2. Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

The proposal form part of the broader upgrade of the Great Western Highway between Katoomba and Lithgow. The proposal, as part of the broader upgrade is needed to provide a safer and more efficient link between Central West NSW and the Sydney Motorway network.

The Great Western Highway (route A22) is a 201-kilometre-long state highway in NSW connecting Bathurst with Sydney. It is the primary road network link connecting the Central West NSW to Sydney for freight, tourist and general traffic. It also serves an important access function to the local communities along the highway. The Great Western Highway has been upgraded to dual carriageway standard from the Sydney motorway network to the northern outskirts of Katoomba. Transport for NSW are now investigating upgrading the Great Western Highway between Katoomba and Lithgow, being the Great Western Highway Upgrade Program.

The highway's topography and existing two lane carriageway design results in the following constraints:

- reduces freight efficiency by limiting access for safer and more sustainable high productivity vehicles
- limits access during incidents and natural disasters
- slows travel speeds with limited overtaking opportunities and steep gradients (more than double the recommended maximum level)
- causes delays of up to 80 minutes in peak times and hours if there is an incident
- has higher than state average crash rates, and
- impairs amenity for local communities with high through traffic volumes and congestion.

The Katoomba to Blackheath section of the Great Western Highway is an important local transport link, connecting the Medlow Bath community with Katoomba and Blackheath communities and further afield. It connects local communities to jobs, health care, education and other services both within townships and in neighbouring regional cities and strategic centres. The Great Western Highway also provides access from within the proposal study area to the Greater Sydney region and accommodates travel for visitors and tourists to the region. The highway also facilities the movement of freight both inbound for local consumption and outbound to Sydney, interstate and to the international port terminals.

2.1.1 Strategic planning and policy documents

The proposal has been reviewed against, and is found to be consistent with, relevant strategic plans as summarised in the following sections.

NSW Premier's and State priorities

The New South Wales Government has committed to achieve 12 Premier's priorities and 18 state priorities to grow the economy, deliver infrastructure, protect the vulnerable, and improve health, education and public services across NSW.

The proposal supports and is relevant to the following Premier's priority:

- Building infrastructure - Key infrastructure projects to be delivered on time and on budget across NSW.

The proposal supports and is relevant to the following state priorities:

- Improving road travel reliability - 90 per cent of peak travel on key road routes is on time
- A safe transport system for every customer with the aim for zero deaths or serious injuries on the network by 2056.

The *Premier's Priorities* (NSW Government, 2021) recognises that key infrastructure projects immensely benefit the local economy through sustainable urban connections and land use planning. The proposal would increase capacity that would reduce travel time and improve road safety by improving traffic flow between Katoomba and Blackheath. Together with other safety upgrades in the Great Western Highway corridor, the proposal would provide the same benefits to the highway between Katoomba and Lithgow. Therefore, the proposal supporting the relevant Premier's and state priorities.

Future Transport Strategy 2056

The *NSW Future Transport Strategy 2056* (Transport, 2018b) outlines a clear framework to address transport challenges in NSW over the next 40 years. It integrates planning for roads, freight and all other modes of transport and sets out initiatives, solutions and actions to meet NSW transport challenges. Transport is identified as an enabler of economic and social activity and contributes to long term economic, social and environmental outcomes.

Future Transport 2056 outlines six state-wide outcomes to guide investment, policy and reform and service provision. They provide a framework for planning and investment aimed at harnessing rapid change and innovation to support a modern, innovative transport network.

The proposal directly aligns with the following state-wide outcomes:

- A strong economy – The transport system powers NSW's future $1.3 trillion economy and enables economic activity across the state. The proposal supports this outcome enabling growth in economic activity, including the movement of freight
- Safety and performance – Every customer enjoys safe travel across a high performing, efficient network. The proposal supports this outcome through the separation of carriageways and the implementation of contemporary design standards.

By upgrading the highway to current design standards, the proposal would support the following regional NSW transport customer outcomes:

- supporting centres with appropriate transport services and infrastructure. The proposal would support the access between Sydney and the Central West of NSW, including the various towns and urban centres along the alignment.
- the appropriate movement and place balance is established enabling people and goods to move efficiently through the network whilst ensuring local access and vibrant places. The proposal would provide an opportunity, through options selection and the design development process, to balance the movement function of the Great Western Highway with the place functions of the various towns and urban centres along the alignment.
- economic development is enabled by regional transport services and infrastructure.
- a safe transport system for every customer with the aim for zero deaths or serious injuries on the network by 2056. The proposal would improve safety via the separation of carriageways and the implementation of contemporary design standards.
- customers enjoy improved connectivity, integrated services and better use of capacity.

Future Transport Strategy 2056 identifies future directions for road customers including the provision of better road connections, an expanded network of bus lanes, and safer roads, particularly during extreme weather events. The proposal would meet these directions by improving road capacity, reinstating bus

stops on the highway at Bonnie Doon Reserve, Explorers Road and Foy Avenue and reinstatement of parts of the active transport paths or creation of new active transport trails.

Infrastructure Priority List (Australian Infrastructure Plan)

The *Infrastructure Priority List* (Infrastructure Australia, 2021) sets out the investment opportunities that can deliver nationally significant benefits to Australia. It directs Australia's governments to the projects and initiatives that will deliver world-class infrastructure services to all Australians across the energy, telecommunications, water, waste, social and transport sectors. Great Western Highway improvements: Katoomba to Lithgow is identified in both the 2020 and 2021 Infrastructure Priority Lists.

Great Western Highway improvements: Katoomba to Lithgow is categorised as national connectivity project with the problem timeframe being in the 'near term' (0-5 years). Delivery of the proposal is therefore of national significance.

State Infrastructure Strategy 2018 – 2038: Building Momentum

The *State Infrastructure Strategy* (Infrastructure NSW, 2018) is a 20-year investment plan prepared by Infrastructure NSW. The State Infrastructure Strategy assesses infrastructure problems and solutions and provides recommendations to grow the state economy, enhance productivity and improve living standards.

The strategic objective in the *State Infrastructure Strategy* relating to transport is to ensure the transport system creates opportunities for people and businesses to access the services and support they need. As Greater Sydney will need to cater for an additional 1.7 million people, this strategy acknowledges that a comprehensive review of the existing transport infrastructure is needed, including reference to the need to modernise the city's motorways, and upgrade strategically important corridors to ensure efficient movement of freight.

The proposal would assist in addressing the following key challenges and opportunities identified in this strategy document:

- addressing capacity constraints
- improving productivity
- shaping our regions and cities
- improving road safety
- embracing technological changes
- resilience and climate change
- leveraging health benefits.

Regional NSW Services and Infrastructure Plan

The *Regional NSW Services and Infrastructure Plan* (Transport, 2018c) is the NSW Government's blueprint for transport in regional NSW from now until 2056. It sets out the big trends, issues, services and infrastructure needs which are now, or will soon shape transport in regional NSW.

The vision for regional NSW is a safe, efficient and reliable network of transport services and infrastructure. This is in recognition of the vital role of regional cities as hubs for services, employment and social interaction for their surrounding communities.

The regional customer outcomes in the *Regional NSW Services and Infrastructure Plan* are the same as those in *NSW Future Transport Strategy 2056*, as discussed above.

The plan includes the following future projects that are directly relevant to the proposal:

- 0 to 10 years for investigation – Great Dividing Range long term solution study
- 0 to 10 years for investigation – Great Dividing Range long term solution corridor preservation
- 20 years plus initiative – Delivery of Great Dividing Range long term solution – Delivery of solution to improve freight connectivity across the Great Dividing Range in order to connect inland areas to Sydney/Wollongong/Newcastle.

Tourism and Transport Plan

The *Tourism and Transport Plan* (Transport, 2018e) is a companion document to the *NSW Future Transport Strategy 2056* (Transport, 2018b) that recognises the connection between transport and tourism and identifies the potential to support and enhance existing tourism as well as create new economic development opportunities.

The plan includes the following four customer outcomes:

- Customer Outcome 1: Enhancing the visitor experience
- Customer Outcome 2: Greater access to more of NSW
- Customer Outcome 3: Making transport the attraction
- Customer Outcome 4: A seamless experience.

By improving transport infrastructure on the main route to the Central West region, the proposal aligns with Customer Outcome 2. There may also be opportunities to contribute to Customer Outcomes 1 and 3 as the design process continues, particularly through the interpretation of heritage values along the proposal.

NSW Design Policy (Better Placed)

The *NSW Design Policy (Better Placed)* (Government Architect NSW, 2017) informs seven design objectives for the New South Wales built environment:

- Better fit: contextual, local and of its place
- Better performance: sustainable, adaptable and durable
- Better for community: inclusive, connected and diverse
- Better for people: safe, comfortable and liveable
- Better working: functional, efficient and fit for purpose
- Better value: creating and adding value
- Better look and feel: engaging, inviting and attractive

These are all relevant considerations for the proposal. The proposal will modify the built environment and has considered the importance of design quality on the function, integration and contribution of places and spaces to users, inhabitants and audiences they support or attract.

Central West and Orana Regional Plan 2036

The *Central West and Orana Regional Plan 2036* (NSW Department of Planning, Industry and Environment, 2017) provides an overarching framework to guide detailed land use plans, developments and infrastructure funding decisions for the region.

The plan provides a number of goals to drive the framework. Those relevant are under Goal 3: Quality freight, transport and infrastructure networks:

- Direction 18: Improve freight connections to markets and global gateways
- Direction 19: Enhance road and rail freight links.

The proposal, in increasing the capacity of the highway between Katoomba and Blackheath is consistent with these directions by improving general and freight traffic efficiency.

Western City District Plan

The *Western City District Plan* (Greater Sydney Commission, 2018) is a 20-year plan to manage growth and achieve the 40-year vision of the Greater Sydney Region Plan. The aim of this plan is to coordinate and align the planning that will shape the future of Greater Sydney and make it more liveable, productive and sustainable.

The proposal aligns with Planning Priority W1 of the *Western City District Plan* which is planning for a city supported by infrastructure. The proposal would therefore be consistent with the direction of the Western City District Plan as it is a transport infrastructure project that aligns with forecast growth and demonstrates adaptation of existing infrastructure to meet future needs.

NSW Road Safety Strategy 2012-2021

The *NSW Road Safety Strategy 2012-2021* (Transport, 2012) sets the direction for road safety in NSW. This strategy is underpinned by the safe system approach to improving road safety. This takes a holistic view of the road transport system and interactions among the key components of that system – the road user, the roads and roadsides, the vehicle and travel speeds.

The proposal would provide the opportunity to reduce crashes and help achieve the targets set by the strategy by improving road safety, upgrading intersections, improving pedestrian and cyclist facilities and increasing capacity to reduce congestion.

Road Safety Plan 2021

The *Road Safety Plan 2021* (Transport, 2018d) outlines how the NSW Government will work towards the State Priority Target of reducing fatalities by 30 per cent by the end of 2021 compared to average annual fatalities over 2008–2010. It also aligns the Towards Zero vision with NSW Future Transport Strategy 2056, which aims to have a NSW transport network with zero trauma by 2056.

The proposal is consistent with the directions set out in Road Safety Plan 2021 because it would provide a better standard of road with improved safety through the separation of carriageways and the implementation of contemporary design standards.

NSW Freight and Ports Strategy 2013

The *NSW Freight and Ports Strategy* (Transport, 2013b) targets specific challenges associated with the forecast doubling of the NSW freight task by 2031. It recognises that providing a network that minimises congestion will support economic growth and productivity and encourage regional development. In this context the strategy identifies the need to develop and maintain capacity for freight on the road network.

Objectives of the *NSW Freight and Ports Strategy* relevant to the proposal include:

- delivery of a freight network that efficiently supports the projected growth of the NSW economy
- balancing freight needs with those of the broader community and the environment
- actions and tasks of the strategy and task actions relevant to the proposal include:
  - Action 2B – Develop and maintain capacity for freight on the road network
  - Task 2B-2 – Prioritise road infrastructure investments
- Action 3B – Manage congestion, noise and emission impacts of freight transport

- Task 3B-1 – Recognise costs of congestion.

The proposal is considered consistent with the objectives, actions and tasks referenced above. As discussed in Section 2.1, the proposal would help address growth in freight demand and would reduce congestion and enhance safety for all road users. Without the proposal, congestion on this section of highway would worsen and freight would continue to be constrained (particularly due to the highway only being able to cater for General Access heavy vehicles).

NSW Freight and Ports Plan 2018-2023

The *NSW Freight and Ports Plan* (Transport, 2018a) is aligned with the NSW Future Transport Strategy 2056 and has the aim of providing a network to move goods in an efficient, safe and environmentally sustainable manner, providing successful outcomes for communities and industry.

The proposal directly supports the following plan objectives:

- Objective 1 Economic growth – Providing confidence and certainty that encourages continued investment in the freight industry to support economic growth
- Objective 2 Efficiency, connectivity and access – Improving the efficiency of existing infrastructure and ensuring greater connectivity and access along key freight routes
- Objective 3 Capacity - Maximising infrastructure investment and increasing
- infrastructure and land use capacity to accommodate growth
- Objective 4 Creating a safe freight supply chain, involving safe networks, safe transport, safe speeds and safe people – Creating a safe freight supply chain, involving safe networks, safe transport, safe speeds and safe people
- Objective 5 Sustainability - Developing a sustainable supply chain that delivers benefits to our environment and continued operations into the future.

The plan also includes the goal to deliver new infrastructure to increase road freight capacity and improve safety. To address this goal several projects and initiatives for investigation were identified. This includes capacity enhancement crossing the Blue Mountains including the duplication of the Great Western Highway from Katoomba to Forty Bends.

Blue Mountains Local Strategic Planning Statement

Blue Mountains 2040: Living Sustainably Local Strategic Planning Statement (Blue Mountains City Council, 2020) is the long-term land use plan aimed at ensuring the Blue Mountains local government area can respond in a locally appropriate way, to the challenges and opportunities for the future. This Local Strategic Planning Statement is required by legislation to identify the basis for strategic planning in the area, having regard for social, economic and environmental matters.

The Local Planning Statement aligns with, and responds to, the key directions of the Blue Mountains Community Strategic Plan 2035. The Local Planning Statement includes nine local planning priorities within three themes: Sustainability, Liveability and Productivity. Key infrastructure priorities are embedded within each of these themes.

Local planning priority nine is the most relevant to this proposal, which focuses on improving local transport connections and accessibility.

This planning priority identifies the need to obtain local benefit and protect the World Heritage setting as part of the upgrades to the Great Western Highway. It is recognised that highway improvements have improved freight movements and brought associated productivity benefits for NSW, however, the impacts on the local environment and local traffic movement have been adverse. The proposal is identified as having potential to compound environmental issues by further prioritising regional freight movement. The

statement notes that Council would continue to advocate for the best outcome for the local area in any decisions affecting the Blue Mountains and for alternatives to regional road freight (Action 9.1). Council would also advocate for the preservation of local values and amenity (Action 9.3) and improved local connections and improved safety and accessibility (Action 9.4).

The issue of congestion points on the Great Western Highway and local linkages that affect the safe and effective movement of traffic is also highlighted. The statement notes that Council would advocate for the upgrade of key intersections with the aim of decreasing congestion and improving road function (Action 9.5).

This planning priority also indicates that improved local connections along the Great Western Highway should facilitate the mobility of residents and visitors in the Blue Mountain area. This would aid evacuation during emergencies and improve day-to-day local movements (Action 9.9). Council would also prioritise opportunities to fund and construct the Great Blue Mountains Trail to provide shared linkages between communities in the Blue Mountains (Action 9.12).

The proposal would improve local transport connections and meet the objectives of Actions 9.1, 9.3, 9.4, 9.5, 9.9 and 9.12 through:

- the provision of an upgraded active transport trail between Katoomba and Blackheath
- improved intersections of Nellies Glen Road, Explorers Road and Foy Avenue with the Great Western Highway (refer to Section 3.2.3)
- improved safety and reliability for motorists travelling along the Great Western Highway via the separation of carriageways and the implementation of contemporary design standards.

Blue Mountains Community Strategic Plan 2035

Blue Mountains Community Strategic Plan 2035 (Blue Mountains City Council, 2017) identifies the Blue Mountains community's main priorities and aspirations for the future and plans strategies for achieving these goals.

The proposal directly supports multiple strategies identified in this plan, including:

- 5.2a – Improve the safety, amenity and linkages for the local road network
- 5.2b – Complete the upgrade and widening of the Great Western Highway west of Katoomba so that it delivers improved safety, accessibility, and amenity
- 5.2c – Develop transport links between towns and villages for vehicles (including emergency vehicles), cyclists and pedestrians other than the Great Western Highway
- 5.4a – Provide safe and accessible active transport networks that will improve connectivity and encourage increased confidence in walking and cycling.

The proposal would meet these strategies through:

- the widening of the Great Western Highway from one to two lanes in each direction in two sections:
  - between Rowan Lane, Katoomba and Bellevue Crescent, Medlow Bath (about 3.5 kilometres)
  - between Station Street, Medlow Bath and Tennyson Road, Blackheath (about 1.8 kilometres)
- improved safety and reliability for motorists travelling along the Great Western Highway via the separation of carriageways and the implementation of contemporary design standards
- improved safety due to intersection upgrades at Nellies Glen Road, Explorers Road and Foy Avenue
- improved reliability of emergency services access due to the widening of the highway, widened shoulders and ability for contraflow to operate on the new second, separated carriageway if one carriageway is required to close due to an incident
- the provision of an upgraded active transport trail between Katoomba and Blackheath, which would form part of the broader Great Blue Mountains Trail.

2.2 Limitations of existing infrastructure

The key limitations on the existing highway between Katoomba and Medlow Bath and Medlow Bath to Blackheath relate to limited capacity and safety. The highway is only two lanes (one lane in either direction) with traffic volumes regularly exceeding the capacity of the highway. In addition, congestion leads to flow on safety and accessibility issues.

The Great Western Highway is a key transport route across and along the Great Dividing Range for all vehicles, including emergency and essential services, local and through rail customers, tourists and freight. The Great Western Highway between Katoomba and Blackheath has a higher average traffic volume than other duplicated interregional highways surrounding Greater Sydney. Average weekday traffic volumes were about 23,000 vehicles between Katoomba and Medlow Bath and 21,000 vehicles between Medlow Bath and Blackheath (March 2020). Heavy vehicles along these sections of highway account for around 22 per cent of the average annual daily traffic volume.

Due to the one lane either direction, limited overtaking opportunities and lack of alternative roads, traffic incidents along the highway can result in long traffic delays. The existing infrastructure is already restrained in its capacity to accommodate the existing vehicle moments, with traffic peaks and congestion a common occurrence at current merge points on the highway. Congestion is especially restrictive during weekends, where there is an increase in tourist and visitor traffic on top of day to day travel volumes; special event and the school holiday periods. This congestion results in increased travel times and a steady stream of traffic along the highway that anecdotally, reduces the opportunity for local residents venturing out for local trips. Congestion also results in delays for emergency services to get to the site of incidents and well as other incidents in the areas such as bushfires restricted traffic flows due to congestion, limited overtaking opportunities and steep gradients.

The two-lane two-way Great Western Highway in the proposal area generally has a level of service (LOS) D, which means the highway is approaching capacity. This is mostly due to inadequate lane capacity, lower than average travel speed, substandard road geometry, lower posted speed limits and traffic composition as the key contributing factors. It is expected that level of service would further deteriorate during event type peaks (such as in holiday periods).

The current performance of the corridor constrains local and inter regional traffic, including between Sydney and proposed new freight infrastructure (and associated land use changes) in the Central West such as the Parkes National Logistics Hub and the Inland Rail Program. At present, the Great Western Highway is the only major regional freight connection into Sydney currently limited to General Access heavy vehicles, including 19 metre B-doubles and 20 metre Performance Based Standards (PBS) vehicles. This is a major limitation for the current and ongoing functionality of this highway as modern, Higher Productivity Vehicles can carry more freight in one load than General Access heavy vehicles. The amount of freight on the Great Western Highway is expected to continue to grow regardless of the proposal but allowing modern Higher Productivity Vehicles could reduce articulated truck trips on the highway by at least 15 per cent.

Even without the proposal, private vehicle and freight traffic movements along the corridor are expected to increase. Between 2018 and 2026, it is predicted that daily car volumes would increase by 19 per cent along the Katoomba to Medlow Bath section and 17 per cent along the Medlow Bath to Blackheath section. This increase in traffic would result in a worsening of the existing performance of the Great Western Highway unless it is upgraded.

There are sections of the highway, particularly at intersection locations where there is substandard alignment, grades and visibility that result in a high crash rate.

In particular, the Nellies Glen Road intersection has a substandard alignment. Previously, vehicles turning left from Nellies Glen Road onto the Great Western Highway needed to be careful due to the limited visibility of oncoming highway traffic as well as the wide turning circle required to enter the highway westbound. However, Blue Mountains City Council removed this movement in 2021. These deficiencies are

highlighted by the crash data, which shows that there have been a number of crashes over the past 12 years including serious injury crashes at the Nellies Glen Road intersection. The upgrade would reinstate the left-out movement (so the intersection would be left-in left-out only).

Crash data along the Katoomba to Medlow Bath section of highway over the 12-year period to 2021 identified:

- thirty-seven crashes
- one fatal crash due to an opposite head-on collision
- six serious injury crashes, at Nellies Glen Road intersection, west of Explorers Road and near Bellevue Crescent
- eleven moderate injury crashes
- four minor/other injury crashes
- fifteen non-casualty towaway crashes
- one uncategorised crash.

The spatial grouping of crashes suggests that most accidents occur between Nellies Glen Road and to the west of Explorers Road. Most of these accidents are head on collisions with a small number of rear end and run off bend crashes.

Crash data along the Medlow Bath to Blackheath section of highway over the 12-year period to 2021 identified:

- sixty-five crashes
- one fatal crash due to an opposite head-on collision
- seven serious injury crashes
- twenty-nine moderate injury crashes
- nil minor/other injury crashes
- twenty-nine non-casualty towaway crashes.

Within the Medlow Bath to Blackheath section, most accidents occurred about one kilometre west of the Great Western Highway / Railway Parade intersection in Medlow Bath.

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

As part of a staged upgrade program, the proposal aims to deliver outcomes consistent with the Great Western Highway Upgrade Program objectives, for the Katoomba and Blackheath locality.

Table 2-1 summarises how the proposal would address the overall objectives of the Great Western Highway Upgrade Program.

Table 2-1: Proposal response to Great Western Highway Upgrade Program objectives

Theme	Great Western Highway Upgrade Program objective	Katoomba to Blackheath Upgrade proposal response
1. Economic development, productivity and recovery	Improve ability to drive regional economic development and freight productivity	Providing a four-lane divided carriageway with dedicated turn lanes to improve freight productivity and reduce congestion.
2. Resilience and future proofing	Provide a dependable and adaptable transport network that enables continuity of transport and essential services	Make network provisions for emergency services and provide safe continuous access to transport services.
3. Network performance	Improve transport network efficiency	Provide suitable capacity to reduce congestion during peak periods and to support overtaking of slower vehicles.
4. Safety	Reduce actual and perceived safety risks	Separate traffic flows and user groups, upgrading intersections, provide shoulders, improve alignment and remove roadside hazards along the corridor.
5. Movement, place and amenity	Maintain and enhance local amenity and character, and protect environmental and cultural assets	Improve local traffic connectivity along and across the corridor. Provide facilities to encourage active transport as part of the Great Blue Mountains Trail. Preserve, consolidate and interpret cultural heritage through sensitive urban design along the highway, including both Aboriginal and non-Aboriginal heritage themes.

2.3.2 Development criteria

The design development criteria for the proposal include:

- maintain the functional operation of the highway to traffic and users during construction
- provide four lane dual carriageway separated by median between Katoomba and Lithgow, with a design speed generally 90 kilometres per hour
- provide facilities for active transport users appropriately linked to other trails of the area
- adjust, maintain, relocate or reinstate property access to all private properties along the highway frontage
- adopt water quality control measures to improve the management of stormwater out flows into the Sydney drinking water catchment through the Blackheath Special Catchment Area
- no impact to the Greater Blue Mountains World Heritage Area.

2.3.3 Urban design objectives

The urban design vision adopted for the proposal is:

- reinforce the journey sequence of bushland and village
- evoke a sense of its history and heritage
- provide views and a clear sense of orientation for users
- create a road design that integrates urban design and engineering
- establish active transport links between towns and connections to key points along the journey.

To achieve this vision, the urban design objectives for the proposal are to:

- develop an integrated design that fits with the existing high visual qualities, ecology and character of areas between townships in the Blue Mountains setting
- minimise impacts to the integrity of heritage sites, significant trees and cultural values of the community within the proposal
- enhance local and regional connectivity incorporating key principles of NSW Government's 'Practitioner's Guide to Movement and Place, 2020'
- provide a memorable journey experience that positively contributes to the identity of the area
- consider approaches consistent with the Transport '*Reconciliation Action Plan'* & '*Designing with Country'* discussion paper, GANSW 2020.

2.4 Alternatives and options considered

This section summarises the options that were considered for the proposal and documents the justification of why the preferred option was chosen.

To define and select the preferred option for an upgrade of the Great Western Highway between Katoomba and Blackheath the section passed through a series of option analyses, including:

- historic route development – past decisions and projects that defined the preferred corridor
- corridor route alignment and strategic design development – the 2019 corridor route options and 2020 strategic design refinement and display as part of the Great Western Highway Upgrade Program
- concept design development and environmental planning approval – outlined in this REF.

2.4.1 Historic route development

The Great Western Highway between Katoomba and Blackheath has straddled the ridgetop terrain between forested private property and the railway line since the 1813 crossing of this part of the Blue Mountains by Blaxland, Lawson and Wentworth. The road corridor between Katoomba and Blackheath was first formally constructed as Cox's Road in 1814 – 1815. Through the 19th century, the road corridor was developed with bridges and retaining walls and the 1887 Plan of the Village of Katoomba shows the Great Western Highway alignment in its modern location.

Bypassing Katoomba, Medlow Bath and Blackheath further to the east would shift the alignment onto difficult and steep, undulating terrain and pass entirely through the Blue Mountains National Park and impact sensitive water catchment areas. Bypassing to the west would move the highway off the escarpment, into the Megalong Valley. Historic corridor development did not consider tunnel options, so the existing route remained favoured from the establishment to the present day. The existing road corridor in the proposal area has served movement of people and goods over the mountains for about 200 years.

An option to pass through Medlow Bath on the east was considered in the 1950s using a Eumemmering Street alignment and quickly ruled out a few years later due to impacts on the residential village area.

Since the 1950s, different corridor options have been considered between Katoomba and Blackheath through Medlow Bath. However, due to the terrain constraints, corridor options from Katoomba to Medlow Bath have focussed on the existing corridor, with land reserved for future widening in most locations. There is an exception between Medlow Bath and Blackheath, where land was reserved along Station Street, should future widening favour an alignment along the Megalong Valley escarpment into Blackheath.

However, in 2002, the bridge over the railway at Medlow Bath confirmed that the upgrade of the highway to four-lanes would cross over the railway at Medlow Bath. This in turn reinforced that the upgrade would occur along the existing highway corridor between Katoomba and Blackheath.

In 2009, planning and investigations for the duplication of the Great Western Highway for the corridor between Mount Victoria and Lithgow were undertaken to inform the Local Environmental Plan (LEP) corridor reservation.

In June 2018, the NSW Government committed to investigating the feasibility of extending the duplication of the Great Western Highway from north of Katoomba to Forty Bends. In late 2018 and 2019, a corridor route option analysis was undertaken for the length of highway.

2.4.2 2019 corridor route options

Methodology for selection of the preferred corridor route

In August 2018, the corridor route options development for the upgrade began. To develop the corridor route options, corridor environmental and engineering constraints were considered during the corridor route options identification process. These constraints included:

- steep topography, the existing Main Western Railway and the proximity of the Blue Mountains National Park and Blue Mountains World Heritage Area
- requirement for major horizontal alignment improvements between Katoomba and Medlow Bath to achieve the nominated design speed of 90 kilometres per hour
- need for substantial cuts and high retaining walls between Katoomba and Medlow Bath
- need to ensure continued traffic flow during construction, which would require construction staging and complex traffic switches on some parts of the alignment
- interaction with the rail corridor in the southern and northern parts of Blackheath
- opportunity to improve urban amenity (and protect heritage values) within Blackheath with a bypass of the main township which sits to the east of the railway
- presence of underground and above ground public utilities, particularly through Blackheath
- need for tunnels, bridges and deep fills for alignments to the west of Blackheath and associated challenges for construction access
- need to implement water quality controls within a constrained corridor to ensure a neutral or beneficial effect on water quality within drinking water catchments.

In addition, a range of option / project design requirements were adopted to assist in providing corridor route options of a consistent design across the upgrade. The required features of the corridor route options included:

- four lane dual carriageway separated by a median
- design speed generally 90 kilometres per hour and posted speed limit 80 kilometres per hour
- 3.5 metre travel lanes and wide 2.5 metre shoulders between Blue Mountains villages (for better road safety and provision for cyclists)
- connection with existing four lane sections built at Katoomba in the 1990s
- design alignment and pavement to allow potential future improvement to freight productivity (including 26 metre and 30 metre B-doubles
- adequate heavy vehicle rest stop facilities consistent with a finalised corridor strategy or plan when confirmed
- safe, accessible heavy vehicle enforcement infrastructure
- desired one in 20-year flood immunity
- potential active transport infrastructure (to be investigated through development of an Urban Design Framework).

Once corridor route options were identified, a value management workshop (VM workshop) for the proposal was held on 14 November 2018. The workshop was attended by a cross section of (the then) Roads and

Maritime personnel supported by consultants with extensive experience in project development and options investigation processes for major road projects.

The intent of the VM workshop was to identify a ranking of the corridor route options to provide context to the community, and the selection of the proposed corridor route option would only occur after feedback from the community had been received.

Between Katoomba and Medlow Bath and Medlow Bath and Blackheath, there were minimal options that could be generated due to the environmental and engineering constraints.

Identified corridor route options

The corridor route options between Katoomba and Mount Victoria were divided into four zones due to the nature of the options considered (refer to Figure 2-1):

A. Katoomba to Medlow Bath

B. Medlow Bath to Blackheath

C. Blackheath Bypass

D. Blackheath Bypass to Browntown Oval (Mount Victoria)

The relevant zones for this proposal (Katoomba to Medlow Bath and Medlow Bath to Blackheath) are Zone A and Zone B and so only these zones are discussed in the following sections. Table 2-2 discusses the corridor route option zones. It should be noted that part of Zone A also captured the Medlow Bath upgrade.

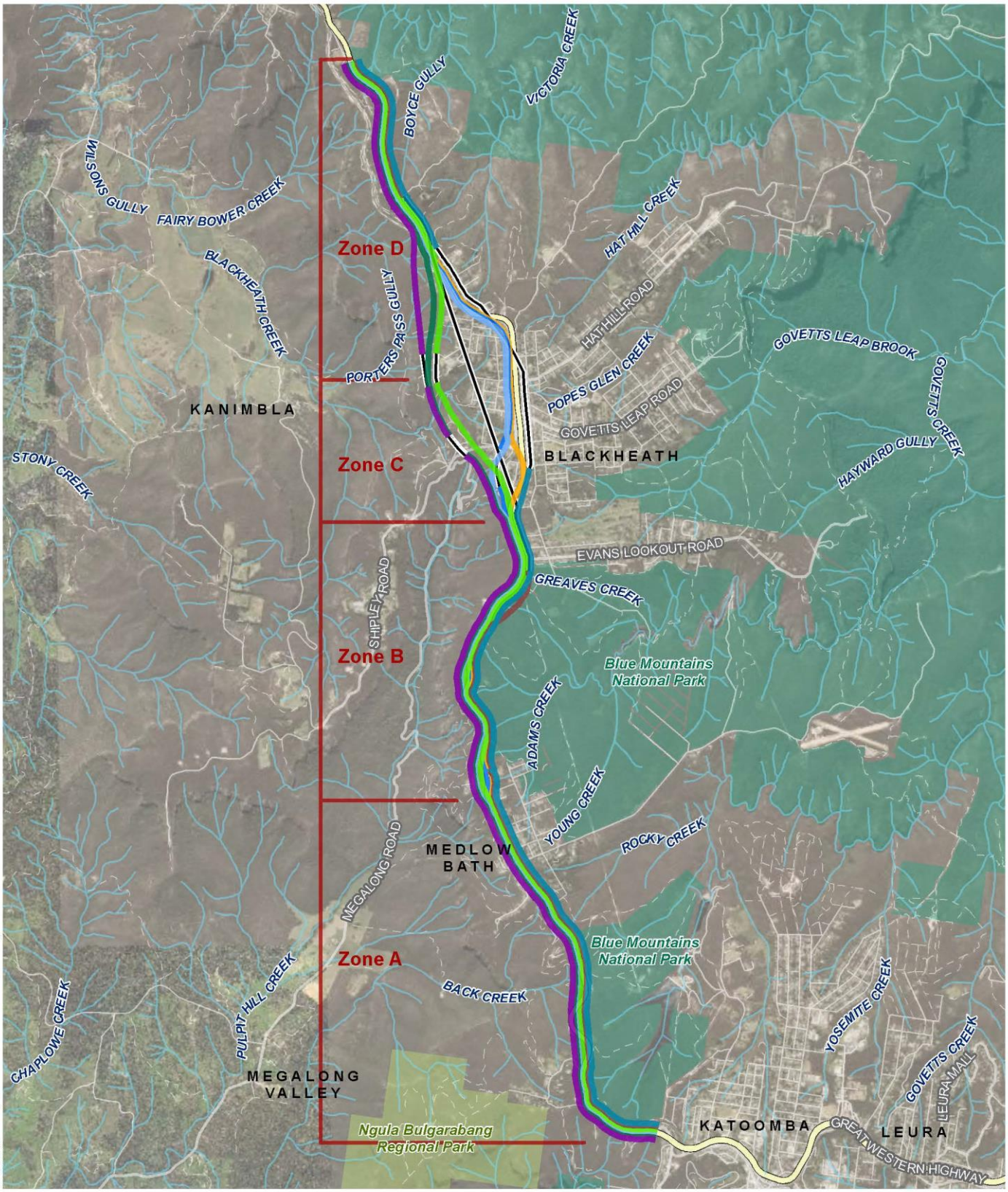
Table 2-2: Corridor route option zones

Zone	Existing scenario	Constraints	Options considered
Zone A – Katoomba to Medlow Bath (4.7 kilometres on existing alignment)	The eastern two thirds of the road corridor within Zone A comprises one westbound overtaking lane but few other overtaking opportunities. The western third of the alignment passes through Medlow Bath village.	• Main Western railway line to the east of the highway • Upper Cascade Creek Dam located to the east of the Main Western railway line • Near Medlow Bath, the terrain falls sharply to the west into the Megalong Valley • The highway crosses the Main Western line at the northern extent of the zone	The constraints indicate new alignments are not practicable and led to an approach that would focus on widening and upgrading the current highway alignment. As such, the main corridor route option considered was for the realignment and upgrade of the existing highway to a four-lane divided carriageway to achieve an 80 km/h posted speed outside Medlow Bath.
Zone B – Medlow Bath to Blackheath (3.2 kilometres)	This zone contains one eastbound overtaking lane to the east of Blackheath and few other overtaking opportunities.	• Main Western railway line to the west of the highway • Alignments to the west of the railway are further constrained in Medlow Bath by residential and commercial developments and the need to retain property access • There are also severe topographical constraints with the land sloping down towards the escarpment that joins to Pulpit Hill Creek and the Megalong Valley • The remainder of a western alignment lies within native vegetation with Blue	The corridor route options considered in Zone B were: • realign and upgrade the existing alignment to achieve 80 kilometres per hour posted speed outside Medlow Bath and widen the alignment to provide a four-lane divided carriageway (refer to Options 1A, 1B, 3A, 3B, 4A, 4B on Figure 2-1). • new four lane carriageway west of the

Zone	Existing scenario	Constraints	Options considered
		Mountain Swamps threatened ecological community (BC Act and EPBC Act listed) affected • Alignments to the east are constrained by residential development in Medlow Bath and Blackheath • Construction of alignments to the east would be complicated by the need to work adjacent to 'live' highway traffic.	existing road corridor and rail line, including extensive retaining walls (refer to Options 2A, 2B, 2C on Figure 2-1).

By keeping the Great Western Highway on the existing alignment on the ridgeline through Zone A and Zone B, environmental impact was reduced while still providing opportunities to support and enhance the character of the surrounding area.

All corridor route options would reduce travel time, improve safety and reduce vehicle operating costs. Options were found to have varying advantages and disadvantages with reference to construction, property, visual and environmental considerations.

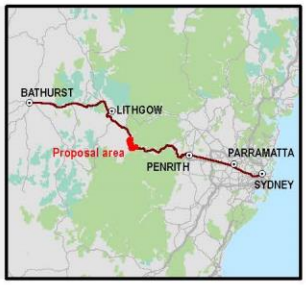


P:\GIS\Project-4\project\511168_GWH\GWHE_REF_Fig_2_1_RouteOptionsZones.mxd\JOB No.\21-02-22\Virgil.Robinson\Rev 0

Great Western Highway

Corridor route options

- 1A
- 1B
- 2A
- 2B
- 2C
- 3A
- 3B
- 4A
- 4B
- Tunnels
- Blue Mountains National Park
- Ngula Bulgarabang Regional Park



Source: Aurecon, LPI, DPIE

1:60,000 @A4

0 750 1,500m

Great Western Highway East **Review of Environmental Factors**

Projection: GDA2020 MGA Zone 56

FIGURE 2-1: 2019 Corridor route options zones

Preferred corridor

In Zone A, due to the constraints, all corridor route options followed the same alignment and there were no options to choose between. As such, the preferred corridor route was to realign and upgrade the alignment to achieve 90 kilometres per hour design speed (80 kilometres per hour posted speed) outside Medlow Bath and widen the full length to provide a four-lane divided carriageway. This included straightening up the alignment including bridging across the valley north of Explorers Road.

For Zone B, there were two corridor route options: one that passed to the west of the Main Western Rail Line and would be a new highway alignment or realigning and widening the existing alignment. The assessment of these options is summarised in Table 2-3.

Table 2-3: Corridor route option assessment – Zone B

Corridor route option	Assessment
All options	• Traffic impacts during construction
Options to the west of the existing highway	• Greater impact on the State Heritage Register listed Medlow Bath Railway Station Group than other corridor route options • Reduced traffic impacts during construction
Options along the existing alignment	• Some impact to the Blue Mountains National Park • Opportunity to maximise the use of the existing road pavement and corridor

As such, the preferred corridor route was to realign and upgrade the alignment to achieve 90 kilometres per hour design speed (80 kilometres per hour posted speed) outside Medlow Bath and widen the full length to provide a four-lane divided carriageway.

2.4.3 2020 strategic design

Once the preferred corridor route was confirmed, Transport developed strategic design options to consider the design of the upgrade between Katoomba and Medlow Bath.

The strategic design sought to develop designs within the chosen corridor that would minimise impacts while being constructable. The main area of changes during strategic design focussed on the cutting at Pulpit Hill and bridges across the valleys of Explorers Road leading to Mount Mark.

The strategic design sought to improve constructability of the Pulpit Hill cutting and Explorers Road valley by providing for construction widths that would not restrict the daily operation of the highway. The alignment was also pulled closer to the rail corridor after the Explorers Road valley to realign the climb up the surrounds of Mount Mark to Foy Avenue. This realignment successfully removed bridges previously required to span this valley.

A number of different designs were developed during this stage (refer to Table 2-4). These options are different to those discussed in Section 2.4.2.

Table 2-4: 2020 Strategic design options for the proposal

Option	Description
Katoomba to Medlow Bath	
Option A	**New westbound carriageway with eastbound traffic on existing carriageway** • The existing carriageway would be converted to be eastbound only, with a new westbound carriageway constructed adjacent to the existing highway. Where required, existing curves would be realigned. • The eastern limit of work connects into the existing section of dual carriageway on the Great Western Highway at Rowan Lane then climbs to the intersection with Nellies Glen Road. • Nellies Glen Road intersection is provided as left in/left out, including left turn deceleration lane. • Explorers Road intersection would connect only to the existing highway (becoming the eastern carriageway), with a right turn deceleration lane on the Great Western Highway. With the left in/left out intersection at Nellies Glen Road and the right turn intersection at Explorers Road, the design provides full access to residential area of Pulpit Hill. • On the approaches to and from Medlow Bath, the posted speed is reduced to 60 kilometres per hour. • The western limit of work for this section is 100 metres south of Bellevue Crescent, Medlow Bath. • No separate bus facilities would be provided. • Existing off-road active transport trails would be maintained.
Option B	**Upgrade existing alignment with one curved twin bridge** • The southern limit of work connects into the existing section of dual carriageway on the Great Western Highway at Rowan Lane then climbs to the intersection with Nellies Glen Road. • The eastern section of the alignment has one major curved bridge. • Nellies Glen Road intersection is provided as left in/left out, including left turn deceleration lane. • Explorers Road intersection removes the right turn bay on the Great Western Highway for southbound access to Explorers Road. However, access would be provided to eastbound traffic, via a service road along the existing highway alignment. With the left in/left out intersection at Nellies Glen Road and the right turn intersection at Explorers Road, provides full access to residential area of Pulpit Hill. • A curved bridge structure would span across the valley west of Explorers Road, commencing just east of Explorers Road and connecting back to the highway about 450 metres to the west. • On the approaches to and from Medlow Bath, the posted speed is reduced to 60 kilometres per hour. • The western limit of work for this section is 100 metres south of Bellevue Crescent, Medlow Bath. • No separate bus facilities would be provided. • Existing off-road active transport trails would be maintained.
Medlow Bath to Blackheath	
Option A	**Alternate alignment at Coachhouse Lane** • The eastern limit of work for this option is the westbound departure of existing traffic control signalised intersection with Station Street and Railway Parade. • Where possible, the alignment is vertically similar to the existing road corridor. • There would be no impacts to rail infrastructure. • The alignment at Coachhouse Lane would impact on private property. However, new access to properties on Coachhouse Lane would be provided. • On the approaches to and from Medlow Bath, the posted speed limit would be reduced from 80 kilometres per hour to 60 kilometres per hour. • The existing right turn lane into Station Street and left turn lane for southbound traffic into Railway Parade is maintained. • There would be no active transport trails or bus facilities provided.

Option	Description
Option B	**Alternate alignment at Coachhouse Lane** • Option B was a variation to Option A for the Medlow Bath to Blackheath section which was developed considering feedback from the community. The differences with Option A were: – existing alignment and property accesses at Coachhouse Lane are retained – the alignment at the southern end encroaches into the rail corridor, impacting on the existing Medlow Bath West Sectioning Hut, requiring a retaining wall and potentially reducing the width of maintenance access adjacent to the live rail lines. This option takes advantage of Transport (Sydney Trains) relocating the existing Medlow Bath West Sectioning Hut under a separate planning approval as it has reached its end of life.

The strategic designs recommended to progress to concept design stage were:

- Katoomba to Medlow Bath Option B
- Medlow Bath to Blackheath Option B.

Option B was selected for the Katoomba to Medlow Bath section as Option A did not meet the objectives of the proposal and used existing highway alignment with known constraints and safety issues. Option B was selected for the Medlow Bath to Blackheath section as it was considered to provide similar traffic benefits to Option A while minimising impacts to existing properties along Coachhouse Lane.

2.4.4 2021 concept design refinements

The concept design proposed in this REF was developed based on the strategic designs undertaken in 2020. The concept designs were undertaken to provide further design and constructability information to obtain planning approval. The concept designs have further refined the strategic design outlined in Section 2.4.3.

A series of workshops were held to challenge the strategic design during the early phase of concept design. This included:

- risk and constructability
- health and safety in design
- bridge optioneering
- value management.

A range of other stakeholders were also engaged through design and direct engagement initiatives to inform the designs development. Transport will continue to engage with these stakeholders in future design and construction phases. A list of stakeholders and the subject areas of engagement include:

- water quality design – Water NSW and Blue Mountains City Council water quality team
- National Parks and Wildlife Service – planning and compensatory land strategy
- heritage values – Aboriginal groups (refer to Section 5.3), Blue Mountains City Council heritage team, Blue Mountains City Council Heritage Committee and Heritage NSW
- active transport – Blue Mountains Cycling Safety Forum and Crossley Transport Planning (movement and place specialist).

The concept design refinements carried out during this process are outlined in Table 2-5.

Table 2-5: Concept design refinements

Design element	Refinements
Intersection upgrades	• Great Western Highway / Nellies Glen Road intersection was moved about 70 metres east along the westbound carriageway to provide greater driver visibility at the intersection. This also allows the existing Heritage interpretation area to be retained as far as practicable with improved carparking. • The service road from the Great Western Highway to Explorers Road intersection was widened to allow for more efficient construction staging. • The Great Western Highway / Foy Avenue intersection was modified for safer in and out movements by adding an auxiliary left turn lane in and right median turn lane in.
Heritage	• The Pulpit Hill heritage interpretation area was retained as far as practicable through the shift in the Nellies Glen Road intersection. The proposal would provide opportunities to provide a more cohesive and inclusive heritage interpretation of the broader Pulpit Hill. In addition, the proposal would include improved car parking facilities at this location. • Land owned by Deerubbin Local Aboriginal Land Council was avoided in the Medlow Bath to Blackheath section.
Bridge options	• The bridge design straightens up the alignment of the Great Western Highway, including bridging across the valley north of Explorers Road, to achieve the design speed limit. • The incrementally launched method is being considered for bridge construction to minimise the construction footprint required under the bridges and limit the need for extensive crane lifts. This would improve constructability and minimise the environmental impacts of construction of the twin bridges. • The separation between the two bridges was reduced for safety reasons due to the proposal being in an area which experiences high levels of fog.
Active transport options	• Additional upgraded active transport connections have been included between Katoomba to Medlow Bath to provide continuous upgraded active transport connections along this section. This included extension of the active transport trail to include a new connection between Rowan Lane and Nellies Glen Road and Foy Avenue and the Medlow Bath Upgrade. • The alignment of active transport trails along the Medlow Bath to Blackheath section was changed to follow the natural topography.
Split carriageway	Within the Medlow Bath to Blackheath section: • the westbound and eastbound carriageways have been separated, with a varied median width • the eastbound carriageway was lowered to remove the retaining wall along the entire carriageway • a widened median has been included to allow vegetation to be retained where possible through the section.
Rail corridor and Coachhouse Lane	While the 2020 strategic option chosen would avoid private property on Coachhouse Lane while impacting on the rail corridor, the concept design was able to: • avoid acquisition of private property on Coachhouse Lane. • minimise encroachment on the rail corridor opposite Coachhouse Lane. • minimise impact to the existing retaining wall near Coachhouse Lane. The design takes advantage of Transport (Sydney Trains) relocating the existing Medlow Bath West Sectioning Hut which has reached its end of life under a separate planning approval. In addition, along the proposal alignment, maintenance and emergency accesses to the rail corridor have been replaced where they would be impacted by the proposal.
Constructability	• The concept design follows an alignment that is constructable alongside highway traffic. During construction, one carriageway with one lane in each direction would always remain open, maintaining flow along the Great Western Highway between Katoomba and Blackheath.

Design element	Refinements
Water quality	• Six water quality basins have been added along Katoomba and Medlow Bath section and five along the Medlow Bath to Blackheath section. Accesses into drainage basins have been designed to allow for a maintenance vehicle to access bio-retention portion of drainage basins from the maintenance access track.
Heavy vehicles	• Truck stopping bays have been added on existing road pavement, near Explorers Road in the Katoomba to Medlow Bath section (eastbound) and about one kilometre north of Medlow Bath in the Medlow Bath to Blackheath section (westbound).
Tie-ins	• At the western end of the Katoomba to Medlow Bath section west of Foy Avenue, the design speed on the westbound carriageway was reduced from 90 kilometres per hour to 70 kilometres per hour to be more appropriate speed for entering a township along the highway. • Great Western Highway Blackheath to Little Hartley tie-in has been included in the road design for the Medlow Bath to Blackheath section. This has been developed to ensure the pavement constructed in the interim case also suits the final lane configuration. The stub location for the final eastbound and westbound carriageways has been provided in the design. The westbound truck stopping bay would not be operational during the interim configuration.

2.4.5 Preferred design

The preferred design for the proposal has been developed through strategic and concept design development, involvement of stakeholders through workshops, and included a range of refinements to minimise impacts and improve constructability. The preferred design:

- provides a four-lane dual carriageway through the sections of Katoomba to Medlow Bath, and Medlow Bath to Blackheath suitable for a posted speed of 80 kilometres per hour
- follows an alignment that is constructable alongside highway traffic to maintain existing highway operation during construction
- provides upgraded intersections at Nellies Glen Road, Explorers Road and Foy Avenue
- makes best use of redundant highway sections for maintenance, local access and for truck stopping areas for load checking
- avoids impacts on properties in Coachhouse Lane
- provides for improvement to water quality along the proposal while also providing suitable access to maintain and manage assets along the corridor
- provides opportunities to enhance locations with heritage value through interpretation and urban design features
- makes best use of the landscape to provide connections between villages that integrate with the surrounding natural landscape
- construction of the bridge structures identified to be incrementally launched to minimise direct environmental impacts under the bridge structure and reduce construction logistics.