Appendix D
Transport and traffic

Great Western Highway Blackheath to Little Hartley

Appendix D - Technical report - Transport and traffic

Client: Transport for NSW

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18-Jan-2023

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Glossary and abbreviations

Key terms	Description
Active transport	Collective term for walking and cycling
Capacity	The nominal maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or roadway in one direction during a given time period under prevailing roadway conditions.
Construction footprint	The area required for construction of the project.
Corridor	A substantial segment of the transport network, in which parallel, possibly competing, transport routes (and modes, where appropriate) operate between two locations.
Entry ramp	A ramp by which one enters a limited-access highway/tunnel.
Exit ramp	A ramp by which one exits a limited-access highway/tunnel.
Great Western Highway	Major east-west arterial road between Sydney and Bathurst.
Heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Lane	A portion of the carriageway allotted for the use of a single line of vehicles.
Mid-block	Section of road between two intersections.
Mitigation	Actions or measures to avoid or reduce the impacts of a project.
Operational footprint	The area required for operation of the proposed project.
The project	The construction of a tunnel and upgrades to the existing Great Western Highway between Blackheath and Little Hartley.
SIDRA	Modelling software used to assess intersection performance.
The project	Proposed changes to be made to the existing condition.
Transport	Transport for New South Wales
Upgrade Program	The Upgrade Program consists of: • Great Western Highway Upgrade – Medlow Bath (Medlow Bath Upgrade): upgrade and duplication of the existing surface road corridor with intersection improvements and a new pedestrian bridge • Great Western Highway East – Katoomba to Blackheath (Katoomba to Blackheath Upgrade): upgrade, duplication and widening of the existing surface road corridor, with connections to the existing Great Western Highway east of Blackheath • Great Western Highway Upgrade Program – Little Hartley to Lithgow (West Section) (Little Hartley to Lithgow Upgrade): upgrade, duplication and widening of the existing surface road corridor, with connections to the existing Great Western Highway at Little Hartley (approved) • Great Western Highway Blackheath to Little Hartley: construction and operation of a twin tunnel bypass of Blackheath and Mount Victoria

Key terms	Description
	and surface road works for tie-ins to the east and west of the tunnel (the project).

Acronym	Definition
ABS	Australian Bureau of Statistics
ACT	Australia Capital Territory
CBD	Central Business District
CEMP	Construction Environmental Management Plan - A site specific plan developed for the construction phase to ensure that all contractors and sub-contractors comply with the environmental conditions of approval and that the environmental risks are properly managed.
CTAMP	Construction Transport and Access Management Plan
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW)
EPA	NSW Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Act 1999 (Commonwealth)
EPL	Environment protection licence
FFF	future freight forecasts
GMA	Greater Metropolitan Area
HML	Higher Mass Limit
HPV	High Productivity Vehicle
HFF	Heavy vehicle forecasts
km	kilometres
LEP	Local Environmental Plan
LGA	Local Government Area
LoS	Level of service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
m	metres
MKVT	Million vehicle kilometres travelled
NMC	Neil Matthews Consulting
NSW	New South Wales
OTM	operational travel model
PBS	Performance Based Standards

Acronym	Definition
PCU	Passenger car units
PCU/km/ln	Passenger car units per kilometre per lane
RTM	Regional Travel Model
SA	Statistical Area
SCATS	Sydney Coordinated Adaptive Traffic System
SEARs	Secretary's environmental assessment requirements
SFM	Strategic Freight Model
TBM	Tunnel Boring Machine
TCS	Traffic Control Signal
TZP19	Travel Zone Projections 2019
Transport	Transport for New South Wales
VHT	vehicle hours travelled
VKT	vehicle kilometres travelled

Executive summary

Project overview

Together, the Australian Government and the NSW Government are investing more than $4.5 billion towards upgrading the Great Western Highway between Katoomba and Lithgow (the Upgrade Program).

The project would comprise new twin tunnels around 11 kilometres in length between Blackheath and Little Hartley and associated surface road upgrade work for tie-ins to the east and west of the proposed tunnel portals. Key components of the project are summarised in Table 1-1 and shown in Figure 1-2.

The project has the following key objectives which align with the objectives of several strategic plans developed by the Australian Government, NSW Government and the Blue Mountains City Council and Lithgow City Council:

- improve economic development, productivity and freight accessibility within and through the Blue Mountains, Central West and Orana regions
- improve the resilience of the corridor between Blackheath and Little Hartley
- improve transport network performance, reliability and efficiency of the corridor between Blackheath and Little Hartley
- improve the overall safety of the corridor for all transport users between Blackheath and Little Hartley.

The purpose of this technical report is to provide a transport and traffic assessment which addresses the Secretary's environmental assessment requirements outlined in Table 1-2.

Study area

The majority of the project would be located below ground generally along or adjacent to the west of the existing Great Western Highway between around Blackheath and Little Hartley. Therefore, the study area selected for this technical report extends along the Great Western Highway between Blackheath to the south of Evans Lookout Road and Little Hartley to the east of Coxs River Road, where the project's impacts and benefits are most likely.

Methodology

The assessment of operational and construction transport and traffic impacts of the project were evaluated using traffic demand data from the Transport's Regional Travel Model (RTM) and the Upgrade Program's freight demand study.

The Upgrade Program's weekday operational traffic model (OTM), a microsimulation model and SIDRA Intersection modelling were used to assess the impacts of the project on the study area road network in 2026 (during construction) and 2030 (year of opening) and 2040 (year of opening plus 10 years). This included an assessment of the project's impacts on freight customers, through-traffic and the local communities along the Great Western Highway, including Blackheath and Mount Victoria.

The project's impacts on road safety, public transport, active transport, parking and access and movement and place were also qualitatively assessed.

Existing transport and traffic environment

The weekday AM and PM peak hour road network performance assessment indicates that the existing Great Western Highway alignment between Blackheath and Little Hartley currently operates with minimal congestion. However, the mid-block Level of Service (LoS) assessment indicates that outside the townships, the Great Western Highway operates with a LoS D or E.

On peak days such as busy weekends and public holidays vehicle travel times are substantially longer and vehicle speeds are substantially lower than a weekday peak hour, due to the increased traffic demands.

Construction impact assessment

The peak construction activity is estimated to occur in 2026, within an eight-year construction period. Three construction sites are proposed at Blackheath, Soldiers Pinch and Little Hartley.

It is planned that all haulage activity would travel between the construction sites and locations west of the study area via the Great Western Highway to minimise the number of heavy vehicles that would travel through the townships of Blackheath and Mount Victoria.

Across all construction footprints, the construction works could conservatively generate up to 4,160 vehicle movements per day including 1,805 heavy vehicles movements (includes vehicles travelling in and out of the sites).

The additional construction traffic volumes would result in a minor increase to weekday peak hour travel times between Katoomba and Lithgow of about one to two minutes for both directions. Similarly, average vehicle speeds would reduce by about one to two kilometres per hour.

Seven of the eight existing intersections (excluding Great Western Highway and Browntown Oval access intersection) would operate with similar delays and LoS in 2026 with and without construction during the weekday peak hours. However, the project's construction would substantially increase delays for vehicles turning right out of Evans Lookout Road at the Great Western Highway in Blackheath during the weekday AM and PM peak hours.

Vehicles turning right (heading eastbound) from the Soldiers Pinch construction site access would also experience lengthy delays during the weekday AM and PM peak hours. However, demand for this movement during the peak hours isn't expected. This would need to be enforced to avoid unsafe movements occurring during peak hours.

Similar intersection performance would be expected at 6pm on a weekday during peak shift changeover, given that the total traffic volumes at 6pm would be similar to those during the weekday road network peak hour. However, the performance of these intersections would likely be worse at 6am on a weekday and 6pm on weekend.

Measures to minimise the impacts of the project's construction on the transport and traffic network would be further investigated by Transport and the appointed contractor, including the following potential mitigation measures:

- stagger shift times to minimise the hourly traffic generation
- encourage the use of alternative transport modes and carpooling for workers and potentially provide shuttle bus transfers between construction footprints
- minimise heavy vehicle and spoil truck movements during weekend peak periods
- parking management measures to minimise workers using nearby on-street parking near construction footprints, particularly in Blackheath
- investigate upgrades or options to minimise impacts to the Great Western Highway and Evans Lookout Road intersection and the Great Western Highway and Browntown Oval intersection
- develop a construction traffic and access management plan for active transport to document how the active transport interfaces with the construction footprints will be managed.

The cumulative impacts resulting from the combined construction traffic generation for the Upgrade Program would likely include localised increased congestion within townships, poor intersection performance in townships, particularly to the east and west of the Upgrade Program works and reduced travel speeds along the existing Great Western Highway. In addition, multiple traffic switches, lane reductions and speed limit reductions would be active across the Upgrade Program. This would also result in lower travel speeds and longer travel times along the Great Western Highway between Katoomba and Lithgow, particularly at night or during off-peak periods when these are most likely to

occur. However, Transport plans to stage, stagger and manage the Upgrade Program works to minimise these impacts.

Operational impact assessment

In 2030 and 2040, traffic volumes along the existing Great Western Highway within the study area are forecast to increase to around 20,000 and 21,000 vehicles on a typical weekday without the project. The project would attract an additional 1,000-1,600 and 4,000-5,000 vehicles per day to the Great Western Highway corridor in 2030 and 2040, respectively. These attracted vehicles are associated with forecast changes to travel behaviours to take advantage of the improved accessibility and reduced travel time offered by the project.

Traffic volumes along the existing Great Western Highway alignment through Blackheath would reduce by about 60 per cent to 7,300 and 8,300 vehicles per day in 2030 and 2040, respectively. Similarly, traffic volumes on the existing Great Western Highway alignment through Mount Victoria would substantially reduce by nearly 80 per cent to 3,300 and 3,700 vehicles per day in 2030 and 2040, respectively. Heavy vehicles would comprise around 10 per cent of the total trips travelling through the Blackheath and Mount Victoria townships each day. Most of these heavy vehicles would have origins and destinations within the townships.

Reduced traffic volumes along the existing Great Western Highway alignment would offer the following benefits for transport customers that would continue to use this corridor:

- improved mid-block LoS, substantially improved intersection performance, increased travel speeds and travel time savings for all vehicles including buses
- potentially 70 to 75 per cent less crashes per year on the existing Great Western Highway
- improved access and safety for pedestrians and cyclists, which could encourage more walking and cycling along the existing Great Western Highway alignment.

Vehicle trips between Sydney and Blue Mountains and Lithgow and the Central West via the tunnel would benefit from the improved alignment, developed to current design standards which include, wider lanes, improved sightlines, reduced grades, separation of opposing traffic flows, and grade separation from other roads (fewer intersections) when compared to the bypassed sections of the existing Great Western Highway.

Weekday peak hour travel times through the study area (between south of Blackheath and Little Hartley) in 2030 and 2040 would reduce by around 45 per cent from 18 to 19 minutes without the project (via the existing Great Western Highway alignment) to 10 minutes with the project (via the tunnel). It is expected that these weekday travel times with the project would also typically be experienced on weekends and public holidays, given that the tunnel is anticipated to operate with substantial spare capacity and a LoS A or B on a weekday.

Following the completion of the Upgrade Program, the average trip between Katoomba and Lithgow via the upgraded Great Western Highway is estimated to take less than 30 minutes, during a typical weekday peak hour, a saving of up to 13 minutes in 2030 and up to 15 minutes in 2040.

1.0 Introduction

1.1 Project context and overview

The Great Western Highway is the key east-west road freight and transport route between Sydney and Central West New South Wales (NSW). Together, the Australian Government and the NSW Government are investing more than $4.5 billion towards upgrading the Great Western Highway between Katoomba and Lithgow (the Upgrade Program). Once upgraded, over 95 kilometres of the Great Western Highway will be two lanes in each direction between Emu Plains and Wallerawang.

The Upgrade Program consists of:

- Great Western Highway Upgrade – Medlow Bath (Medlow Bath Upgrade): upgrade and duplication of the existing surface road corridor with intersection improvements and a new pedestrian bridge (approved)
- Great Western Highway East – Katoomba to Blackheath (Katoomba to Blackheath Upgrade): upgrade, duplication and widening of the existing surface road corridor, with connections to the existing Great Western Highway east of Blackheath (approved)
- Great Western Highway Upgrade Program – Little Hartley to Lithgow (West Section) (Little Hartley to Lithgow Upgrade): upgrade, duplication and widening of the existing surface road corridor, with connections to the existing Great Western Highway at Little Hartley (approved)
- Great Western Highway Blackheath to Little Hartley: construction and operation of a twin tunnel bypass of Blackheath and Mount Victoria and surface road works for tie-ins to the east and west of the tunnel (the project).

The components of the Upgrade Program are shown in Figure 1-1.

Transport for NSW (Transport) is seeking approval under Division 5.2, Part 5 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) to upgrade the Great Western Highway between Blackheath and Little Hartley (the project).

The project would comprise the construction and operation of new twin tunnels around 11 kilometres in length between Blackheath and Little Hartley, and associated surface road upgrade work for tie-ins to the east and west of the proposed tunnel portals.

The project would be located around 90 kilometres northwest of the Sydney CBD and located within the Blue Mountains and Lithgow Local Government Areas (LGA).

The majority of the project would be located below ground generally along or adjacent to the west of the existing Great Western Highway between around Blackheath and Little Hartley.

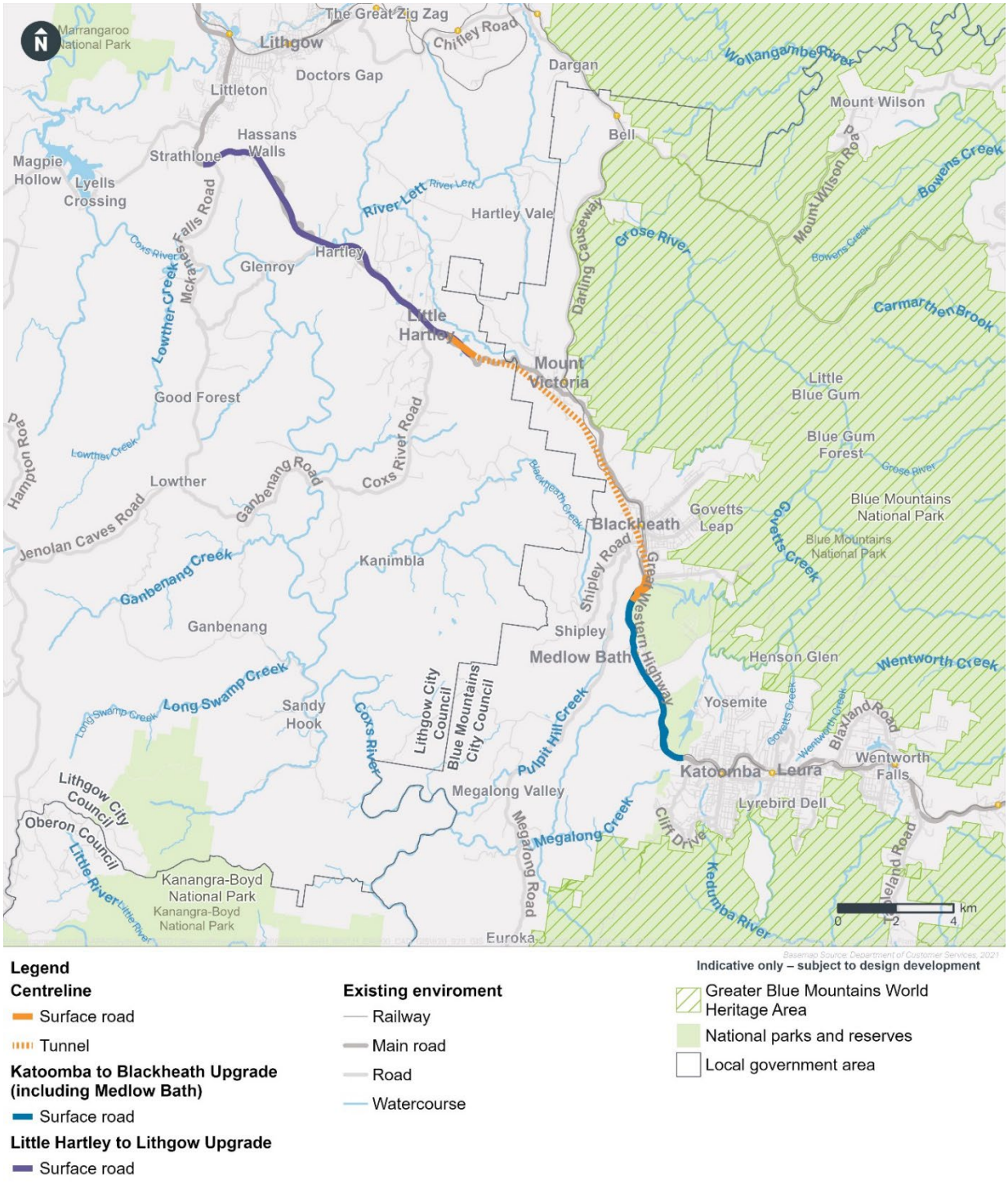


Figure 1-1 The Great Western Highway Upgrade Program

1.2 The project

1.2.1 Key components of the project

Key components of the project are summarised in Table 1-1 and shown in Figure 1-2. These components are described in more detail in Chapter 4 (Project description) of the environmental impact statement (EIS).

The indicative operational configuration of the surface road network at Blackheath and Little Hartley is shown in Figure 1-3 and Figure 1-4.

Subject to approval, the project is anticipated to be open to traffic in 2030.

Table 1-1 Key components of the project

Key project component	Summary
Tunnels	Twin tunnels around 11 kilometres in length between Blackheath and Little Hartley, connecting to the upgraded Great Western Highway at both ends. Each tunnel would include two lanes of traffic and road shoulders and would range in depth from just below the surface near the tunnel portals, to up to around 200 metres underground at Mount Victoria.
Surface work	Surface road upgrade work would be required to connect the tunnels and surface road networks east of Blackheath and at Little Hartley. The twin tunnels would connect to the surface road network via: • mainline carriage ways and on- and off-ramps at the Blackheath portal, located adjacent to the existing Great Western Highway and east of Evans Lookout Road • mainline carriageways at the Little Hartley portal, located adjacent to the existing Great Western Highway at the base of the western escarpment below Victoria Pass and southwest of Butlers Creek.
Operational infrastructure	Operational infrastructure that would be provided by the project includes: • a tunnel operations facility adjacent to the Blackheath portal • in-tunnel ventilation systems including jet fans and ventilation ducts connecting to the ventilation facilities • one of two potential options for tunnel ventilation currently being investigated, being: - ventilation design to support emissions via ventilation outlets; or - ventilation design to support emissions via portals • water quality infrastructure including sediment and water quality basins, an onsite detention tank at Blackheath and a water treatment plant at Little Hartley • fire and life safety systems, emergency evacuation and ventilation infrastructure and Closed Circuit Television • lighting and signage including variable message signs and associated infrastructure such as overhead gantries.
Utilities	Key utilities required for the project would include: • a new electricity substation at Little Hartley to facilitate construction and operational power supply • a new pipeline between Little Hartley and Lithgow to facilitate construction and operational water supply • other utility connections and modifications, including electricity substations in the tunnel
Other project elements	The project would also include: • integrated urban design initiatives • landscape planting.

Figure 1-2 Overview of the project

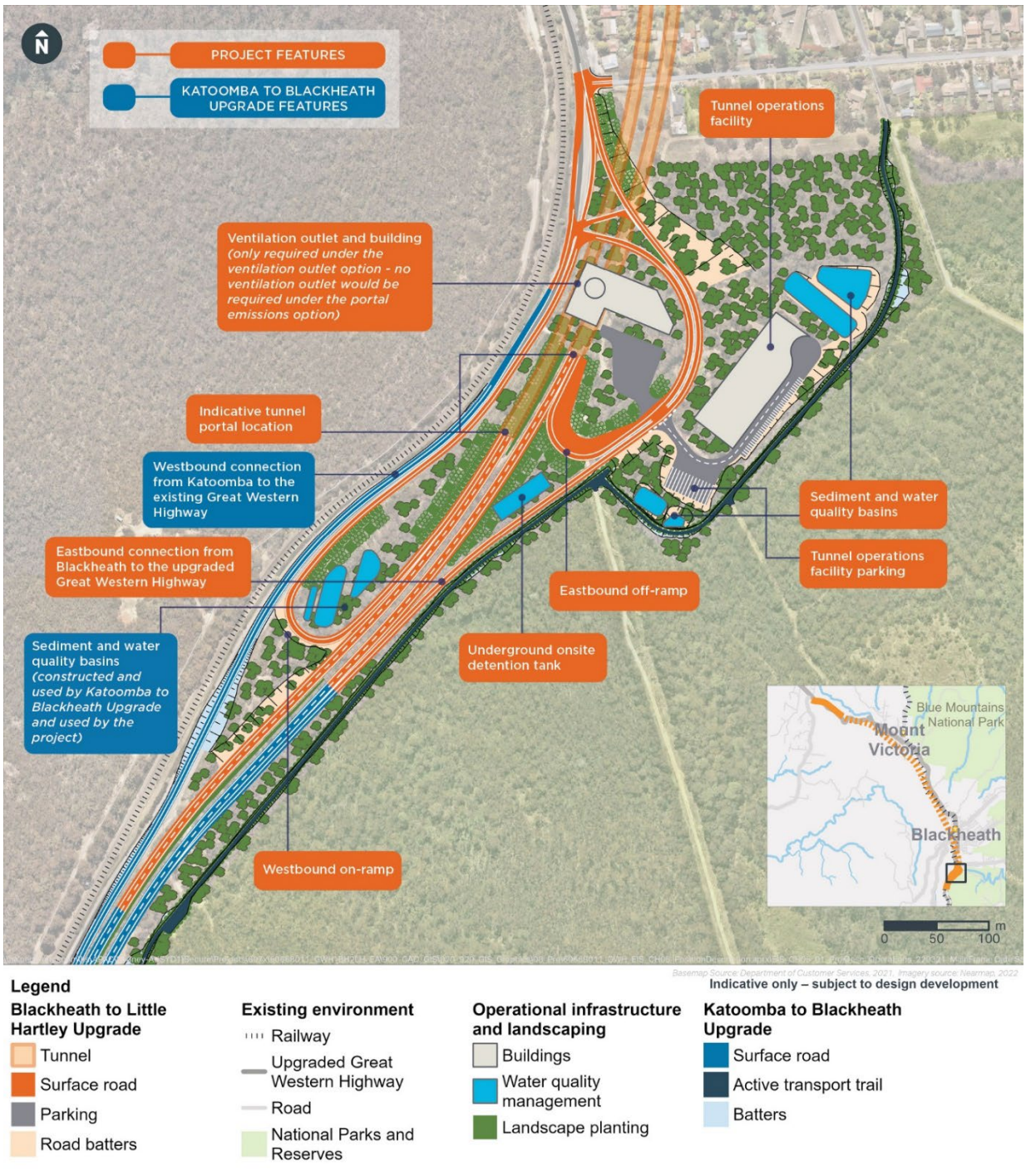


Figure 1-3 Indicative operational configuration at Blackheath

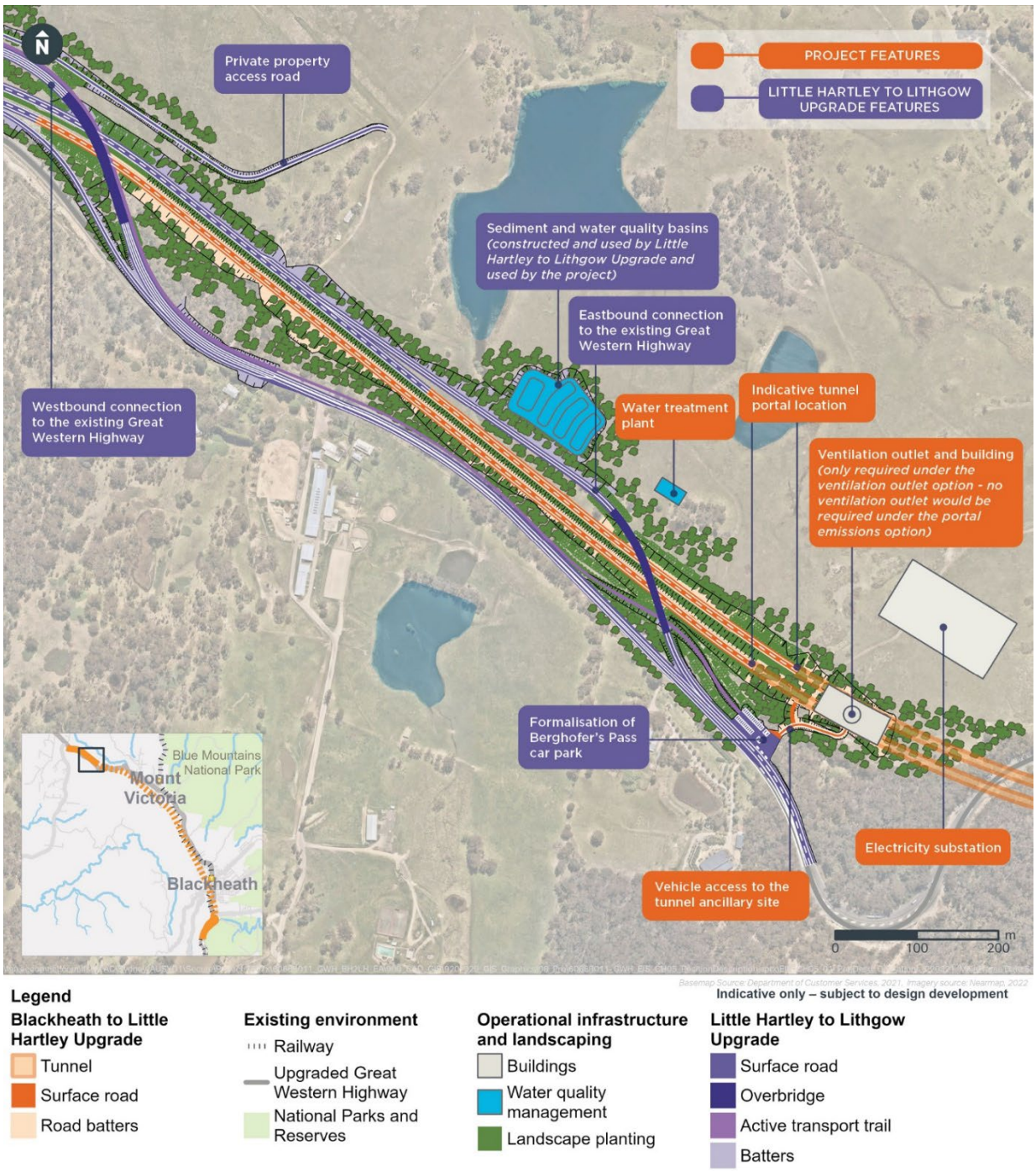


Figure 1-4 Indicative operational configuration at Little Hartley

1.2.2 Project construction

Construction of the project would include:

- site establishment and enabling works
- tunnel portal construction
- tunnelling and associated works
- surface road upgrade works
- operational infrastructure construction and fit-out, including construction of operational environmental controls
- finishing works, testing, and commissioning.

These activities are described in more detail in Chapter 5 (Construction) of the EIS and Section 5.1 of this report.

The indicative construction footprint for the project is shown in Figure 1-5 to Figure 1-7, including construction site layout and access arrangements.

Construction of the project is expected to take around eight years. Subject to planning approval, construction is planned to commence in 2024 and be completed by late 2031; however, the project would be open to traffic by 2030.

Figure 1-5 Indicative construction footprint at Blackheath

Figure 1-6 Indicative construction footprint at Soldiers Pinch

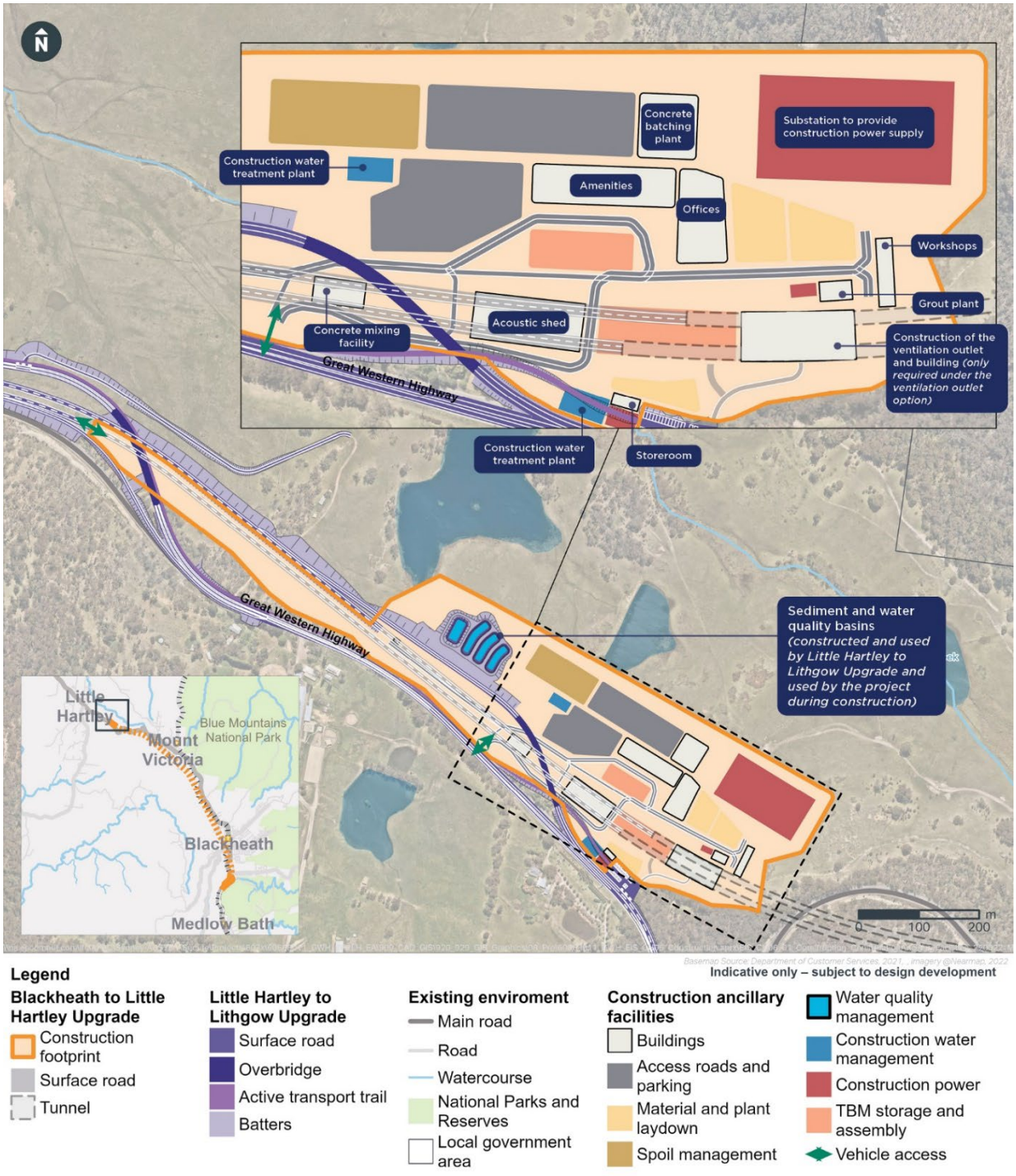


Figure 1-7 Indicative construction footprint at Little Hartley

1.2.3 Baseline environment

The Katoomba to Blackheath and Little Hartley to Lithgow Upgrades adjoining the project to the east and west respectively would be under construction when construction of the project commences (refer to Figure 1-8). To minimise environmental impacts, parts of the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade construction footprints would be used to support construction of the project.

As a result, the following activities will be undertaken at the construction footprints as part of the Katoomba to Blackheath and Little Hartley to Lithgow Upgrades:

- vegetation would be cleared
- topsoil would be levelled and compacted
- site access tracks would be established
- water quality controls such as water quality and sediment basins would be installed.

The environmental impacts associated with these works have been assessed as part of the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade.

The construction footprint for these projects are shown in Figure 1-9 and Figure 1-10 and form the baseline environment considered at Blackheath and Little Hartley for this EIS.

No work is proposed at Soldiers Pinch as part of the Katoomba to Blackheath Upgrade or the Little Hartley to Lithgow Upgrade and therefore the existing environment forms the baseline environment for this EIS.

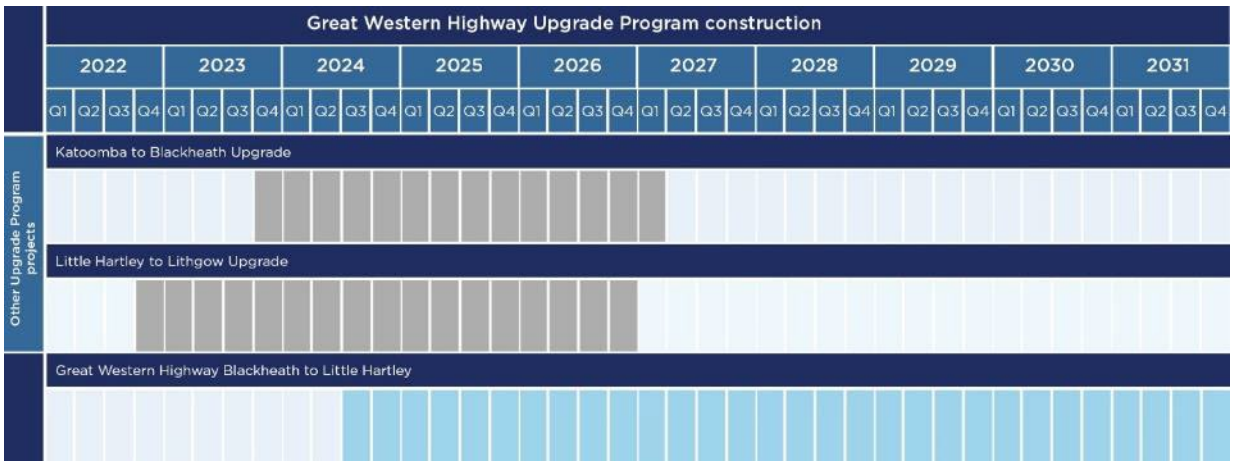


Figure 1-8 Great Western Highway Upgrade Program construction

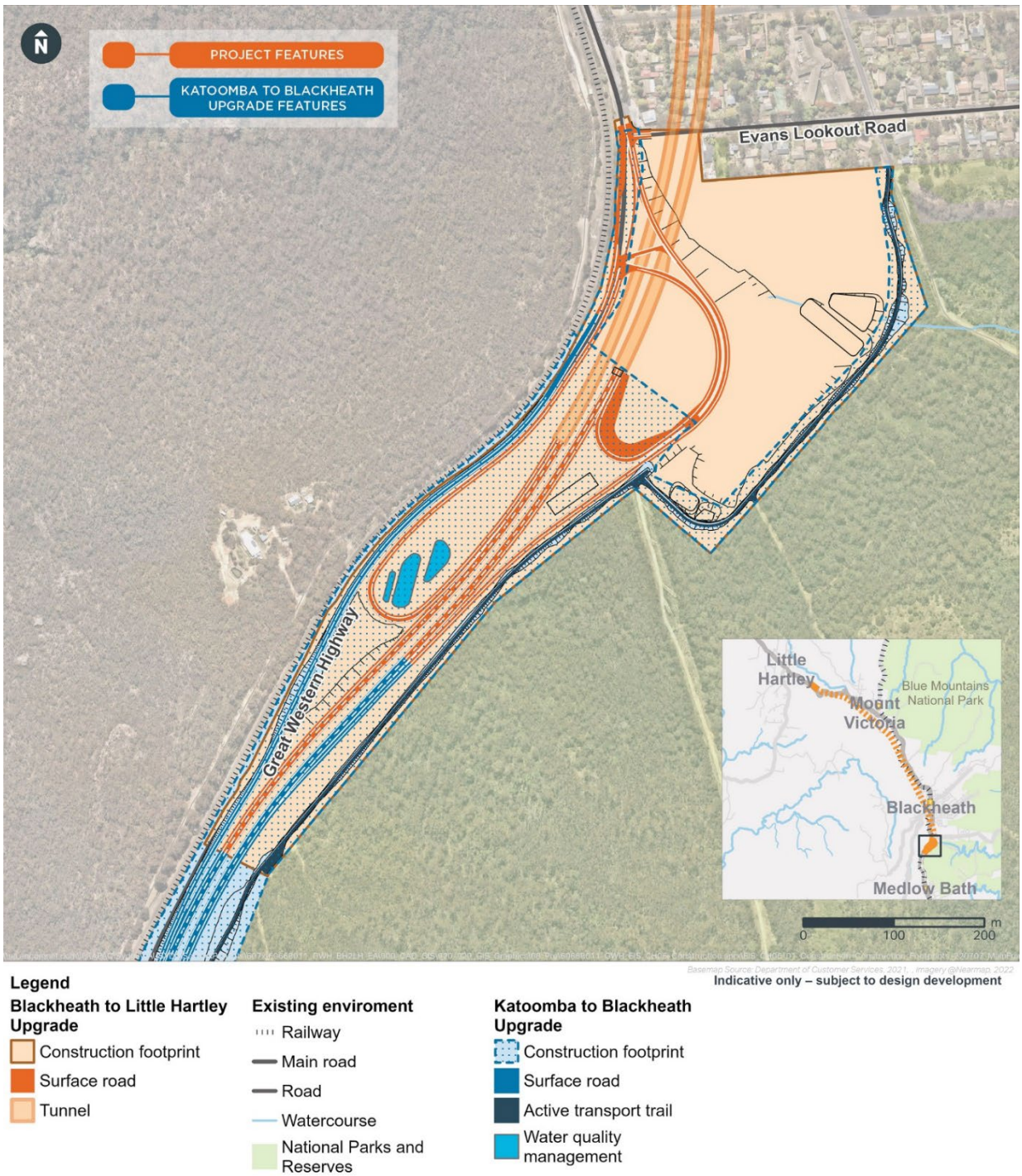


Figure 1-9 Baseline environment at Blackheath

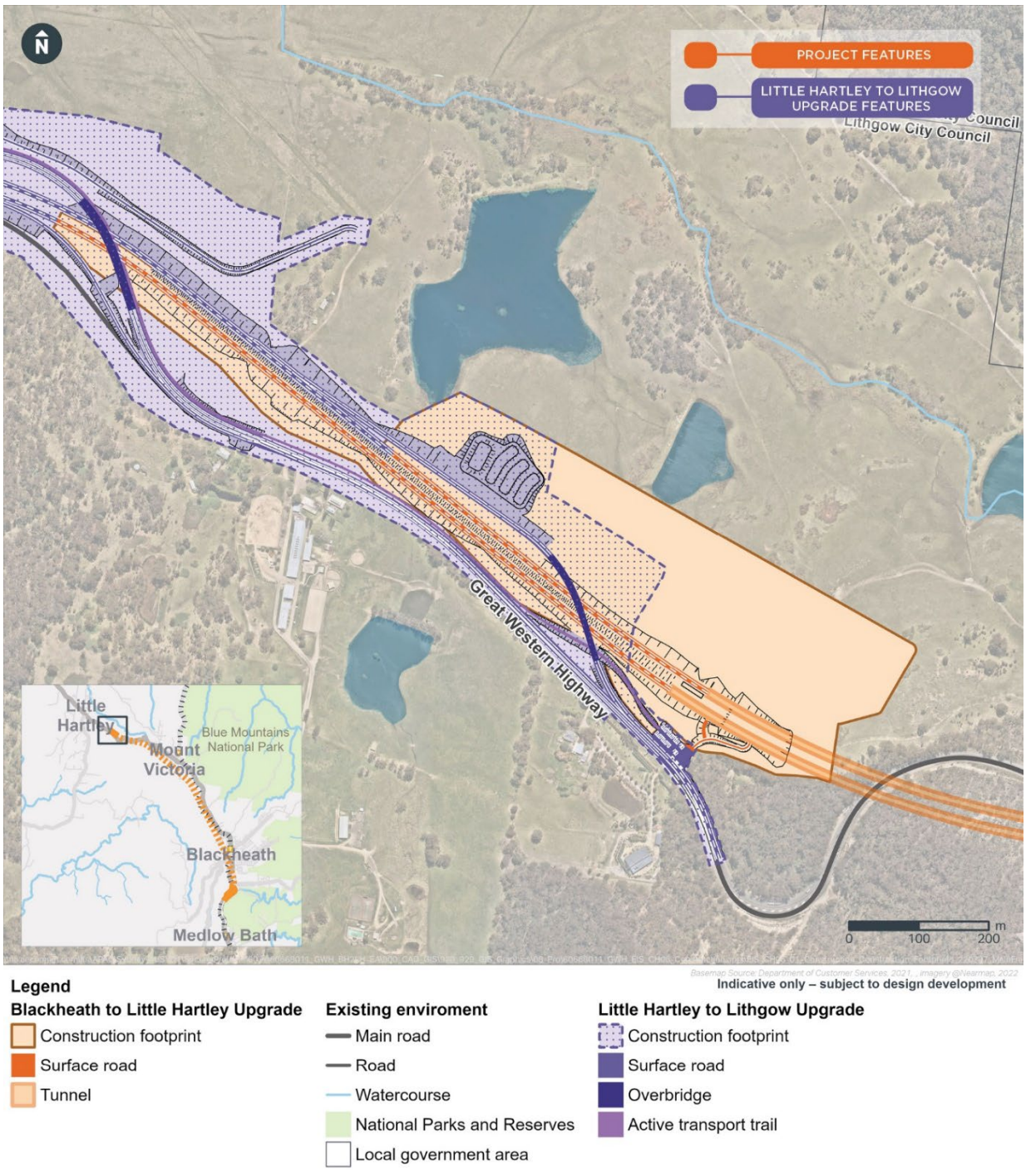


Figure 1-10 Baseline environment at Little Hartley

1.2.4 Other project specific aspects

1.2.4.1 Existing Great Western Highway

The existing Great Western Highway would be retained between Blackheath and Little Hartley and would continue to function as an alternative route for local and tourist traffic and be an alternative route should there be planned or unplanned shutdowns of the tunnels.

1.2.4.2 Blackheath surface work

The Blackheath portal would be located along the Great Western Highway alignment to the south of Evans Lookout Road. Surface work at Blackheath would include tie-in work with the upgraded Great Western Highway as well as on- and off-ramps for all eastbound and westbound movements and access to Blackheath.

The indicative operational configuration of the surface road network to be delivered as part of this project at the Blackheath portal is shown in orange in Figure 1-3. Figure 1-3 also shows how the project would connect to the Katoomba to Blackheath Upgrade and the existing Great Western Highway to Blackheath. Operational infrastructure delivered by the Katoomba to Blackheath Upgrade is shown in blue and has been subject to separate assessment and approvals.

Proposed connectivity at Blackheath is shown in Figure 1-11 and would include:

- mainline carriageway connection for vehicles heading westbound towards Lithgow via the new tunnel
- mainline carriageway connection for vehicles heading eastbound towards Katoomba via the upgraded Great Western Highway
- connection between the tunnel and the existing Great Western Highway at the Blackheath portal area, including:
    - westbound on-ramp into the tunnel from Blackheath town centre
    - eastbound connection from Blackheath onto the mainline carriageway
    - eastbound off-ramp from the tunnel to access Blackheath town centre
    - restricted access connections within the interchange arrangement to provide access from the east and the west to the operations facility, located south of Evans Lookout Road.
- upgrade of the existing Great Western Highway and Evans Lookout Road intersection.

While active transport is not permitted within the tunnel, the Katoomba to Blackheath Upgrade would include active transport connections to Blackheath as shown in Figure 1-11.

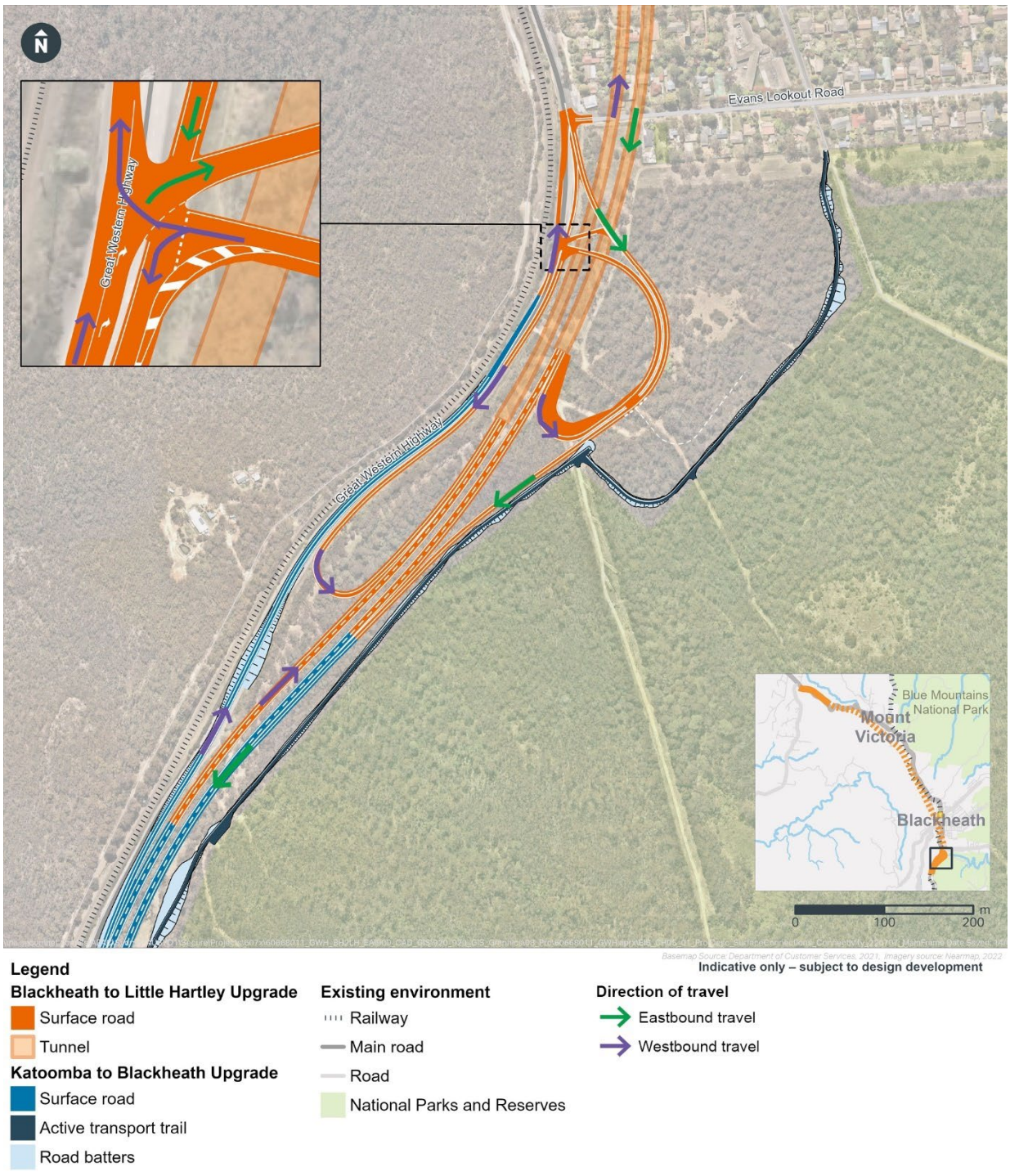


Figure 1-11 Indicative connectivity at Blackheath portal

1.2.4.3 Little Hartley surface work

The Little Hartley portal would be located at the base of the western Blue Mountains escarpment below Victoria Pass and southwest of Butlers Creek.

The indicative operational configuration of the surface road network at Little Hartley is shown in orange in Figure 1-4 and would include:

- mainline carriageway connection for vehicles heading eastbound towards Katoomba via the new tunnel
- mainline carriageway connection for vehicles heading westbound towards Lithgow via the upgraded Great Western Highway
- vehicle access to the tunnel ancillary site from Berghofer's Pass car park for operation and maintenance purposes.

Figure 1-4 also shows how the project would connect to the Little Hartley to Lithgow Upgrade. Operational infrastructure delivered by the Little Hartley to Lithgow Upgrade is shown in purple and is subject to separate approval.

While active transport is not permitted within the tunnel, the Little Hartley to Lithgow Upgrade includes an active transport connection to Little Hartley as shown in Figure 1-4.

1.3 Purpose of this report

This transport and traffic technical report is one of a number of technical documents that forms part of the EIS. The purpose of this technical report is to provide a transport and traffic assessment which addresses the requirements outlined in Section 1.3.1. This technical report provides an assessment of the operational and construction transport and traffic impacts of the project.

1.3.1 Assessment requirements

The Secretary's environmental assessment requirements (SEARs) issued by the NSW Department of Planning and Environment (DPE), relating to transport and traffic and where these requirements are addressed in this technical report are outlined in Table 1-2.

Table 1-2 Secretary's environmental assessment requirements – transport and traffic

SEARs		
Transport, Traffic and Movement		
Desired performance outcome	Requirement	Section where addressed in report
Network connectivity, safety and efficiency of the transport system in the vicinity of the project are managed to minimise impacts. The safety of transport system customers is maintained.	1. Construction transport and traffic (vehicle, pedestrian and cyclists) impacts, including, but not necessarily limited to:	Section 5.0
	a. a considered approach to route identification and scheduling of construction vehicle movements, including spoil haulage;	Section 5.5
	b. the indicative number, frequency and size of construction-related vehicles (passenger, commercial and heavy vehicles, including spoil haulage and tunnel fit out vehicles), including the indicative number and route of heavy vehicle movements outside of standard construction hours;	Sections 5.3.2, 5.3.3, 5.3.4, and 5.4
	c. construction worker parking, including the location and capacity of proposed parking facilities;	Sections 5.3.2, 5.3.3, 5.3.4

SEARs		
Impacts on network capacity and the level of service are effectively managed. Works are compatible with existing infrastructure and future transport corridors.	d. the nature of existing traffic (types and number of movements) on construction access routes (including consideration of peak traffic times, when alternative public transport arrangements are in place during rail track work, pedestrian and cyclist activities and on-street parking arrangements);	Sections 5.7.1 and 5.7.2
	e. access constraints and impacts on public transport (infrastructure and services), pedestrians and cyclists, town centres, businesses and schools; and	Sections 5.5, 5.8, 5.9 and 5.10
	f. how construction of the project affects the capacity of, and the need to close, divert or otherwise reconfigure elements of, the road, cycle and pedestrian network;	Section 5.6
	g. details of how construction and scheduling of works are to be coordinated in regard to public events and cumulative traffic impacts resulting from concurrent work on the project and other major projects, under or preparing for or commencing construction in the vicinity of the proposal;	Sections 5.1.2, 5.1.3 and 7.1
	h. the likely risks of the project to public safety; and	Section 5.7.7
	i. impacts to on-street parking, including to residents, businesses and schools.	Section 5.10
	2. Model the operational transport impacts of the project including, but not necessarily limited to:	
	a. forecast travel demand and traffic volumes for the project and the surrounding road, cycle and public transport network;	Sections 6.1.1, 6.2 and 6.3
	b. travel time analysis;	Section 6.1.5
	c. performance of key interchanges and intersections by undertaking a level of service analysis at key locations;	Sections 6.1.4 and 6.1.6
	d. wider transport interactions (local and regional roads, cycling, public and freight transport);	Sections 6.1.7, 6.2, 6.3 and 7.2
	e. induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consideration of opportunities to improve public transport;	Section 6.1.1 and 6.2
	f. property and business access and on-street parking.	Section 6.4
	g. an explanation of the scope of the modelled area, including justification of the nominated boundaries.	Section 3.4

2.0 Strategic transport context

This chapter summarises the strategic planning considerations for the project.

2.1 Background

The Great Western Highway is recognised as a key movement corridor over the Blue Mountains connecting Greater Sydney with the Central West and Orana region. This corridor also provides freight connections to Port Botany, Port Kembla, and Port of Newcastle, and would provide access to the new Western Sydney International (Nancy-Bird Walton) Airport.

The Great Western Highway also forms part a key national road corridor which extends between Sydney and Adelaide.

About 200 kilometres in length, the Great Western Highway is a four-lane state highway in New South Wales (NSW) between Sydney and Bathurst. In the east, the Great Western Highway (route A22) starts west of Railway Square in Sydney's Central Business District (CBD), heads west through Ashfield, Parramatta, and Penrith, extending beyond Sydney through the Blue Mountains and Lithgow. The western-most section of the Great Western Highway is in Bathurst, where it transitions to the Mitchell Highway (route A32).

Of the four major freight connections between Sydney and regional NSW destinations, the Great Western Highway is the only route limited to 19 metre B-doubles and 20 metre Performance Based Standard (PBS) vehicles. This restriction applies between the M4 Western Motorway at Emu Plains and Castlereagh Highway at Marrangaroo. Alternative longer routes over the Great Dividing Range for larger commercial vehicles are the Hume Highway or the Golden Highway.

The Upgrade Program would result in 34 kilometres of four-lane divided highway between Katoomba and Lithgow, designed for use by High Productivity Vehicles (HPV's) including B-doubles over 26 metres in length. Once upgraded, over 95 kilometres of the Great Western Highway will be two lanes in each direction between Emu Plains and Wallerawang.

The project has the following key objectives, as well as some additional transport and traffic objectives that are highlighted in Figure 2-1:

- improve economic development, productivity and freight accessibility within and through the Blue Mountains, Central West and Orana regions
- improve the resilience of the corridor between Blackheath and Little Hartley
- improve transport network performance, reliability and efficiency of the corridor between Blackheath and Little Hartley
- improve the overall safety of the corridor for all transport users between Blackheath and Little Hartley.

Figure 2-1 Key project transport and traffic objectives

2.2 Strategic context

The project aligns with several strategic planning documents prepared by, and on behalf of, local, state and federal government authorities, as discussed in the following sections.

2.2.1 Australian Government

As shown in Figure 2-2, the Upgrade Program was identified by the Australian Government in 2009 as an outcome of the Central West Transport Needs Study. Subsequently, the Upgrade Program has been identified as a near-term priority project on the 2021 Infrastructure Priority List in response to recommendations from the 2021 Australian Infrastructure Plan relating to improving liveability, connectivity and access to regional areas.

Figure 2-2 Overview of Australian Government strategic planning documents relevant to the project

2.2.2 NSW Government

Future Transport 2056 and its plans set out the NSW Government's 40-year vision for the transport network and customer mobility in NSW and the planned initiatives to achieve these. The transport vision was developed to support the land-use planning visions for Greater Sydney and regional NSW including the two most relevant to this project; Central West and Orana Regional Plan and the Western City District Plan – encompassing Sydney's Western Parkland City.

Both the Central West and Orana Regional Plan and the Western City District Plan have objectives to grow their productivity and diverse economies, in addition to population growth. As a primary east-west corridor between these two regions, these land-use plans recognise the importance of the Upgrade Program, and particularly the project, to strengthen the connectivity for freight and passenger cars between these two regions to leverage planned growth.

Therefore, the project aligns with the objectives of the abovementioned strategic plans, but also aligns with several other strategic planning documents prepared by the State Government, as summarised in Figure 2-3.

The relevant themes that the project aligns with include:

- supporting population, productivity, and economic growth, particularly in the Central West and Orana region and the Western Parkland City
- opportunity for improved movement and place outcomes for local communities along the existing Great Western Highway
- improved road safety outcomes
- more efficient freight movements.

The benefits of the project are discussed further throughout Section 6.0 of this report.

Figure 2-3 Overview of NSW Government strategic planning documents relevant to the project

2.2.3 Local Government

The project also aligns with the objectives of several strategic plans developed by Blue Mountains City Council and Lithgow City Council, as summarised in Figure 2-4.

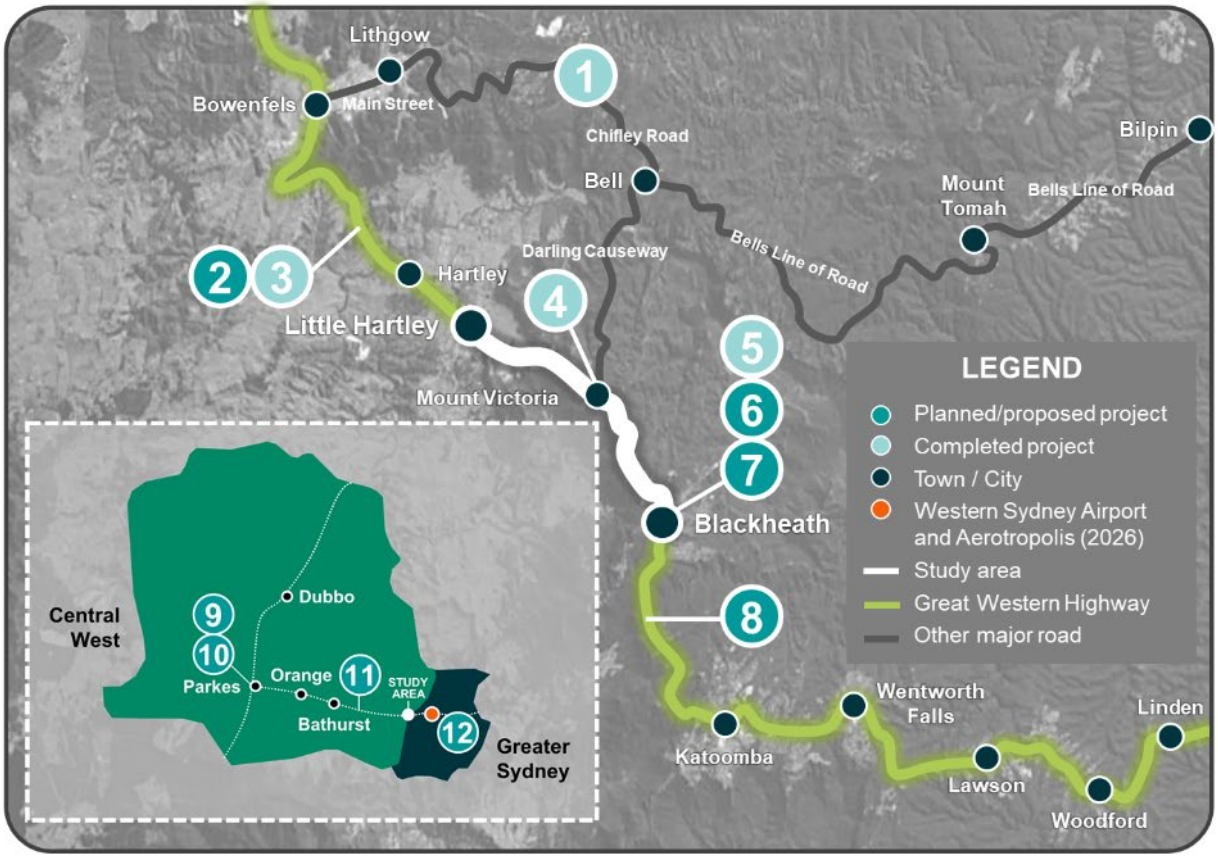
Figure 2-4 Overview of Local government strategic planning documents relevant to the project

2.3 Adjacent infrastructure projects

In addition to the proposed upgrade of Great Western Highway, there are several other transport and land use projects within and surrounding the study area which have been recently delivered or are planned or proposed. Figure 2-5 shows the location and briefly describes the most relevant infrastructure upgrade projects.

Most of the completed projects have been specifically incorporated into the Operational Traffic Model (OTM) that has been used to assess the project's road network impacts. These are discussed in Section 3.4.2 and Section 3.4.4.

Many of the proposed or planned projects are likely to generate additional vehicle movements within the study area as a result of construction or operation. None of these have been specifically included in the OTM. However, the additional demands generated from these projects on the Great Western Highway would broadly be captured in future travel demand forecasts that were taken from the Regional Travel Model (RTM) and have been adopted in the OTM.



1 Bells Line of Road Upgrades
Completed: December 2017
Overview: New overtaking lanes and slope improvements between Lithgow and Kurrajong Heights.

2 Little Hartley to Lithgow Upgrade
Completion: 2026
Overview: Upgrade of the existing Great Western Highway to four lane divided highway and intersection upgrades.

3 Hartley to Forty Bends Upgrade
Completed: October 2017
Overview: Safety upgrades along Great Western Highway including intersection upgrades, more arrows and reflective markers, and new safety barriers.

4 Mount Victoria Village Safety Improvements
Completed: March 2018
Overview: Upgraded intersections, widened shoulders and new footpaths within village centre.

5 Blackheath Village Safety Improvements
Completed: March 2020
Overview: Upgrades to three intersections including left and right turn bays to improve traffic flow.

6 Blackheath Village Centre Upgrades
Planned completion: Ongoing
Overview: Public domain improvements to improve liveability and accessibility within town centre.

7 Blackheath Train Station Transport Access Program
Planned completion: 2023
Overview: Accessibility upgrades to existing station including lifts, accessible parking and kiss and ride spaces.

8 Katoomba to Blackheath Upgrade and Medlow Bath Upgrade
Planned completion: 2026/2027
Overview: Upgrade of existing Great Western Highway corridor to four lane divided highway and intersection upgrades.

9 Parkes Special Activation Precinct (SAP)
Planned completion: 20+ years
Overview: New industrial release area taking advantage of the Parkes National Logistics Hub and its proximity to the Inland Rail line, the Trans-Australian Railway.

10 Inland Rail
Planned completion: 2027
Overview: New freight rail line between Melbourne and Brisbane via regional QLD, NSW and VIC. The Parkes to Narromine section opened in 2020.

11 Fast Rail – Western Corridor
Planned completion: Long-term
Overview: Fast Rail corridor between Greater Sydney and Central West via Lithgow, Bathurst and Orange/Parkes.

12 Moorebank Intermodal Terminal Precinct
Planned completion: 2025
Overview: major freight terminal supporting the movement of freight to and from south-west Sydney.

Figure 2-5 Infrastructure upgrade projects interfacing with the project

3.0 Assessment methodology

3.1 Relevant guidelines and policies

The following guidelines were referenced in carrying out this assessment:

- Automatic Vehicle Classification by Vehicle Length (Austroads, 2006)
- Cycling Aspects of Austroads Guides (Austroads, 2017)
- Guide to Traffic Generating Developments (Transport, formerly NSW Roads and Traffic Authority, 2002)
- Guide to Traffic Management Part 3: Transport Studies and Analysis Methods (Austroads, 2020)
- Highway Capacity Manual (Transportation Research Board, 2022)
- NSW Bicycle Guidelines (Transport, 2005)
- Planning Guidelines for Walking and Cycling (Department of Infrastructure, Planning and Natural Resources, 2004)
- Policy and Guidelines for Overtaking Lanes (Mainroads Western Australia, 2011)
- Principles and Guidelines for Economic Appraisal of Transport Investment, (Transport, 2016)
- Traffic Modelling Guidelines (Transport, 2013).

3.2 Methodology overview

The assessment methodology adopted in this transport and traffic assessment includes:

- identifying the transport and traffic assessment requirements
- identifying transport and traffic assessment criteria
- assessment of the existing transport and traffic conditions within the study area
- assessment of the transport impacts of the project during construction and operations (post-construction) including cumulative impacts using a suite of traffic modelling software as discussed in Section 3.4 in combination with qualitative assessments, as required
- identifying mitigation measures that manage and minimise the risk of the identified impacts.

3.3 Assumptions and limitations

Forecasting future year traffic demand is highly complex and involves sophisticated traffic modelling processes. Reasonable variations in forecast model input parameters, data and assumptions result in variations in forecast traffic demand. Forecast traffic volumes from models should therefore be considered as a range as opposed to absolute numbers. For the purposes of this technical assessment report, the (OTM with its inputs and assumptions has been constructed to produce an estimate of the future traffic demands within the study area and to assess the project's impacts. Most of the input data used in the OTM including demand forecasts and calibrated base year OTM were provided to the authors of this report by Transport. It is assumed that the provided information is reasonable and correct.

3.4 Road network assessment

3.4.1 Modelling approach overview

Traffic modelling was used to understand the impacts and benefits of the project on freight customers, through-traffic, and the local communities along the Great Western Highway, including Blackheath and Mount Victoria.

A four-tier modelling system was developed by Transport for the Upgrade Program. The modelling system adopted for this assessment includes the following tiers which are discussed in more detail in the following sections:

- strategic demand modelling using Transport's Regional Travel Model (RTM). This modelling was undertaken by Veitch Lister Consulting and is discussed in Section 3.4.2
- future freight forecasting using Transport's Strategic Freight Model (SFM) and analysis undertaken by Neil Matthews Consulting (NMC) as discussed in Section 3.4.3
- operational traffic modelling using Aimsun microsimulation, referred to as the Weekday OTM. Demand data used in the OTM was derived by Veitch Lister Consulting from the RTM and the NMC freight analysis, as discussed in Section 3.4.4. The OTM was updated for the purpose of this assessment
- intersection modelling using the SIDRA Intersection software to assess the construction and operational impacts of the project on the study intersections.

The key components of the modelling approach are also depicted in Figure 3-1.

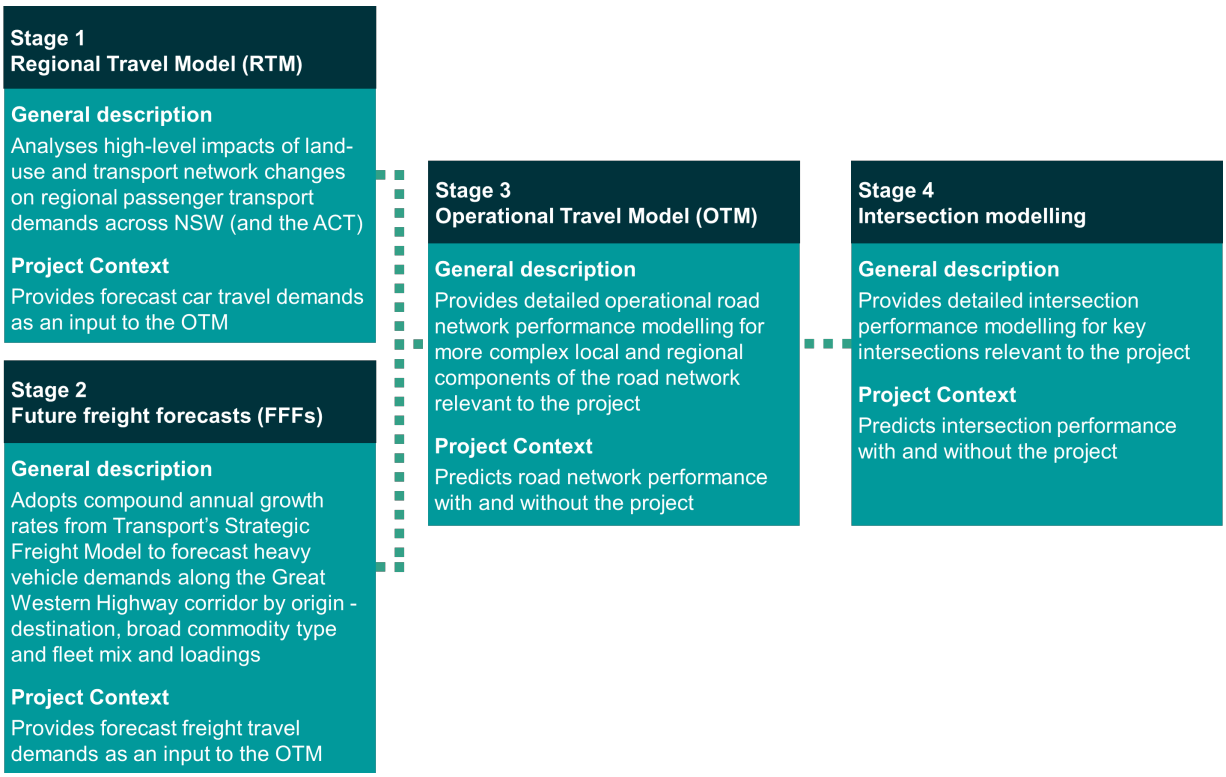


Figure 3-1 Traffic modelling approach

3.4.2 Regional Travel Model

The NSW Government's RTM is typically used to analyse high-level impacts of land-use and transport network changes on regional passenger transport demands across NSW (and the ACT). Veitch Lister Consulting used the RTM for the Upgrade Program to forecast growth in private vehicle travel across NSW and within the Upgrade Program study area.

The RTM is a multi-modal strategic model developed by Transport that covers NSW and the ACT and is underpinned by mobile phone data.

The RTM incorporates Travel Zone Projections 2019 (TZP19) land use assumptions for NSW and 2016 Australian Bureau of Statistics (ABS) Census data and projections for the ACT. The future road network and rail network assumptions adopted in the RTM reflect those from Sydney Strategic Travel Model (STM).

The RTM's original Statistic Area Level 2 (SA2) zoning system was disaggregated to 47 zones (groups of SA1's or smaller) to better inform the demand forecasts for the Upgrade Program. The associated input data such as population and employment data was also generally disaggregated to the new zoning system.

Outside Greater Sydney, the RTM network is generally limited to major roads. Some additional roads were added to the RTM within the Upgrade Program extents. These include:

- competing routes to the Great Western Highway, such as Browns Gap Road, Hartley Vale
- roads to allow connectivity to the Great Western Highway, such as Magpie Hollow Road, South Bowenfels
- roads to allow demand from new zones to connect to the RTM network.

Within the RTM, demand is modelled as a typical full weekday (7am-6pm).

For this transport and traffic assessment, private vehicle demands were extracted from the refined RTM for 2026 and 2036. Linear interpolation was used to estimate demands for use in the OTM, for the following scenarios:

- 2026 without project (during construction)
- 2030 without project and with project (year of opening)
- 2040 without project and with project (year of opening plus 10 years).

It is noted that the project is planned to be open to traffic by late 2030, with overall construction works including site rehabilitation and demobilisation to be completed by late 2031.

For the purpose of the RTM demand development, the 'with project' scenarios included the whole Upgrade Program. This is discussed further in Section 3.4.4.

3.4.3 Future freight forecasts

NMC developed future freight forecasts (FFF) for the Great Western Highway corridor with and without the project. The current freight task along the Great Western Highway was estimated for 2016, using a range of observed data sources on heavy vehicle movements and freight flows in the Great Western Highway corridor. The freight volumes for 2016 were extrapolated to 2036 by applying compound annual growth rates from Transport's SFM and documented in the NSW Freight Commodity Demand Forecasts 2016-2056 (Transport, 2018) to the current origins, destinations and movement patterns.

The 2036 freight forecasts were attributed to various vehicle classes, adopting assumptions on maximum and typical vehicle carrying capacities. Subsequently, the number of heavy vehicle movements travelling in each direction along the Great Western Highway was estimated for the following scenarios:

- 2036 without project – adopting the same fleet mix as existing conditions
- 2036 with project– assuming larger Higher Mass Limit (HML) or Performance Based Standards (PBS) vehicles could access the Great Western Highway corridor, and therefore changing the fleet mix.

The 2026, 2030 and 2040 freight forecasts were interpolated and extrapolated from the 2016 and 2036 demands (described above) for incorporation into the OTM.

For the purpose of the FFF, the 'with project' scenarios included the whole Upgrade Program. This is discussed further in Section 3.4.4.

3.4.4 Operational travel model

Veitch Lister Consulting developed a project specific microsimulation model for the Upgrade Program. The model extent is indicatively shown in Figure 3-2 and extends between Katoomba and Lithgow and also includes the Darling Causeway and Chifley Road alternative route between Mount Victoria and Lithgow. The model area was selected as it reflects the area most susceptible to change associated with the Upgrade Program.

The OTM was developed, calibrated, and validated for a 2018 base year for the typical weekday period between 7am and 6pm. The modelled weekday peak hours were determined from traffic surveys (see Section 4.9.1.1). These are:

- AM peak – 8-9am
- PM peak – 3-4pm.

The model calibration and validation process included matching the model operations with observed traffic conditions including surveyed traffic volumes and travel times collected in 2018.

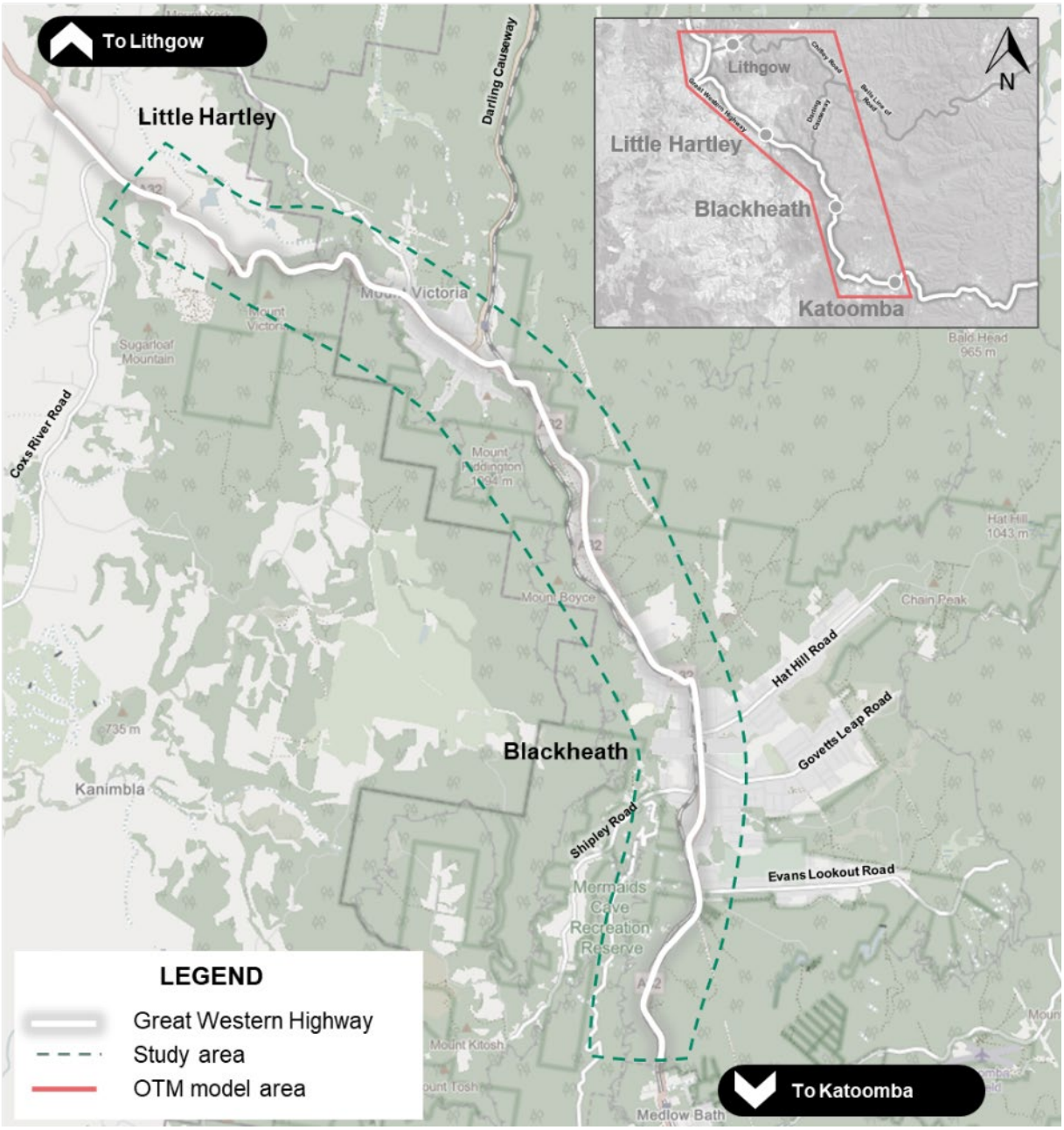


Figure 3-2 Study area and indicative model extents

In addition to the 2018 base year, the Upgrade Program's OTM has also been used to assess the future performance of the study area and the impacts of the project on the existing road network.

In developing the future year operational models, the future year traffic demand from the RTM and FFF were incorporated into the OTM. The daily demands from the RTM and FFF were proportionally split into individual hours for the OTM period of 7am-6pm based on the observed daily profiles.

For the purpose of this assessment, the OTM future assessment years include:

- 2026 representing peak construction activity with construction activity expected to occur between 2024 and 2031
- 2030 representing the year of opening
- 2040 representing the year of opening plus 10 years.

While the EIS assumes that the Katoomba to Blackheath Upgrade, Medlow Bath Upgrade and Little Hartley to Lithgow Upgrade projects would be operational in early 2027 and therefore form part of the ‘baseline environment’ for this project, this assumption is not reflected in the OTM. This is because the OTM which extends between Katoomba and Lithgow was developed to assess the cumulative impacts and benefits of the Upgrade Program including the project as well as the Katoomba to Blackheath Upgrade, Medlow Bath Upgrade and Little Hartley to Lithgow Upgrade projects.

The OTM scenarios include the following:

- 2026 without construction (does not include any components of the Upgrade Program)
- 2026 with construction (includes the project's construction traffic estimates and does not include any other components of the Upgrade Program)
- 2030 without project (does not include any components of the Upgrade Program)
- 2030 with project (includes the project and all other components of the Upgrade Program)
- 2040 without project (does not include any components of the Upgrade Program)
- 2040 with project (includes the project and all other components of the Upgrade Program).

Notwithstanding the above, the impacts and benefits of the project that are discussed in this report are generally limited to those associated with the project and don’t include contributions made by the adjacent projects (unless specifically mentioned) because the study area that has been selected considers the Great Western Highway between Blackheath and Little Hartley (east of Coxs River Road) where the project's impacts and benefits are most likely.

The cumulative impacts section in this report considers the combined operational impacts and benefits of the Upgrade Program on the Great Western Highway between Katoomba and Lithgow. It also qualitative considers the likely impacts of all Upgrade Program components being constructed simultaneously.

For this study, the following road network assessment criteria have been adopted and assessed using the OTM, as detailed in Section 3.5:

- traffic volume changes
- road network performance statistics
- roadway (mid-block) level of service
- intersection performance
- travel times.

How the project and Upgrade Program components contribute to the assessment of these criteria are discussed further in Table 3-1.

Table 3-1 Overview of the road network assessment using the OTM

Criteria	Extent of assessment	Construction impacts	Operational impacts
Traffic volume changes	Selected locations between Blackheath and Little Hartley	Assesses construction vehicle estimates associated with the project's construction works. The traffic volume changes described in this section are as a result of the project.	Assesses forecast weekday traffic volume changes along the Great Western Highway corridor associated with the project. This includes traffic volumes attracted to the corridor because of the project and traffic volume changes along the existing Great Western Highway alignment in Blackheath and Mount Victoria. The traffic volume changes described in this section are as a result of the project. The Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade are unlikely to result in major changes to the traffic volumes along the corridor, as demonstrated in the Great Western Highway Upgrade – East Package Traffic and Transport Assessment Report that was prepared for the REF.
Road network performance statistics	Whole model area between Katoomba and Lithgow	Considers the network performance with the project's additional construction vehicles and indicative speed zone reductions near proposed construction accesses. This analysis is considered to be conservative as it does not include the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade works, which would be largely complete by 2026 and would provide additional capacity along the respective upgraded sections of the Great Western Highway.	Considers the cumulative impacts of the Upgrade Program on the modelled network. Most of the benefits described in this section are a result of the project, although the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade would also contribute to these.
Roadway (mid-block) level of service	Selected locations between Blackheath and Little Hartley	Considers the mid-block level of service with the project's additional construction vehicles. The impacts described in this section are as a result of the project.	Considers the mid-block level of service (LoS) with the project's forecast traffic volume changes. The mid-block LoS benefits described in this section are a result of the project.

Criteria	Extent of assessment	Construction impacts	Operational impacts
Intersection performance	Selected intersections between Blackheath and Little Hartley	Assesses the impacts of additional construction traffic generated by the project on intersections located within the study area, as well as an additional intersection located in Lithgow which would not be modified by the Upgrade Program. The impacts described in this section are as a result of the project.	Considers the intersection performance with the project's forecast traffic volume changes, particularly the traffic volumes that would be diverted from the existing Great Western Highway alignment to the tunnel. The intersection performance benefits described in this section are a result of the project.
Travel times	Construction - travel time route between Katoomba to Lithgow Operations - travel time route between Blackheath and Little Hartley (Note: this is currently being updated) and the travel time route between Blackheath and Mount Victoria	Considers the travel times with the project's additional construction vehicles and indicative speed zone reductions near proposed construction accesses. This analysis is considered to be conservative as it does not include the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade works, which would be largely complete by 2026 and would provide additional capacity along the respective upgraded sections of the Great Western Highway. However, qualitative discussion that addresses the anticipated changes to these impacts if Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade were operational is included.	Considers the project's impact on travel times within the study area. The travel time savings described in this section are a result of the project.

Changes were made to the future year road network in the OTM to reflect road network changes that have occurred since 2018 or planned to be completed prior to 2026. These include:

- modifications to the following intersections in Blackheath
  - Great Western Highway, Govetts Leap Road and Bundarra Street (completed in late 2019 early 2020)
  - Great Western Highway, Prince George Street and Abbott Street (completed in 2020)
  - Great Western Highway and Leichhardt Street (completed in 2019)
  - Great Western Highway and Sturt Street (completed in 2019)
- alignment and geometry changes on Chifley Road (completed in 2020)
- speed limit changes on Great Western Highway between Hartley and Bowenfels (completed in 2021)
- modifications to the Great Western Highway and Bellevue Crescent intersection in Medlow Bath (to be completed by 2026).

The location of these network modifications are shown in Figure 3-3 and the road network assumptions adopted for each of the OTM scenarios are summarised in Table 3-2.

Table 3-2 Road network assumptions adopted for OTM scenarios

Year	Scenario	Existing road network (2018)	Recent road network changes	Forecast land use changes from the RTM	Medlow Bath Upgrade	Katoomba to Blackheath Upgrade	Little Hartley to Lithgow Upgrade	The project
2018	Base	x						
2026	Without construction	x	x	x				
	With construction	x	x	x				x
2030	Without project	x	x	x				
	With project	x	x	x	x	x	x	x
2040	Without project	x	x	x				
	With project	x	x	x	x	x	x	x

Note: The Upgrade Program has been included in the “with project” scenarios.

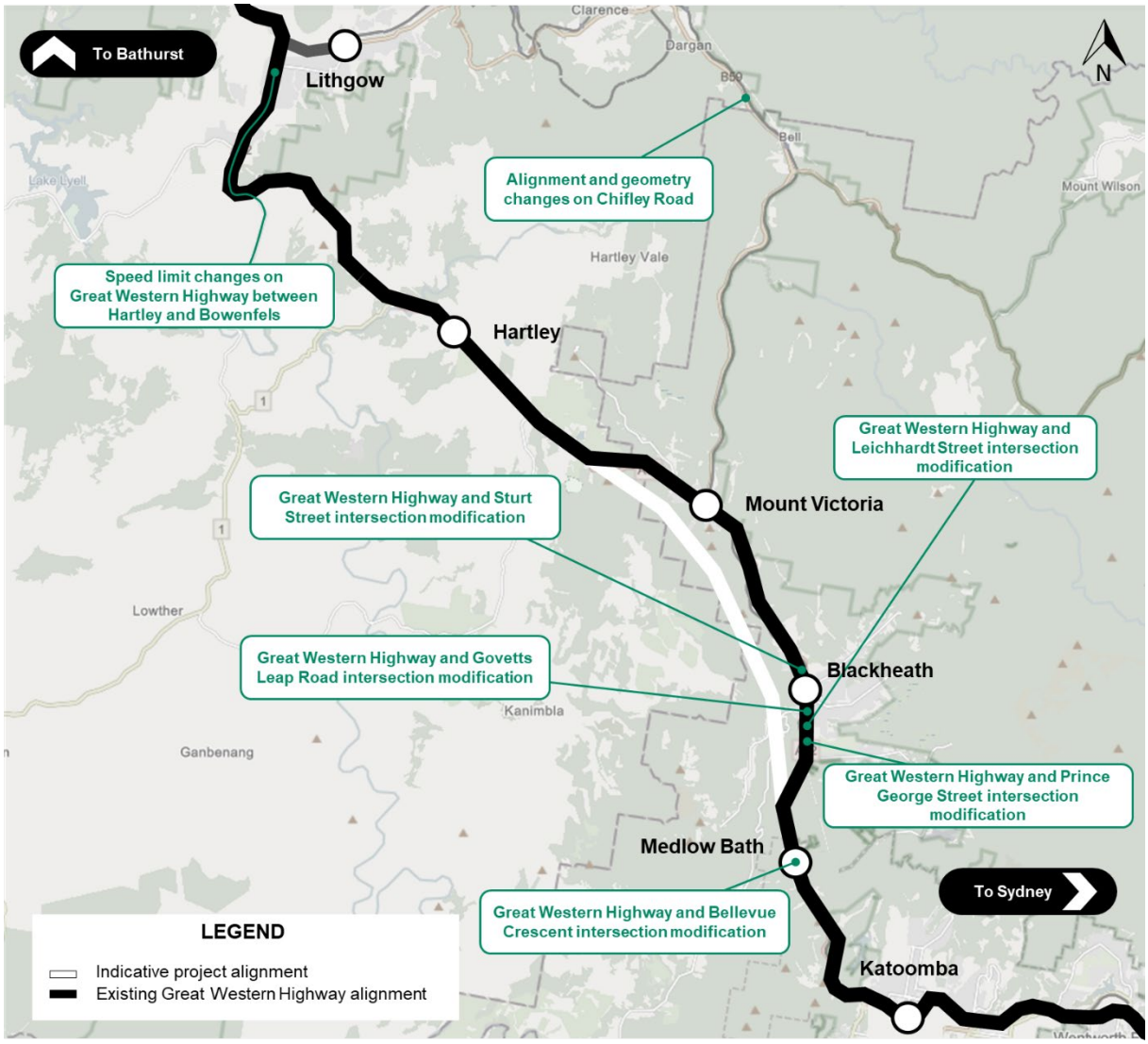


Figure 3-3 Network changes that have occurred since 2018

3.4.5 Covid-19 considerations

Supplementary traffic data was collected in early December 2021 (prior to the school holidays and Christmas period). The 2021 traffic data was collected at the same locations as the classified intersection count data and 24-hour, 7-day week automatic tube counts that were collected in September and October 2018. The 2021 traffic data was collected to compare traffic patterns and volumes with the 2018 data that is the basis of the OTM to understand the potential impacts of the COVID-19 pandemic on traffic patterns in the study area.

The following observations are made from comparing the two data sets:

- the weekday AM and PM peak hours were largely consistent between 2018 and 2021
- the total traffic volumes were consistently higher in 2021 at most of the surveyed intersections during both the AM and PM peak hours, as shown in Figure 3-4 and Figure 3-5. The overall traffic growth between 2018 and 2021 was higher than historical growth patterns, which could suggest that more people were travelling in December 2021, after extended travel restrictions for the COVID-19 pandemic were removed and, in the lead-up to the Christmas period
- in general, traffic volumes for individual turning movements at intersections within the study area were similar between 2018 and 2021. Only a small number of turning movements experienced a substantial change in traffic volumes. All these movements were located within the local centres. Given the local nature of the turning movements that experienced traffic volume changes, these

may be attributed to changes to local traffic patterns associated with the COVID-19 pandemic or other changes to the local road network implemented by Council

- the daily traffic profiles at each of the tube count sites appear similar between 2018 and 2021, with some minor seasonal and daily variation, as shown in the graphs included in Annexure A. At all tube count sites, the PM peak traffic volumes were higher in 2018 than 2021. However, the PM peak hour traffic volumes at the surveyed intersections were higher in 2021 when compared with 2018. This could suggest that there may have been a higher proportion of local trips within the centres, generating higher turning movements and local activity in 2021 when compared with 2018 – a pattern that would be expected as a result of change in traffic patterns and travel behaviour due to the COVID-19 pandemic.

Overall, the comparison of traffic data from December 2021 and September 2018 suggests the data sets are similar with some observed changes in traffic patterns in the townships. It is likely that most of the traffic pattern changes can be attributed to changes in travel behaviour due to the COVID-19 pandemic that could be temporary, as well as some seasonal and daily variation e.g. typical differences in travel patterns between September (2018) and December (2021). It is expected that changes to traffic patterns and travel behaviour due to the COVID-19 pandemic would become less pronounced over time. Therefore, the 2018 traffic data was considered to be more representative of typical traffic patterns than the December 2021 data and the best data source to inform the base year OTM.

Figure 3-4 and Figure 3-5 compare the 2018 and 2021 traffic volumes at the existing intersections shown in Table 3-3, during the AM and PM peak hours respectively.

No traffic data was available for Great Western Highway and Browntown Oval access intersection (Intersection 6) and therefore it has not been included in Figure 3-4 and Figure 3-5. In addition, the Little Hartley construction footprint intersection (Intersection 9) and the new intersection in Blackheath (Intersection 10) do not currently exist and therefore have also not been included in the comparison in Figure 3-4 and Figure 3-5.

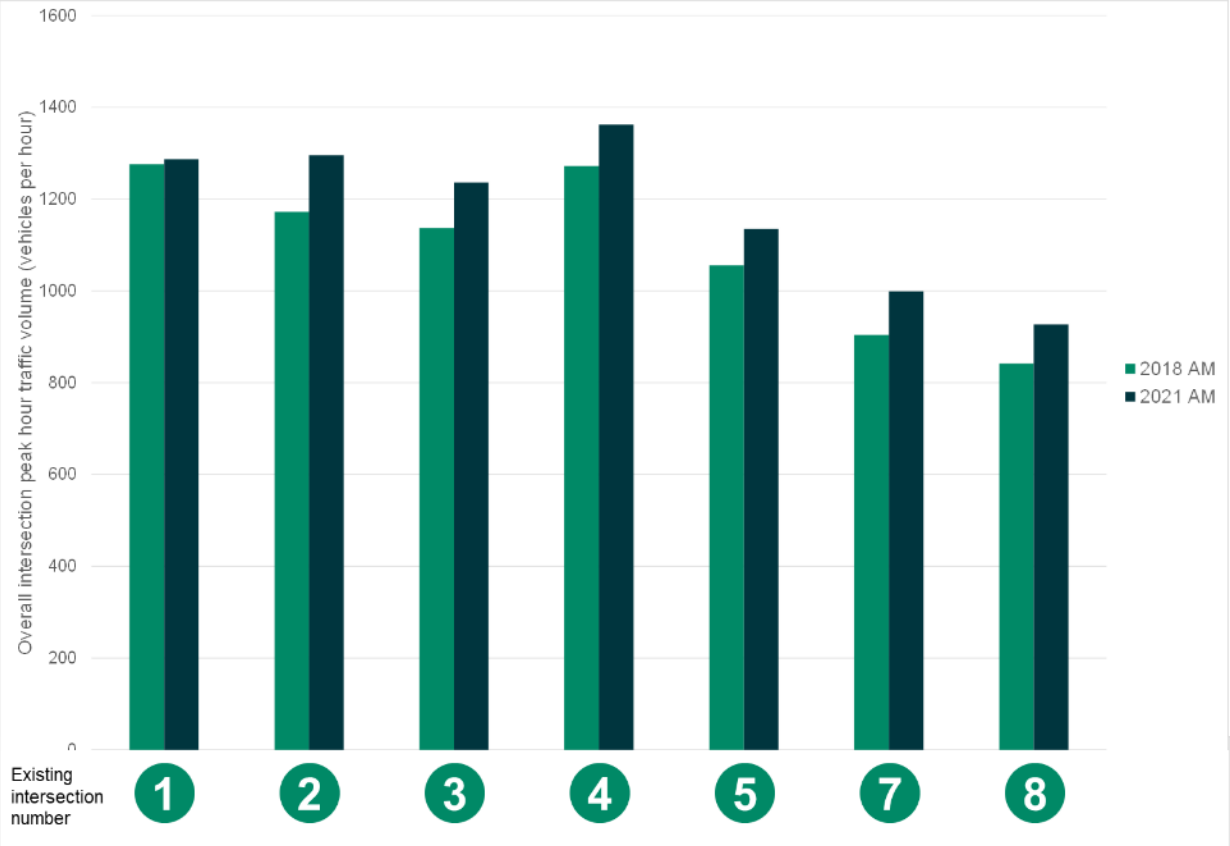


Figure 3-4 Comparison of 2018 and 2021 traffic volumes during AM peak (8-9am) at existing intersections

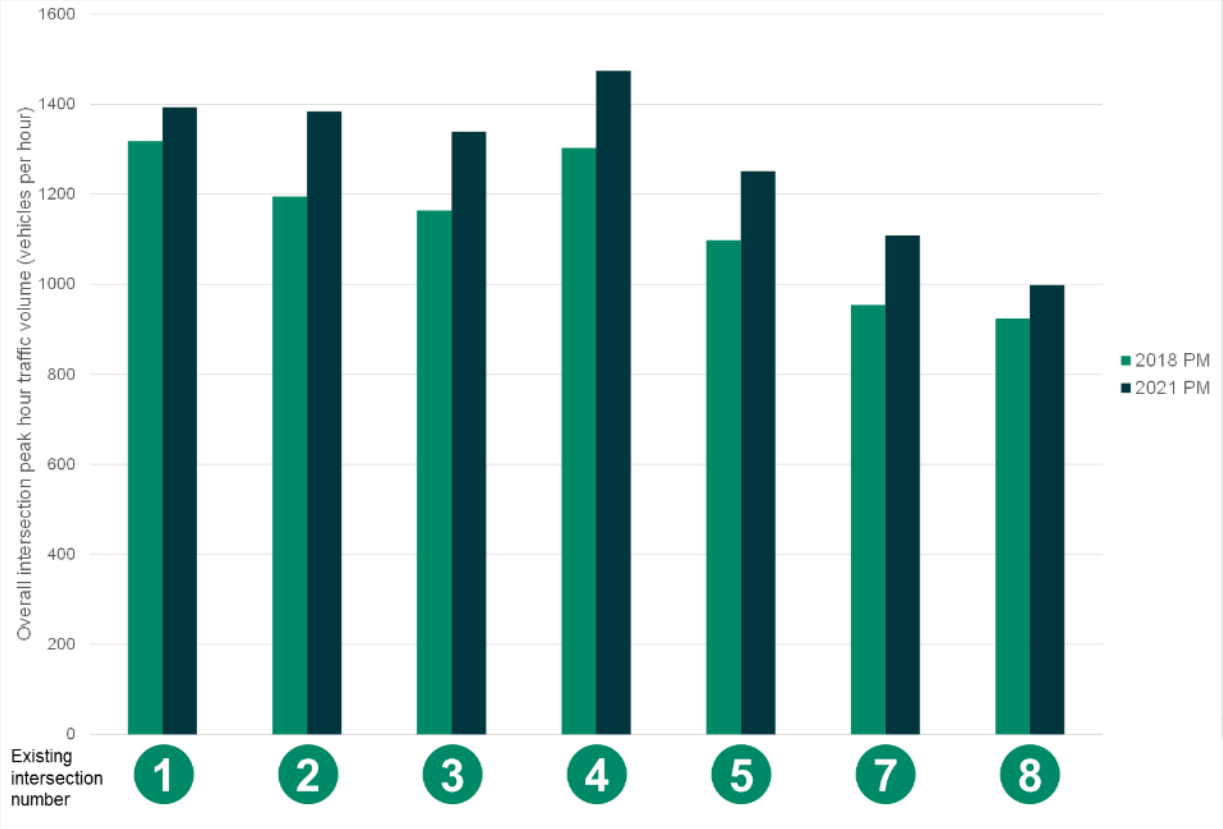


Figure 3-5 Comparison of 2018 and 2021 traffic volumes during PM peak (3-4pm) at existing intersections

3.4.6 Intersection assessment

The weekday AM and PM operation of several key intersections were assessed using the SIDRA Intersection software. SIDRA Intersection is a modelling micro-analytical software package, capable of analysing isolated and coordinated intersections.

The following information was used to inform the base year SIDRA Intersection modelling:

- satellite imagery and Traffic Control Signal (TCS) plans obtained from Transport informed the intersection geometry and posted speed limits
- traffic signal phasing and timing data for September 2018 from Sydney Coordinated Adaptive Traffic System (SCATS) provided by Transport
- existing and forecast traffic volumes extracted from the OTM for all assessment scenarios discussed in Section 3.4.4.

For the construction and operational assessment, the intersections listed in Table 3-3 were assessed. Most of the selected intersections are located within the study area which are anticipated to be most susceptible to change because of the project. However, the Great Western Highway and Main Street and Caroline Avenue (Intersection 9) is a signalised intersection located in Lithgow, to the west of the study area because it is the highest capacity intersection west of the project. This intersection has been included to assess the impacts of the proposed construction vehicles and haulage to the west of the study area.

Other intersections between Lithgow and the project were not assessed due to either currently operating with spare capacity or due to planned upgrades, including some grade separations as part of the Lithgow to Little Hartley upgrade.

Figure 3-6 illustrates the respective location of the assessed intersections.

Table 3-3 Overview of intersections included for performance assessment

ID	Location	Intersection type
1	Great Western Highway and Evans Lookout Road, Blackheath	Existing
2	Great Western Highway and Prince George Street, Blackheath	Existing
3	Great Western Highway and Leichhardt Street, Blackheath	Existing
4	Great Western Highway, Govetts Leap Road and Bundarra Street, Blackheath	Existing
5	Great Western Highway and Hat Hill Road, Blackheath	Existing
6	Great Western Highway and Browntown Oval access intersection (used to access the Soldiers Pinch construction footprint), Blackheath	Existing [1]
7	Great Western Highway and Harley Avenue, Mount Victoria	Existing
8	Great Western Highway and Station Street (Darling Causeway), Mount Victoria	Existing
9	Great Western Highway and Main Street and Caroline Avenue, Lithgow [2]	Existing
10	Little Hartley construction footprint	New construction (temporary)
11	New intersection in Blackheath	New operational (permanent)

[1] Intersection is an existing intersection that would be used to access the Soldiers Pinch footprint. No existing traffic data is available and therefore this intersection has only been assessed for its operation during construction
[2] Intersection is located outside the study area but is a major intersection located along the proposed haulage route. Therefore, this intersection has only been assessed for its operation during construction

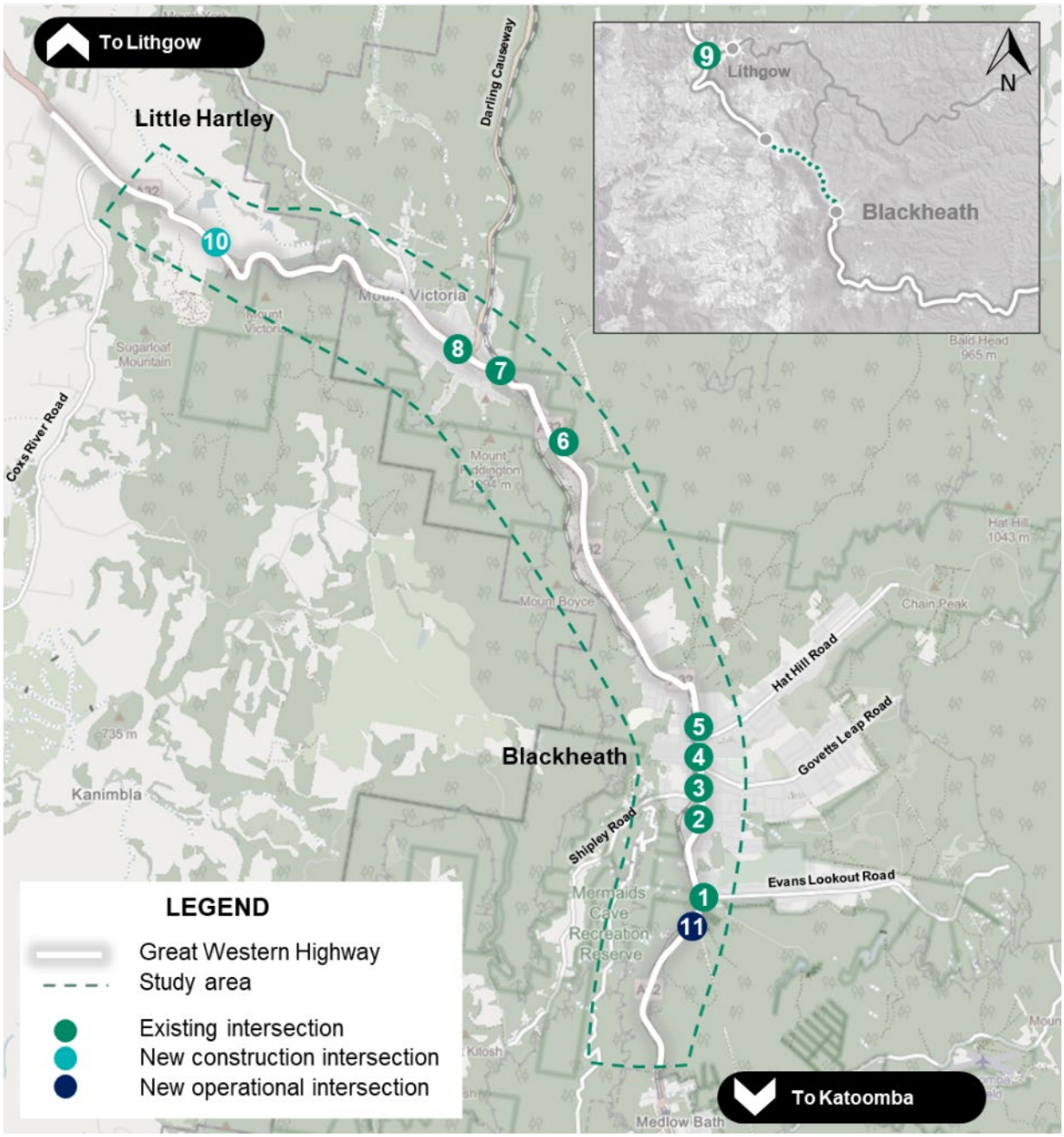


Figure 3-6 Intersections assessed as part of construction and operational assessment

Traffic volumes were extracted from the OTM for all assessment scenarios. The intersection performance for the Great Western Highway, Govetts Leap Road and Bundarra Street intersection was assessed using the OTM, given that the adjacent rail level crossing affects this intersection operation and this is better assessed using the OTM instead of the SIDRA intersection software.

3.5 Road network performance assessment criteria

The assessment criteria used to evaluate the project's impacts on the road network performance during construction and operation is based on the SEARs and include:

- traffic volumes and patterns
- road network performance statistics
- performance of intersections, roadway and merge and diverge points
- travel times.

3.5.1 Traffic volumes

Traffic patterns including forecast growth can be identified by comparing the proportion of total traffic volumes that cross a line at specific points for various scenarios (known as screenline assessment).

The screenlines identified for this assessment are shown in Figure 3-7 and include:

- Medlow Bath – south of Rutland Road (located south of the study area to assess traffic volume changes east of the project)
- Blackheath – near Prince George Street
- Mount Victoria – near Harley Avenue
- Little Hartley – east of Coxs River Road (located west of the Little Hartley construction footprint and the Little Hartley portal to assess traffic volume changes west of the project).

For each of the screenlines, the total directional traffic volumes across the screenline have been assessed for the existing conditions and the future 2026, 2030 and 2040 conditions with and without the project.

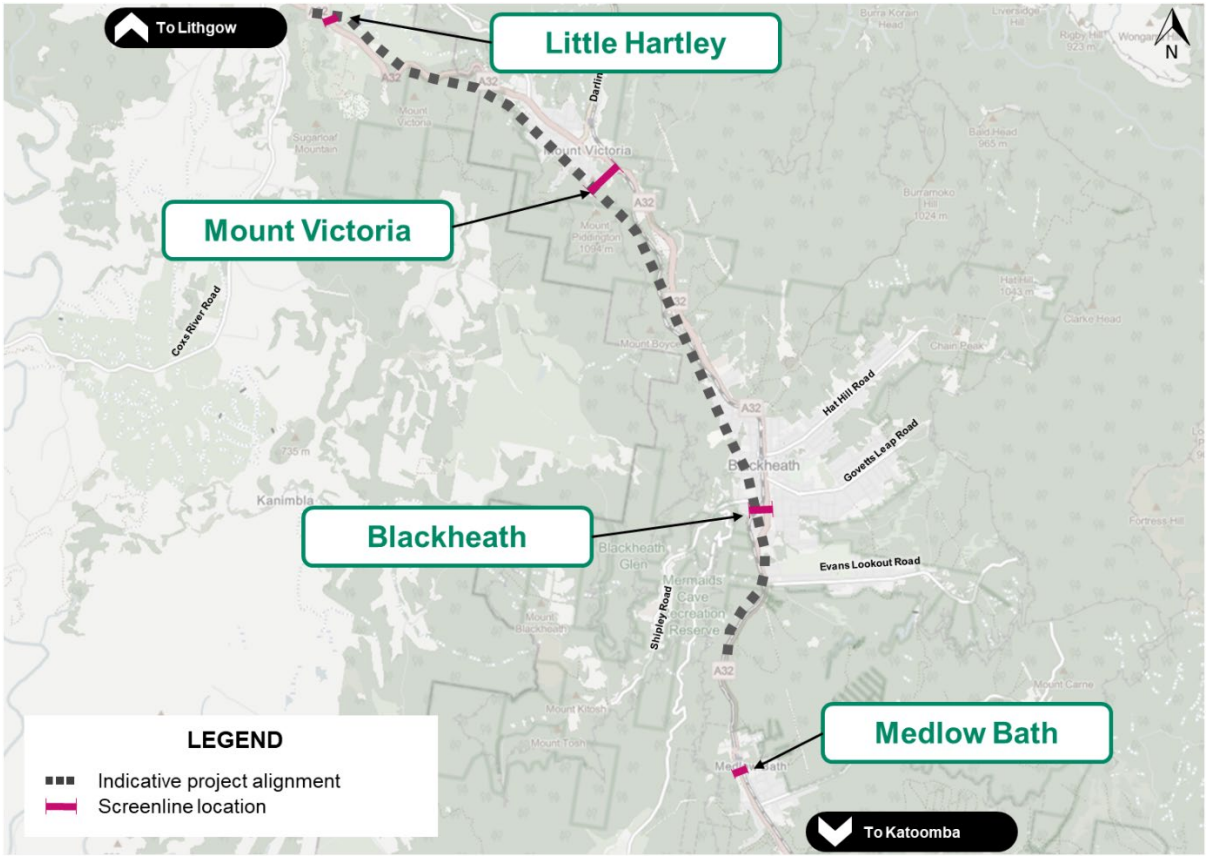


Figure 3-7 Screenline locations

3.5.2 Road network performance statistics

Table 3-4 displays the network performance statistics that were adopted for this assessment and a description of each statistic.

Table 3-4 Network performance statistics descriptions

Network performance statistic	Description
Total traffic demand (vehicle)	The total number of vehicles making trips in the network during the evaluation hour
Vehicle kilometres travelled through network (VKT)	The total distance travelled by all vehicles making trips in the network during the evaluation hour
Total vehicle travel time through the network	The total time taken by all vehicles making trips in the network during the evaluation hour, sometimes known as Vehicle Hours travelled (VHT). Generally, for a given number of vehicles the lower the total travel time, the better the network operates
Total vehicles arrived	The total number of vehicles completing their journey on the network during the modelled evaluation hour
Total number of stops	The total number of stops made by all vehicles while travelling through the network. The higher the number of stops the more congested the network is.
Average network speed	The average speed at which vehicles travel through the network calculated by dividing the total distance travelled and dividing by the total travel time
Unreleased demand	The number (or percentage of vehicles) that could not enter the model network due to congestion within the model

3.5.3 Roadway level of service

Level of service (LoS) is a measure to determine the operational conditions and efficiency of a roadway or intersection. The definition of LoS generally outlines the operating conditions in terms of speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and road safety.

3.5.3.1 Freeway

The LoS for freeway or motorway sections and ramps where the design speed is greater than 70 kilometres per hour is calculated based on vehicle density. Density is measured in passenger car units per kilometre per lane (PCU/km/ln) and is calculated as the design flow rate divided by the average passenger-car speed. PCU is explained further in Section 4.10.2.

Table 3-5 shows the six LoS definitions for a freeway, ranging from LoS A, representing optimum and free-flow operating conditions and LoS F, representing breakdown in flow. When a roadway performance is LoS D or worse, investigations are generally initiated to determine if suitable remediation can be achieved.

Table 3-5 Mid-block level of service definitions and criteria – freeway segment

Level of service	Definition	Freeway ramp density (PCU/km/ln)	Freeway (mid-block) density (PCU/km/ln) [1]
A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high.	6.0 or less	7.0 or less

Level of service	Definition	Freeway ramp density (PCU/km/ln)	Freeway (mid-block) density (PCU/km/ln) [1]
B	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort is a little less than with LoS A.	6.1 to 12.0	7.1 to 11.0
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	12.1 to 17.0	11.1 to 16.0
D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	17.1 to 22.0	16.1 to 22.0
E	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.	More than 22.1	22.1 to 28.0
F	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.	Demand exceeds capacity	Greater than 28.0

[1] Where free flow speed is taken as 80 kilometres per hour
Source: Guide to Traffic Management – Part 3 Traffic Studies and Analysis, Austroads, 2020

3.5.3.2 Two-lane highway

The LoS for two-lane highway segments depends on the segment's categorisation as outlined by the Highway Capacity Manual (Transportation Research Board, 2022) which distinguishes three categories: Class I, Class II and Class III. The existing Great Western Highway alignment within the study area has been considered to be a Class I two-lane highway, which is defined as a two-way highway on which motorists expect to travel at relatively high speeds and often serve long-distance trips or provide connecting links between facilities that serve long distance-trips.

Passing manoeuvres on two-lane highways can take place in the opposing lane where permitted. The LoS for two-lane highway segments is calculated based on the average travel speed and the per cent-time-spent-following which is a measure of overtaking opportunities. The calculations and methodology set out in the Highway Capacity Manual were adopted to estimate the average travel speed and per cent-time-spent-following.

Table 3-6 shows the six LoS definitions for a two-lane highway, ranging from LoS A, representing optimum and free-flow operating conditions and passing opportunities, and LoS F, representing breakdown in flow. The adopted LoS for a segment is taken as the worst of the average travel speed and per cent-time-spent-following.

It is noted that for the purpose of this assessment, the Great Western Highway has been assessed as a rural highway.

Table 3-6 Level of service criteria for class I two-lane highways

Level of service	Definition	Average travel speed (km/h)	Per cent-time-spent-following (per cent)
A	Motorists experience high operating speeds and little difficulty in passing. Platoon of three or more vehicles are rare.	Greater than 90	Less than or equal to 35
B	Passing demand and passing capacity are balanced. The degree of platooning becomes noticeable with some speed reductions present.	81 to 90	36 to 50
C	Most vehicles are travelling in platoons. Speeds are noticeably curtailed.	71 to 80	51 to 65
D	Platooning increases significantly. Passing demand is high but passing capacity approaches zero. A high percentage of vehicles are now travelling in platoons, and the per cent-time-spent-following is quite noticeable.	61 to 70	66 to 80
E	Demand is approaching capacity. Passing is virtually impossible, and the per cent-time-spent-following is more than 80%. Speeds are seriously curtailed.	Less than or equal to 60	Greater than 80
F	Arrival flow in one or both directions exceeds the capacity of the segment. Operating conditions are unstable, and heavy congestion exists.	LOS F applies whenever the arrival flow exceeds the segment capacity.	

Source: Guide to Traffic Management – Part 3 Traffic Studies and Analysis, Austroads, 2020

The following two mid-block segments of the Great Western Highway within the study area have been identified as a two-lane highway and have therefore been assessed using the above methodology:

- Segment 1 – Great Western Highway between Blackheath (near Ridgewell Road) and Mount Victoria (near Victoria Falls Road)
- Segment 2 - Great Western Highway between Mount Victoria (near Victoria Street) and Little Hartley (east of Coxs River Road).

The two segments and their respective locations within the study area are shown in Figure 3-8.

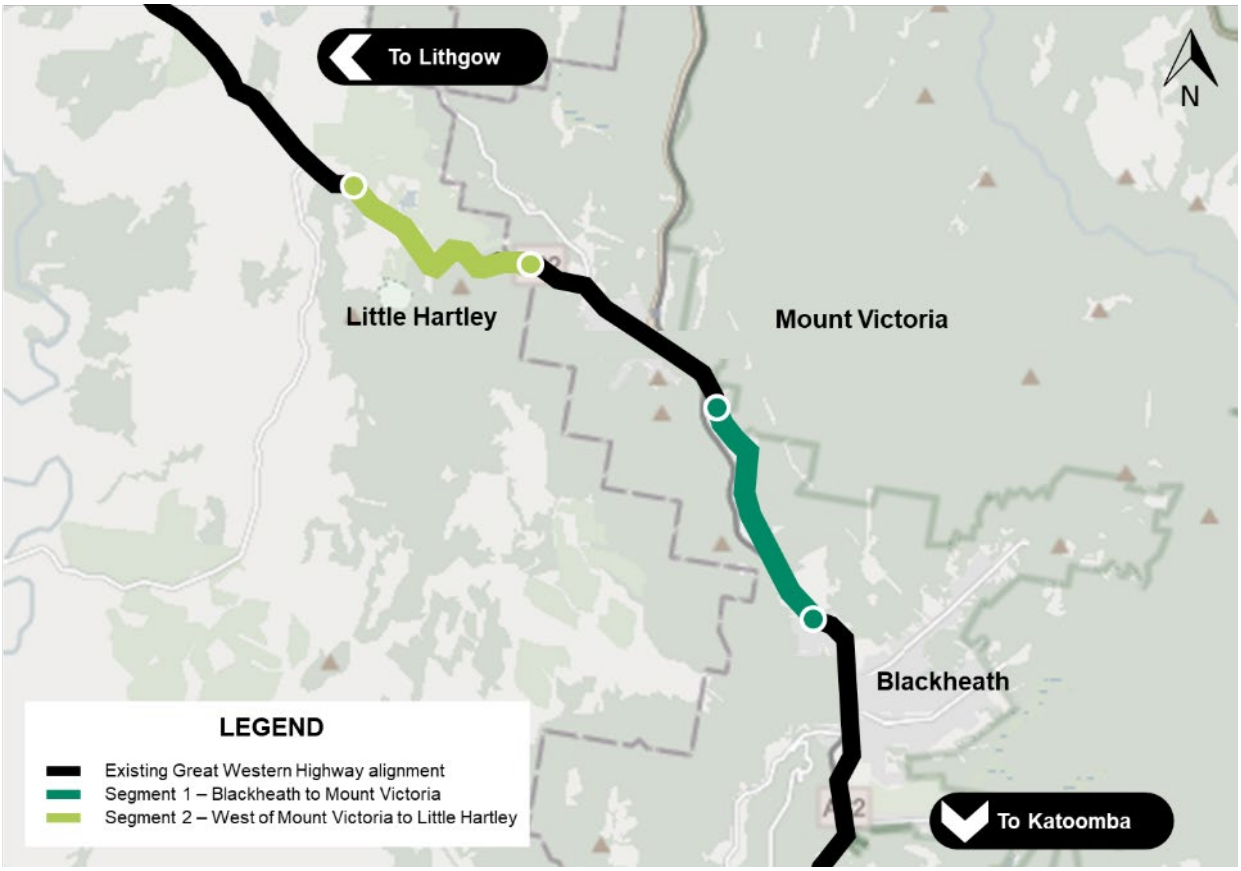


Figure 3-8 Segments for two-lane highway LoS assessment on the Great Western Highway

LoS along the Great Western Highway segments within the Blackheath and Mount Victoria townships is largely driven by intersection performance. Therefore, no mid-block performance criteria is allocated to these segments.

3.5.4 Intersection performance

Average delay is commonly used to assess the operational performance of intersections, with LoS used as an index. A summary of the intersection LoS criteria is shown in Table 3-7.

Similar to the mid-block performance measures, common practice suggests that when intersection performance falls to LoS D, investigations should be initiated to determine if suitable remediation can be provided. However, limited road capacity and high demand mean that LoS E and F are regularly experienced by motorists at pinch points on the existing strategic road network in Sydney, generally during peak periods. It should also be noted that capacity constraints can be used as a demand management technique, which discourages vehicle use and that conversely, over-provision of capacity can encourage more vehicle use.

Table 3-7 Level of service criteria for intersections

Level of service	Average delay per vehicle (seconds per vehicle)	Traffic signals, roundabout	Give way and stop sign
A	0 to 14	Good operation	Good operation
B	15 to 28	Good operation with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required

Level of service	Average delay per vehicle (seconds per vehicle)	Traffic signals, roundabout	Give way and stop sign
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, incidents at signals will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Source: Traffic Modelling Guidelines, Transport, 2013

3.5.5 Travel times

Travel time is a measure of the time taken to travel between two defined locations. Travel times along key routes in the model area have been used to determine the relative impacts or benefits of the project by comparing the change in travel times with and without the project.

The selected travel time routes for the operational assessment are identified in Table 3-8 and shown in Figure 3-9. The key reason/purpose that these travel time routes have been selected is also included in Table 3-8.

Table 3-8 Travel time routes.

Route name	Travel time route description	Main purpose
Between south of Blackheath and Little Hartley	Great Western Highway between 1.5 kilometres south of Evans Lookout Road, Blackheath and about 200 metres east of Coxs River Road, Little Hartley	Assess the change in travel time through the study area due to the project's operation and construction
Between Blackheath and Mount Victoria	Great Western Highway between Leichhardt Street, Blackheath and Station Street, Mount Victoria	Assess the change in travel time along this section of existing Great Western Highway alignment due to the project
Between Katoomba and Lithgow	Great Western Highway between Katoomba and Lithgow	Assess the operational cumulative impacts of the Upgrade Program

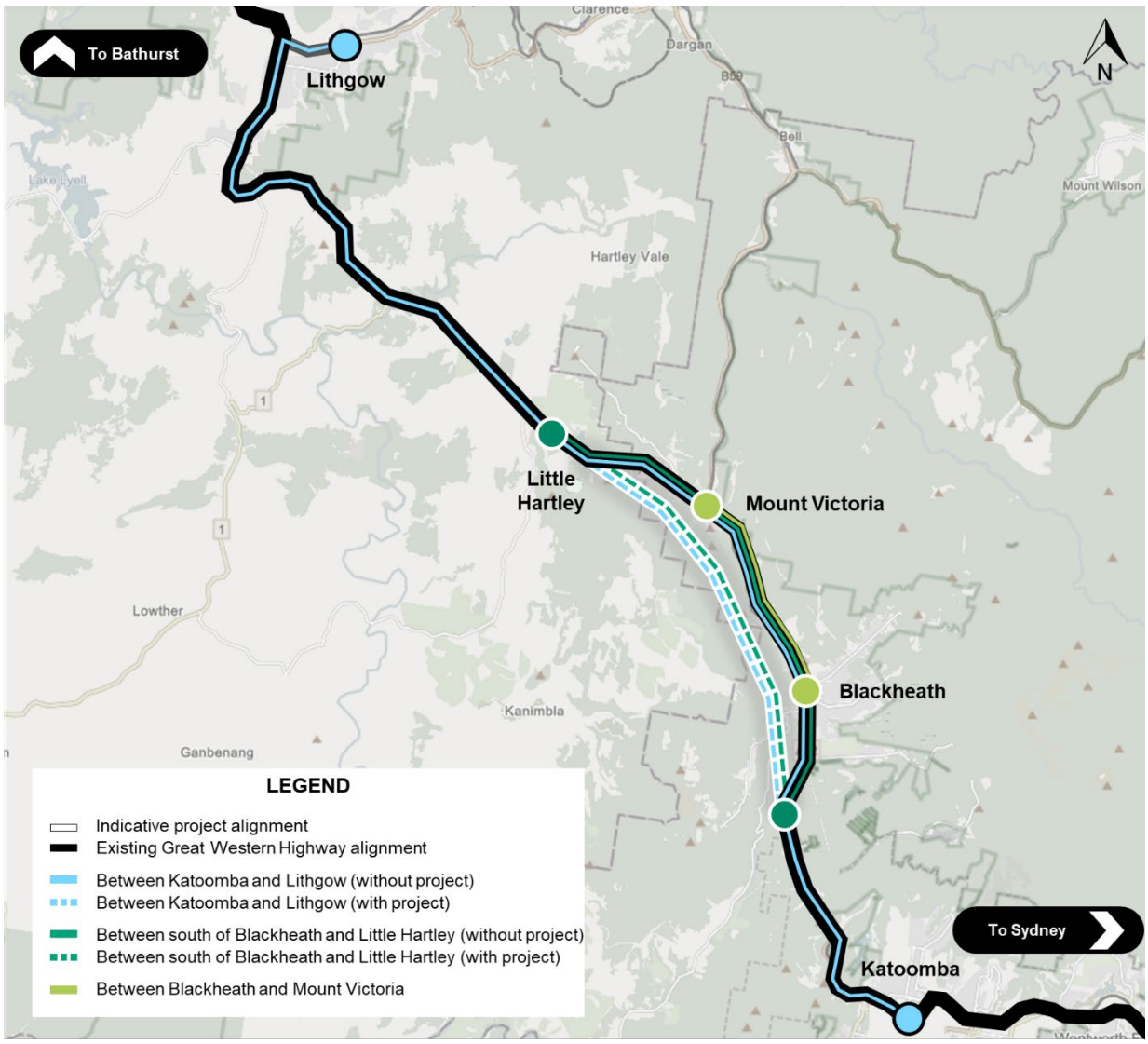


Figure 3-9 Travel time routes

3.5.6 Road safety assessment

Throughout the development phase of the project, mitigation measures and design standards have been considered to avoid or minimise potential safety impacts identified.

The following data was analysed to identify existing road safety issues, as well as future impacts and benefits of the project:

- five years of historical crash data by crash type, location, and severity
- current traffic volumes
- forecast change in traffic volumes due to construction
- forecast change in traffic volumes with and without the project
- the project's road design.

3.6 Public and active transport assessment

The public and active transport assessment includes examination of the operational impacts or benefits of the project or its construction on public transport services and active transport provisions.

Throughout the project development and design, mitigation measures have been considered and assessed to avoid or minimise any potential impacts identified as well as to enhance the performance of the project and the surrounding transport network.

Any improvements that were identified during project development, formed part of an iterative process between traffic modelling, construction staging and project design process to confirm that the connectivity, safety and efficiency of the public and active transport network is maintained throughout all project phases.

Based on this, the following public and active transport elements have been assessed:

- temporary changes to current services and bus stops during construction, if any
- changes in travel times along bus service routes during project operations and construction
- changes to accessibility and connectivity of the pedestrian and cycling network
- opportunities to improve current safety issues for pedestrians and cyclists.

3.7 Parking and access assessment

The project's impacts on car parking, local area access and property access during construction and operations have been assessed including:

- changes to current parking including permanent and temporary changes, if any
- changes to any existing property access points, including assessing suitability of the provided alternative routes and associated changes in travel time or distance
- changes to any existing local area access arrangements, if any, including identifying alternative routes and associated changes in travel time or distance.

3.8 Movement and place

Movement and place recognises that streets contribute more than just the movement of people and goods from point to point – they are also places for people to live, work and spend quality time. This is achieved by recognising that transport corridors have two primary functions:

- movement – how the corridor moves people (e.g. major freight route, high-pedestrian activity area)
- place – how the corridor is a destination in its own right (e.g. bypass road, civic spaces).

A movement and place assessment was prepared for the Upgrade Program. The assessment identified the movement and place classifications for existing conditions within the Upgrade Program extents and considered future movement and place opportunities. The study adopted the movement and place framework set out in the Practitioners Guide to Movement and Place (NSW Government Architect, 2020).

Figure 3-10 displays the movement and place framework. The framework classifies corridors based on their movement and place significance using the following four street environments:

- **Civic spaces** – are streets at the heart of our communities and have a significant meaning, activity function, or built environment. They are often in our major centres, our tourist and leisure destinations, and our community hubs.
- **Local streets** – are the majority of streets within our transport networks and often have important local place qualities. Activity levels are less intense; however, these streets can have significant meaning for local people.
- **Main streets** – have both significant movement functions and place qualities. Balancing the functions of these streets is a common challenge.
- **Main roads** – are routes central to the efficient movement of people and freight. They include motorways, primary freight corridors, major public transport routes, the principal bicycle network, and key urban pedestrian corridors. Place activity levels are less intense; however, these roads and routes can have significant meaning to local people.

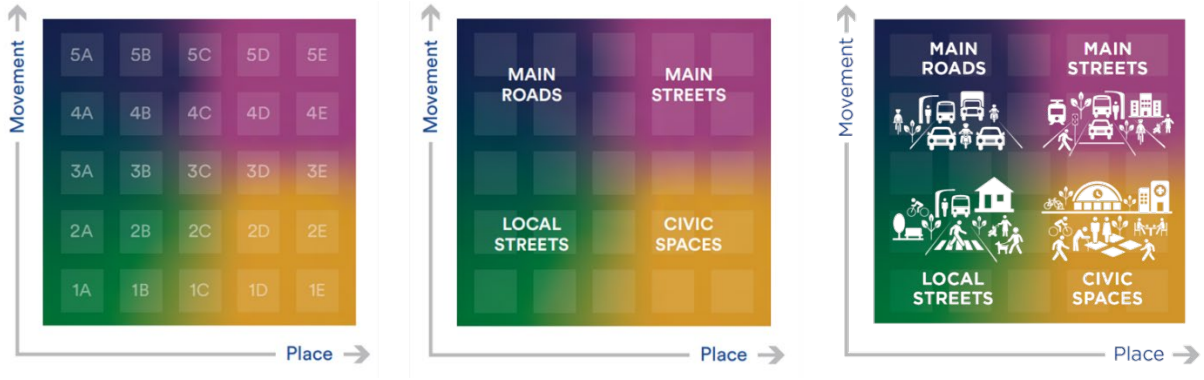


Figure 3-10 Movement and place framework (source: Practitioner's Guide to Movement and Place, March 2020)

The movement and place classifications which were identified for the study area have been referenced in Section 4.13.

4.0 Existing environment

This section discusses the existing transport and traffic environment within the study area. The baseline environment which includes changes to the study area that are proposed to be delivered as part of the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade is also considered in Section 4.14, as these would be operational by 2027 prior to opening of the project.

4.1 Route overview

Within the study area, the Great Western Highway passes the Blue Mountains suburbs of Blackheath, Mount Victoria, and Little Hartley from east to west, as discussed further in Section 4.2. It generally follows the alignment of the railway line until Mount Victoria, where the Great Western Highway passes over the rail line at which point the road and rail alignments diverge.

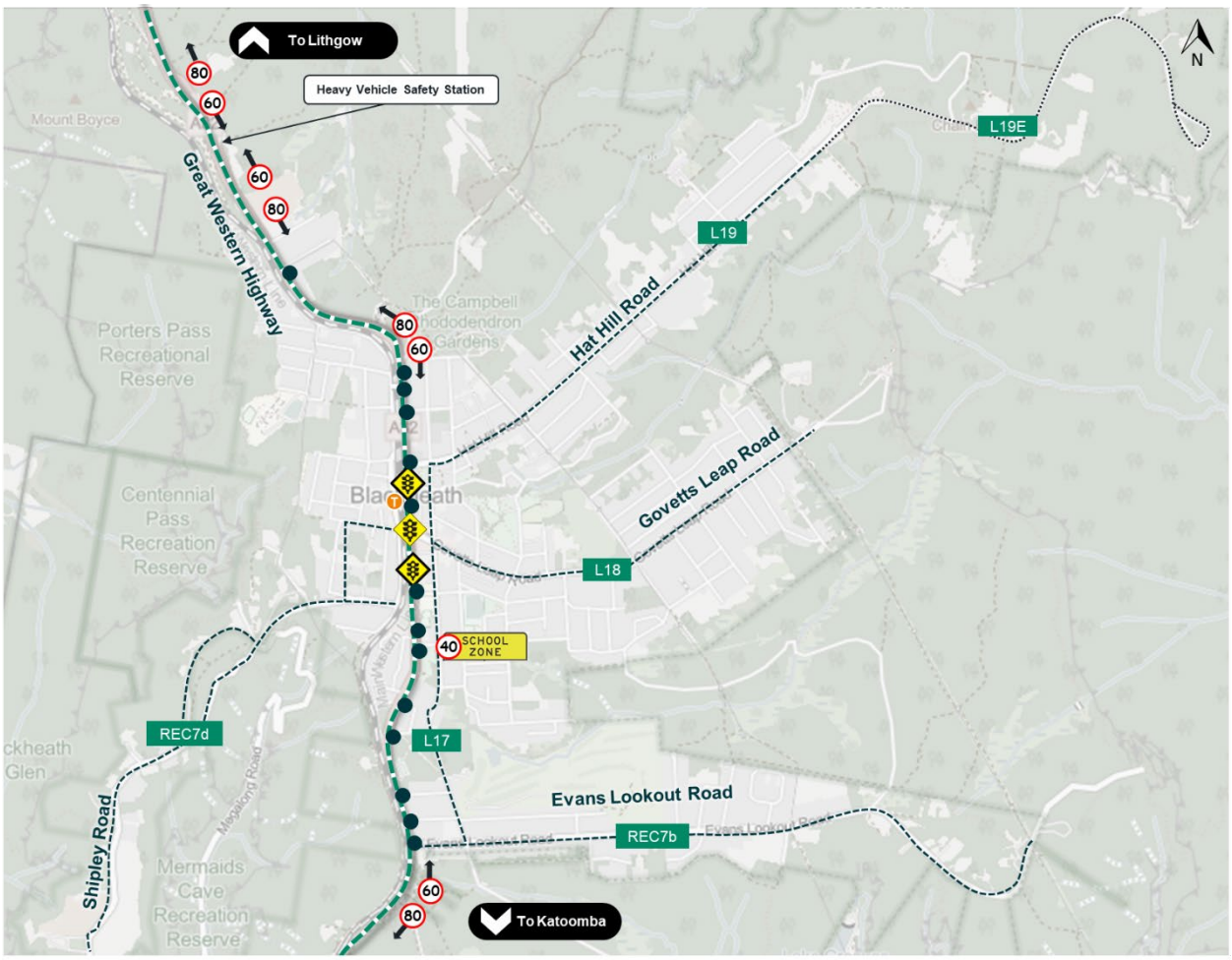
The main functions of the Great Western Highway, within the study area include:

- local access for residents of the adjacent townships and rural destinations located along the Great Western Highway
- major tourist route providing access to and from key destinations in the NSW Central West region and Blue Mountains
- major freight route facilitating vehicles up to 19 metre B-doubles carrying freight between (to and from) Sydney and the Central West.

East of Katoomba, the Great Western Highway generally has two lanes in each direction. However, between Bathurst Road at Katoomba and Forty Bends near Lithgow (including the study area), the Great Western Highway is generally undivided and has one lane in each direction, with limited overtaking lanes and auxiliary lanes.

Currently, the Great Western Highway typically has a posted speed limit of 60 kilometres per hour as it passes through townships and 80 kilometres per hour in areas outside the townships. However, between Mount Victoria and Little Hartley the 60 kilometres per hour posted speed limit continues for cars because of steep grades and a winding road alignment through Victoria Pass. Truck speeds are restricted to 40 kilometres per hour through this section.

Figure 4-1, Figure 4-2 and Figure 4-3 display an overview of the existing transport and traffic features along the Great Western Highway in the Blackheath, Mount Victoria and Little Hartley townships, respectively. Further details are provided in the subsequent sections.



Legend

- Signalised intersection
- Signalised pedestrian crossing
- Pedestrian bridge
- Unsignalised intersection
- Train station
- On-road local cycle route
- On-road unsealed cycle route
- On-road regional cycle route
- Posted speed limit
- School zone
- Cycling route

Figure 4-1 Overview of existing conditions in Blackheath

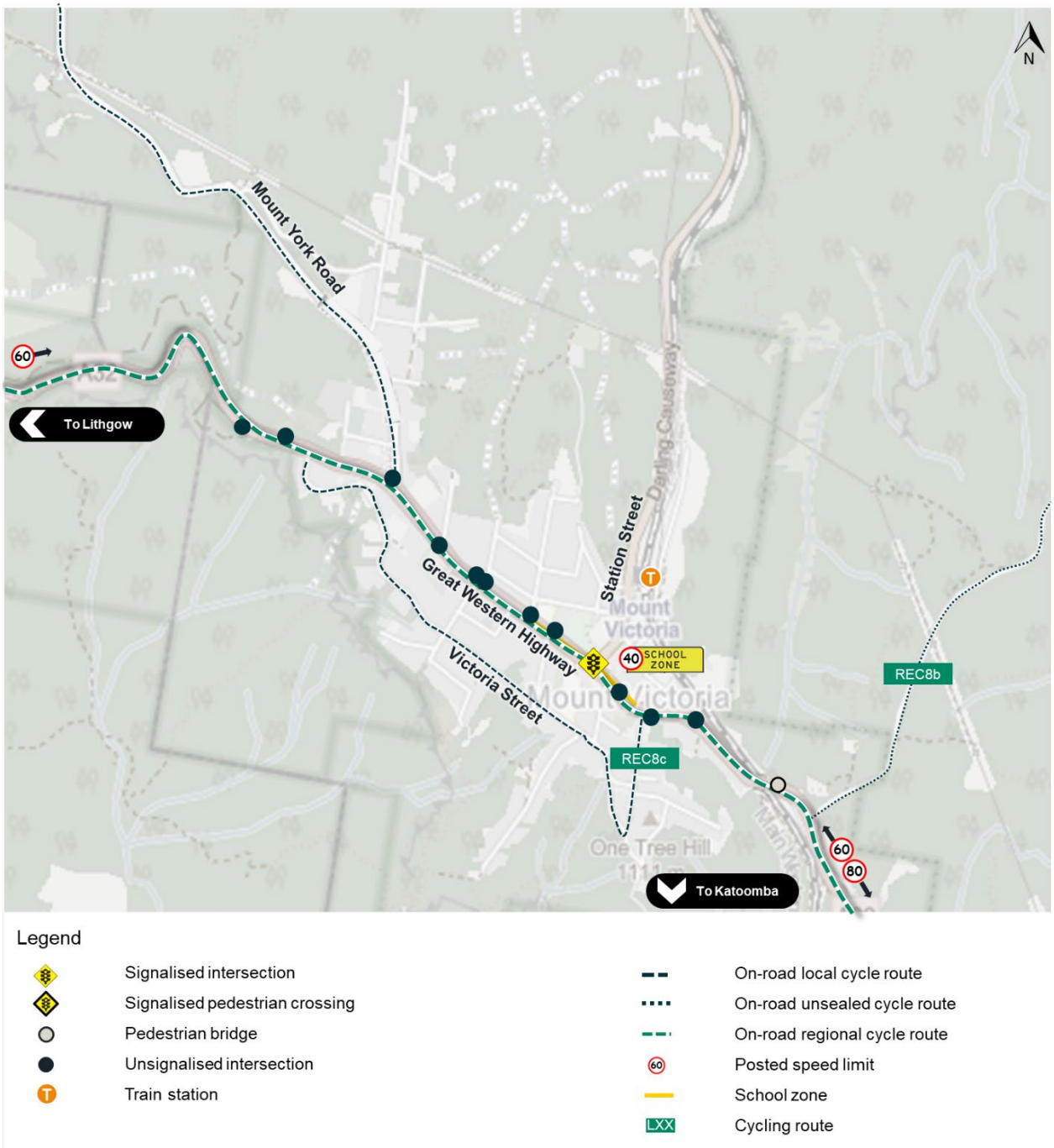


Figure 4-2 Overview of existing conditions in Mount Victoria

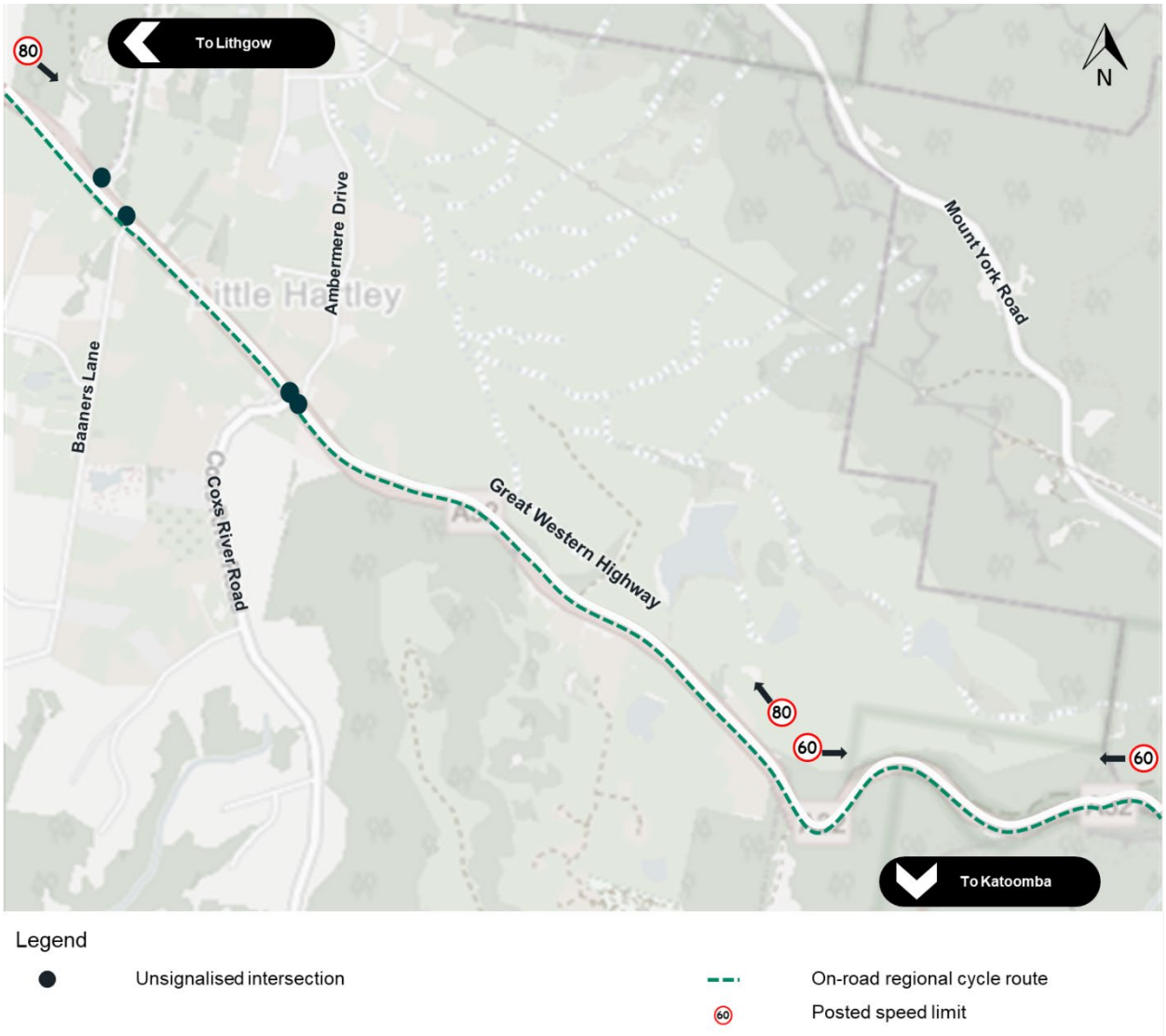


Figure 4-3 Overview of existing conditions in Little Hartley

4.2 Local townships

4.2.1 Blackheath

Blackheath is a village located about 30 kilometres southeast of the district centre at Lithgow and about 10 kilometres northwest of Katoomba, both via the Great Western Highway. Located within the Blue Mountains LGA, Blackheath has a population of nearly 4,500 people, representing about five per cent of the Blue Mountains LGA population, according to the 2016 Census.

The Blackheath township is mostly located to the east of the Great Western Highway, with access available at several intersections including signalised access at Govetts Leap Road. Some residential properties are located to the west of the Great Western Highway, with access largely facilitated by Bundarra Street which intersects with the Great Western Highway at Govetts Leap Road.

Blackheath is known for its guesthouses, cafés, antique stores, galleries, and local markets as well as the following lookouts and associated hikes:

- Evans Lookout (accessed via Evans Lookout Road)
- Pulpit Rock Lookout (accessed via Hat Hill Road)
- Govetts Leap Lookout (accessed via Govetts Leap Road).

4.2.2 Mount Victoria

Mount Victoria is a small village located about 25 kilometres southeast of Lithgow and about 20 kilometres northwest of Katoomba. Mount Victoria is the westernmost village in the Blue Mountains LGA and has a population of approximately 1,000 people. This represents about one per cent of the Blue Mountains LGA population, according to the 2016 Census.

The Mount Victoria village is dispersed to the north and south of the Great Western Highway. Mount Victoria Station and the main village is generally accessed via Station Street, which transitions to Darling Causeway to the north of the station, and is a main road between the Great Western Highway and Bells Line of Road.

Mount Victoria is known for its historical guesthouses, museums and cinema, as well as the following lookouts and associated hikes:

- Sunset Rock Lookout (accessed by Beaufort Avenue)
- Mitchell Ridge Lookout (accessed via Great Western Highway)
- Mount Piddington (accessed via Mount Piddington Road).

4.2.3 Little Hartley

Little Harley is a small rural village located immediately east of the larger village of Hartley and about 20 kilometres southeast of Lithgow and about 5 kilometres west of Mount Victoria. Little Harley is located within the Lithgow LGA and has a population of approximately 500 people, representing about two per cent of the total Lithgow LGA population, according to the 2016 Census.

Properties within Little Hartley are distributed to both the north and south sides of the Great Western Highway, with access largely facilitated by Coxs River Road and Baaners Lane to the south and Ambermere Drive and Browns Gap Road to the north.

A small number of retail, food and beverage land uses have frontages to the Great Western Highway within Little Hartley.

4.3 Travel patterns

4.3.1 Household travel survey

The Transport Open Data Portal's, Household Travel Survey Data, provides the following information in relation to travel patterns in 2019/2020[1] for some Local Government Area's (LGA's):

- mode share estimates for a typical weekday
- trip purpose estimates (reason for travelling).

The study area passes through the Blue Mountains and Lithgow LGA's. However, data was not available for the Lithgow LGA. Therefore, mode share and trip purpose data is discussed below for the Blue Mountains LGA, as well as a comparison to the Sydney Greater Metropolitan Area (GMA).

4.3.1.1 Mode share

Figure 4-4 shows the 2019/ 2020 travel mode share estimates for the Blue Mountains LGA, as well as a comparison with the same data for the Sydney GMA. The data shows the following with regards to travel on a typical weekday:

- approximately 80 per cent of trips generated by the Blue Mountains LGA were car-based travel compared to 70 per cent for the Sydney GMA
- less than ten per cent of trips generated by the Blue Mountains LGA were made on public transport compared to 15 per cent for the Sydney GMA

[1] For the 2019/20 release, the data is based on four-year pooled data. Due to the impacts of Covid-19 and late data collection (2019/20 and 2018/19) 2019/20 data estimates are based on data pooled for the years 2016/17, 2017/18, 2018/19, and 2019/20, weighted to 2019/20 population.

- nearly 15 per cent of trips generated by the Blue Mountains LGA were made by walking compared to more than 20 per cent for the Sydney GMA.

Overall, the Blue Mountains region has a slightly higher car reliance and slightly less reliance on public transport and active transport modes compared to the Sydney GMA.

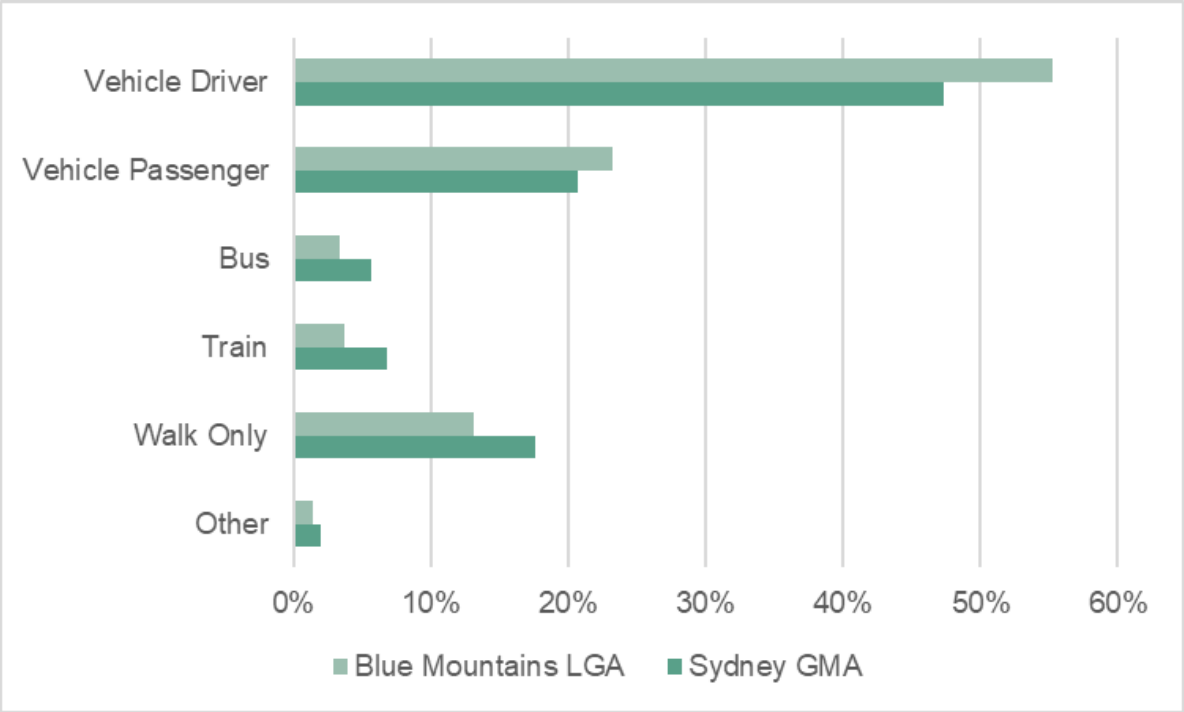
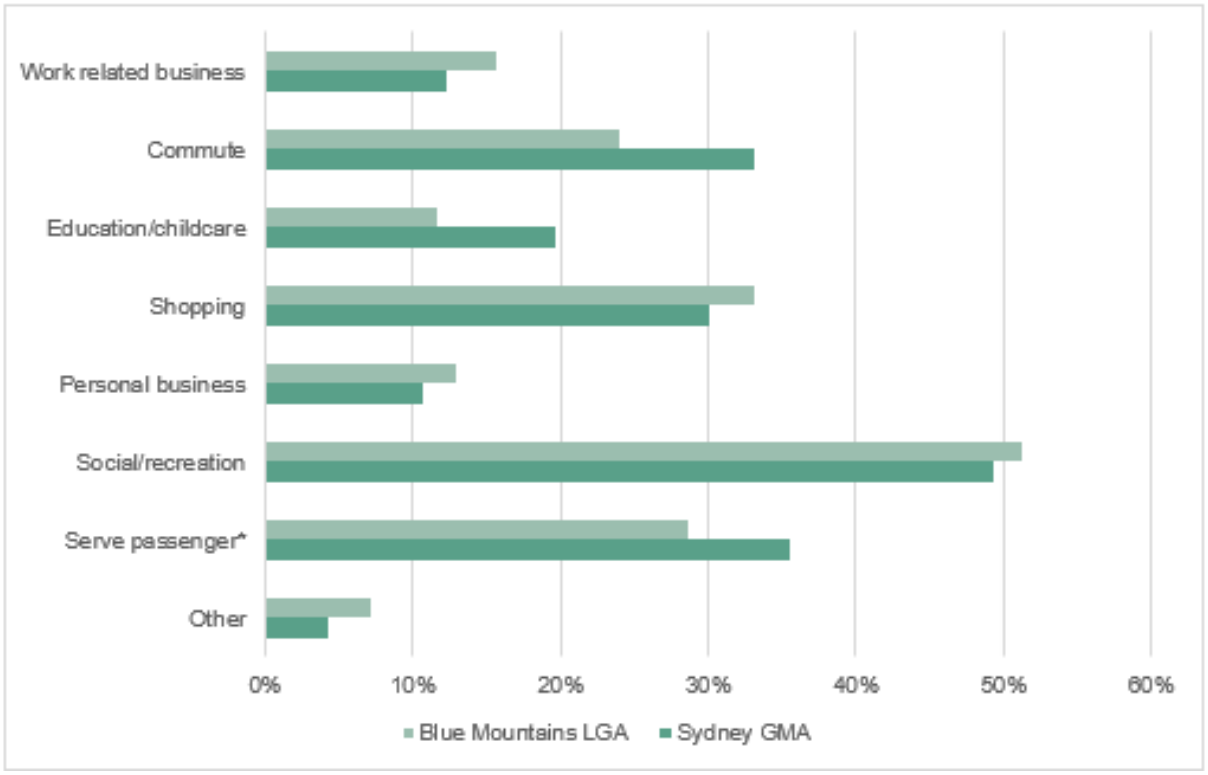


Figure 4-4 Typical weekday travel mode share for Blue Mountains LGA and Sydney GMA (2019/2020)

4.3.1.2 Trip purpose

Figure 4-5 shows the 2019/2020 trip purpose estimates for the Blue Mountains LGA, as well as a comparison with the same data for the Sydney Greater Metropolitan Area (GMA). On a typical weekday, travel in the Blue Mountains LGA generally has a higher portion of work- related business, social and recreation and shopping than the Sydney GMA.

The proportion of travel for the purpose of commuting, education and childcare and serving passengers in the Blue Mountains is typically less than the Sydney GMA.



*Serve passengers refers to drop-off, pick-up or accompany another person

Figure 4-5 Typical weekday trip purpose for Blue Mountains LGA and Sydney GMA (2019/2020)

4.3.2 Journey to work

The ABS 2016 Census data provides mode share estimates for commuting travel to and from defined Statistical Areas (SA). This section reviews the mode share estimates for the following:

- residents of the Blackheath-Megalong Valley region (SA1), in Figure 4-6
- employees of the Sydney-Outer West and Blue Mountains region (SA4), in Figure 4-7.

The data shows the following with regards to commuting travel modes for Blackheath residents and Blue Mountains employees:

- approximately 70 per cent of residents drive to work and approximately 85 per cent of employees drive to work
- approximately 15 per cent of residents work from home and approximately 5 per cent of employees work from home
- approximately 10 per cent of residents use public transport to travel to work and only four per cent of employees use public transport
- approximately five per cent of residents use active transport to travel to work and only three per cent of employees use active transport.

The journey to work data suggests that private vehicle is the predominant mode used to travel to and from work. In addition, a higher percentage of residents of the Blackheath area work from home. This could suggest that traditional weekday AM and PM travel patterns may be less pronounced in the study area.

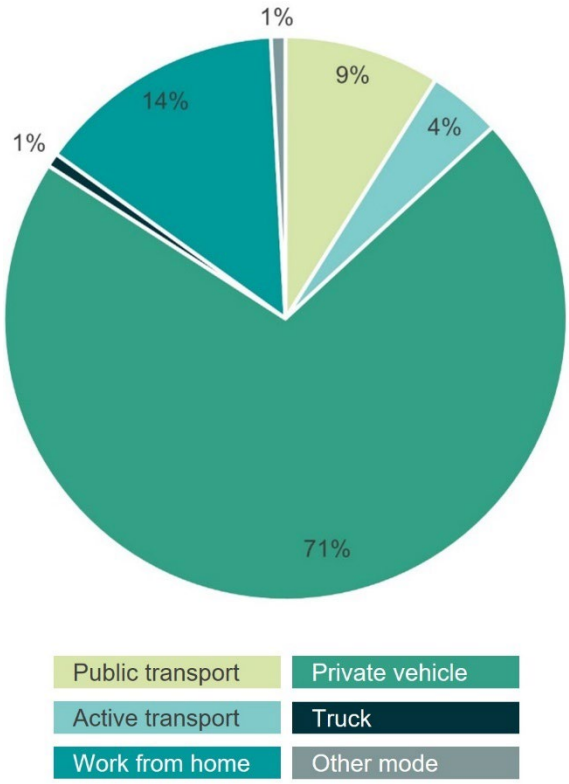


Figure 4-6 Journey to work by mode from Blackheath-Megalong Valley (SA1)

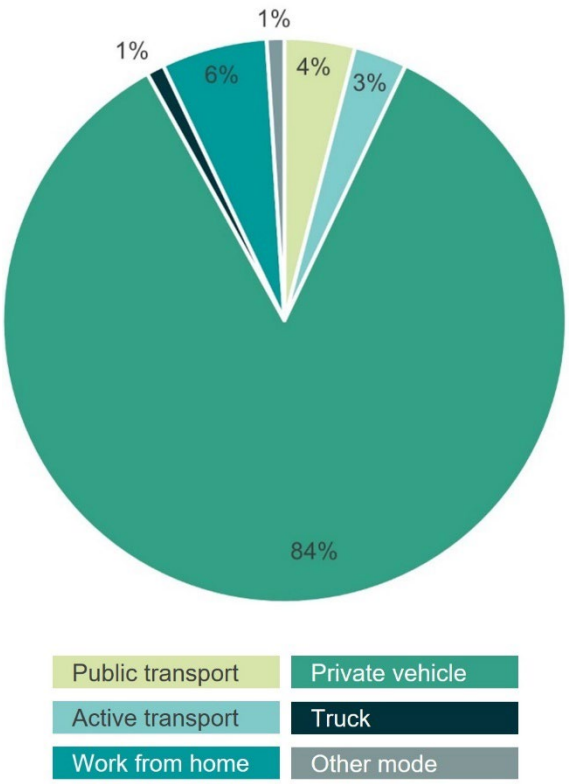


Figure 4-7 Journey to work from the Blue Mountains region (SA4)

4.4 Public transport

4.4.1 Rail

4.4.1.1 Services and network

The Blue Mountains Line travels through the study area and provides the primary public transport service for the Blue Mountains and the NSW Central West region. The Blue Mountains Line is an extension of Sydney's Western Line, extending from Emu Plains to Bathurst via the Blue Mountains and Lithgow, as shown in Figure 4-8.

The Great Western Highway generally follows the alignment of the railway line to Mount Victoria, where the Great Western Highway overpasses the rail line extending to the west and the rail transitions to the north.

Within the study area, stations are provided at Blackheath and Mount Victoria. However, the electrified rail line ends at Lithgow requiring most rail services to terminate at Lithgow or Mount Victoria.

The frequency of rail services on the Blue Mountains Line and within the study area includes:

- two express diesel services in each direction between Sydney and Bathurst per day, with shuttle rail services also operating between Lithgow and Bathurst during weekday morning and evening peak periods
- citybound services between 5.30am and 7am have a frequency of about 15 minutes at Mount Victoria and Blackheath, with 1-2 services stopping at Mount Victoria and Blackheath per hour outside these hours
- outbound services departing the Sydney CBD between 4pm and 6.30pm and stopping at Mount Victoria and Blackheath typically have a frequency of about 30 minutes, with 1-2 services stopping at Mount Victoria and Blackheath outside these hours per hour
- on weekends, one to two services typically stop at Mount Victoria and Blackheath per hour.

Figure 4-8 Blue Mountains Line network map

4.4.1.2 Station access

Mount Victoria Station is to the north of the Great Western Highway and accessed via Station Street, Darling Causeway to the west of the station and Patrick Street to the east. Commuter car parking is accessible via both Darling Causeway and Patrick Street.

Blackheath Station is located parallel to the Great Western Highway. Access to Blackheath Station is facilitated by Station Street. A rail level crossing on Bundarra Street facilitates vehicle access between the Great Western Highway and Station Street and a rail overbridge facilitates access between the Great Western Highway and Station Street.

Commuter parking is available on both sides of the station. Station Street provides access to commuter parking (approximately 20 spaces) and some commuter parking (five spaces including two disability) is also accessible directly from the Great Western Highway. Bike lockers which are accessible from the Great Western Highway are also provided at Blackheath Station.

4.4.1.3 Patronage

Customer entry and exit data for Mount Victoria and Blackheath stations covering the years from 2016 to 2021 were sourced from the Transport Open Data Portal. The data provides the total entry and exits at both stations on a typical day in each year for a 24-hour period, as shown in Figure 4-9.

For 2020, data is shown for May and September representing periods before and after NSW travel restrictions caused by the COVID-19 pandemic.

The data shows that more customers typically access Blackheath Station than Mount Victoria Station. However, the total number of customers at both stations decreased in 2019 and 2020 when compared with the years between 2016 and 2018. In September 2020, the number of customers accessing Blackheath Station was more than double the data from May 2020.

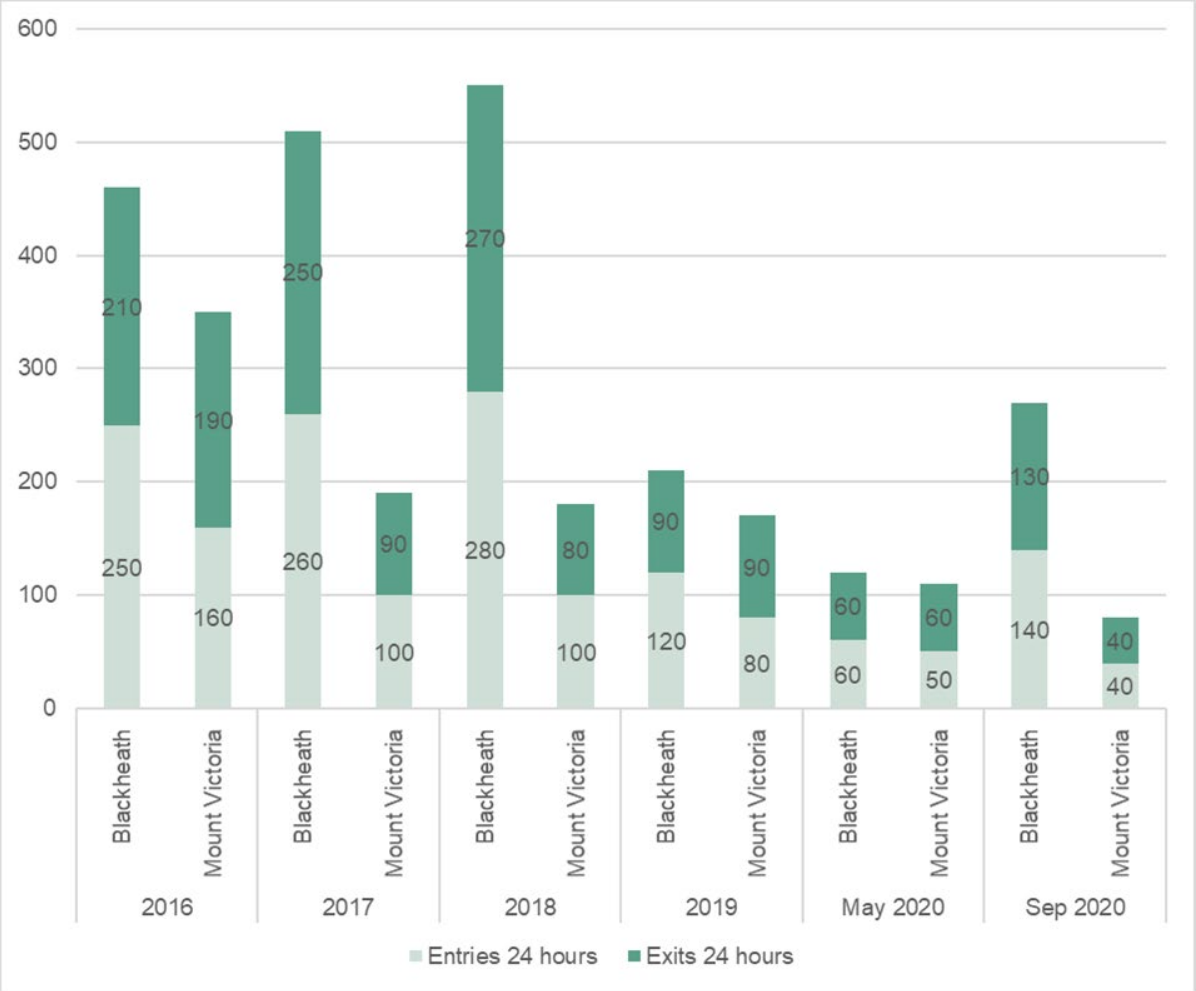


Figure 4-9 Customer daily entry and exits at Blackheath and Mount Victoria train stations (Transport Open Data Portal)

4.4.1.4 Rail replacement

As is standard practice across the NSW TrainLink network, planned closures for servicing and maintenance of rail equipment are often conducted on the Blue Mountains Line.

When practical, planned closures on the Blue Mountains Line generally occur on weekdays outside peak periods or weekends to minimise disruption. However, future closures are also planned within weekday peak periods. Buses generally replace trains during planned closures. Due to a reduction in service quality, customers may use private vehicles instead of replacement buses during these closures. However, considering the low rail patronage discussed in Section 4.4.1 and the journey to work data discussed in Section 4.3.2, only minor traffic volume increases would typically occur within the study area during these planned closures.

Unplanned closures are an increasingly common occurrence on the Blue Mountains Line due to severe impacts from natural disasters including bushfires, landslides, and flooding. This generally results in prolonged closures, with buses replacing trains for extended durations, or shuttle train services operating on unaffected sections of track.

4.4.2 Bus

4.4.2.1 Services and network

Bus services in the upper Blue Mountains region including the study area are operated by CDC. Route 698 links the Blackheath community with Katoomba and Leura to the east. Route 698V links the Blackheath and Mount Victoria communities with Katoomba. The bus route maps are shown in Figure 4-10.

Route 698 operates seven days a week, whereas 698V only operates on weekdays. However, both services have relatively infrequent service patterns. Table 4-1 summarises the number of services for each route on a weekday and weekend.

In addition, the 690K Springwood to Katoomba travels through Blackheath on a school day morning to access the Blue Mountains Christian School. The 8710 school bus service travels through Blackheath during a school day afternoon.

Table 4-1 Frequency of bus services within the study area

Bus route	Description	Number of services per day		
		Weekday	Saturday	Sunday and public holidays
698	Katoomba to Blackheath (loop service)	14	4	2
698V	Katoomba to Mount Victoria (loop service)	5	0	0

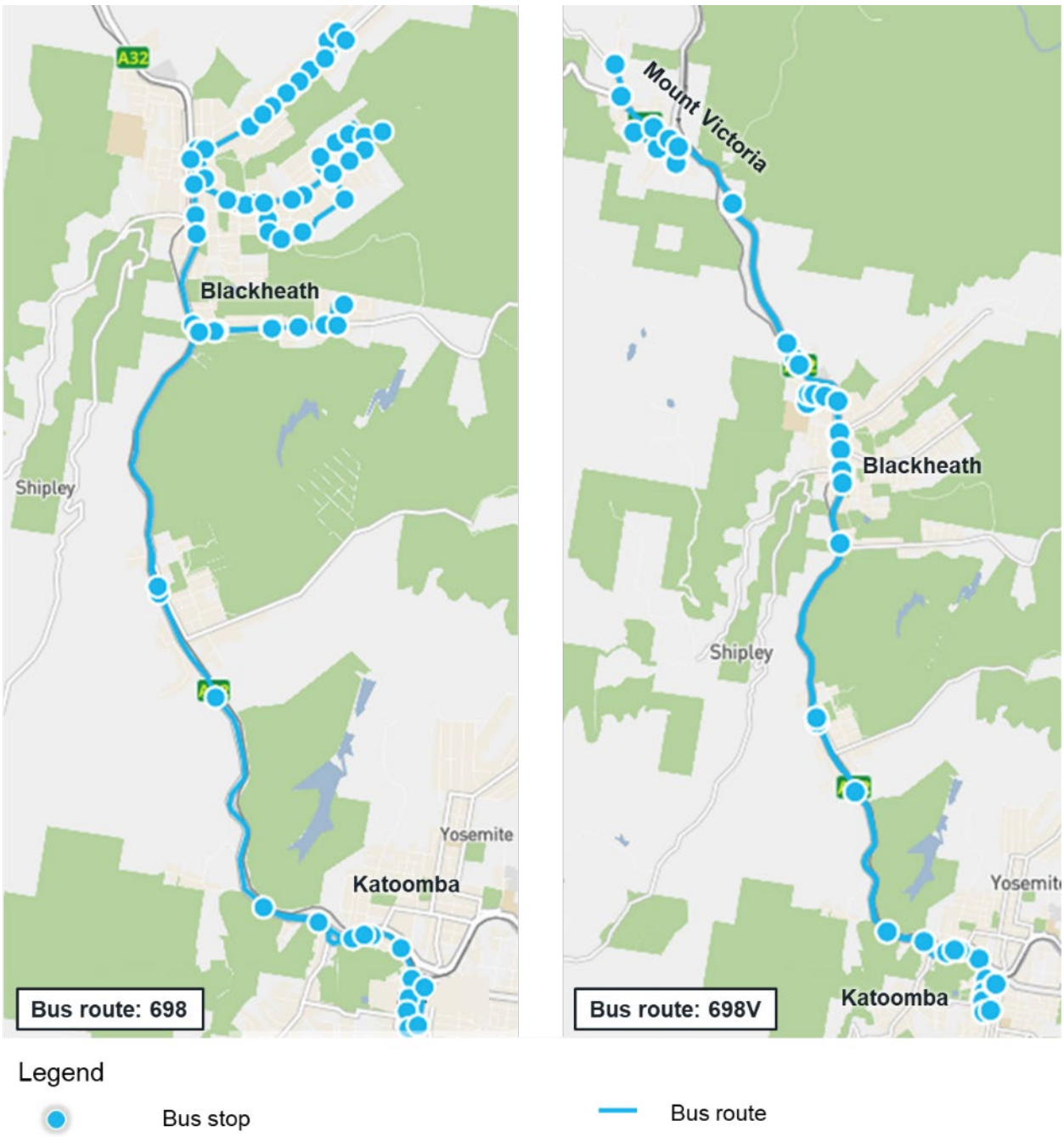


Figure 4-10 Bus route maps (source: https://transportnsw.info/routes/details/blue-mountains-buses-network/698/64698, accessed 29 September 2022)

4.4.2.2 Bus stops

Bus stops are located at the following locations along the Great Western Highway in Blackheath and Mount Victoria:

- Blackheath:
  - north of Prince George Street
  - south of Leichhardt Street
  - south of the Govetts Leap Road, Bundarra Street and Great Western Highway intersection
  - north of the Station St overbridge

  - opposite Sunbeam Avenue and Radiance Avenue.
- Mount Victoria:
  - east of Mount Paddington Road
  - southeast of Station Street
  - east of Selsdon Street.

Additional bus stops are located across the local road network of Blackheath and Mount Victoria including key stops on Govetts Leap Road and Hat Hill Road in Blackheath and Victoria Street and Mount York Road in Mount Victoria.

No bus stops are provided in Little Hartley.

4.5 Active transport

4.5.1 Pedestrian facilities

Within the Blackheath township, footpaths are generally provided on at least one side of the road, particularly in the higher activity areas. Along the Great Western Highway, a footpath is provided on eastbound side of the road between Chelmsford Street and Mount Boyce. The footpath on the westbound side is generally limited to the Blackheath town centre. The Great Western Highway footpaths have widths ranging from one metre to 3.5 metres.

Footpaths are less prevalent in the local street network, particularly on residential access streets.

Figure 4-11 shows the following key pedestrian crossing facilities are provided within Blackheath:

- a signalised mid-block pedestrian crossing near Blackheath Public School, about 40 metres north of Leichhardt Street
- signalised pedestrian crossings on all legs of the Great Western Highway, Govetts Leap Road and Bundarra Street intersection
- signalised mid-block pedestrian crossing on the Great Western Highway near Blackheath Railway Station, about 50 metres east of Gardiner Crescent and immediately east of the Blackheath Station concourse
- pedestrian bridge over rail line at Blackheath Station
- a rail level crossing at Bundarra Street.

In Mount Victoria, footpaths are generally limited to the Great Western Highway and Station Street. Footpaths are typically provided along both sides of the Great Western Highway in the Mount Victoria township, between Hooper Street and Mount York Road. These footpaths are generally 1.2 metre wide.

Footpaths are also provided on both sides of Station Street, providing access to and from Mount Victoria Station. The Station Street footpaths are one metre to 3.5 metres wide.

Figure 4-12 shows that signalised pedestrian crossings are provided on two of three legs of the Great Western Highway and Station Street intersection. In addition, pedestrians can cross the rail line at the following locations:

- pedestrian bridge near Fairy Bower Road
- pedestrian bridge at Mount Victoria Station.

In Little Hartley, footpaths and pedestrian crossing facilities are not provided. Therefore, it is anticipated that pedestrian demand in Little Hartley is limited.

Between the townships, pedestrian activity along the Great Western Highway is generally low.

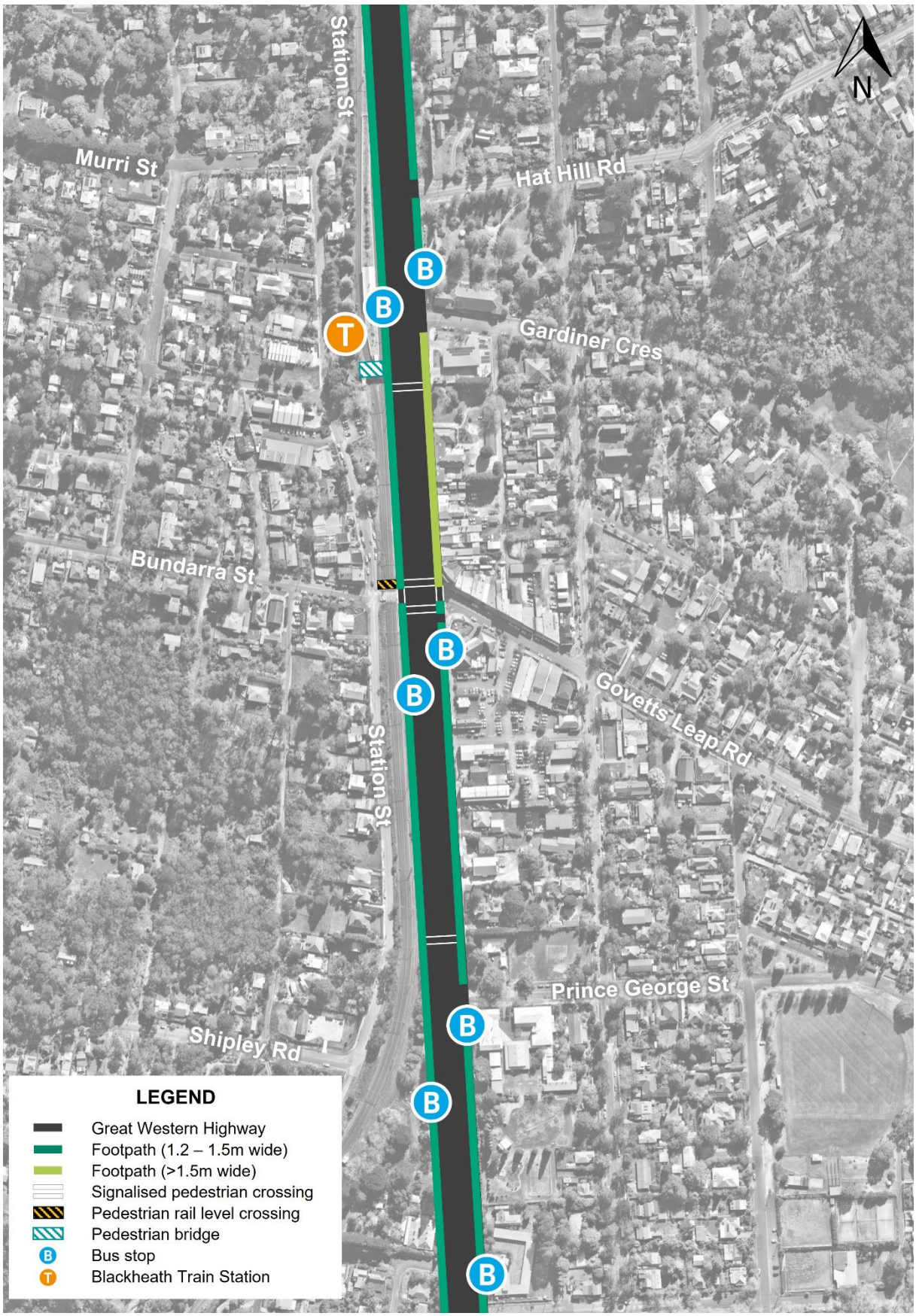


Figure 4-11 Blackheath pedestrian facilities on Great Western Highway (Basemap source: Nearmap)

Figure 4-12 Mount Victoria pedestrian facilities on Great Western Highway (Basemap source: Nearmap)

4.5.2 Pedestrian demand

Intersection surveys conducted in 2018 and 2021 counted the number of pedestrians crossing at key locations along the Great Western Highway in the study area during a weekday AM and PM peak periods of 7-10am and 3-6pm.

The locations with the highest recorded pedestrian counts were:

- Great Western Highway, Govetts Leap Road and Bundarra Street, Blackheath
- Great Western Highway and Gardiner Crescent, Blackheath
- Great Western Highway and Station Street, Mount Victoria.

The outputs of the 2018 and 2021 survey of pedestrian crossing volumes in the AM and PM peak periods is shown in Figure 4-13. The data suggests that pedestrian activity at the Govetts Leap Road is higher than other surveyed locations along the Great Western Highway, with more than 200 pedestrian movements counted in 2018 and more than 160 pedestrian movements counted in 2021.

At Gardiner Crescent in Blackheath, about 50 pedestrian movements were counted during most periods and at Station Street in Mount Victoria, generally less than 20 pedestrian movements were counted per period.

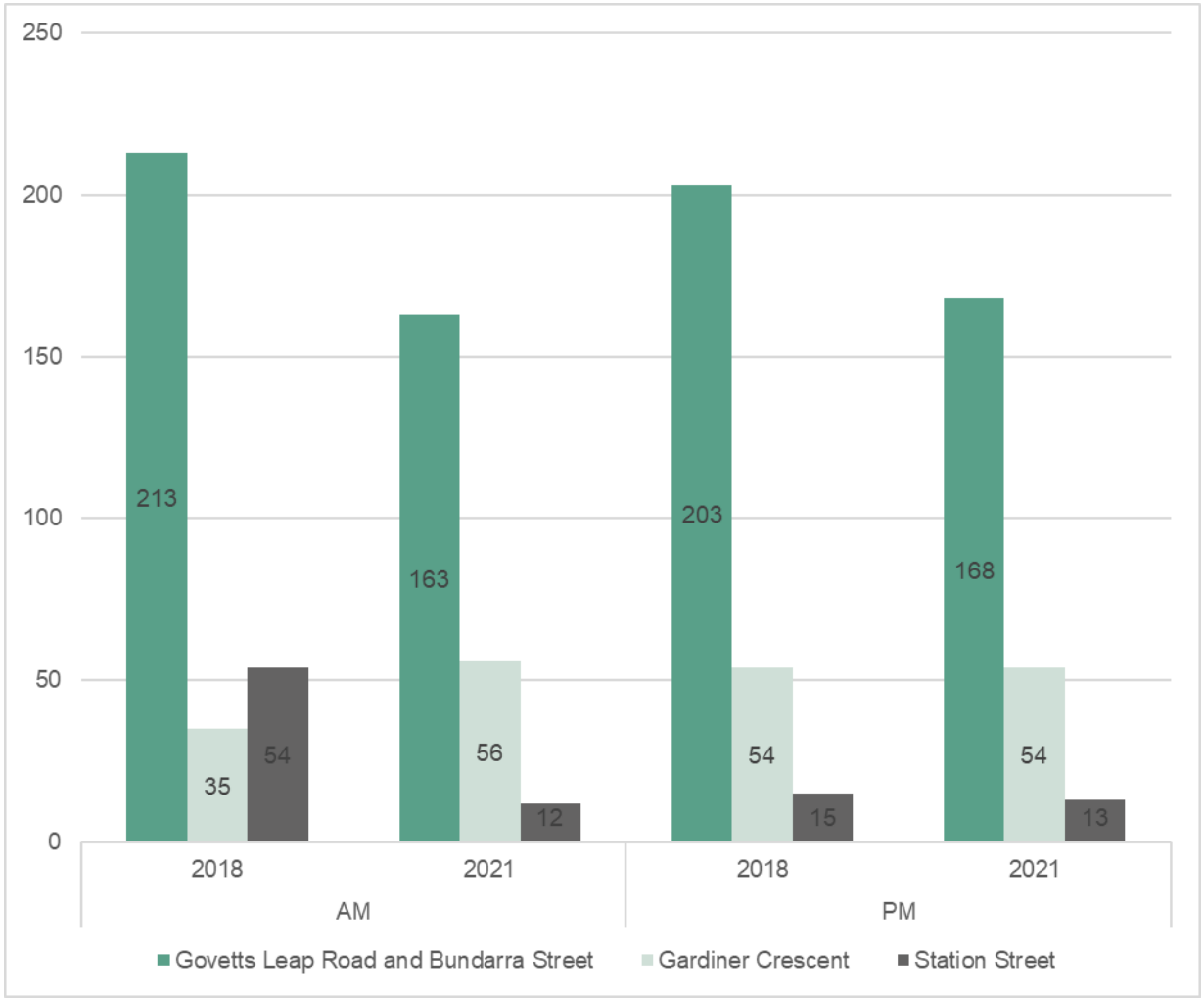


Figure 4-13 Pedestrian crossing activity along the Great Western Highway

4.5.3 Cycling facilities

The Great Western Highway is considered by Blue Mountains Council as a Regional Cycle Route. However, dedicated cycle facilities are not provided along the Great Western Highway. Therefore cyclists use the shoulders where they are available, particularly in the Blackheath and Mount Victoria townships. Continuous shoulders are not provided on both sides of the Great Western Highway outside of the townships.

The Blue Mountains Bike Plan 2020 identifies several on-road cycle routes in Blackheath and Mount Victoria, as shown in Figure 4-14 and Figure 4-15, respectively. The key cycle routes identified by Blue Mountains Council include:

- Great Western Highway – Regional cycle route 1
- recreational cycle routes 7b, 7c and 7d in Blackheath
- local cycle routes 17, 18 and 19 in Blackheath
- recreational cycle routes 8a, 8b and 8c in Mount Victoria.

No cycle routes are identified in Little Hartley.

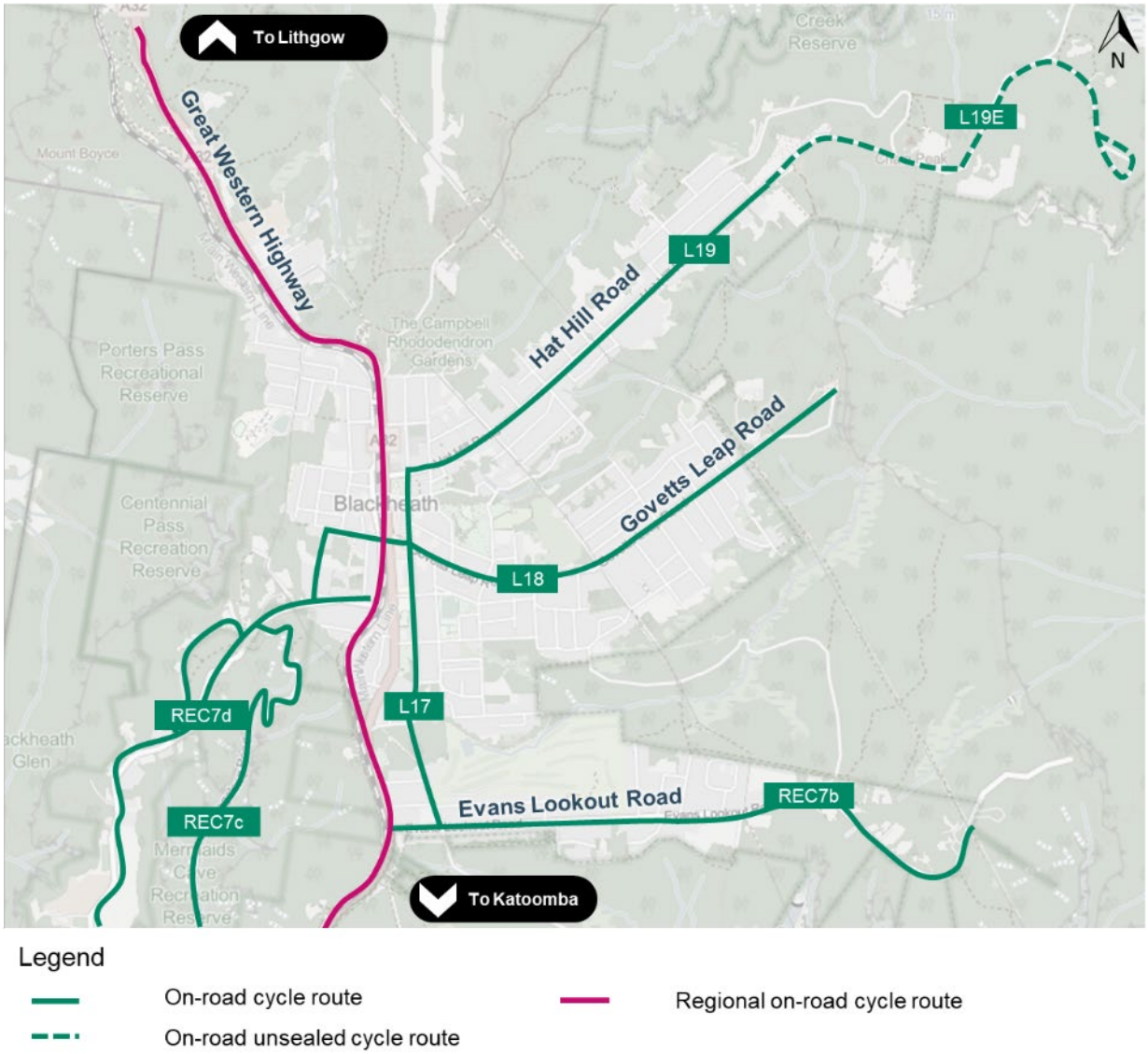


Figure 4-14 Existing cycle routes in Blackheath

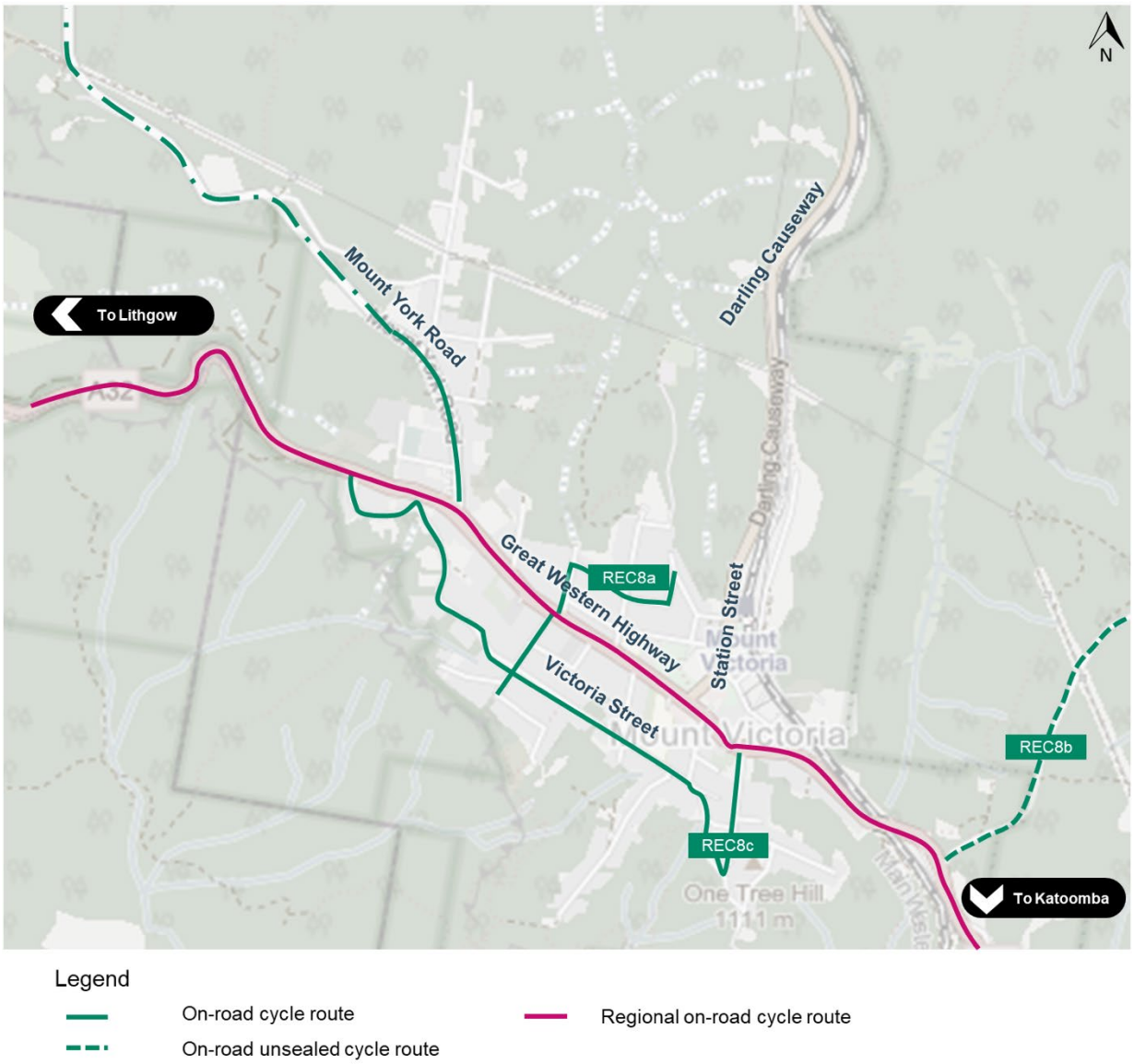


Figure 4-15 Existing cycle routes in Mount Victoria

4.5.4 Cycling demand

Intersection surveys conducted in September 2018 and December 2021 counted the number of cyclists crossing at key locations along the Great Western Highway in the study area during the weekday AM and PM peak periods of 7-10am and 3-6pm.

The surveyed cyclist activity was very low, with five to ten cyclists typically counted in the AM and PM peak period at most locations. However, at the intersection of the Great Western Highway, Govetts Leap Road and Bundarra Street in Blackheath, more than 200 cyclists were counted in each period in 2018. Less than ten cyclists were counted for each period and at each location in 2021.

4.6 Road network

In Blackheath, the Great Western Highway intersects with Bundarra Street and Govetts Leap Road, which provide access to the east and west sides of the Blackheath township, respectively. Bundarra Street also provides access to the Megalong Valley community. Several other local roads also intersect with the Great Western Highway in Blackheath via unsignalised intersections.

In Mount Victoria, the Great Western Highway intersects with Station Street which transitions to the Darling Causeway; a state road between the Great Western Highway and Chifley Road and Bells Line of Road in Bell to the north. Several other local roads also intersect with the Great Western Highway in Mount Victoria via unsignalised intersections.

Bells Line of Road is an east-west state road between Bell and Windsor, transitioning to Chifley Road which extends to Lithgow in the west. The Bells Line of Road and Chifley Road corridor provides an alternative east-west connection between Sydney's northwest and Lithgow.

A section of the Great Western Highway between Mount Victoria and Little Hartley is known as Victoria Pass and has sustained lengths of steep grades and horizontal curves. This section of the Great Western Highway has a posted speed limit of 60 kilometres per hour for cars and 40 kilometres per hour for heavy vehicles.

Table 4-2 summarises the local and state road network along the Great Western Highway.

Table 4-2 Summary of key roads within the study area

Location	Classification	Road	Great Western Highway intersection type	Function	Configuration	Posted speed limit
Blackheath, Mount Victoria and Little Hartley	State road (A32)	Great Western Highway	Not applicable	East-west state road between Sydney, Blue Mountains and Central West	Two way; one to two lanes in each direction	60km/h to 80km/h
Blackheath	Local road	Evans Lookout Road	Unsignalised	Local road providing access for residents in Blackheath and Evans Lookout	Two-way, one lane each direction	50km/h
	Local roads	Brightlands Avenue Chelmsford Avenue Hargraves Street Prince George Street Leichhardt Street Sutton Lane	Unsignalised	Local roads providing access for Blackheath residents and township	Generally two-way, one lane in each direction	50km/h*
	Local road	Abbott Street	Unsignalised	Local access road for Blackheath residents located between Great Western Highway and the rail line	Two-way, one lane each direction	50km/h
	Local road	Bundarra Street and Govetts Leap Road	Signalised	Key road providing access to Blackheath township. Bundarra Street provides access over the rail line facilitating access to suburbs further west, such as Megalong Valley	Two-way, one lane each direction	50km/h
	Local roads	Gardiner Crescent Sturt Street Ridgewell Road	Unsignalised	Local access road for Blackheath residents	Two-way, one lane each direction	50km/h

Location	Classification	Road	Great Western Highway intersection type	Function	Configuration	Posted speed limit
	Local road	Hat Hill Road	Unsignalised	Access road for Blackheath residents and Pulpit Rock Lookout	Two-way, one lane each direction	50km/h
	Local road	Station Street overbridge	Unsignalised	Secondary local access road over rail line providing access for Blackheath west residents	Two-way, one lane each direction	50km/h
Mount Victoria	Local road	Harley Avenue	Unsignalised	Local access road for residents an alternative connection between Station Street to the Great Western Highway	Two-way, one lane each direction	50km/h
	Local road	Mount Piddington Road Hooper Street	Unsignalised.	Local access road for residents	Two-way, one lane each direction	50km/h
	State road	Station Street	Signalised	Main Road between Great Western Highway and Bells Line of Road (transitions to Darling Causeway)	Two-way, one lane northbound and two lanes southbound on approach to Great Western Highway	60km/h
	State road (MR184)	Darling Causeway (extension of Station Street)	Unsignalised	Main Road between Great Western Highway and Bells Line of Road	Two-way, one lane each direction	80km/h
	Local road	Kanimbla Valley Road Selsdon Street Cassilis Street Grand View Road Fairy Dell Road Mount York Road	Unsignalised	Local access road for residents	Two-way, one lane each direction	50km/h

Location	Classification	Road	Great Western Highway intersection type	Function	Configuration	Posted speed limit
	Local road	Victoria Street	Unsignalised	Local access road for residents which runs parallel to the Great Western Highway	Two-way	50km/h
	Local road	Browns Gap Road	Unsignalised	Local access road for residents, connecting to Hartley Valley Road (to Lithgow)	Two-way, one lane each direction	80km/h
	Access road	Browntown Oval access road	Unsignalised	Regional connector between Little Hartley and Lithgow	Two-way, one lane in each direction.	50km/h
Little Hartley	Local road	Ambermere Drive	Unsignalised	Local access road for residents, no through road	Two-way, one lane each direction, no through road	60km/h
	Local road	Coxs River Road	Unsignalised	Local access road for residents, connecting Great Western Highway with Ganbenang Road	Two-way, one lane each direction	80km/h
North of study area	State road (B59)	Chifley Road and Bells Line of Road	-	East-west state road between Sydney and Lithgow	Two-way, one lane each direction	80km/h when wet, 100km/h when dry, 60km/h near the Chifley Road and Darling Causeway intersection

*40km/h School Zone posted on Prince George Street and Leichhardt Street

4.7 Parking

On-street parking is generally provided along local roads within Blackheath and Mount Victoria.

Within Blackheath and along the Great Western Highway, on-street parallel parking is provided on the eastbound side of the road between Evans Lookout Road and Hat Hill Road. Between Leichhardt Street and Gardiner Crescent, the on-street parking is time restricted to one hour. On-street parking is also provided on the westbound side of the Great Western Highway between Abbott Street and Murri Street and between the Station Street overbridge and Ridgewell Road.

One hour on-street parking is also provided along Govetts Leap Road between the Great Western Highway and Clanwilliam Street.

In Mount Victoria, on-street parking is generally provided along the eastbound side of the Great Western Highway between Harley Avenue and west of Mount York Road. Parking is permitted on the westbound side of the Great Western Highway in select locations in Mount Victoria.

On-street parking is not permitted along the Great Western Highway in Little Hartley. However, vehicles frequently park on a gravel area on the eastbound side of the Great Western Highway located at the bottom of Victoria Pass to gain access to Berghofer's Pass.

4.8 Heavy vehicle routes

The Great Western Highway is classified as a Transport B-double route for vehicles up to 19 metres long. This services an east-west connection between the M4 Western Motorway in Sydney and NSW's Central West region.

Alternative longer routes over the Great Dividing Range for larger commercial vehicles include the Golden Highway to the north and the Hume Highway and Lachlan Valley Way to the south.

4.9 Traffic volumes

4.9.1 Great Western Highway

4.9.1.1 2018 traffic survey data

Hourly traffic volume data from 24-hour, 7-day week automatic tube counts collected for the period of 21 to 27 September 2018 have been used to estimate the weekday and weekend traffic volumes along the Great Western Highway, within the study area.

The tube count data was collected at the following locations:

- 800 metres north of Station Street and Railway Parade, Medlow Bath
- 450 metres south of Browntown Oval access, Blackheath
- 300 metres west of Mount York Road, Mount Victoria
- 500 metres east of Coxs River Road, Little Hartley.

The surveyed weekday and weekend daily traffic volume profile is shown in Figure 4-16. The profile shows two spikes of around 500 to 550 vehicles per direction associated with the weekday morning and afternoon peak periods at around 8am and 3pm, with a similar daily profile for eastbound and westbound traffic. This suggests that the Great Western Highway doesn't necessarily have peak directional flows. The weekend daily profile varies but westbound traffic volumes were highest on a Saturday morning and the eastbound traffic was highest on a Sunday afternoon.

Figure 4-16 Great Western Highway hourly traffic volume profile – 2018

The surveyed weekday and weekend peak hour and daily traffic volumes for each of the four tube count locations are summarised in Table 4-3. For both the weekend and weekday, traffic volumes gradually decrease between the eastern tube count (Railway Parade, Medlow Bath) and the most western tube counts (Mount York Road, Mount Victoria and Coxs River Road, Little Hartley). The Great Western Highway at Railway Parade was carrying the highest traffic volumes, with approximately 18,300 vehicles per day on a weekday and 19,500 vehicles per day on a weekend. The daily weekend traffic volumes were about five to ten per cent higher than the daily weekday traffic volumes.

Table 4-3 Total weekday and Sunday traffic volumes on the Great Western Highway -- 2018

#	Location along the Great Western Highway	Weekday two-way traffic (vehicles)			Sunday two-way traffic (vehicles)	
		AM peak hour	PM peak hour	Daily	Peak hour	Daily
1	Railway Parade, Medlow Bath	1,260	1,490	18,280	1,910	19,460
2	Browntown Oval access, Mount Victoria	930	1,060	13,580	1,450	15,050
3	Mount York Road, Mount Victoria	780	880	11,340	1,300	12,660
4	Coxs River Road, Little Hartley	850	920	11,890	1,330	13,260
Average		955	1,088	13,773	1,498	15,108

4.9.1.2 Traffic patterns

The traffic volume data from the Transport permanent count station 6188 was used to understand the average weekday, weekend and public holiday daily traffic profiles along the Great Western Highway. Count station 6188 is located 260 metres west of Victoria Street in Mount Victoria (to the west of the Mount Victoria township).

Figure 4-17 compares the average weekday, weekend and public holiday 24 hour traffic profiles in 2018, with the following key findings:

- the average weekday peak hours occur at 8am and 4pm, with an average of 400 to 450 vehicles per hour travelling in each direction during the peak hours
- the average weekday traffic volumes are 5,500 to 5,800 vehicles per day in each direction
- the average weekend and public holiday traffic volumes are higher than the average weekday traffic volumes
- the average weekend traffic volumes include between 6,200 and 6,600 vehicles per day in each direction and up to 650 vehicles per hour in each direction
- on the weekend, the average westbound traffic volumes are higher in the morning and eastbound traffic is higher in the afternoon. This potentially reflects the higher proportion of day trips that occur through the Blue Mountains on a weekend.
- the average public holiday traffic volumes include between 6,100 and 6,800 vehicles per day in each direction and up to 650 vehicles per hour in each direction.

In addition, the data showed increased traffic volumes for key events, such as the Bathurst Super Car event, has seen daily traffic volumes on the Great Western Highway exceed 14,000-15,000. Similarly, the Good Friday and Easter Sunday historically experienced the highest public holiday traffic volumes, in the order of 15,000-17,000 vehicles per day (excluding where this period was affected by the COVID-19 pandemic).

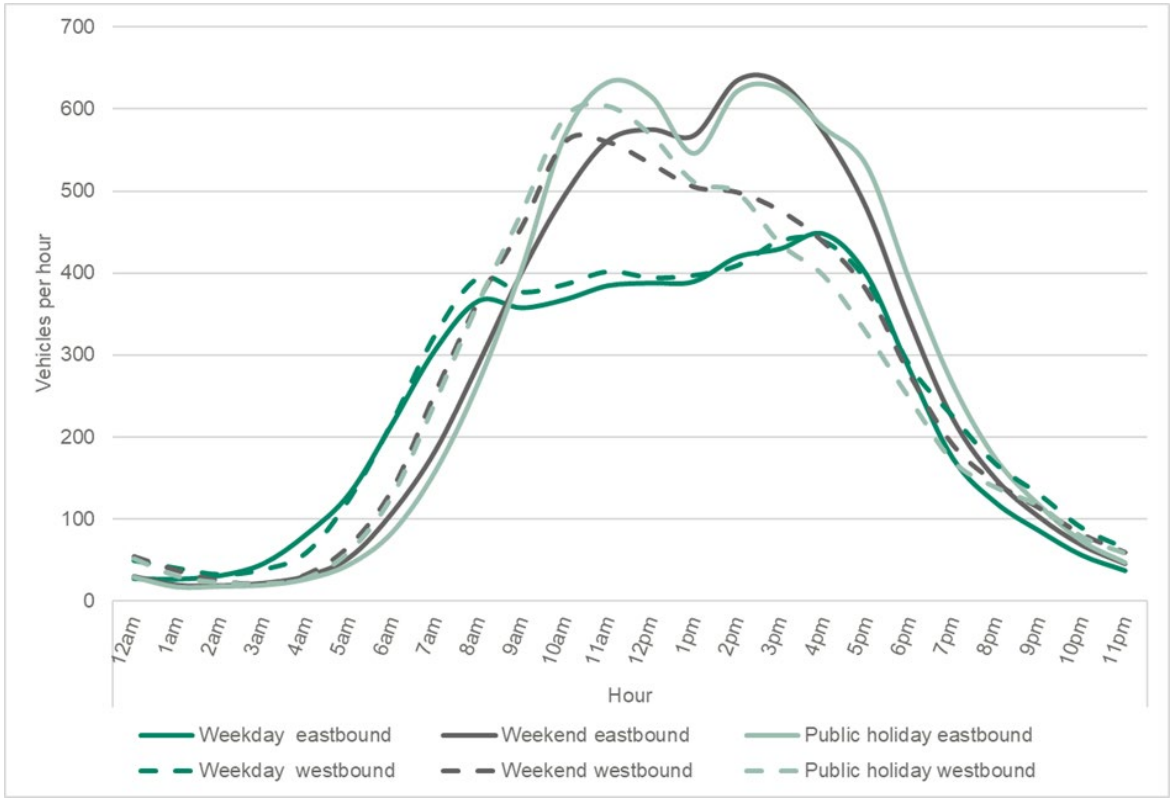


Figure 4-17 Average weekday, weekend, and public holiday traffic volume profile – 2018

4.9.2 Surrounding road network

Classified intersection count data collected during a weekday peak period in September 2018, has been used to understand the existing traffic volumes on the road network surrounding the Great Western Highway. Specifically, peak hour traffic volumes for the following locations were analysed:

- Evans Lookout Road
- Prince George Street
- Leichhardt Street
- Govetts Leap Road
- Bundarra Street
- Gardiner Crescent
- Hat Hill Road
- Harley Avenue
- Station Street (Darling Causeway)
- Mount York Road
- Coxs River Road
- Ambermere Drive.

The AM peak hour, PM peak hour and estimated weekday traffic volumes at each of these locations are summarised in Table 4-4. The traffic volumes show the following:

- Govetts Leap Road and Bundarra Street are estimated to carry more than 1,400 and 1,000 vehicles per day respectively in each direction, the highest traffic volumes of the study area roads that intersect with the Great Western Highway
- Evans Lookout Road and Hat Hill Road are estimated to carry between 750 and 1,200 vehicles per day in each direction
- all other streets that intersect with the Great Western Highway are estimated to carry 500 or less vehicles per day in each direction.

Table 4-4 Weekday traffic volumes at key locations surrounding the Great Western Highway - 2018

Location	Road	Direction	AM peak hour		PM peak hour		Estimated weekday traffic (vehicles) [1]
			Vehicles	Heavy vehicle percentage	Vehicles	Heavy vehicle percentage	
Blackheath	Evans Lookout Road	Eastbound	80	3%	70	3%	750
		Westbound	50	0%	120	3%	1,190
	Prince George Street	Eastbound	40	3%	30	8%	340
		Westbound	50	6%	50	2%	490
	Leichhardt Street	Eastbound	50	0%	40	0%	440
		Westbound	40	3%	50	2%	430
	Govetts Leap Road	Eastbound	160	2%	170	2%	1,630
		Westbound	140	1%	150	3%	1,450
	Bundarra Street	Eastbound	100	3%	110	5%	1,100
		Westbound	100	8%	110	3%	1,080
	Gardiner Crescent	Eastbound	30	4%	30	0%	250
		Westbound	40	0%	60	0%	570
	Hat Hill Road	Eastbound	100	2%	90	2%	1,000
		Westbound	40	8%	80	4%	740
Mount Victoria	Harley Avenue	Northbound	50	24%	30	35%	410
		Southbound	40	21%	40	13%	390
	Station Street	Northbound	20	6%	40	3%	340
		Southbound	20	25%	30	4%	230
	Mount York Road	Northbound	40	6%	30	4%	330
		Southbound	40	6%	30	7%	350
Little Hartley	Coxs River Road	Northbound	60	2%	40	9%	520
		Southbound	20	16%	40	15%	400
	Ambermere Drive	Northbound	30	5%	10	0%	30
		Southbound	10	0%	20	0%	20
Bell	Bells Line of Road	Eastbound	70	23%	160	19%	1,550
		Westbound	70	13%	80	16%	760
	Chifley Road	Eastbound	70	24%	160	23%	1,590
		Westbound	80	18%	90	17%	840
	Darling Causeway [2]	Northbound	30	27%	40	25%	400
		Southbound	30	33%	50	11%	440

[1] The average weekday traffic volumes were estimated using a peak to daily ratio of 10 per cent.
[2] Darling Causeway traffic volumes were based on 24 hour tube count data collected in September 2018

4.10 Heavy vehicles

4.10.1 Classification

The classified traffic volume data from the 24-hour, 7-day week automatic tube counts that were discussed in Section 4.9.1 have also been used to understand the classification of heavy vehicles that use the Great Western Highway in the study area.

Using the number of axles, the traffic data is classified in accordance with Austroads standard types. The technical report “Austroads Automatic Vehicle Classification by Vehicle Length” outlines 12 standard vehicle types to ensure a uniform classification system across Australia.

The standard vehicle types include classes one and two, representing cars and light vehicles, and classes three to 12 representing heavy vehicles of increasing length. The heavy vehicle classes can further be broken down into 4 sub-categories based on the functional description:

- rigid trucks (Classes 3, 4, 5)
- articulated trucks such as a semi-trailer (Classes 6, 7, 8, 9)
- B-double trucks (Class 10)
- road trains (and larger) (Classes 11, 12).

Vehicles classes up to B-doubles are permitted on the Great Western Highway, and these are the largest common vehicle. Vehicles larger than this would be classified as a restricted access vehicle and could be used with appropriate permits only.

Figure 4-18 and Figure 4-19 show the heavy vehicle proportions on a weekend and weekday, respectively. These graphs adopt the average traffic volumes across the four surveyed sites. The key statistics include:

- a total of 900 and 1,080 vehicles (two-way) were recorded during the weekday AM and PM peak hours respectively, including:
    - 80 to 85 per cent light vehicles and light vehicles with trailers (classes 1 and 2)
    - 10 to 15 per cent rigid trucks (Classes 3, 4 and 5)
    - less than five per cent articulated trucks (Classes 6, 7, 8 and 9) and B-double trucks (Class 10)
- the highest proportion of heavy vehicles on a weekday occurs between 10pm and 4am, averaging 60% of all traffic per hour and reaching a peak of 75% of all traffic at 2am
- over the weekday, the total heavy vehicle proportion of all traffic is about 20 per cent including 12 per cent rigid trucks, seven per cent articulated trucks and three per cent B-double trucks
- on a weekend, the total heavy vehicle proportion of all traffic is about five per cent including ten per cent comprising mostly rigid trucks. Therefore, weekend heavy vehicle volumes are lower than on a weekday.

It is noted that of the four surveyed sites, heavy vehicle activity was highest at the site located closest to Blackheath. This suggests a notable proportion of heavy vehicle activity has origins and destinations in Blackheath.

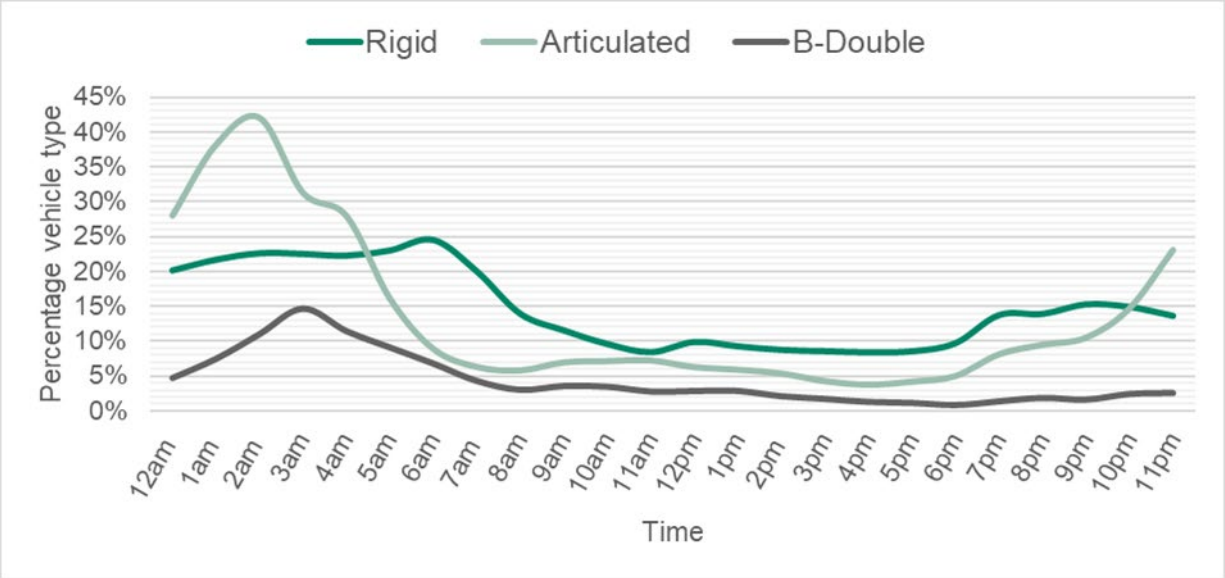


Figure 4-18 Weekday heavy vehicle profile – 2018

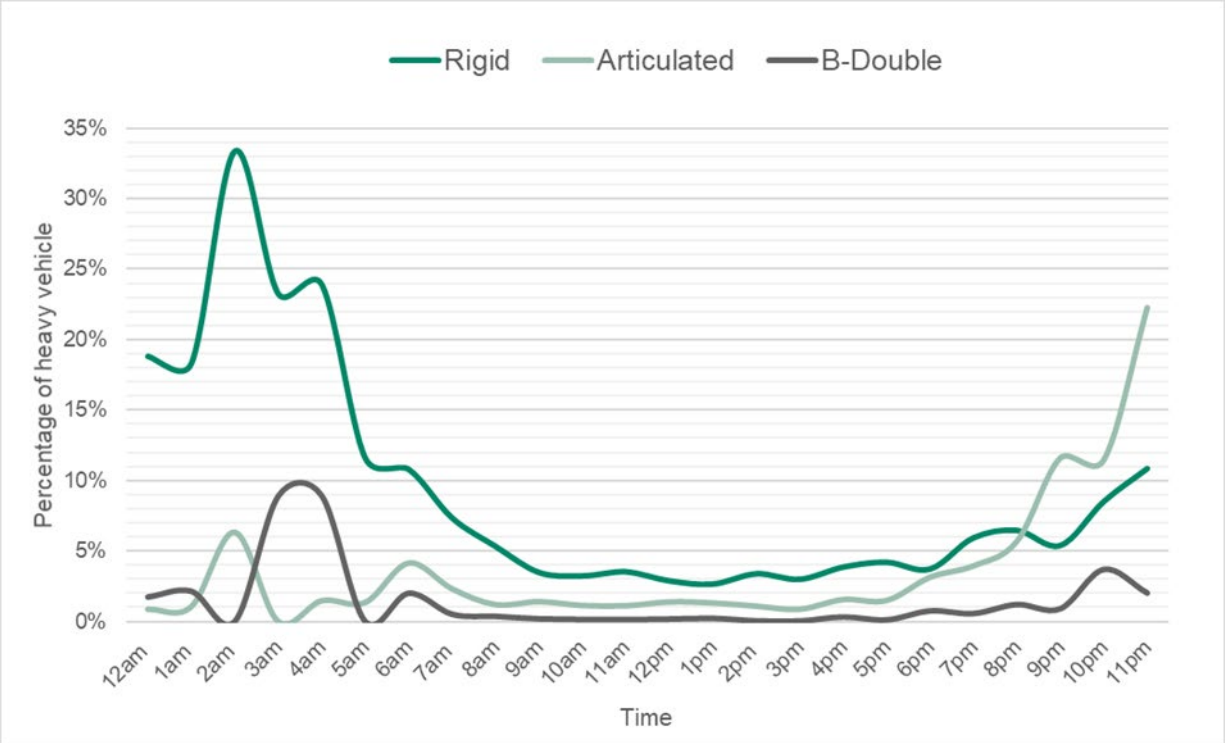


Figure 4-19 Weekend (Sunday) heavy vehicle profile - 2018

4.10.2 Passenger car unit factors

Understanding the make-up of vehicle classifications on a particular road allows for a broader understanding of the impact of each vehicle upon the flow of traffic. In standard traffic counts each vehicle is counted as one vehicle, no matter how large it is. This however does not take into consideration that a heavy vehicle would occupy a larger space then a car while traveling. As such, vehicle classifications are used to convert a larger vehicle on the network into a PCU value. The PCU factor aims to account for the different performance and physical characteristics of vehicle types in the network. It does this by assigning a higher conversion factor to larger, slower vehicles. When the PCU

factors for each class of vehicle are multiplied by the number of vehicles within that classification, it enables a representation of the effects of large vehicles upon road network performance.

The Traffic Modelling Guidelines (Transport, 2013) and Policy and Guidelines for Overtaking Lanes (Mainroads Western Australia, 2011) amongst other documents provide reference values for PCU factors to convert different vehicle types into PCUs. The adopted PCU factors from these documents are reproduced in Table 4-5.

Table 4-5 Suggested PCU values for vehicle classification

Vehicle type	PCU factor
Car (light vehicle)	1
Bus and rigid truck	2
Articulated truck (including semi-trailer)	2.9
Road train (including A-double and B-double)	4

4.11 Road network performance

4.11.1 Network performance statistics

Table 4-6 presents the 2018 base case network performance statistics for all vehicles travelling through the modelled area, for the weekday AM and PM peak hours. The results indicate the following:

- vehicles travel through the model network with an average speed of around 55 kilometres per hour in the AM and PM hours
- the PM peak hour has a higher traffic demand than the AM peak hour (approximately 600 vehicles)
- both peak hours have similar total vehicles kilometres travelled and trip duration (PM peak hour is marginally higher)
- no unreleased vehicles were recorded (the number of vehicles unable to enter the model due to congestion extending back into a model's entry points) which suggests there is limited congestion on the network.

Table 4-6 Weekday AM and PM peak hour model network performance statistics in 2018

Network performance statistic	AM peak hour	PM peak hour
All vehicles		
Total traffic demand (vehicles)	4,350	4,961
Total vehicle kilometres travelled in the network (kilometres)	47,685	47,632
Total time travelled in the network (hour)	864	871
Total vehicles arrived	4,256	4,758
Total number of stops	2,922	3,942
Average per vehicle in network		
Average vehicle kilometres travelled in the network (kilometres)	11	10
Average time travelling in network (minutes)	12	11
Average number of stops	0.7	0.8
Average speed (kilometres per hour)	55	55
Unreleased vehicles		
Unreleased demand (vehicles)	0	0

4.11.2 Roadway level of service

The mid-block LoS for the existing Great Western Highway mid-block segments identified in Figure 3-8 for the 2018 AM and PM peak hours are included in Table 4-7.

During the AM peak hour, the existing Great Western Highway between Blackheath and Mount Victoria (Segment 1) operates at LoS D and between Victoria Pass and Little Hartley (Segment 2) operates at LoS E in both the eastbound and westbound directions. During the PM peak hour, Segment 1 and Segment 2 operate at LoS E in both the eastbound and westbound directions. The average travel speed along these segments was estimated to be approximately 20 kilometres per hour slower than the sign posted speed limit and both segments have limited-to-no opportunities to overtake with the per cent-time-spent-following estimated to be high at approximately 70 per cent.

Table 4-7 Two-lane highway mid-block level of service on the Great Western Highway – existing conditions

Great Western Highway segment	Direction	AM peak hour			PM peak hour		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	61	68%	D	60	72%	E
	Westbound	61	68%	D	60	73%	E
Segment 2	Eastbound	57	68%	E	56	70%	E
	Westbound	56	69%	E	55	72%	E

4.11.3 Intersection performance

Figure 4-20 presents the existing (2018) intersection performance of the study intersections as identified in Section 3.4.6, including:

- Intersection 1 - Great Western Highway and Evans Lookout Road, Blackheath
- Intersection 2 - Great Western Highway and Prince George Street, Blackheath
- Intersection 3 - Great Western Highway Evans and Leichhardt Street, Blackheath
- Intersection 4 - Great Western Highway, Govetts Leap Road and Bundarra Street, Blackheath
- Intersection 5 - Great Western Highway and Hat Hill Road, Blackheath
- Intersection 7 - Great Western Highway and Harley Avenue, Mount Victoria
- Intersection 8 - Great Western Highway and Station Street (Darling Causeway), Mount Victoria
- Intersection 9 - Great Western Highway and Main Street and Caroline Avenue, Lithgow.

Both the AM and PM peak hour average vehicle delay (seconds) and LoS is supplied for each intersection.

All intersections currently operate with an overall LoS C or better during the weekday AM and PM peak hours. Though, lengthy delays and vehicle queuing are often experienced on the minor roads at the signalised intersections of the Great Western Highway, Bundarra Street and Govetts Leap Road in Blackheath and Great Western Highway and Station Street in Mount Victoria, as the signal phasing prioritises the Great Western Highway movements.

While not modelled, it is well known that many of these intersections currently operate with lengthy delays and vehicle queuing on peak days such as busy weekends and public holidays.

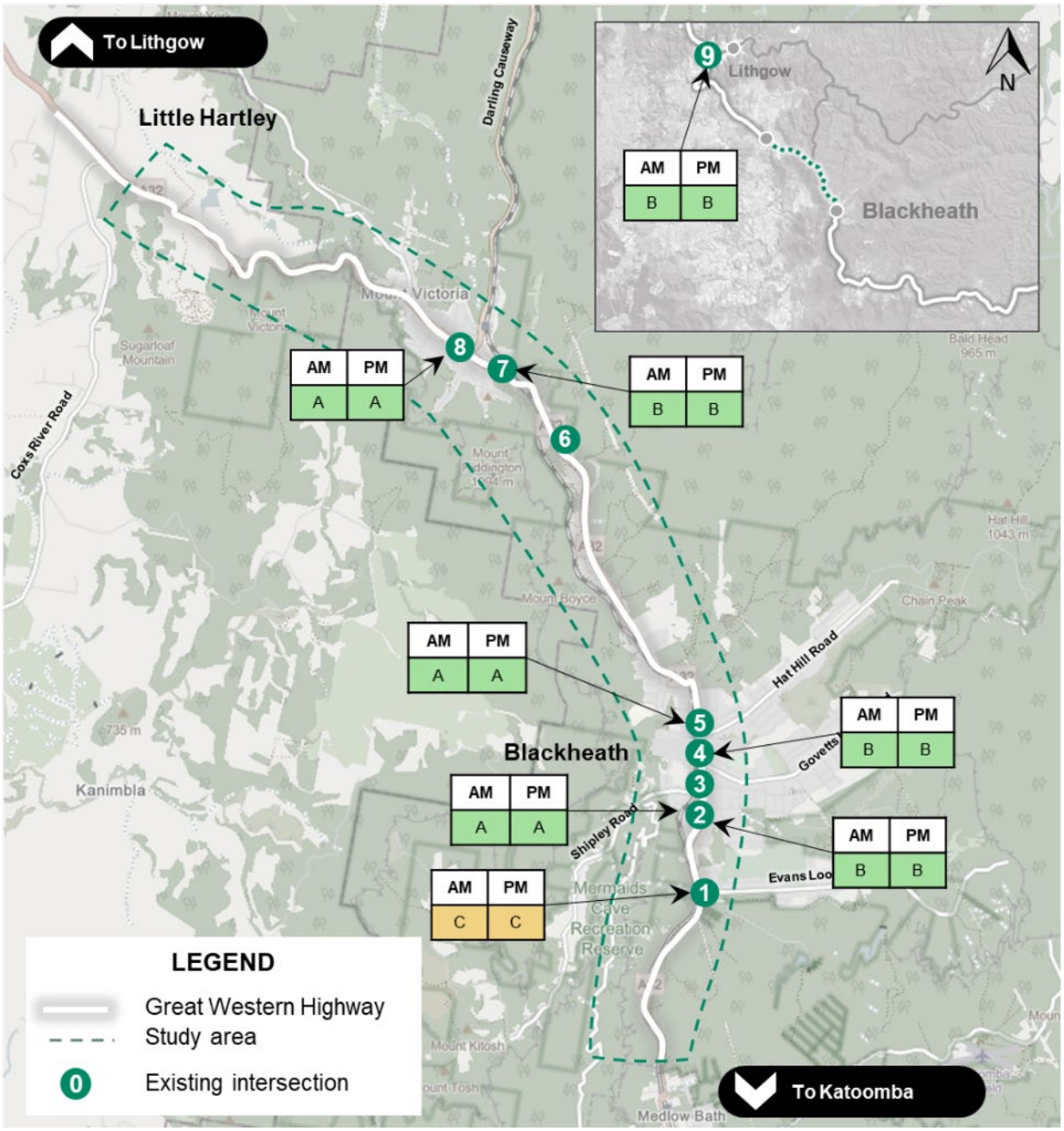


Figure 4-20 AM and PM peak hour intersection performance – 2018

4.11.4 Travel times and speed

The 2018 modelled average travel times were estimated by the operational model for the weekday AM and PM peak hours. Figure 4-21 shows the AM and PM peak hour travel times and average speed for the three routes identified in Section 3.5.5. The average travel times and speeds for each route for 2018 are as follows:

- Blackheath and Mount Victoria – seven to eight minutes and 50 to 55 kilometres per hour
- south of Blackheath and Little Hartley – 17 to 18 minutes and 52 to 54 kilometres per hour
- Katoomba and Lithgow – 39 to 41 minutes and 56 to 60 kilometres per hour.

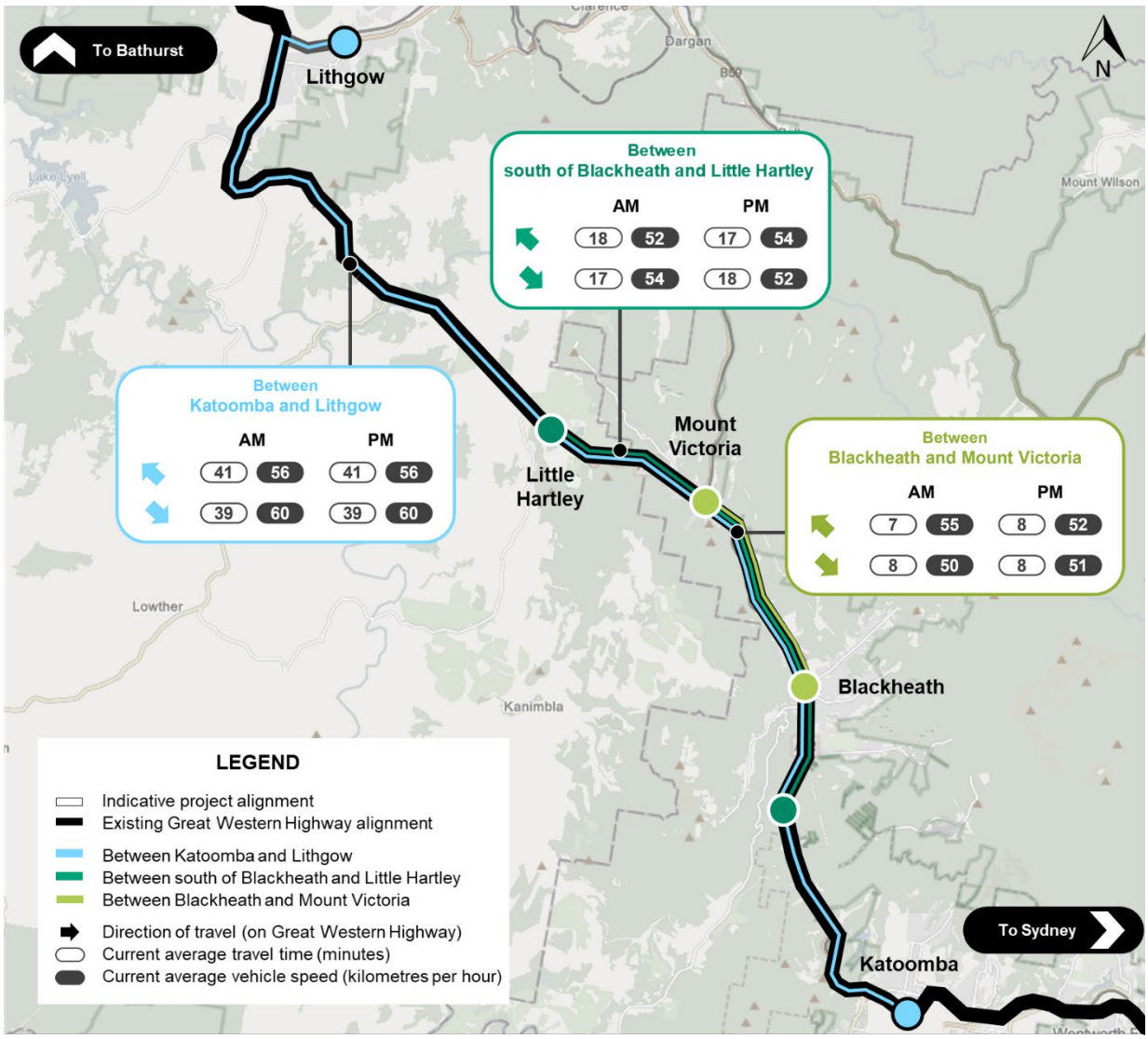


Figure 4-21 Modelled travel times and speeds for AM and PM peak hours (2018)

On peak days such as busy weekends and public holidays vehicle travel times are substantially longer and vehicle speeds are substantially lower than a weekday peak hour, due to the increased traffic demands. When vehicles begin to queue eastbound at Mount Victoria during these periods, Transport manages the traffic at the base of Victoria Pass in Little Hartley to prevent traffic congestion, breakdowns and start/stop movements up Victoria Pass[2].

The following management measures are put in place by Transport:

- vehicles are held at the base of Victoria Pass, Little Hartley
- once there is enough storage room at the top of the Pass, vehicles are released in groups
- groups of vehicles travel up the Pass in one smooth movement, free from stopping.

[2] https://roads-waterways.transport.nsw.gov.au/projects/west-region-projects/victoria-pass.html viewed on the 16/08/2022

4.12 Historical crash data

4.12.1 Crash types

Table 4-8 summarises the crash history for five years (1 January 2016 to 31 December 2020) along the Great Western Highway between Blackheath and Little Hartley. The location of the crashes is shown in Figure 4-22 and Figure 4-23.

A total of 64 crashes were recorded along the Great Western Highway within the study area, including:

- one crash resulted in a fatality which occurred to the south of Evans Lookout Road in Blackheath (two percent)
- 42 crashes resulting in an injury (65 per cent)
- 21 crashes that did not result in an injury (33 per cent).

The following common crash types occurred:

- nearly 35 per cent of crashes involved a run-off road collision, including 18 (nearly 30 per cent) on bends
- nearly 35 per cent of crashes involved a rear-end (or same direction) type crash
- about 20 per cent of crashes involved an intersection or opposing type crash including eight (nearly 15 per cent) head-on collisions.

A total of four crashes (five per cent) involved a heavy vehicle including two off-road crashes, one rear-end and one head-on[3].

Table 4-8 Great Western Highway historical crash data (January 2016 to December 2020)

Section from	Section to	Section length (km)	Crashes by type			
			Fatal	Injury	Tow-away	Total
South of Blackheath (south of Evans Lookout Road)	Ridgewell Road, Blackheath	4.2	1	18	8	27
Ridgewell Road, Blackheath	Mount York Road, Mount Victoria	6.4	0	11	4	15
Mount York Road, Mount Victoria	Coxs River Road, Little Hartley	4.8	0	13	9	22
Total		15.4	1	42	21	64

Source: Data obtained from Transport's interactive crash statistics website

[3] https://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/heavy-vehicles.html?r=eyJrIjoiODhiYjI0OGUtOWU4Yi00ZjEwLWJhZTAtNDczOTU3NzE4MGZhIiwidCI6ImNiMzU2NzgyLWFkOWEtNDdmYi04NzhiLTdlYmNlYjg1Yjg2YyJ9&pageName=ReportSectione8335aa6dd0c46c9524e

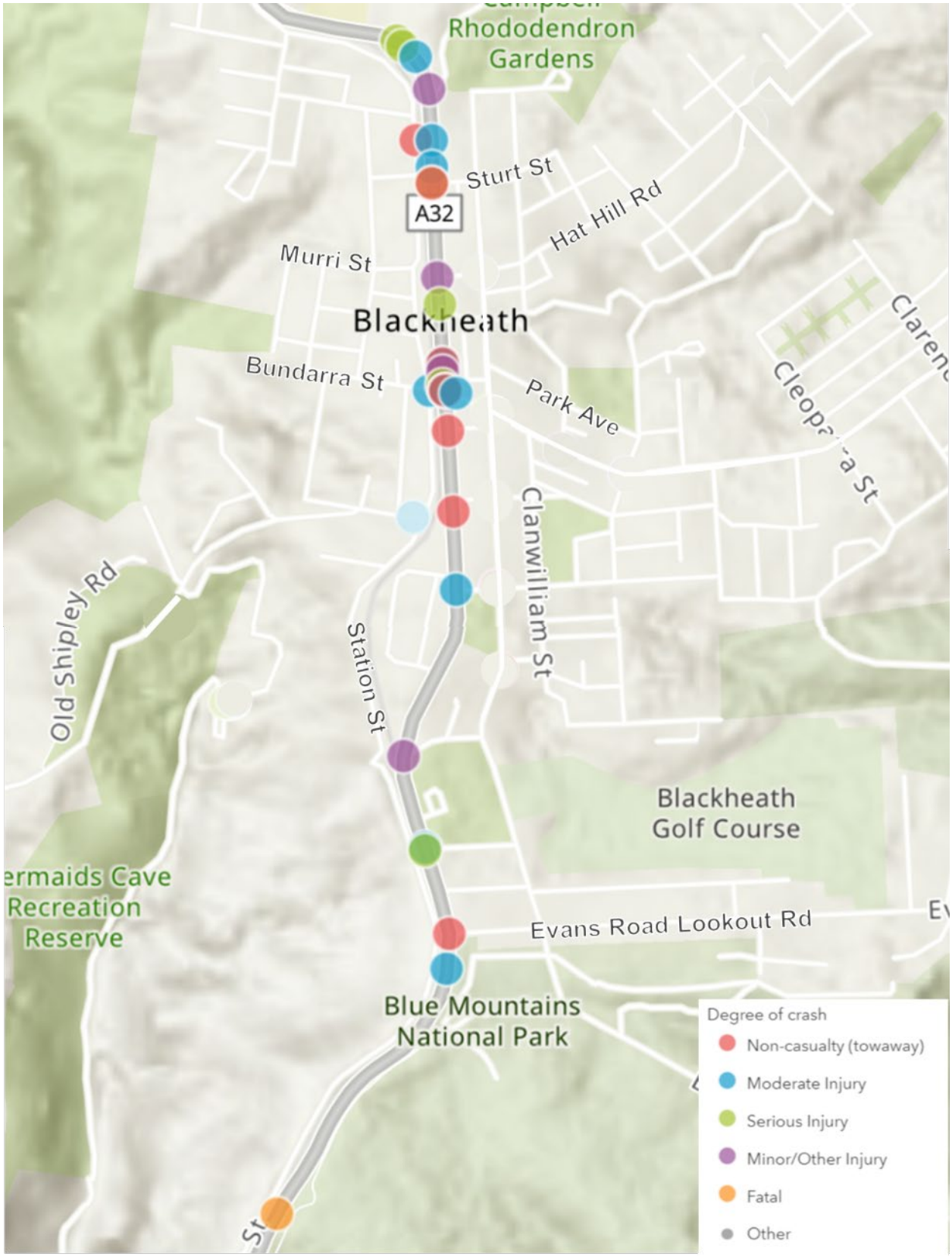


Figure 4-22 Crash locations in Blackheath (Base map source: Transport, 2022)

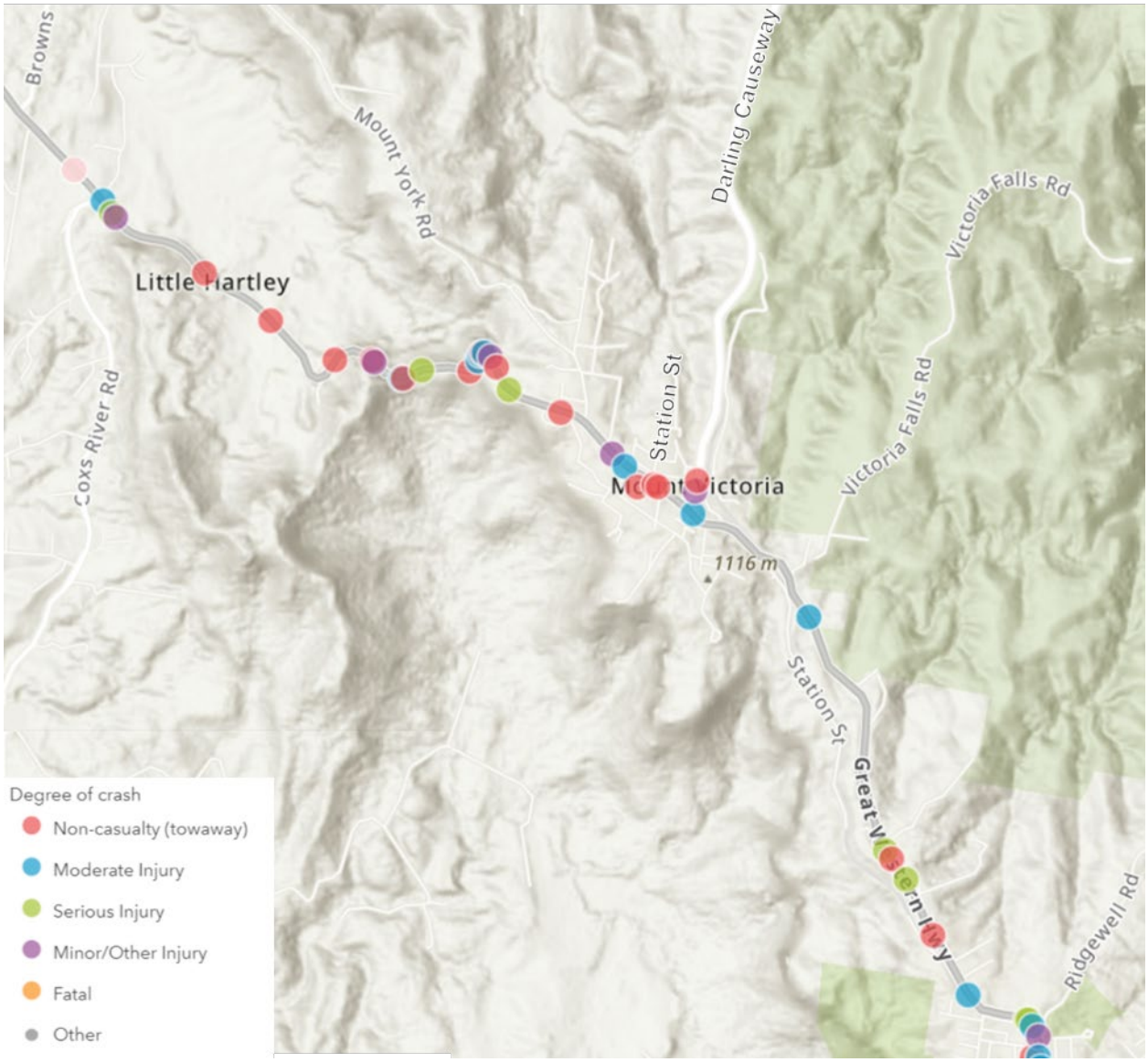


Figure 4-23 Crash locations in Mount Victoria and Little Hartley (Base map source: Transport, 2022)

4.12.2 Crash severity index

Crash severity indices provide an assessment of road safety based on the type and number of crashes occurring on a route. Fatal, injury and tow-away crashes carry different weightings; they are determined independently of absolute traffic volumes and calculated to establish the average level of severity of crashes that occur. Table 4-9 shows crash severity indices for the Great Western Highway sections and Figure 4-24 illustrates the formula used to calculate this index.

Figure 4-24 Crash severity index formula

The average crash severity index on the Great Western Highway in the study area is 1.36, compared to an average of 1.27 for all crashes reported on public roads across NSW. This index indicates the Great Western Highway has a higher than average proportion of fatal and injury crashes.

Table 4-9 Great Western Highway crash severity index (January 2016 to December 2020)

Section from	Section to	Crash severity index
South of Blackheath	Ridgewell Road, Blackheath	1.41
Ridgewell Road, Blackheath	Mount York Road, Mount Victoria	1.37
Mount York Road, Mount Victoria	Cox River Road, Little Hartley	1.30
Average		1.36
NSW		1.27

4.12.3 Crash rate per 100 million vehicle kilometres travelled

Crash rates per 100 million vehicle kilometres travelled (100MVKT) are shown in Table 4-10. These crash rates are calculated using the volume of traffic and distance travelled along a route, therefore offering a measure of risk per kilometre travelled. The formula used to calculate this rate is shown in Figure 4-25.

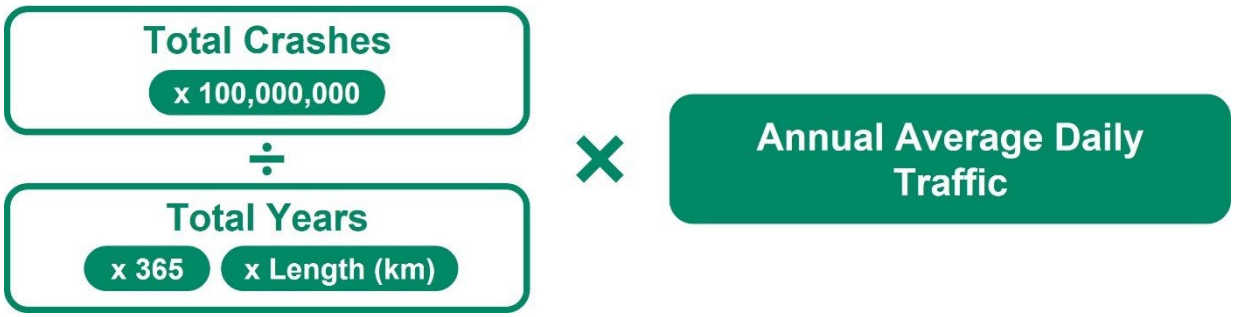


Figure 4-25 Crash rate per 100 MVKT formula

Table 4-10 shows the average fatality and injury rate on the Great Western Highway between Blackheath and Little Hartley is 0.4 per 100MVKT and 13.7 per 100MVKT respectively, estimated using 2018 traffic volumes.

The latest available Transport NSW data (for 2020) shows an average fatality and injury rate across NSW of 0.4 per 100MVKT and 17.7 per 100MVK T[4] respectively.

This data indicates that the occurrence of fatal crashes on the assessed section of the Great Western Highway occurred at the same rate as the NSW average, and crashes causing injury occurred at a lower rate than the NSW average rate.

[4] https://roadsafety.transport.nsw.gov.au/downloads/crashstats2020.pdf

Table 4-10 Great Western Highway crash rate per 100MVKT (January 2016 to December 2020)

Section from	Section to	Section length (km)	2018 average daily traffic	Crash rate per 100MVKT			
				Fatal	Injury	Tow-away	Total
South of Blackheath	Ridgewell Road, Blackheath	4.2	11,600	1.1	20.2	9.0	30.4
Ridgewell Road, Blackheath	Mount York Road, Mount Victoria	6.4	11,600	0	8.1	3.0	11.1
Mount York Road, Mount Victoria	Coxs River Road, Little Hartley	4.8	11,600	0	12.8	8.9	21.7
Average				0.4	13.7	6.9	21
NSW				0.4	17.7	-	-

4.12.4 Crash costs

Table 4-11 provides details of the crash costs for the assessed sections of the Great Western Highway. Average crash costs based on crash severity have been provided in the Principles and Guidelines for Economic Appraisal of Transport Investment, (Transport, 2016). The crash costs presented in this report are based on a 'willingness to pay' approach. Willingness to pay values for road safety reflect the accumulated value the NSW community is willing to pay or forgo in exchange for a reduction in the probability of crash related injuries and road accident deaths on NSW roads.

Crashes on the assessed section of the Great Western Highway between January 2016 and December 2020 cost an estimated total of $18.4 million, or $3.6 million per annum. The cost of crashes per 100MVKT on the Great Western Highway is estimated to be $19.2 million.

Table 4-11 Great Western Highway crash costs (January 2016 to December 2020)

Section from	Section to	Section length (km)	Total cost (2016 – 2020)		
			Total cost	Average annual cost	Cost per 100MVKT
South of Blackheath	Ridgewell Road, Blackheath	4.2	$12,532,016	$2,506,403	$14,094,536
Ridgewell Road, Blackheath	Mount York Road, Mount Victoria	6.4	$2,673,479	$534,696	$1,973,222
Mount York Road, Mount Victoria	Coxs River Road, Little Hartley	4.8	$3,201,196	$640,239	$3,150,287
Total		15.4	$18,406,691	$3,681,338	$19,218,046

Source: Based on Transport's Crash Data and NSW Government's Principles and guidelines for economic appraisal of transport investment, 2016)

4.13 Movement and place

The Great Western Highway Upgrade Program movement and place assessment identifies that the Great Western Highway as a Main Road for segments outside townships and a Main Street for segments located within Blackheath and Mount Victoria, as summarised in Table 4-12. This recognises that through the townships, the Great Western Highway has substantial movement functions and place qualities. Whereas between the townships, the Great Western Highway's primary function is as a movement corridor. The movement and place classifications presented for relevant segments of the Great Western Highway are described in Section 3.8.

Table 4-12 Existing movement and place classification

Great Western Highway segment		Existing movement and place classification		
From	To	Movement	Place	Street type
Evans Lookout Road	Leichhardt Street	5	A	Main Road
Leichhardt Street	Govetts Leap Road	5	C	Main Street
Govetts Leap Road	Hat Hill Road	5	D	Main Street
Hat Hill Road	Hooper Street	5	A	Main Road
Hooper Street	Station Street	5	C	Main Street
Station Street	Selsdon Street	5	B	Main Road
Selsdon Street	Little Hartley	5	A	Main Road

4.14 Future baseline conditions

As discussed in Section 1.1, the Upgrade Program consists of:

- Medlow Bath Upgrade
- Katoomba to Blackheath Upgrade
- Little Hartley to Lithgow Upgrade
- Blackheath to Little Hartley (the project).

The Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade adjoining the project to the east and west respectively will be under construction when construction of the project commences and would be complete prior to the project being operational in 2030.

While this hasn't been adopted in the OTM as discussed in Section 3.4.4, it has been qualitatively considered throughout this report.

This section of the report outlines the features of the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade that would be operational before the project is operational in 2030, as these define the baseline conditions at the east and west project extents. However, the baseline is not expected to result in any substantial changes to the existing transport and traffic conditions described throughout Section 4 of this report unless otherwise stated.

4.14.1 Blackheath

As shown in Figure 1-3, at the eastern extent of the study area, the Katoomba to Blackheath Upgrade would include the following transport and traffic features:

- westbound connection from Katoomba to the existing Great Western Highway
- temporary eastbound carriageway between the permanent eastbound carriageway to the east and the existing Great Western Highway alignment to the west
- active transport trail connection between Medlow Bath and Valley View Road in Blackheath.

4.14.2 Little Hartley

As shown in Figure 1-4, at the western extent of the study area, the Little Hartley to Lithgow Upgrade would include the following transport and traffic features:

- formalised Berghofer's Pass car park
- new separated eastbound and westbound connections to the existing Great Western Highway including a new 2.5m wide active transport trail along the southern side of the new eastbound connection

- altered private property access arrangements include a new private property access road for one property.

5.0 Assessment of construction impacts

This section provides an assessment of the construction impacts of the project on the surrounding transport network.

5.1 Construction strategy

Reference has been made to Chapter 6 of the EIS report in preparing this section of the report. It describes an indicative approach to construction of the project. It outlines the proposed construction activities, working hours, construction footprints and proposed traffic management measures. A summary of the project's construction works is also discussed in the project description included in Section 1.2.2 of this report.

The construction work described in Chapter 6 of the EIS is indicative and based on the current level of design. The approach to construction would continue to be refined as part of ongoing design development and where relevant, in response to feedback from the community and other stakeholders.

Detailed construction planning would be carried out before construction begins. This would include further refinement of specific construction methods, and the program, and would be developed by the construction contractor(s) when appointed.

5.1.1 Construction activities

The proposed construction activities required for the project are described in Section 6.4 (Construction) of the EIS and include:

- site establishment and enabling works
- tunnelling and associated works
- surface road upgrade works
- operational ancillary infrastructure construction and fit-out, including construction of operational environmental controls
- finishing works, testing and commissioning.

5.1.2 Construction program

An indicative program of works for the project is provided in Figure 5-1. Construction of the project is expected to be around eight years. Subject to planning approval, construction is planned to commence in 2024. The project is planned to be opened to traffic by late 2030, with overall construction works including site rehabilitation and demobilisation to be completed by late 2031.

The activities shown in this program would not occur at all construction footprints for the entire duration shown. Construction works for the project at the Little Hartley and Blackheath construction footprints would be flexibly scheduled to minimise impacts and the interface with adjacent construction works as part of the Upgrade Program.

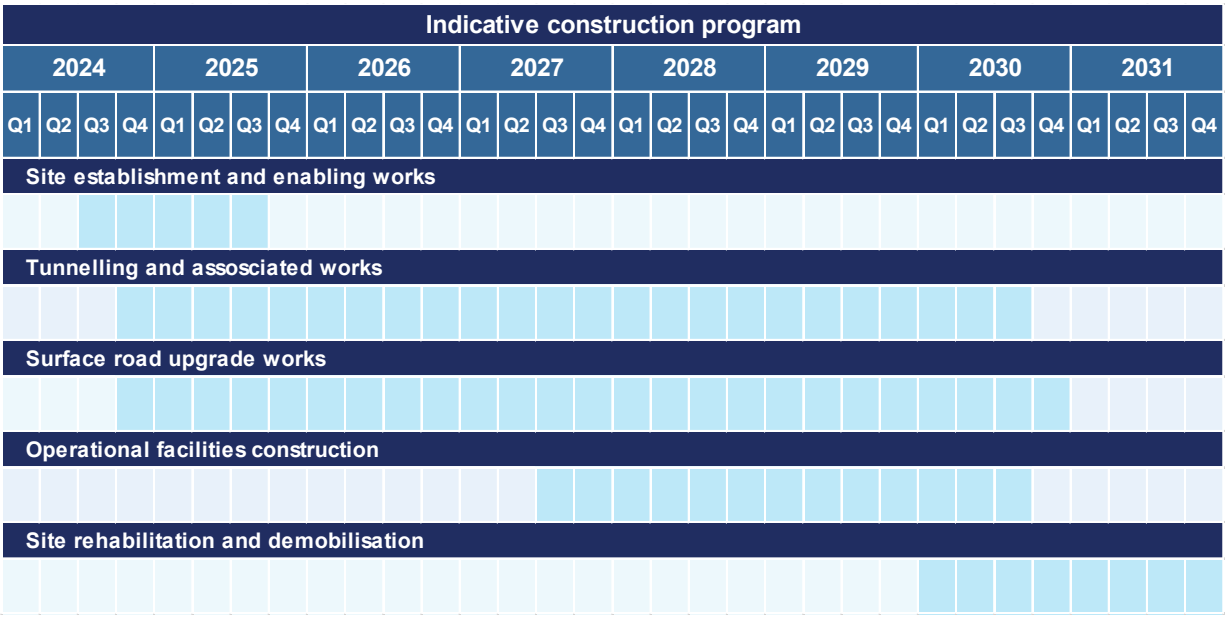


Figure 5-1 Indicative program of works for construction of the project

5.1.3 Construction hours

Proposed construction hours have been developed in consideration of reducing the duration of construction program and minimising potential construction noise and traffic related impacts.

Where possible, the above ground construction activities would be carried out during the recommended standard construction hours. Tunnelling, spoil handling and transport and other below ground construction activities would generally take place 24 hours per day, seven days per week. This would include access to the tunnel via the Little Hartley portal and the Soldiers Pinch mid-tunnel access shaft (once the Tunnel Boring Machines (TBM) have tunnelled past the mid-point of the tunnel).

However, peak traffic generating activities would be scheduled to avoid peak days such as public holidays and associated weekends, and days associated with major public events such as the Bathurst Super Car event. The Little Hartley construction site would have capacity to store spoil and tunnel segments for around three days to accommodate these peak periods. In addition, the appointed contractor could delay segment deliveries to avoid the peak periods with some forward planning.

Proposed construction hours for the project are outlined in Table 5-1.

Table 5-1 Construction hours

Work hours	Activity
24 hours a day, up to seven days a week	• underground construction, including tunnelling and construction of roads and other infrastructure within tunnels • spoil handling within the tunnels and acoustic sheds • spoil haulage • tunnel mechanical and electrical fit-out • emergency work, if required.
Standard construction hours • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • no work on Sundays or public holidays	• general construction activities at construction footprints • surface work including earthworks, stormwater drainage, road pavement and finishing work • construction of surface operational ancillary facilities • cut-and-cover construction • equipment delivery and waste removal.

Work hours	Activity
Any time	The following activities may also be undertaken outside standard construction hours where required, provided the local community has been notified of the work: • utility installations or relocations to minimise utility downtime or to prevent adverse impacts to the relevant utility, utility user or road network • activities as directed by a relevant authority • the occasional delivery of materials via oversized transport as required by the NSW Police or other authorities (including Transport) for safety reasons • work determined to comply with the relevant noise management level at the nearest sensitive receiver • activities agreed with potentially affected receivers.

For the purposes of this assessment the shift times for construction of the project are assumed to be:

- day shift – 6am to 6pm (seven days per week)
- night shift – 6pm to 6am (seven days per week).

Therefore, the following assumptions are made:

- day shift and night shift worker arrival and departure hours are:
  - day shift arrivals occur between 5am and 7am (with majority arriving from 6am)
  - day shift departures occur between 5pm and 7pm
  - night shift arrivals occur between 5pm and 6pm
  - night shift departures occur between 6am and 7am.
- heavy vehicle activity would typically be spread out between:
  - day shift - 6am and 6pm
  - night shift – 6pm and 6am.

Other activities that may reduce the performance of the road network would be scheduled for periods of typically lower traffic volumes, where feasible and reasonable, so as to minimise potential disruption to the regional and local traffic network.

5.2 Construction workforce

The project is expected to support an indicative peak construction workforce of up to 1,100 full time equivalent jobs (direct employment) during the eight years of construction. This workforce would be primarily concentrated at the Little Hartley construction footprint.

The construction workforce would comprise trades and construction personnel, subcontract construction personnel and engineering, functional and administrative staff. The size of the workforce would vary depending on the construction activities being undertaken.

5.3 Construction footprints

5.3.1 Overview

Three construction footprints would be required to support construction of the project:

- Blackheath construction footprint located south of Evans Lookout Road, Blackheath
- Soldiers Pinch construction footprint located south of Browntown Oval, Mount Victoria

- Little Hartley construction footprint located approximately 400m west of Victoria Pass.

The indicative location of the three construction footprints is shown in Figure 5-2.

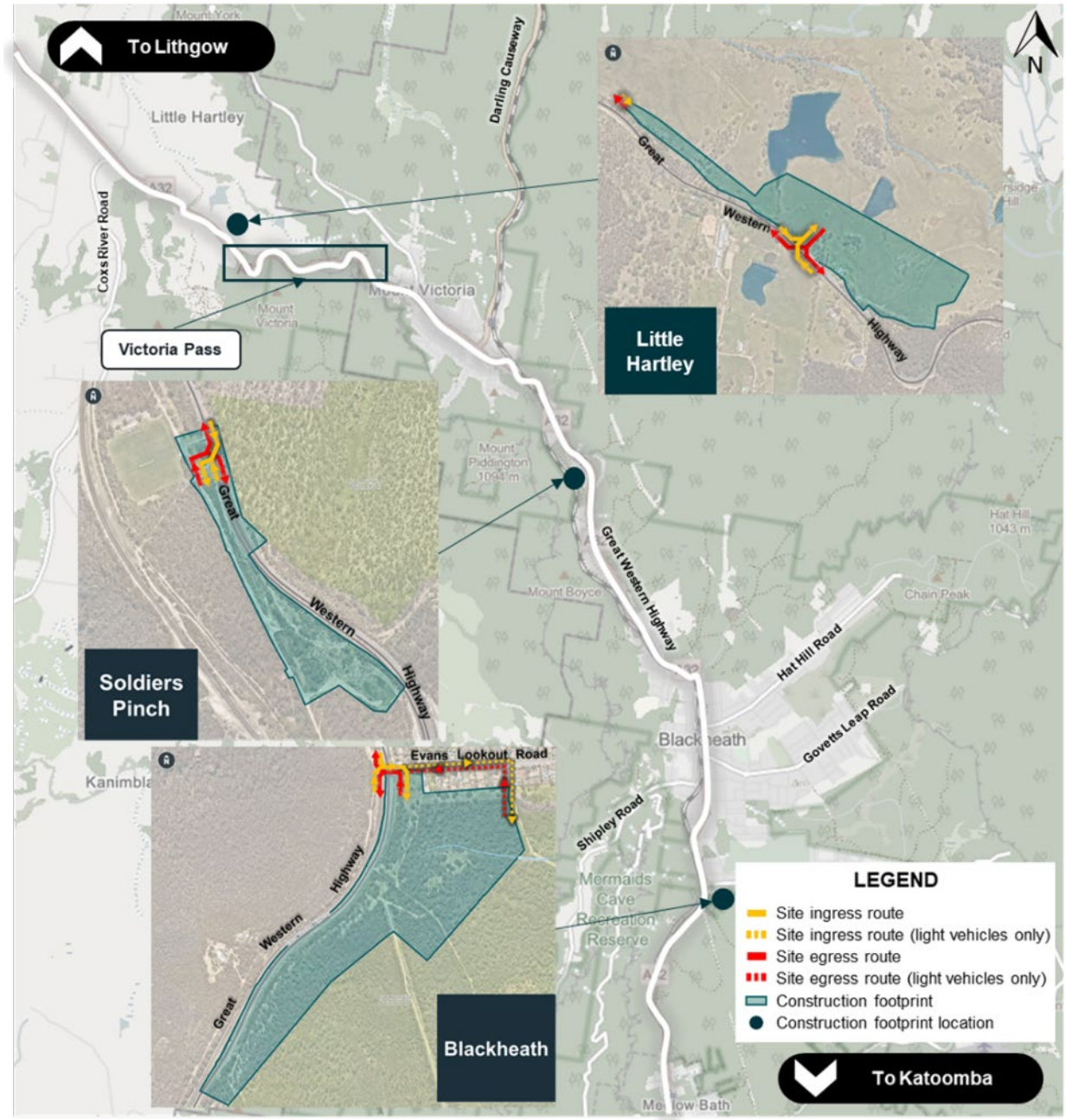


Figure 5-2 Indicative construction footprint locations

5.3.2 Blackheath

5.3.2.1 Overview

The indicative Blackheath construction footprint at Blackheath is shown in Figure 1-5. The Blackheath construction footprint would be located to the south of the Blackheath township.

The Blackheath construction footprint would be operational throughout the construction duration from 2024 to late 2031, as shown in the indicative program in Figure 5-3.

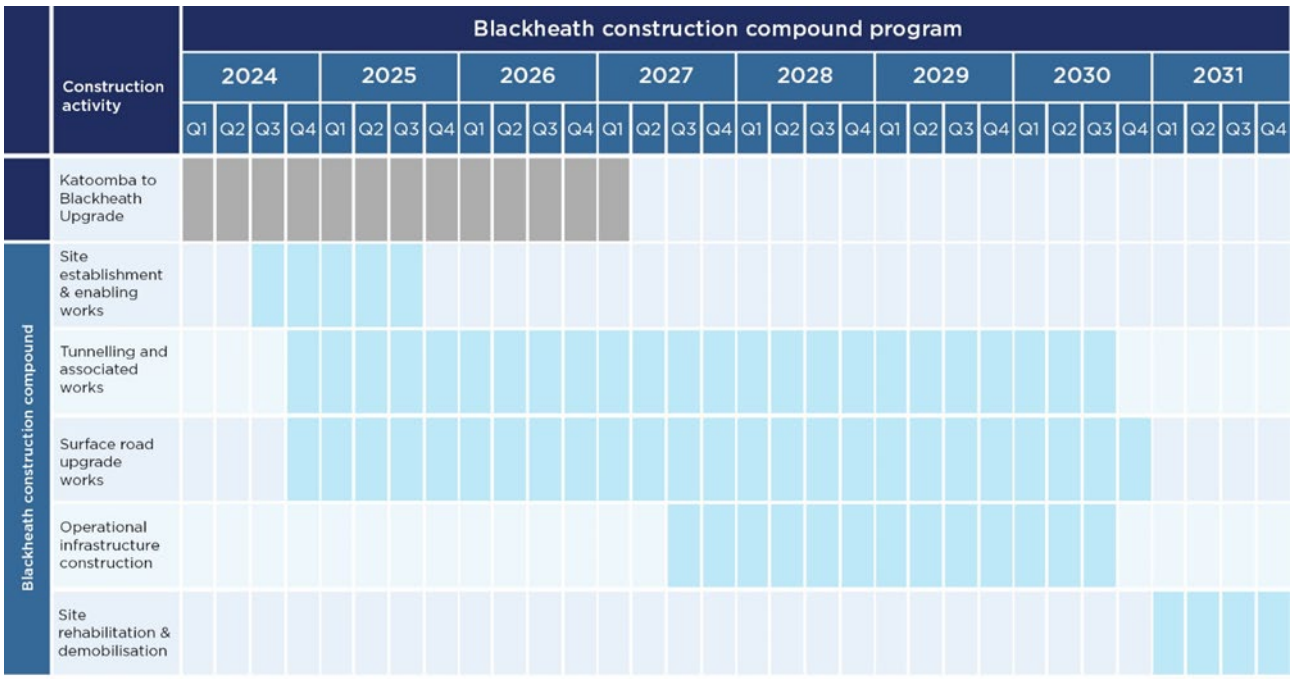


Figure 5-3 Indicative construction program for the Blackheath construction footprint

5.3.2.2 Vehicle access and car parking

The indicative access points for the Blackheath construction footprint are shown in Figure 5-2. Where practical, vehicle access to and from the Blackheath construction footprint would be via Valley View Road (light vehicles only), Evans Lookout Road and the existing intersection of the Great Western Highway and Evans Lookout Road.

All vehicles would use Evans Lookout Road and the existing intersection of the Great Western Highway and Evans Lookout Road which permits all vehicle movements.

An alternative access may also be required with a new intersection with the Great Western Highway to the south of Evans Lookout Road, to facilitate access directly to and from the Blackheath construction footprint. Site access arrangements will need to remain flexible during the various stages of the project, with increased access capacity more likely to be required during more intensive construction periods.

Additional assessment of site access may be required by the contractor once appointed.

Up to 100 car parking spaces would be provided at the Blackheath construction footprint for use by construction workers.

5.3.2.3 Traffic volumes

Table 5-2 summarises the peak construction vehicle movements[5] for the Blackheath construction footprint, which includes:

- up to 130 vehicle movements (in and out) per hour
- up to 440 vehicle movements (in and out) per day, including up to 270 light vehicles and 170 heavy vehicles.

The maximum hourly construction vehicle movements would occur at 6am coinciding with worker shift changeover. This is outside the AM peak hours on the road network. During the road network peak hours, construction vehicle movements would be approximately 15 vehicle movements per hour, as summarised in Table 5-3.

[5] For the purpose of this assessment, vehicle movement refers to each movement that a vehicle makes i.e. one vehicle would usually make two movements (in and out) of the compound per day

For the purpose of this assessment, construction vehicle movement estimates for the Blackheath construction footprint were developed using broad assumptions which are considered to be conservative. The arrival and departure of construction workers to and from the construction footprint is planned to occur outside road network peak hours. However, this would be confirmed by the contractor once appointed.

Table 5-2 Blackheath construction footprint construction vehicle movement

Vehicle movements per day (in and out)					Maximum vehicle movements per hour (6-7am)		
Daytime (6am-6pm)		Night-time (6pm-6am)		Total			
Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles		Light vehicles	Heavy vehicles	Total
150	160	120	10	440	115	15	130

Table 5-3 Blackheath construction footprint peak hour construction vehicle movement

Peak hour	Vehicle movements per hour (in and out)		
	Light vehicles	Heavy vehicles	Total
AM (8-9am)	0	15	15
PM (3-4pm)	0	15	15

5.3.3 Soldiers Pinch

5.3.3.1 Overview

The indicative construction footprint at Soldiers Pinch is shown in Figure 1-6. The Soldiers Pinch construction footprint would be located to the north of Blackheath and around 450 metres south of Browntown Oval.

The Soldiers Pinch construction footprint would be operational until 2030, as shown in the indicative program in Figure 5-4.

Figure 5-4 Indicative construction program for the Soldiers Pinch construction footprint

5.3.3.2 Vehicle access and car parking

The indicative access points for the Soldiers Pinch construction footprint are shown in Figure 5-2. Vehicle access to and from the Soldiers Pinch construction footprint would be via an existing gravel access track and the existing Great Western Highway intersection with the Browntown Oval access. The existing track would be widened to accommodate construction vehicles. All turning movements are permitted at the existing intersection.

Up to 70 car parking spaces would be provided at the Soldiers Pinch construction footprint for use by construction workers.

5.3.3.3 Traffic volumes

Table 5-4 summarises the peak construction vehicle movement[6] for the Soldiers Pinch construction footprint, which includes:

- up to 105 vehicle movements (in and out) per hour
- up to 395 vehicle movements (in and out) per day, including up to 190 light vehicles and 205 heavy vehicles.

The maximum hourly construction vehicle estimates would occur at 6am coinciding with worker shift changeover. During the road network peak hours, construction vehicle movements would be approximately 10 vehicle movements per hour, as summarised in Table 5-5.

For the purpose of this assessment, construction vehicle movement for the Soldiers Pinch construction footprint were developed using broad assumptions which are considered to be conservative. The arrival and departure of construction staff to and from the Soldiers Pinch construction footprint is planned to occur outside road network peak hours. However, this would be confirmed by the contractor once appointed.

Table 5-4 Soldiers Pinch construction footprint vehicle movements

Vehicle movements per day (in and out)					Maximum vehicle movements per hour (6-7am)		
Daytime (6am-6pm)		Night-time (6pm-6am)		Total			
Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles		Light vehicles	Heavy vehicles	Total
120	140	70	65	395	95	10	105

Table 5-5 Soldiers Pinch construction footprint peak hour vehicle movements

Peak hour	Vehicle movements per hour (in and out)		
	Light vehicles	Heavy vehicles	Total
AM (8-9am)	0	10	10
PM (3-4pm)	0	10	10

5.3.4 Little Hartley

5.3.4.1 Overview

The indicative Little Hartley construction footprint layout is shown in Figure 5-2. The Little Hartley construction footprint would be located around 400 metres west of Victoria Pass.

The Little Hartley construction footprint would be operational throughout the construction duration from 2024 to late 2031, as shown in the indicative program in Figure 5-2.

[6] For the purpose of this assessment, vehicle movement refers to each movement that a vehicle makes i.e. one vehicle would usually make two movements (in and out) of the compound per day

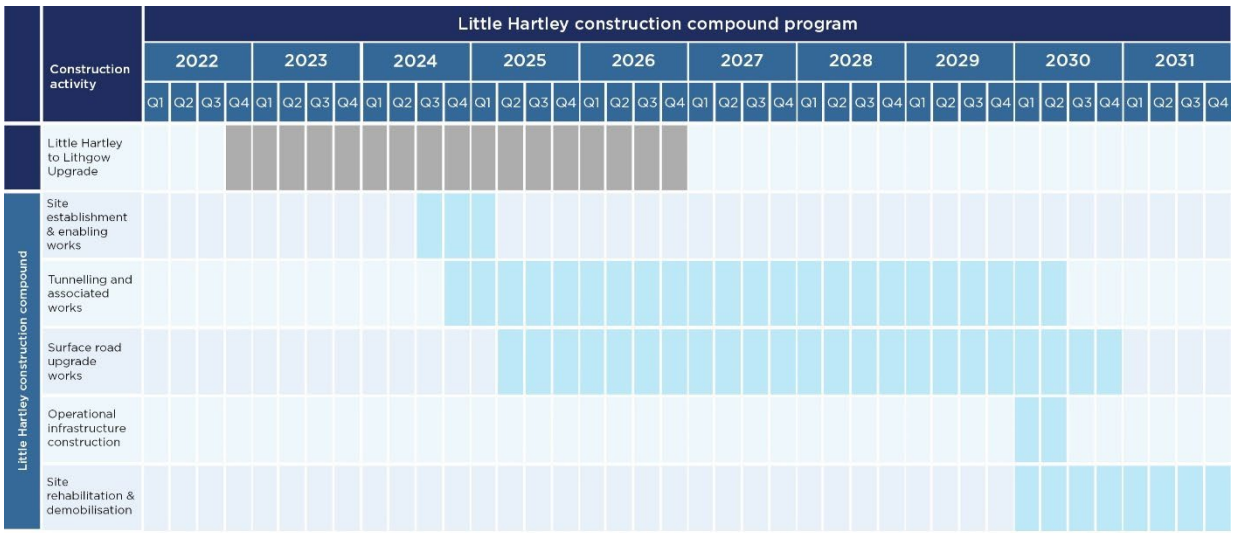


Figure 5-5 Indicative construction program for the Little Hartley construction footprint

5.3.4.2 Vehicle access and car parking

The indicative access point for the Little Hartley construction footprint is shown in Figure 5-6. Vehicle access to and from the Little Hartley construction footprint would be via one of two new unsignalised intersections with the Great Western Highway. All turning movements would be permitted at the proposed temporary intersections.

For the purpose of this assessment, it is assumed that all traffic entering and exiting the Little Hartley construction footprint would use one intersection at any one time. Therefore, the intersection performance assessment discussed in Section 5.7.6 is a conservative assessment.

On-site parking for around 500 to 600 vehicles would be provided at the Little Hartley construction footprint, to facilitate the construction workforce and support staff. To reduce the car parking requirements and associated traffic generation, opportunities to provide shuttle bus transfers from local hubs to minimise individuals traveling by car to the construction footprints would be investigated during detailed construction planning. Construction workers would be encouraged to carpool to travel to and from site, where possible.

5.3.4.3 Traffic volumes

Table 5-6 summarises the peak construction vehicle movements[7] for the Little Hartley construction footprint, which includes:

- up to 905 vehicle movements (in and out) per hour
- up to 3,325 vehicle movements (in and out) per day, including up to 1,895 light vehicles and 1,430 heavy vehicles.

The maximum hourly construction vehicle movements would occur at 6am coinciding with worker shift changeover. This is outside the AM peak hours on the road network. During the road network peak hours, construction vehicle movements would be approximately 90 vehicle movements per hour, as summarised in Table 5-7.

For the purpose of this assessment, construction vehicle movement for the Little Hartley construction footprint were developed using broad assumptions which are considered to be conservative. The arrival and departure of construction staff to and from the Little Hartley construction footprint is planned to occur outside road network peak hours. However, this would be confirmed by the contractor once appointed.

[7] For the purpose of this assessment, vehicle movement refers to each movement that a vehicle makes i.e. one vehicle would usually make two movements (in and out) of the compound per day

Table 5-6 Little Hartley construction footprint vehicle movements

Vehicles movements per day (in and out)					Maximum vehicle movements per hour (6-7am)		
Daytime (6am-6pm)		Night-time (6pm-6am)		Total			
Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles		Light vehicles	Heavy vehicles	Total
1,230	1,095	665	335	3,325	815	90	905

Table 5-7 Little Hartley construction footprint peak hour vehicle movements

Peak hour	Vehicle movements per hour (in and out)		
	Light vehicles	Heavy vehicles	Total
AM (8-9am)	0	90	90
PM (3-4pm)	0	90	90

5.4 Construction traffic volume summary

A summary of the daily construction vehicle movements at each construction footprint is included in Table 5-8. Across all construction footprints, the construction works could generate up to 4,160 vehicle movements per day including 1,805 heavy vehicles movements (in and out). This includes passenger, commercial and heavy vehicles, including spoil haulage, segment deliveries and tunnel fit out vehicles.

These traffic volume estimates assume that the peak activity at each construction footprint would occur at the same time. Therefore, the assessment presented in this report is considered to be a conservative assessment, as it is unlikely that peak activity at the Little Hartley and Soldiers Pinch construction footprints would occur at the same time.

Table 5-8 Summary of construction vehicle movements

Construction footprint	Vehicle movements per day (in and out)				
	Daytime (6am-6pm)		Night-time (6pm-6am)		Total
	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles	
Blackheath	150	160	120	10	440
Soldiers Pinch	120	140	70	65	395
Little Hartley	1,230	1,095	665	335	3,325
Total	1,500	1,395	855	410	4,160

5.5 Construction vehicle and haulage routes

As discussed in Section 5.3, the construction footprints have convenient and direct access to/ from the Great Western Highway. Therefore, all vehicles would use the Great Western Highway to travel between origins and destinations and each of the construction footprints.

For the purpose of this assessment it is assumed that the about 75 per cent of light vehicle movements would have origins and destinations to the east of the study area and 25 per cent would have origins and destinations to the west of the study area.

In terms of excavated material, a portion of the tunnelling spoil would be used as backfill within the tunnel to provide a flat surface for road pavement. Where possible, tunnelling spoil would also be stockpiled for future reuse as fill material for the surface road upgrade works to be constructed for the project. Opportunities to use excess spoil that cannot be reused within the project for adjacent or nearby Transport projects including other components of the Upgrade Program would be considered.

Excess spoil that cannot be reused within the project or for the other components of the Upgrade Program would be loaded directly into trucks and removed from site for appropriate reuse. Section 6.5.1

of the EIS outlines several off-site spoil reuse sites that are being investigated for the project. All identified locations are to the west of the study area. Therefore, all haulage activity would travel to and from the construction footprints and locations west of the study area, as indicatively shown in Figure 5-6.

Most of spoil haulage movements would be from TBM operation and would occur at the Little Hartley compound. Some haulage movements would occur at the Soldiers Pinch construction footprint (once the TBM have tunnelled past the mid-point of the tunnel).

The early construction planning has minimised the need for spoil haulage to occur at the Blackheath construction footprint. This aims to minimise associated impacts of additional haulage movements on sections of Great Western Highway, particularly in the Blackheath and Mount Victoria townships to avoid impacts on businesses and schools.

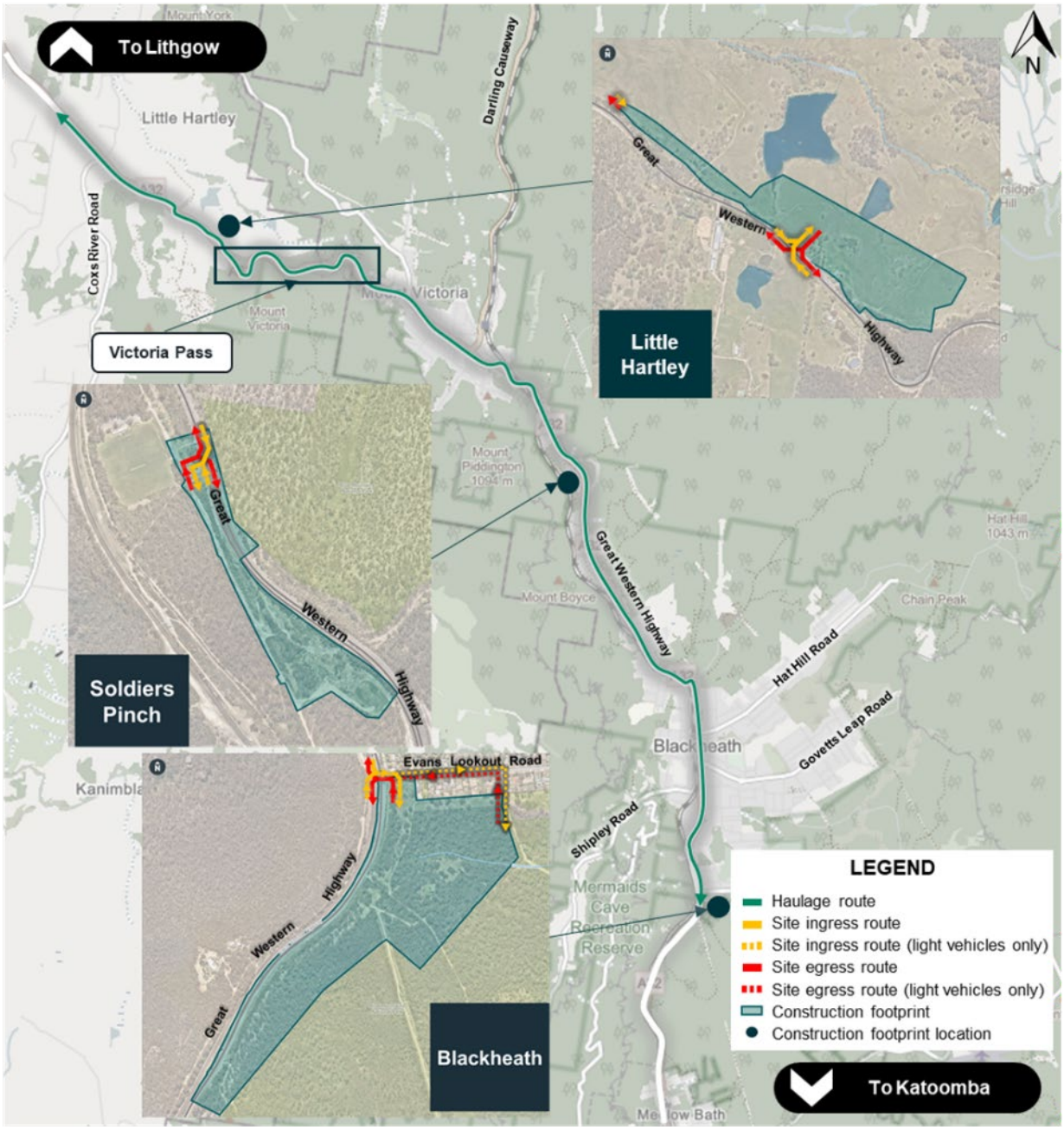


Figure 5-6 Indicative construction access and haulage route

5.6 Temporary traffic management measures

Some temporary modifications to the existing road network would be required during construction of the project, to maintain the functionality of surrounding roads, and to protect the safety of all road users, including pedestrians, cyclists, motorists, public transport users and construction personnel.

Temporary traffic modifications would be staged so as to not impact traffic movements unnecessarily and to maintain a minimum of one lane on traffic in each direction along the Great Western Highway throughout the construction of the project. Therefore, full road closures aren't expected to be needed. If required, the impacts of any required road closures would need to be assessed by the contractor and measures to minimise and manage impacts would be identified in the Construction Transport and Access Management Plan (CTAMP).

Traffic speed zones would also be adjusted to enhance safety around the construction work where required. The posted speed limit on the Great Western Highway would be reduced from 80 kilometres per hour to 60 kilometres per hour or lower in the vicinity of the construction footprints to enhance safety around the construction work where required. The full extent and durations of the speed reductions are not currently known and would be confirmed by the construction contractor when appointed.

Construction traffic impacts would be managed under a CTAMP developed for the project.

5.7 Road network impacts

As discussed in Section 5.1.3, tunnelling, spoil handling and transport and other below ground construction activities would generally take place 24 hours per day, seven days per week.

Therefore, the following assessment considers the project's impacts to the road network during the weekday peak hours, using results extracted from the OTM. The impacts on a weekend have been also estimated using 2018 traffic count data.

However, peak traffic generating activities would be scheduled to avoid peak days such as public holidays and associated weekends, and days associated with major public events such as the Bathurst Super Car event. Therefore, this assessment doesn't consider road network impacts on these peak days, as they aren't expected to occur.

5.7.1 Background traffic volumes and patterns

Based on the construction program, 2026 has been used as the assessment year for construction impacts, as this is when peak construction traffic volumes are expected. As shown in Table 5-9, traffic along the Great Western Highway is anticipated to increase by 17 to 25 per cent between 2018 and 2026 without the project. These traffic volumes have been extracted from the OTM.

The proportion of heavy vehicles along the Great Western Highway would remain relatively consistent between 2018 and 2026. Heavy vehicles are estimated to make up between 10 and 25 per cent of the weekday peak hour traffic volumes in 2026.

Table 5-9 Forecast existing (without project) traffic volume changes between 2018 and 2026

#	Screenline location along the Great Western Highway	Peak hour	Traffic volumes (without project)				2026 heavy vehicle percentage
			2018	2026	Difference		
1	South of Medlow Bath	AM	1,330	1,540	210	16%	16%
		PM	1,440	1,810	370	26%	15%
2	Blackheath	AM	1,100	1,510	410	37%	13%
		PM	1,260	1,690	430	34%	12%
3	Mount Victoria	AM	990	1,190	200	20%	14%
		PM	1,040	1,340	300	29%	14%
4	Little Hartley	AM	860	960	100	12%	22%
		PM	890	1,050	160	18%	13%

5.7.2 Additional construction related traffic volumes

As discussed in Section 5.4 the project's construction could generate up to 4,160 vehicles per day including 1,805 heavy vehicles. These traffic volume estimates assume that the peak activity at each construction footprint would occur at the same time. Therefore, the assessment presented in this report is considered to be a conservative assessment, as it is unlikely that peak activity at the Little Hartley and Soldiers Pinch construction footprints would occur at the same time.

As shown in Table 5-10, the construction traffic volumes would represent an increase to weekday peak hourly traffic volumes along the Great Western Highway of less than five per cent through to the townships. However, at Little Hartley, the construction traffic volumes would represent an increase of up to 10-15 per cent during the weekday AM and PM peak hours.

In addition, the construction traffic volumes would result in a minor increase to the heavy vehicle percentage along the Great Western Highway during the weekday peak hours, noting that heavy vehicle activity would be spread across 24 hours per day to support continuous TBM operations i.e. spoil haulage from the Little Hartley construction footprint. It is anticipated that this will assist with minimising heavy vehicle volumes generated in each individual hour. These volume increases are relatively small and expected to be manageable given that they are within the realm of daily traffic variations typically experienced across NSW's road network including the Great Western Highway. The subsequent sections of this report further discuss the impacts of the additional construction traffic volumes on the existing road network.

Table 5-10 Forecast 2026 traffic volume changes with and without construction of the project – weekday AM and PM peak hours

#	Screenline location along the Great Western Highway	Peak hour	Traffic volumes				2026 with construction heavy vehicle percentage
			2026 without construction	2026 with construction	Difference		
1	South of Medlow Bath	AM	1,540	1,570	30	2%	16%
		PM	1,810	1,810	0	0%	16%
2	Blackheath	AM	1,510	1,550	40	3%	14%
		PM	1,690	1,740	50	3%	13%
3	Mount Victoria	AM	1,190	1,210	20	2%	17%
		PM	1,340	1,360	20	1%	16%
4	Little Hartley	AM	960	1,050	90	9%	29%
		PM	1,050	1,190	140	13%	22%

The peak construction related traffic would occur during shift changeover, which is assumed to occur outside the weekday peak hours at 6-7am and 5-7pm. At these times, weekday traffic volumes on the Great Western Highway are less than the weekday peak hour traffic volumes. Table 5-11 presents the traffic volume estimates for 2026 with and without construction during the construction peak hours (6-7am and 6-7pm). The traffic volume estimates during these hours have been estimated by applying the 2018 daily profile from traffic survey data to the weekday 2026 traffic volumes from the OTM.

As shown in Table 5-11, the construction traffic volumes would represent substantial traffic volume increases at 6am and 6pm. At 6pm, the total traffic volumes along the Great Western Highway with construction would be similar to the weekday road network peak hours in 2026. However, at 6am, the total traffic volumes along the Great Western Highway with construction would substantially exceed the total traffic volumes during weekday road network peak hours in 2026 in Blackheath, Mount Victoria and Little Hartley.

Figure 4-17 shows that the average weekend traffic volumes along the Great Western Highway at 6-7am are typically substantially lower than at the same time on a weekday. At 5-7pm, the weekend traffic volumes are up to 20 per cent higher than at the same time on a weekday.

Therefore, the construction traffic volumes are most likely to affect the Great Western Highway performance during the weekday AM period of 6am and weekend PM period of 5-7pm. Measures to minimise the construction traffic volumes and their impacts on the surrounding road network would be further investigated as part of the contractor's CTAMP. Measures for further consideration include:

- stagger shift times to minimise the hourly traffic generation
- encourage the use of alternative transport modes and carpooling for workers
- provide shuttle bus transfers between construction footprints and local hubs to minimise the use of individuals traveling by car to the construction footprints
- minimising heavy vehicle and spoil truck movements during weekend peak periods.

Table 5-11 Forecast 2026 traffic volume changes with and without construction of the project – construction peak hours

#	Screenline location along the Great Western Highway	Peak hour	Traffic volumes				2026 with construction heavy vehicle percentage
			2026 without construction	2026 with construction	Difference		
1	South of Medlow Bath	6am	690	1,870	1,180	170%	14%
		6pm	1,000	1,650	650	65%	8%
2	Blackheath	6am	650	1,910	1,260	195%	21%
		6pm	960	1,580	620	65%	8%
3	Mount Victoria	6am	530	1,850	1,320	250%	28%
		6pm	740	1,370	630	85%	13%
4	Little Hartley	6am	450	2,140	1,690	375%	69%
		6pm	610	1,230	620	100%	39%

5.7.3 Network performance statistics

Table 5-12 and Table 5-13 compare the forecast network performance statistics for the modelled area during the weekday AM and PM peak hours, with and without construction of the project in 2026.

The additional construction traffic would have a minor impact to the following network performance statistics for the weekday AM and PM peak hours:

- total traffic demand would increase by two per cent during the AM and PM peak hours
- total VKT would increase by about 100 vehicles (2-3 per cent) during the AM and PM peak hours, respectively
- total VHT would increase by approximately 40 and 70 hours (4-6 per cent) during the AM and PM peak hours, respectively
- average vehicle speed would decrease from 55 kilometres per hour to 54 kilometres per hour (2 per cent) during the AM and PM peak hours.

Overall, the weekday peak hour network performance would be similar with and without the project's construction in 2026, and limited change in congestion is expected on a typical weekday noting that the zero unreleased vehicles were identified. The combination of reduced speed limits and additional construction traffic volumes would result in a minor increase to weekday peak hour travel times of about one minute for both directions along the Great Western Highway (between Katoomba and Lithgow).

As discussed in Table 3-1, this analysis is considered to be conservative as it does not include the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade works, which would be largely complete by 2026 and would provide additional capacity along the respective upgraded sections of the Great Western Highway.

Table 5-12 Weekday AM peak hour model network performance statistics in 2026 with and without construction of the project

Network performance statistic	2018	2026			
		Without project	With project	Difference	
All vehicles					
Total traffic demand (vehicles)	4,350	4,825	4,931	106	2%
Total VKT (kilometres)	47,685	56,381	57,714	1,333	2%
Total VHT (hours)	864	1,047	1,091	44	4%
Total vehicles arrived	4,256	4,766	4,833	67	1%
Total number of stops	2,922	3,515	3,604	89	3%
Average per vehicle in network		**0**	**0**		
Average VKT (kilometres)	11	12	12	0	0%
Average VHT (minutes)	12	13	14	1	8%
Average number of stops	1	1	1	0	0%
Average speed (kilometres per hour)	55	54	53	-1	-2%
Unreleased vehicles					
Unreleased demand (vehicles)	0	0	0	0	0

Table 5-13 Weekday PM peak hour model network performance statistics in 2026 with and without construction

Network performance statistic	2018	2026			
		Without project	With project	Difference	
All vehicles					
Total traffic demand (vehicles)	4,961	5,384	5,493	109	2%
Total VKT (kilometres)	47,632	64,021	66,294	2,273	3%
Total VHT (hours)	871	1,177	1,247	70	6%
Total vehicles arrived	4,758	5,334	5,436	102	2%
Total number of stops	3,942	4,781	4,824	43	1%
Average per vehicle in network					
Average VKT (kilometres)	10	12	12	0	0%
Average VHT (minutes)	11	13	14	1	8%
Average number of stops	1	1	1	0	0%
Average speed (kilometres per hour)	55	54	53	-1	-2%
Unreleased vehicles					
Unreleased demand (vehicles)	0	0	0	0	0

5.7.4 Roadway level of service

The mid-block LoS along the existing Great Western Highway was assessed for the 2026 without and with construction scenarios. Comparison of the mid-block LoS for Segment 1 and 2 (see Table 3-6) during the weekday AM and PM peak hours are summarised in Table 5-14 and Table 5-15, respectively.

For both scenarios, the LoS would be similar between the with and without construction. Similar mid-block LoS would be expected at 6pm given that the total traffic volumes at 6pm on a weekday during peak shift changeover would be similar to those during the weekday road network peak hour. The mid-block segments would likely operate with a LoS E or worse at 6am on a weekday and 6pm on weekend.

As discussed in Section 5.7.2, measures to minimise the construction traffic volumes and their impacts on the surrounding road network during these hours would be further investigated as part of the contractor's CTAMP. Measures for further consideration include:

- stagger shift times to minimise the hourly traffic generation
- encourage the use of alternative transport modes and carpooling for workers
- provide shuttle bus transfers between construction footprints and local hubs to minimise the use of individuals traveling by car to the construction footprints
- minimising heavy vehicle and spoil truck movements during weekend peak periods.

Notwithstanding this, this analysis is considered to be conservative as it does not include the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade works, which would be largely complete by 2026 and would provide additional capacity along the respective upgraded sections of the Great Western Highway.

Table 5-14 Weekday AM peak hour two-lane highway mid-block level of service - 2026 without and with construction scenarios

Location	Direction	Without construction			With construction		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	57	77%	E	56	77%	E
	Westbound	56	77%	E	56	77%	E
Segment 2	Eastbound	56	72%	E	55	74%	E
	Westbound	56	73%	E	55	75%	E

Table 5-15 Weekday PM peak hour two-lane highway mid-block level of service - 2026 without and with construction scenarios

Location	Direction	Without construction			With construction		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	54	82%	E	53	83%	E
	Westbound	53	82%	E	53	83%	E
Segment 2	Eastbound	55	76%	E	54	75%	E
	Westbound	54	77%	E	53	75%	E

5.7.5 Travel times

Table 5-16 compares travel times along the Great Western Highway between Katoomba and Lithgow in 2026 with and without construction of the project. The additional construction traffic volumes would result in a minor increase to weekday peak hour travel times between Katoomba and Lithgow of about one to two minutes for both directions. Similarly, average vehicle speeds would reduce by about one to two kilometres per hour.

The introduction of construction speed limits or temporary traffic lane closures along sections of the Great Western Highway would be required to improve safety but would result in further increases in travel time.

Similar travel times would be expected at 6pm on a weekday during peak shift changeover, given that the total traffic volumes at 6pm would be similar to those during the weekday road network peak hour. However, the travel time increase would likely be higher at 6am on a weekday and 6pm on weekend. As discussed in Section 5.7.2, measures to minimise the construction traffic volumes and their impacts on the surrounding road network during these hours would be further investigated as part of the contractor's CTAMP. However, this analysis is considered to be conservative as it does not include the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade works, which would be largely complete by 2026 and would provide additional capacity along the respective upgraded sections of the Great Western Highway.

The introduction of construction speed limits or temporary traffic lane closures along sections of the Great Western Highway would be required to improve safety but would result in further increases in travel time at all times.

Table 5-16 AM and PM peak hour average travel times and average speed in 2026 with and without construction

Peak hour	Direction	Average travel time (minutes)				Average speed (km/h)			
		2026 without construction	2026 with construction	Difference		2026 without construction	2026 with construction	Difference	
AM	Eastbound	39	40	1	3%	59	58	1	2%
	Westbound	43	43	0	0%	55	54	1	2%
PM	Eastbound	40	41	1	3%	58	56	2	3%
	Westbound	41	43	2	5%	56	54	2	4%

5.7.6 Intersection performance

Table 5-17 compares intersection performance during the weekday AM and PM peak hours at study intersections (see Section 3.4.6) with and without construction in 2026. Seven of the eight existing intersections (excluding Great Western Highway and Browntown Oval access intersection) would operate with similar delays and LoS in 2026 with and without construction.

The Great Western Highway and Evans Lookout Road intersection would operate a LoS F in 2026 without construction because of background traffic growth along the Great Western Highway. This relates to delays to vehicles turning right from Evans Lookout Road to the Great Western Highway westbound. Additional right turning traffic generated by construction of the project at Blackheath would result in increased delays and a LoS F.

Construction access arrangements would be confirmed by the contractor in consultation with Transport and relevant stakeholders. Options to minimise construction vehicles turning right from Evans Lookout Road to the Great Western Highway are being investigated and include:

- restricting construction vehicles exiting the site to turn left from Evans Lookout Road to the Great Western Highway, with a U-turn facility provided on the Great Western Highway to the south of Evans Lookout Road

- providing a temporary signalised intersection for construction access to the south of Evans Lookout Road.

Vehicles turning right (heading eastbound) from the Soldiers Pinch construction site access would also experience lengthy delays during the weekday AM and PM peak hours. However, it isn't expected that there would be demand for this movement during the peak hours. This would need to be enforced to avoid unsafe movements occurring during peak hours.

Similar intersection performance would be expected at 6pm on a weekday during peak shift changeover, given that the total traffic volumes at 6pm would be similar to those during the weekday road network peak hour. However, the performance of these intersections would likely be worse at 6am on a weekday and 6pm on weekend. As discussed in Section 5.7.2, measures to minimise the construction traffic volumes and their impacts on the surrounding road network during these hours would be further investigated as part of the contractor's CTAMP.

Table 5-17 Intersection level of service in 2026 with and without construction of the project

ID	Intersection	Peak hour	2026 without construction		2026 with construction	
			Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
1	Great Western Highway and Evans Lookout Road	AM	76	F	186	F
		PM	282	F	>300	F
2	Great Western Highway and Prince George Street	AM	8	A	8	A
		PM	13	A	13	A
3	Great Western Highway and Leichhardt Street	AM	8	A	8	A
		PM	12	A	12	A
4	Great Western Highway, Govetts Leap Road and Bundarra Street [1][2]	AM	25	B	26	B
		PM	32	C	33	C
5	Great Western Highway and Hat Hill Road	AM	29	C	30	C
		PM	45	D	49	D
6	Great Western Highway and Browntown Oval access intersection (Soldiers Pinch construction footprint)	AM	-	-	92	F
		PM	-	-	148	F
7	Great Western Highway and Harley Avenue	AM	42	C	33	C
		PM	41	C	45	D
8	Great Western Highway and Station Street (Darling Causeway)	AM	9	A	8	A
		PM	5	A	5	A
9	Great Western Highway and Main Street and Caroline Avenue	AM	23	B	24	B
		PM	25	B	25	B
10	Little Hartley construction footprint access	AM	-	-	28	B
		PM	-	-	38	C

[1] intersection performance has been extracted from the OTM which considers the impacts of the adjacent level crossing
[2] while it is anticipated that this intersection would be upgraded to a grade separated intersection as part of the Little Hartley to Lithgow Upgrade, this upgrade was not included in the 'with project' construction year scenario (2026) as part of the Operational Travel Model

5.7.7 Public and road safety

Road safety is the main concern regarding transport and traffic related public safety issues, given the location of construction sites having limited interface with the public. Construction safety impacts on active transport are discussed in more detail in Section 5.9.

The proposed construction strategy discussed in Section 5.1 has been developed to minimise impacts of the construction activities on the existing road network, including road safety. In particular, the indicative haulage arrangements would minimise the number of heavy vehicles that would travel through the townships of Blackheath and Mount Victoria, minimising interaction of heavy vehicles with pedestrians, cyclists and local traffic, particularly around schools and local businesses.

The existing steep grades on the Great Western Highway at Victoria Pass currently result in low vehicle speeds and frequent breakdowns for heavy vehicles, particularly in the eastbound directions. The speed difference between heavy vehicles and faster-moving light vehicles creates a road safety risk which will remain an issue during the construction of the project. To mitigate this impact, the proposed construction strategy aims to minimise the number of additional heavy vehicles that need to use Victoria Pass by transporting most TBM spoil from the Little Hartley site.

Notwithstanding the above, road safety risks would inherently be introduced because of vehicles entering and exiting the construction footprints and increased heavy vehicles using the Great Western Highway. Construction traffic impacts on safety for all road users would be managed through the contractor's CTAMP that would be developed for the project in consultation with Transport and relevant stakeholders.

Appendix O (Technical report - Social) of the EIS identifies that the presence of construction sites and the construction workforce may result in changes to perceptions of public safety in an area. This may include changes to local sight lines, restrictions for pedestrian traffic reducing passive surveillance, the provision of new surfaces for graffiti, or perception that criminal activities may be attracted to construction facilities. However, based on the location of the construction sites away from urban centres, Appendix O of the EIS suggests that the overall significance of impact would be a low (negative) impact.

5.8 Public transport

Buses that travel along the Great Western Highway in the study area including routes 698, 698V, 690K, 8710 would be subject to the same minor road network impacts that are discussed in Section 5.7. For example, these bus services could experience travel time increases of less than one minute in each direction during the weekday AM and PM peak hours. This travel time increase is expected to be minor and manageable.

It is not currently planned to temporarily modify or move any existing bus stops during construction of the project. If bus stop modifications are required, the proposed changes, impacts and mitigation measures would be included in the contractor's CTAMP.

The rail services within the study area are not expected to be affected by construction of the project. However, as discussed in Section 4.4.1 rail replacement bus services are frequently used in the study area to replace rail services during planned and unplanned works to the rail line. Rail replacement bus services would be subject to the same minor impacts as the bus services.

5.9 Walking and cycling

As discussed in Section 5.1, the indicative construction strategy has been developed to minimise the number of heavy vehicles that need to travel through the Blackheath and Mount Victoria townships. Therefore, the interaction of heavy vehicles and pedestrians and cyclists in these townships has been minimised as much as practical. Access to public space and community facilities would not be directly affected during construction, however the above changes in anticipated level of service on the local road network may result in minor delays.

There are limited formal pedestrian or cyclist facilities near the proposed construction footprints. There is a recreational trail used by hikers and cyclists that extends into the Soldiers Pinch construction footprint. Access to the trail is provided near the intersection of the Great Western Highway and Browntown Oval. If required, the trail would be temporarily diverted around the Soldiers Pinch construction footprint to avoid the conflict between construction vehicles and the public, which would marginally increase walking or cycling time. Access would be maintained during construction and therefore this temporary impact would be negligible.

Active transport links would be provided as part of the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade in the vicinity of Blackheath and Little Hartley respectively. These active transport links, including the shoulders along the Great Western Highway which are used by cyclists, would be maintained during construction of the project. Where temporary modifications to existing pedestrian or cyclist facilities are required to facilitate construction of the project, impacts would be managed under the CTAMP.

At the Little Hartley construction footprint, vehicles accessing the footprint would need to cross the shared path that would be provided as part of Little Hartley to Lithgow Upgrade, as discussed in Section 4.14.2. This conflict would be managed by the contractor to maintain the safety of all road users. Available management measures include pedestrian and cyclist control signage, pavement markings, pedestrian gates, and flashing lights. Opportunities to improve the intersection of Great Western Highway and Browntown Oval access would be further investigated as part of further design refinement.

5.10 Parking and access

On-site parking for workers would be provided within the construction footprints (see Figure 1-5 to Figure 1-7). Parking provided at each construction site would be sufficient for the associated worker demand, except for during worker shift changeover. During worker shift changeover specific measures would be implemented such as staggering shift start and end times to make parking available for incoming workers. The project would also utilise carpooling and shuttle bus transfers for workers to and from construction sites.

Nevertheless, construction workers may choose to use available on-street parking, particularly near the Blackheath construction footprint. As part of the CTAMP, the contractor would develop a parking and access management plan and consider travel demand management measures to minimise the impacts of potential worker parking upon adjacent on-street parking and the residents and businesses that use these. This would be developed in consultation with Transport and local councils.

As discussed in Section 4.7, on-street parking is currently provided along the Great Western Highway within the Blackheath and Mount Victoria townships. On-street parking along the Great Western Highway would be maintained during construction of the project.

During construction, informal parking for around a 50-100 metre section of Evans Lookout Road near the Great Western Highway would be removed. This area accommodates space for up to five parked vehicles (not formal car parking spaces). This area would be required to facilitate heavy vehicles turning in and out of the Blackheath construction footprint at the intersection of Evans Lookout Road and the Great Western Highway.

The project is not expected to remove any access to and from any adjacent properties. Access to Browntown Oval would be maintained via its existing intersection with the Great Western Highway. The oval includes a cricket pitch used for cricket matches and training in the summer months, and is used for archery practice on Sundays. The oval is also available for one-off events or seasonal bookings. Intersection improvements and/or traffic controllers could be used by the contractor to manage heavy vehicles turning in and out of the Soldiers Pinch construction footprint when the oval is in use. Mitigation measures would be confirmed during design development by the construction contractor(s).

As discussed in Section 4.14, revised property access arrangements and access roads would be provided as part of the Little Hartley to Lithgow Upgrade in the vicinity of Little Hartley. These would be maintained during construction of this project.

5.11 Emergency vehicles

The Great Western Highway and the surrounding local road network are currently used by emergency services. Construction of the project may require temporary traffic modifications but is unlikely to require full closures of the Great Western Highway. Therefore, emergency services access along the Great Western Highway would be maintained throughout construction.

Access to the Sydney Drinking Water Catchment and Blue Mountains National Park at Blackheath via B6 Lake Medlow Trail (fire trail accessed via Valley View Road) would also be maintained during construction.

The CTAMP for the project would be developed in consultation with relevant emergency services, ensuring that procedures are in place to maintain safe, priority access for emergency vehicles through or around construction zones. In addition, local emergency services would be periodically updated on the staging and progress of construction works.

6.0 Assessment of operational impacts

This section provides an assessment of operational impacts of the project on the surrounding transport network.

6.1 Road network

6.1.1 Total traffic volumes and patterns

6.1.1.1 Upgraded Great Western Highway weekday traffic volumes

In 2030 the project is forecast to attract additional traffic to the upgraded Great Western Highway, including:

- about 500 more vehicles (five per cent) per day with the project in each direction at Medlow Bath to the south of the study area
- about 800 vehicles (13 per cent) per day with the project in each direction at Little Hartley at the western extent of the study area.

In 2040 the project is forecast to attract additional traffic to the upgraded Great Western Highway, including:

- about 2,000-2,500 more vehicles (20 per cent) per day with the project in each direction at Medlow Bath to the south of the study area
- about 2,000-2,300 more vehicles (30 per cent) per day with the project in each direction at Little Hartley at the western extent of the study area.

The additional traffic volumes were forecast by the RTM and are associated with changes to travel behaviours to take advantage of the improved accessibility and reduced travel time (Section 6.1.5) offered by the project including:

- travellers choosing more distant destinations
- travellers switching travel modes
- travellers choosing to use the Great Western Highway instead of alternative routes including Bells Line of Road.

The project is not expected to generate new trips that would not have otherwise occurred (induced demand). Higher productivity vehicles that can transport larger freight volumes that are not permitted to use the Great Western Highway would be able to use the tunnel and are likely to result in increased freight transport efficiency.

Figure 6-1 illustrates the total traffic volume estimates in each direction (eastbound and westbound) at four screenline locations and for 2030 and 2040, with and without the project.

The screenline locations were shown in Figure 3-7.

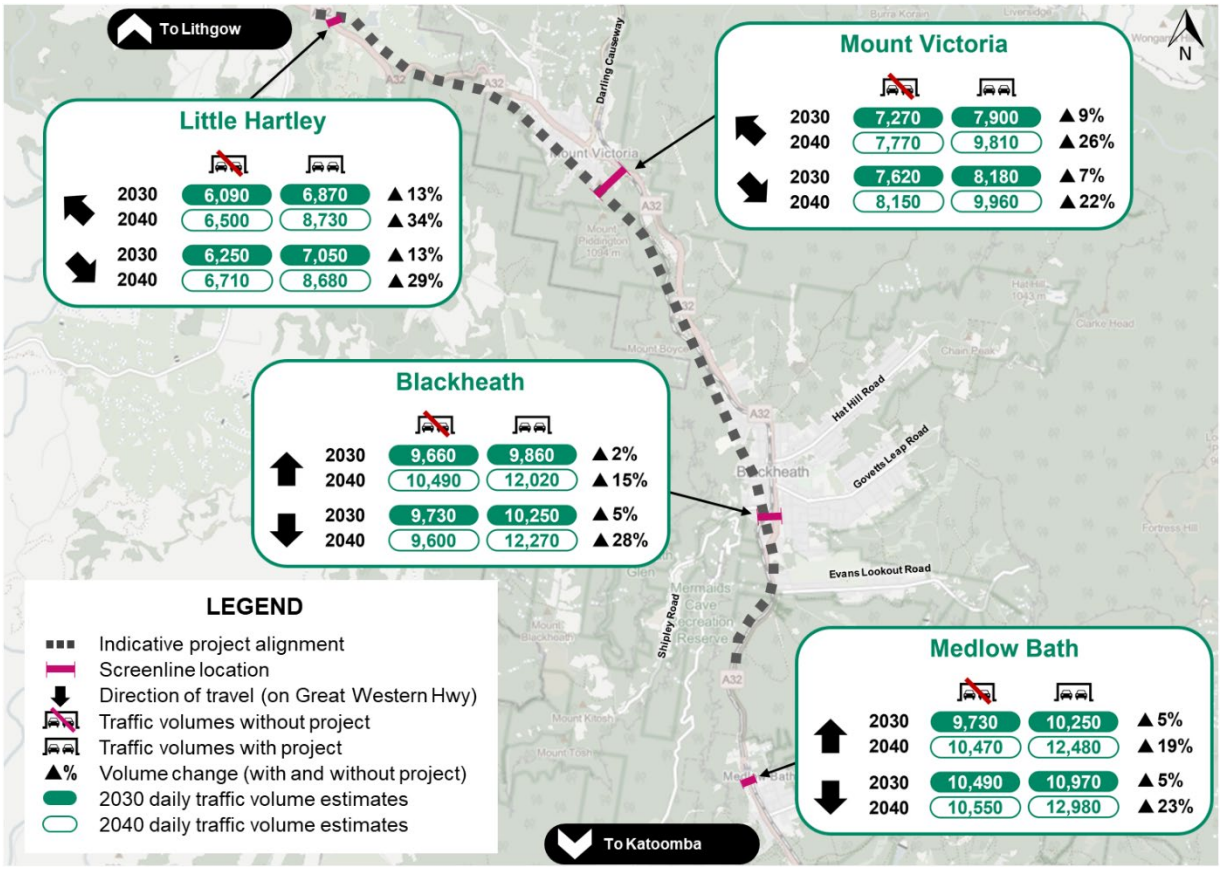


Figure 6-1 Daily traffic volume estimates for 2030 and 2040 with and without project

6.1.1.2 Existing Great Western Highway weekday traffic volumes

Figure 6-2 compares the forecast 2030 and 2040 traffic volumes along the existing Great Western Highway alignment with and without the project.

In 2030 and 2040 the existing Great Western Highway alignment through Blackheath would carry approximately 20,000 vehicles per day without the project. With the project, traffic volumes along the existing Great Western Highway alignment through Blackheath would reduce by about 60 per cent to 7,300 and 8,300 vehicles per day in 2030 and 2040, respectively.

Traffic volumes on the existing Great Western Highway alignment through Mount Victoria would be 15,000 and 16,000 vehicles per day without the project. With the project, these would substantially reduce by nearly 80 per cent to 3,300 and 3,700 vehicles per day in 2030 and 2040, respectively.

It is anticipated that vehicles continuing to use the existing Great Western Highway alignment through Blackheath and Mount Victoria instead of the project would have origins and destinations in Blackheath and Mount Victoria.

The substantial reduction to traffic volumes along the existing Great Western Highway through Blackheath and Mount Victoria would substantially improve the accessibility and amenity of these townships and will not affect public transport and cycle networks.

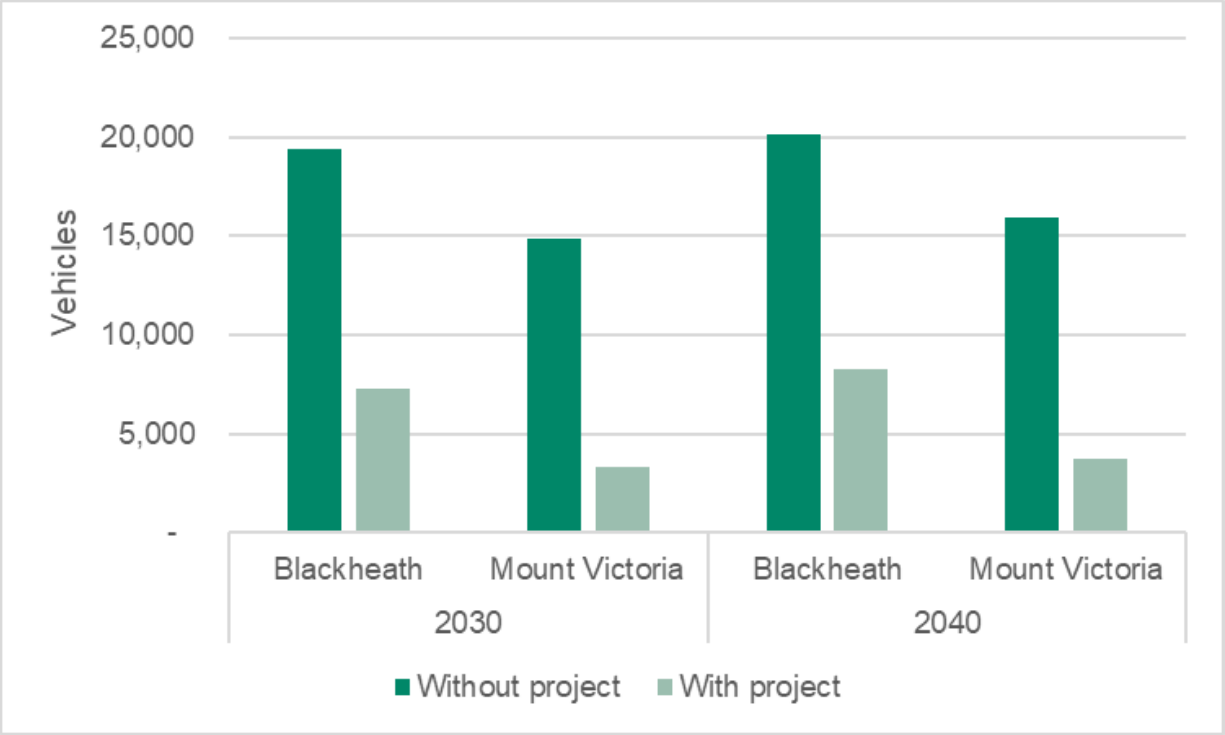


Figure 6-2 Comparison of 2030 and 2040 light vehicle traffic volumes through Blackheath and Mount Victoria with and without the project

6.1.1.3 Existing Great Western Highway public holiday and weekend traffic volumes

Using 2018 permanent count station data, expansion factors were calculated to estimate the average weekday, weekend and public holiday traffic volumes in 2030 and 2040.

Figure 6-3 and Figure 6-4 compares the forecast average traffic volumes using the existing Great Western Highway alignment in Blackheath and Mount Victoria for the average weekday, weekend and public holiday in 2030 and 2040, respectively.

Traffic volumes on the existing Great Western Highway alignment through Blackheath and Mount Victoria without the project could reach 25,000 and 20,000 vehicles per day on an average public holiday, respectively. With the project, these volumes would substantially reduce to 11,000 and 5,000 vehicles per day in Blackheath and Mount Victoria, respectively. The traffic forecasts indicate that with the project, traffic volumes on the existing Great Western Highway alignment through Blackheath and Mount Victoria in 2040 would be less than the volumes experienced in 2018 (see Table 4-3).

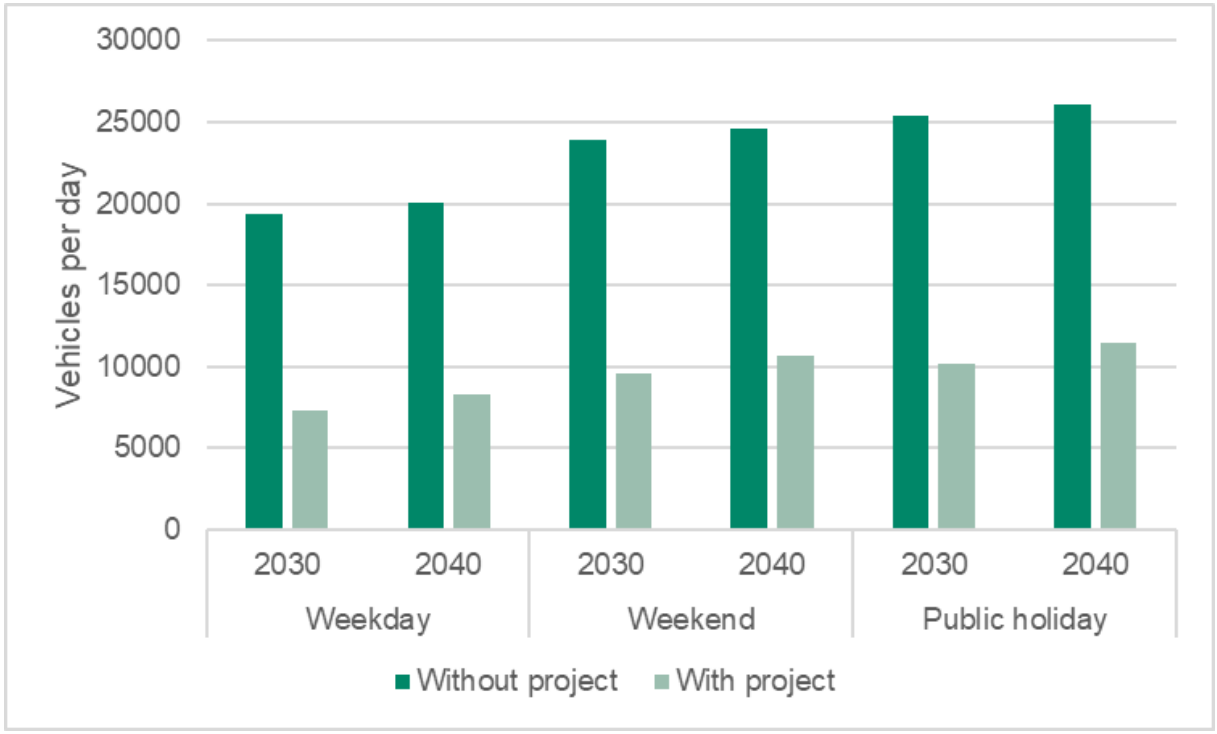


Figure 6-3 Average weekday, weekend and public holiday traffic volumes per day in Blackheath -2030 and 2040

Figure 6-4 Average weekday, weekend and public holiday traffic volumes per day in Mount Victoria -2030 and 2040

6.1.2 Heavy vehicle volumes and patterns

6.1.2.1 Upgraded Great Western Highway weekday heavy vehicle volumes

Figure 6-5 illustrates the corridor total heavy vehicle volume estimates in each direction (eastbound and westbound) across four screenline locations for 2030 and 2040, with and without the project.

In 2030 with the project, the number of heavy vehicles travelling west on the Great Western Highway corridor would decrease by between 50 and 100 vehicles (four to six percent) per day at each screenline location (see Figure 3-7) when compared to the without project scenario. This includes heavy vehicles traveling on the project and existing Great Western Highway alignment. The number of heavy vehicles travelling east on the existing Great Western Highway corridor would increase with the project by around 20 vehicles (two per cent) at Little Hartley and around 40 vehicles (three per cent) at Mount Victoria, with no change expected in the corridor at Blackheath and Medlow Bath.

In 2040, the project would reduce the number of heavy vehicles travelling west on the Great Western Highway corridor, with a reduction of between 70 and 100 vehicles (five to six per cent) per day across each screenline location. The number of heavy vehicles travelling east in the Great Western Highway corridor would decrease with the project by 30 vehicles (two per cent) per day at Little Hartley and increase in the corridor by 140 vehicles per day (nine per cent) at Blackheath and 50 vehicles per day (three per cent) at Medlow Bath.

Heavy vehicle volumes on the Great Western Highway corridor are likely brought about by the project and the Upgrade Program, which would accommodate high productivity vehicles longer than 20 metres between Katoomba and Lithgow. The following key changes that were identified as part of the FFF include:

- around ten per cent of road freight on Lachlan Valley Way and five per cent of freight on the Golden Highway is assumed to reroute to use the Great Western Highway corridor following the Upgrade Program
- some rail freight may transfer to road freight to use the Great Western Highway following the Upgrade Program
- the heavy vehicle fleet mix would change towards more High Productivity Vehicles (HPV's) including B-Doubles over 26 metres in length which would result in fewer heavy vehicles but with increased load capacity using the Great Western Highway corridor following the Upgrade Program.

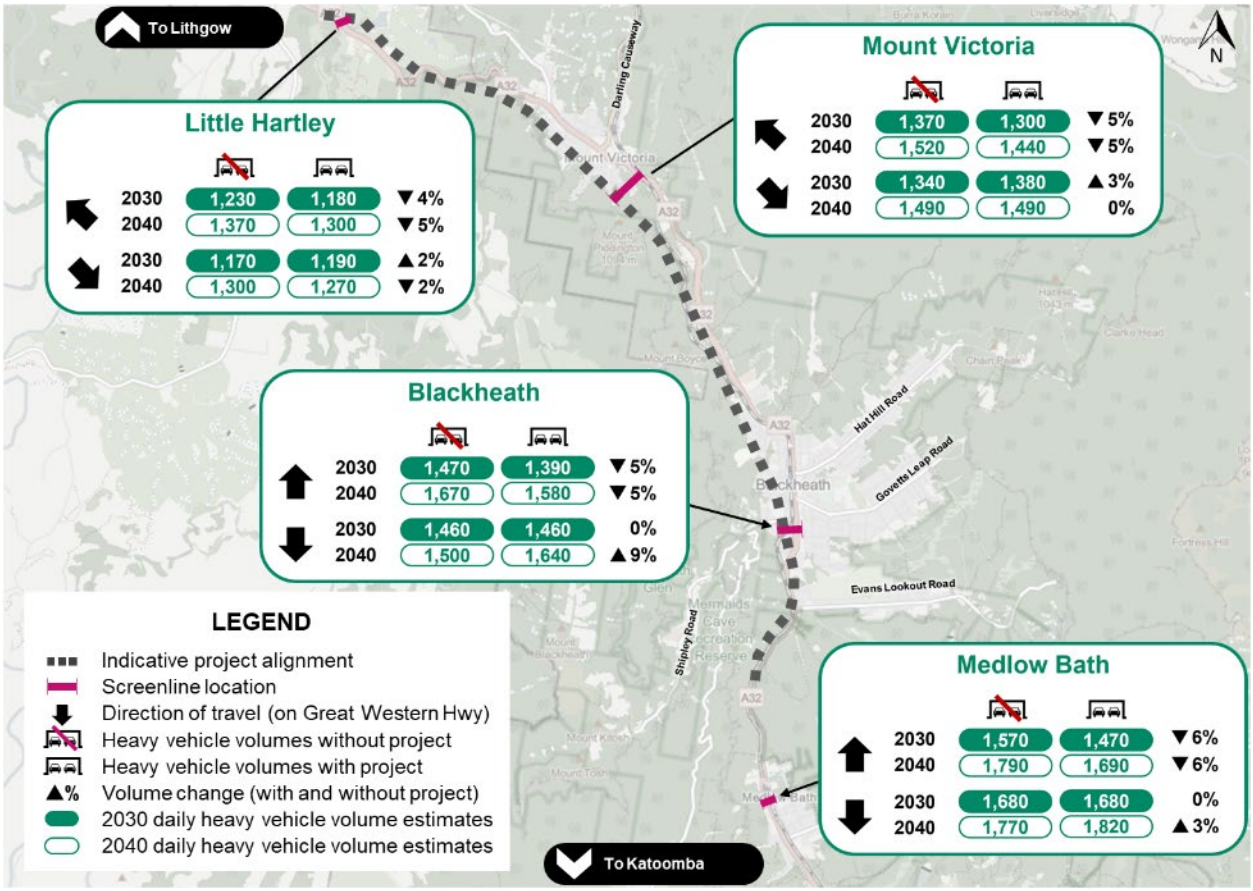


Figure 6-5 Daily heavy vehicle corridor volume estimates for 2030 and 2040 with and without project

6.1.2.2 Existing Great Western Highway weekday traffic volumes

Figure 6-6 compares the forecast 2030 and 2040 heavy vehicle volumes along the existing Great Western Highway alignment with and without the project.

In 2030 and 2040 the existing Great Western Highway alignment through Blackheath would carry approximately 3,000 heavy vehicles per day without the project. With the project, heavy vehicles volumes along the existing Great Western Highway alignment through Blackheath would substantially reduce by approximately 80 per cent to 550 and 700 heavy vehicles per day in 2030 and 2040, respectively.

Heavy vehicle volumes on the existing Great Western Highway alignment through Mount Victoria would be 2,700 and 3,000 vehicles per day without the project in 2030 and 2040 respectively. With the project, these would substantially reduce by nearly 90 per cent to 380 and 400 heavy vehicles per day in 2030 and 2040, respectively.

Approximately 70 per cent of the heavy vehicles that would continue to use the existing Great Western Highway alignment through Blackheath instead of the project would have origins and destinations in Blackheath and Mount Victoria.

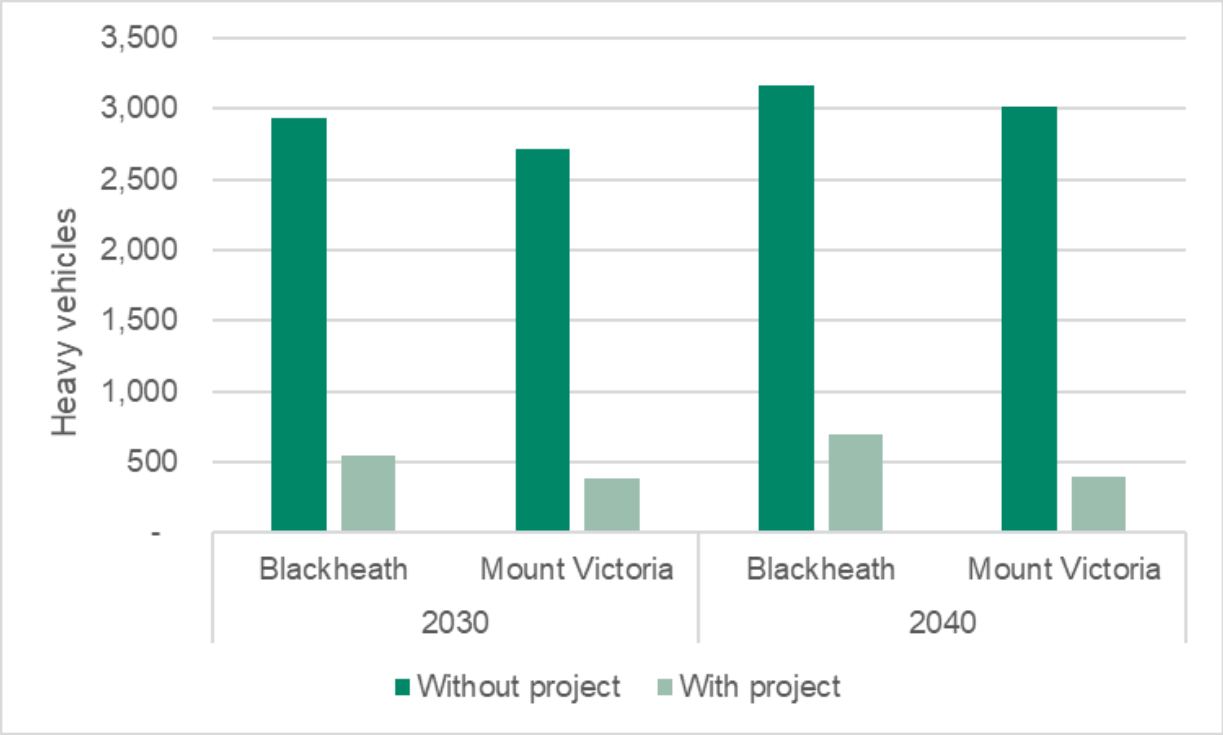


Figure 6-6 Forecast heavy vehicles through Blackheath and Mount Victoria with and without the project in 2030 and 2040

6.1.3 Network performance statistics

Table 6-1 and Table 6-2 compare the forecast network performance statistics for the modelled area during the weekday AM and PM peak hours, with and without the project in 2030 and 2040.

There would be limited congestion through the modelled network on a typical weekday noting that less than 20 unreleased vehicles were identified in all scenarios. However, overall, the modelled network performance statistics would improve with the project in both 2030 and 2040 based on the following findings:

- average vehicle speeds would increase by around 10 to 15 kilometres per hour with the project
- total VHT would decrease by approximately 200 to 300 hours (20-30 per cent) with the project during the AM and PM peak hours
- total number of stops would decrease with the project in both the AM and PM peak hours.

The total hours travelled, and vehicle kilometres travelled would decrease with the project in 2030 and 2040, as a result of the increased vehicle speeds and reduced travel distances with the project.

Table 6-1 Weekday AM peak hour model network performance statistics in 2030 and 2040 with and without the project

Network performance statistic	2018	2030				2040			
		Without project	With project	Difference		Without project	With project	Difference	
All vehicles									
Total traffic demand (vehicles)	4,350	4,913	4,905	8	0%	5,159	5,172	13	0%
Total VKT (kilometres)	47,685	59,454	56,588	2865	5%	61,677	61,639	38	0%
Total VHT (hours)	864	1,104	867	237	21%	1,224	928	296	24%

Network performance statistic	2018	2030				2040			
		Without project	With project	Difference		Without project	With project	Difference	
Total vehicles arrived	4,256	4,877	4,843	34	1%	5,110	5,027	83	2%
Total number of stops	2,922	3,582	3,455	127	4%	4,087	3,775	312	8%
Average per vehicle in network									
Average VKT (kilometres)	11	12	12	0	0%	12	12	0	0%
Average VHT (minutes)	12	14	11	3	21%	14	11	3	21%
Average number of stops	1	1	1	0	0%	1	1	0	0%
Average speed (kilometres per hour)	55	54	65	11	20%	50	66	16	32%
Unreleased vehicles									
Unreleased demand (vehicles)	0	1	0	1	100%	0	1	1	0%

Table 6-2 Weekday PM peak hour model network performance statistics in 2030 and 2040 with and without the project

Network performance statistic	2018	2030				2040			
		Without project	With project	Difference		Without project	With project	Difference	
All vehicles									
Total traffic demand (vehicles)	4,961	5,596	5,569	27	0%	5,784	5,920	136	2%
Total VKT (kilometres)	47,632	66,222	64,043	2179	3%	67,469	73,887	6418	10%
Total VHT (hours)	871	1,224	985	239	20%	1,344	1,135	209	16%
Total vehicles arrived	4,758	5,510	5,427	83	2%	5,704	5,887	183	3%
Total number of stops	3,942	4,861	4,427	434	9%	5,669	5,090	579	10%
Average per vehicle in network									
Average VKT (kilometres)	10	12	12	0	0%	12	13	1	8%
Average VHT (minutes)	11	13	11	2	15%	14	12	2	14%
Average number of stops	1	1	1	0	0%	1	1	0	0%

Network performance statistic	2018	2030				2040			
		Without project	With project	Difference		Without project	With project	Difference	
Average speed (kilometres per hour)	55	54	65	11	20%	50	65	15	30%
Unreleased vehicles									
Unreleased demand (vehicles)	0	13	0	13	100%	14	1	13	93%

6.1.4 Roadway level of service

6.1.4.1 Existing Great Western Highway alignment

The comparison of the estimated mid-block LoS for the 2030 AM and PM peak hours, without and with project scenarios, are summarised in Table 6-3 and Table 6-4 respectively. Similarly, the estimated mid-block LoS for the 2040 AM and PM peak hours, without and with project scenarios, are summarised in Table 6-5 and Table 6-6.

Without the project, both segments are estimated to perform at LoS E in the 2030 and 2040 AM and PM peak hours. With the project, both segments are estimated to perform at an improved LoS D in the 2030 and 2040 AM and PM peak hours when compared to the without project scenario. The minor change in LoS is driven by the current road geometry of these segments including limited overtaking opportunities and sections of steep grade.

For all periods, the average travel speed is estimated to improve by approximately 10 kilometres per hour on average with the project; per cent-time-spent-following would reduce by approximately 25 per cent on average with the project.

Table 6-3 Weekday AM peak hour two-lane highway mid-block level of service - 2030 without and with project scenarios

Location	Direction	Without project			With project		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	57	76%	E	66	52%	D
	Westbound	56	77%	E	66	53%	D
Segment 2	Eastbound	56	72%	E	66	45%	D
	Westbound	56	74%	E	65	53%	D

Table 6-4 Weekday PM peak hour two-lane highway mid-block level of service - 2030 without and with project scenarios

Location	Direction	Without project			With project		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	52	84%	E	65	59%	D
	Westbound	52	84%	E	62	60%	D
Segment 2	Eastbound	54	77%	E	65	46%	D

Location	Direction	Without project			With project		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
	Westbound	53	79%	E	63	53%	D

Table 6-5 Weekday AM peak hour two-lane highway mid-block level of service - 2040 without and with project scenarios

Location	Direction	Without project			With project		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	56	79%	E	66	53%	D
	Westbound	55	79%	E	65	54%	D
Segment 2	Eastbound	56	74%	E	68	40%	D
	Westbound	55	75%	E	65	53%	D

Table 6-6 Weekday PM peak hour two-lane highway mid-block level of service - 2040 without and with project scenarios

Location	Direction	Without project			With project		
		Average travel speed (km/h)	Per cent-time-spent-following	LoS	Average travel speed (km/h)	Per cent-time-spent-following	LoS
Segment 1	Eastbound	53	83%	E	64	60%	D
	Westbound	53	84%	E	64	61%	D
Segment 2	Eastbound	54	76%	E	63	53%	D
	Westbound	53	76%	E	63	49%	D

6.1.4.2 Proposed tunnel and ramps

The mid-block (tunnel) and ramp level of service for the 2030 and 2040 AM and PM peak hours are provided in Table 6-7 and Table 6-8, respectively. Demands were extracted from the OTM and process set out in the Highway Capacity Manual (Transportation Research Board, 2022) was used to estimate the LoS. All elements of the project are estimated to perform at a LoS B or better in 2030 and 2040. This suggests that the project would operate with free flow speeds, minimal congestion and substantial spare capacity during a weekday AM and PM peak hour.

The ramp locations are shown in Figure 1-3 and Figure 1-4.

Table 6-7 Weekday AM peak hour mid-block and ramp level of service – 2030 and 2040 with project scenarios

Location	Direction	Number of traffic lanes	2030		2040	
			Density (PCU/km/ln)	Level of service	Density (PCU/km/ln)	Level of service
Project (tunnel)	Eastbound	2	3.5	A	4.3	A
	Westbound	2	4.0	A	4.9	A
Blackheath exit ramp	Westbound	1	6.2	A	7.3	B

Location	Direction	Number of traffic lanes	2030		2040	
			Density (PCU/km/ln)	Level of service	Density (PCU/km/ln)	Level of service
Blackheath entry ramp	Westbound	1	6.7	B	7.6	B
Blackheath exit ramp	Eastbound	1	4.8	A	5.4	A
Blackheath entry ramp	Eastbound	1	8.5	B	9.4	B
Little Hartley entry ramp	Westbound	1	6.7	B	7.7	B
Little Hartley exit ramp	Eastbound	1	3.6	A	3.0	A

Table 6-8 Weekday PM peak hour mid-block and ramp level of service – 2030 and 2040 with project scenarios

Location	Direction	Number of traffic lanes	2030		2040	
			Density (PCU/km/ln)	Level of service	Density (PCU/km/ln)	Level of service
Project (tunnel)	Eastbound	2	4.3	A	5.0	A
	Westbound	2	3.6	A	4.6	A
Blackheath exit ramp	Westbound	1	5.6	A	6.7	B
Blackheath entry ramp	Westbound	1	6.1	A	7.1	B
Blackheath exit ramp	Eastbound	1	6.2	B	6.9	B
Blackheath entry ramp	Eastbound	1	9.7	B	10.6	B
Little Hartley entry ramp	Westbound	1	6.1	A	7.1	B
Little Hartley exit ramp	Eastbound	1	4.2	A	4.9	A

Adopting expansion factors developed from the available 2018 traffic data, the traffic volumes and roadway and ramp LoS for an average peak day i.e. weekend or public holiday in 2030 and 2040 have been estimated. The project, including its ramps would continue to operate with a LoS B or better on an average weekend or public holiday.

6.1.5 Travel times and average speed

Figure 6-7 shows weekday AM and PM peak hour travel time comparisons with and without the project in 2030 and 2040 for two routes.

The average weekday peak hour travel times between south of Blackheath and Little Hartley would range from 18 to 19 minutes without the project in 2030 and 2040 respectively, reducing by around 45 per cent to 10 minutes with the project. Therefore, the project provides substantial travel time savings for vehicles travelling through the study area.

The average peak hour travel times between Leichhardt Street, Blackheath and Station Street, Mount Victoria via the existing Great Western Highway alignment would range from eight to nine minutes without the project in 2030 and 2040 respectively, reducing to seven minutes with the project. Therefore, as a result of the project, local traffic in Blackheath and Mount Victoria would experience travel time savings of 15 to 20 per cent from the reduced traffic volumes using the existing Great Western Highway alignment.

It is expected that the weekday travel times with the project discussed above would also typically be experienced on weekends and public holidays, given the estimated performance of the tunnel during weekends and public holidays, as discussed in Section 6.1.4.

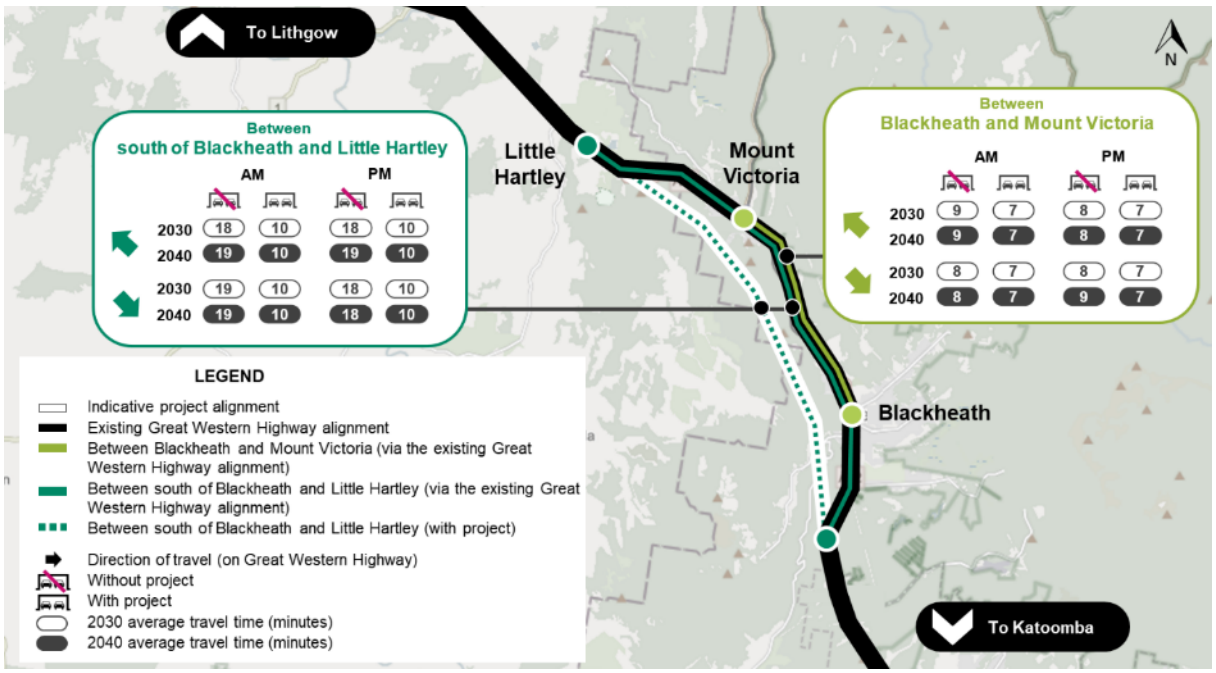
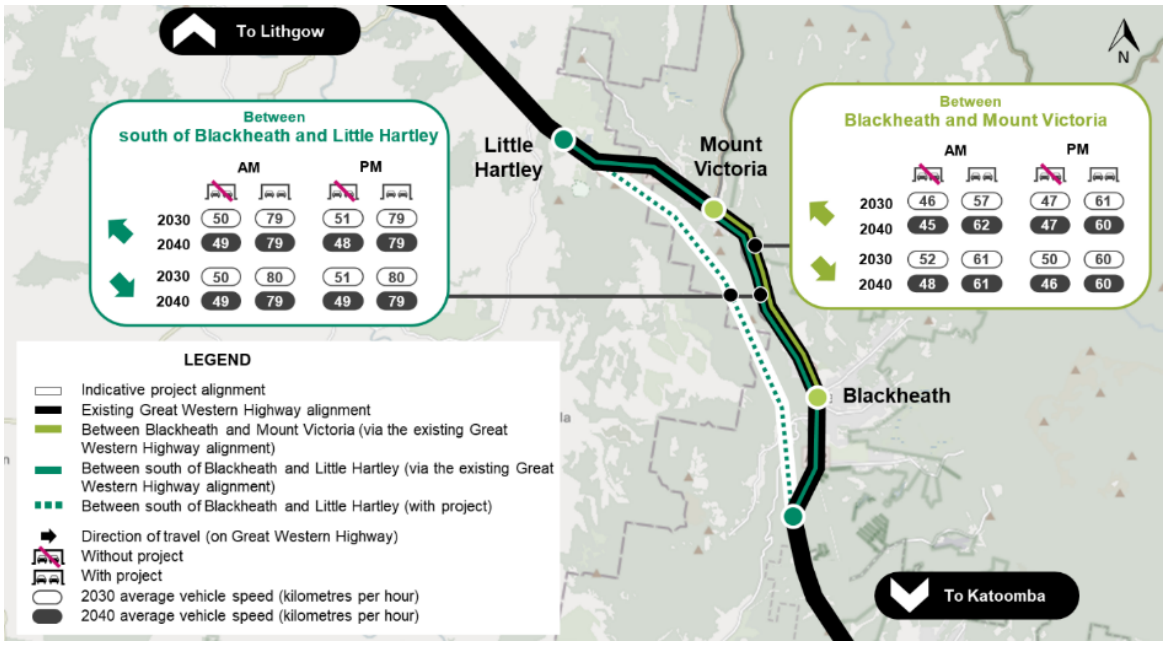


Figure 6-7 Weekday peak hour travel time comparisons in 2030 and 2040

Figure 6-8 shows average vehicle speeds with and without the project in 2030 and 2040 during the weekday AM and PM peak hours. Average vehicle speeds between south of Blackheath and Little Hartley would increase from about 50 kilometres per hour to 80 kilometres per hour (up to 65 per cent) due to the project.

The project would also result in free-flow vehicle speeds of 60 kilometres per hour along the existing Great Western Highway alignment between Blackheath and Mount Victoria. This includes vehicle speed increases from 45 to 52 kilometres per hour in 2030 and 2040 without the project to 57 to 62 kilometres per hour with the project.



Note: The OTM allows vehicle speeds slightly higher than the posted speed limit, which models reality, especially in uncongested, free-flow conditions.

Figure 6-8 Weekday peak hour travel speed comparisons in 2030 and 2040

6.1.6 Intersection performance

The modelled LoS for key intersections within the study area with and without the project are provided in Table 6-9, Table 6-10, Figure 6-9 and Figure 6-10 for the 2030 and 2040 weekday AM and PM peak hours. The following findings are displayed:

- intersection LoS further declines from 2018 levels in 2030 and 2040 without the project due to background traffic growth at the following intersections:
  - Great Western Highway and Evans Lookout Road
  - Great Western Highway and Govetts Leap Road and Bundarra Street
  - Great Western Highway and Hat Hill Road
  - Great Western Highway and Harley Avenue
- intersection LoS substantially improves with the project in 2030 and 2040
- intersections operating at a LoS E or worse without the project improve to operate at a minimum LoS C with the project
- the majority of intersections would operate at LoS A or B with the project in 2030 and 2040 during the AM and PM peak
- the intersection LoS would remain consistent between 2030 and 2040 with the project.

A new unsignalised intersection is proposed at Blackheath (Intersection 11) to the south of Evans Lookout Road. This would operate with a LoS A during the weekday AM and PM peak hours.

A typical cycle time of 120 seconds has been adopted at the Great Western Highway and Station Street intersection during the AM and PM peak hours in the with and without the project scenarios for 2030 and 2040 instead of the longer undesirable cycle times that are currently adopted.

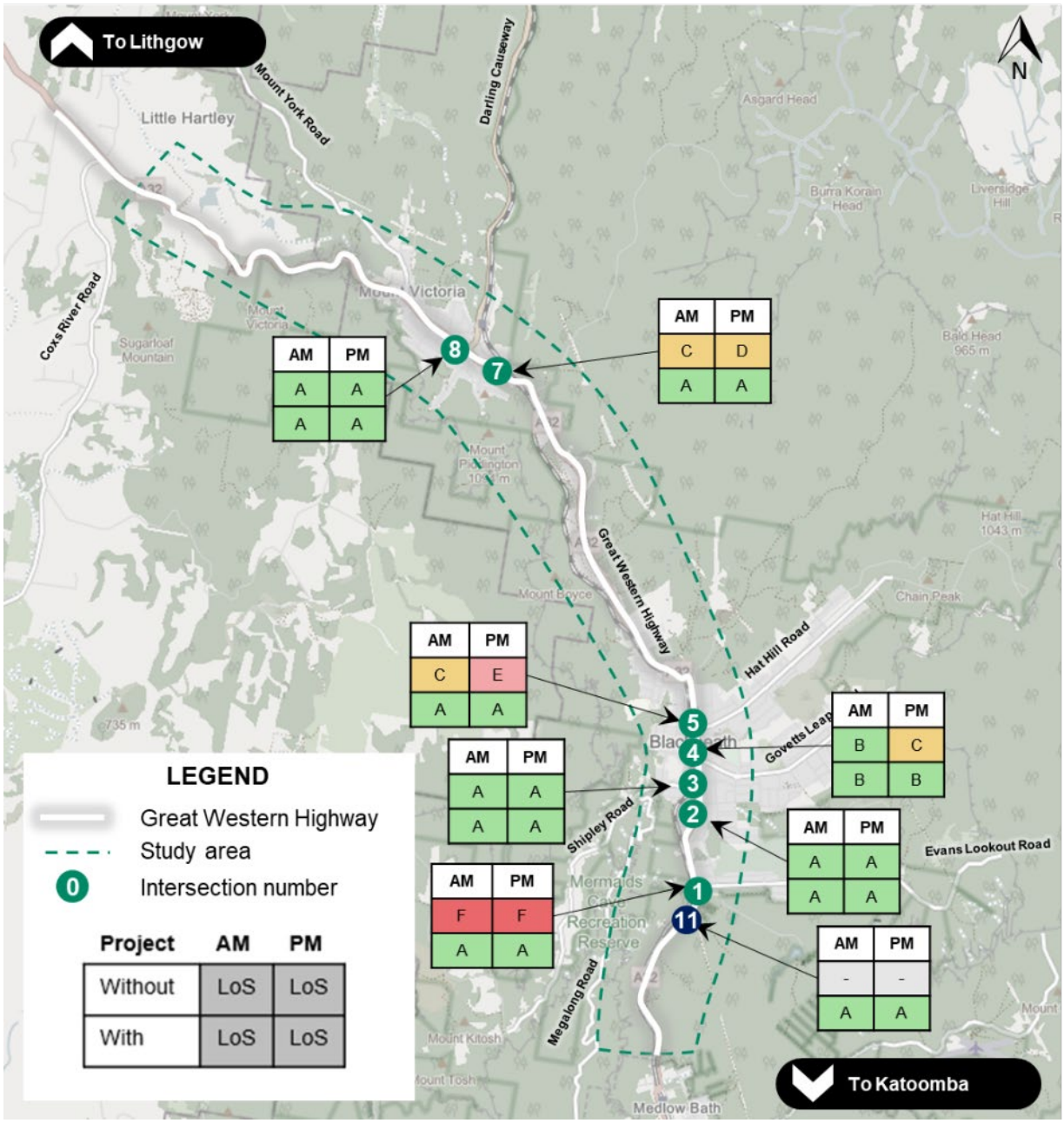


Figure 6-9 AM and PM peak hour intersection performance with and without project – 2030

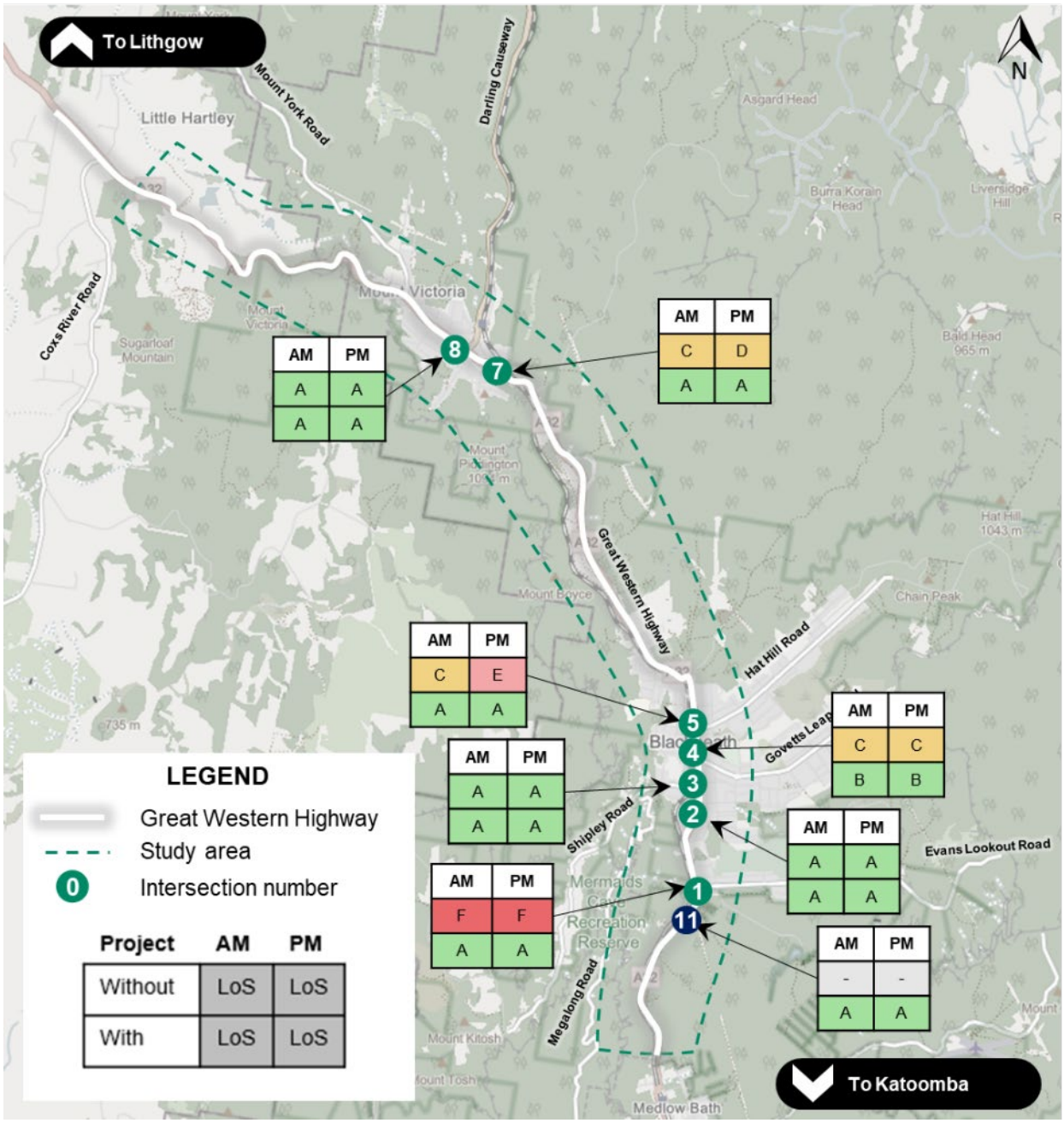


Figure 6-10 AM and PM peak hour intersection performance with and without project – 2040

Table 6-9 Intersection performance during the AM peak with and without the project - 2030 and 2040

ID	Intersection	2030 without project		2030 with project		2040 without project		2040 with project	
		Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
1	Great Western Highway and Evans Lookout Road	80	F	11	A	124	F	11	A
2	Great Western Highway and Prince George Street	8	A	5	A	9	A	5	A
3	Great Western Highway and Leichhardt Street	7	A	4	A	8	A	4	A
4	Great Western Highway, Govetts Leap Road and Bundarra Street [1]	22	B	15	B	29	C	15	B
5	Great Western Highway and Hat Hill Road	32	C	7	A	40	C	8	A
7	Great Western Highway and Harley Avenue	33	C	9	A	36	C	9	A
8	Great Western Highway and Station Street (Darling Causeway)	7	A	8	A	6	A	14	A
11	New intersection in Blackheath	-	-	7	A	-	-	7	A

[1] intersection performance has been extracted from the OTM which considers the impacts of the adjacent level crossing
Note: Intersections 9 and 10 are not included in this assessment as they were assessed for construction impacts only

Table 6-10 Intersection performance during the PM peak with and without the project - 2030 and 2040

ID	Intersection	2030 without project		2030 with project		2040 without project		2040 with project	
		Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
1	Great Western Highway and Evans Lookout Road	517	F	13	A	598	F	14	A
2	Great Western Highway and Prince George Street	14	A	6	A	14	A	7	A
3	Great Western Highway and Leichhardt Street	13	A	7	A	12	A	7	A
4	Great Western Highway, Govetts Leap Road and Bundarra Street	29	C	17	B	36	C	17	B
5	Great Western Highway and Hat Hill Road	68	E	8	A	70	E	8	A
7	Great Western Highway and Harley Avenue	49	D	9	A	49	D	9	A
8	Great Western Highway and Station Street (Darling Causeway)	6	A	6	A	6	A	6	A
11	New intersection in Blackheath	-	-	8	A	-	-	8	A

[1] intersection performance has been extracted from the OTM which considers the impacts of the adjacent level crossing
Note: Intersections 9 and 10 are not included in this assessment as they were assessed for construction impacts only

6.1.7 Heavy vehicle performance

The project would improve heavy vehicle performance by providing a consistent grade of around 1.75 per cent in the tunnel between Blackheath and Little Hartley and up to four per cent along the surface sections at Blackheath and Little Hartley. This is a substantial improvement compared with the existing Great Western Highway alignment which has several segments with steep grades of more than 10 per cent. The maximum grade on the existing Great Western Highway alignment is approximately 13 per cent on Victoria Pass. This is the highest grade on any classified road or freight route in NSW.

The performance of different heavy vehicle types has been assessed using modelled vehicle speed along the proposed grades. Within the OTM, the project has been segmented into 100 metre segments on the approach to the tunnel at Blackheath and Little Hartley and into 200 metre segments within the tunnel, where the tunnel grade is relatively consistent.

Heavy vehicle speed in each segment for each vehicle class has been extracted from the OTM. The vehicle speeds, distance along the project alignment and altitude were plotted for the eastbound and westbound directions. Figure 6-11 shows the modelled vehicle speeds for vehicles travelling eastbound during the weekday AM peak hour in 2040.

The heavy vehicle speeds in the westbound direction would be higher, noting that the proposed tunnel grade has an incline in the eastbound direction and a decline in the westbound direction.

The project would also incorporate high-speed curves rather than the low-speed curves provided on the current alignment, where advisory speed limits are as low as 45 kilometres per hour.

The project would also have a positive impact upon operational freight costs by reducing fuel consumption and the likelihood of breakdowns, as well as creating opportunities for the use of HPV's rather than smaller vehicles.

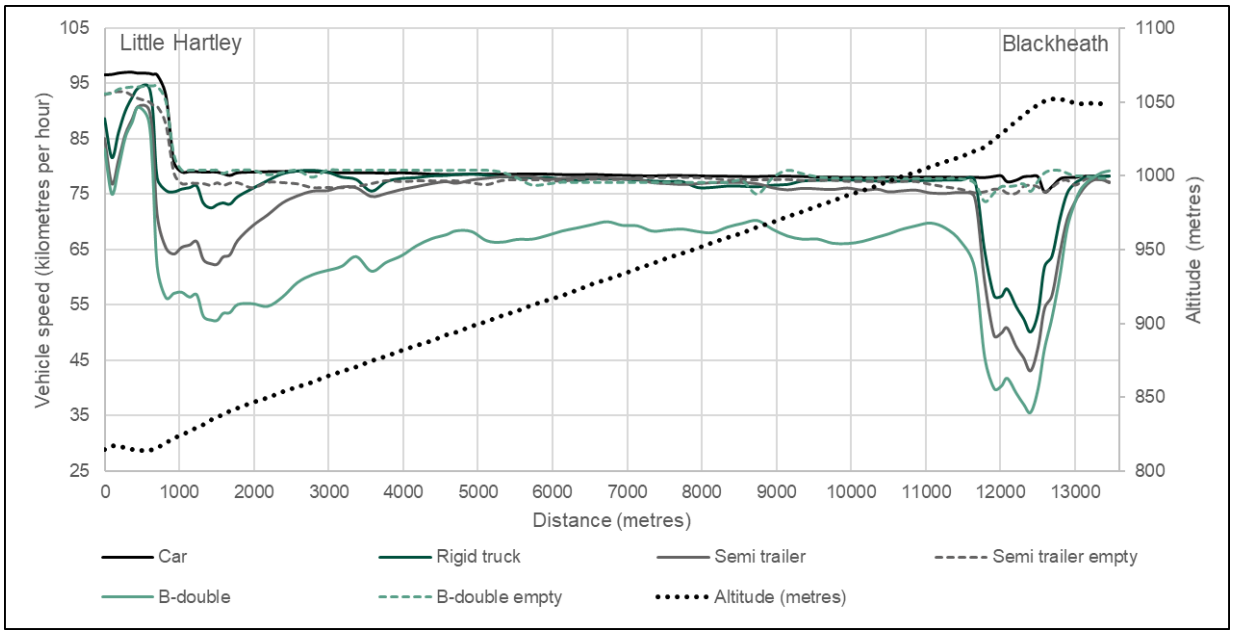


Figure 6-11 – OTM vehicle speeds for eastbound vehicles during the weekday AM peak hour

6.1.8 Road safety

Vehicle trips between Sydney and Blue Mountains and Lithgow and the Central West would benefit from the improved alignment developed to current design standards which include, wider lanes, improved sightlines, reduced grades, separation of opposing traffic flows, and grade separation from other roads (fewer intersections) when compared to the bypassed sections of the existing Great Western Highway.

The project would substantially reduce the traffic volumes using the existing Great Western Highway alignment through Blackheath and Mount Victoria. Less traffic using the existing Great Western Highway alignment would likely proportionally reduce the number of crashes occurring on the existing

Great Western Highway alignment by 70 to 75 per cent. In addition, this would also improve access and safety for pedestrians crossing at intersections or mid-block and cyclists that would use the shoulder of the existing Great Western Highway.

6.2 Public transport

The project includes no specific provision for public transport. However, buses would be permitted to use the tunnels.

As discussed in Section 6.1.5, travel times are shown to decrease on the existing Great Western Highway alignment and for longer trips as a result of the project. Buses would benefit from these travel time savings. The project would also reduce congestion along the existing Great Western Highway which could result in improved travel times for local routes. The extent of benefit would depend on the future bus network routes and services. However, the faster travel times present opportunities for potential bus service changes that could encourage more bus use for local trips.

6.3 Walking and cycling

The project does not include any specific provisions for active transport users, as pedestrians and cyclists would not be permitted to use the tunnel for safety reasons. However, active transport connections to the east and west would be provided as part of the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade.

Notwithstanding this, the reduced traffic volumes on the existing Great Western Highway alignment would reduce delays for pedestrians crossing at intersections, as well as improve the amenity, walkability and safety for pedestrians and cyclists using the existing Great Western Highway alignment. This could encourage more walking and cycling demand along the existing Great Western Highway alignment.

As discussed in Section 4.5.4, existing surveyed cyclist activity was very low. If demands were to double between 2018 and 2030, this would result in more than 400 cyclists using the existing Great Western Highway alignment in Blackheath during the weekday AM and PM peak three-hour period.

Opportunities to provide an improved active transport connection between Blackheath and Little Hartley would be investigated by Transport and the local councils.

6.4 Parking and access

The project is unlikely to have operational impacts to property access and on-street parking. To the west, new access roads would be completed as part of the Little Hartley to Lithgow Upgrade to maintain access around the project.

In addition, on-street parking in the townships would not be affected by the project.

6.5 Movement and place

The Great Western Highway Upgrade Program movement and place assessment identifies the project as an opportunity to reduce the movement function of parts of the existing Great Western Highway alignment enabling placemaking opportunities in Blackheath and Mount Victoria. This is demonstrated through the comparison of existing and with project movement and place classifications for segments within the study area. These classifications are summarised in Table 6-11.

The reduction of traffic volumes along the existing Great Western Highway alignment due to the project presents the following opportunities for amenity and place improvements in the townships:

- reduction in traffic noise
- reduction in traffic emissions and therefore local improvements to air quality
- improved walkability
- improved safety and legibility for cyclists along the shoulder or in mixed traffic conditions.

The assessment noted that as a result of the project, people within the local area are likely to feel more relaxed which could enable improved liveability and amenities of the townships, encouraging people to walk, ride or shop.

Table 6-11 Existing and future movement and place classification

Great Western Highway segment		Existing movement and place classification			Future movement and place classification		
From	To	Movement	Place	Street Type	Movement	Place	Street Type
Evans Lookout Road	Leichhardt Street	5	A	Main Road	4	A	Main Road
Leichhardt Street	Govetts Leap Road	5	C	Main Street	4	C	Main Street
Govetts Leap Road	Hat Hill Road	5	D	Main Street	4	D	Main Street
Hat Hill Road	Hooper Street	5	A	Main Road	4	A	Main Road
Hooper Street	Station Street	5	C	Main Street	4	C	Main Street
Station Street	Selsdon Street	5	B	Main Road	3	B	Local Street
Selsdon Street	Little Hartley	5	A	Main Road	3	A	Local Street

7.0 Assessment of cumulative impacts

Cumulative impacts have the potential to occur when benefits or impacts from a project overlap or interact with those of other projects, potentially resulting in a larger overall effect (positive or negative) on the environment or local communities. Cumulative impacts may occur when projects are constructed or operated concurrently or consecutively. Once the project is operational, other projects which interrelate may enhance the project and create positive cumulative benefits.

Four projects were reviewed against the following screening criteria for this cumulative impact assessment:

- spatially relevant (i.e., the development or activity overlaps with, is adjacent to or within two kilometres of the project)
- timing (i.e., the expected timing of its construction and/or operation overlaps or occurs consecutively to construction and/or operation of the project)
- scale (i.e., large-scale major development or infrastructure projects that have the potential to result in cumulative impacts with the project), as listed on the NSW Government Major Project website and on the relevant council websites)
- status (i.e., projects in development with sufficient publicly available information to inform this environmental impact statement and with an adequate level of detail to assess the potential cumulative impacts).

Projects identified as contributing to potential cumulative impacts have met these criteria and include:

- Katoomba to Blackheath Upgrade (including Medlow Bath Upgrade)
- Little Hartley to Lithgow Upgrade.

Given the regional setting of the project primarily within the Blue Mountains LGA and a small portion within the Lithgow LGA, there are fewer major projects within the locality.

Figure 1-8 shows the interface of the Katoomba to Blackheath Upgrade (including Medlow Bath) and the Little Hartley to Lithgow Upgrade with the project.

Chapter 24 (Cumulative impacts) details the full cumulative impact assessment methodology adopted for the project.

7.1 Construction

As shown in Figure 1-8, the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade are planned to commence in 2024 and be complete in early 2027 and late 2026, respectively. With construction of the project to occur between 2024 and late 2031, the peak construction activity for the project is anticipated to commence in 2026. Therefore, the peak construction activities for each section of the Upgrade Program would be unlikely to occur at the same time.

Table 7-1 presents the estimated cumulative construction related traffic volumes generated by the Upgrade Program along the Great Western Highway. It is estimated that the Upgrade program could result in:

- 2,600 heavy vehicles per day along the Great Western Highway, which is 45 per cent more than the project alone
- 3,315 light vehicles per day along the Great Western Highway, which is 40 per cent more than the project alone.

It is anticipated that vehicles associated with the Medlow Bath and Katoomba to Blackheath Upgrade would mostly travel between the works and the east via the Great Western Highway. Similarly, vehicles associated with the Little Hartley to Lithgow Upgrade would mostly travel between the works and the west via the Great Western Highway. As discussed in Section 5.5, the project's heavy vehicles would mostly travel to and from the west and the project's light vehicles mostly travel to and from the east.

Therefore, it is estimated that the Upgrade Program could result in 40 to 50 per cent more construction related vehicles at any one location, than those assessed in Section 5.7 of this report.

The cumulative impacts resulting from the combined construction traffic generation for the Upgrade Program would likely include localised increased congestion within townships, poor intersection performance in townships, particularly to the east and west of the project's works and reduced travel speeds.

In addition, multiple traffic switches, lane reductions and speed limit reductions would be active across the Upgrade Program. The cumulative impacts of these traffic management measures would likely result in lower travel speeds and longer travel times (in the order of 10 minutes) along the Great Western Highway between Katoomba and Lithgow, particularly at night or off-peak periods when these are most likely to occur.

However, Transport plans to stage the works associated with all sections of the Upgrade Program to minimise these impacts. In particular, it is planned that the Katoomba to Blackheath and Little Hartley to Lithgow Upgrade would have completed all works in the vicinity of the project prior to peak activities associated with the project commencing. In addition, upgraded sections of the Great Western Highway would be opened to traffic sequentially, providing additional mid-block capacity and grade separated or upgraded intersections along the corridor as works are completed.

Table 7-1 Cumulative heavy vehicle traffic volumes [1]

Upgrade Program	Planned construction period	Daily light vehicle movements (in and out vehicles)	Daily heavy vehicle movements (in and out vehicles)	Total vehicle movements (in and out vehicles)
Blackheath to Little Hartley (project)	2024 to 2031	2,355	1,805	4,160
Medlow Bath Upgrade	2022 to 2024	360	200	560
Katoomba to Blackheath Upgrade	2024 to 2027	200	140	340
Little Hartley to Lithgow Upgrade	2024 to 2026	400	450	850
Total		3,315	2,595	5,910

[1] For the purpose of this assessment, vehicle movement refers to each movement that a vehicle makes e.g one vehicle would usually make two movements (in and out) per day

7.2 Operation

Figure 7-1 shows a comparison of average travel times and vehicle speeds with and without the Upgrade Program between Katoomba and Lithgow. Following the completion of the Upgrade Program, average travel times on the 40 kilometre section of Great Western Highway between Katoomba and Lithgow would reduce by up to 13 minutes in 2030 and 15 minutes in 2040. The total trip would take less than 30 minutes.

Following the completion of the Upgrade Program, average vehicle speeds on the 40 kilometre section of Great Western Highway between Katoomba and Lithgow would increase from an average of 57 kilometres per hour to 77 kilometres per hour in 2030 and from an average of 54 kilometres per hour to 76 kilometres per hour in 2040.

Therefore, the cumulative impacts of the project and the adjacent Upgrade Program components would be substantial travel time reductions and increased vehicle speeds for vehicles travelling through the Blue Mountains.

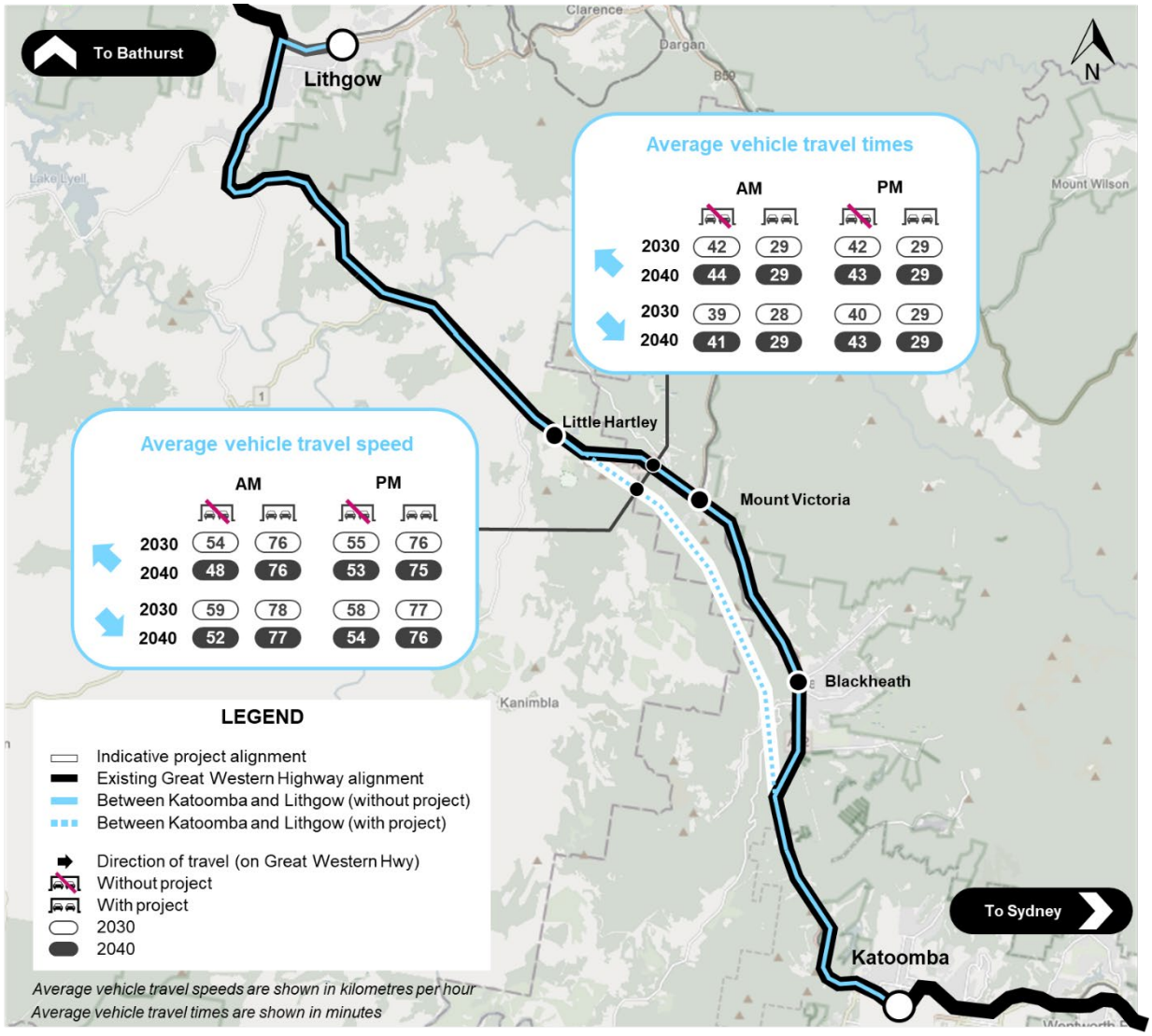


Figure 7-1 Weekday peak hour travel time comparison between Katoomba and Lithgow in 2030 and 2040

Table 7-2 and Table 7-3 present heavy vehicle travel times and speeds between Katoomba and Lithgow in 2030 and 2040 with and without the project for the AM and PM peak hours. The travel times demonstrate that the Upgrade Program would result in a 10 to 15 minute (20 to 35 per cent) travel time saving for heavy vehicles travelling between Katoomba and Lithgow during the weekday AM and PM peak hours.

The vehicle speeds demonstrate that the Upgrade Program would result in faster heavy vehicle speeds including 15 to 20 kilometres per hour (30-40 per cent) in the eastbound direction and 12 to 16 kilometres per hour (25-30 per cent) in the westbound direction.

These faster travel speeds and travel time savings would provide substantial benefits for regional freight.

Table 7-2 Heavy vehicle travel times between Katoomba and Lithgow in 2030 and 2040

Heavy vehicle type	Year	Heavy vehicle travel times (minutes) between Katoomba and Lithgow															
		Eastbound								Westbound							
		AM peak				PM peak				AM peak				PM peak			
		Without project	With project	Difference		Without project	With project	Difference		Without project	With project	Difference		Without project	With project	Difference	
Truck	2030	44	31	13	30%	44	31	13	30%	44	33	11	25%	43	33	10	23%
	2040	45	31	14	31%	46	31	15	33%	45	33	12	27%	44	33	11	25%
Semi-trailer	2030	46	32	14	30%	46	32	14	30%	45	34	11	24%	45	35	10	22%
	2040	47	33	14	30%	47	32	15	32%	46	35	11	24%	46	35	11	24%
B-double	2030	50	35	15	30%	51	-	-	-	51	39	12	24%	-	-	-	-
	2040	50	36	14	28%	51	36	15	29%	51	39	12	24%	-	38	-	-

Note: Where values are not provided, travel times could not be calculated as the OTM did not have any vehicles completing this trip during the respective hour.

Without project With project

Table 7-3 Heavy vehicle travel speeds between Katoomba and Lithgow in 2030 and 2040

Heavy vehicle type	Year	Heavy vehicle travel speeds (kilometres per hour) between Katoomba and Lithgow															
		Eastbound								Westbound							
		AM peak				PM peak				AM peak				PM peak			
		Without project	With project	Difference		Without project	With project	Difference		Without project	With project	Difference		Without project	With project	Difference	
Truck	2030	52	71	19	37%	52	71	19	37%	53	67	14	26%	53	68	15	28%
	2040	51	71	20	39%	50	70	20	40%	51	67	16	31%	52	66	14	27%
Semi-trailer	2030	50	69	19	38%	50	68	18	36%	51	64	13	25%	51	64	13	25%
	2040	49	67	18	37%	49	68	19	39%	50	64	14	28%	50	63	13	26%
B-double	2030	46	63	17	37%	46	-	-	-	45	56	11	24%	-	-	-	-
	2040	46	61	15	33%	45	61	16	36%	45	57	12	27%	-	57	-	-

Note: Where values are not provided, travel times could not be calculated as the OTM did not have any vehicles completing this trip during the respective hour.

Without project With project

8.0 Management of impacts

8.1 Performance outcomes

Performance outcomes have been developed that are consistent with the SEARs for the project. The performance outcomes for the project are summarised below in Table 8-1 and identify measurable, performance-based standards for environmental management.

Table 8-1 Performance outcomes for the project – transport and traffic

SEARs desired performance outcome	Project performance outcome	Timing
Network connectivity, safety and efficiency of the transport system in the vicinity of the project are managed to minimise impacts.	Avoid or minimise adverse impacts to the performance of the existing road network, including with respect to level of service, travel times and road safety.	Construction and operation
The safety of transport system customers is maintained.		
Impacts on network capacity and the level of service are effectively managed.		
Works are compatible with existing infrastructure and future transport corridors.	Coordinate and deliver the project as part of the integrated package of works comprising the Upgrade Program	Construction and operation

8.2 Management of construction impacts

A construction environmental management plan (CEMP) would be prepared for the project. The CEMP would detail the proposed approach to environmental management, monitoring and reporting during construction. A number of sub-plans (and other supporting documentation, as required) would also be prepared as part of the CEMP.

A community and stakeholder engagement plan (Engagement Plan) has been prepared for the Upgrade Program and would be used to guide community and stakeholder engagement activities during construction of the project. Engagement during construction would include updates on planned construction activities and would respond to concerns and enquiries in a timely manner, seeking to minimise potential impacts where possible.

Construction mitigation measures to manage potential transport and traffic impacts of the project are outlined in Table 8-2.

As discussed in Table 8-2, a CTAMP would be prepared as part of the CEMP for the whole project. The CTAMP will be developed with the main purpose of mitigating impacts of the project and will be prepared by construction contractor. The CTAMP will consider the following:

- measures to minimise the worker shift arrivals and departures on the surrounding transport network including:
  - staggered construction worker shifts
  - shuttle bus transfers between construction footprints and local hubs to minimise the use of individuals traveling by car to the construction footprints.
  - encouraging the use of alternative transport modes and carpooling for workers

- transport and traffic management measures including traffic control plans, developed in accordance with relevant safety standards to maintain and manage a safe transport network around and adjacent to the construction footprints
- on-site parking provisions and measures to minimise impacts to existing on-street parking near construction footprints, particularly in Blackheath
- measures to minimise changes to the existing road network including property accesses, bus stops and active transport facilities
- measures to communicate and notify the community and stakeholders of any changes to the existing road and transport network
- monitoring of road surface conditions and updating surfaces to address impacts during construction.

Table 8-2 Construction mitigation and management measures – transport and traffic

ID	Measure	Timing
TT01	A Construction Transport and Access Management Plan (CTAMP) will be prepared as part of the Construction Environmental Management Plan (CEMP) in consultation with the relevant local councils and emergency services. The CTAMP will include: • measures to minimise and manage construction traffic and road safety impacts on other road users, including pedestrians, cyclists and buses • planning to minimise the movement of construction heavy vehicles during the AM and PM peak hours, weekend peak hours and on peak weekends (such as the Bathurst Super Car event) and public holidays, where practicable • access management measures, including safety measures, for active transport interfaces with construction areas and construction sites • measures to provide safe and adequate access to residential premises and businesses during construction, particularly where construction activities affect existing property access arrangements • details of the types of temporary traffic management measures that would be required during construction, such as posted speed limit reductions, detours and full or partial road closures, and how these measures would be managed to minimise impacts on other road users • measures to periodically update local emergency services on the staging and progress of construction works, and to maintain safe adequate access for emergency services during the construction period • a framework for coordinating construction planning and traffic management with adjacent Great Western Highway upgrade projects to minimise potential cumulative construction traffic impacts.	Construction
TT02	Sufficient car parking spaces will be provided within the project construction sites to accommodate anticipated construction worker parking requirements. During detailed construction planning, opportunities to provide a shuttle bus or other initiatives to transfer construction workers from local hubs to construction sites will be investigated.	Design and construction
TT03	Opportunities to minimise the impacts of construction traffic on the level of service at the Great Western Highway/ Evans Lookout Road intersection and the Great Western Highway/ Browntown Oval intersection will be investigated during detailed construction planning.	Design and construction

8.3 Management of operational impacts

Operational mitigation measures to manage potential transport and traffic impacts of the project are outlined in Table 8-3.

Table 8-3 Operational mitigation and management measures – transport and traffic

ID	Issue	Measure	Timing
TT04	Operational performance	The operational traffic performance of the project will be reviewed 12 months after commencement of operation. The review will aim to confirm the predicted positive effects of the project on the road network and, if relevant, identify adverse operational traffic impacts on road network performance. In the event that adverse operational traffic impacts on the road network are identified, opportunities to mitigate these impacts will be considered for implementation.	Operation

8.4 Management of cumulative impacts

Transport will coordinate the staging and timing of planned projects in the vicinity of the project to minimise and manage any cumulative transport and traffic impacts.

9.0 Conclusion

The assessment of operational and construction transport and traffic impacts of the project were evaluated using traffic demand data from the Transport's Regional Travel Model (RTM) and the Upgrade Program's freight demand study which were then incorporated into the Upgrade Program's weekday operational traffic model (OTM). SIDRA Intersection modelling was also used to assess the performance of key intersections.

Construction impact assessment

Key outcomes of the construction impact assessment include:

- across all construction footprints, the construction works could conservatively generate up to 4,160 vehicle movements per day including 1,805 heavy vehicles movements (includes vehicles travelling in and out of the sites), assuming that the peak activity at each construction footprint would occur at the same time
- the additional construction traffic volumes would result in a minor increase to weekday peak hour travel times Katoomba and Lithgow of about one to two minutes for both directions. Similarly, average vehicle speeds would reduce by about one to two kilometres per hour
- seven of the eight existing intersections (excluding Great Western Highway and Browntown Oval access intersection) would operate with similar delays and LoS during the weekday AM and PM peak hours in 2026 with and without construction
- the project's construction would substantially increase delays for vehicles turning right out of Evans Lookout Road at the Great Western Highway in Blackheath during the weekday AM and PM peak hours and vehicles turning right from Soldiers Pinch construction site access would also experience similar delays during the same periods
- the peak construction related traffic would occur during shift changeover, which is assumed to occur outside the weekday peak hours at 6-7am and 5-7pm (including on weekends). Considering the existing and 2026 traffic volumes along the Great Western Highway at these times, the construction traffic volumes are most likely to affect the Great Western Highway performance during the weekday AM period of 6am and weekend PM period of 5-7pm
- measures to minimise the construction traffic volumes during these hours would be further investigated as part of the contractor's CTAMP, including:
    - stagger shift times to minimise the hourly traffic generation
    - encourage the use of alternative transport modes and carpooling for workers
    - provide shuttle bus transfers between construction footprints and local hubs to minimise the use of individuals traveling by car to the construction footprints
    - minimising heavy vehicle and spoil truck movements during weekend peak periods
- the cumulative impacts resulting from the Upgrade Program would likely include localised increased congestion within townships, poor intersection performance in townships, particularly to the east and west of the works and reduced travel speeds along the existing Great Western Highway
- Transport plans to stage the works associated with all sections of the Upgrade Program to minimise impacts. In particular, it is planned that the Katoomba to Blackheath and Little Hartley to Lithgow Upgrade would have completed all works in the vicinity of the project prior to peak activities associated with the project commencing. In addition, upgraded sections of the Great Western Highway would be opened to traffic sequentially, providing additional mid-block capacity and grade separated or upgraded intersections along the corridor as works are completed.

Operational impact assessment

Key outcomes of the construction impact assessment include:

- in 2030 and 2040, traffic volumes along the Great Western Highway within the study area are forecast to increase to around 20,000 and 21,000 vehicles on a typical weekday without the project
- with the project, traffic volumes along the existing Great Western Highway alignment through Blackheath would reduce to 7,300 and 8,300 vehicles per day in 2030 and 2040, respectively
- similarly, traffic volumes on the existing Great Western Highway alignment through Mount Victoria would substantially reduce to 3,300 and 3,700 vehicles per day in 2030 and 2040, respectively
- with the project, heavy vehicles would comprise around 10 per cent of the total trips travelling through the Blackheath and Mount Victoria townships each day. Most of these heavy vehicles would have origins and destinations within the townships
- reduced traffic volumes along the existing Great Western Highway alignment would offer the following benefits for transport customers that would continue to use this corridor:
    - improved mid-block LoS, substantially improved intersection performance, increased travel speeds and travel time savings for all vehicles including buses
    - reduced number of crashes occurring on the existing Great Western Highway alignment by 70 to 75 per cent
    - improved access and safety for pedestrians crossing at intersections or mid-block and cyclists that would use the shoulder of the existing Great Western Highway to cycle, which could encourage more walking and cycling demand along the existing Great Western Highway alignment
- vehicle trips between Sydney and Blue Mountains and Lithgow and the Central West via the tunnel would benefit from the improved alignment developed to current design standards which include, wider lanes, improved sightlines, reduced grades, separation of opposing traffic flows, and grade separation from other roads (fewer intersections) when compared to the bypassed sections of the existing Great Western Highway
- the project would result in travel time savings of eight to nine minutes through the study area (between south of Blackheath and Little Hartley) during the weekday AM and PM peak hours in 2030 and 2040. It is also expected that these weekday travel times with the project would also typically be experienced on weekends and public holidays, given that the tunnel is anticipated to operate with substantial spare capacity and a LoS A or B
- following the completion of the Upgrade Program, average travel times on the 40 kilometre section of the Great Western Highway between Katoomba and Lithgow would reduce by up to 13 minutes in 2030 and 15 minutes in 2040 and the total trip via the upgraded Great Western Highway would take less than 30 minutes during a typical weekday peak hour
- following the completion of the Upgrade Program, heavy vehicle travel times between Katoomba and Lithgow would reduce by up to 10 to 15 minutes in 2030 and 2040, with travel times ranging between 31 minutes for a rigid truck and 39 minutes for a B-double in 2040. These travel time savings would provide substantial benefits for regional freight.

10.0 References

Australian Infrastructure Plan (Australian Government, 2021)

Automatic Vehicle Classification by Vehicle Length (AustRoads, 2006)

Central West and Orana Regional Plan 2036 (Department of Planning and Environment, 2022)

Central West and Orana Transport Plans (Transport, 2018)

Central West Transport Needs Study (Australian Government, 2009)

Cycling Aspects of Austroads Guides (Austroads, 2014)

Greater Sydney Services and Infrastructure Plan (Transport, 2008)

Guide to Traffic Generating Developments Version 2.2 (NSW Roads and Traffic Authority, 2002)

Guide to Traffic Management–Part 3 Traffic Studies and Analysis (Austroads, 2020)

Highway Capacity Manual (Transportation Research Board, 2022).

Infrastructure Priority List (Australian Government, 2021)

Integrated Transport Strategic Plan (Blue Mountains City Council, 2018)

Lithgow Active Transport Plan (Lithgow City Council, 2020)

Local Strategic Planning Statement (Blue Mountains City Council, 2020)

Local Strategic Planning Statement (Lithgow City Council, 2020)

NSW Bicycle Guidelines v1.2 (NSW Roads and Traffic Authority, 2005)

NSW Freight and Ports Plan 2018-2023 (Transport, 2018)

NSW Heavy Vehicle Access Policy (Transport, 2018)

NSW Sustainable Design Guidelines Version 3.0 (Transport, 2013)

Planning Guidelines for Walking and Cycling (DIPNR, 2004)

Policy and Guidelines for Overtaking Lanes (Mainroads Western Australia, 2011)

Practitioner’s Guide to Movement and Place (NSW Government Architect, 2020)

Principles and Guidelines for Economic Appraisal of Transport Investment, (Transport, 2016)

Regional NSW Services and Infrastructure Plan (Transport, 2018)

Road Safety Plan 2021 (Transport, 2018)

Traffic Modelling Guidelines (Transport, 2013)

Western City District Plan (Greater Sydney Commission, 2020)

Annexure A

Hourly traffic volume comparison for 2018 and 2021

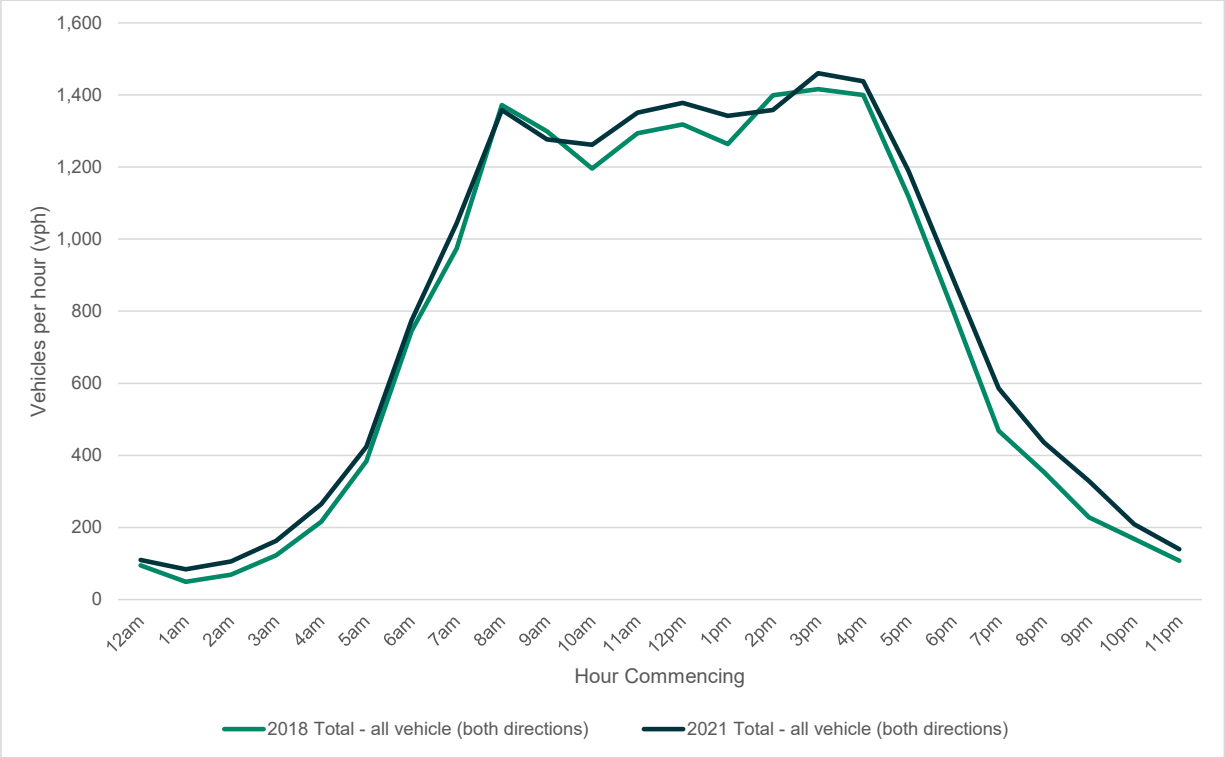


Figure A-1 Great Western Highway hourly flows near Station Street, Medlow Bath

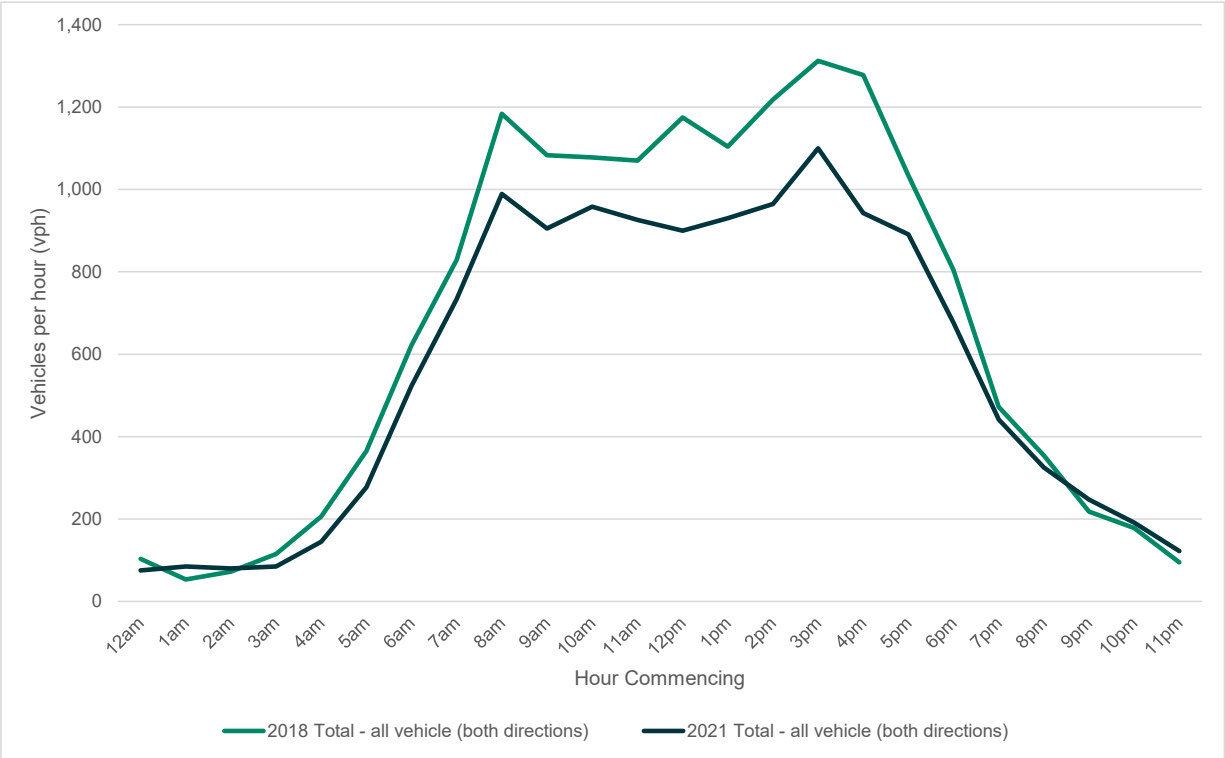


Figure A-2 Great Western Highway hourly flows near Browntown Oval Access

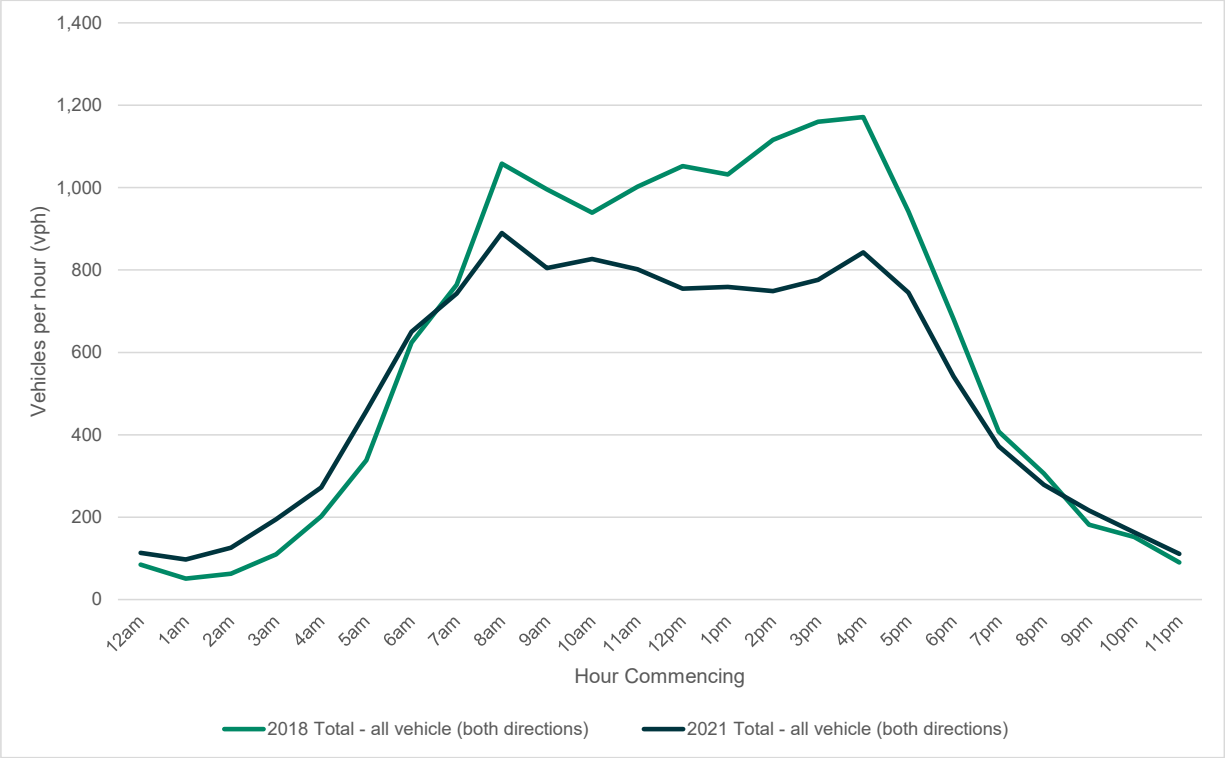


Figure A-3 Great Western Highway hourly flows near Mount York Road, Mount York

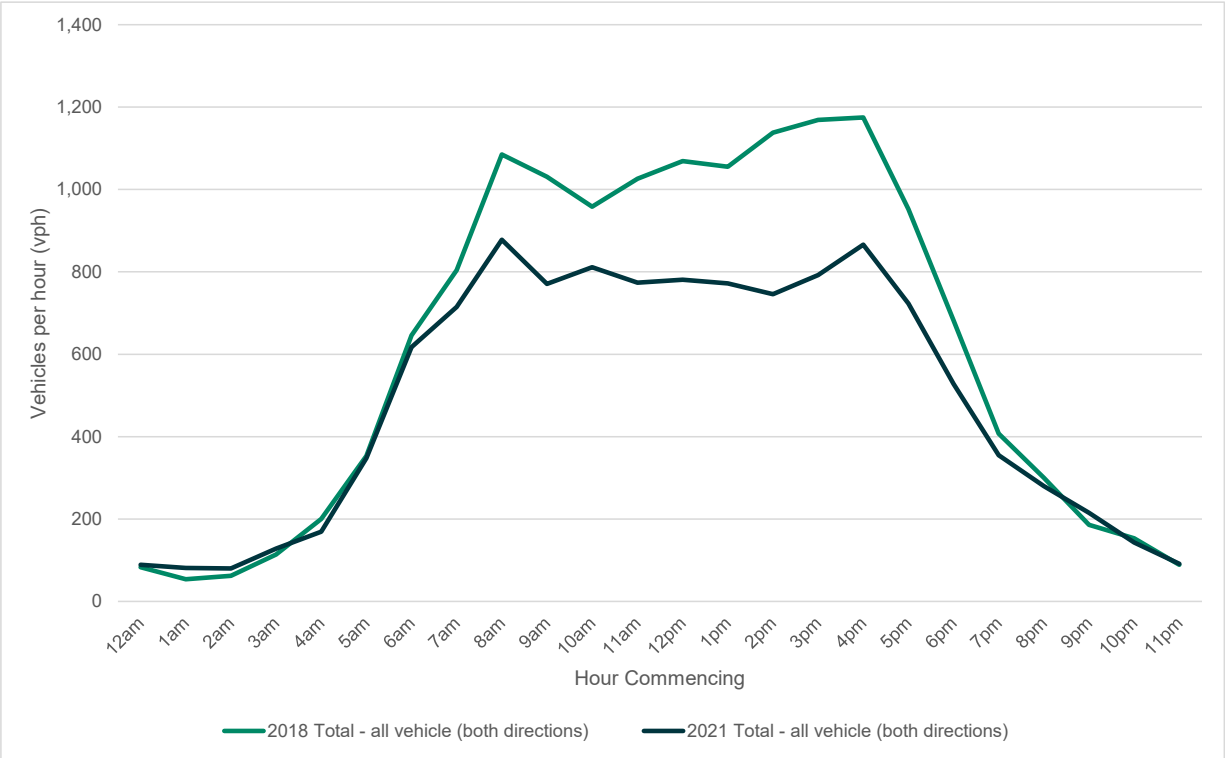


Figure A-4 Great Western Highway hourly flows near Coxs River, Little Hartley