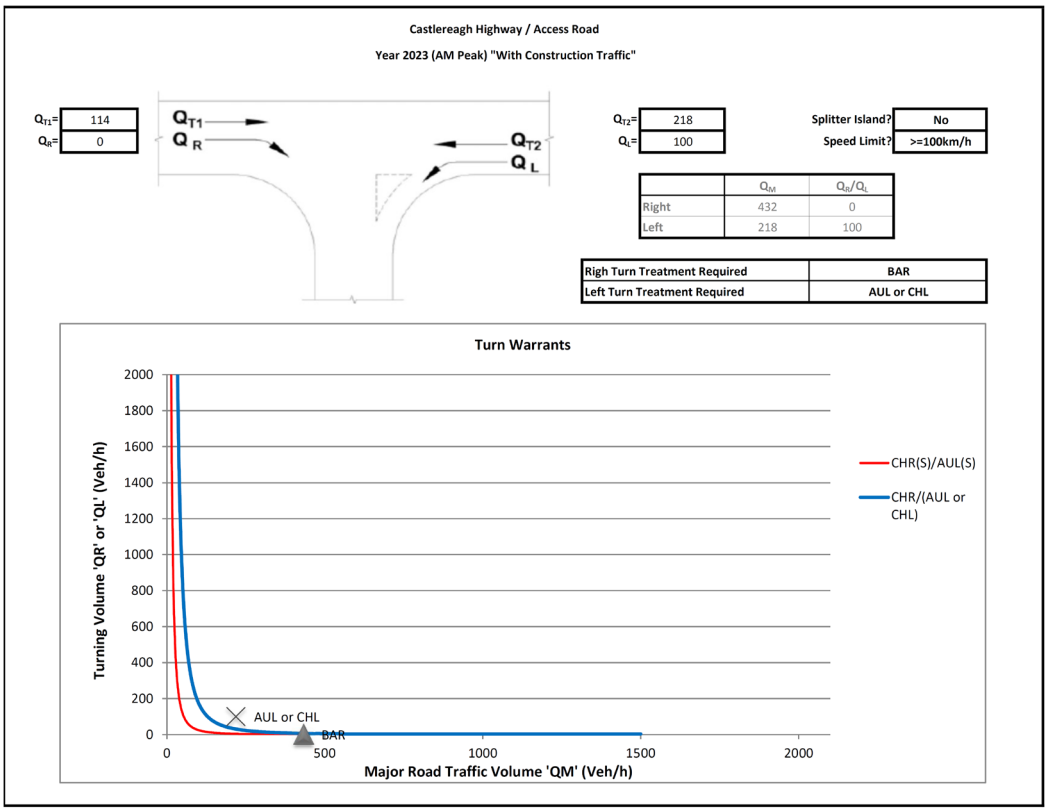


Table 4-27 Turn Lane Warrant Assessment –Construction year 2023 – 6am to 7am

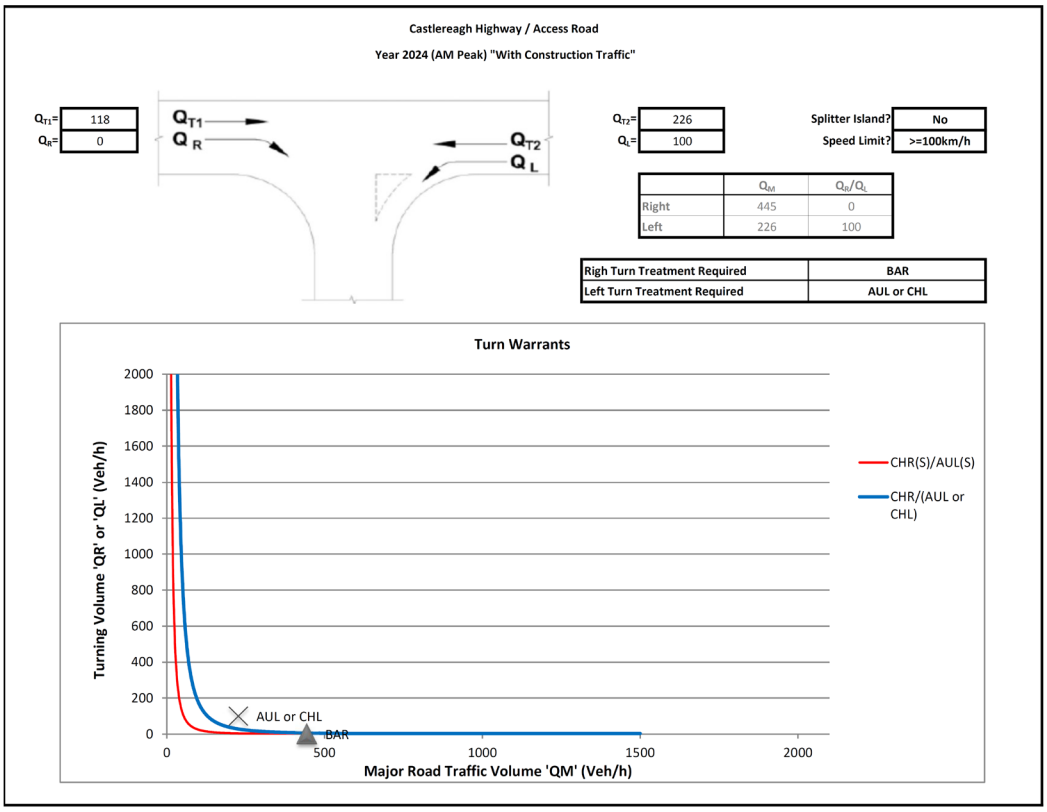
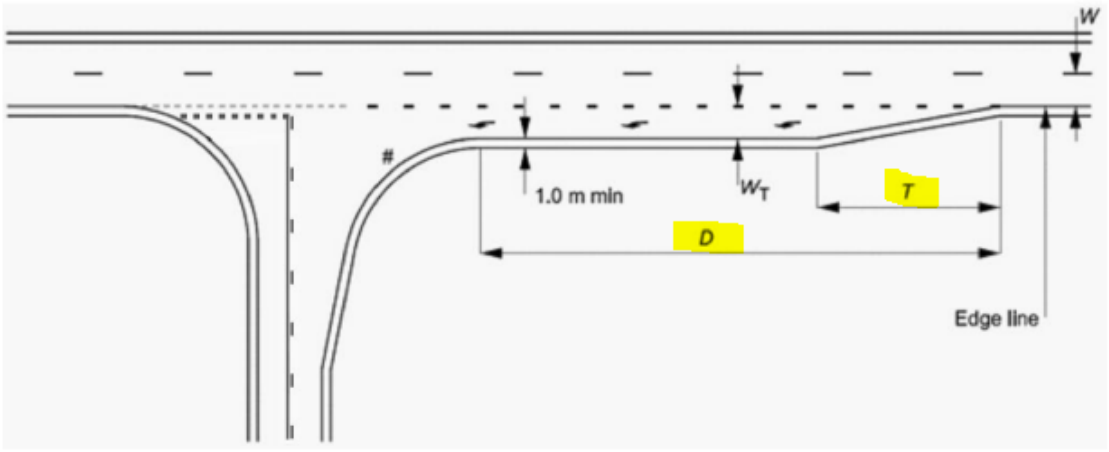


Table 4-28 Turn Lane Warrant Assessment –Construction year 2024 – 6am to 7am

Given that there will be no increase in right turning movements associated with the proposed development, based on the expected worst case peak hour traffic volumes in the period from 6am to 7am, the turn warrants assessment shows that an auxiliary left turn lane (AUL) treatment and basic right turn (BAR) treatment would be sufficient for the access to accommodate the construction stage turn movement volumes.

Figure 4-12 illustrates the AUL turn treatment requirements for rural intersections. An AUL(S) (short left-turn treatment AUL) has been adopted to avoid impact to the neighbouring intersection south of the access intersection. Predominantly, light vehicles will be accessing the intersection and the provided storage of 85 metres (excluding the taper) is more than adequate to cater for the expected demand from 6am to 7am.

Figure 8.3: Rural AUL(S) treatment with a short left-turn lane



Notes:

- *# For setting out details of the left-turn geometry, use vehicle turning path templates and/or Table 8.2.*
- *Approaches to left-turn slip lanes can create hazardous situations between cyclists and left-turning motor vehicles. Treatments to reduce the number of potential conflicts at left-turn slip lanes are given in AGRD Part 4 (Austroads 2017).*
- *The dimensions of the treatment are defined as follows. Values of D and T are provided in Table 8.2.*

W = Nominal through lane width (m) (including widening for curves). For a new intersection on an existing road, the width is to be in accordance with the current link strategy.

W_T = Nominal width of the turn lane (m), including widening for curves based on the design turning vehicle = 3.0 m minimum.

T = Physical taper length (m) given by Equation 5 being: $T = \frac{0.33VW_T}{3.6}$

V = Design speed of major road approach (km/h).

Source: Department of Main Roads (2006)[37].

Table 8.2: Dimensions for AUL(S) treatment on major leg

Design speed of major road approach (km/h)	Diverge/deceleration length *D* (m)[1]	Taper length *T* (m)[2]
50	15	15
60	25	15
70	35	20
80	45	20
90	55	25
100	70	30
110	85	30
120	100	35

Figure 4-12 Rural AUL treatments at intersection.

As a result of the sensitivity testing, the proposed intersection layout included in Appendix E now includes the auxiliary left turn lane (AUL) treatment and basic right turn (BAR) treatment. Figure 4-13 also shows the vehicle swept path assessment for a B-Double truck, which demonstrates that the turning movements can be contained in the traffic lanes.

Figure 4-13 Proposed intersection layout and swept paths following sensitivity analysis

4.2 Operational phase

The impact assessment evaluates the following items during the operational phase of the Project:

- Impact on intersections
- Impact on road link capacity (Castlereagh Highway)
- Access and frontage analysis.

During operation of the Proposal (i.e. following the completion of the construction stage), the estimated workforce would consist of a small number of workers (i.e. approximately 5 staff). In a worst-case scenario if all workers travel alone, this will equate to 5 (two way) vehicle trips per day. It is expected that there may be some irregular heavy vehicle movements during the operational stage such as replacing of transformers etc. This would however constitute very low vehicle volumes. It is considered that operational generated traffic would be negligible from a traffic engineering or transport planning perspective.

4.2.1 Operational phase intersection impact assessment

There is no impact on intersection capacity expected as a result of the minimal operational phase traffic volumes which would be generated. Regular maintenance of vegetation would be required to eliminate any obstruction to safe intersection sight distances and marginal gap acceptance sight distances.

4.2.2 Operational phase road link capacity assessment

A road link capacity impact analysis has been undertaken for Castlereagh Highway. The operational phase impact analysis evaluates the impact on roadway capacity at opening year 2024 (after completion of the construction phase)

as well as opening + 10 years i.e year 2034. The projected future year volumes along Castlereagh Highway is expected to be:

- Year 2024 of Operations AM Peak Hour – 390 vehicles per hour
- Year 2024 of Operations PM Peak Hour – 529 vehicles per hour
- Year 2034 of Operations AM Peak Hour – 561 vehicles per hour
- Year 2034 of Operations AM Peak Hour – 762 vehicles per hour

The results are indicated in Table 4-29.

Table 4-29 Operational Phase Road Link Capacity Impact

Construction Year	AM Peak Hour	PM Peak Houre	Spare Capacity (%)
2024	Volume to Capacity Ratio: 0.23	Volume to Capacity Ratio: 0.33	AM Peak Hour - 77% AM Peak Hour - 67%
2034	Volume to Capacity Ratio: 0.31	Volume to Capacity Ratio: 0.44	AM Peak Hour - 69% AM Peak Hour - 56%

It is considered that there would not be any impact on roadway capacity of Castlereagh Highway during the operational phase of the Project.

4.2.3 Access and frontage

It is expected that the access configuration required to accommodate the operational phase traffic would be unchanged from the layout indicated in Figure 4-2. The operational generated traffic would be minimal and create less of an impact than the construction generated traffic and as such basic left and basic right turn treatment requirements would still prevail. Sufficient absorption capacity and probability of gaps within the major road is expected to prevail during year 2024 of operations and even year 2034 of operations. Similar to the analyses which was carried out for the construction phase impacts. To demonstrate this, a conservative analysis of the future year 2034 of operations were evaluated based on an absorption capacity assessment. Table 4-30 provides the results.

Table 4-30 Year 2034 of Operations Absorption Capacity

Operational Year 2034 Access AM Peak Hour Absorption Capacity Analyses			
Units		Left Turn Absorption Capacity	Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.06	0.16
Critical Gap Acceptance Required (s)	ta	5	5
Follow-up Headway (s)	tf	3	3
Constant	e	2.7183	2.7183
Equation	qpe^(-qpta)	164.4	258.3
Equation	1-e^-qptf	0.2	0.4
Absorption Capacity (C)		963	682
Absorption Capacity (Cp)		771	546
Construction Year 2034 Access PM Peak Hour Absorption Capacity Analyses			

Operational Year 2034 Access AM Peak Hour Absorption Capacity Analyses			
Units		Left Turn Absorption Capacity	Right Turn Absorption Capacity
Major stream flow (veh/s)	qp	0.09	0.12
Critical Gap Acceptance Required (s)	ta	5	5
Follow-up Headway (s)	tf	3	3
Constant	e	2.7183	2.7183
Equation	qpe^(-qpta)	208.8	240.0
Equation	1-e^-qptf	0.2	0.3
Absorption Capacity (C)		868	773
Absorption Capacity (Cp)		694	619

It was found that the sufficient practical absorption capacity would be available along Castlereagh Highway to allow operational generated traffic the exit the site access and enter the major stream of flow even at year 2034 of operations.

4.2.4 Operational phase impact summary

In summary, the additional traffic generated by the Project Site is not expected to compromise the safety, function or operational performance of the surrounding road network. Overall, the operation of the surrounding road network, public transport services and pedestrian connections will remain unchanged as a result of the Project. Regular maintenance of vegetation would be required to eliminate any obstruction to safe intersection sight distances and marginal gap acceptance sight distances.

4.3 Traffic mitigation measures

The following mitigation measures are provided based on the impact assessment findings.

4.3.1 Road links

The road link analysis determined that neither the construction or operational stage traffic volumes as a result of the Project will significantly affect the capacity. However, traffic management strategies can be introduced in order to mitigate even the possible minor impacts along link roads. These should include:

- Travel demand management (TDM) campaign to inform the public on works and its effect on network operations
- Construction Traffic Management Plan managing hours of work and deliveries, staff transport and staff parking, with the provision of on-site tool storage where practicable
- Ongoing consultation with relevant authorities
- Specific traffic management plans for special events developed in conjunction with the relevant stakeholders
- Relevant emergency services should be notified in advance prior to the movement of all hazardous/dangerous or oversize construction material and equipment
- Secondary alternative construction route activities should be determined as part of the Traffic Management Plan, in the event of the primary route is blocked off by an emergency

- All Oversize Over Mass Vehicles which might be used during construction should have a detailed route assessment completed
- Fatigue management measures should be introduced and enforced for all workers
- Undertake a visual pavement condition assessment of Castlereagh Highway prior to construction and post final stage of operational activities
- The impacted Castlereagh Highway is improved to a similar condition to what it will be during the initial visual pavement inspection assessment to mitigate impact on road pavement.

4.3.2 Intersections

Traffic management strategies to be introduced to mitigate impacts along intersections should include:

- Traffic Management Plans should be prepared prior to construction activities. Road safety measures should take into consideration speed restrictions, driver fatigue, in-vehicle communications, signage, demarcations, maintenance, safety checks, and interaction with public transport, transport of hazardous and dangerous goods and emergency response and disaster management.
- Temporary road works at the access road, including diversion and signage, should be in accordance with relevant road design and road sign manuals.
- Construction activities and vehicle movements to minimise travel during background peak hour.
- Fatigue management measures should be introduced and enforced for all workers.
- Police vehicle escorts to be used for all OSOM (over size over mass) vehicles for the transport of equipment.
- It is proposed that advance truck turning signage be installed to warn vehicles of heavy vehicles turning in and out of the Project Site access during the construction phase.

4.3.3 Oversize over mass vehicle movement requirements

The following safety mitigation measures are proposed as part of this TIA report regarding the movement of oversize over mass vehicles.

4.3.3.1 Pilot or escort or police escort requirements – width and length

Figure 4-14 shows the minimum level 1 pilot or level 2 escort or police escort required. The requirements of Table 78 do not include critical areas, critical roads and major roads. Additional pilot/escort and/or police escorts are required as indicated in the *Over Size and Over Mass Heavy Vehicles and Loads, TfNSW, 2020*.

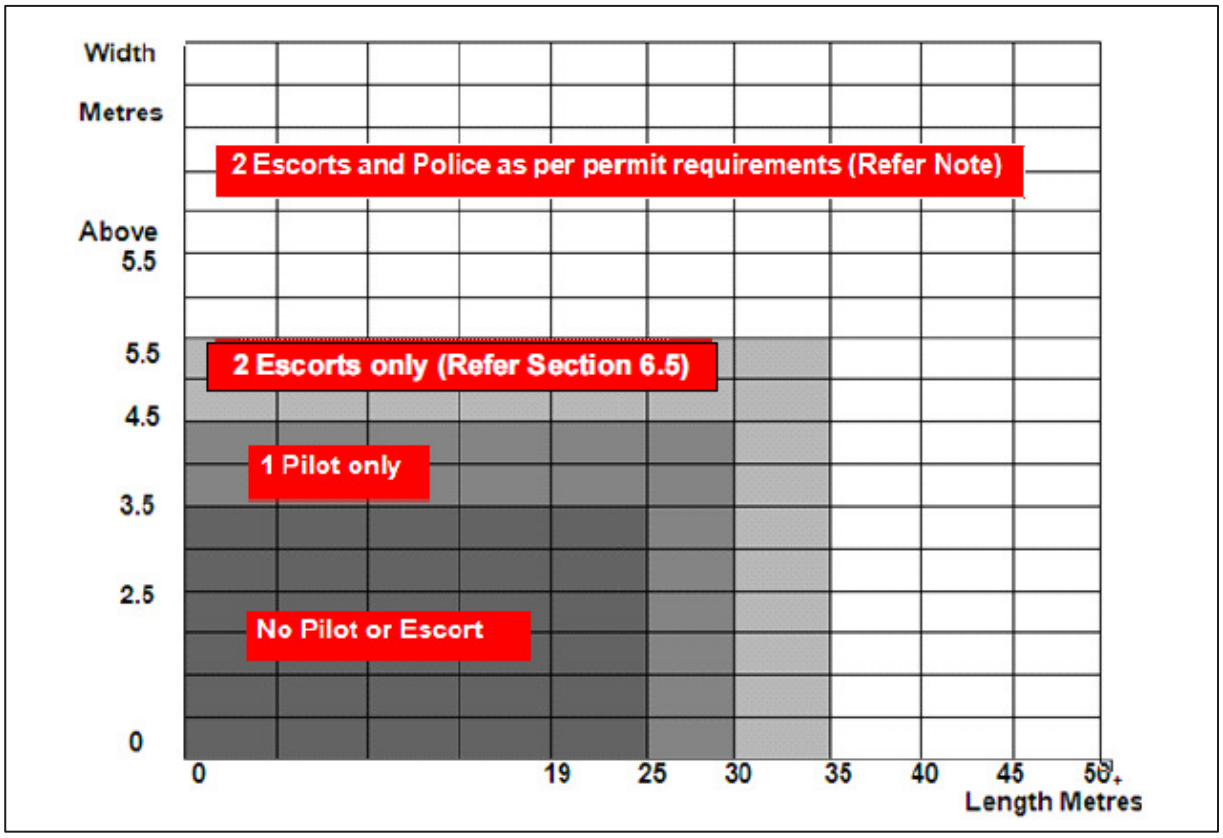


Figure 4-14 Minimum Level 1 Pilot or Level 2 escort or police escort required

4.3.3.2 Night-time travel – Police permits

Police permits are required for all other night-time movements. The permit will specify the required number of level 1 pilot/level 2 escort drivers and any operating requirements.

4.3.3.3 Oversize vehicle or combination requirements

The person responsible for moving the load must ensure that the route is suitable for travel with a minimum inconvenience to other road users. The person responsible for moving the load must obtain all relevant permissions, authorities or inquiries prior to the movement to ensure the movement of the oversize vehicle or combination does not pose a danger to property or other road users whilst travelling that route.

4.3.3.4 Safe loading

A vehicle or combination must be loaded in a manner that ensures:

a) The risks to other road users are minimised; and

b) The loading does not adversely affect the vehicle's stability; and

c) The load on the vehicle is securely restrained by an appropriate method

   a. See the 'Load Restraint Guide' for examples of safe ways of lading vehicles. The 'Load Restraint Guide' is published by the National Transport Commission and may be accessed on the commission's website.

4.3.3.5 No travel in low visibility

The driver of an oversize vehicle or combination must not begin to travel, if due to circumstances such as glare, fog, heavy rain, smoke, dust or insect plague:

a) Visibility is less than 250m in the daytime; or

b) The headlights of a vehicle approaching within 250m could not be seen at night time; or

c) Visibility is sufficiently restricted that the safety of the pilot or escort operation, or other road users may be compromised.

4.3.3.6 Minimum following distance for all oversize vehicles

The driver of an oversize vehicle or combination must maintain a distance of at least 200m from another oversize vehicle or combination travelling in front of it, unless:

a) it is overtaking the front vehicle and the front vehicle is stopping; or

b) it is overtaking the front vehicle and there is a separate lane available for the use of overtaking traffic; or

c) it is in an urban area and it is not practicable to maintain a distance of 200m.

4.3.3.7 Communication requirements for drivers of oversize vehicles or combinations

The driver of an oversize vehicle or combination being accompanied by a pilot or escort vehicle must ensure two-way communication equipment is available in the oversize vehicle or combination. The communication equipment must be in working order allowing communication between the escorted vehicle and the pilot/escort vehicle.

4.3.3.8 Damage caused by oversize vehicles – driver of oversize vehicle or combination responsibility

The driver of an oversize vehicle or combination must immediately report any damage caused by an oversize vehicle or combination to the asset owner/s, and in the event it presents a dangerous situation, the local police.

4.3.3.9 Warning devices required when exceeding width

An oversize vehicle or combination that is wider than 2.5m must have:

a) One warning sign at its front; and

b) one warning sign at the rear, or if it is carrying a rear projecting load, at the rear of the load; and

c) four warning flags, with one flag fitted to each side of the front and rear of the vehicle, or if there is any projecting load at each side of both the front and rear of the projecting load.

An oversize vehicle or combination must display a warning light if it is wider than 3m.

If a load projects more than 150mm beyond the sides of a vehicle or combination, and the projection is less than 500mm thick from top to bottom, there must be:

a) a warning light attached to the vehicle or combination; and

b) at least two yellow rigid pieces of material (known as “delineators”), one attached to the front, and one to the rear of the load where it projects beyond the sides of the vehicle or combination.

An oversize vehicle or combination wider than 2.5m or longer than 25m in length must have its low beam headlights on while travelling.

4.3.3.10 Warning devices required when exceeding rear overhang

If loading or equipment projects more than 5.5m behind the rear overhang line of a prime mover semitrailer combination, the sides of the projection must be highlighted with a warning pattern.

4.3.3.11 Additional warning devices required during night time travel

An oversize vehicle or combination must display:

a) side markers - yellow lights to the front and red or yellow lights to the rear no more than 2m apart along both sides of the oversize vehicle and along any front and rear projection; and

b) rear clearance lights - two red lights fixed to the rear of any projecting load within 400mm of each side of the load, and at least 1m but no more than 2.1m above the ground.

c) All lights must be Australian Design Rule (ADR) compliant.

If a load or equipment is higher than 5.0m, it must have a white light adequate to illuminate the front of the highest point of the vehicle or load. The light must be directed or shielded so as not to dazzle any driver.

4.3.3.12 Warning devices required for pilot and escort vehicles

Pilot and escort vehicles must have the following warning devices:

a) a warning sign on its roof; and

b) a warning light.

Any warning light which a pilot or escort vehicle is required to have must be operating when the vehicle is accompanying an oversize vehicle or combination.

A warning light must be attached for a pilot or escort vehicle:

a) above or below the warning sign; or

b) at each side of the warning sign.

Additionally, an escort vehicle must be fitted with two wig wag lights at the front of the vehicle and have the wig wag lights operating only during the day when escorting an oversize vehicle or combination. The low beam headlights on a pilot or escort vehicle must be switched on when it is accompanying an oversize vehicle or combination.

An escort vehicle must carry six traffic cones or triangles.

4.3.3.13 Warning device specifications for oversize vehicles or combinations and pilot/escort vehicles – warning flags

A warning flag must:

a) be at least 450mm long and at least 450mm wide; and

b) be brightly coloured red, yellow, or red and yellow.

4.3.3.14 Warning device specifications for oversize vehicles or combinations and pilot/ escort vehicles – warning lights

A warning light must, when operating:

a) emit a yellow coloured light of rotating and flashing effect; and

b) flash between 120 and 200 times a minute; and

c) have a power of at least

   a. if LED technology is used – 25 watts; or

   b. if another technology is used – 55 watts; and

d) not be a strobe light

A warning light, when operating must be clearly visible at a distance of 500m in all directions, or be supplemented by one or more additional warning lights so that the emitting light from at least one of them is clearly visible at a distance of 500m in any direction.

4.3.3.15 Wig Wag lights for escort vehicles only

An escort vehicle's wig wag lights when operating must:

a) emit a yellow or white coloured light; and

b) not be a strobe light; and

c) have a power of at least

   a. if LED technology is used – 25 watts; or

   b. if another technology is used – 55 watts; and

e) flash alternatively to give a wig wag effect.

Wig wag lights must be installed in the following position:

a) fitted symmetrically (same position on both sides of the vehicle); and

b) no higher than the top of dipped beam lamp; and

c) not less than 250mm from the ground; and

d) mounted at the front of the vehicle so as to not obstruct the driver's view; and

e) the outside edge of the lights is to be no further than 400mm from the side of the car.

4.3.3.16 Delineators

A delineator must:

a) be at least 300mm long and at least 300mm wide; and

b) comply with Class 1 or 2 of Australian Standard AS 1906 Retro-reflective Materials and Devices for Road Traffic Control Purposes.

A delineator must be attached so that its reflective surface is facing:

a) forward of the vehicle, if at the front of the projection; and

b) rearward of the vehicle, if at the rear of the projection.

4.3.3.17 Warning signs

A warning sign for oversize vehicles or combinations and pilot/escort vehicles must comply with the following specifications:

a) the face must have a yellow surface which complies with Class 1 or 2 of Australian Standard AS 1906 Retro-reflective Materials and Devices for Road Traffic Control Purposes; and

b) the face of the warning sign must have a black border at least 20mm wide; and

c) the outermost edge of the border must be set at least 10mm in from the edge of the sign unless the sign has been made with a box edge; and

d) the warning sign must have it manufacturer's name or trademark permanently marked in letters at least 3mm but not more than 10mm high in any visible location on the sign. The manufacturer's marking may appear in any visible location of the sign.

A warning sign must be made of:

a) a rigid, flat, weatherproof material; or

b) may be made of flexible, waterproof material if the sign is —

i. held taut; and

ii. clearly visible; and

iii. unlikely to become dislodged, furl or otherwise become difficult to read by other road users.

A warning sign must be made of:

a) a rigid, flat, weatherproof material; or

b) may be made of flexible, waterproof material if the sign is —

i. held taut; and

ii. clearly visible; and

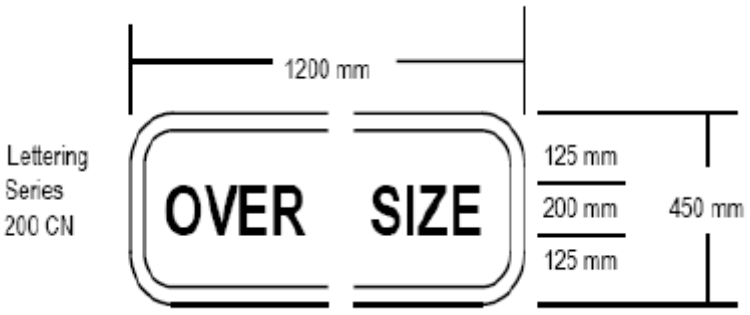
iii. unlikely to become dislodged, furl or otherwise become difficult to read by other road users.

A warning sign which is split in two parts on an oversize vehicle or combination must have:

a) the part mounted on the left showing the letters 'OVER'; and

b) the part mounted on the right showing the letters 'SIZE'; and

c) there must be no border between the two parts.



A warning sign on an oversize vehicle or combination must be mounted:

a) in a way unlikely to be dislodged; and

b) the lower edge of the sign must be:

a. above the bottom of the bumper bar or bull bar; or

b. if there is no bumper bar, at least 500mm from the ground; and

c) if the sign is split into two parts, each part must be fitted at the same height as the other.

A warning sign on a pilot or escort vehicle must have faces showing:

a) the words 'OVERSIZE' and 'LOAD AHEAD' must be on the front and rear of the sign; and

b) the word 'OVERSIZE', in black upper case lettering at least 200mm high, conforming with Australian Standard AS 1744, Forms of Letters and Numerals for Road Signs, in typeface Series C(N); and

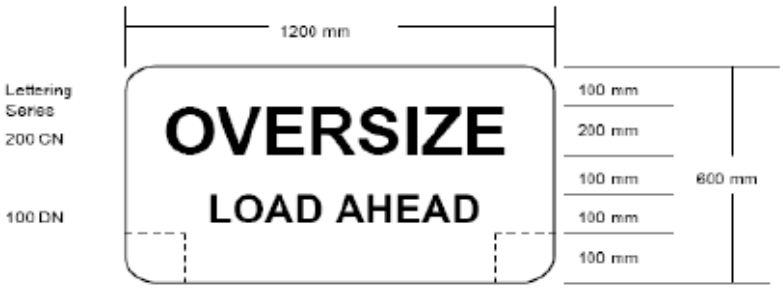
c) the words 'LOAD AHEAD', in black upper case lettering at least 100mm high, conforming with Australian Standard AS 1744, Forms of Letters and Numerals for Road Signs, in typeface Series D(N); and

d) the bottom of the lettering of the word 'OVERSIZE' must be at least 300mm from the bottom of the sign; and

e) the bottom of the words 'LOAD AHEAD' must be at least 100mm from the bottom of the sign; and

f) the word 'LOAD AHEAD' must be at least 100mm below the word 'OVERSIZE'.

A warning sign on a pilot or escort vehicle must be at least 1200mm long and at least 600mm high.



A warning sign must be mounted on a pilot or escort vehicle in the following way:

a) central position above the vehicle's roof; and

b) leaning back so that the top edge of the sign is not more than 200mm from the upright position

A warning sign on pilot/escort vehicles may have bottom corner cut-outs not more than 150mm wide and not more than 100mm high if they are needed for mounting the warning lights.

A warning sign must be clearly visible and legible to other road users. A warning sign on a pilot/escort vehicle must be entirely covered, removed, or laid flat so as not to be read by other road users when the pilot/escort vehicle is not actively engaged in piloting/escorting an oversize load or combination.

4.3.3.18 Warning pattern

A warning pattern must:

a) cover an area of at least 0.16 sq m (e.g. 100mm x 1600mm); or

b) if less space is available, due to the construction of the projection, cover the maximum practical space available; and

c) consist of diagonal stripes at least 150mm wide and alternately coloured:

a. red and white; or

b. black and white.

5 CONCLUSION

This section summarises the main findings of the impact assessment.

5.1 Impact on public transport

The following key bus routes services running along the Great Western Highway might be impacted by the Project:

- Route 600 – Portland to Lithgow via Wallerawang
- Route 636 – Portland to Lithgow via Wallerawang

Impact is considered to be negligible given the low service frequencies as indicated in Section 2.2. There are no bus services running long the frontage (Castlereagh Highway) of the Project.

5.2 Impact on active transport

There are no cycle paths along Castlereagh Highway or Great Western Highway which indicates cyclist usage would not be evident, even with the existing operating speed of 100km/h along Castlereagh Highway. There is no impact on cyclists expected as a result of the Project during both construction and operational stages.

5.3 Road network impact

There are no capacity concerns regarding the operation of the key intersections identified in this TIA for both construction and operational stages. It is considered that the impact of the construction generated traffic on the operational performance of intersections and road links would be minimal and only account for 2 additional heavy vehicle volumes during background AM and PM peak hours. Operational traffic would also be insignificant and include an estimate of 5 daily two-way vehicle trips should maintenance activities occur.

It was also determined within the TIA that sufficient road link capacity would be available on Castlereagh Highway to accommodate construction year traffic as well as operational traffic even at future year 2034 conditions.

5.4 Access and frontage

The following summary of findings relating to the impact on accesses are made:

- The analyses indicate that the proposed accesses would allow for sufficient absorption capacity to accommodate for the development traffic demand during both AM and PM peak hours
- The access analysis results indicate that the construction traffic vehicles would experience insignificant levels of vehicle delay in order to enter the major stream traffic flow. The accesses would operate within acceptable levels of vehicle delay
- Turn warrants assessments of the proposed accesses indicate that only BAL and BAR treatments would be sufficient
- Based on a desktop assessment, it was found that vegetation clearance would be required in order to meet the minimum sight distance requirements for SISD. This would be required for the south to north approach along Castlereagh Highway. The extent of vegetation clearance or maintenance should be determined during detail design stage of formalising the access road intersection. Sufficient SISD is considered available for the north to south movement along Castlereagh Highway.
- It is considered from desktop analysis that sufficient MGSD would be available along the northern approach of Castlereagh Highway, however it is perceived that available MGSD is less than the minimum required MGSD along the southern approach of Castlereagh Highway. It is proposed that vegetation clearance be conducted in order to

remove any sight line obstructions within the sight envelope which may occur along the road verge. The extent of vegetation clearance or maintenance thereof should be determined during the design stage of the access.

- There would occur acceptable likelihoods (probabilities) that gaps more than the required critical gaps would occur within the major stream of flow to allow right turn heavy vehicles to enter at base year 2021 and future year 2024 conditions for both AM and PM peak hours.
- It is proposed that advance truck turning signage be installed to warn vehicles of heavy vehicles turning in and out of the Project Site access during the construction phase.

5.5 Sensitivity Testing

In response to comments raised by TfNSW (letter dated 18 March 2022), a sensitivity test was conducted to examine the required intersection treatment for the worst-case scenario for construction traffic arriving at the access intersection between 6am to 7am (one hour) prior to the start of the shift at 7am. An intersection turn warrant assessment was conducted for the access intersection for the period from 6am to 7am.

Based on the expected worst case peak hour traffic volumes in the period from 6am to 7am, the turn warrant assessment shows that an auxiliary left turn lane (AUL) treatment and basic right turn (BAR) treatment would be sufficient for the access to accommodate the construction stage turn movement volumes. An AUL(S) (short left-turn treatment AUL) has been adopted to avoid impact to the neighbouring intersection south of the access intersection. Predominantly, light vehicles will be accessing the intersection and the provided storage of 85 metres (excluding the taper) is more than adequate to cater for the expected demand from 6am to 7am.

To minimise the impact of construction traffic at the access intersection during the 6am to 7am period, workers from the north (estimated to be around five vehicles) will be mandated to come from the south (i.e., via Main Street and Barton Avenue through the town of Wallerawang) to access the site. This results in a total of 100 trips per hour coming from the south to the access intersection. This mandate will be enforceable for the peak period between 6am to 7am with camera monitoring, heavy penalties, emphasised at Toolbox sessions with workers and included in the construction traffic management plan. A maximum travel time of 10 minutes is expected with the proposed alternative travel route for workers from the north which is not a significant impost. It is also expected that the number of vehicles using this alternative travel route would be low in the worst case scenario, which further impact assessment on route is not warranted. This arrangement will significantly enhance traffic safety at the access intersection during the 12 to 24-month construction period.

5.6 Parking

It is proposed that temporary staff parking be provided on site during the construction stage. It is recommended that parking opportunities be recorded within a detailed Construction Traffic Management Plan which also designates parking locations to be used during the construction stage.

Formal parking locations to accommodate the operational stage maintenance workforce are assumed to be provided in line with relevant planning scheme standards as well as design requirements contained in Australian Standard for off-street car parking (AS2890.1 and AS2890.2).

5.7 Oversize over mass vehicles

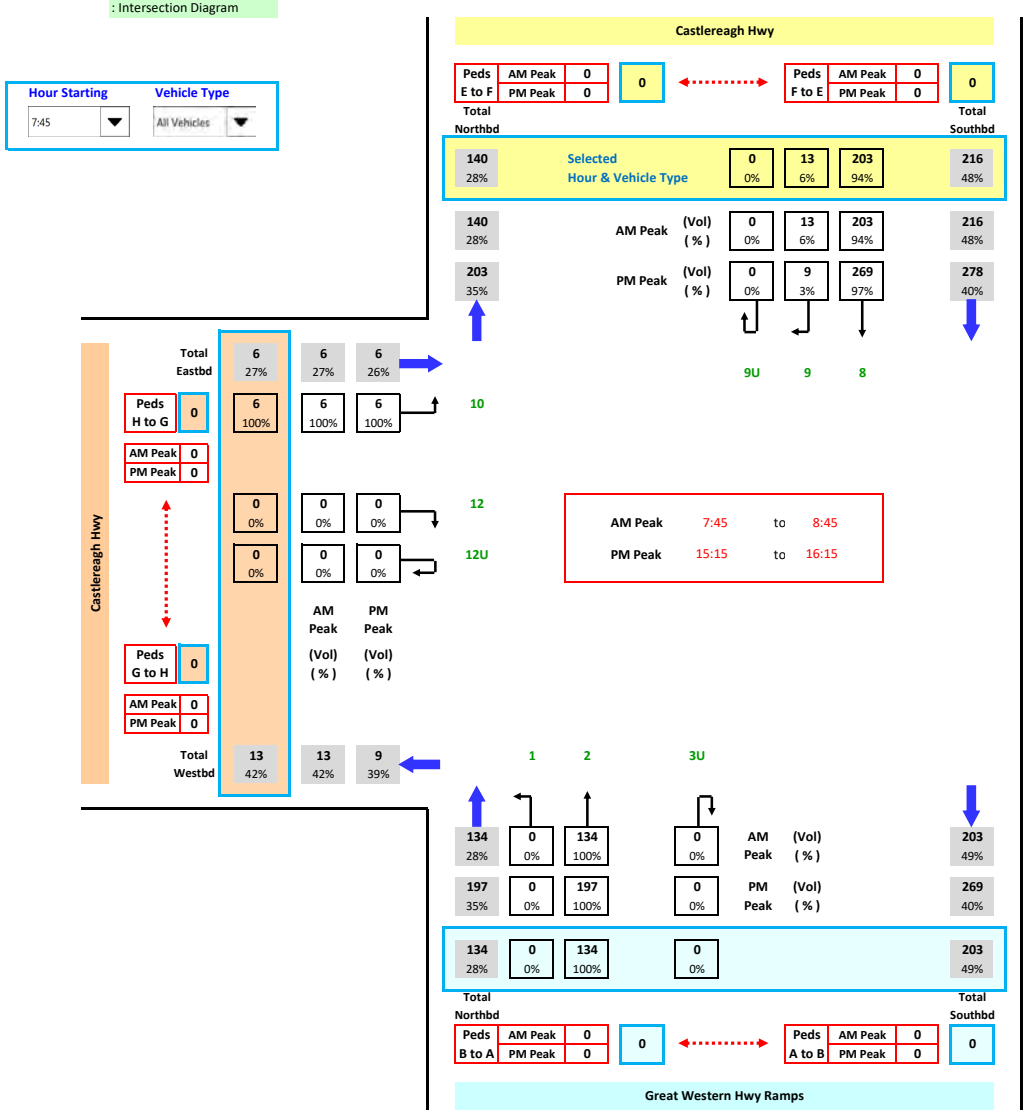
This TIA provides mitigation measures for the transport of oversize over mass vehicles in Section 4.3.3. The use of such vehicles should be addressed in a comprehensive Construction Traffic Management Plan with appropriate permits applied for with TfNSW as nominated by the contractor.

APPENDIX A – BASE YEAR 2021 TRAFFIC SURVEY VOLUMES

Job No. : AUNSW441
Client : Herman Joubert Arcadis Australia Pacific Pty/Ltd - NSW
Suburb : Wallerawang
Location : 1. Castlereagh Hwy / Great Western Hwy

Day/Date : Tue, 30th March 2021
Weather : Fine
Description : Classified Intersection Count
: Intersection Diagram

MATRIX Traffic and Transport Data

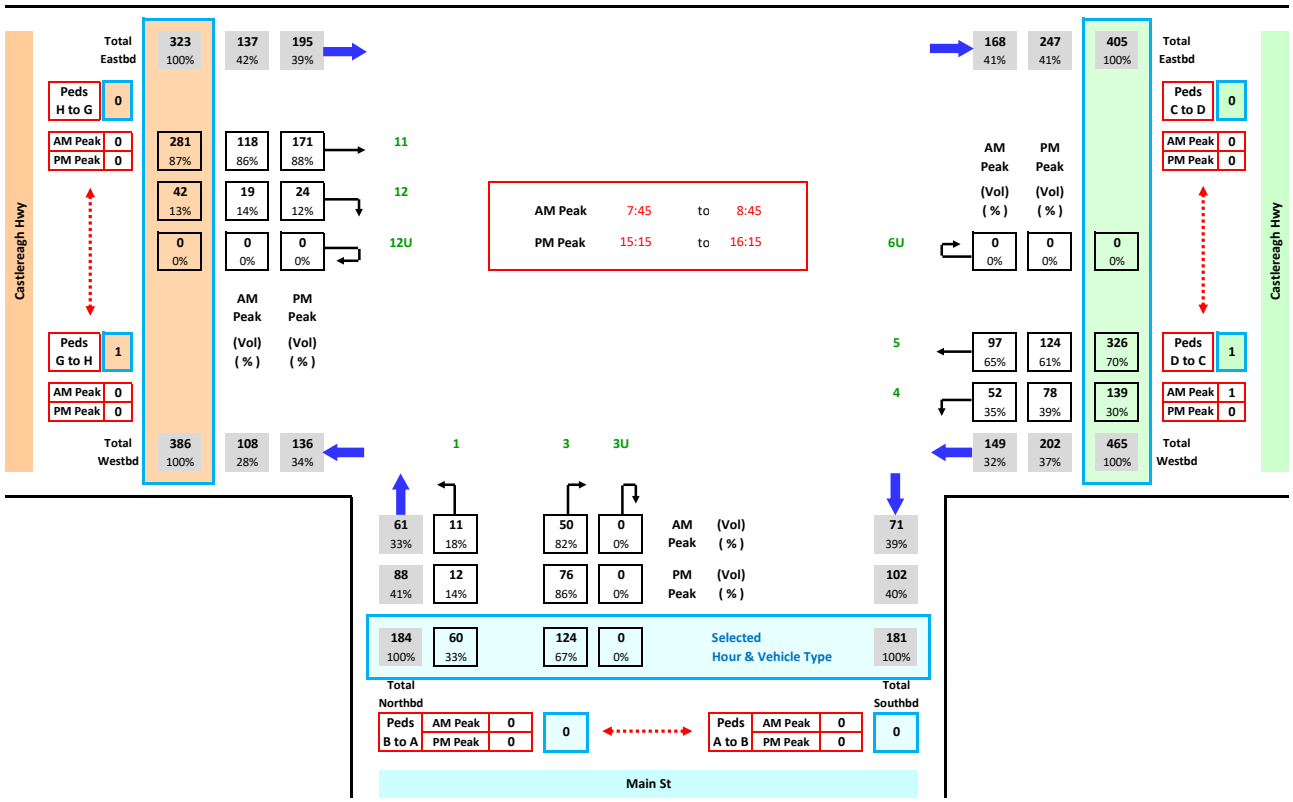


N

Job No. : AUNSW441
Client : Herman Joubert Arcadis Australia Pacific Pty/Ltd - NSW
Suburb : Wallerawang
Location : 2. Main St / Castlereagh Hwy

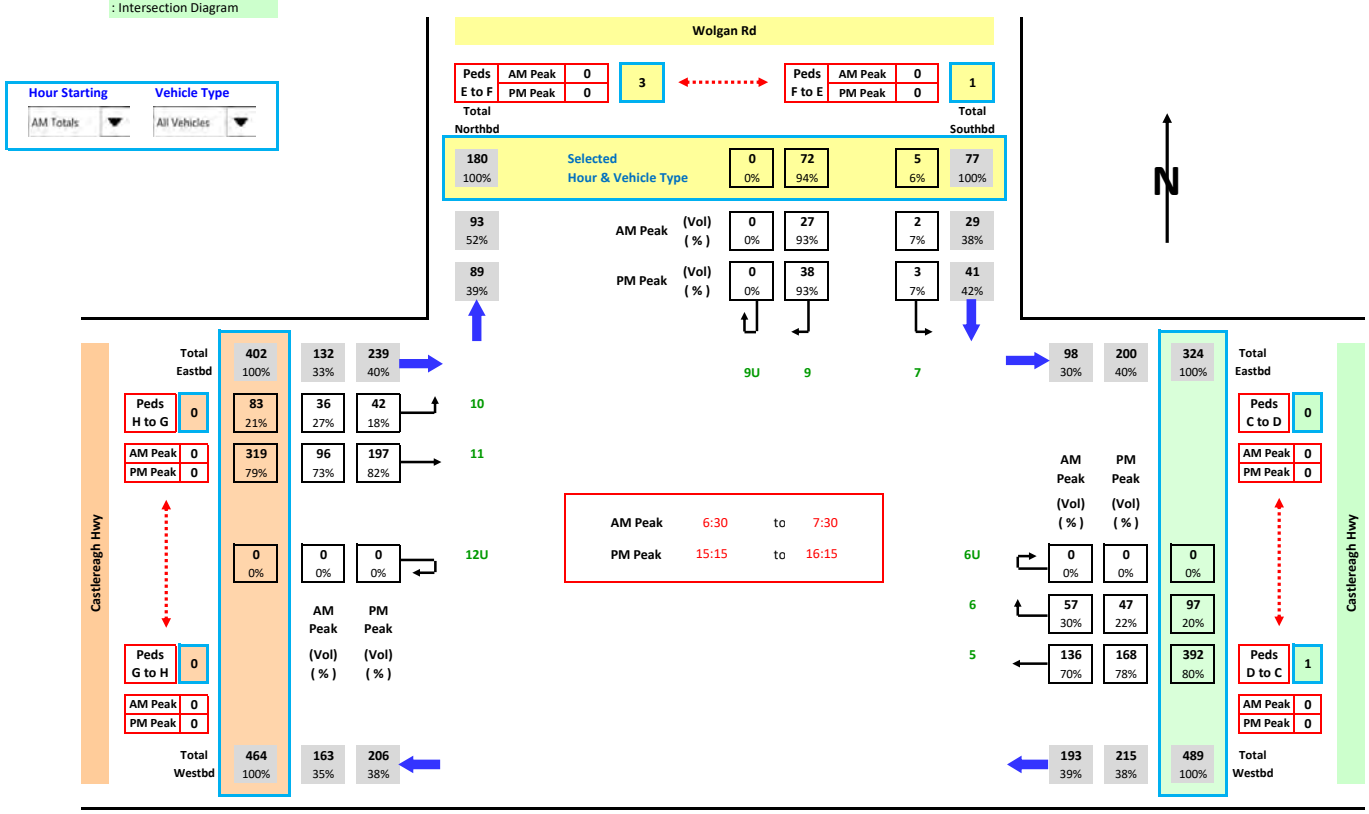
Day/Date : Tue, 30th March 2021
Weather : Fine
Description : Classified Intersection Count
: Intersection Diagram

Hour Starting	Vehicle Type
AM Totals	All Vehicles



Job No. : AUNSW441
Client : Herman Joubert Arcadis Australia Pacific Pty/Ltd - NSW
Suburb : Wallerawang
Location : 3. Wolgan Rd / Castlereagh Hwy

Day/Date : Tue, 30th March 2021
Weather : Fine
Description : Classified Intersection Count
: Intersection Diagram

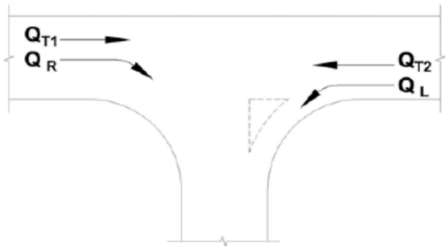


APPENDIX B – ACCESS TURN LANE WARRANT ANALYSIS

Castlereagh Highway / Access Road

Year 2021 (AM Peak) "With Construction Traffic"

Q_{T1}=	216
Q_R=	0

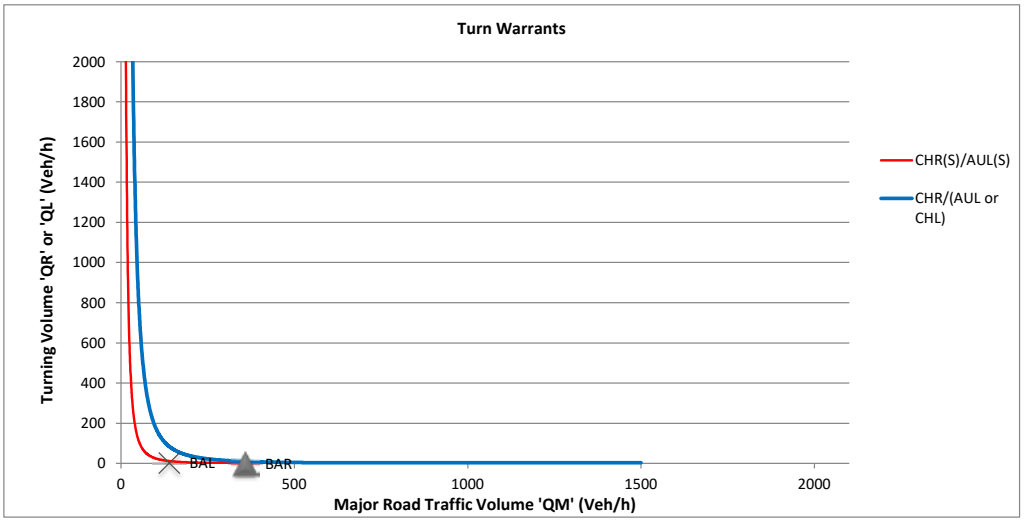


Q_{T2}=	140
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	358	0
Left	140	2

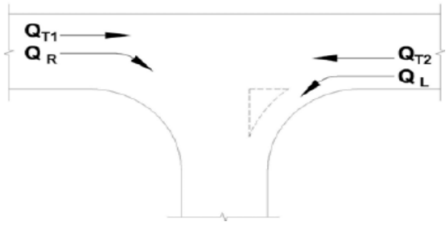
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2021 (PM Peak) "With Construction Traffic"

Q_{T1}=	278
Q_R=	0

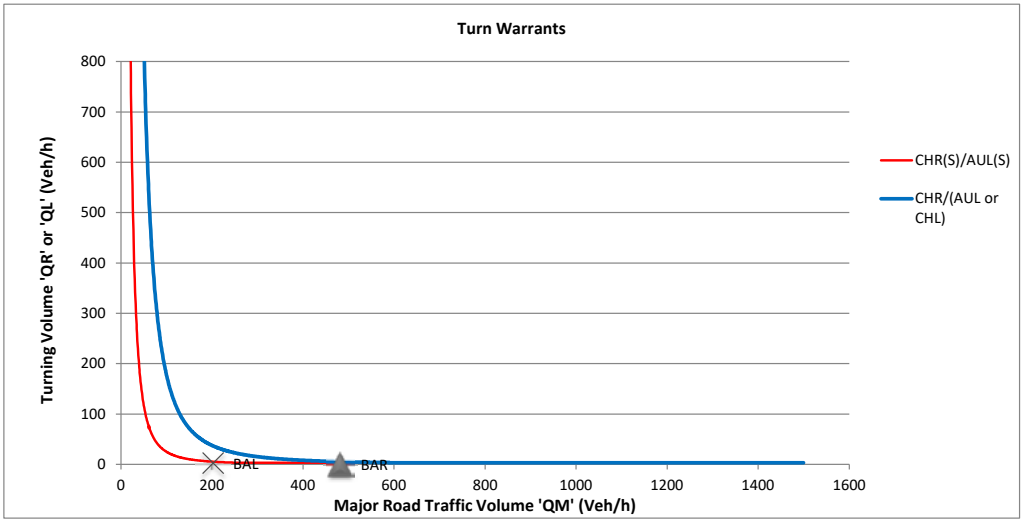


Q_{T2}=	203
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	483	0
Left	203	2

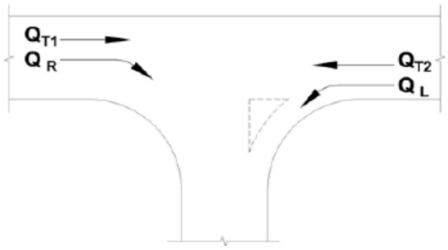
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2022 (AM Peak) "With Construction Traffic"

Q_{T1}=	393
Q_R=	0

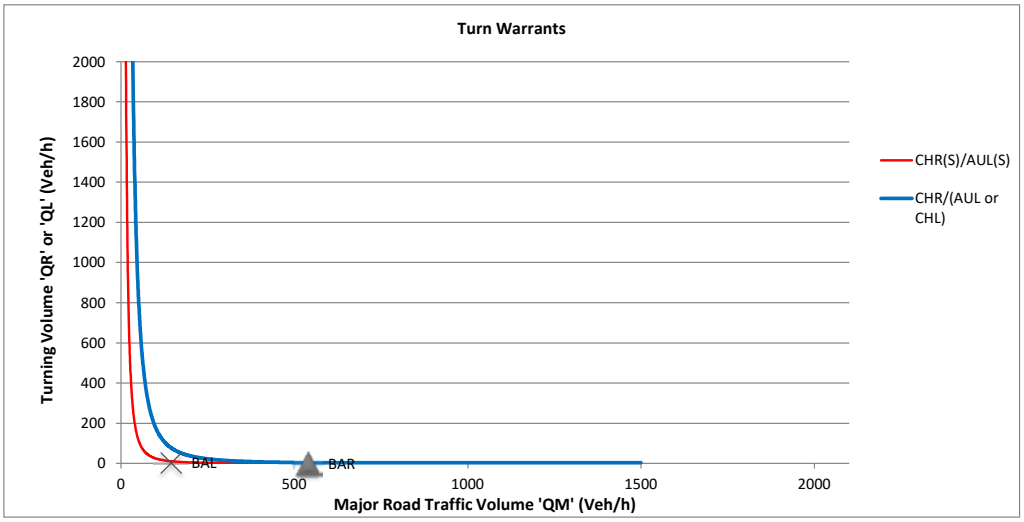


Q_{T2}=	145
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	540	0
Left	145	2

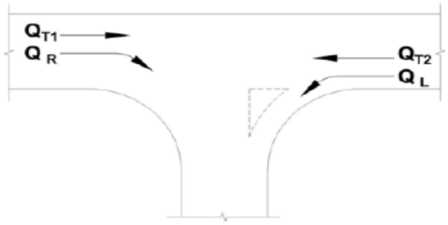
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2022 (PM Peak) "With Construction Traffic"

Q_{T1}=	288
Q_R=	0

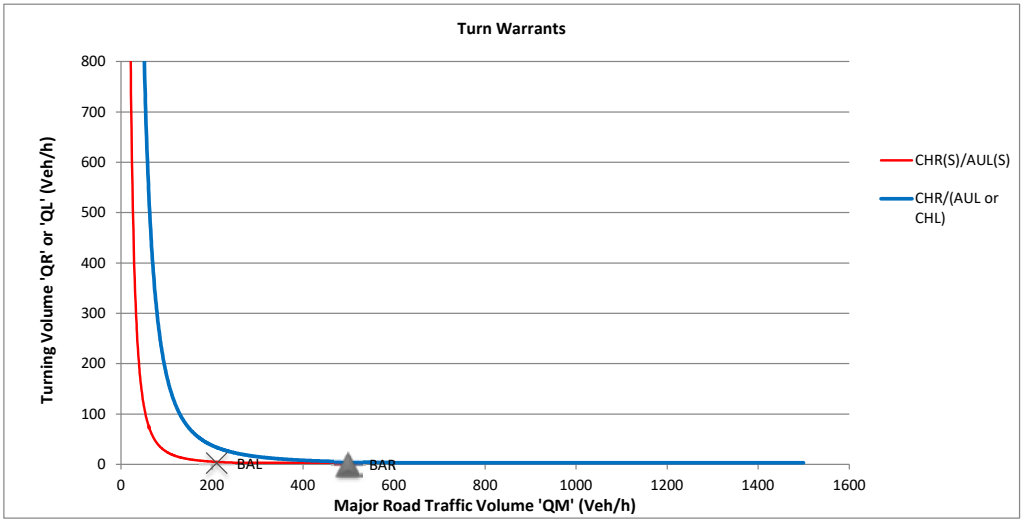


Q_{T2}=	211
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	501	0
Left	211	2

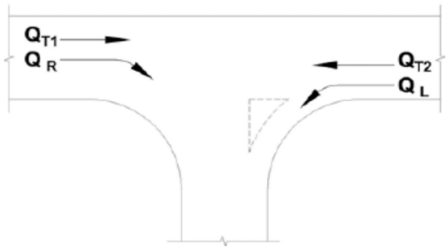
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2023 (AM Peak) "With Construction Traffic"

Q_{T1}=	232
Q_R=	0

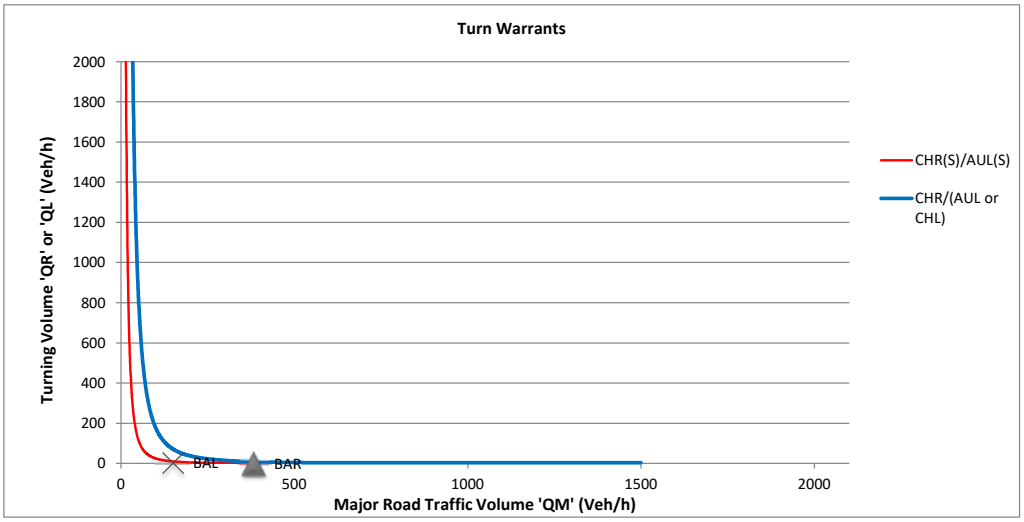


Q_{T2}=	151
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	385	0
Left	151	2

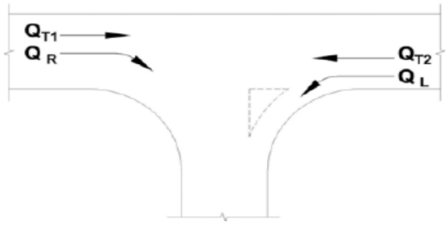
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2023 (PM Peak) "With Construction Traffic"

Q_{T1}=	299
Q_R=	0

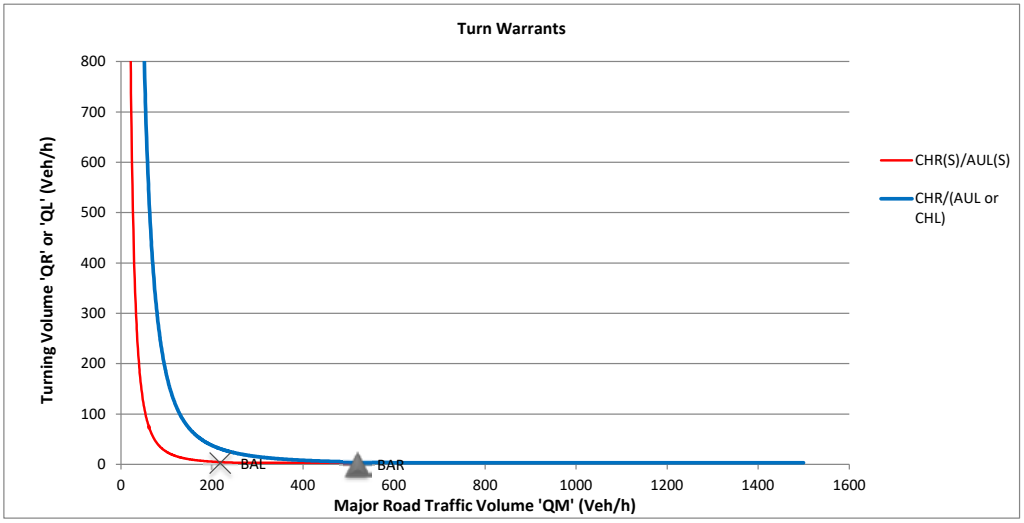


Q_{T2}=	218
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	519	0
Left	218	2

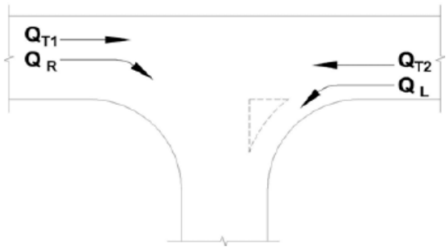
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2024 (AM Peak) "With Construction Traffic"

Q_{T1}=	241
Q_R=	0

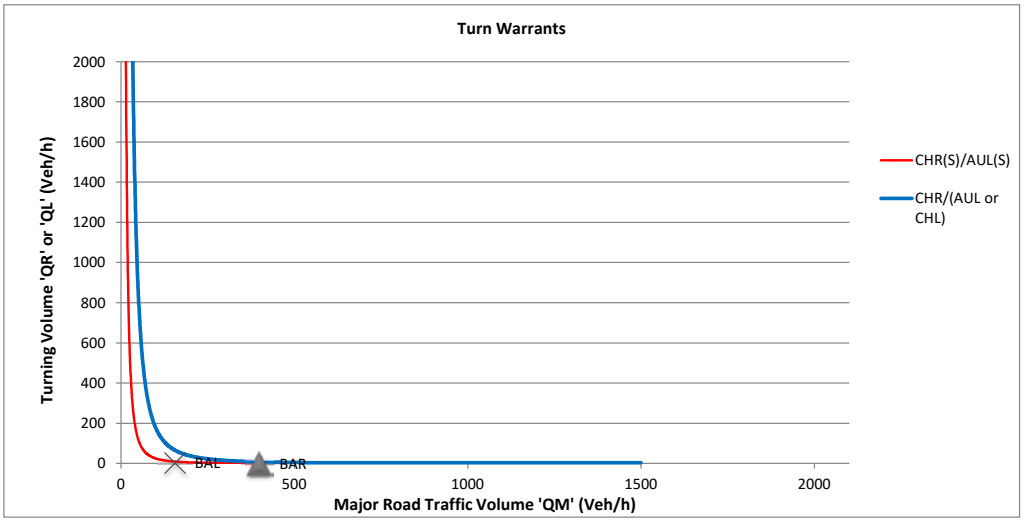


Q_{T2}=	156
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	399	0
Left	156	2

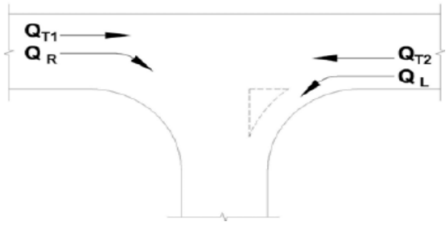
Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



Castlereagh Highway / Access Road

Year 2024 (PM Peak) "With Construction Traffic"

Q_{T1}=	310
Q_R=	0

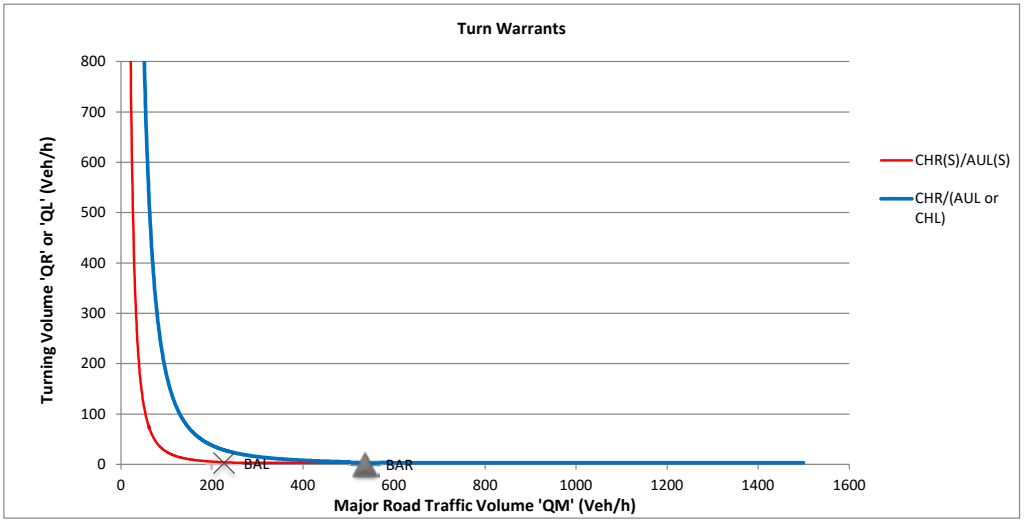


Q_{T2}=	226
Q_L=	2

Splitter Island?	No
Speed Limit?	>=100km/h

	Q_M	Q_R/Q_L
Right	538	0
Left	226	2

Righ Turn Treatment Required	BAR
Left Turn Treatment Required	BAL



APPENDIX C – PROPOSED EIS ACCESS LAYOUT PLAN

NOT FOR CONSTRUCTION

1:250 0 2 4 6 8 10m

WALLERAWANG
BATTERY PLANT
PAVEMENT PLAN

SKETCH DOCUMENT

SK-002

ARCADIS
© ABN 76 104 485 289
LEVEL 5 120 EDWARD STREET
BRISBANE QLD. 4000
PH 07 3337 0000 aus@arcadis.com
www.arcadis.com

DRAWING FILE LOCATION / NAME
C:\Users\jc61565\OneDrive - ARCADIS\ArcadisAU-NSW\Wallerawang Battery Plant\CAD\30076781-SK-002.dwg

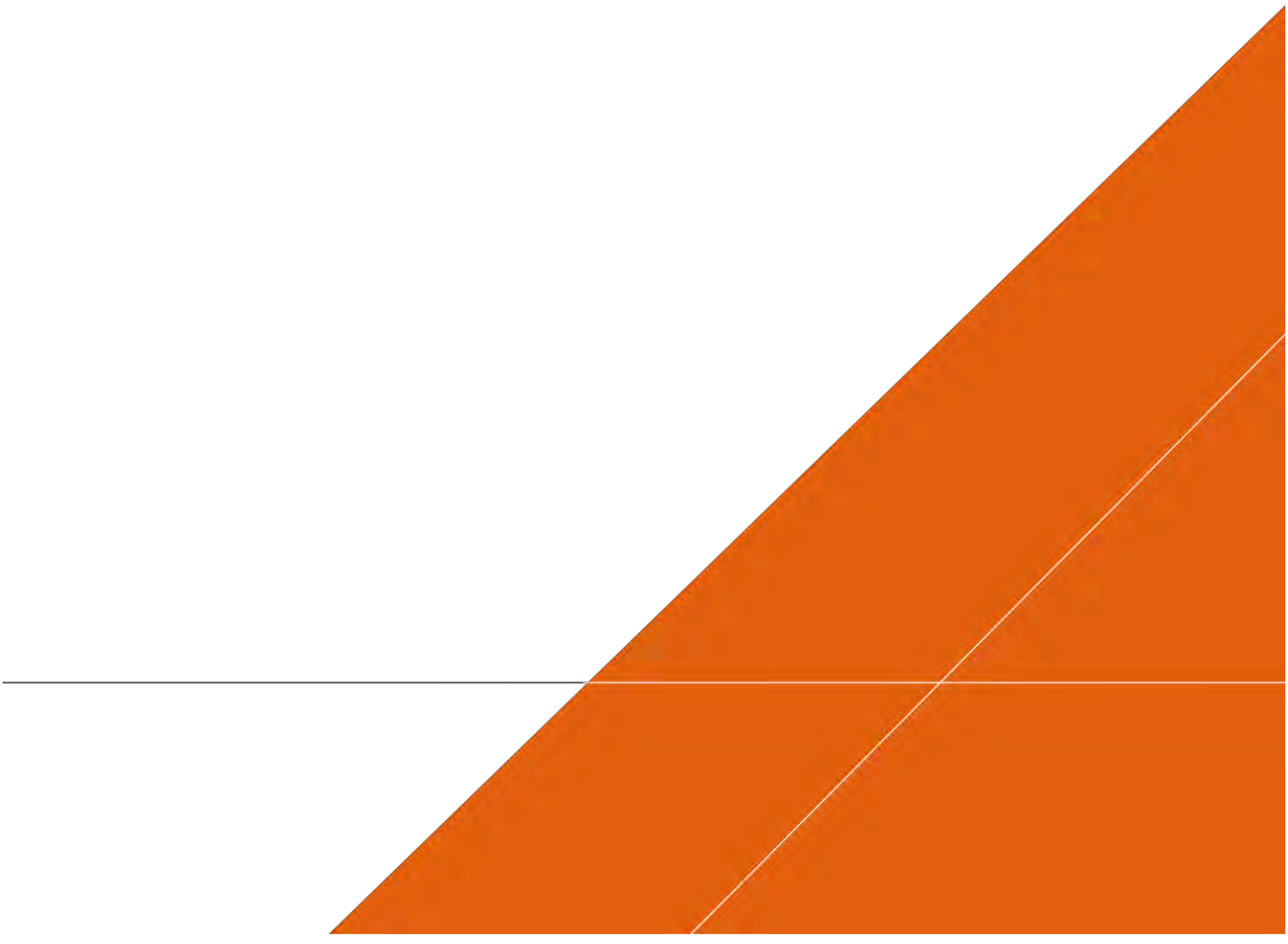
APPENDIX D – PRELIMINARY CONSTRUCTION TRAFFIC MANAGEMENT PLAN

ARCADIS Design & Consultancy for natural and built assets

WALLERAWANG BATTERY PLANT

Preliminary Construction Traffic Management Plan

22 APRIL 2022



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Sydney, NSW 2000, Australia

GREENSPOT WALLERAWANG BATTERY PLANT

PRELIMINARY CONSTRUCTION TRAFFIC MANAGEMENT PLAN

Final Report

Author	Author Name	Herman Joubert
Checker	Checker Name	Michael Yong
Approver	Approver Name	Nicole Vukic
Report No	Report Number	
Date	22/04/2022	
Revision Text	This draft report has been provided to Environment for comments and review.	

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	04/06/2019	Draft Report	HJ	NV
01	18/06/2021	Draft Report	HJ	NV
02	28/06/2021	Draft Report	HJ	NV
02	30/06/2021	Final Report	HJ	NV
03	22/04/2022	Final Report (Updated)	CL	NV

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TABLES

ABBREVIATIONS

Abbreviation	Description
CTMP	Construction Traffic Management Plan
LSBS	Large-scale battery storage
MUTCD	Manual for Uniform Traffic Control Devices
PTSS	Portable Traffic Signal System
TCP	Traffic Control Plan
TfNSW	Transport for New South Wales
TGS	Traffic Guidance Scheme
TMP	Traffic Management Plan
WMS	Work Method Statement

1 INTRODUCTION

1.1 Project overview

Greenspot Wallerawang Pty Ltd (Greenspot) (the Proponent) is seeking development consent for the construction, operation and maintenance of a Battery Energy Storage System (BESS) within the buffer lands of the decommissioned Wallerawang Power Station site. The BESS will be approximately 500 Megawatt (MW) and would provide between 500 to 1,000 Megawatt hours (MWh) of battery storage capacity or 1 to 2 hours of storage duration. To reflect the legacy of the Wallerawang Power Station and acknowledge the long-term role the Power Station played in the NSW energy sector, the battery will be known as the **'Wallerawang 9 Battery'** (the Project).

The Project is considered to meet the definition of State Significant Development (SSD) under Clause 8 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). The Project would be for electricity generating works (above $30 million Capital Investment Value (CIV) on land where this use is permitted with development consent under Clause 34 of the *State Environmental Planning Policy (Infrastructure)* (ISEPP).

The Proponent is seeking SSD approval for the Project under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 Project background

The Project would involve construction and operation of a large-scale Battery Energy Storage System (BESS) at Wallerawang, NSW. The BESS would have a capacity of approximately 500 MW and between 500 and 1000 megawatt hours (MWh) of storage capacity. The project also includes the construction and operation of ancillary infrastructure to support the operation of the BESS.

Key features of the Project include:

- Large-scale BESS including battery enclosures, inverters and transformers
- 33/330 kV switchyard
- Transmission line connection between the BESS and the nearby TransGrid Wallerawang 330 kV substation
- Ancillary elements including site access from the Castlereagh Highway, internal access roads and parking, site office and amenities, stormwater and fire management infrastructure, utilities, signage, fencing, security systems and landscaping.

The Project would also include subdivision of the Project site to align with major project elements and ancillary upgrades to the existing Wallerawang 330 kV substation operated by TransGrid.

The new power supply connection from the BESS to the Wallerawang 330 kV substation would be established on land owned by Greenspot and/or TransGrid and no other third-party easements would be required.

Table 1-1 Project Overview specifications

Project Component	Details
Application Lots	• Lot 3, DP 1018958 (BESS facility and office) • Lot 4, DP 1016725 (BESS facility) • Lot 3, DP 1181412 (Transmission connection line, Lake Wallace and Coxs River, west of the Project site) • Lot 3, DP 1226927 (Includes the access road) • Lot 4, DP 1226927 (Includes the access road) • Lot 91, DP1043967 (TransGrid 330kV Substation) • Castlereagh Highway (east of the Project site).

Project Component	Details
Zoning	• The Project is located on land zoned as a combination of IN3 Heavy Industrial and SP2 (Infrastructure) Electricity generating works.
Project footprint	• Total footprint – approximately 21 ha • BESS, switchyard, ancillary development - approximately 14 ha • Transmission line - approximately 6 ha • Access road to the BESS facility, office and amenities – approximately 1ha
Access	• Access to the Project site will be via the access road off the Castlereagh Highway
BESS facility and components	• Up to 2013 battery enclosures housing lithium-ion type battery cells, associated control systems and HVAC (heating, ventilation and air conditioning) units • Up to 372 power inverters • 86 MV transformers • Up to four medium voltage (MV) switch rooms containing MV switchgear
33/330 kV Switchyard	• Switchyard (330 kV) including up to four high voltage (HV) transformers and HV switchgear and associated control building
Transmission line connection	• Approximately 1,000 m transmission line • Cabling infrastructure from TransGrid substation to the BESS substation • Alteration to Wallerawang 33 kV switchyard (bay changes for connection)
Ancillary elements	• Project site access road off the Castlereagh Highway • Permanent site office, staff amenities and car park • Signage at site entrances and within the Project site for the purposes of way finding, safety and building identification. • Perimeter and internal lighting of the Project site • Installation of stormwater drainage and management measures • Two 20,000 L water tank for fire suppression • Installation of on-site security system including but not limited to, closed circuit television (CCTV) and an integrated telecommunication system • Connections to telecommunications infrastructure • Single electricity 330 kV back fed for supply • Rainwater capture • Contained onsite sewage system
Construction	
Activities	Construction of the Project is expected to comprise: • Site establishment • Trenching • Installing of footings • Delivery, installation and fit out of the BESS • Delivery installation and fit out of the switchyard • Construction of ancillary elements • Installation of permanent fencing and security systems. • Testing and commissioning. • Removal of construction equipment and materials and rehabilitation of construction areas (where applicable).

Project Component	Details
Program	• Commence construction in Quarter 2 of 2022 and will continue for approximately 12-24 months.
Hours	• 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • No works on Sundays or public holidays.
Workforce	• Approximately 100 full-time equivalents will be required for construction during the project peak
Operation	
Capacity	• The BESS would have a capacity of approximately 500 MW and 500 to 1000 MWh of storage capacity, or one to two hours of storage duration.
Life of BESS	• The estimated life of the initial BESS equipment is 15 – 20 years. It is expected that replacement of the batteries would be undertaken extending the life of the BESS to 30 - 40 years.
Workforce	• Up to five operational personnel. In addition to this, maintenance staff would be on site periodically.
Operational hours	• 24 hours, 7 days a week.

The layout of the BESS including the key features is shown on Figure 1-1.

Figure 1-1 Proposed EIS Project Layout

1.3 Purpose of Preliminary Construction Traffic Management Plan (CTMP)

The purpose of this Preliminary Construction Traffic Management Plan (PCTMP) is to outline strategies to minimise the impact on all road users who would share the road network with vehicles involved in the construction of the Project as well as maintain the safety and efficiency of the road network. The preparation of a final CTMP will be developed in relation to the requirements provided by the *Roads and Maritime Services Traffic Control at Work Sites Manual Technical Manual, 27 July of 2018.*

This PCTMP aims to provide basic principles for traffic management to guide project development through the planning and design phases. Additional detail regarding final project traffic volumes and configurations, construction programming, stakeholder communication and traffic guidance schemes would be required to prepare the final CTMP. The key objectives to be met by this PCTMP are to:

- Ensure the safety of all road users on the road network, including vehicles, pedestrians and cyclists
- Minimise traffic delays resulting from the development
- Maintain satisfactory property access
- Minimise disruption to adjacent properties
- Minimise disturbance to the environment
- Meet the requirements of legislation and codes of practice regarding traffic management.

The following legislation, policies and guidelines have been used to prepare this preliminary CTMP:

- Transport for NSW Traffic Control at Work Sites Technical Manual Issue 6, 2020
- Austroads Guide to Temporary Traffic Management Part 9
- Austroads Guide to Temporary Traffic Management Part 3
- Manual of Uniform Traffic Control Devices (MUTCD) Part 3: Traffic control for Works on Roads, November 2019
- Supplement to Manual of Uniform Traffic Control Devices (MUTCD) Part 3, November 2019
- Traffic Management for Construction or Maintenance Work Code of Practice, 2008
- Traffic Controller Accreditation Scheme Approved Procedure, December 2017
- AZ/NZS ISO 31000:2009 Risk Management – Principles and guidelines
- Work Health and Safety Act, 2011
- Traffic and Road Use Management (TRUM) Manual.

The construction works for the Project will be predominantly contained within private land and are not expected to encroach into the adjacent road corridors apart from the required site access construction works and construction traffic management signage. Therefore, traffic management at the Project site is anticipated to be limited to the control of the vehicle movements at the identified access into the Project site from the external road network and surrounding intersections.

The CTMP is considered a ‘live’ document which needs to be updated by the contractor and submitted for approval by TfNSW, prior to commencement of construction activities, once more detailed information is available.

1.4 Constraints

1.4.1 Principal's Requirements

Due to the preliminary stage of the Project the exact Principal requirements are still unknown. All requirements of the Principal which impact the road network will be listed here when identified in subsequent stages of the Project development and implementation.

These include:

- Providing the necessary resources for the development, implementation and monitoring of Worksite Traffic Management Plans and Strategies;
- Ensuring that the Construction Traffic Management Plan (CTMP) and Traffic Guidance Scheme (TGS) developed for the project maximise the safety of road workers and road users;
- Ensuring suitable communication and consultation with affected stakeholders is maintained at all times, including advising Emergency Services and Traffic Management Centre prior to each Stage implementation and upon stage completion; and
- Comply with all necessary legislative and contractual requirements for the movement of traffic through, past and around the work site.

1.4.2 Contractor's Requirements

At this preliminary stage a Contractor has not yet been appointed for the works. However, when a Contractor is involved their requirements which impact the road network will be listed here.

These include but not limited to:

- Providing the necessary resources for the development, implementation and monitoring of Worksite Traffic Management Plans and Strategies;
- Ensuring that the CTMP and TGS developed for the project maximise the safety of road workers and road users;
- Ensuring the approved CTMP and TGS are provided to the Traffic Management Company and implemented in accordance with the approved documentation;
- Ensuring that employees (including subcontractors) have the required skills and training to conduct worksite traffic management activities;
- Ensuring any incidents are recorded and closed out and appropriate actions taken within minimal timeframes;
- Ensuring that all identified hazards are controlled (SFAIRP) and all Work Method Statement (WMS) are approved prior to the works;
- Ensuring that safety at all times is maintained or improved;
- Ensuring suitable communication and consultation with affected stakeholders is maintained at all times, including advising Emergency Services and Traffic Management Centre prior to each Stage implementation and upon stage completion; and
- Comply with all necessary legislative and contractual requirements for the movement of traffic through, past and around the work site.

1.4.3 Local governments

The Project is located in the Lithgow Local Government Area (LGA). Should construction works entail heavy vehicle movements along Council owned roads consultation will be undertaken with Council during development of the final CTMP addressing concerns such as (but not limited to) council owned

assets, the surrounding environment, and other transport modes. The CTMP shall be updated to include the outcomes of this consultation.

1.4.4 Emergency services

Whilst the emergency services have no vested interest in the work, they would be affected by any traffic management that is put in place. Access along the road network through the construction work sites shall be provided for emergency service vehicles. This will need to be identified in the final CTMP and clearly signed in the relevant TGS's.

The Contractor will liaise closely with all parties regarding the management schemes that would be implemented and when these would be implemented. Records of such notifications and discussions shall be maintained by the Contractor.

1.4.5 Schools, local businesses and surrounding land uses

The Contractor and the Nominated Traffic Control Officer will consult with all the schools and local business owners who may be impacted by the works, even though none were specifically identified within this TIA report. The project construction works will need to ensure that all commercial properties shall remain operational at all times. Should construction vehicle movements occur along school roads, adequate safety measures will be put in place to ensure safety is provided to all, especially pedestrians traversing around schools.

2 TRAFFIC CONTROL MEASURES

There are three aspects of the Project which are addressed in this PCTMP, including:

- Traffic management planning associated with the transportation of construction material and equipment, including over-dimension components, for the establishment of the Project site and during construction of the Project.
- Traffic management planning associated with construction works at the Project site access (interface with Castlereagh Highway), limited to providing safe access from the adjacent road network (Castlereagh Road) to the Project site.

The need for traffic management for each of these activities is described further below.

2.1 Transport of over dimensional construction material and equipment

The transport of any over dimensional construction material and equipment will require a permit from TfNSW and may also require a police escort. Transport of components and material will be planned in detail and in consultation with New South Wales Police Force (NSWPF), recognising and determining whether the scale of oversized vehicle movements will require a significant commitment of police resources to facilitate. The following measures are proposed to manage the overall transport operations and minimise impacts on other road users:

- Develop a regular schedule of road closures comprising a list of specific roads/intersections and closure times and communicate this widely to provide advance warning of closures to road users (If required).
- No over-dimension vehicle operations will occur during school bus operating hours (where feasible) which may occur along the routes from where the vehicles would be travelling from
- Transport activities will occur outside of peak hour conditions (where feasible).

2.2 Project site traffic management option analysis (access works)

There may be a possibility that partial closure of Castlereagh Highway would be required to undertake the minor upgrades to the proposed access site, and this is proposed to be under shuttle flow conditions. Traffic management measures to mitigate any risks during these minor works will be included in the final CTMP.

Traffic management options for all road users (vehicles) and construction vehicles have been considered when selecting the preferred traffic management strategy for the Project site during the minor access upgrade works. The traffic management options analysis is provided in Table 0-1.

Table 0-1 Traffic Management Options Analysis

Option		Features	Comment
Vehicle Traffic around the access track upgrade worksite	Side-track	Would allow closure of the entire carriageway, creating more efficient works Insufficient area to implement. The road corridor is narrow and there is not enough space to fit a side-track with a lane each way without accommodation works. The cost of a side-track would be excessive.	Not practical
	Detour	No practical detour route available within vicinity of the site.	Not Practical
Traffic through the access track upgrade worksite		Excavation works with workers on foot are required to construct widenings, therefore separation requirements would not be satisfied.	Not practical

Option	Features	Comment
Traffic past the access track upgrade worksite	Will ensure full separation between road users and road work site. Main traffic is not detoured away from existing routes. Traffic remains on a similar distance route so will not adequately increase travel time (apart from speed restrictions) Emergency Vehicles have limited reduction in travel time.	Adopted

It is proposed that bi-directional traffic movements be prevented during periods when the access is anticipated to be used, with traffic flow to be restricted to a single direction at a time (shuttle flow) as controlled by portable traffic signals.

The peak two-way traffic flow at the site is expected to be less than 500 vehicles per hour (bi-directional) during the Project construction period which is acceptable for single lane operations which may be required for the minor access road upgrade. It is recommended that a TGS / Traffic Control Plan (TCP) be prepared for the CTMP to illustrate the required arrangement of traffic signals (if considered), traffic controllers and advanced warning signs to manage traffic flow and interface between the works area and the traffic movements.

The upgrade proposed to the access will involve a slight widening on the western side of Castlereagh Highway to facilitate the formulation of the required bell mouths and pavement widening. It is expected this road widening will take a duration of 8 weeks and constructed in one stage:

1st Stage - Construction of the Westbound widening and access works

A specific separate CTMP should be prepared for these construction works at the access by the contractor when appointed and is expected to form part of a submission package for approval from TfNSW for these works.

3 TRAFFIC MANAGEMENT REQUIREMENTS OF ACCESS UPGRADE WORKS

3.1 Control Type

The requirements of Transport for NSW Traffic *Control at Work Sites Technical Manual Issue 6, 2020* shall apply as traffic signals are considered for use during the minor access road upgrade.

A Type-2 Portable Traffic Signal System (PTSS) or Vehicle Priority Systems shall be adopted with two modes of operation such as manual and vehicle-actuated. Vehicle actuation is the preferred operating mode, with manual to be adopted as a second alternative.

3.2 Portable Traffic Signal Approach Conditions

Sight distance on the approach to traffic signals shall be:

- A minimum of 2D (with the maximum value of D) for portable traffic signals under manual operation by a Traffic Controller
- Four cones, spaced 4 m apart, should be installed on the centreline starting 6 m in advance of the portable traffic signal position during single-lane reversible flow operation. These traffic cones are used to highlight the traffic control device position, the location of where vehicles are required to stop and for delineation / traffic management purposes.
- The temporary hazard marker (T5-Q02) or KEEP LEFT delineator (R2-3-Q01) sign may be installed at the start of the row of the four cones in each direction to direct traffic to the correct travel path.
- A temporary stop line, when used, shall be located 6 m in advance of a temporary traffic signal or portable traffic signal. A STOP HERE ON RED SIGNAL sign (R6-6) should also be used at this location to supplement the stop line.
- Where a temporary stop line is not used, a STOP HERE ON RED SIGNAL sign (R6-6) shall be located 6 m in advance of a temporary traffic signal or portable traffic signal.

3.3 Traffic Signal Operations

The requirements of MUTCD Part 3 Supplement Section 4.11 Procedures for the installation and operation of traffic control devices – portable traffic signals shall apply.

A Type-2 Portable Traffic Signal System (PTSS) shall be adopted which has three modes of operation (manual, fixed-time, and vehicle-actuated) with adjustable time settings and is able to operate unattended. Vehicle-actuated is the preferred operating mode at this location, with manual operation to be adopted where vehicle-actuated is unsuitable or not working.

Preliminary timing is outlined in Table 0-1 noting that the maximum cycle time shall always be less than 240 seconds.

Table 0-1 Preliminary Portable Traffic Signal Timing

Time setting	Time	References
Yellow time	4 seconds	Transport for NSW Traffic Control at Work Sites Technical Manual Issue 6, 2020 MUTCD Part 3 Supplement Section 4.11-7.2 Austroads Guide to Traffic Management Part 9: Traffic Operations
All-red time	To be determined at a later stage	Transport for NSW Traffic Control at Work Sites Technical Manual Issue 6, 2020 MUTCD Part 3 Supplement Section 4.11-7.3 and Table 4.11-1.7.3

Time setting	Time	References
Minimum green time	5-10 seconds	Transport for NSW Traffic Control at Work Sites Technical Manual Issue 6, 2020 MUTCD Part 3 Supplement Section 4.11-7.1 and Table 4.11-1.7.1
Maximum green time	To be determined at a later stage	Transport for NSW Traffic Control at Work Sites Technical Manual Issue 6, 2020 MUTCD Part 3 Supplement Section 4.11-7.3 and Table 4.11-1.7.4-A

3.4 Signage and delineation

Signage where required, should be displayed during both daytime and at night with the retroreflective material used for the signs meeting the requirement for Class 1W sheeting as specified in AS1906.1. Additional to the requirement for the Class 1W retro-reflectivity, all signs shall be free from defects, such as being bent or broken, and are to be kept free of accumulated dirt, road grime and other contaminants.

Where both “A” and “B” sizes for the T Series signs are available, only “B” size signs should be used. This will be updated during development of the CTMP once traffic guidance measures are developed.

Advisory truck turning signage shall be installed at the access location where heavy vehicle turn movements would occur.

3.5 Variable message signs

The use of advisory variable message signs (VMSs) may be used to supplement other traffic signage devices and provide advanced warning of slow-moving heavy vehicles. Where major traffic changes are planned (such as detours and road closures) VMSs should be displayed at least seven days prior to the implementation of the traffic change. Messages displayed on the VMS shall comply with the requirements of the Manual for Uniform Traffic Control Devices Part 3, Clause 3.16.6.

3.6 Minimise impacts on traffic flows and congestion on roads

In the event that road closures are required for construction works, stakeholders will be given a minimum of 48 hours’ notice. Temporary road closures, single-lane access and relocations during the construction period will be subject to coordination with the appropriate authorities. All traffic-related issues and changes will be presented to stakeholders as part of the consultation process and will be carried out to minimise impacts on the road network wherever possible.

The following requirements shall also be adopted within the CTMP, to minimise impacts on local amenity during these works:

- Construction machinery and vehicles will be well maintained and in good working order to minimise the potential for machinery breakdowns whilst undertaking construction works and the associated impacts during the construction period.
- Speed limits will be set and observed at the site to minimise road safety related incidents and dust generation.
- Appropriate directional signage and traffic control will ensure vehicles enter and exit the Project Site with minimal disturbance to other road users and to provide advice of any temporary changes in road conditions.

3.7 Road user delay management

Delays to road users during construction will be minimised by:

- Providing experienced and qualified traffic control personnel.
- Planning construction works to occur outside of peak hours as much as possible in order to minimise disruptions to local road users and residents.
- Notifying local road users and residents in advance to the construction works being undertaken to ensure adequate opportunities are provided to seek alternative routes.

Where traffic has to be stopped or diverted at particular times adequate notification will be provided through community engagement procedures to ensure local road users and residents are able to plan alternative routes in advance of the construction works being undertaken. This will be planned in advance, so that the durations of impacts are kept to a minimum and traffic queues are minimised as far as practicable.

3.8 Other traffic control devices

Other traffic control devices which may be used include barrier boards, plastic mesh fencing, temporary post mounted delineators, cones, flaps, traffic warning lamps, temporary pavement markings, boom gates and portable traffic signals. These items will be provided as required.

3.9 Incident management

In the event of a site safety incident relating to traffic, the following procedures shall be implemented:

- Stop vehicle/personnel involved in the incident immediately (or as appropriate).
- Operate warning lights and warn other drivers to slow down.
- In the event of spillage, clear the spill whilst engaging appropriate safety and environmental standards as relevant to the event and in accordance with the final CEMP.

In the event of a complaint or failure to comply with a permit or licence condition, a suitable member of the construction team (eg site supervisor) will investigate the complaint promptly and initiate appropriate action to reduce the impact. The following process shall be followed:

- Undertake an investigation to determine the cause of the problem.
- Undertake monitoring, if possible.
- Modify transportation practices as necessary to reduce the duration or level of impact.
- Report the results of the investigation to relevant authorities.

3.10 Induction safety training

All new personnel and visitors to the site will undergo a general site induction as soon as they arrive on site. Inductions will include site specific traffic details such as construction traffic hazards, driver code of conduct, and any relevant construction traffic management procedures in place on the site at the time of induction.

4 TRAFFIC MANAGEMENT REQUIREMENTS OF PROJECT SITE WORKS

All Project related construction work would occur within the Project Site. Construction works at the site access would be complete before construction commences, however it is recommended that the following measures be included to manage construction vehicle movements to and from the site access in order to ensure appropriate road safety conditions prevail:

- Workers from the north will be mandated to come from the south of the site access (i.e. via Main Street and Barton Avenue through the town of Wallerawang) to access the site during the 6am to 7am period. This mandate will be enforceable with camera monitoring, heavy penalties and emphasised at daily Toolbox sessions with workers
- Advisory truck turning signage shall be installed at the access location where heavy vehicle turn movements would occur.

4.1 General requirements

The following general requirements which should be taken into consideration during development of the CTMP:

- Identification of all Heavy Vehicle (HV) and Over Dimensional (OD) vehicle haulage routes for all work stages.
- A mechanism to review identified haulage route road conditions prior to the commencement of works.
- Mechanisms/agreements (if deemed necessary) to maintain haulage route roads and road infrastructure, including local public roads used by site traffic, during construction works and to reinstate roads to at least pre-construction conditions.
- Qualify and identify any relevant mechanisms for OD vehicle permits and traffic management requirements.
- HV movements should be timed wherever possible to avoid or minimise localised impacts such as avoiding peak traffic zones and school zones between the hours of 7am to 9am and 2pm to 4pm.
- Where oversized vehicles are used, suitable controls and management would be put into place and heavy vehicle permits would be obtained as required.
- Oversized loads would be transported in accordance with relevant TfNSW guidelines.
- Appropriate management of the transportation of construction materials and project components to maximise vehicle loads and thereby minimise vehicle movements.
- Heavy vehicle turn signs should be installed at the compound area accesses.
- Installation of specific warning signs at local access roads to the construction corridor to warn existing road users of entering and exiting traffic.
- Distribution of warning notices to advise local road users, residents and site owners of scheduled construction activities and the potential impacts they may have on access.
- Induction of staff and truck drivers on the requirements of the CTMP.

This is not an exhaustive list, and the requirements for the CTMP will need to address the requirements outlined in the development consent.

5 WORKPLACE AND TRAFFIC SAFETY TRAINING

5.1 Induction safety training

All new personnel and visitors to the site will undergo a general site induction as soon as they arrive on site. Inductions will include site specific traffic details such as construction traffic hazards, driver code of conduct, and any relevant construction traffic management procedures in place on the site at the time of induction.

5.2 Accredited work zone traffic controllers and management training

Only trained and accredited traffic control personnel will be used for traffic control works on public roads.

Traffic controllers will undergo appropriate training and be certified as competent prior to their assignment to undertake traffic management at construction work sites. The minimum requirement is to have satisfactorily completed the RMS's training as per RMS Technical Direction TDT 2010/01.

5.3 Review of the Construction Traffic Management Plan

This preliminary CTMP was prepared to provide basic principles for traffic management to guide project development through the planning and design phases. Additional detail regarding final project traffic volumes and configurations, construction programming, stakeholder communication and traffic guidance schemes will be required to prepare the final CTMP, which must be prepared by an accredited Traffic Management Company, and approved prior to the commencement of works.

During the construction phase, formal reviews of the CTMP should occur regularly by relevant personnel, including ongoing consultation with stakeholders, to ensure the safety of all road users and manage changes. All changes to the CTMP should be clearly communicated to stakeholders and project staff in a timely manner.

6 INSPECTIONS AND MONITORING

6.1 Inspections

Construction traffic inspections will be undertaken at the commencement of construction, and at appropriate regular intervals thereafter, to ensure the safe movement of traffic and the protection of persons and property in and around the worksite.

6.2 Monitoring

Monitoring of the following aspects shall be undertaken to confirm compliance with the CTMP and regulatory requirements:

- Visual monitoring of traffic movements on site will be carried out to ensure the safe movement of traffic and the protection of persons and property through and around the site.
- Construction roads will be inspected to ensure road conditions support safe working and driving.
- Following periods of heavy rain or adverse conditions, construction roads will be inspected prior to heavy vehicle traffic use to ensure driver and vehicle safety.
- The site will be comprehensively inspected to ensure signage and traffic barriers etc. are in place, clearly visible, and performing their function in directing traffic and alerting drivers of safety issues. Signs will need to remain appropriate for changing circumstances during the construction phase.

7 REVIEW AND IMPROVEMENT

An effective CTMP includes processes that allow for continual improvement. The CTMP will identify the processes for providing effective feedback on the environmental performance of mitigation measures.

Updates or amendments of the CTMP will be implemented where mitigation strategies are not achieving compliance. Continual improvement through planning, implementing, acting and monitoring the environmental performance of the project will occur during the construction phase.

8 DOCUMENTATION

The CTMP and CEMP will include a section to identify the documentation requirements for construction traffic management of the Proposal. The section will identify the responsibilities of the project team for capturing and keeping data and documents.

The construction contractor is required to develop and implement a system for document control for documents relating to construction traffic management and compliance. This must be documented within the CTMP and CEMP

8.1 Document Control

The construction contractor will coordinate the preparation, review and distribution of construction traffic management documents, as appropriate. Construction traffic management documents would be stored at the Proposal site for ready reference.

The construction contractor is required to develop and implement a document control procedure to control the flow of documents within and between the Principal Representative, stakeholders and subcontractors.

The procedure must also ensure that documentation is:

- Developed, reviewed and approved prior to issue.
- Issued for use.
- Controlled and stored for the legally required timeframe.
- Removed from use when superseded or obsolete.
- Archived.

A register and distribution list must identify the current revision of particular documents or data. Document control would be in accordance with ISO 14001.

APPENDIX E – 2D INTERSECTION DESIGN

NOT FOR CONSTRUCTION

PLOT DATE / TIME	PLOT BY
$TIME$	ARCADIS Road Design

STRATEGIC JUNCTION DESIGN LAYOUT
WALLERAWANG BESS RTS

SCALE ON DRAWING	CO-ORDINATE SYSTEM	DATUM
1 : 800.00000	MGA ZONE 56	AHD

NOT FOR CONSTRUCTION

PLOT DATE / TIME	PLOT BY
$TIME$	ARCADIS Road Design

STRATEGIC JUNCTION DESIGN LAYOUT
WALLERAWANG BESS RTS

SCALE ON DRAWING	CO-ORDINATE SYSTEM	DATUM
1 : 800.00000	MGA ZONE 56	AHD