

Lithgow City Council

Wolgan Valley Access Road

Corridor Assessment Report

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Wolgan Valley Access Road Corridor Assessment Report

Lithgow City Council

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

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Our ref: PS129742-SYD-GEO-REP-102-REV 00

19 December 2022

Confidential

Jonathon Edgecombe
Director Infrastructure Services
Lithgow City Council
180 Mort Street
Lithgow, NSW 2790

Dear Jonathon

**Wolgan Valley Access Road
Corridor Assessment Report**

WSP are pleased to provide this assessment report which examines the three identified corridors and assesses these against the constraints documented in our previous constraints study.

Based on the findings, the Southern Corridor, located immediately north of Wolgan Gap, is the most favourable of the three corridor alternatives assessed in which to develop route options. Those route options would be subject to a detailed assessment to select a preferred route for the new Wolgan Valley access.

We would be delighted to provide ongoing support to Council for the next phase and leverage the learnings we have made since the project started. We would be happy to provide a fee offer for the next stage of the route assessment and for advice on the planning approvals and procurement methods to expedite the earliest start for construction of the new access road.

Yours sincerely

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Executive Summary

Lithgow City Council (Council) has engaged WSP to provide assistance with finding a long-term resilient access route into the Wolgan Valley. The existing access from Castlereagh Highway via Wolgan Road has been subject to many rockfalls and landslips. As of the date of this report, the road is closed due to slope instability within the approximately 2 km section of Wolgan Road descending from the Wolgan Gap lookout. Slope hazards over that section of the road, including rockfall and landslide, present a risk to road users which is poorer than the tolerability criteria defined by Council. In addition, those hazards obstruct safe access for the investigation required to design remediation and mitigation measures and would impede the safe construction of those remediation and slope hazard mitigation measures.

Even if remediation and mitigation measures were limited to targeting slope hazards that currently present a residual loss of life risk below Council's risk tolerability thresholds the cost of the works is likely to be in the order of multi-million dollars of capital expenditure. However, the road would still remain subject to significant rockfall and landslide hazards and be prone to periodic closures. Furthermore, the annualised cost of repairs from rock fall and landslide damage to the road formation, pavement, drainage infrastructure and street furniture (e.g. guardrails) is expected to exceed industry property risk tolerability thresholds. As such, Council has decided that rehabilitation of the existing closed section of the route is not a viable option on the basis of safety, cost, residual loss of life risk, residual property risk and resilience.

In November, WSP prepared a high-level constraints study (Refer report PS129742-SYD-GEO-REP-101 REV 00) to identify and discuss the key constraints that would need to be considered when choosing an alternative route into the Wolgan Valley. That study identified constraints which are broadly categorised as environment, engineering or cost constraints. This current study has compared three possible corridors within which a future access road could be built against those constraints. An Eastern Corridor, based on the former rail route and old Coach Road, a Northern Corridor from Glen Davis and a Southern Corridor following the existing Wolgan Road through Wolgan Gap were assessed.

Based on consideration of a range of environmental, engineering and relative cost factors, but primarily due to its shorter length and shortest overall distance from Lithgow, the conclusion of this study is that the Southern Corridor offered the most favourable corridor in which to develop a new access road into the Wolgan Valley.

The next step in the development of a long-term resilient access route into the Wolgan Valley is the identification of route alignment options within the preferred corridor. That step will require more detailed evaluation of the key constraints described herein. In conjunction with that evaluation, it is expected that the completion of an REF or EIS will inform selection of a preferred route alignment. Depending on the specific nature of the works and its impacts, assessment in the form of an REF with Council as the Determining Authority might be possible.

The procurement method adopted will impact the timing and detail of investigations and design and ultimately influence timeframes for delivery of the new road. Hence, our recommendation is that Council start considering options for procurement of the final construction. Typically, our experience is that both Early Contractor Involvement and Design and Construct methods offer overall savings in delivery time frames, compared to conventional detailed design followed by a Construct only contract.

1 Project background

1.1 Introduction

Lithgow City Council (Council) has engaged WSP to provide assistance with finding a long-term resilient access route into the Wolgan Valley. The existing access from Castlereagh Highway via Wolgan Road has been subject to many rockfalls and landslips. As of the date of this report, the road is closed due to slope instability within the approximately 2 km section of Wolgan Road descending from the Wolgan Gap lookout. Refer to Figure 1 which is a map showing the extent of Wolgan Road from the junction with Castlereagh Highway west of Lithgow up to Newnes.

The Wolgan Valley includes private residences, farms, tourist destinations including Emirates One & Only, a luxury resort located near the Wolgan River. The Newnes area grew out of the Commonwealth Oil Shale Company operations at Newnes Junction. The ruins of the shale oil mine processing are a popular attraction to this day.

Wolgan Valley is formed by the Wolgan River in mountainous country. The river flows generally east, joining the Capertee River, and then becomes the Colo River. The Wolgan Valley includes sections of Wollemi National Park, Gardens of Stone National Park and the UNESCO declared Greater Blue Mountains World Heritage Area.

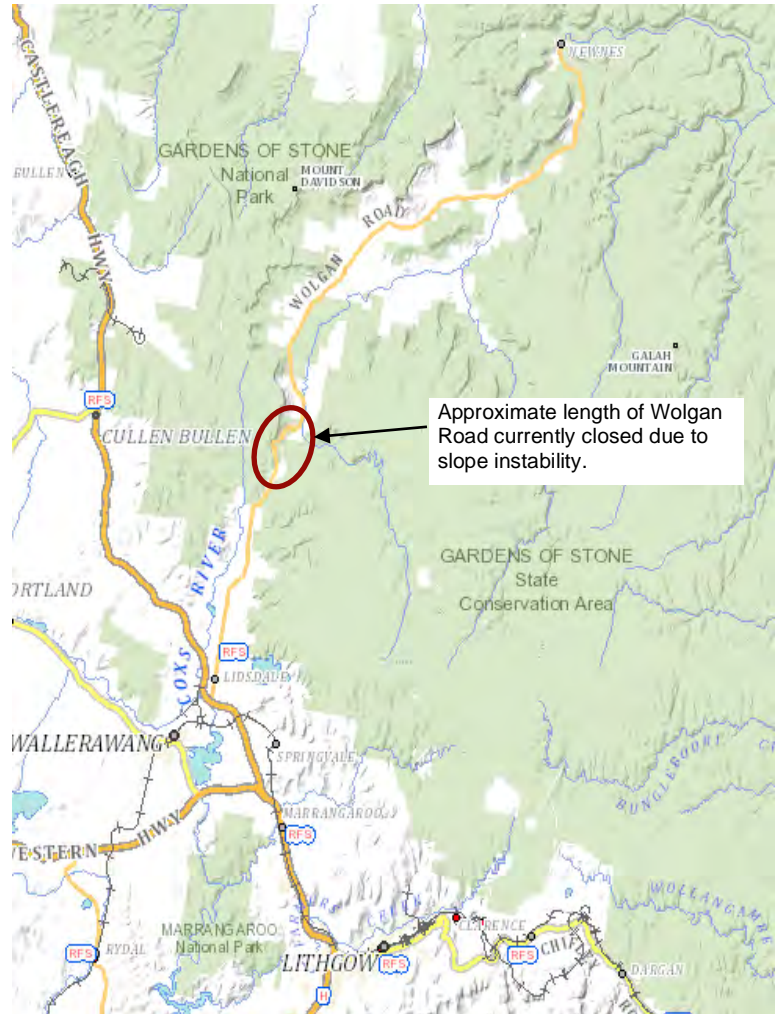


Figure 1: Location of Wolgan Road

1.2 Background

The section of Wolgan Road that traverses Wolgan Gap has a history of rockfall and slope instability and is shown in Figure 2. The section is around 2.8km in length and comprises several undesirable alignment elements, such as:

- steep grades downhill into the valley (up to 18%)
- tight curve radii (as low as 12m)
- narrow cross section.

These elements are evident in Figure 3 below.

The route traverses the western slopes of the valley, tightly following the gullies and ridges. In the past, the primary slope instability risk has been from the cliff

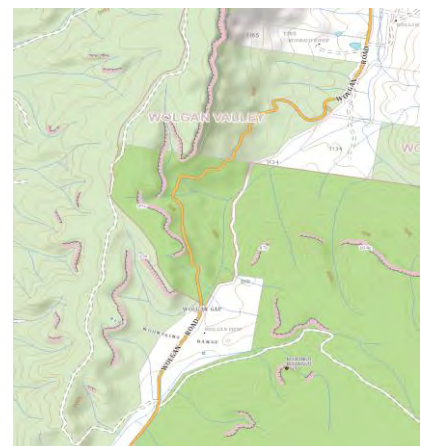


Figure 2: Section of Wolgan Road subject to instability

lines above in the form of rockfalls and landslides. In the previous 2 years the frequency and magnitude of both upslope and downslope instabilities affecting the road have increased, such that the majority of the 2.8 km section of pavement is experiencing some form of displacement and deformation relating to on-going slope processes.



Figure 3: Section of Wolgan Road subject to instability (image dated February 2010; prior to current instability)

1.3 Definition of the problem

1.3.1 Description of slope instability

The section of Wolgan Road shown in Figure 2 is currently closed (as of 11 November 2022). Emergency access is available via the Northern Emergency Access/Egress (Old Coach Road) with vehicles chaperoned as per NSW National Parks and Wildlife Service's plan. By the end of 2022, Council intends to construct a new emergency access following the Donkey Steps path on the eastern side of the valley through which the currently closed section of road passes.

The picture in Figure 4 on the right shows the rockfall typical of this section of Wolgan Road which periodically requires closure for clean-up (for the example shown the estimated volume of clean-up required was less than $< 50 \text{ m}^3$).

There are several sections of the road supported on embankments that have partially collapsed on the downslope side, narrowing the road to a single lane, such as is shown in Figure 5 below.

Figure 6 below shows a site of instability where approximately 250 m^3 of material required removal from the road in early November 2022. At the same location, upslope site inspection by WSP on

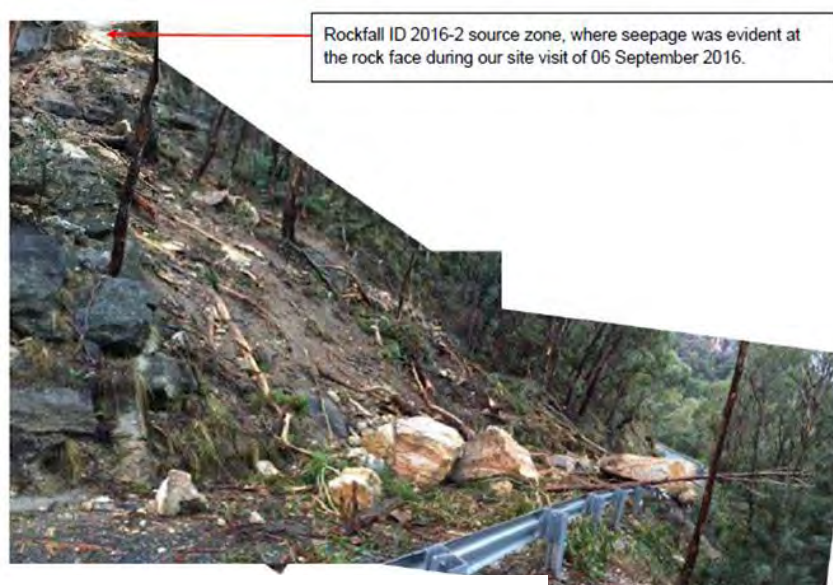


Figure 4: Rockfall blocking Wolgan Road - 2016

11 November 2022 revealed signs of a potential major instability mechanism (i.e. formation of an approximately 50 m wide, 1.5 m high scarp approximately 20 m upslope of the vegetated crest shown in Figure 6). The results of high resolution LiDAR survey undertaken on 15 November 2022 of that area, and comparison of that survey with previous LiDAR survey undertaken in August 2022, confirmed the presence of an active landslide that has resulted in cracking and movement of slope material extending up to approximately 100 m upslope of road level. In addition, the November 2022 LiDAR survey confirmed additional slope movement adjacent and downslope of the main body of the landslide. A potential displaced volume of more than $50,000 \text{ m}^3$ is considered conceivable for the landslide mechanism evident at that location, possibly extending beneath and downslope below the road.



Figure 5: Loss of downslope lane - 2022



Figure 6: Slip debris evident on 11 November 2022

The road has been closed on previous occasions due to landslips and rock and tree falls, as documented in local newspaper records...

"blocked roads...rubble and rocks...while crossing the area large rocks continually slipped free of the mountainside and bounded down the hillside...because the conditions were so critical the police closed the road to traffic. Inspector Lind said it was impassable except on foot or horseback...even if it were properly cleared it would be unsafe to attempt to take even a light spring cart over the road"

Lithgow Mercury, Monday 31 July 1950, page 1

Rockfall and slope instability has been evident throughout the history of the road since it was built in the 19th Century. However, the frequency, extent and magnitude of slope instability experienced in 2022 exceeds that evident from historic records and accounts of the performance of the road. The rainfall during 2022 has exceeded historical annual averages and is likely the reason for the increased landslide activity.

1.3.2 Remediation challenges

Remediation and repair of the approximately 2.8 km section of Wolgan Road shown in Figure 2 above to a standard which might be considered by Council as appropriately resilient in the long-term, and which meets Council's loss of life slope risk tolerability criteria, would face significant challenges including:

- Extent and scale of the existing slope instabilities and damaged road requiring remediation
- Potential for additional new areas of slope instability, not currently evident
- Constructability and worker safety
- Safety in Design

- Construction cost
- On-going monitoring and maintenance costs
- Achieving resilience of a remediated road asset within an area of on-going natural slope processes which is inherently prone to large scale slope instability hazards as part of naturally occurring environmental processes.

1.3.3 *Community impact*

The Community impact caused by the ongoing slope instability manifests itself in several ways. These include:

- Isolation impacts due to the difficulty in using the long alternative route via Old Coach Road
- Loss of business due to restricted visitor access to facilities such as the Emirates One and Only resort, the Newnes Hotel and camping grounds, and other tourist facilities
- Difficulty in bringing in goods and products and transporting products out of the valley
- Challenging access for emergency situations, such as ambulance, fire trucks, police
- Safety concerns from encountering rockfalls while transiting the unstable section

These impacts are in addition to the inherent problems with the route, such as steep grade, tight curvature and narrow cross section as noted in Section 1.2 above.

1.4 This study

1.4.1 *Continued use of existing route*

At the time of this report Wolgan Road is closed due to ongoing slope instability along the section of Wolgan Road that traverses the western valley slope north of Wolgan Gap. The type of slope hazards includes rockfall and landslides of medium to large scale (i.e. 50,000 m³ to 250,000 m³ magnitude according to Fell's 1994 classification). A challenge to reopening this section of Wolgan Road is that the slope hazards present a risk to loss of life risk that is poorer than Council's risk tolerability thresholds.

The slope hazards in the closed section of Wolgan Road present significant challenges to the safe investigation for, and ultimately construction of, mitigation measures (e.g. drainage, earthworks, anchors, netting and catch fences). In addition, mitigation and repair measures would likely require many millions of dollars to implement, even if only the highest risk areas were treated to target residual loss of life risk marginally within Council's adopted loss of life risk tolerability thresholds. If such mitigation measures were able to be safely implemented the road would still be subject to numerous slope hazards over its length and prone to on-going closures due to rockfall. In addition numerous landslide hazards would likely continue to impact the performance of the road and require such high on-going maintenance and repair costs that the road would not meet conventional property risk tolerability thresholds (i.e. on annualised cost basis) as described in the Journal of the Australian Geomechanics Society Volume 42, No. 1, March 2007 (AGS 2007). On this basis, Council has decided that repair of the existing closed section of road is not a viable option to meet their requirements for a resilient, all weather, two wheel drive access to the Wolgan Valley.

For detail regarding the most recent identified slope hazards, calculated loss of life and property risk for the closed section of Wolgan Road, reference can be made to the Review of Wolgan Gap Slope Hazards 2022 (Report reference PS129742-SYD-GEO-REP-001-REV 0).

1.4.2 *Route selection process*

Given the reasons discussed in Section 1.4.1 above, a new route for access into Wolgan Valley is needed.

In November 2022, WSP prepared a high-level constraints study (refer report PS129742-SYD-GEO-REP-101 REV 00) to identify and discuss the key constraints that would need to be considered when choosing an alternative route into the

Wolgan Valley. That stage of the study, shaded green in Figure 7 below, was the first stage of a route assessment process that would initially identify a preferred corridor and then a preferred new route within that corridor.

This report considers three primary corridors for a new access to the Wolgan Valley and identifies a preferred corridor for a new access road to be developed, to consideration by Council. This current study stage is shown in yellow in Figure 7 below.

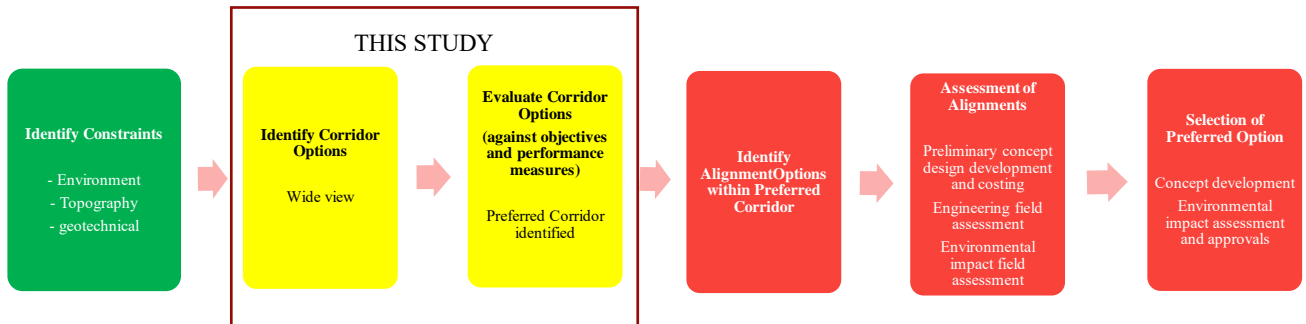


Figure 7: Route assessment process

The next stage in the process of finding a new access into the Wolgan Valley is shown in red in Figure 7. Several alternative alignments for a new road will be developed within the preferred corridor. These routes will be assessed against criteria including environmental impact, cost, and constructability to determine the preferred option that can be subsequently designed and constructed.

2 Information / data used in the study

Data used in preparation of this report has been sourced from readily available data sources and from site inspections where available. Refer Table 2.1 below for specific references

Table 2.1: Sources of data used in this study

Heading	Heading
Landform	<ul style="list-style-type: none"> — LiDAR – Extracted from Geoscience Australia – Elevation and Depth – Foundation Spatial Data. The coverage of this dataset is over the WALLERAWANG region. The 2 metre Digital Elevation Model (DEM) is produced using TIN (Triangular Irregular Network) method of averaging ground heights to formulate a regular grid. This data set contains a ground surface model in grid format derived from Spatial Services Category 2 (Classification Level 3) LiDAR (Light Detection and Ranging) from an ALS50 (SN092). The model is not hydrologically enforced. The data used to create this DEM has an accuracy of 0.3 m (95% Confidence Interval) vertical and 0.8 m (95% Confidence Interval) horizontal (note: less control points are used to validate this accuracy than Spatial Services Category 1 LiDAR data). For more information on the data accuracy, please refer to the lineage provided in the data history.
Geotechnical	<ul style="list-style-type: none"> — In addition to landform LiDAR referenced above, site specific high resolution Unmanned Aerial Vehicle (UAV) aquired LiDAR for the 2.8 km section of road shown in Figure 2 has been used along with publicly available NSW Spatial Services aerial imagery. A preliminary search of newspaper records, historic memoirs, pictorial histories and photographs available in the Local History section of the Lithgow Library has been used to augment existing project rockfall and landslide inventories. That data along with the existing WSP Golder geotechnical model for the site, knowledge gained from our geotechnical work in the area, site walk-overs conducted at the Donkey Steps and Old Coach Road and reference to the following documents has been used to undertake the preliminary slope hazard susceptibility zoning provided herein. — Notes to the 1:100,000 Western Coalfield Geology Maps (Yoo, Tadros and Bayley) — Proceedings of the Australian Institute of Mining and Metallurgy, No. 273
Environment	<ul style="list-style-type: none"> — National Parks & State Conservation Area boundary data sets (GIS) — Vegetation mapping from Department of Planning and Environment.
Planning	<ul style="list-style-type: none"> — GIS data source for Mining titles within the study area.
Existing access routes	<ul style="list-style-type: none"> — Publicly available mapping.
Watercourses	<ul style="list-style-type: none"> — OpenStreetMap dataset NSW Key Fish Habitats (GIS)
Utilities	<ul style="list-style-type: none"> — Dial before you dig enquiries covering Endeavour Energy and Telstra
Cadastral & Boundary Information	<ul style="list-style-type: none"> — The following data sets were extracted from Spatial Services NSW: Easements, Road Corridors & Property Boundaries (GIS)
Heritage	<ul style="list-style-type: none"> — GIS data sources for the Lithgow Local Environmental Plan 2014 — AHIMS Web Service search has been carried out within the study area.

3 Corridor description

3.1 List of identified corridors

Three corridors were identified based on existing access routes into the Wolgan Valley. These can be described by the direction of access into the Wolgan Valley. The corridors are listed below, shown in Figure 8 below and described in more detail in this section.

- **Eastern Corridor** incorporating the old Coach track and former Wolgan Valley Railway track bed and tunnels
- **Northern Corridor**, incorporating the existing pipeline Track to Glen Davies
- **Southern Corridor**, covers the existing valley from Wolgan Gap into the Wolgan Valley

Each of the above corridors are described within the sections below. An overview of each corridor’s susceptibility to slope hazards is also provided below. Further detail of the slope hazard susceptibility assessment is contained in Section 4.3.3 of this report.

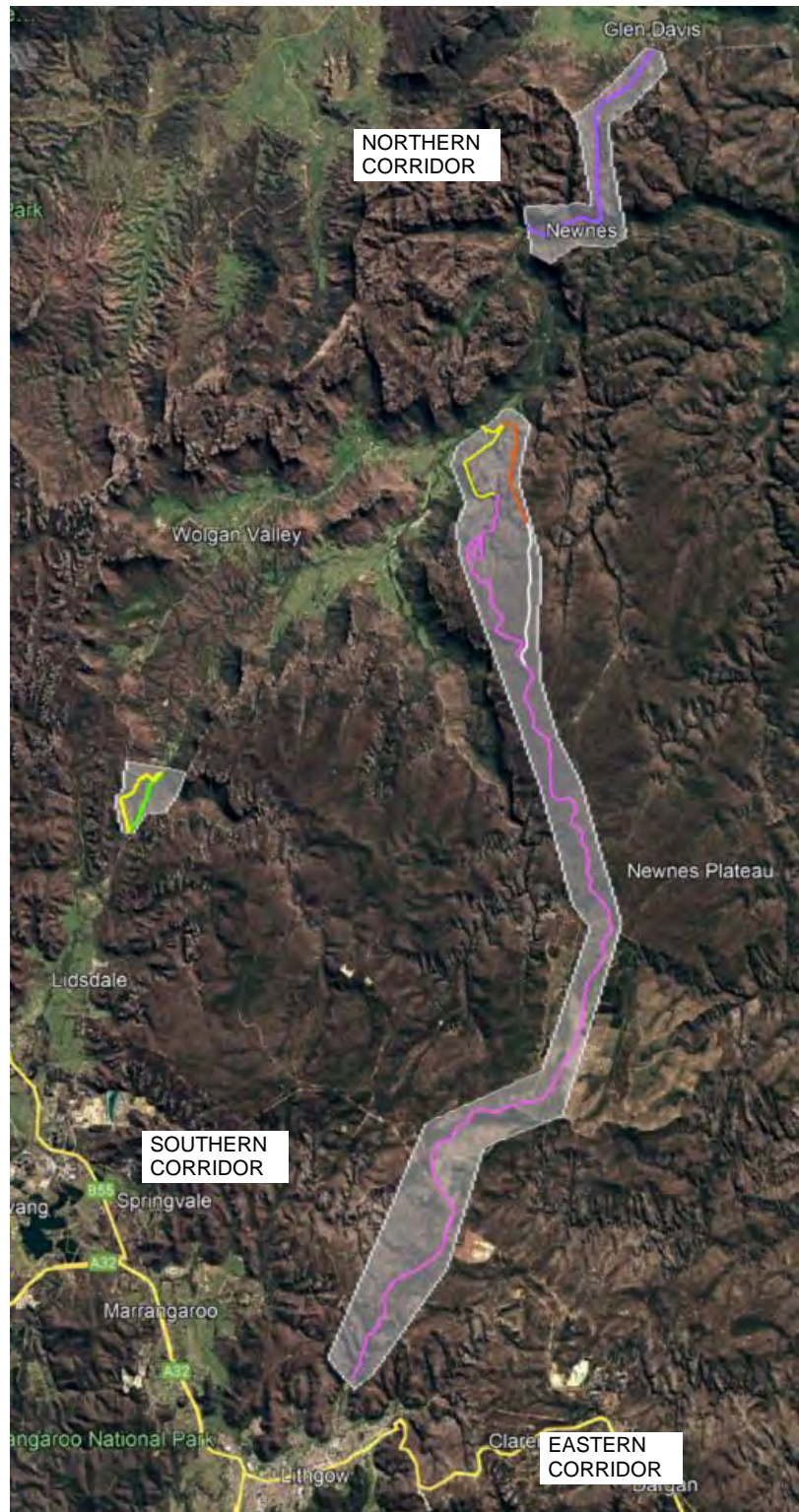


Figure 8: Corridor locality

3.1.1 Eastern Corridor

Route description

The Eastern Corridor contains an alternative route into the Wolgan Valley which utilises State Mine Gully Road north of Lithgow and then Glow Worm Tunnel Road. The road climbs steeply up to the Newnes Plateau after which grades are gentle. The route splits just north of Deans Siding into Glow Worm Tunnel Road and the Old Coach Road. Figure 9 shows the main features.

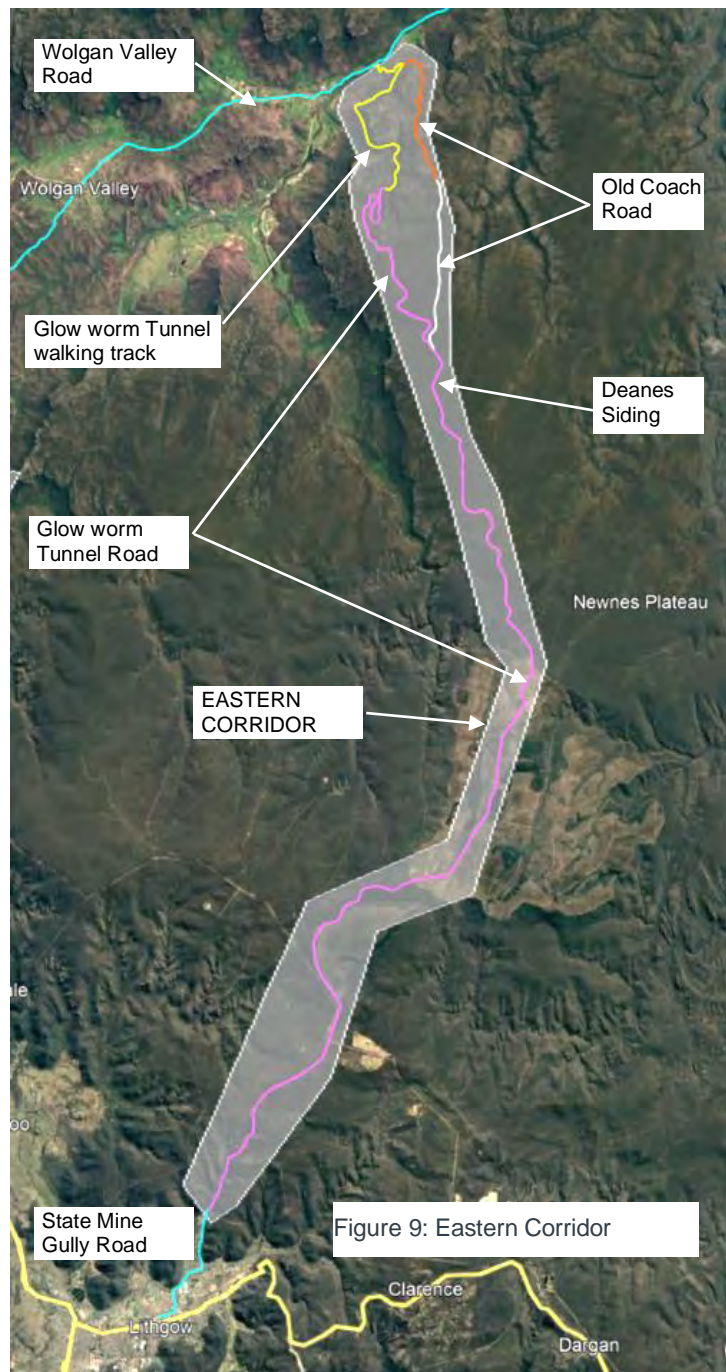
Glow Worm Tunnel Road continues to follow the old Newnes railway track bed through the first tunnel to a carpark. The latter section passes through several narrow cuttings on either side of the tunnel. From here a walking track continues to the Glow Worm tunnel then follows the track bed around the west facing escarpment before joining the Old Coach Trail and descending to Wolgan Road at the north-eastern end of the Wolgan Valley.

The eastern leg of the bifurcation follows the Old Coach Road route. A car park at the start of the decent to Wolgan Valley Road marks the end of the better standard of road. The road down the escarpment to Wolgan Valley Road is steep and winding and eventually meets the former Newnes railway track bed and descends the remaining distance to Wolgan Road. The Old Coach Road is used as an alternate (emergency) route to and from the Wolgan Valley.

The majority of the Eastern corridor within Newnes Plateau is assessed as being of low slope hazard susceptibility. However, it is the longest of the corridors and includes significant areas of high slope hazard susceptibility at its northern end. As such the Eastern Corridor has the highest total slope hazard susceptibility score of those assessed.

Condition

The road for the majority of its length as far north as the two car parks, is suitable for four-wheel drive vehicles year-round and two-wheel drive vehicles having reasonable ground clearance in dry conditions. Beyond the Glow Worm Tunnel Road car park, the remainder of the route is suitable for walking only. The Old Coach Road beyond the car park can be traversed by four-wheel drive vehicles, having steep grades and tight curvature. The Old Coach Road in that area is subject to significant slope hazards, including rockfall and landslide. NSW National Parks and Wildlife Service's management of those hazards is understood to be in accordance with their Landslides and Rockfall Procedures (ISBN 978-1-922317-82-7) and include periodic inspections and slope risk assessment by others.



Truck access for single unit trucks would be possible in good weather as far as the car parks. Beyond that, specialist all-wheel drive trucks would be needed. In periods of wet weather, the additional axle loading of trucks would cause severe rutting of the road surface and potentially lead to trucks requiring recovery from bogged conditions.

3.1.2 Northern Corridor

Route description

The northern corridor runs between Glen Davis and Newnes utilising the Wolgan River Valley and Green Gully as depicted in Figure 10. The northern corridor is centred on an existing walking track called the Pipeline Track. The track from Newnes heads in an easterly direction gradually climbing the northern side of the Wolgan River valley before turning north and steeply climbing into Green Gully. The crest lies around 1km into Green Gully after which the trail descends Green Gully towards Glen Davis on a reasonable grade that would be traversable with minimal earthworks by a medium sized truck.

Between Glen Davis and Lithgow, the route follows Glen Davis Road which is a two-lane road that is sealed to within 8.5km of Glen Davis after which the surface is unsealed. The remainder of the route to Lithgow from Glen Davis Road is via the Castlereagh Highway and Great Western Highway, which are State and National routes respectively, comprising single and dual carriageway with sealed lanes and shoulders.

The northern corridor is the second longest of the corridors and includes significant areas of high slope hazard susceptibility, primarily over its central portion. The Eastern Corridor has the second highest slope susceptibility score of those assessed.

Condition

As noted above, the track through the northern corridor is currently suitable for walking and has not been used for vehicular access to the best of our knowledge. The track has a steep section between the Wolgan River valley and Green Gully, over a distance of around 800m.



3.1.3 Southern Corridor

Route description

The southern corridor contains the existing main access to the Wolgan Valley and is shown in Figure 11. The existing road is closed due to slope instability but the route has provided access to the valley for over 100 years. From Wolgan Gap, the route descends the western side of the valley from Wolgan Gap to the valley floor over a distance of around 2.2km, dropping around 250m in elevation. The road is sealed and was upgraded in around 2010 with w-beam safety barriers, concrete drainage channels and new surfacing.

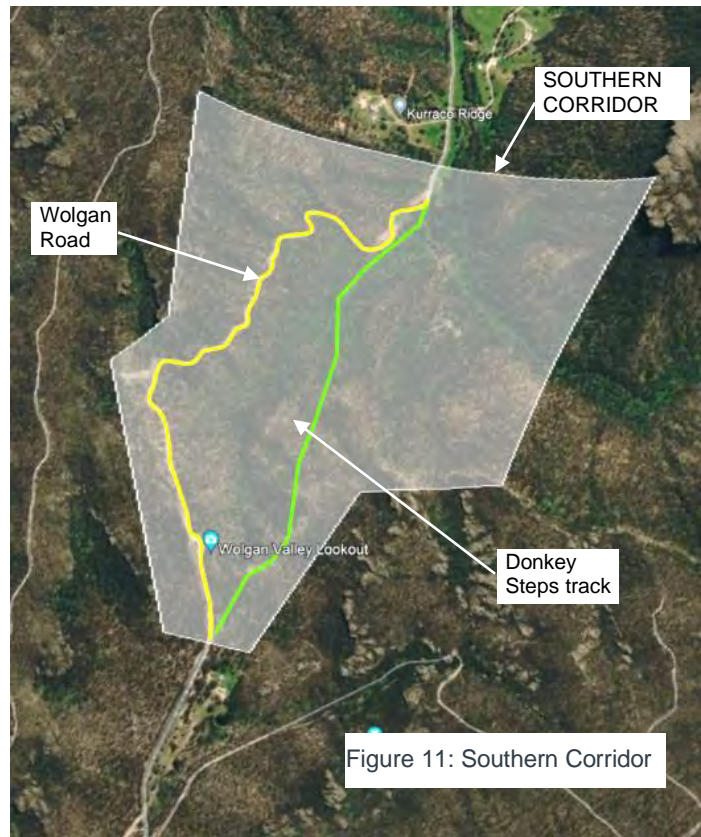
On the eastern side of the valley, opposite Wolgan Road, lies an historic track known as the Donkey Steps. This track is subject to planned improvements to create an emergency access to and from the Wolgan Valley until such time as a new route can be put in place.

The slope hazard susceptibility of the western portion of the southern corridor (i.e. west of the Wolgan River's tributary at the Gap) is significantly higher than the eastern portion (i.e. the area of the Donkey Steps). As such the southern corridor has been subdivided into an eastern and western portion for the purposes of slope hazard susceptibility assessment, as shown in Figure A4 of Appendix A. The eastern portion (i.e. Donkey Steps) has the lowest area weighted slope susceptibility score of any of the corridors assessed, whereas the western portion (i.e. the area containing the currently closed portion of Wolgan Road) has the highest. Their relatively short distances result in the eastern and western portions of the southern corridor recording the lowest and second lowest total slope hazard susceptibility scores respectively when corridor distance is taken into account.

Condition

The existing closed route (shown in yellow) contains numerous slope hazards which currently result in an unacceptable loss of life risk to road users (based on Council's adopted loss of life risk tolerability thresholds). The magnitude (i.e. extent and volume) and continuing loss of life risk posed by some of the hazards in that area present significant challenges to safe investigation for and implementation of slope hazard risk mitigation measures.

South of Wolgan Gap, the existing Wolgan Road is a good quality sealed single carriageway road, reaching Lithgow via the Castlereagh Highway and Great Western Highways.



4 Corridor assessment

4.1 Assessment methodology

The objective of the assessment is to determine a preferred corridor for the new access into the Wolgan Valley. To achieve a balanced assessment, each of the three corridors are assessed against environmental, cost and engineering criteria. The best performing corridor against those criteria is nominated as the preferred corridor. In the absence of any known 'showstoppers' or fatal flaws that would render any one of the three identified corridors unacceptable, the preferred corridor will be the one that, on balance, provides the best solution to providing a new access route into the Wolgan Valley.

4.2 Environmental Assessment

4.2.1 *Relevant legislation*

Environmental Planning and Assessment Act 1979 (EP&A Act)

The Environmental Planning and Assessment Act 1979 (EP&A Act) and the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) provide the framework for development and environmental assessment in NSW.

Councils have a statutory responsibility under the EP&A Act to consider the impacts of their activities, including road construction and maintenance works, on the environment.

Council must satisfy Sections 5.5, 5.6 and 5.7 of that EP&A Act by examining, and considering to the fullest extent possible, all matters which are likely to affect the environment. Section 171 of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) defines the factors which must be considered when determining if an activity assessed under Division 5.1 of the EP&A Act would have a significant impact on the environment.

In considering the factors, if assessment or field work indicates that the activity is likely to significantly affect the environment then an Environmental Impact Statement (EIS) would need to be prepared under Section 5.7 of the EP&A Act and approval sought from the NSW Minister for Planning.

State Environmental Planning Policy (Transport and Infrastructure) 2021

The State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across the State. Section 2.109 of the Transport and Infrastructure SEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

The Wolgan Road proposal could be characterised as development for the purposes of a road or road infrastructure facilities and is to be carried out by or on behalf of Lithgow City Council. Therefore, if the works can be undertaken without significant impact on the environment and without triggering NSW or Commonwealth legislative requirements (see Table 4.1 below), the works can be assessed under Division 5.1 of the EP&A Act in the form of a Review of Environmental Factors (REF), with Lithgow City Council being the Determining Authority.

Lithgow Local Environmental Plan 2014

The Lithgow Local Environmental Plan 2014 (LEP) is the principal planning instrument affecting land use in the Lithgow Local Government Area. Under clause 5.12(1) of the LEP, the LEP does not restrict or prohibit the carrying out of development by or on behalf of a public authority that is permitted to be carried out without consent under the Transport and Infrastructure SEPP.

Other Environmental Legislation

There is other Commonwealth and NSW environmental legislation that must be considered when assessing the planning and approvals of the project. Some key examples are listed in Table 4.1 below.

Table 4.1: Relevant planning legislation

LEGISLATION	RELEVANCE TO THE PROPOSED ACTIVITY
COMMONWEALTH LEGISLATION	
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	<p>The EPBC Act protects matters of National Environmental Significance (NES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others).</p> <p>There is a risk that impacts resulting in the removal of intact native vegetation may directly or indirectly impact matters of NES.</p> <p>Impacts on National Parks in the area would also impact Greater Blue Mountains World Heritage Area, which comprises the Blue Mountains, Wollemi, Yengo, Nattai, Kanangra-Boyd, Gardens of Stone and Thirlmere Lakes National Parks, and the Jenolan Karst Conservation Reserve. The Gardens of Stone National Parks is in the vicinity of Wolgan Valley.</p> <p>If there were impacts on matters of NES, a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water would be required. Significant impacts may trigger a Commonwealth Environmental Impact Statement (EIS) and approval by the Minister for the Environment.</p>
STATE LEGISLATION	
Biodiversity Conservation Act 2016 (BC Act)	<p>Part 7 of the BC Act provides the environmental assessment requirements for activities being assessed under Part 5 of the EP&A Act 1979. If a significant impact is likely, a Species Impact Statement is required. A biodiversity development assessment report may also be required. Section 7.2(1)(a) and 7.3 describe the assessment requirements and thresholds for what is considered a significant impact.</p> <p>There is a risk that impacts resulting in the removal of intact native vegetation may have significant impacts on biodiversity.</p>
Fisheries Management Act 1995 (FM Act)	<p>FM Act provides for the protection, conservation, and recovery of threatened species, populations and ecological communities of fish and marine vegetation and fish habitats, as well as promoting the development and sharing of fishery resources in NSW.</p>
National Parks and Wildlife Act 1974 (NPW Act)	<p>The NPW Act regulates the control and management of all National Parks, historic sites, nature reserves, and Aboriginal areas.</p> <p>The main aim of the Act is to conserve the natural and cultural heritage of NSW. Where works will disturb Aboriginal objects, an Aboriginal Heritage Impact Permit (AHIP) is required.</p> <p>Under clause 2.15 of the Transport and Infrastructure SEPP, Lithgow City Council is required to consult with the NPWS regarding any development on land adjacent to land reserved under the NP&W Act.</p> <p>Section 188C of the NPW Act enables the boundary of land reserved or acquired under that Act which adjoins a public road to be adjusted to follow the formed path of the road, or to provide an appropriate setback from the formed road. These adjustments can be made so long as a significant reduction in the size or value of reserved land does not occur. Section 188C cannot be used to adjust the park boundary to allow for an increase in the width of existing road, alteration of the physical location of an existing built road or construction of a new road.</p>

	<p>Most proposals within areas reserved under the NPW Act require authorisation under the NPW Act or Regulation, as well as an environmental impact assessment, before they can be carried out.</p> <p>Lands reserved under the NPW Act can be revoked if there are boundary encroachments or non-permissible development within the boundaries. Revocation will generally only be revoked as a last resort and where no other practical options are available. Only the Government (via a Cabinet proposal) and ultimately the NSW Parliament (via an Act of Parliament) can decide if land reserved under the NPW Act can be revoked.</p>
Heritage Act 1977	<p>The <i>Heritage Act 1977</i> (Heritage Act) aims to protect items of State and local heritage significance and outlines the process for the approval of development that may impact on items of heritage significance.</p> <p>Matters protected under the Heritage Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under section 170 of the Heritage Act by NSW Government agencies. The Heritage Act also provides for the protection of archaeological ‘relics’, being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.</p>
Protection of the Environment Operations Act 1997 (POEO Act)	<p>The POEO Act is the key environmental protection and pollution statute. The POEO Act is administered by the EPA and establishes a licensing regime for waste, air, water and pollution.</p> <p>Any work potentially resulting in pollution must comply with the POEO Act. Relevant licences must be obtained if required.</p>
Water Management Act 2000 (WM Act)	<p>The WM Act’s main objective is to manage NSW water in a sustainable and integrated manner that will benefit today’s generations without compromising future generations’ ability to meet their needs. Although formal approval under the WM Act is not required, if the proposed activity is within 40m of a waterway, an attempt should be made to comply with the requirements of controlled activities in order to reduce risks to waterways.</p>

Environmental assessment of corridor options below are high level in nature, centred on desk-based analysis of selected environmental aspects only. Once a Preferred Corridor is determined, a detailed comparison of the environmental impacts of each route would be required and may include other aspects such as non-Aboriginal heritage, water quality, social and economic impacts.

4.2.2 Ecological impacts

The Eastern Corridor primarily traverses the Newnes Plateau and lies substantially within the Newnes State Forest with the northern section within Wollemi National Park and flanked by Gardens of Stone National Park. Road widening would have a moderate but direct impact on the National Park. The improved route from the Plateau down to the Wolgan Valley floor would also have adverse ecological impact.

The NSW Government has announced Newnes State Forest, Wolgan State Forest and parts of Ben Bullen State Forest, near Lithgow, will be transferred to the Gardens of Stone Reserves managed by the National Parks and Wildlife Service.

The Northern Corridor lies fully in the Wollemi National Park. The length of impact is less than for the Eastern Corridor, but the lack of any previous development would amplify any impacts.

The Southern Corridor is bounded by the Gardens of Stone State Conservation Area which partly intrudes on the corridor. This corridor would have least direct impact on National Park reserves given the shortest length of impact. There is a possibility of avoiding National Parks and Conservation areas within the Southern Corridor.

4.2.3 *Aboriginal heritage impacts*

Aboriginal heritage impacts are likely to occur within all the corridor options. However, due to the lack of detailed spatial information, the impact assessment was based on route length; the greater the length of disturbance due to construction, the greater the expected impact on Aboriginal heritage objects. The Eastern Corridor has the greatest length of impact, which may be offset somewhat by the existing forest trails and former railway track bed having already been disturbed.

The Northern Corridor has been subject to limited development and so any Aboriginal heritage sites within this corridor could be impacted depending on the actual road alignment chosen.

The Southern Corridor incorporates the existing Wolgan Road and the historic Donkey Steps packhorse trail, currently being upgraded. Where rockfall and landslides have occurred they will have disturbed historic archaeological deposits. Investigations and consultation with the Local Aboriginal Land Council in relation to the upgrade of the Donkey Steps trail has not identified any Aboriginal archaeological or cultural sites in the area of investigation. The Southern Corridor has the shortest length of impact of any corridor and therefore it is anticipated that it has the lowest heritage impact.

4.2.4 *Visual impact*

The Eastern Corridor contains existing disturbed landscapes due to fire trails, forest tracks and the former railway branch line. An improved route from the Newnes Plateau down to Wolgan Valley would be visible from Wolgan Road. Impact would be moderate overall.

The Northern Corridor would be visible as a line on the valley flank from Newnes. The northern section would be visible from Glen Davis over the 3 km section from Glen Davis. Impact against undisturbed landscape would be relatively high.

The Southern Corridor routes would be visible from the valley to the north of Wolgan Gap. Impact would again be moderate to low.

4.3 Engineering assessment

4.3.1 *Overall route length*

A comparison of route length was undertaken as a measure of the operating cost and convenience to road users in terms of fuel and time to reach a destination in the Wolgan Valley. It was assumed that the majority of people wanting the access the Wolgan Valley would be from the East, hence Lithgow Post Office was used as a starting point for route measurement.

For a destination point, a location towards the centre of the Wolgan Valley was chosen. The location acknowledges the influence of destinations such as Newnes and Emirates One & Only resorts.

Eastern Corridor

The measured distance between Lithgow Post Office to the destination point via State Mine Gully Road, Glow Worm Tunnel Road, the Old Coach Road and Wolgan Road is around **44.5km**.

Northern Corridor

The Northern Corridor requires a more circuitous route from Lithgow Post Office, via Great Western Highway, Castlereagh Freeway, Glen Davis Road to Glen Davis and then the 8km new route to Newnes and finally along Wolgan Road to reach the destination point. This route is around **91.4 km** in length.

Southern Corridor

The Southern Corridor route closely reflects the existing distance and includes Great Western Highway, Castlereagh Freeway and Wolgan Road to the destination point. The route length for the Southern Corridor is **37.5 km**.

In summary, the existing Southern Corridor offers the shortest travel distance into the Wolgan Valley and the Eastern Route is some 7 km longer. The Northern Corridor by comparison requires a much longer route which is twice the

distance of the Eastern Corridor route and 2.5 times the travel distance using the Southern Corridor. As a sensitivity test, to make the second shortest (Eastern Corridor) the shortest route would require the destination point to be moved east by around 3.5 km, placing it at the location where the Eastern Corridor joins Wolgan Road. Visually, this is at the northern extremity of the Wolgan Valley and well beyond where the weighted average destination would lie.

4.3.2 Hydrology

Eastern Corridor

The eastern corridor follows or crosses several watercourses including State Mine Creek and Tunnel Creek and meets the Wolgan River south of Newnes. The corridor contains the headwaters of numerous watercourses including tributaries flowing into the Farmers Creek 2 Dam, Paddys Creek, Bungleboon Creek, Dingo Creek, Carne Creek, Budgary Creek, Rocky Creek and Deanes Creek. Despite the number of watercourses potentially impacted, the control of pollutants into these watercourses can be achieved with normal water quality devices. Further, the sealing of the road would have a positive impact on reducing silt laden runoff. Overall impact on watercourses is considered to be neutral.

Northern Corridor

The Northern Corridor follows the Wolgan River and Green Gully watercourses, the latter flows into the Capertee River. Any route would be in close proximity to these watercourses. The steep slopes and proximity to watercourses also make the operation of water quality devices more challenging. Given the absence of any existing roads within the Northern Corridor, water quality impacts in this corridor are more likely to be adverse.

Southern Corridor

The southern corridor incorporates a tributary flowing into Wolgan River at the northern end of the valley. Any route within the corridor will be close to the tributary and may need to cross the watercourse. In comparison to the Northern Corridor, impacts on the Southern Corridor would be lower.

4.3.3 Slope Hazard Susceptibility

Slope Hazard Susceptibility zoning was undertaken as part of the Wolgan Valley Road Route Constraints Study (Refer report PS129742-SYD-GEO-REP-101 REV 00). A general description of the geology and slope hazard susceptibility of the Wolgan Valley and details of the slope hazard susceptibility zoning methodology is provided in that report. The zoning divided areas within Wolgan Valley and the three corridors described herein into four categories from lowest to highest susceptibility to slope hazards (i.e. rockfall and landslide). To determine the category which a zone was allocated, individual areas were scored against the following characteristics which influence slope hazard susceptibility in the Wolgan Valley and its immediate surrounds.

- Slope angle
- Maximum individual cliff-line height
- Slope aspect/orientation
- Presence of colluvium
- Presence of water courses/drainage lines
- Presence of Narrabeen Group cap rock at cliff line
- Presence of coal measures
- Evidence of past rock fall and topple
- Evidence of past landslide

Table 4.2 below shows the slope hazard susceptibility zone categories and corresponding score ranges. The range of possible scores is 0 to a maximum of 100.

Table 4.2 Slope Hazard Susceptibility Zoning Categories

Category	Score
1 – Highest	≥ 75
2 - High	50 to 75
3 - Low	25 to 50
4 - Lowest	< 25

For the purposes of a corridor comparison, the slope hazard susceptibility scores of individual areas within a corridor have been weighted against the total area of the corridor to determine a weighted average score for each corridor. In the cases of the Eastern and Southern corridors sub-division of the corridors into smaller portions was considered appropriate due to the significantly varied slope hazards susceptibility and/or distance of possible alternate routes through eastern and western portions of those routes. Sub-division of the Northern Corridor was not considered warranted. Weighted average slope hazard susceptibility scores were calculated for the following (sub) corridors.

- Northern
- Eastern –
 - o Eastern A: State Mine Creek Road area (southern portion)
 - o Eastern B1: Old Coach Road area (north-eastern portion)
 - o Eastern B2: Glow Worm Tunnel area (north-western portion)
- Southern –
 - o Southern A: Donkey Steps area (eastern portion)
 - o Southern B: Wolgan Road area (western portion)

The results of the weighted average calculation for each of the above (sub) corridors are summarised in Table 4.3 below.

Table 4.3 Weighted average Slope Hazard Susceptibility scores for each (sub) corridor

Corridor Name	Portion of Corridor	Length (km)	Weighted Slope Susceptibility Score
Northern	All (Pipeline track area)	8	64
Southern	Southern A (Donkey Steps area)	2	43
	Southern B (Wolgan Rd area)	2	72
Eastern	Eastern A (State Mine Gully Rd area)	26	25
	Eastern B1 (Old Coach Rd area)	4	46
	Eastern B2 (Glow Worm tunnel area)	4	58

As shown in Table 4.3, the sub corridor with the highest weighted average susceptibility score is the western portion of the Southern Corridor, which includes the closed portion of the existing Wolgan Road. The lowest weighted slope susceptibility score is for the southern portion of the Eastern Corridor (i.e. Eastern A which mostly traverses relatively flat plateau). However, the Eastern A sub corridor must be combined with either the Eastern B1 sub corridor or Eastern B2 sub corridor to produce a route into the valley. The Southern A sub corridor is the next lowest scoring area and does not require combination with another corridor to produce a route into the valley.

To enable comparison which accounts for the relative exposure to slope hazards which a longer route will result in compared to a shorter route, weighted average slope susceptibility scores were multiplied by the medial length (i.e. the length along the midpoint of a corridor) for the following (sub) corridor combinations.

- Northern
- Eastern AB1: State Mine Creek Road then Old Coach Road area (north-eastern portion)
- Eastern AB2: State Mine Creek Road then Glow Worm Tunnel area (north-western portion)
- Southern A: Donkey Steps area (eastern portion)
- Southern B: Wolgan Road area (western portion)

The results of that calculation are summarised for the above (sub) corridor combinations in Table 4.4 below.

Table 4.4: Slope Hazard Susceptibility scores for each (sub) corridor

Combined sub corridor Name	Length (km)	(Sub) Corridor Slope Susceptibility Score ¹
Northern (Pipeline)	8	499
Eastern AB1 (State Mine Creek then Old Coach)	30	836
Eastern AB2 (State Mine Creek then Glow Worm)	30	881
Southern A (Eastern Donkey Steps side)	2	98
Southern B (Western Wolgan Road side)	2	149

1. Calculated as the sum of the weighted average scores for each portion multiplied by their lengths.

Figure 12 below presents the (sub) corridor slope susceptibility scores of Table 4.4 as a histogram.

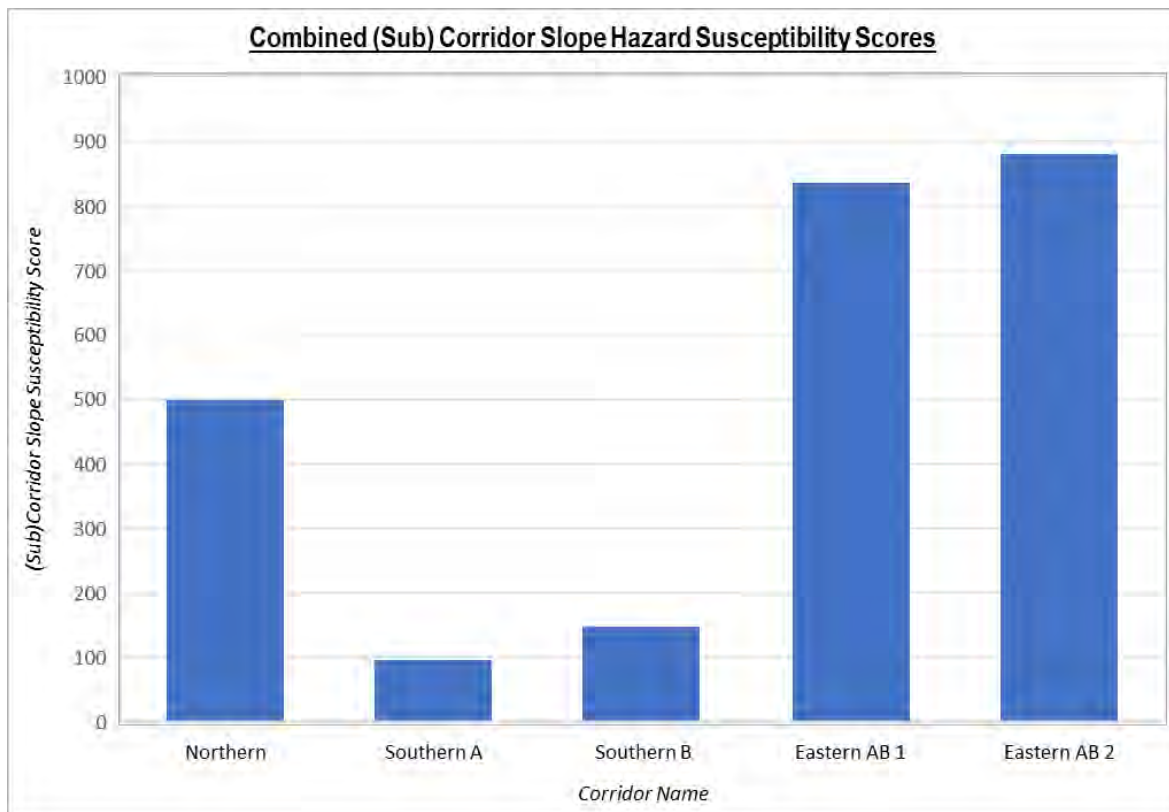


Figure 12: Combined (sub) corridor slope hazard susceptibility scores

The location of the corridors and sub-corridors discussed above are shown on Figures A1 to A5 of Appendix A, along with individual area slope hazard susceptibility scores and summary tables. The implications of the above (sub) corridor comparisons are discussed with respect to each of the three main corridors in turn below.

Eastern Corridor

The Eastern Corridor is assessed to be the least favourable from a slope hazard susceptibility perspective. That outcome is primarily a result of its length.

Northern Corridor

The Northern Corridor is assessed to be the second least favourable from a slope hazard susceptibility perspective. That outcome is a result of its length in combination with the presence of significant areas of relatively high slope hazard susceptibility.

Southern Corridor

The Southern Corridor is assessed to be the most favourable from a slope hazard susceptibility perspective. That outcome is a result of its short length and the presence of relatively lower slope hazard susceptibility within its eastern portion (i.e. in the area of the Donkey Steps). This scoring does not preclude slope hazards from impacting the corridor. There will be a requirement for engineering design of a road alignment in this corridor to limit the risks from the slope hazards, although to an expected lesser extent than for the other corridors.

4.3.4 Utility impacts

A Dial Before You Dig enquiry was lodged with Endeavour Energy and Telstra for four locations covering Wolgan Gap, the Pipeline Track, the area south of Newnes and between Newnes and The Wolgan Gap.

Preliminary data from DBYD shows Endeavour Energy assets are present in the Wolgan Valley but no High Voltage (HV) assets noted. Medium voltage assets pass through the Wolgan Gap but appear to be clear of likely routes.

Based on the above information and knowledge of the corridors, the impact of utilities is assessed below.

Eastern Corridor

Electrical and communications assets are expected to be encountered within the corridor but are unlikely to have a significant impact on the selection of this route.

Northern Corridor

Given the green field nature of this corridor, few if any utility services are expected to exist in the corridor.

Southern Corridor

As this is the current mail access corridor to the Wolgan Valley electrical and communications (Optic Fibre) assets are present. The Optic Fibre asset is likely to be impacted by new road construction along the eastern side of the valley.

4.3.5 Resilience

Resilience measures how susceptible a corridor or route is to closure from operational impacts and the degree of ease with which infrastructure can be fully or partly restored to operational levels after an adverse impact event. Typically, adverse impact events include adverse weather, accidents, flood, landslide etc.

Eastern Corridor

The Eastern Corridor includes the original Newnes Railway and is currently used as the road to the Wolgan Valley, due to closure of Wolgan Road at the Wolgan Gap. The road passes through natural slopes and cuttings containing significant slope hazards and with a reported history of instability (e.g. rockfalls). The works to provide a year-round reliable road should improve stability but risk of rockfalls and landslides would remain in some areas even with relatively extensive and costly mitigation measures being implemented (e.g. rock face scaling, bolting, netting and catch fences). The relative long length of this route increases the overall exposure to slope hazards. The route is also the highest in elevation of the

three corridors with sections above 1000m and a significant portion of the route above 900m elevation and hence carries more risk of snowfall and ice.

Northern Corridor

Any road route through the Northern Corridor would require earthworks in a greenfield situation and would be expected to include high cut and fill batters. The central portion of the corridor traverses areas of high slope hazard susceptibility and the steep terrain would make design of an alignment with low vulnerability to periodic closure due to rockfall and landslide challenging. Regarding snow and ice, the corridor has a lower maximum elevation of 850m however the full route to reach the Wolgan Valley includes a 1000m elevation summit. A road alignment to current industry engineering design standards within the Northern Corridor is considered likely to provide more resilience against closure than a similar standard road alignment through the Eastern Corridor.

Southern Corridor

There are significant slope hazards (i.e. rockfall and landslide) within the corridor and areas of active landslides (particularly within the western portion of the Southern Corridor), but the length of exposure to slope hazards (i.e. around 2km) is less than the Northern and Eastern Corridors. The eastern portion of the Southern Corridor has much lower slope hazard susceptibility than the western portion (reference can be made to Figure A4 of Appendix A for the east and west division of the Southern Corridor). Regarding ice and snow, the Wolgan Gap has an isolated high point of 950m and the route to Lithgow includes a 1000m elevation point. The Southern Corridor, and in particular the eastern portion of the Southern Corridor, is considered to present the opportunity for the most resilient route of the three corridors.

4.4 Comparative cost

Cost is a key factor in selecting a preferred corridor. Given the time allocated to this study, the cost assessment has utilised comparative costs in lieu of actual costs. The comparative cost has been calculated based on the length of the primary route existing within each corridor. The length has been broken down into sections requiring a particular treatment to bring the route to an acceptable standard. The treatments are summarised Table 4 below.

Table 4:: Construction cost reference table

Cost Score	Upgrade works required
1	Widening of an existing route, minimal earthworks
2	Widening of an existing route, batters recut, pavement and drainage improvements
3	Construction of a new route in flat terrain
4	Construction of a new route in moderately steep terrain
5	Construction of a new route in steep terrain

Example cost calculation

A potential route within a corridor requires 7km of widening and new pavement and 2km of realignment in moderately steep terrain. The cost factor would be $7 \times 2 + 2 \times 4 = 22$.

4.4.1 Eastern Corridor

The eastern Corridor upgrade cost is based nominally on the existing road that follows the route of State Mine Gully Road, Glow Worm Tunnel Road and the Old Coach Road. The existing roads up to the car park on Old Coach Road

would require some widening and pavement and drainage upgrades to provide an all-weather route suitable for heavy vehicles. North of the car park, a realigned route would be needed down the steep escarpment to Wolgan Road. The length of each type of treatment and score is detailed below.

Construction type	1	2	3	4	5	Score
Length	0	32.9km	0	0	4.9km	90.3

4.4.2 Northern Corridor

The Northern Corridor cost is based on the line of the existing Pipeline Track. The full length of 8km would be new road. From Newnes the section following the Wolgan River is expected to be moderately steep terrain and the remainder of the route through Green Gully would be in steep terrain.

Construction type	1	2	3	4	5	Score
Length	0	0	0	2km	6km	38.0

4.4.3 Southern Corridor

The Southern Corridor cost is based on a route generally following the Donkey Steps route along the eastern side of the valley. The nature of the terrain is steep in nature and the road would be an all-new construction similar in nature to the route within the Northern Corridor above.

Construction type	1	2	3	4	5	Score
Length	0	0	0	0	2.2km	11.0

4.4.4 Cost assessment

From the scores calculated above, the Eastern Corridor would have a high comparative cost given the length of road needing some form of upgrade to be suitable for all weather access. Only a relatively short length would require costly reconstruction but the length of road needing widening, pavement and drainage is considerable (32.9km). The Northern and Southern Corridors require new roads constructed in moderate to steep terrain, however their cost scores are lower due to the much shorter route lengths involved. The Southern Corridor is likely to have the lowest cost given its short (2.2km) length of realigned road.

As a check, if the relevant cost indices were incorrect, a comparison based just on the length of new construction in steep terrain would still result in the Southern Corridor being preferred on the basis of its much shorter length of construction in this terrain.

5 Summary and conclusions

The three corridors have been compared and assessed against a range of environmental and engineering factors and against relative cost. The results of the assessment are summarised below using a simple colour code where:

	The best performing corridor (largest positive or least negative impact)
	The next best performing corridor
	The worst performing corridor (largest negative or least positive impact)

Refer to Table 5.1 below for the summary of findings from the corridor assessment, presented in terms of environmental, engineering and cost factors.

Table 5.1: Summary of assessment findings

	Assessment Criteria	Eastern Corridor	Northern Corridor	Southern Corridor
Environment	Ecology impact			
	Aboriginal heritage impact			
	Visual impact			
Engineering	Route length			
	Hydrology			
	Slope Hazard Susceptibility			
	Utility impacts			
	Resilience			
Cost	Comparative cost			

In summary, the Eastern Corridor is a mid-range performer, its environmental impacts being influenced by the disturbed nature of the majority of the corridor from existing road and rail developments. Being the longest route, the cost of upgrading the route would also be high and the total length of slope hazard is highest.

The Northern Corridor is currently undeveloped as a transport corridor, hence environmental impacts would be high. The overall distance between Lithgow and the Wolgan Valley is also the longest making this route the least desirable in terms of travel time. The total length of slope hazard is the second highest. The lack of known conflicts with existing utility services does make this corridor attractive.

The Southern Corridor, given its short length of disturbance, is expected to have the least environmental impact of all the corridors. Being the shortest route also means it is likely to be the most cost-effective corridor for a new road route and it is also the most direct (shortest distance) route between Lithgow and the Wolgan Valley. Utility asset impacts are likely to be highest with this corridor, given that it contains the existing road into the valley. For the purposes of slope hazard susceptibility assessment the Southern Corridor was sub-divided into an eastern and western portion (as shown on Figure A4 of Appendix A).

The western portion of the Southern Corridor (containing the closed portion of Wolgan Road) recorded the second lowest slope hazard susceptibility of all the corridors assessed due to its short length. However, when normalised for corridor length the western portion of the Southern Corridor has the highest slope hazard susceptibility of all corridors. The

eastern portion of the Southern Corridor (containing the existing Donkey Steps track) recorded the lowest slope hazard susceptibility of all the corridors assessed whether normalised for corridor length or not.

Overall, Table 5.1 above shows that the Southern Corridor is favoured for the location of a new road access to the Wolgan Valley compared to the other corridors assessed as part of this study.

6 Next steps

This report is the second stage of the process in locating a preferred alignment for a new access road into the Wolgan Valley. The study has confirmed that the Southern Corridor, which covers the valley north of Wolgan Gap including the existing closed section of Wolgan Road is the preferred location for the new access road.

The next stage of the process is highlighted red in the flow chart shown in Figure 13 below.

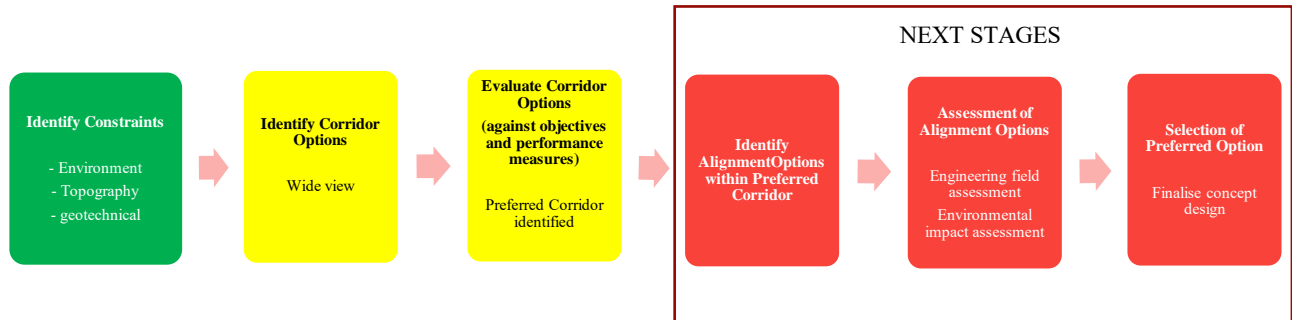


Figure 13: Option selection process

The next stage will require a more detailed study of the Southern Corridor to locate the best alignment for a new access road. A rigorous process should be followed to identify and support investment in the optimum alignment option. The process would include the following steps:

- Obtain better quality ground mapping such as a recent high resolution Lidar survey
- Undertake field surface investigations covering archaeology, geotechnics, ecology, utilities to locate any constraints
- Design alternate road alignments that meet design requirements (speed, curve radii, gradient) and minimise impact on the constraints.
- Determine the extents of bridges and retaining walls required
- Investigate the planning approval pathway needed to obtain approval for a new access
- Carry out an environmental assessment (REF, EIS) to assess impacts and determine a preferred option
- Undertake geotechnical investigations to inform the preliminary design, including structures
- Complete the concept design for the preferred option – earthworks, pavements, drainage, road furniture, landscape

WSP recommend that Council start considering options for procurement of the final construction. In our view, several options are available to Council with varying risk profiles and delivery timeframes. Procurement would most likely be via one of the following mechanisms:

- 1 Detailed design followed by a separate construction contract
- 2 Design and construct contract (D&C), or
- 3 A form of Early Contractor Involvement (ECI) contract

Both the D&C or ECI procurement method offers savings in overall delivery time which Council may value when seeking to open a new route in the shortest possible timeframe. If either option was chosen, the tender documentation could be prepared in parallel with finalising the concept design, which would form the Reference Design used for pricing the construction tender documentation. The timing, nature and extent of geotechnical investigation required will depend on the design and procurement option adopted.

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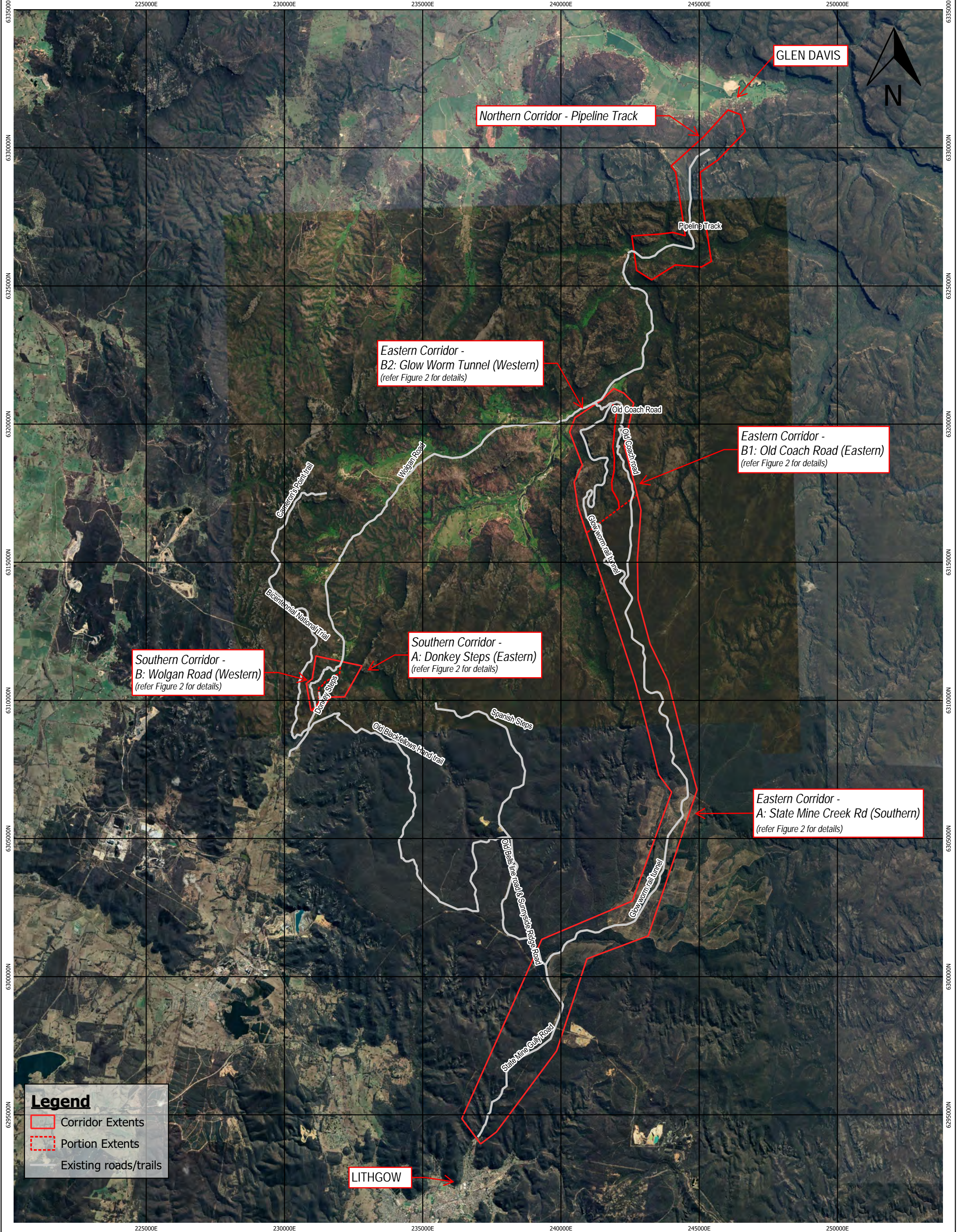
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Appendix A

Slope Hazard Susceptibility Corridor Comparison Plans



CLIENT
Lithgow City Council

PROJECT
Wolgan Valley Access Road - Corridor Comparison Assessment



CONSULTANT
wsp GOLDER

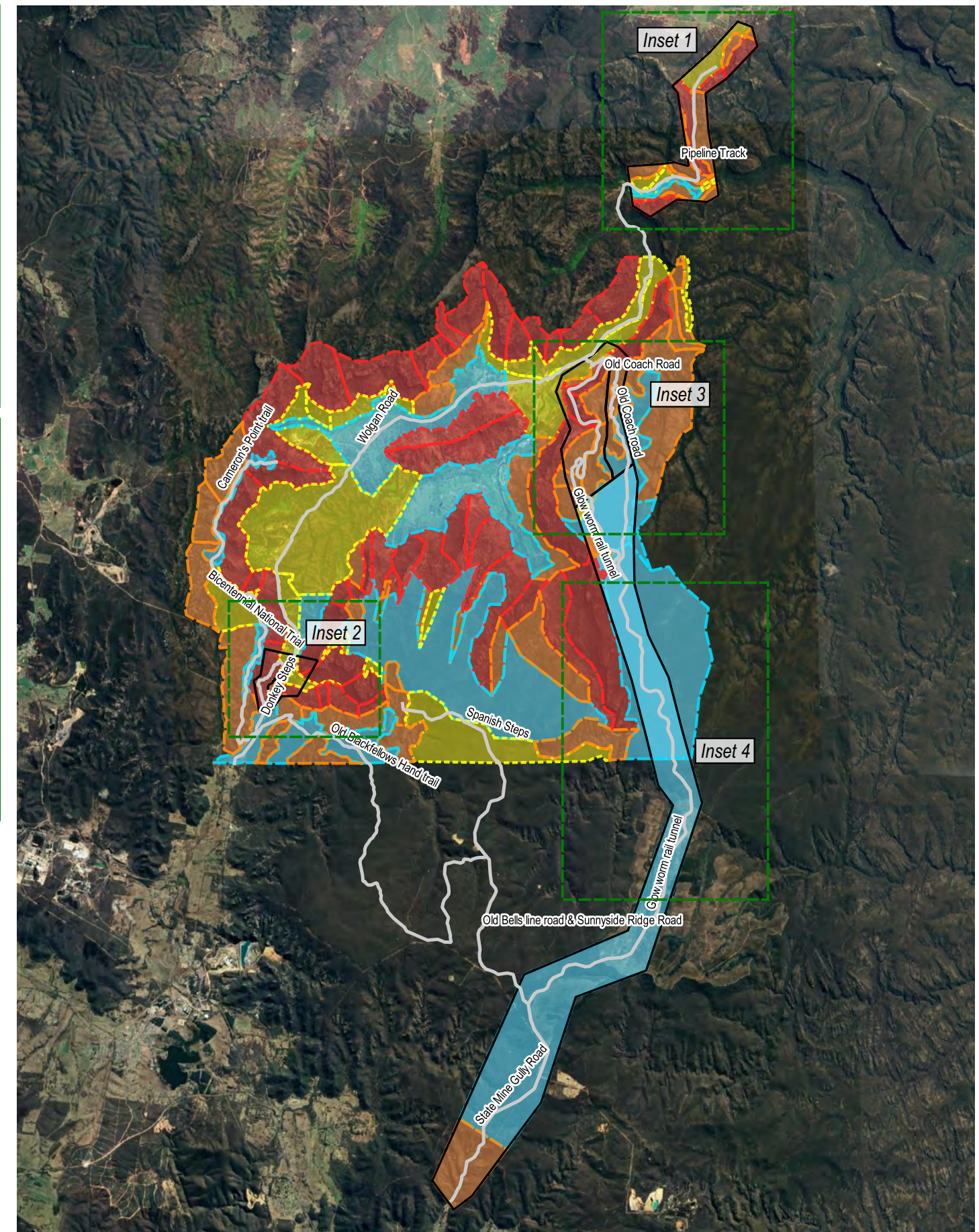
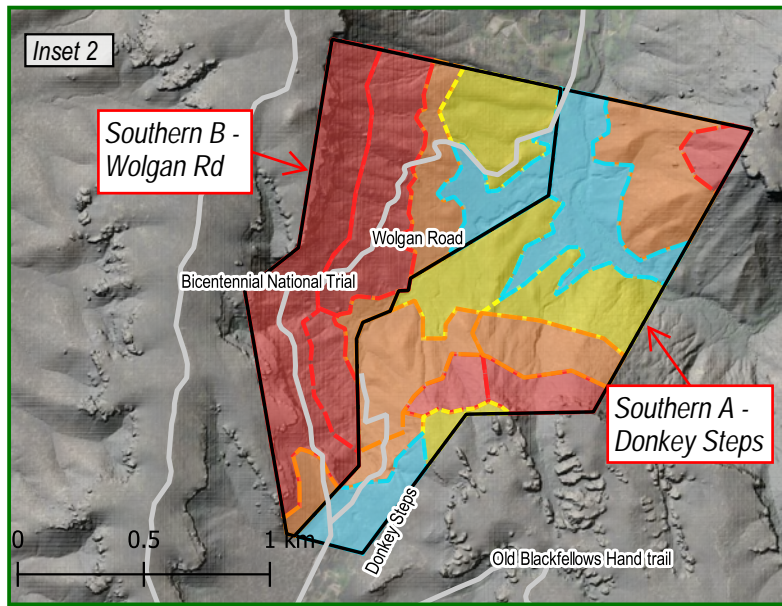
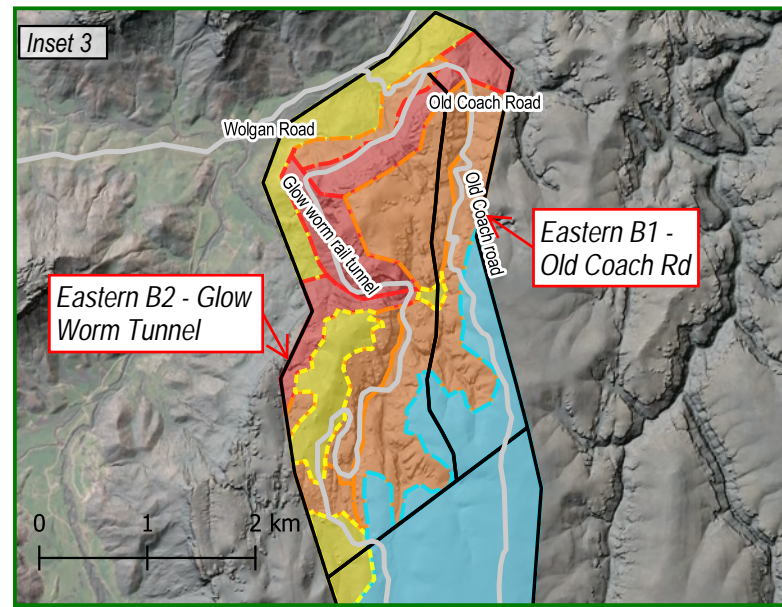
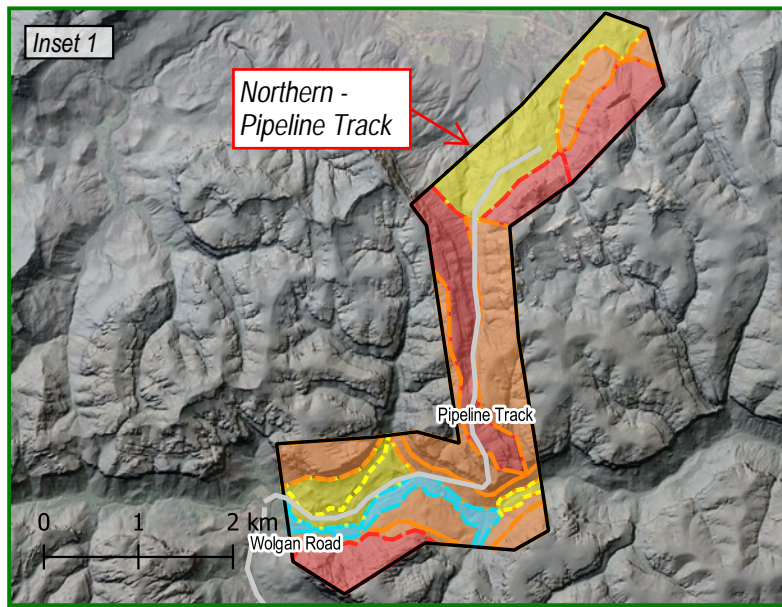
YYYY-MM-DD	2022-12-19
DESIGNED	GW
PREPARED	GW
REVIEWED	NS
APPROVED	GKS

TITLE
Slope Hazard Susceptibility - Site Location

PROJECT NO	DOC	REV.	FIGURE
PS129742	102	0	A1

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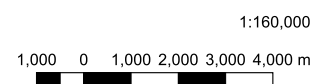


Corridor Name	Portion of Corridor (Refer figure A2)	Weighted score	Length (km)
Northern	All (Pipeline track area)	64	8
Southern	Southern A (Donkey Steps area)	43	2
	Southern B (Wolgan Road area)	72	2
Eastern	Eastern A (State mine gully road area)	25	26
	Eastern B 1 (Old Coach Road area)	46	4
	Eastern B 2 (Glow worm tunnel area)	58	4

Legend

- Slope Hazard Susceptibility Category
- Category 1 (Highest)
- Category 2 (High)
- Category 3 (Low)
- Category 4 (Lowest)
- Existing Access Routes, roads, tracks

LIDAR dataset extracted from Geoscience Australia - Elevation and Depth - Foundation Spatial Data. 2m Digital Elevation Model dataset coverage is over the Wallerawang region.



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PROJECT
Wolgan Valley Access Road - Corridor Comparison Assessment

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APPROVED

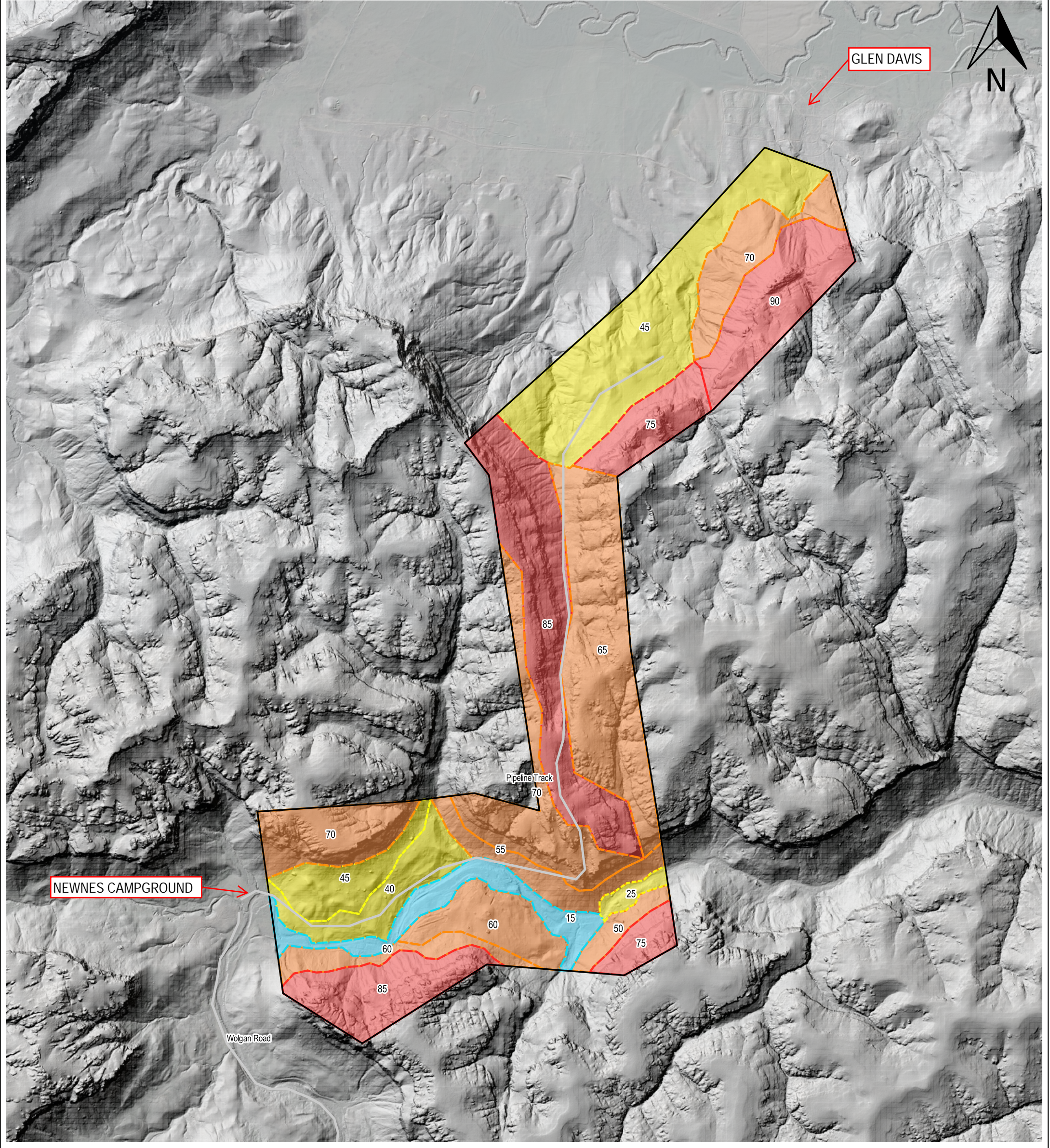
TITLE
Slope Hazard Susceptibility Corridor Comparison

PROJECT NO
PS129742

DOC
102

REV.
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FIGURE
A2



Legend
 Slope Hazard Susceptibility Category
 Category 1 (75-100 : Highest)
 Category 2 (50-75 : High)
 Category 3 (25-50: Low)
 Category 4 (0-25: Lowest)

Corridor Name	Sub-Corridor (Refer figure A2)		Length (km)	(Sub)Corridor Slope Susceptibility Score*
	Name	Description		
Northern	Northern	Glen Davis to Newnes Campground (pipeline track area)	8	499
Southern	Southern A	Eastern side of Southern corridor (Donkey Steps area)	2	98
	Southern B	Western side of Southern corridor (Wolgan Road area)	2	149
Eastern	Eastern AB 1	Entry along State Mine Gully road and continuation through Old Coach Road area	30	836
	Eastern AB 2	Entry along State Mine Gully road and continuation through Glow Worm Tunnel area	30	881

LIDAR dataset extracted from Geoscience Australia - Elevation and Depth - Foundation Spatial Data. 2m Digital Elevation Model dataset coverage is over the Wallerawang region.

*Refer Section 4.3.3 in PS129742-SYD-GEO-REP-102-REV 00 for calculation method

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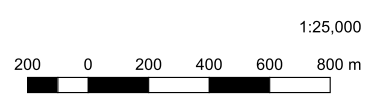
PROJECT
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YYYY-MM-DD 2022-12-19
 DESIGNED GW
 PREPARED GW
 REVIEWED NS
 APPROVED NS

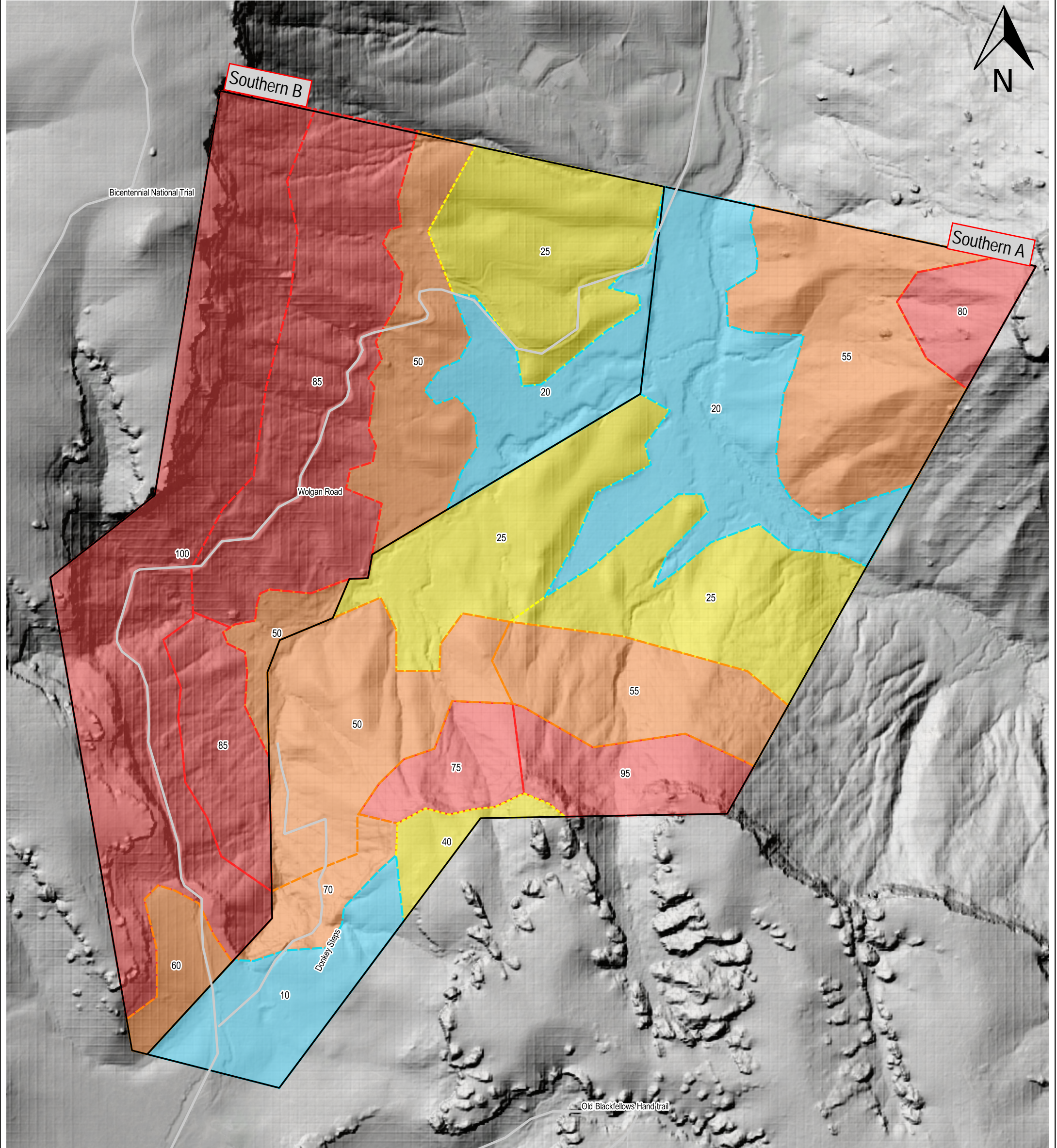
TITLE
Northern Corridor - Slope Hazard Susceptibility

PROJECT NO PS129742 DOC 102 FIGURE A3



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Legend

- Portion Division
- Slope Hazard Susceptibility Category**
- Category 1 (75-100 : Highest)
- Category 2 (50-75 : High)
- Category 3 (25-50: Low)
- Category 4 (0-25: Lowest)

Corridor Name	Sub-Corridor (Refer figure A2)		Length (km)	(Sub)Corridor Slope Susceptibility Score*
	Name	Description		
Northern	Northern	Glen Davis to Newnes Campground (pipeline track area)	8	499
Southern	Southern A	Eastern side of Southern corridor (Donkey Steps area)	2	98
	Southern B	Western side of Southern corridor (Wolgan Road area)	2	149
Eastern	Eastern AB 1	Entry along State Mine Gully road and continuation through Old Coach Road area	30	836
	Eastern AB 2	Entry along State Mine Gully road and continuation through Glow Worm Tunnel area	30	881

*Refer Section 4.3.3 in PS129742-SYD-GEO-REP-102-REV 00 for calculation method

LIDAR dataset extracted from Geoscience Australia - Elevation and Depth - Foundation Spatial Data. 2m Digital Elevation Model dataset coverage is over the Wallerawang region.

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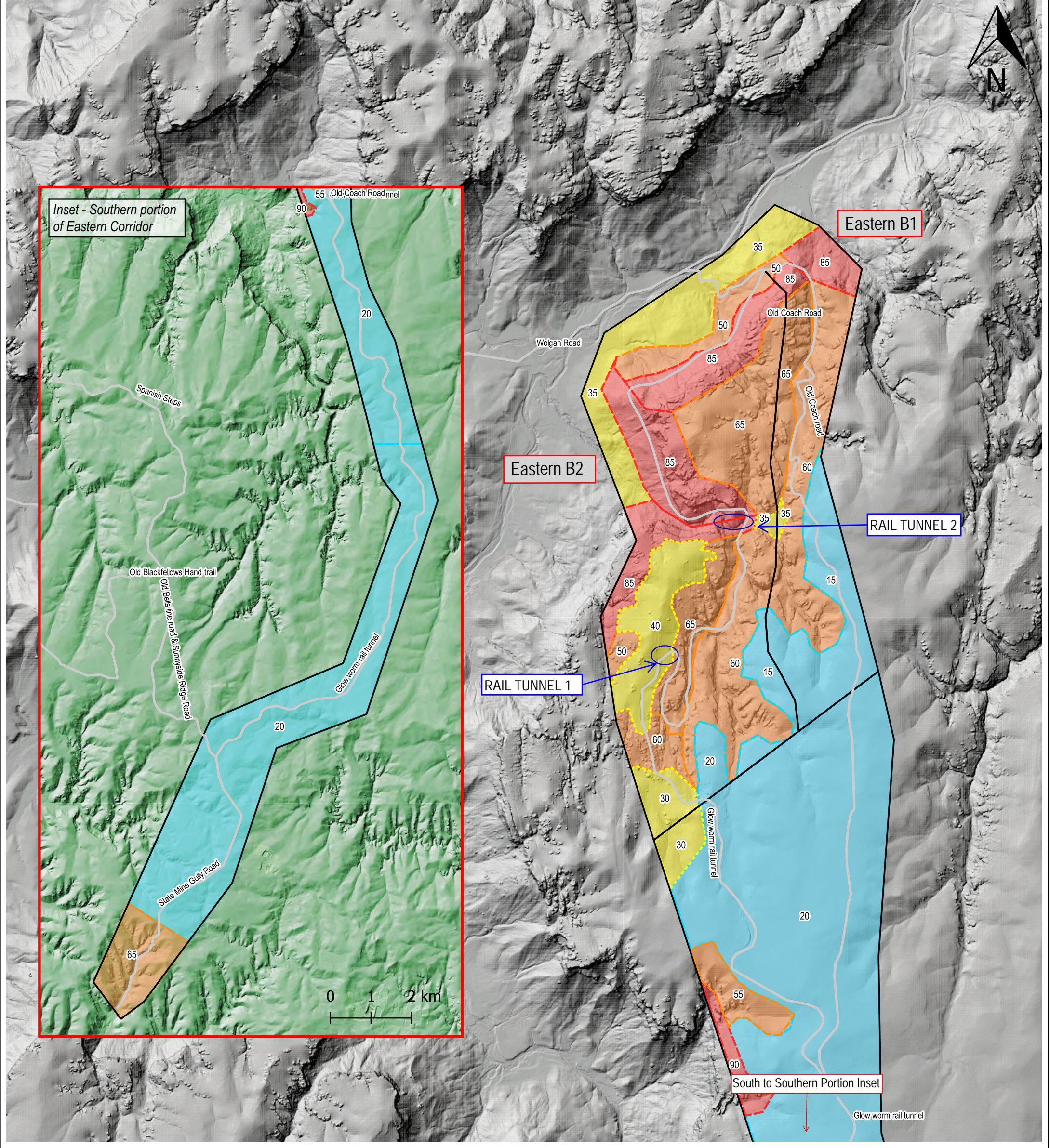
YYYY-MM-DD 2022-12-19
DESIGNED GW
PREPARED GW
REVIEWED NS
APPROVED NS

TITLE
Southern Corridor - Slope Hazard Susceptibility

PROJECT NO **PS129742** DOC **102** REV. **0** FIGURE **A4**

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Legend

□ Portion Division

Slope Hazard Susceptibility Category

- Category 1 (75-100 : Highest)
- Category 2 (50-75 : High)
- Category 3 (25-50: Low)
- Category 4 (0-25: Lowest)

Corridor Name	Sub-Corridor (Refer figure A2)		Length (km)	(Sub)Corridor Slope Susceptibility Score*
	Name	Description		
Northern	Northern	Glen Davis to Newnes Campground (pipeline track area)	8	499
	Southern A	Eastern side of Southern corridor (Donkey Steps area)	2	98
Southern	Southern B	Western side of Southern corridor (Wolgan Road area)	2	149
Eastern	Eastern AB 1	Entry along State Mine Gully road and continuation through Old Coach Road area	30	836
	Eastern AB 2	Entry along State Mine Gully road and continuation through Glow Worm Tunnel area	30	881

*Refer Section 4.3.3 in PS129742-SYD-GEO-REP-102-REV 00 for calculation method

LIDAR dataset extracted from Geoscience Australia - Elevation and Depth - Foundation Spatial Data. 2m Digital Elevation Model dataset coverage is over the Wallerawang region. Alternate hillshade colourisation shown on inset for clarity

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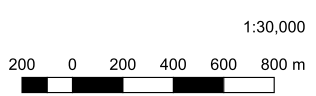
PROJECT
Wolgan Valley Access Road - Corridor Comparison Assessment

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YYYY-MM-DD 2022-12-19
DESIGNED GW
PREPARED GW
REVIEWED NS
APPROVED NS

TITLE
Eastern Corridor - Slope Hazard Susceptibility

PROJECT NO PS129742 DOC 102 REV. 0 FIGURE A5



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