NSW GOVERNMENT

Great Western Highway
Blackheath to Little Hartley

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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.

Transport for NSW (Transport) is seeking approval to upgrade the Great Western Highway between Blackheath and Little Hartley (the project) as part of the Upgrade Program. 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 tunnel portals (i.e. the entrance and exit points for the tunnels).

The project would be located around 90 kilometres west of the Sydney central business district and within the Blue Mountains and Lithgow local government areas. The majority of the project would be located below ground, generally along or adjacent to the existing Great Western Highway alignment between Blackheath and Little Hartley. The Blue Mountains National Park and Greater Blue Mountains World Heritage Area are located generally to the east of the existing Great Western Highway. A large part of the project is also located within the Sydney Drinking Water Catchment. Low and medium density residential and commercial areas are generally located in the town centres of Blackheath and Mount Victoria. The location of the project is shown in Figure 1.

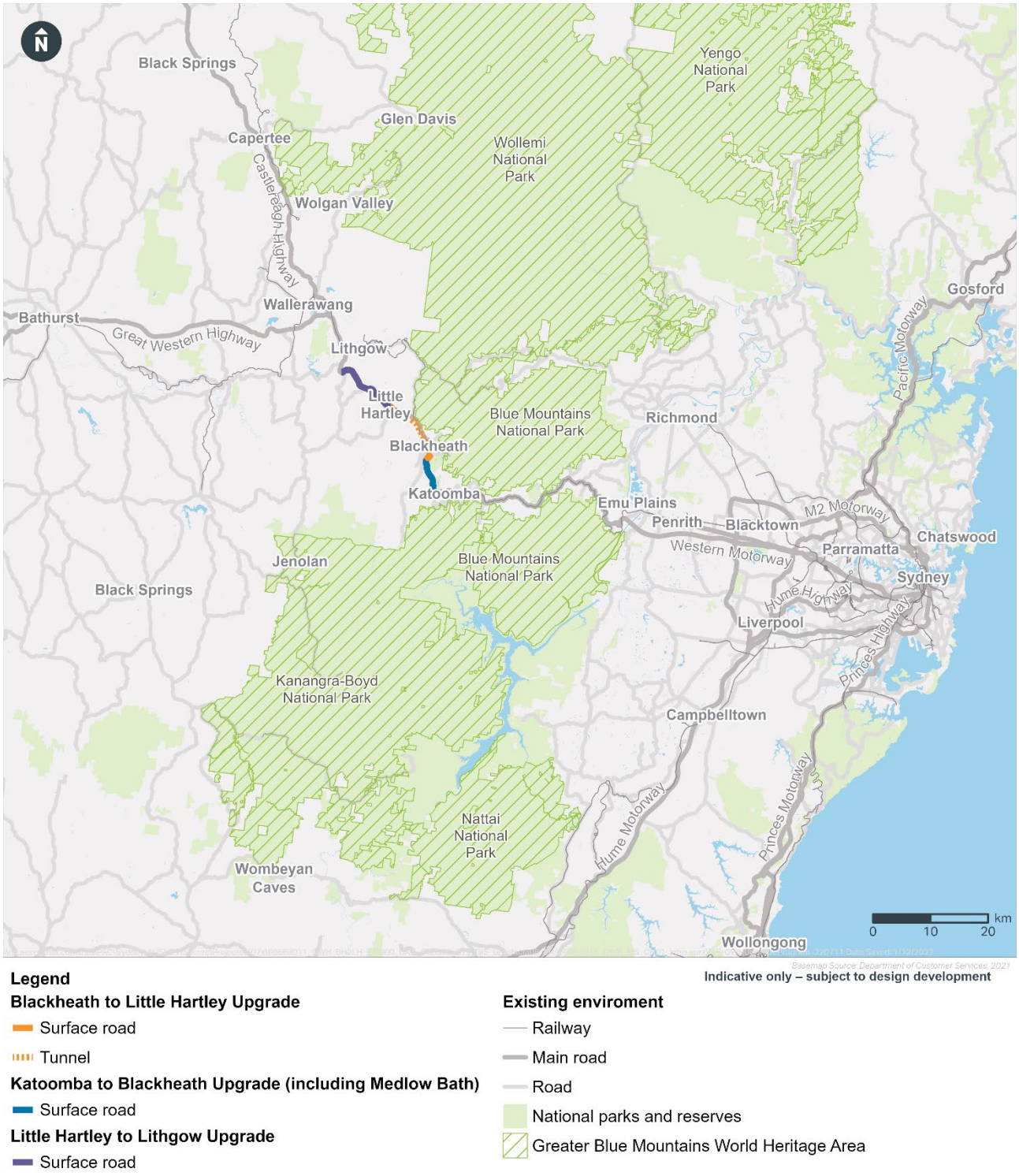


Figure 1 Regional context of the project

Environmental impact statement

Transport has prepared an environmental impact statement (EIS) based on the preliminary concept design and construction methodology for the project which would be confirmed during design development. The EIS describes the project, discusses the alternatives that were considered, explains why the project is the preferred option, and assesses how the project would impact the environment.

The EIS also describes how Transport has engaged with project stakeholders including the local community, Aboriginal stakeholders and government agencies during the development of the project.

Transport is seeking State significant infrastructure and critical State significant infrastructure declaration for the project by the Minister for Planning.

Transport has submitted a referral under the *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth) (EPBC Act) to the Department of Climate Change, Energy, the Environment and Water (DCCEEW). At the time of finalisation of this EIS there has been no decision by DCCEEW on whether the project is a controlled action or not.

Why is an upgrade of the highway needed?

The Great Western Highway provides the main transport link through the Blue Mountains for access between the Central West of NSW (Bathurst, Orange, Parkes and Dubbo region) and the Sydney motorway network for freight, tourist and general traffic. It also plays a vital role in local traffic distribution between the townships of the Blue Mountains.

Supporting the current needs and future growth of Sydney and Central West NSW through an efficient transport network is fundamental to the liveability, productivity and sustainability of Greater Sydney and NSW. The need to address these issues is recognised in a number of strategic plans for improving transport, placemaking, and freight efficiency across Greater Sydney and regional NSW.

The existing Great Western Highway between Blackheath and Little Hartley is mostly a two-way undivided carriageway with one lane in each direction. Traffic volumes are expected to grow by two per cent per annum between Blackheath and Forty Bends, and visitors to regional NSW grew by 23 per cent between 2010 and 2017 prior to travel disruptions caused by the COVID-19 pandemic. The critical function of the Great Western Highway is being the key east-west road freight and transport route between Sydney and Central West NSW. Heavy vehicle movements along the Great Western Highway are predicted to increase by around 30 per cent by 2036. Growth in demand for this east-west transport route has led to the need for the upgrade of the Great Western Highway between Katoomba and Lithgow to a four lane carriageway (the Upgrade Program) and the project is a key component of this program.

The Great Western Highway is currently susceptible to closure during natural disasters and extreme weather events, has steep grades with limited overtaking opportunities and does not currently accommodate larger freight vehicles. The current constraints affecting the Great Western Highway which would be addressed by the project are shown in Figure 2.

The critical functions of the Great Western Highway coupled with growth in demand for these functions has led to the need for the project, as part of the broader Upgrade Program.

	Constraints	Project objectives	Project benefits
	Growing freight inefficiency	Improve economic development, productivity and freight accessibility in and through the Blue Mountains, Central West and Orana regions	Improved economic development, productivity and recovery
	Vulnerability to closure	Improve the resilience of the corridor between Blackheath and Little Hartley to ensure continuity and safety of transport and essential services	Improved resilience and future-proofing
	Sub-optimal travel times	Improve transport network performance and efficiency along the corridor between Blackheath and Little Hartley to meet the needs of customers	Improved network performance
	Safety issues	Improve the overall safety of the corridor for all transport users between Blackheath and Little Hartley	Safety improvements
	Amenity issues	Enhance the liveability and be sensitive to the unique environmental and cultural assets along the corridor between Blackheath and Little Hartley	Movement, place and amenity improvements
	Project delivery	A value for money, sustainable and deliverable solution	Socio-economic opportunities

Figure 2 Constraints, project objectives and project benefits

Alternatives considered

The project has undergone years of investigation including consideration of various strategic alternatives and route options. Following the selection of the Great Western Highway Upgrade Program as the preferred strategic alternative, four separate projects were identified including:

- the Great Western Highway East – Katoomba to Blackheath Upgrade (Katoomba to Blackheath Upgrade)
- the Great Western Highway Upgrade – Medlow Bath (Medlow Bath Upgrade)
- the Great Western Highway Blackheath to Little Hartley (the project)
- the Great Western Highway Upgrade Program – Little Hartley to Lithgow (West Section) (Little Hartley to Lithgow Upgrade).

The project alternatives and options development process is shown in Figure 3. Strategic alternatives and project options were assessed against the project objectives, which are consistent with the Upgrade Program objectives. Strategic alternatives and project options were also informed by outcomes of community and stakeholder engagement.

The project has been developed through an environment-led design process whereby preliminary environmental investigations, assessment and advice and community and stakeholder consultation has informed the design to avoid, where possible, or otherwise minimise potential impacts to sensitive environments and communities in this part of the Blue Mountains. Table 1 contains a summary of project design elements adopted to avoid or minimise potential environmental impacts. Options were also considered for specific project elements, including interchanges, tunnel ventilation, construction sites and spoil transport. Ongoing design development would continue to explore opportunities to reduce environmental and community impacts.

Figure 3 Approach to project alternatives and options development

Table 1 Design refinements to minimise and/or avoid environmental impacts

Design development	Environmental impact minimised and/or avoided
Construction	
Using tunnel boring machines (TBMs) as primary tunnel excavation method rather than roadheaders	• minimised construction duration due to faster rate of excavation compared to roadheaders • ability to progressively install precast structural, waterproof tunnel lining to minimise the extent of groundwater drawdown and potential impacts on groundwater dependent ecosystems • reduced number of tunnel excavation access points required compared with using roadheaders, minimising the construction footprint and spoil haulage route.
Excavating from west only rather than from both east and west	• minimised construction footprint at Blackheath, reducing native vegetation clearance, as the site would not need to accommodate TBM launch • reduced spoil haulage through Blackheath and Mount Victoria (including associated potential safety and amenity impacts), as spoil would primarily be hauled westbound from the Little Hartley construction site.
Optimised construction methodology which has reduced the construction footprint and number of construction sites	The project would use parts of the construction sites used for the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade to minimise vegetation clearance. Potential construction sites at Browntown Oval and at the old Blackheath tip site were considered (and discounted) to support construction. Avoiding use of these sites would result in: • reduced amenity impacts for residents near Browntown Oval and the old Blackheath tip site associated with use of, and access to and from, these sites • avoidance of impacts to social infrastructure at Browntown Oval which would continue to be available for recreational purposes • reduced impacts to human and ecological health (by limiting the risk of exposure to contaminated lands and friable asbestos at the old Blackheath tip site) • minimised biodiversity impacts (to the observed wetland and Commonwealth listed threatened species (Gang-gang Cockatoos and Blue Mountains Water Skink) identified near the old Blackheath tip site) • minimised construction noise impacts and construction traffic impacts through Blackheath • shorter construction duration at Blackheath, and reduced construction impacts to the community.
Revised tunnel alignment deviating from the existing Great Western Highway alignment to achieve a shorter and straighter tunnel	• less spoil, and shorter construction duration associated with a shorter tunnel length.

Design development	Environmental impact minimised and/or avoided
Operation	
Revised tunnel alignment deviating from the existing Great Western Highway alignment to achieve a shorter and straighter tunnel	• improved sustainability outcomes associated with reduced vehicle emissions from travelling along a shorter and straighter tunnel alignment • improved sustainability outcomes given the lower resource use and energy consumption associated with a shorter tunnel alignment • improved driver safety outcomes (minimising curvature and extending sight distance).
Reduced operational footprint at the Blackheath portal	• minimised visual impacts for road users, tourists and residents near the Blackheath portal • simplification of the Blackheath interchange and associated improved driver safety outcomes • increased opportunities for landscaping and better visual outcomes.
Physical separation of tunnel entry and exit portals at Blackheath and Little Hartley	• reduced localised air quality impacts if the portal emissions option is preferred • avoidance of portal emissions from the exit portal of one tunnel re-entering the entry portal of the adjacent tunnel • allows space for ventilation buildings and outlets for the ventilation outlet option (if identified as the preferred option), without requiring a change to the project footprint.
Use of portal emissions instead of ventilation outlets (if identified as the preferred option)	• minimised visual impacts as a result of removing the need for ventilation outlets • improved sustainability outcomes given the lower resource use, greenhouse gas emissions and energy consumption associated with operating under a portal emissions option.

Description of the project

The project would comprise new twin tunnels between Blackheath and Little Hartley and forms part of the Upgrade Program.

The key components of the project are summarised in Table 2. An overview of the project is shown in Figure 4. The operational configuration of the project at Blackheath and Little Hartley is shown in Figure 5 and Figure 6 respectively.

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. It would also be an alternative route should there be planned or unplanned shutdowns of the tunnels.

Two options for ventilation facilities are being considered for the project including ventilation design to support emissions via ventilation outlets or via the tunnel exit portals. If required, ventilation outlets would require a ventilation building and ventilation outlet around 10 metres above ground level at the tunnel portals at Blackheath and Little Hartley. The portal emissions option would not require outlets or buildings, and emissions would be dispersed via the tunnel exit portals.

Table 2 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 south of Blackheath and at Little Hartley. The twin tunnels would connect to the surface road network via: • mainline carriageways and on- and off-ramps at the Blackheath portal, located adjacent to the existing Great Western Highway and south 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 provided by the project would include: • 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 • drainage and 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 for construction and operational power supply • a new pipeline between Little Hartley and Lithgow for construction and operational water supply • other utility connections and modifications, including electricity substations in the project tunnels.
Other project elements	The project would also include: • integrated urban design initiatives • landscaping planting.

Figure 4 Overview of the project

Figure 5 Indicative operational configuration at Blackheath

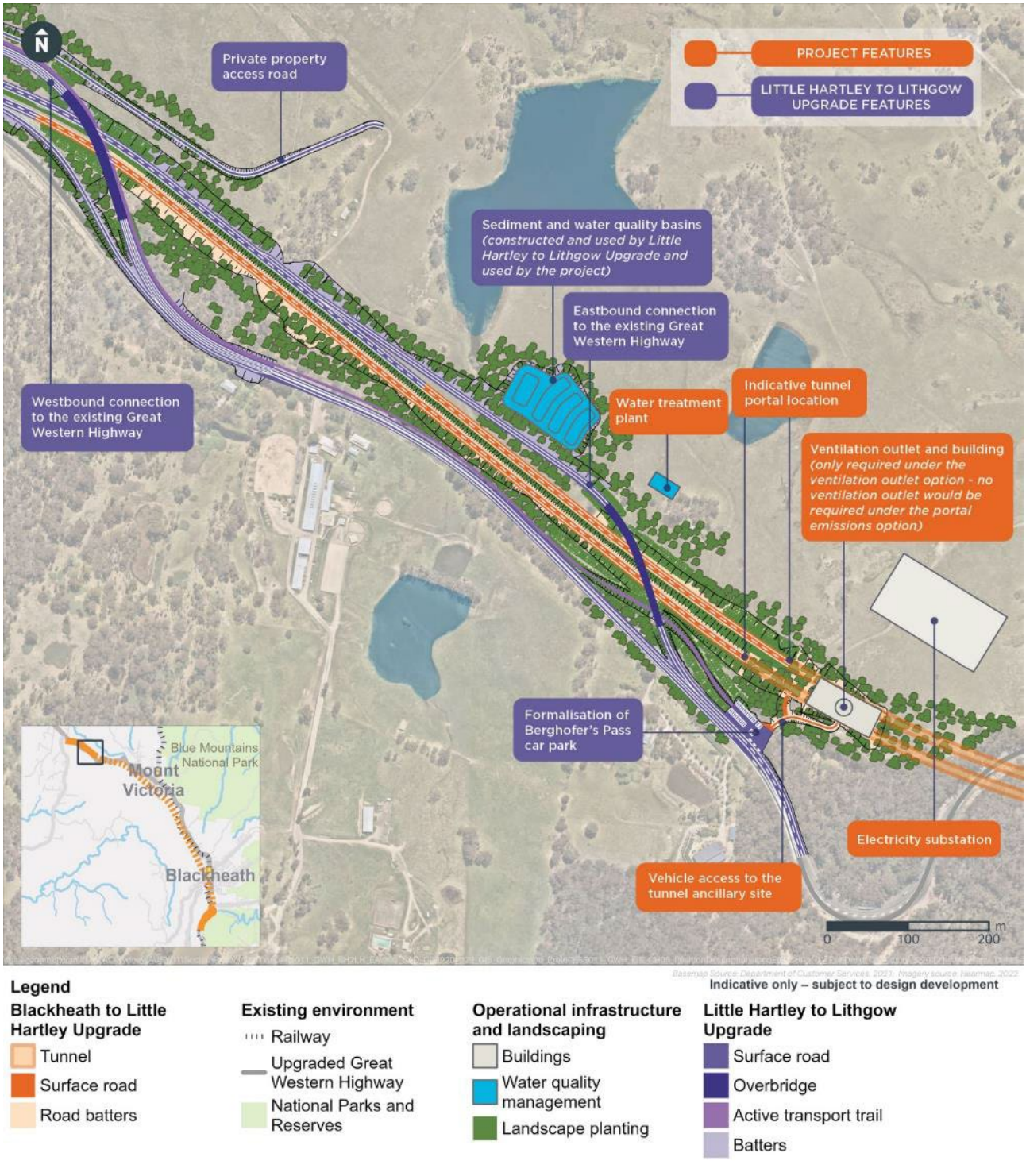


Figure 6 Indicative operational configuration at Little Hartley

Construction

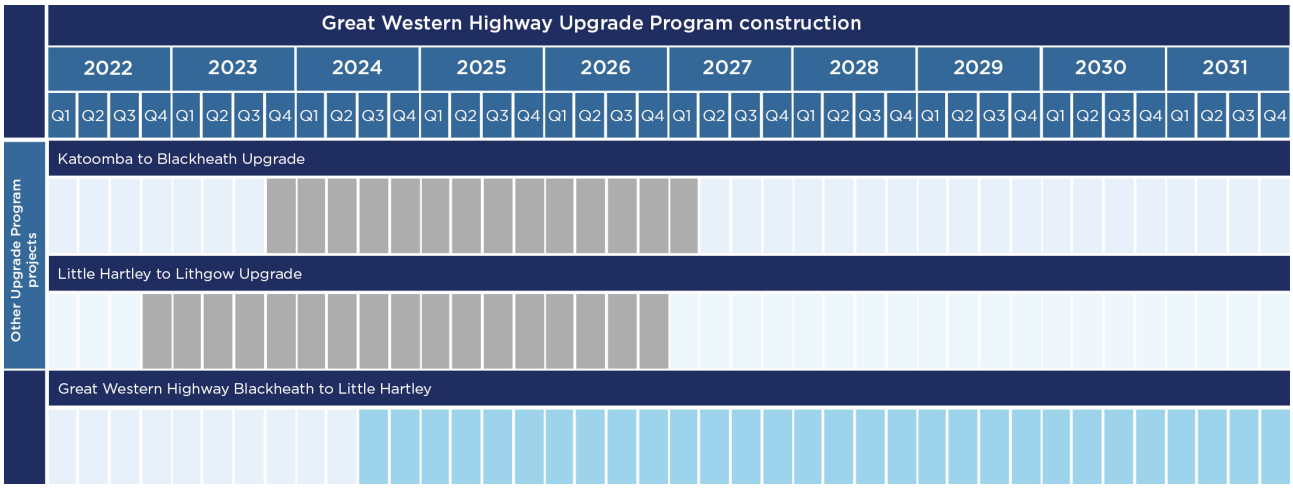
Subject to planning approval, construction is planned to commence in early 2024 and continue until 2031. The project is expected be open to traffic by 2030. The indicative construction program for the project including the relationship with other components of the upgrade of the Great Western Highway between Katoomba and Lithgow (the Upgrade Program) is shown in Table 3.

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.

The proposed construction activities required for the project 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.

Table 3 Indicative construction program



The indicative construction footprint for the project is shown in Figure 7 to Figure 9.

To minimise environmental impacts, parts of the construction sites used for the Katoomba to Blackheath Upgrade and the Little Hartley to Lithgow Upgrade would be used to support construction of the project. As shown in Table 4, construction of these projects is expected to be underway before the commencement of this project. These areas are shown in Figure 7 and Figure 9. The project would also require a new construction site at Soldiers Pinch.

Figure 7 Indicative construction footprint at Blackheath

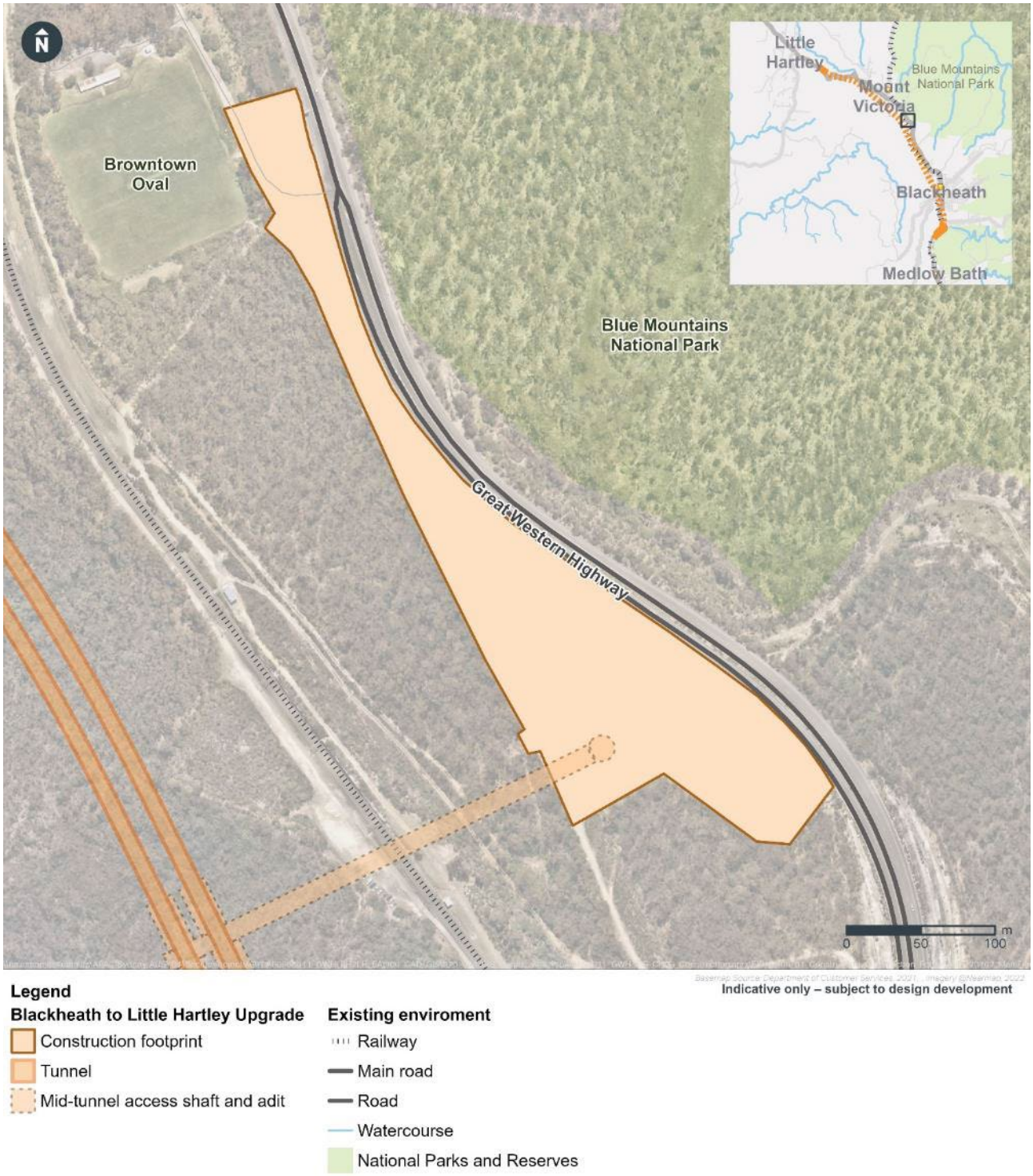


Figure 8 Indicative construction footprint at Soldiers Pinch

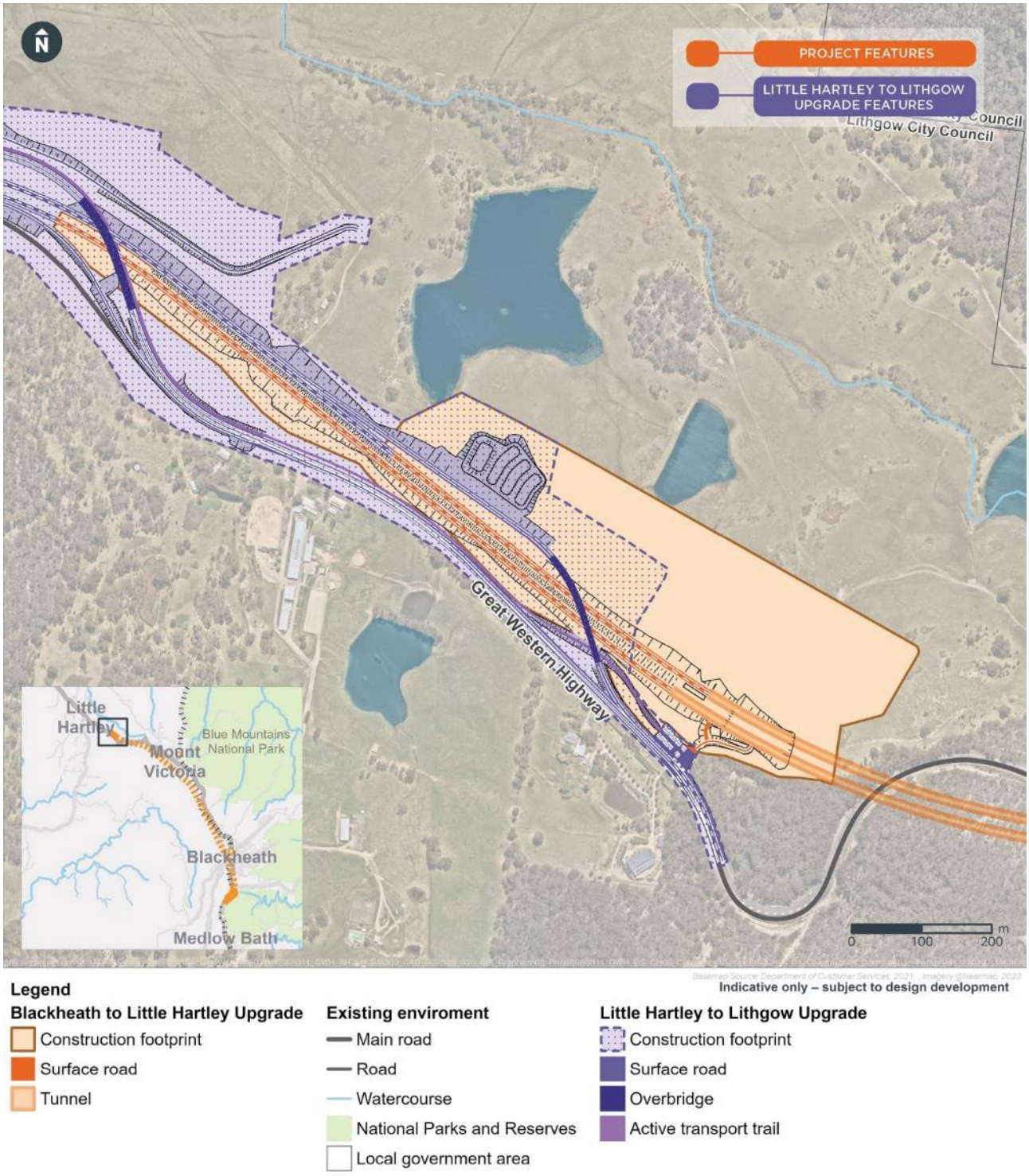


Figure 9 Indicative construction footprint at Little Hartley

Benefits of the project

The key benefits of the project would include:

- improved economic development, productivity, and recovery – during the first ten years of operation, the project would contribute up to around $10 million per year in net output for the regional area (refer to Chapter 20 (Business, land use and property)) and would create a faster, safer, and more efficient freight connection between Blackheath and Little Hartley. During construction, the project would create up to 1,100 jobs and is expected to contribute around $130 million per year to the regional economy

- improved resilience and future-proofing – the project would provide an alternative route to the current Great Western Highway between Blackheath and Little Hartley and would improve access for emergency vehicles in the event of an incident. It would also assist in minimising broader traffic delays and disruptions that may be caused by an incident. The project has been designed to improve the level of service for predicted traffic volumes in future years with scope to accommodate future growth
- improved network performance – the project would reduce light vehicle travel times between Blackheath and Little Hartley by around nine minutes, and heavy vehicle travel times by around nine minutes during the weekday AM peak hour period. The project would also provide a connection for high productivity vehicles longer than 20 metres (with an upper limit of 36 metres) between Blackheath and Little Hartley, contributing to a total reduction in the current route for these vehicles by up to 100 kilometres between Sydney and Central West NSW. The project would substantially reduce traffic on the existing Great Western Highway between Blackheath and Little Hartley improving travel time, speeds and safety on this part of the route
- safety improvements – the project would provide a safer alternative to the current steep grades, limited overtaking opportunities and at-grade intersections along sections of the Great Western Highway between Blackheath and Little Hartley. The project would provide a bypass route for heavy vehicles, avoiding local townships and two school zones and allowing separation of through and freight traffic from local and tourist traffic
- movement, place, and amenity improvements – the project would result in improved amenity for residents of Blackheath and Mount Victoria due to a substantial reduction in traffic and associated reductions in traffic noise and vehicle emissions along the existing Great Western Highway. The project would also incorporate urban design principles as described in Chapter 4 (Project description) and create potential opportunities for placemaking initiatives by reducing through traffic, including freight vehicles, at key locations along the Great Western Highway, particularly at Blackheath and Mount Victoria. These placemaking opportunities are consistent with the Movement and Place Framework (NSW Government, 2020a) adopted by Transport for the Upgrade Program.

In addition, the project (as part of the Upgrade Program) would present socio-economic opportunities, including:

- improving connections between the national high productivity vehicle network and Sydney
- strengthening supply chains due to better access to regions
- improving access to employment opportunities and services.

Community and stakeholder consultation

Consultation and engagement activities undertaken for the project and planned moving forward include:

- consultation for the Upgrade Program relevant to early project development, strategic corridor options, route options and engagement with the Blackheath Co-Design Committee (comprising various stakeholder group representatives, independently selected community representatives, Blue Mountains City Council, Lithgow City Council and emergency services representatives)
- consultation for the project during preparation of the EIS, including for the preferred option in May 2022
- engagement during and following the public exhibition of the EIS, including the display of the EIS and the preparation of a submissions report and an amendment report (if required)
- engagement carried out during construction of the project, including proposed engagement activities during project delivery.

Assessment of environmental impacts

The EIS is a comprehensive document that considers a wide range of potential environmental impacts.

For the purposes of this assessment, it has been assumed that parts of the Blackheath and Little Hartley construction footprints will have been prepared for use as part of the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade, including being cleared of vegetation and installation of water quality controls.

The environmental impacts associated with these works have been assessed as part of the Katoomba to Blackheath Upgrade Review of Environmental Factors (REF) and the Little Hartley to Lithgow Upgrade REF. These areas, as modified by these other projects, form the baseline environment considered at Blackheath and Little Hartley for the purposes of the EIS. At Soldiers Pinch, the existing environment forms the baseline environment for the purposes of the EIS.

Assessment of impacts on the Greater Blue Mountains World Heritage Area

The project is located nearby the Greater Blue Mountains World Heritage Area which is listed on the World Heritage List. This is an area of breathtaking views, rugged tablelands, sheer cliffs, deep, inaccessible valleys and swamps which support a rich and diverse ecosystem. The area demonstrates the evolution of Australia's unique eucalypt vegetation and its associated communities, plants and animals.

The project has been designed to avoid and minimise impacts to the values of the Greater Blue Mountains World Heritage Area, including selecting a tunnel option instead of surface road upgrades and an optimised construction methodology to reduce the construction footprint at the surface, particularly at Blackheath. The project would not directly impact the Greater Blue Mountains World Heritage Area.

Transport and traffic

There would be an increase in traffic on the existing Great Western Highway during construction as a result of spoil haulage, other construction vehicles and the construction workforce travelling to and from construction sites. Design refinements described in Table 1 and in Chapter 3 (Project alternatives and options) have minimised construction spoil haulage through the townships of Blackheath and Mount Victoria, minimising the interaction of heavy vehicles with pedestrians and cyclists and other vehicles in these areas. The tunnel boring machine construction methodology whereby spoil would be transported westbound from the Little Hartley construction site would also minimises the number of additional heavy vehicles that need to use Victoria Pass, which frequently experiences heavy vehicle breakdowns due to steep grades. In addition, the management of construction traffic would be in accordance with a Construction Transport and Access Management Plan and site-specific mitigation measures, including minimising haulage vehicle movements and peak traffic generating activities during the AM and PM peak hours, weekend peak hours and on peak weekends and public holidays where practicable.

Temporary modifications to the existing road network such as construction site access arrangements, staged works and speed zone changes would be required during construction of the project. During construction, relatively small and manageable increases in traffic volumes of up to five per cent are expected through Blackheath and Mount Victoria, and up to 13 per cent in Little Hartley. Minor increases to weekday peak hour travel times of about one minute for both directions along the existing Great Western Highway between Blackheath and Little Hartley are also expected during construction. Additional right turning construction traffic combined with background traffic growth along this section of the Great Western Highway would contribute to decreased levels of service at the Great Western Highway and Evans Lookout Road intersection. Opportunities to minimise the impacts of construction traffic on the level of service at this intersection are being investigated.

Emergency vehicles would also potentially be affected by minor road network impacts such as increased traffic volumes, increased travel times and reduced intersection performance during

construction of the project. Vehicular access to the Blue Mountains National Park and Sydney Drinking Water Catchment at Blackheath would be maintained during construction and operation. The Construction Transport and Access Management Plan 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.

Given that the project comprises new underground infrastructure separate to the existing road network, the potential transport and traffic impacts of the project have been largely minimised. During operation, weekday traffic volumes are expected to be reduced by about 60 per cent in Blackheath and nearly 80 per cent in Mount Victoria. Heavy vehicle volumes are expected to reduce by around 80 and 90 per cent in Blackheath and Mount Victoria respectively. The large reduction in traffic volumes along the existing Great Western Highway through Blackheath and Mount Victoria would noticeably improve accessibility, amenity and safety for these townships including for active transport users.

The tunnels would accommodate two lanes of traffic in each direction and are expected to have adequate capacity to cater for predicted growth in traffic volumes in the future. The tunnels would be designed to accommodate larger freight vehicles. The project is expected to provide substantial travel time reductions in the area, along with a number of road safety benefits including improved grades, fewer intersections, wider lanes, improved sightlines, improved overtaking opportunities and separation of opposing traffic flows. Improved grades are also expected to provide better heavy vehicle performance, and by allowing the use of High Productivity Vehicles, the project would result in fewer heavy vehicles but with increased load capacity.

Air quality

Air quality during construction of the project would be adequately managed in accordance with standard mitigation measures.

During construction of the project, the risk of dust soiling for human receptors was considered medium to high at Blackheath construction site due to the proximity of sensitive receptors to the north, and low at Soldiers Pinch and Little Hartley construction sites. Due to the low density of sensitive receptors and low existing PM_{10} (particulate matter equal to or less than 10 micrometres in diameter) background concentrations, unmitigated dust health risks were considered low across all construction sites. Construction traffic emissions and mobile and stationary plant and equipment exhaust emissions are unlikely to have a significant impact on local air quality.

The assessment approach for assessing portal emissions was developed by Transport in consultation with and endorsed by the Advisory Committee on Tunnel Air Quality. Operational air quality impacts were assessed for both tunnel ventilation design options currently being investigated for the project (emissions via ventilation outlets or portals).

In both ventilation outlet and portal emissions scenarios, predicted total ground level concentrations of pollutants were below the NSW Environment Protection Authority's criteria for all pollutants and all modelled scenarios at the most affected receptors. The results of the modelling indicate an improvement in air quality due to the improved traffic flow and reduced traffic volumes along the existing Great Western Highway as a result of traffic diverting to the tunnel, and the reduced gradient in the tunnel compared to the existing Victoria Pass, as well as improved emissions standards. Assessment of ecological impacts for all examined pollutants found no significant air quality related ecological impacts are anticipated from the project for either ventilation option.

Human health

The human health impact assessment focused on health-related impacts associated with air quality, noise and vibration and social impacts of the project.

During construction, unmitigated dust impacts would pose a low risk to community health. With the implementation of appropriate mitigation measures, dust related impacts would be minimised including the potential for associated health impacts such as stress and anxiety. Construction noise has the potential to exceed health-based noise criteria during and outside during standard hours.

With the implementation of noise mitigation measures, the potential for human health impacts from construction noise would be low to moderate. Potential health impacts associated with changes in access and connectivity, property acquisition and changes to visual amenity during construction would be low. The increased employment and improved economic vitality caused by construction of the project would provide potential benefit to community health.

Potential health impacts from changes to ambient air quality during operation include negligible impacts from volatile organic compounds and carbon monoxide, and low and acceptable exposures to benzene, polycyclic aromatic hydrocarbons, diesel particulate matter and PM_{10}. The project would result in potential long term health benefits by decreasing the level of exposure to nitrogen dioxide and $PM_{2.5}$. The proposed in-tunnel air quality limits for carbon monoxide and nitrogen dioxide would be adequately protective of the health of users of the project during operation. The project would result in reduced noise levels at a number of sensitive receptors where the tunnel provides a bypass to the existing Great Western Highway at Blackheath and Mount Victoria. Increases in road traffic noise during operation of the project at levels that may be of concern to health would be limited to two properties. Subject to the implementation of proposed noise mitigation measures, no substantial health impacts are expected for these properties.

Potential health impacts associated with changes in access and connectivity, and changes to visual amenity during construction would be low. The ongoing economic benefits provided by the project, including increased business productivity and increased tourism spend in the area, would provide considerable community health benefits.

Noise and vibration

Construction noise and vibration would be managed through a Construction Noise and Vibration Management Plan to be prepared as part of the Construction Environmental Management Plan (CEMP). The final number, degree and nature of the mitigation measures within this plan would ultimately depend on the construction strategy and work carried out.

During construction, noise levels may exceed noise management levels at some residential receivers, largely near the Blackheath construction site. Most of these noise exceedances are in the range of about one to 10 decibels and would occur mainly during tunnelling and surface road works. A number of exceedances are also predicted during site establishment and tunnel portal construction at Blackheath, also in the range of about 10 decibels. Relatively few exceedances above 10 decibels are predicted to occur, however the majority of these are also at Blackheath. Some night works may also exceed sleep disturbance criteria during construction, particularly near the Little Hartley construction site where around 19 residential receivers may experience some level of sleep disturbance. While most construction activities are expected to occur during standard construction hours it is possible that some noisy construction activities for the project may occur at the same time in close proximity to each other, thereby increasing construction noise levels.

Some receivers located near shallower sections of the tunnel, closer to the tunnel portals are predicted to experience levels of ground-borne noise (noise generated from vibration propagated through the ground) which would exceed the ground-borne noise criteria. Ground-borne noise at these receivers would be temporary (for a few days at a time) as the TBMs progress at an average rate of around 70 to 90 metres per week. As the works are expected to be staged and progressive, the number of affected residential receivers at any one time would be limited.

Construction vibration may be generated due to the vibration intensive equipment to be used during some stages of the project. Equipment size would be selected by the construction contractor and would take into account the minimum working distances and the distance between the area of construction and the nearest receiver. If vibration intensive works are required within these minimum working distances, mitigation measures to control excessive vibration would be implemented.

Operation of the project is expected to result in reduced noise levels at around 2,000 residential receivers located adjacent to the existing Great Western Highway between Blackheath and Little Hartley where the tunnel provides a bypass to the existing surface road. By providing an improved gradient and alignment, the project would also reduce maximum noise levels and events

associated with truck engine braking, exhausts and horns. Two receivers located adjacent to new and upgraded sections of surface road may experience elevated levels of operational road traffic noise. The use of low noise road pavement or at-receiver noise mitigation would be investigated to reduce traffic noise at these receivers.

For the portal emissions design option, 16 receivers at Blackheath may experience exceedances of up to four decibels mainly due to the operation of jet fans located near the Blackheath portal. No exceedances for receivers at Little Hartley are expected. To reduce the noise levels emanating from the tunnel portals, quieter jet fans could be used or the use of attenuators could be investigated.

For the ventilation outlet design option, 26 receivers at Blackheath may experience exceedances of up to five decibels, and two receivers at Little Hartley may experience exceedances of up to four decibels. These exceedances would be caused by the fire pump which would operate under emergency conditions only.

Biodiversity

The project has been designed to minimise biodiversity impacts in the following ways:

- selecting a tunnel option between Blackheath and Little Hartley to minimise surface impacts including vegetation clearance
- the size of the Blackheath and Little Hartley construction sites have been minimised and partially located within the footprints of the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade projects which will have been cleared for construction of these projects, minimising the total impact to vegetation
- use of TBMs rather than road headers meaning that the excavated sections of tunnel are only exposed for a short duration of time before the concrete segments which line the tunnel are installed, minimising groundwater drawdown and potential impacts on groundwater dependent ecosystems.

The key biodiversity impacts include:

- removal of around 9.71 hectares of native vegetation and up to 20 hollow-bearing trees
- potential impacts to habitat for threatened Large-eared Pied Bat, Greater Glider and Purple Copper Butterfly
- potential groundwater drawdown and changes to baseflow within the Greaves Creek sub-catchment during construction and operation of the project, potentially impacting on groundwater dependent ecosystems (GDEs) associated with Temperate Highland Peat Swamps on Sandstone (THPSS) (listed as endangered under both NSW and Commonwealth legislation)
- potential indirect impacts on GDEs resulting from changes to water quality and hydrological processes, particularly from increased runoff volumes from discharge locations at Little Hartley.

There are no impacts to threatened flora. Other potential indirect impacts such as inadvertent impacts on adjacent habitat vegetation and bush rock removal and disturbance can be managed by adopting standard mitigation measures. Opportunities to minimise these impacts would be investigated further during design development, and mitigation measures have been proposed to minimise and/or avoid potential biodiversity impacts which have not been avoided through design.

Residual biodiversity impacts would be offset in accordance with the NSW Biodiversity Assessment Method. Up to 279 ecosystem credits and 510 species credits may be required to offset impacts to threatened fauna, flora and ecological communities.

Groundwater and geology

To limit potential groundwater inflows and groundwater drawdown, the tunnels would be tanked (designed to prevent the inflow of groundwater, typically using concrete lining and waterproofing membranes). Use of TBMs would mean that the excavated sections of tunnel are only exposed for a short duration of time before the concrete segments which line the tunnel are installed.

Impacts to groundwater flow during construction may include localised changes to flow rates and drawdown near the Blackheath portal and mid-tunnel access shaft, adit and caverns. Given the low magnitude and localised spatial extent of groundwater drawdown, the project would have a low impact on regional groundwater flow patterns. Groundwater collected during construction would be treated at construction water treatment plants at Blackheath, Soldiers Point and Little Hartley before discharge. With the application of standard mitigation measures and management plans, construction activities would be low risk and impacts to groundwater quality during construction of the project would be unlikely.

Potential dewatering due to construction activities is predicted to impact baseflow within the Fairy Bower sub-catchment, however this impact would be low given that the greatest predicted baseflow reduction would be during wet periods.

The areas which are most likely to be affected by tunnel excavation induced settlement are where tunnelling is closest to the ground surface (shallowest), around the tunnel portals and entry and exit ramps. The typical predicted settlement at the location of the tunnels would have a negligible ground movement risk during construction. Settlement induced as a result of groundwater drawdown is expected to be negligible.

During operation, groundwater drawdown would occur at permanently drained structures, being the Blackheath and Little Hartley portals and the mid-tunnel caverns. Maximum drawdown is predicted to be between 5.1 to 20 metres and between 2.1 to 5 metres at the Blackheath and Little Hartley portals, respectively. Groundwater drawdown would potentially affect 33 registered bores during operation (2030 to 2130), however modelling shows that no registered water supply bores would experience a maximum drawdown greater than two metres during operation or longer-term. Given the low magnitude and spatial extent of groundwater drawdown, the project would have a low impact on regional groundwater flow patterns. With the application of standard mitigation measures and management plans, activities during operation are considered low risk and impacts to groundwater quality are considered unlikely.

Potential dewatering and changes to baseflow within the Greaves Creek sub-catchment near the Blackheath portal could impact on water availability for water supply purposes at Lake Greaves and Lake Medlow. Reduction in baseflows could also affect GDEs associated with THPSS at Greaves Creek. During further design development and prior to construction, the numerical groundwater model will be updated and the existing groundwater monitoring network will be reviewed and maintained around the project to characterise the hydrogeological environment along and around Greaves Creek and associated GDEs. Subject to the outcomes of further consideration of potential impacts on GDEs, options to avoid and/ or minimise anticipated impacts will be identified and implemented if reasonable and feasible.

Surface water and flooding

Water quality

Construction activities have the potential to temporarily impact the water quality of surrounding waterways and downstream of the project. Erosion and sedimentation management measures and water treatment plant maintenance procedures would be detailed in the CEMP for the project. These measures would be implemented in accordance with Managing Urban Stormwater – Soils and Construction, commonly referred to as the ‘Blue Book’. With the implementation of these controls, potential water quality impacts during construction would be appropriately managed and would be minor.

During operation, there is the potential for increased sedimentation and turbidity, nutrient runoff, visual amenity impacts (from turbid/polluted water), potential pollution, increase in scour and erosion and increase in surface water acidity if surface water runoff is not managed appropriately. These potential surface water runoff impacts would be mitigated through stormwater treatment devices and procedures for spills management. Therefore, the project would not be expected to impact the environmental values and water quality objectives of the receiving environment.

The project is located within the Sydney Drinking Water Catchment. A neutral or beneficial effect (NorBE) assessment has been carried out and has found that the project would have a beneficial effect on water quality in the Sydney Drinking Water Catchment.

Flooding

The project has been and would continue to be designed to avoid potential flooding impacts.

At Blackheath, there would be some overland flow risk during construction due to temporary blockage or diversion of waterways and drainage lines due to construction activities. These temporary impacts would be minor and would be managed through the implementation of standard construction techniques. At Little Hartley, there is potential for inundation and damage to occur during construction if a flood event larger than a one in twenty year flood event were to occur. Site planning would be conducted to minimise potential flooding and scour impacts during construction. The Soldiers Pinch construction site is unlikely to be affected by flooding during construction.

At Blackheath, operation of the project is not expected to adversely impact existing flow path characteristics. At Little Hartley, potential overtopping of the Great Western Highway may occur under a one per cent annual exceedance probability flood event. Drainage design would be further refined as part of design development to mitigate overtopping of the road. Impacts to existing and proposed community emergency management arrangements for flooding would be minimal. Improvements in flood immunity of the existing Great Western Highway at Little Hartley are expected as a result of the project. Key project infrastructure such as tunnel portals are not predicted to be impacted during nominated flood events.

Soils and contamination

Soils

Construction of the project would temporarily expose the natural ground surface and subsurface through the removal of vegetation, excavation and compaction of topsoil. The temporary exposure of soil to water runoff and wind could result in soil erosion. There is the potential that exposed soils and other unconsolidated materials (such as spoil, sand and other aggregates) could be transported from the construction sites into surrounding waterways via stormwater runoff. Erosion controls would be implemented and managed in accordance with relevant guidelines to manage this risk and achieve a beneficial effect on receiving watercourses.

It is unlikely that saline or acid sulfate soils would be encountered during construction. Potential oxidation and/or runoff from stockpiles comprising acid sulfate rock at Little Hartley during construction excavation, earthworks and tunnelling could occur. An Acid Sulfate Rock Management Plan will be prepared in accordance with the appropriate acid sulfate soil management guidelines.

During operation, soil would generally not be disturbed.

Contamination

No areas likely to be affected during construction have been identified as having a high risk of potential contamination. Areas identified as having a medium risk of potential contamination would be subject to targeted site investigations during ongoing design development. Where required, remedial actions will be developed for contamination identified through targeted site investigations.

Given the majority of the project tunnels would be constructed within bedrock and the majority of the tunnel would be tanked to minimise groundwater ingress, the potential for contaminated groundwater to be intercepted would be low. The potential to encounter coal seam gas during

tunnelling would be mitigated through measures such as advance investigation and monitoring, and possibly gas drainage (depressurising the coal seams of gas and water).

Aboriginal cultural heritage

The key design feature adopted to minimise impacts on Aboriginal heritage was selection of a tunnel option between Blackheath and Little Hartley to minimise surface disturbance and the potential to impact Aboriginal heritage sites located along the Great Western Highway.

No direct Aboriginal cultural heritage impacts are anticipated as a result of the project. Vibration from tunnelling is unlikely to impact artefact-bearing deposits near the ground surface as the tunnels are deep enough as to not impact subsurface deposits. One Aboriginal cultural heritage within the minimum working distances for some types of vibration intensive plant consists of individual stone artefacts within or adjacent dirt roads regularly traversed by vehicles, and therefore potential impacts from vibration are unlikely. Based on the settlement analysis, predicted settlement calculations indicate that no known Aboriginal heritage items would be affected by settlement.

Transport recognises the potential for the project to indirectly impact Aboriginal cultural heritage values. A preliminary Aboriginal Narrative Report and Body of Story Report has been prepared for the Upgrade Program to assist with the interpretation and integration of intangible Aboriginal cultural values identified during Aboriginal consultation and exploratory workshops by giving Aboriginal communities a voice in the design of the Upgrade Program. The report includes a series of core narratives and stories and outlines a set of overarching cultural design principles to inform the projects design principles. These highlight opportunities to develop a design that would deepen the understanding of place and the rich history of the Aboriginal cultural, spiritual and physical connection to the area and importantly will facilitate greater Aboriginal visibility.

Consultation was undertaken with Aboriginal stakeholders including Local Aboriginal Land Councils during preparation of the assessment, along with consultation with Registered Aboriginal Parties, who attended site surveys.

If unexpected items of potential Aboriginal cultural heritage significance, including potential Aboriginal burials or skeletal material, are discovered during construction of the project, all relevant activities will cease and the unexpected/chance finds requirements specified in the Unexpected Heritage Items Procedure will be followed.

Non-Aboriginal heritage

The project would not directly impact the Greater Blue Mountains World Heritage Area. Potential indirect impacts to this item would include temporary visual impacts during construction at the Soldiers Pinch construction site.

The Blackheath construction site and north-eastern portion of the Soldiers Pinch construction site are located within the Greater Blue Mountains Area (Additional Values), an item nominated for the National Heritage List. Biodiversity values related to this nominated item include high condition native vegetation. During construction of the project, there would be minor impacts to this nominated item associated with vegetation clearance at the Blackheath and Soldiers Pinch construction sites. Opportunities to minimise the extent of native vegetation clearing within the footprint of the Greater Blue Mountains Area (Additional Values) nominated item will be considered during further design development.

The Little Hartley construction site would result in moderate indirect visual impacts to the Rosedale local heritage item, and potential moderate impacts on archaeology at the Mount Victoria Stockade site (archaeological site) during construction. Subject to confirmation of the precise location of the site of the Plough Inn (archaeological site), there may also be potential major impacts on archaeology from construction at the Little Hartley construction site. Based on current construction programming, impacts from the Little Hartley to Lithgow Upgrade project on the Plough Inn site are likely to occur before commencement of the project.

A detailed archaeological survey will be carried out within those parts of the Mount Victoria Stockade site and the potential Plough Inn site that would be directly affected by construction of the project, and which have not been previously disturbed/ surveyed by the Little Hartley to Lithgow Upgrade project.

If unexpected items of potential non-Aboriginal heritage significance are discovered during construction of the project, all relevant activities will cease and the unexpected/chance finds requirements specified in the Unexpected Heritage Items Procedure will be followed.

The project may result in potential indirect visual impacts to heritage items from the addition of operational infrastructure at the tunnel portals, such as the tunnel operations facility at Blackheath, water treatment plant and substation at Little Hartley, landscaping and ventilation outlets (if selected as the ventilation design). The Rosedale heritage item would likely be visually impacted by elevated project elements including mainline carriageways, operational ancillary facilities and tunnel portals proposed at Little Hartley. Vegetation screening including retention of existing mature trees proposed as part of the project would serve to provide a visual screen of operational infrastructure and help to reduce the visual impact of the project at Rosedale.

Landscape and visual

Construction of the project would result in moderate to high (adverse) impacts to landscape character. At Little Hartley in particular, the Little Hartley construction site and adjacent Little Hartley to Lithgow Upgrade would impact the rural valley centred around Butlers Creek, including the presence of large equipment, activities and ancillary facilities within the landscape. At Blackheath, the extension of vegetation clearing from the Katoomba to Blackheath Upgrade would result in the spatial widening of the Great Western Highway, with a distinct shift in the local character of the area within the Great Western Highway corridor and within the local area of bushland to the east, within the Blue Mountains National Park. Mitigation measures such as establishing tree protection zones around trees to be retained would be implemented to minimise impacts during construction.

Road users on the Great Western Highway, including tourists or those accessing recreational attractions, would have prominent views of the Blackheath construction site as well as a widened road corridor due to vegetation clearance. At Blackheath, a small number of residents on Evans Lookout Road between Valley View Road and the Great Western Highway would be able to see the Blackheath construction site fencing and hoarding from the rear of their properties. At Soldiers Pinch, road users would have limited views of the construction site.

At Little Hartley, road users and a small number of residents would see construction works at the Little Hartley construction site. A small number of residents would be able to view the construction site and associated work from their properties on the Great Western Highway in Little Hartley. Construction activities and/or machinery that would be visible to these receivers include lighting required for night-time works, TBM operations, an acoustic shed and other large construction infrastructure. Mitigation measures including tree protection, providing cut-off or directed lighting at construction sites, and keeping construction sites clean and tidy would be implemented to minimise impacts during construction.

During operation, the project would be in tunnel for the majority of its length, which generally limits the potential for landscape character and visual impacts to the areas around the tunnel portals where surface works and operational infrastructure are proposed. At Blackheath, visual impacts are considered to be moderate (adverse), as the increased width of the Great Western Highway corridor, portal, tunnel operations facility and ventilation outlet (if selected as the ventilation design) would result in substantial long-term changes uncharacteristic of the surrounding environment.

At Little Hartley, considering the picturesque character of the Little Hartley valley, the high volume of tourist traffic and activity and recreational hiking trails nearby, visual impacts from the ventilation outlet (if selected as the ventilation design), water treatment plant and the substation are also considered to be moderate (adverse). Landscaping and other measures, such as considering murals and surface decoration of ventilation outlets (if selected as the ventilation design), and

landscaping imitating pockets of native and exotic trees, would be considered to reduce potential landscape character and visual impacts.

Social impacts

The main social impacts associated with construction of the project would relate to community health and wellbeing, including increased stress due to construction impacts, impacts to the way in which residents and visitors experience their surroundings due to temporary reductions in local amenity, and impacts on elements which the community have identified as being highly valued - including the natural environment, community facilities and services, social interaction and the quiet local character of the area. These impacts are mainly temporary and would be managed through the implementation of appropriate mitigation measures for other issues, including transport and traffic, noise and vibration, landscape character and visual amenity and air quality.

Operation of the project would result in a number of positive social impacts, with the majority of potential negative impacts considered to be low risk. By diverting a substantial proportion of traffic (including freight) into the project tunnels, the project would allow the existing Great Western Highway to mainly cater for local traffic which would substantially improve movement for residents in and around Blackheath and Mount Victoria. A reduction in traffic on the existing Great Western Highway would improve people's ability to safely and efficiently interact in the local area, particularly in Blackheath and Mount Victoria.

A Social Impact Management Plan (SIMP) will be prepared and implemented during construction and for the first three years of operation of the project. The SIMP will be prepared in consultation with the relevant local councils and will guide monitoring and adaptive management of social impacts resulting from the project.

Business, land use and property

Given that the project largely comprises underground infrastructure and generally follows the existing Great Western Highway alignment, potential impacts to business, property and land use have largely been avoided.

Potential business impacts due to construction of the project would be more than offset by the increased economic activity related to the capital expenditure during construction. Local businesses would experience potential flow on impacts from construction including a temporary uplift in local commercial accommodation occupancy, retail revenue as a result of spending from construction workers, and local construction business revenue. The project would also have positive regional economic and employment impacts, creating up to $130 million dollars in value added annually.

Construction land use impacts would be mostly temporary in nature. The project has been designed to minimise property acquisitions, however some permanent acquisition would be required for the Upgrade Program, including two private properties (across multiple Lot/DPs) required for the project at Little Hartley.

Operation of the project is expected to increase tourism expenditure within the region, benefitting accommodation and other local businesses. Downturns in passing trade are expected to be short-term, and the long-term impacts on passing trade would generally be positive. Transport would identify opportunities such as the development and implementation of a directional signage strategy for the project, which would encourage visitors to areas that are bypassed by the project. The regional economy is expected to be positively impacted during operation, with between around $8 million and $10 million in value added annually.

The location of operational infrastructure has been designed to minimise potential land use impacts, including locating operational infrastructure as close to the tunnel portals as possible. The project would create potential opportunities for placemaking initiatives by reducing through traffic, including freight vehicles, at key locations along the Great Western Highway, particularly at Blackheath and Mount Victoria. This would include consideration of opportunities to improve at-surface active transport infrastructure between Blackheath and Little Hartley, connecting to the active transport trails to be delivered by the Katoomba to Blackheath Upgrade and Little Hartley to

Lithgow Upgrade in consultation with the relevant councils. This active transport infrastructure would be subject to separate assessment and approval and may be delivered by others.

Resource use and waste management

The CEMP prepared for the project will include specific measures and procedures for managing project waste materials, detail waste reporting requirements and the process for identifying waste re-use sites. A Spoil Management Plan would also be prepared for the project, detailing spoil haulage routes, opportunities for spoil reuse, and confirmed spoil disposal sites.

The resource requirements of the project have the potential to temporarily impact resource availability within the Blue Mountains region over the construction period. However, the period between the approval of the project and the start of major construction would be sufficient to allow the market to prepare for the needs of the project in conjunction with the resource needs of other infrastructure projects being constructed in NSW. The preferred option for project water supply is to source water from Lithgow via a pipeline delivered as part of the project.

The largest waste stream associated with construction of the project would be spoil generated from the excavation of the tunnels in excess of what can be reused for the project. It is estimated that the project would generate around 7.8 million tonnes of spoil during construction. Excess spoil would be reused within the project, for the other adjacent or nearby Transport projects, or removed from site for appropriate off-site reuse.

Options for resource recycling would continue to be investigated during ongoing design development and would include consideration of alternatives for high impact resources such as concrete, aggregates and steel.

Materials used for the operation of the project would be limited to those required for ongoing maintenance activities, and for the operation of the tunnel operations facility and support facilities. The volume and type of waste would be typical of an operational tunnel and could be accommodated by existing waste management facilities. With the implementation of standard waste management practices, the overall impact of operational waste streams would be minimal.

Hazards and risk

Potential hazards during construction may be associated with bushfires, storage, use and transportation of dangerous goods and hazardous substances, damage or disruption of utilities and services, potential release of coal seam gas as a result of tunnelling activities, and worker health and safety risks including tunnel hazards, rock falls and the operation of mobile plant and other machinery. These potential impacts would be managed in accordance with standard mitigation measures including a Bushfire Management Plan, and the development of an Incident Response Management Plan.

Potential hazards during operation of the project include those associated with bushfires and other natural disasters, storage, use and transportation of dangerous goods and hazardous substances, and worker safety including the operation of mobile plant and other machinery. Operational ancillary facilities would be located and designed taking into account Planning for Bush Fire Protection and AS3959-2018 guidelines which prescribe minimum setback distances for infrastructure near bushfire prone land.

A decision on whether vehicles carrying dangerous goods would be allowed to travel through the tunnel would be made during ongoing design development. The capacity of fire and life safety measures to manage potential dangerous good incidents would be confirmed at that time. Safety hazards during operational activities would be managed by the implementation of the Bushfire Management Plan and Incident Response Management Plan. Should there be planned or unplanned shutdowns of either the project or the existing Great Western Highway due to an incident or emergency, the other road would function as an alternative route for traffic.

Sustainability, climate change and greenhouse gas

Climate change risk assessment

Climate change risks were identified for key climate hazards (extreme heat, bushfire, drought, extreme rainfall and flooding, and extreme storms).

Potential mitigation and adaptation measures were identified to address all high and severe risks, and the majority of medium risks. These measures will be considered for implementation in later phases of the project. Of the one high risk and one medium risk identified for project construction, proposed adaptation measures have resulted in a residual risk rating of two medium risks. These risks relate to increased extreme heat days and increased storm intensity, and examples of adaptation measures include limiting work hours during extreme weather conditions to minimise health and safety risks to construction workers.

For project operation in 2030 (to assess short-term impacts of climate change) and 2090 (to assess long-term impacts of climate change), proposed adaptation measures have resulted in all severe and high risks lowered to a residual risk rating of medium or low. These adaptation measures may include incorporating First Nations burning practices into operational maintenance plans to minimise the risk of extreme bushfires and selecting drought- and heat-tolerant vegetation, especially native species, for project landscaping to reduce temperature and drought impacts.

This assessment of climate risks would be reviewed and updated during future stages of the project lifecycle to ensure new and emerging risks are addressed and appropriate controls have been implemented.

Sustainability

Sustainability of the project will be assessed in accordance with the Infrastructure Sustainability Council Rating Tool. The project is seeking a minimum Infrastructure Sustainability 'Design' and 'As-Built' rating of 'Excellent', through the application of version 1.2 of the tool. Version 2.1 credits would be applied where beneficial to achieving sustainable project outcomes.

Sustainability initiatives have been identified for planning and design consideration to embed specific sustainability commitments and targets for implementation by the construction contractor. An Infrastructure Sustainability Management Plan will be prepared and implemented during detailed design and construction of the project to guide the implementation of sustainability initiatives. The Plan will detail how the project will achieve an Infrastructure Sustainability rating of 'Excellent'.

Greenhouse gas assessment

Construction of the project is estimated to produce around 1,407,140 tonnes of carbon dioxide equivalent emissions (t CO_2e). The difference in greenhouse gas emissions during construction between the two ventilation options would be negligible. The majority of emissions during construction are estimated to occur from the large electricity requirements of the tunnelling plant and equipment over the construction period.

For the ventilation outlet option, operation and maintenance of the project is estimated to produce around 3,550,000 t CO_2e emissions over a nominal 100-year operational period. For the portal emissions option, operation and maintenance of the project is estimated to produce around 1,300,000 t CO_2e emissions over a nominal 100-year operational period. The majority of operational emissions are expected to occur from electricity consumption of the project's ventilation, lighting and other electrical equipment.

Opportunities to minimise greenhouse gas emissions from the project will be identified as part of further design development and will be implemented during construction and operation where reasonable and feasible. These opportunities may include selecting construction materials with reduced embodied greenhouse gas emissions, through reduced materials use, lower emissions construction materials, and/ or local sourcing of materials and selecting plant and equipment with lower fuel/ electricity consumption and/ or greater energy efficiency.

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 impact (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 interact with the project may enhance the project and create positive cumulative benefits.

The potential cumulative impacts of the project and the other components of the Upgrade Program, including the Katoomba to Blackheath Upgrade, the Great Western Highway Upgrade – Medlow Bath (Medlow Bath Upgrade) and the Little Hartley to Lithgow Upgrade are shown in Table 4.

Table 4 Summary of potential cumulative impacts

Environmental aspect	Cumulative impact
Transport and traffic	A temporary localised increase in congestion, poor intersection performance, and more extensive speed limit reductions as a result of overlapping construction activities associated with the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade, which are due to be complete in 2027 and 2026 respectively. Longer term cumulative impacts following completion of the project, the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade include substantial travel time savings for heavy vehicles, reductions in travel times, and increases in average vehicle speeds between Katoomba and Lithgow.
Air quality	Potential cumulative dust impacts as a result of overlapping construction activities associated with the Katoomba to Blackheath Upgrade and Little Hartley to Lithgow Upgrade. During operation in both ventilation outlet and portal emissions scenarios, predicted total ground level concentrations were below the NSW Environment Protection Authority's criteria for all pollutants and all modelled scenarios at all receptors.
Noise and vibration	Sensitive receivers located near where the project overlaps with the Katoomba to Blackheath Upgrade (at Blackheath) and the Little Hartley to Lithgow Upgrade (at Little Hartley) may be affected by cumulative construction noise. Operation of the Upgrade Program is expected to result in reduced noise levels at around 2,000 residential receivers where the tunnel provides a bypass to the existing surface road between Blackheath and Little Hartley. Some receivers located adjacent to where new and upgraded sections of surface road are proposed may experience elevated levels of operational road traffic noise. Where predicted cumulative traffic noise levels exceed criteria, mitigation options for noise affected receivers will be considered.
Biodiversity	Potential cumulative biodiversity impacts associated with native vegetation removal and the removal of hollow-bearing trees from the project and other components of the Upgrade Program, including removal of up to 128.52 hectares of native vegetation and 369 hollow-bearing trees across all four components of the Upgrade Program.

Environmental aspect	Cumulative impact
Groundwater and geology	Potential cumulative groundwater drawdown impacts associated with areas of proposed cutting/excavation during construction of the Little Hartley to Lithgow Upgrade and the project's tunnel portals at Little Hartley would be negligible.
Surface water and flooding	Potential cumulative water quality impacts due to the increase in impervious surfaces from operation of the Katoomba to Blackheath and Little Hartley to Lithgow Upgrade.
Aboriginal heritage	Potential cumulative impacts to 22 Aboriginal sites. These sites are of increased significance due to their rarity in an increasingly developed environment. The Aboriginal cultural heritage values across the Upgrade Program would be reduced if complete loss of these sites was to occur. Potential negligible or indirect impacts to a site are not considered to be a risk for cumulative impacts to the region's Aboriginal cultural heritage.
Non-Aboriginal heritage	Potential cumulative impacts to the site of Plough Inn archaeological site from construction of the Little Hartley to Lithgow Upgrade and the project (noting the precise location of the Inn is not certain, and it is possible that the Inn will be outside of the construction footprint of both the Little Hartley to Lithgow Upgrade and the project).
Landscape and visual	Potential visual and landscape character impacts at Blackheath and Little Hartley associated with increased construction sites and the length of time construction activity would occur at these locations from the project and other components of the Upgrade Program. The scale of the widened road corridor and the larger pieces of infrastructure that would be added to the landscape as part of the Upgrade Program would be uncharacteristic with the existing landscape setting.
Social	Potential adverse cumulative impacts during construction on people's way of life and ability to move around associated with increased congestion, poor intersection performance and reduced travel speeds, impacts to people's sense of place and wellbeing, impacts to the natural landscape (vegetation removal) which is valued by the community, and potential construction fatigue. Cumulative construction impacts may result in improvements to people's capacity to earn an income and associated benefits to livelihood, as some retail and construction businesses would experience higher levels of spending across the Upgrade Program. Cumulative social impacts during operation primarily consist of social benefits as a result of substantial travel time improvements and decreases in congestion on the existing Great Western Highway as a result of the Upgrade Program, including improved accessibility and substantial safety and amenity improvements.

Environmental aspect	Cumulative impact
Local business and economics	Flow-on benefits on the local and regional economies from cumulative capital expenditure and number of workers associated with the project and other components of the Upgrade Program, including higher levels of spending over the duration of construction. During operation, increased productivity for local workers and improved accessibility and attractiveness for local tourists are expected as a result of substantial travel time reductions and increased vehicle speeds through the Blue Mountains.
Sustainability, climate change and greenhouse gas	Cumulative greenhouse gas emissions during construction of the project and the Little Hartley to Lithgow Upgrade are equivalent to 0.096 per cent of total NSW annual emissions in 2020. Cumulative greenhouse gas emissions during operation of the project and the Little Hartley to Lithgow Upgrade are equivalent to 0.027 and 0.011 per cent of total NSW annual emissions in 2020 for the ventilation outlet and portal emissions options respectively. While the Katoomba to Blackheath Upgrade and Medlow Bath Upgrade greenhouse gas emissions haven't been quantified, these would be of a similar order of magnitude as the Little Hartley to Lithgow Upgrade.

There is the potential for some receivers, particularly at Little Hartley and Blackheath, to experience construction fatigue associated with overlapping construction activities from the Little Hartley to Lithgow Upgrade and Katoomba to Blackheath Upgrade. Opportunities to minimise and manage cumulative impacts across the Great Western Highway Upgrade Program will be identified in consultation with other projects in the Upgrade Program, and implemented where reasonable and feasible. Key focus areas for the minimisation and management of cumulative impacts will include:

- construction planning and staging, including coordination of constructive activities and provision of respite periods to manage construction fatigue
- stakeholder notification and engagement activities, with a focus on managing construction and engagement fatigue
- construction amenity issues, particularly in relation to construction traffic, dust, noise and vibration
- avoidance and minimisation of impacts on biodiversity, Aboriginal heritage and non-Aboriginal heritage, including consolidated monitoring and/ or offsets where relevant
- coordination of waste and resource management, including spoil/ cut-and-fill balances, surface water and water supply requirements, recycling and sustainability initiatives.

Environmental management

A CEMP will be prepared for the project and may be developed as a series of complementary and coordinated CEMPs to address specific construction sites, construction activities or stages during the construction period. The CEMP(s) will detail the approach to environmental mitigation, management, monitoring and reporting during construction of the project. The CEMP(s) will provide a consolidated environmental management framework, supplemented by more detailed sub-plans and other documentation focused on key environmental issues during construction.

Key issues that will be addressed in the CEMP(s), where relevant, will include:

- minimisation and management of air emissions, including dust generation and emissions from plant and equipment
- minimisation and management of noise and vibration, including construction scheduling, protocols for the management of noisy activities outside standard construction hours, protection of sensitive structures and receivers from vibration, and management of ground vibration during tunnelling
- management of construction traffic, including site access arrangements and minimisation of impacts associated with heavy vehicle movements, including spoil haulage
- management of water, including surface, groundwater and wastewater, treatment and reuse standards, discharge locations and requirements, mitigation and management of erosion and sedimentation risks and management of works within areas prone to flooding
- protection of Aboriginal and non-Aboriginal heritage during construction, procedures for managing and salvage of archaeology where relevant, and protocols for the management of unexpected finds
- protection of biodiversity within and around construction sites
- mitigation and management of potential impacts on social infrastructure and businesses, including access requirements, notifications and engagement, and property impacts
- management of waste, including transport and disposal requirements, and resource efficiency and sustainability measures.

During operation, the project's environmental performance would be managed under Transport's existing environmental management system (or similar), prepared in accordance with the AS/NZS ISO 14000 Environmental Management System series. Detailed operational policies and procedures specific to the project would be developed consistent with the environmental management system, and to reflect project-specific requirements arising from the assessments presented in this EIS, conditions of approval that may be applied to the project, and other issues that may arise through ongoing consultation with stakeholders. Performance outcomes and project specific environmental mitigation measures for the project are listed in Appendix R (Compilation of environmental mitigation measures).

A Stakeholder Engagement Strategy 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 will include updates on planned construction activities and will respond to concerns and enquiries in a timely manner, seeking to minimise potential impacts where possible.

Next steps

The NSW Department of Planning and Environment (DPE) has placed this EIS on public exhibition. During this exhibition period project stakeholders and community members can review the EIS and make a written submission to DPE for consideration in its assessment of the project.

Copies of submissions made during exhibition of the EIS would be provided from the Secretary for DPE to Transport as the proponent. The Secretary will then require Transport to respond to issues raised in submissions through a submissions report, and an amendment report (where required) to outline any proposed changes to the project.

DPE would prepare the Secretary's environmental assessment report and provide it to the Minister for Planning, who would then decide whether to approve the project. If approved, the Minister would identify a set of conditions of approval for Transport to adhere to during construction and operation of the project.

The next steps in the assessment and approval process are shown in Figure 10. During the assessment process, Transport will continue to engage with community and key stakeholders regarding development of the project.

At the time of finalisation of this EIS there has been no decision by DCCEEW on whether the project is a controlled action or not. If the project is not determined a controlled action, Transport is not required to provide a separate assessment of the project under a Commonwealth approval pathway. If the project is determined a controlled action, Transport will need to prepare a draft environmental assessment under the EPBC Act to assess the project under additional requirements as required.

If the project is approved, Transport would engage a construction contractor(s) to carry out design development and construction of the project. Communication and engagement with stakeholders and the community during project construction would be the responsibility of Transport and the construction contractor. Community engagement during construction of the project would include engagement carried out for the other components of the Upgrade Program which would be under construction at the same time as the project.

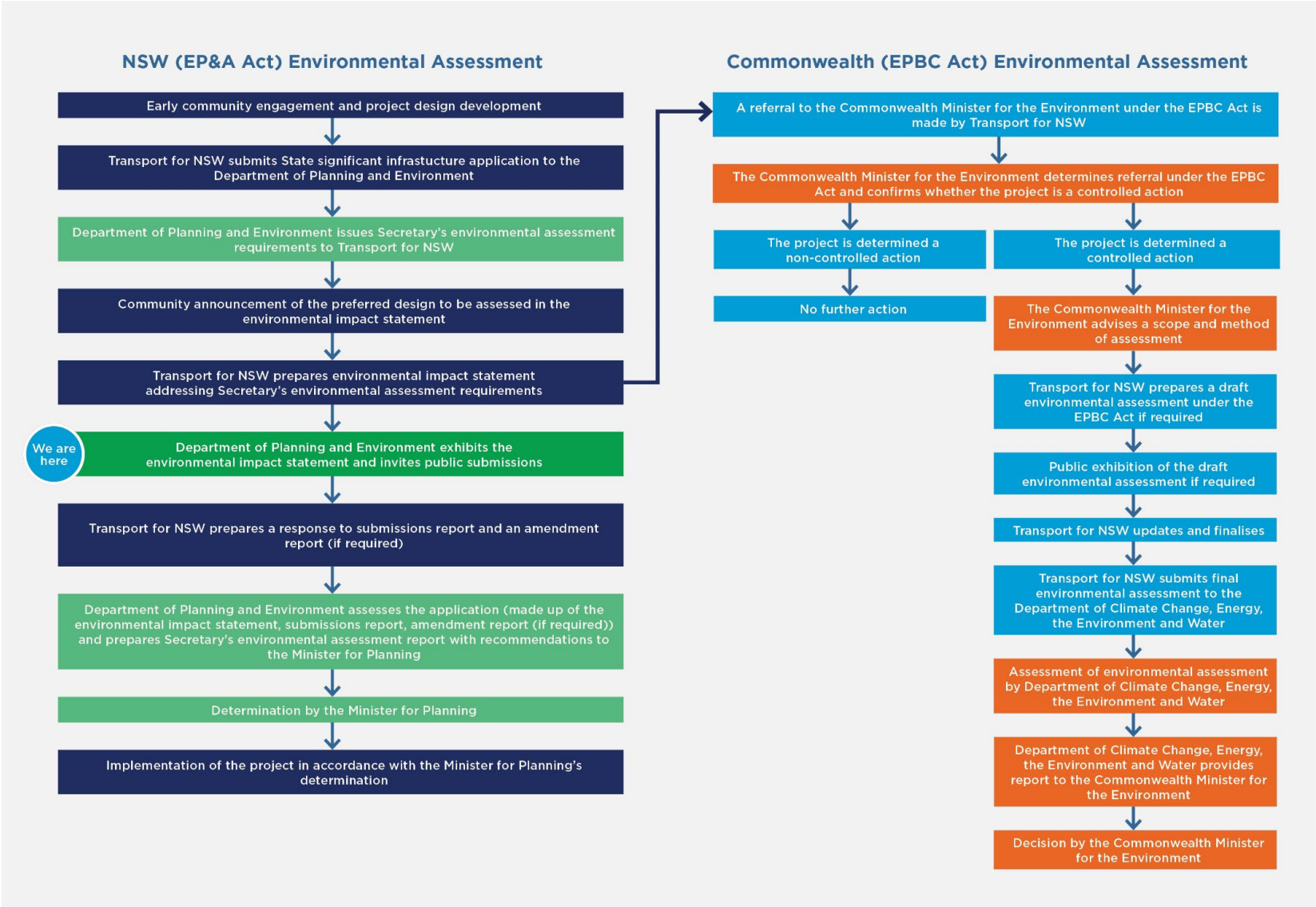


Figure 10 Assessment and approvals process for the project