6. Environmental assessment

6.1 Biodiversity

A detailed impact assessment of the proposal, as described in Chapter 3. The assessment report details the methods, biodiversity field survey results and assessment used to identify the extent and magnitude of potential ecological impacts associated with the proposal for the study area as defined in *the Medlow Bath Upgrade Great Western Highway Biodiversity Assessment* (RPS, 2021a), which is provided in Appendix D. A summary of this assessment is provided below.

6.1.1 Methodology

Background research of mapping, datasets and database searches was undertaken to collect and review publicly available information on the presence or likelihood of occurrence (within a 10 kilometre radius) of:

- threatened and protected terrestrial and aquatic flora and fauna species and their habitat
- threatened ecological communities
- important habitat for migratory species
- declared areas of outstanding biodiversity value.

The list of threatened species and ecological communities (threatened biodiversity) identified by database searches were subject to a habitat assessment. A field inspection of the main proposal area was undertaken by an ecologist on 10 December 2020 (as well as an additional visit on 14 May 2021 for the proposed Bellevue Crescent option). This field work aimed at ground-truthing the results of the background research and habitat assessment.

Five ‘likelihood of occurrence’ categories were applied to the threatened biodiversity listed in Table 6-1 with regard to:

- habitat descriptions as provided in the Threatened Species Profile Database and whether habitat features or components associated with the species occur within the proposal area
- geographic distribution of the species is known or predicted
- the recency of threatened species observations (ie recent being less than five years) and proximity to the proposal area (ie landscape factors such as patch size and connectivity)
- habitat value and condition as determined through the site inspection
- the results of targeted surveys (where performed)
- the likely effect of existing key threatening process (KTPs).

Table 6-1: Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area. It may be an occasional visitor (fauna) and is not dependent on available habitat (ie for breeding or important life cycle periods such as winter flowering resources) or for plants the site is sufficiently disturbed such that plant propagules are not likely to be present in the soil seed bank. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

6.1.2 Existing environment

The proposal area is located in the Wollemi subregion of the Sydney Basin bioregion. Soil and water catchment details are described in Section 6.3 and Section 6.4.

The proposal area typically comprises vegetation that is in a moderate to highly modified state, ranging from areas of bushland with edge effects apparent to fully cleared and managed roadside verges land and parklands. The best condition native vegetation is located along the western margin of the proposal area south of Bellevue Crescent, with higher condition vegetation and habitat occurring in this location.

Plant community types

The native vegetation observed within the proposal area is comprised of one vegetation community, which has been assigned a plant community type (PCT). The PCT identified within the proposal area is listed in Table 6-2 and shown in Figure 6-1.

Table 6-2: Native vegetation community types within the proposal area

Plant community type (PCT)	Condition class	Threatened ecological community	Area (ha) in proposal area	Area (ha) in study area
PCT 1248 Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion	Moderate	None	0.34	1.87
	Poor	None	0.02	0.02
Total			**0.36**	**1.89**

The identified PCT has been classified according to condition class (ie moderate or poor) and does not correlate to a threatened ecological community (TEC).

Other forms of vegetation cover not consistent with a naturally occurring PCT that were observed in the proposal area are listed below:

- 0.08 ha of native (landscaped)
- 1.06 ha of exotic (tree cover)
- 1.49 ha of exotic (groundcover).

Threatened ecological communities

No TECs were identified within the proposal area. The only State and Commonwealth listed TEC occurs outside and northeast of the study area in the Temperate Highland Peat Swamp on Sandstone (THPSS) endangered ecological community (EEC).

The location of this TEC relative to the proposal area is shown in Figure 6-2. This community provides unique habitat conditions for species such as the Blue Mountains Water Skink (*Eulamprus leuraensis*), Giant Dragonfly (*Petaleura gigantea*) and *Carex klaphakei*.

Groundwater dependent ecosystems

No groundwater dependent ecosystems were observed within the proposal area as the identified vegetation does not have high potential for groundwater dependency.

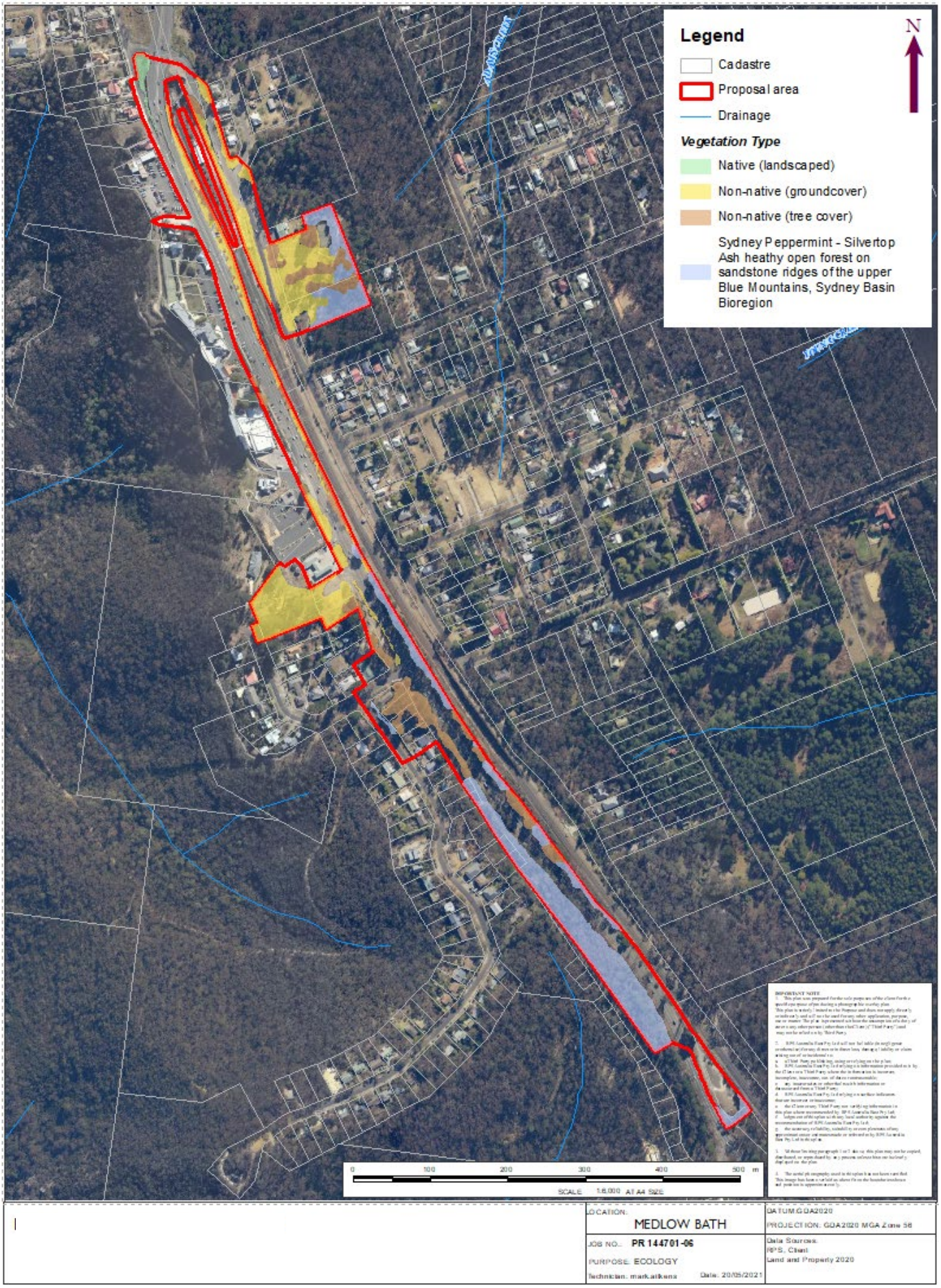

Figure 6-1: Vegetation cover within the proposal area (RPS, 2021a)

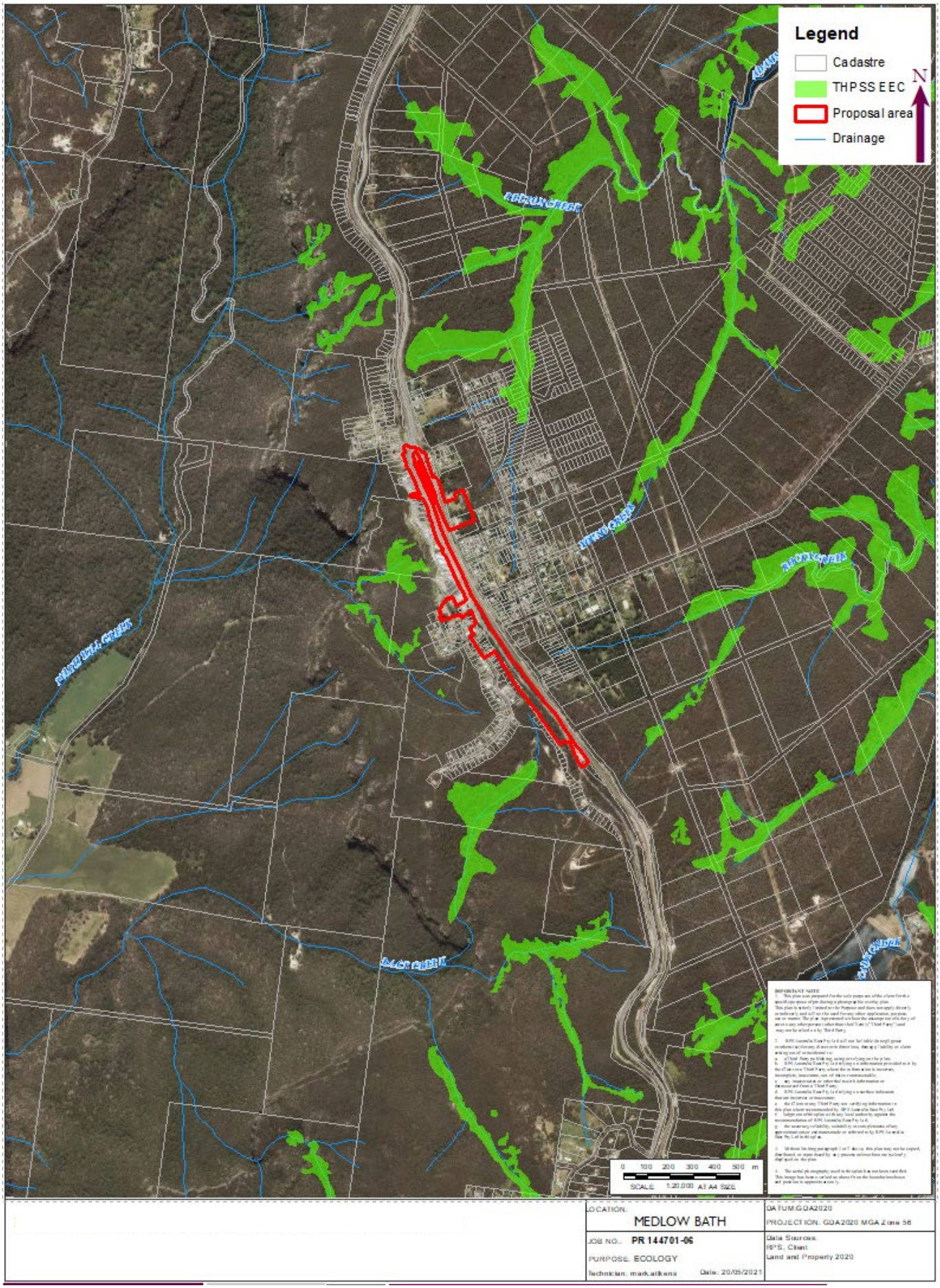

Figure 6-2: Threatened ecological communities within proximity to the proposal area (RPS, 2021a)

Threatened species and populations

Four threatened species were found to have a high likelihood of occurring on site and eighteen threatened species have a moderate likelihood. A summary of the likelihood of occurrence analysis is provided in Table 6-3. None of these species listed were observed during the field investigations.

Table 6-3: Likelihood occurrence analysis for threatened species within proposal area

Scientific name	Common name	Status – BC Act	Status – EPBC Act	Likelihood of occurrence
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Moderate
Heleioporus australiacus	Giant Burrowing Frog	V	V	Moderate
Pseudophryne australis	Red-crowned Toadlet	V	-	Moderate
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Moderate
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	High
Daphoenositta chrysoptera	Varied Sittella	V	-	Moderate
Petroica boodang	Scarlet Robin	V	-	High
Petroica phoenicea	Flame Robin	V	-	Moderate
Glossopsitta pusilla	Little Lorikeet	V	-	High
Ninox connivens	Barking Owl	V		Moderate
Ninox strenua	Powerful Owl	V	-	Moderate
Cercartetus nanus	Eastern Pygmy-possum	V	-	High
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	Moderate
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	Moderate
Phascolarctos cinereus	Koala	V	V	Moderate
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Moderate
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Moderate
Miniopterus australis	Little Bentwing-bat	V	-	Moderate
Miniopterus schreibersii oceanensis	Large Bent-winged Bat	V	-	Moderate
Persoonia hirsuta	Hairy Geebung	E	E	Moderate
Persoonia marginata	Clandulla Geebung	V	-	Moderate
Zieria murphyi	Velvet zieria	V	-	Moderate

V = vulnerable
E = endangered

Aquatic environment

The proposal area does not contain defined drainages that would classify as waterway habitat.

Areas of outstanding biodiversity value

No areas of outstanding biodiversity value (AOBV) occur within or in the vicinity of the proposal area and AOBV would not be impacted by the proposal.

Wildlife connectivity corridors

The well vegetated upper Blue Mountains provides for relatively unconstrainted wildlife connectivity in within the local area with local barriers to movement being limited to the developed parts of Medlow Bath and the Great Western Highway/railway line corridors. These barriers are considered minor and of no regional consequence.

Matters of National Environmental Significance

Commonwealth listed threatened and migratory species with a likelihood of occurrence of 'moderate' or 'greater' within the proposal area are outlined in Table 6-4. None of the species listed below were observed during the field investigation.

No EPBC listed wetlands of importance or threatened ecological communities were identified within the proposal area. One Commonwealth listed TEC is located 250 to 500 metres downstream of the study area.

Table 6-4: Likelihood of occurrence analysis for Commonwealth-listed threatened species within proposal area

Scientific name	Common name	Status – BC Act	Status – EPBC Act	Likelihood of occurrence
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Moderate
Heleioporus australiacus	Giant Burrowing Frog	V	V	Moderate
Apus pacificus	Fork-tailed Swift	-	M	Moderate
Hirundapus caudacutus	White-throated Needletail	-	M	Moderate
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	Moderate
Pseudomys novaehollandiae	New Holland Mouse	-	V	Moderate
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	Moderate
Petauroides volans	Greater Glider	-	V	Moderate
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Moderate
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Moderate

V = vulnerable
E = endangered

6.1.3 Potential impacts

Construction

The construction of the proposal is likely to result in the following impacts:

- removal of native vegetation
- removal of threatened fauna habitat
- removal of threatened flora
- aquatic impacts
- fauna injury or mortality
- impacts from construction noise, light and vibration.

Removal of native vegetation

The proposal is estimated to result in the clearing of 0.36 hectares of native vegetation consistent with a PCT classification. An additional 0.08 hectares of native (landscaped) vegetation would also be removed. A summary of the native vegetation loss by PCT classification is shown in Table 6-5. No TECs would be removed by the proposal.

Table 6-5: Impacts on native vegetation

Plant community type (PCT)	BC Act status	EPBC Act status	Percent cleared[1]	Proposal area[2] (hectares)
1248 Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion (moderate)	-	-	20	0.34
1248 Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion (poor)	-	-	20	0.02
Total				**0.36**

1- Based on the Vegetation Information System classification database.
2- Area to be cleared based on ground-truthed vegetation mapping within the study area.

Removal of threatened fauna habitat

The potential habitat of threatened fauna species with a moderate or greater likelihood of occurrence to be removed by the proposal is outlined in Table 6-6.

Table 6-6: Impacts on threatened fauna and potential habitat

Threatened species	Ecosystem or species credit species	BC Act status	EPBC Act status	Likelihood of occurrence	Potential Habitat to be impacted (ha)
Littlejohn's Tree Frog	Species	V	V	Moderate	0.32
Giant Burrowing Frog	Species	V	V	Moderate	0.32
Red-crowned Toadlet	Species	V	-	Moderate	0.32
Fork-tailed Swift	Ecosystem	-	M	Moderate	0.32
White-throated Needletail	Ecosystem	-	M	Moderate	0.32
Dusky Woodswallow	Ecosystem	V	-	Moderate	0.32
Gang-gang Cockatoo	Species	V	-	High	0.32
Varied Sittella	Ecosystem	V	-	Moderate	0.32
Scarlet Robin	Ecosystem	V	-	High	0.32
Flame Robin	Ecosystem	V	-	Moderate	0.32
Little Lorikeet	Species	V	-	High	0.32
Barking Owl	Species	V	-	Moderate	0.32
Powerful Owl	Ecosystem	V	-	Moderate	0.32
Eastern Pygmy-possum	Species	V	-	High	0.32
Spotted-tailed Quoll	Ecosystem	V	E	Moderate	0.32
New Holland Mouse	Ecosystem	-	V	Moderate	0.32
Southern Brown Bandicoot (eastern)	Ecosystem	E	-	Moderate	0.32
Koala	Species	V	V	Moderate	0.32
Greater Glider	Ecosystem	-	V	Moderate	0.32
Grey-headed Flying-fox	Ecosystem	V	V	Moderate	0.32
Large-eared Pied Bat	Species	V	V	Moderate	0.32
Little Bentwing-bat	Ecosystem/ Species	V		Moderate	0.32
Large Bent-winged Bat	Ecosystem/ Species	V		Moderate	0.32

V = vulnerable
E = endangered

Removal of threatened flora

The potential habitat of threatened flora species with a moderate or greater likelihood of occurrence to be removed by the proposal is outlined in Table 6-7.

Table 6-7: Impacts on threatened flora and potential habitat

Threatened species	Ecosystem or species credit species	BC Act status	EPBC Act status	Likelihood of occurrence	Potential Habitat to be impacted (ha)
Hairy Geebung	Species	E	E	Moderate	0.32
Persoonia marginata	Species	V	V	Moderate	0.32
Zieria murphyi	Species	V	V	Moderate	0.32

Removal of migratory species habitat

The potential habitat of migratory species with a moderate or greater likelihood of occurrence to be removed by the proposal is outlined in Table 6-8.

Table 6-8: Impacts on migratory species and potential habitat

Threatened species	Ecosystem or species credit species	BC Act status	EPBC Act status	Likelihood of occurrence	Potential Habitat to be impacted (ha)
Fork-tailed Swift	-	-	M	Moderate	0.32
White-throated Needletail	-	-	M	Moderate	0.32

Aquatic impacts

Impacts to waterways and aquatic habitats may include:

- temporary displacement of fauna
- loss of riparian and aquatic habitat, including removal or relocation of snags
- changes to flooding regimes, hydrology, turbidity and sedimentation
- changed hydrology including excessive flow velocities, modified depths of waterways, increase water turbulence, in stream structures, realignment of creeks, alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands, and channelization, piping, concrete lining or scour protection of waterways
- changes in shading regime and temperature.

No direct impact on aquatic habitat is expected. Changes to water quality and quantity may emerge in Adams Creek following redirection of overland flows into that drainage. Provided these flows are appropriately mitigated and managed measures it is considered that downstream impacts will be minor and inconsequential.

Injury and mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (eg ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (eg arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed. The study area is known to contain several arboreal species such as birds that may be injured or killed during vegetation removal. Reptiles and frogs may also be injured or killed during construction as habitat is cleared.

Noise, light and vibration

The proposal may result in impacts to fauna from noise and vibration during construction, which may result in fauna temporarily avoiding habitats adjacent to the construction. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

Lighting would be used at night to enable work to be completed that may result in impacts to nocturnal fauna. Nocturnal species such as possums and microbats may avoid the habitat in the proposal area during construction as temporary 'daylight' conditions would be created by the mobile lighting system. This impact is considered temporary and would not have long lasting effects on the biodiversity of the proposal area. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

Operation

The proposal is likely to result in the following operational/indirect impacts:

- reduced wildlife connectivity and habitat fragmentation
- edge effects on adjacent native vegetation
- invasion and spread of weeds, pests, pathogens and disease
- changes to hydrology
- impacts to groundwater dependent ecosystems
- cumulative biodiversity impacts.

Wildlife connectivity and habitat fragmentation

Potential impacts to wildlife connectivity may occur where roads affect the movement of plants and animals between habitats. Wildlife connectivity issues include blocking fish passage, preventing migration of a species, decreasing the opportunity for dispersal or increasing roadkill. The proposal has been identified as having the following impacts on wildlife connectivity and habitat fragmentation:

- loss of overhanging/ adjacent tree canopy and widening of existing tree canopy gaps
- barrier effects due to construction of new road and road widening
- edge effects
- genetic isolation
- life cycle requirements of species potentially impacted by the proposal
- changes to culverts and bridges resulting in wildlife connectivity impacts
- the scale, frequency, intensity and duration of potential wildlife connectivity impacts including direct and indirect impacts and the difference between construction (temporary) and operational (long-term) impacts
- cumulative impacts on corridors and movement.

The proposal is mostly restricted to the existing urban parts of Medlow Bath and consequently would have no discernible impact on wildlife connectivity within the local area. Additional contributions to habitat fragmentation are minor and inconsequential. No adverse impacts on wildlife populations, key habitat resources, genetic interchange, and population viability for some species is expected.

Edge effects on adjacent native vegetation and habitat

The development of linear infrastructure is known to cause disturbance in terms of reducing habitat quality in adjacent areas. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. Edge effects typically take the form of weed invasion, increased light levels, increased wind speeds, and greater temperature fluctuations.

The proposal would be built in an area that is subject to a high level of edge effects from the existing roadways and other development. The vegetation patches within the study area affected by high weed

invasion and other edge effects along existing edges, typically extending five to seven metres from the existing road formation and other clearings. There are likely to be additional edge effects resulting from the proposal as the new edges would typically be in areas only currently experiencing low to moderate weed invasion and other edge effects.

Invasion and spread of weeds and pests

Proliferation of weed and pest species would be an indirect impact (ie not a direct result of proposal activities). The most likely causes of weed dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. The proposal area contains significant weed growth, in all areas, particularly on agricultural land and along minor roads and tracks. As such, the spread and proliferation of weeds would need to be managed during construction.

Proposal activities also have the potential to disperse pest species out of the proposal area across the surrounding landscape. Machinery entering the site would need to be cleaned to remove plant propagules so as to limit the likelihood of importation into the proposal area. The magnitude of this impact is likely to be low and mitigation measures are likely to be effective.

Invasion and spread of pathogens and disease

Several pathogens known from NSW have potential to impact on biodiversity as a result their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- dieback caused by Phytophthora (Root Rot; EPBC Act and BC Act)
- infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed in the proposal area, the potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all phases (construction and operation). Pathogens would need to be managed within the proposal area according to the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a).

Changes to hydrology

The proposal would involve the redirection of waters into Adams Creek thereby increasing water quantity and possible changes to water quality along this drainage. The proposal is likely to cause changes to affect the volume and peak runoff rates into waterways from the upstream catchments. The following recommendations have been made to minimise these impacts:

- provide all runoff discharge locations with level spreaders for limits on the scour potential of runoff entering the existing watercourses
- runoff discharge locations are proposed to have attenuation basins for mitigation of the discharge peak flows to no greater than under the existing conditions. Bioretention is proposed to be integrated into the basin floor to provide stormwater quality filtration and treatment.

Minor and inconsequential impacts on the THPSS EEC located 250 to 500 metres downstream of the proposal are predicted because of these works. No changes in ecosystem functionality and composition are expected.

Operational noise, light and vibration

The existing levels of noise and vibration from the existing Medlow Bath area and other roads by vehicles are substantial, with the proposal unlikely to significantly increase noise and vibration during operation of the road that would result in any increased impacts to biodiversity within the proposal area.

Impacts to groundwater dependent ecosystems

The proposal is not likely to have any direct impacts on groundwater dependent ecosystems. However, alteration to the hydrology of Adams Creek through the direction of increased flows into the watercourse may have an impact on THPSS EEC, which is a groundwater dependent ecosystem. Impacts to this TEC are likely to be minor and inconsequential.

Cumulative impacts

The potential biodiversity impacts of the proposal must be considered as a consequence of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context.

Conclusion on significance of impacts

Even though some clearance of vegetation is required, the proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

Biodiversity offsets

The proposal is not likely to have a significant impact on threatened species, ecological communities and their habitats. Residual impacts are to be minimised and mitigated. A Biodiversity Offset Strategy is not required for this proposal.

6.1.4 Safeguards and management measures

Table 6-9: Safeguards and management measures – Biodiversity

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	A Flora and Fauna Management Plan will be prepared in accordance with TfNSW's *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a) and implemented as part of the CEMP. It will include, but not be limited to: • plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas requirements set out in the *Landscape Design Guideline* (Roads and Maritime Services, 2018a) • pre-clearing survey requirements procedures for unexpected threatened species finds and fauna handling procedures addressing relevant matters specified in the *Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries Fisheries, 2013) • protocols to manage weeds and pathogens.	Contractor	Detailed design / Pre-construction	Section 4.8 of *QA G36 Environment Protection*
Removal of native vegetation	Areas for native vegetation and habitat removal will be minimised through detailed design.	Contractor	Detailed design	Appendix D
Removal of native vegetation	Pre-clearing surveys and habitat removal will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a). Where possible, hollow bearing trees should be retained or relocated.	Contractor	Pre-construction	Appendix D
Removal of native vegetation	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the	Contractor	Construction	Appendix D

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects (Roads and Traffic Authority, 2011a).			
Removal of native vegetation	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a).	TfNSW	Post construction	Appendix D
Removal of native vegetation	The unexpected species find procedure will be followed under the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal area.	Construction contractor	Construction	Appendix D
Aquatic habitat	Aquatic habitats will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (Department of Primary Industries Fisheries, 2013).	Contractor	Construction	Appendix D
Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a).	Contractor	Construction	Appendix D
Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a).	Contractor	Construction	Appendix D
Invasion and spread of pests	Pest species will be managed within the proposal area.	Contractor	Construction	Appendix D
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (Roads and Traffic Authority, 2011a).	Contractor	Construction	Appendix D

6.2 Hydrology and flooding

Hydrological and hydraulic studies were completed to identify design requirements to mitigate the changes in potential flooding risks and to address the requirements of the proposal. Refer to the *Great Western Highway Upgrade – Medlow Bath Hydrology and Hydraulic Impact Assessments* (Mott MacDonald, 2021a) in Appendix E.

6.2.1 Methodology

The hydrological performance of key features of the stormwater drainage system comprising pipes, culverts, open channels and head walls has been assessed through DRAINS model. The assessment approach included:

- hydrologic and hydraulic analysis of existing cross drainage structures
- hydraulic analysis to identify culvert upgrades required for the works
- development of a high-level strategy for discharging runoff from the new pavement drainage system
- impact assessment of the proposed works during construction and operation
- design for mitigation to reduce the impacts of the proposal in terms of water quality and quality of run off.

Data sources

The assessment was completed based on draft masterplans for Medlow Bath Park, digital survey, utility and environmental GIS data, and road design information as detailed in Appendix E.

Existing cross drainage structures

A schedule of the existing cross drainage structures along the Great Western Highway that provide capture and conveyance of upstream runoff are listed below, with information on these culverts obtained through a detailed survey.

- CX3480 - CH3480, 1no. 375 millimetre diameter pipe
- CX3770 - CH3770, 1no. 450 millimetre diameter pipe
- CX3960 - CH3960, 1no. 450 millimetre diameter pipe
- CX4200 - CH4200, 1no. 450 millimetre diameter pipe
- CX4220 - CH4220, 1no. 375 millimetre diameter pipe.

Performance for existing structures:

Due to the small and urban nature of the upstream catchments, the flow regime reflecting the critical storm conditions are consistently short and flashy events with high intensity rainfall. Assumptions were made on the size of cross drainage structures downstream of CX3770, CX3960, CX4200 in the rail corridor as this information is not embedded into the Digital Sending Software digital utility information on the drainage features within the corridor.

The identified drainage standards of existing drainage structures were:

- CX3480 at 2 per cent Annual Exceedance Probability (AEP), discharges freely
- CX3770 at 1 per cent AEP, assumes unblocked rail cross drainage downstream. Rail hydraulic standard less than 1 per cent AEP
- CX3960 at 10 per cent AEP, assumes unblocked rail cross drainage downstream. Rail hydraulic standard less than 1 per cent AEP
- CX4200 at 20 per cent AEP, constrained by downstream rail cross drainage

- CX4220 at 20 per cent AEP, Constrained by downstream rail cross drainage.

A range of rainfall intensities were then selected to assess the existing cross drainage performance, including 1 per cent, 2 per cent, 5 per cent, 10 per cent and 20 per cent AEP storm events and the details are summarised below.

- At 1 per cent AEP, the existing cross drainage structures CX3480, CX3960, CX4200, CX4220 showed overflow results
- At 2 per cent AEP, the existing cross drainage structures CX3960, CX4200, CX4220 showed overflow results
- At 5 per cent AEP, the existing cross drainage structures CX3960, CX4200, CX4220 showed overflow results
- At 10 per cent AEP, the existing cross drainage structures CX4200 and CX4220 showed overflow results
- At 20 per cent AEP, the existing cross drainage structures showed no overflow results.

Design assumptions

The study recognises future upgrade considerations due to the potential impact on peak flows of future development and climate change. TfNSW design criteria for blockage of cross drainage structures has not been considered in the capacity assessment below but would form part of the design criteria for the cross drainage structures in detailed design.

Uplift in rainfall intensities as a result of temperature increases under the latest climate projections in the Australian Rainfall and Runoff 2019 (ARR 2019) have also been incorporated into design infrastructure. The cross drainage capacity for the proposal would be upgraded to 1 per cent AEP inclusive of climate change uplift for the RCP 8.5 in line with the ARR 2019. (The RCP refers to the ‘Representative Concentration Pathway that takes into account emissions of greenhouse gases, aerosols and other chemically active gases, and land use and cover. An RCP of 8.5 represents a scenario at the higher end of likely temperature increases.)

6.2.2 Existing environment

Regional context

The proposal is in the vicinity of multiple tributaries comprising ephemeral streams that feed into the larger river systems of the Coxs River and Grose River. These catchments predominantly comprise of native vegetation with small portions of urban development located adjacent the transport corridor of the Great Western Highway and adjacent rail corridor.

The study area for the hydrology assessment covers 10.58 hectares including Medlow Bath Station and interchange, as well as Medlow Bath Park to the east and downstream of the major sag location and cross drainage structures for the transport corridor. This major sag just south of the existing railway station collects runoff from the majority of the study area and directs the flow to the receiving Adams Creek to the west. Smaller portions of the study area drain to the remaining watercourses.

Climate

Average monthly rainfall for the nearest rainfall station at Katoomba (063039, Murri Street) indicates the area experiences larger summer rainfalls than during the winter months. This is indicated in the Figure 6-3 average monthly plot, with the annual average rainfall at 1,400 millimetres across the 134 year record.

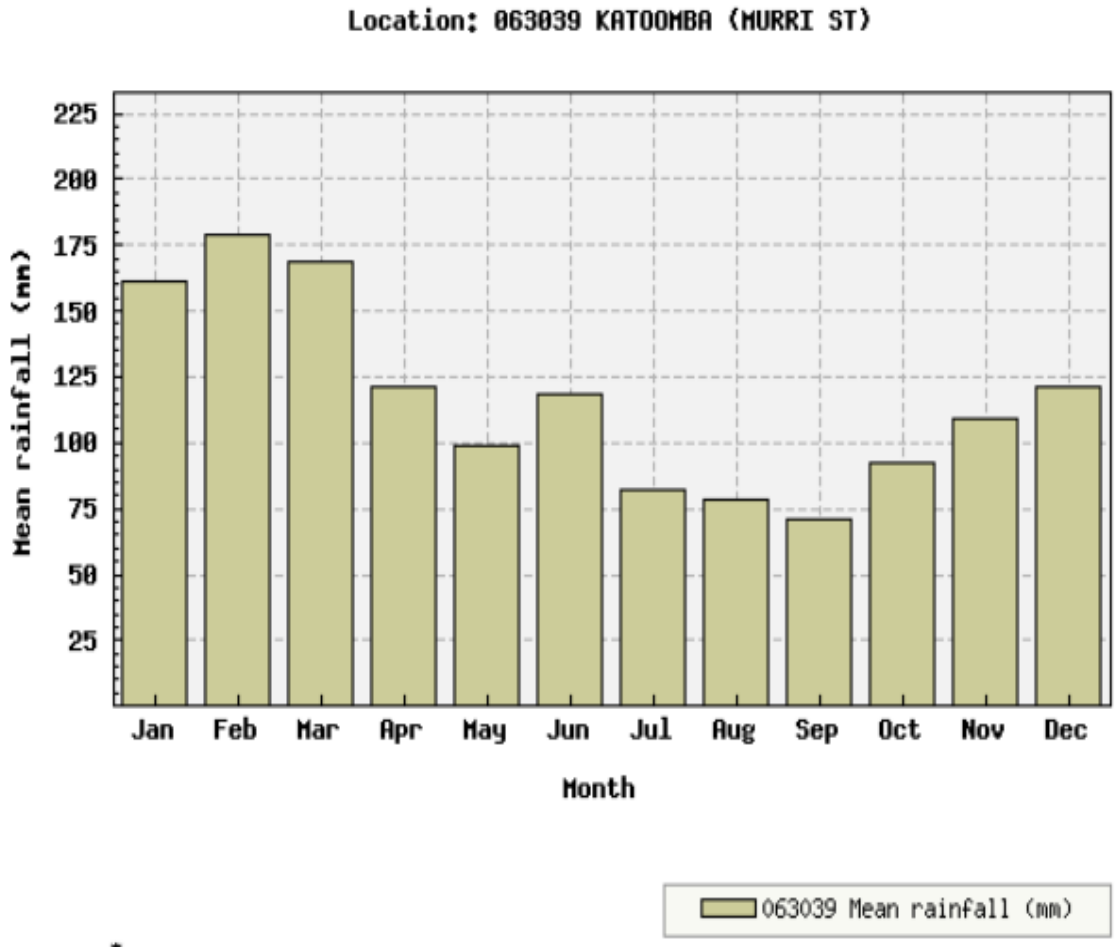

Figure 6-3: Average monthly rainfall data (Source: Bureau of Meteorology)

6.2.3 Potential impacts

The following impacts have been identified based on the concept design and would be reviewed once detailed design is available. During the detailed design phase any additional impact would be identified and added to the project risk assessment for documentation of potential risks and mitigation measures.

Construction

Construction activities would involve earthworks and other ground disturbing activities that would increase the risk of sediment movement off site either through vehicle movements, or wind and water runoff. Impacts from sediment movement are expected to be managed through the implementation of standard erosion and sediment controls and management plans implemented by the contractor.

There is a risk of potential blockages to waterways and drainage lines due to earthworks and other construction activities, which may result in localised flooding upstream and change the ultimate discharge location of overland flows into receiving watercourses. Diversion of drainage lines may also create localised areas of flooding and scour. These impacts are expected to be minor and would be managed through the implementation of standard water management and scour measures.

Operation

Flooding changes

The proposed upgrade includes changes in the road geometry and widening which would create an increase in the paved area, and improve the drainage capacity of the formal drainage infrastructure to current standards. This can change the existing flood behaviour and alter the flood risk to existing sensitive receivers.

The proposal would affect the peak runoff rates from upstream catchments contributing flows to cross drainage structures. The increase in paved areas would result in an estimated 20 per cent increase in the 1 per cent AEP peak flows at the Medlow Bath Park and new cross drainage CD3770 discharge locations. The increased cross drainage capacity removes flood storage from upstream of the rail corridor by allowing higher peak flow rates through the upgraded culverts. These locations are proposed to have attenuation basins for mitigation of the discharge peak flows to no greater than under the existing conditions and to relocate flood storage to within the formal basin structure.

Upstream flooding impacts are caused by increased runoff volumes by the increase in impervious portions of catchments, the increase in catchment size through regrading of the area to create the design pavement profiles, or the redistribution of flows as a result of a change in the formal drainage infrastructure. All three components were found to be influencing the post construction flood impacts in the modelling, however the impacts are generally considered minor given the limitation of vertical alignment changes, maintenance of flow discharge splits to downstream receivers, and general increase in available stormwater storage within the drainage system.

Downstream flooding impacts would be limited through the use of flow control structures including:

- a new detention basin downstream south of the existing cross drainage location (CX3480) where a major flow culvert upgrade across the transport corridor is proposed
- a new detention basin downstream of the existing sag rail cross drainage location (CX4200 and CX4220) where a major flow culvert upgrade across the transport corridor is proposed
- existing intermediate rail cross drainage locations (CX3770 & CX3960) where the highway stormwater system discharges flow to the existing rail cross drainage structures without major flow culvert upgrades.

Scour impacts

Scour potential would be increased with higher velocities and larger flow rates than experienced under existing conditions. With the increase in impervious areas as the road widening is constructed, runoff volumes would increase having the potential for scour events in receiving watercourses. Culvert/channel scour protection to Australian and TfNSW design standards to ensure suitable velocity and peak flow protection would be undertaken during detailed design.

6.2.4 Safeguards and management measures

Table 6-10: Safeguards and management measures – Hydrology and flooding

Impact	Environmental safeguards	Responsibility	Timing	Reference
Blockage causing increased flooding potential	Develop a blockage assessment of the pavement and cross drainage strategy.	Contractor	Detailed design /Pre-construction	Best practice
Overland flows causing localised flooding	Flow diversion bunds and sediment fencing are to be used for redirection of overland flows to dedicated management areas including sediment basins and ultimately to discharge locations.	Contractor	Construction	Best practice

6.3 Surface water and groundwater

The *Great Western Highway Upgrade Medlow Bath Surface and Ground Water Impact Assessments* (Mott MacDonald, 2021b) is included in Appendix F and summarised in this section. The hydrological catchment areas (study area) for the assessment are shown in Figure 6-4.

Figure 6-4: Hydrological catchment areas for the proposal (Mott MacDonald, 2021b)

6.3.1 Methodology

The proposed upgrade includes changes in the road geometry and widening which potentially creates changes to the groundwater table and an overall increased paved area. This can change the existing groundwater infiltration and alter the flow paths of surface water as it becomes runoff and is discharged to existing receivers. To assess potential water quality risks and to address the requirements of the proposal the assessment included:

- collation, analysis and interpretation of the available sensitive ecosystem and groundwater bore data including registered users
- an assessment of the existing soil and potential contamination conditions, including a review of exiting subsurface strata from geological records and geotechnical data
- review of contribution pollutants from the existing catchment
- preparation of a high-level water quality strategy accounting for both increases and changes in the surface and groundwater transportation

- assessment of potential impacts to water quality through the neutral or beneficial effect on water quality (NorBE) assessment tool published by WaterNSW, as a result of the proposal being located within the Sydney Drinking Water Catchment. The NorBE assessment is provided in Appendix C.

The assessment was completed based on draft masterplans for Medlow Bath Park, digital survey, utility and environmental GIS data, contaminated land information, and road design information as detailed in Appendix F.

6.3.2 Existing environment

Regional context

The regional context is described in Section 6.2.2.

Groundwater dependent ecosystems

Refer to the Section 6.1 for a discussion on groundwater dependent ecosystems.

Groundwater

The study area does not have any recorded hydrological landscape data according to the NSW Department of Planning, Industry and Environment; however, it lies adjacent to the Megalong Valley Hydrological Landscape, which provides data that is useful to determine the likely nature of groundwater in this landscape. Characteristics of this adjacent landscape were obtained through the NSW Department of Planning, Industry and Environment eSPADE website.

The key hydrogeological landscape characteristic of the Megalong Valley Hydrological Landscape is a long sandstone escarpment with moderately to steeply inclined colluvial slopes and drainage lines. This characteristic is positively associated with the soil and geology landscape seen within the Medlow Bath Landscape. This landscape is of low salinity, with a low salt load (export) and a relatively high quality of fresh water. In correlation with the acid sulphate data for the area, pyrites are not present. It is an area of moderate rainfall.

As the Medlow Bath Landscape is that of shallow soil, and with a topography leading to a rapid cliff-like drop, it is highly likely that the groundwater flow from the Medlow Bank Landscape discharges into the lithosols/siliceous sands below the sandstone escarpment, flowing then on the surface of the granite bedrock.

Figure 6-5 shows the conceptual cross-section for Megalong Valley Hydrological Landscape showing the distribution of regolith landforms, salt sites and flow paths of water infiltrating the system.

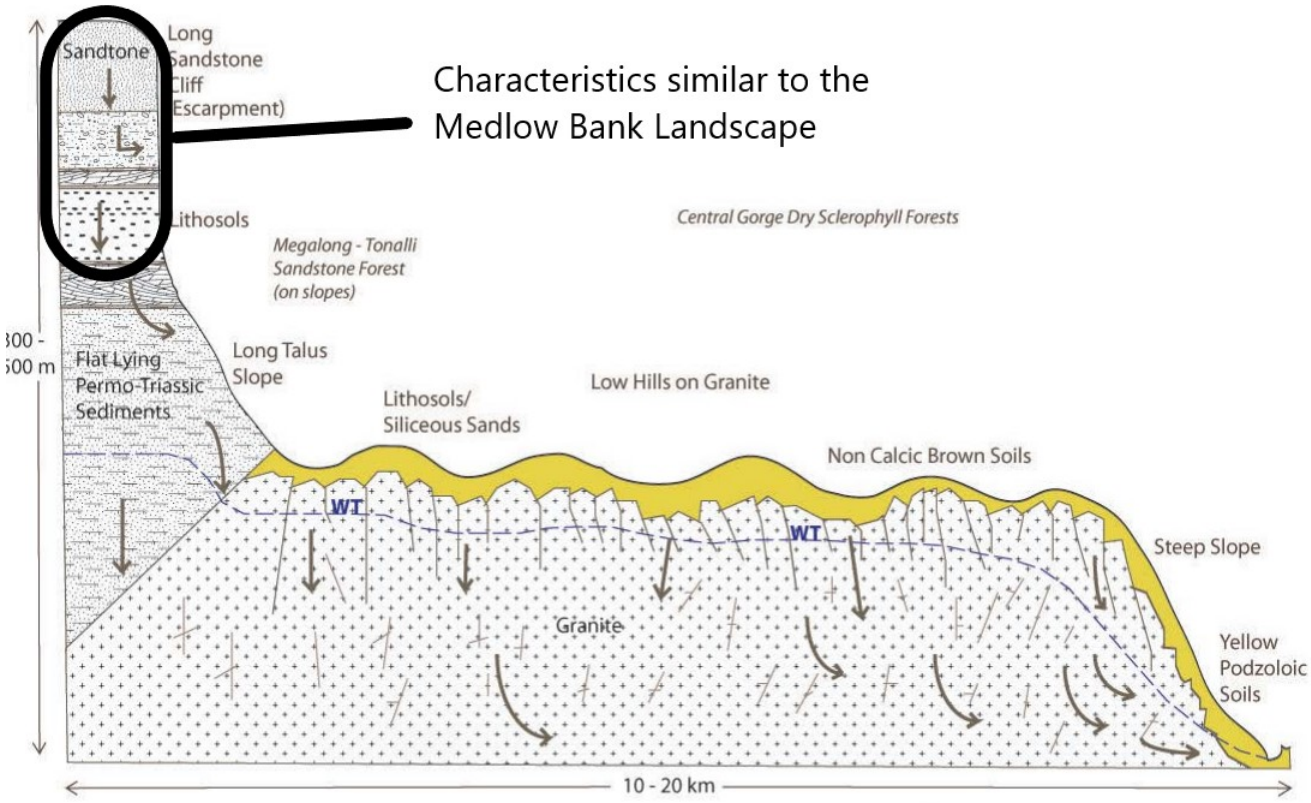

Figure 6-5: Conceptual cross-section for Megalong Valley (Source: Department of Planning, Industry and Environment)

Water quality

Water draining from the study area flows towards the Grose River and Coxs river catchments which are subject to controls under the Sydney Drinking Water Catchment. In the current condition, minimal existing treatment measures are installed in the cross drainage structures to treat the urban runoff from the area flowing into the system prior to discharge to the natural receiving watercourses.

Surface water features

A schedule of existing cross drainage structures for providing capture and conveyance of upstream runoff are listed in Section 6.3.2. The existing cross drainage discharge locations across the rail corridor are to be maintained to continue the connectivity of flow paths to the downstream receiving watercourses. These discharge locations are typically open drains leading to the rail corridor or existing overland flow paths in Medlow Bath Park.

6.3.3 Potential impacts

Construction

In addition to sedimentation and scour impacts which are described in Section 6.2.3 which can contribute to poor water quality there is also a risk of releasing potentially harmful chemicals and other substances in the environment due to spills. This could occur as a result of equipment malfunction and maintenance or refuelling, inappropriate storage, handling and use of contaminated sediment and via treatment and curing processes for concrete. Potential contaminants could include acids and chemicals from washing down of vehicles, construction fuels, oils, lubricants, hydraulic fluids and other chemicals.

Groundwater impacts during construction include risks to groundwater quality as a result of spills or poor management of groundwater encountered during earthworks. Drawdown of groundwater levels may also impact surrounding land uses including affects to groundwater use and settlement of adjacent structures.

Operation

Increases in impervious surface areas have the potential to result in increased runoff due to changes in the hydrological regime. This could lead to water quality impacts associated with increased erosion and sedimentation and increased concentrations or the introduction contain pollutants such as sediments, nutrients, oils and greases, petrochemicals and heavy metals, which could potentially impact on water quality when discharged into receiving waterways.

The operation of the proposal is likely to impact on water quality due to discharge of drainage at new locations or increased discharge at existing locations where road and drainage upgrades have occurred. Increased flow rates can impact on the bed and bank stability of the existing watercourses making them highly susceptible to erosion. Stream erosion increases sediment and nutrient loads leading to decreased water quality which would potentially affect the protection of the nominated environmental values and scour potential is also increased with higher velocities and larger flow rates.

Surface water impacts during operation of the proposal would be minimised by:

- providing level spreaders to limit scour potential at runoff discharge locations entering the existing watercourses
- implementing attenuation/detention basins for mitigation of the discharge peak flows to no greater than under the existing conditions
- integrated bioretention into the basin floor to provide stormwater quality filtration and treatment.

The NorBE assessment carried out for the proposal (included at Appendix C), included MUSIC modelling and is the quantitative approach to assess the potential impacts and provide a basis of pollutant generation that is used in determination of the mitigation measures. The assessment found that assuming the mitigation recommendations are adopted, the proposal would achieve a beneficial outcome with regard to surface water quality. The new treatment measures would remove gross pollutants and further reduce residual pollutants through biofiltration prior to discharge, contributing to a lower level of pollutants than before construction.

With respect to groundwater, all the construction stage risks are also relevant in the operational phase. In addition, the potential long term effects of the changes in impervious surfaces with road widening could alter the groundwater recharge rates in the immediate vicinity and continue the impacts to sensitive receivers such as groundwater dependent ecosystems.

Installation of stormwater detention basin

A key strategy to manage surface water run off during operation is the installation of a new sedimentation basin located adjacent to Medlow Bath (refer Figure 6-6 which shows the proposed location). It is intended that this sedimentation basin would be installed at an early phase of the construction works to be utilised for managing surface water run off during works (including additional pipes below the rail line). The basin would then be used during the operational phase to ensure an acceptable level of water quality is discharged into the existing overland flow paths in Medlow Bath Park.

During both phases, the water would be pre-treated via spill containment (to capture oils from road surfaces) and a gross pollutant trap (to capture sediment, rubbish and vegetation debris). The water would enter the detention basin in order to retard or slow down the flow of water so it is released at a steady state, and this would also enable some water to infiltrate into the ground and potentially allow for storage for use in watering the park. Post treatment, the treated water would discharge into the existing rock lined channel in Medlow Bath Park. Figure 6-7 shows the water quality process that has been incorporated into the design.

Figure 6-6: Proposed location of new sedimentation basin - in yellow (Image source: Mecone Mosaic)

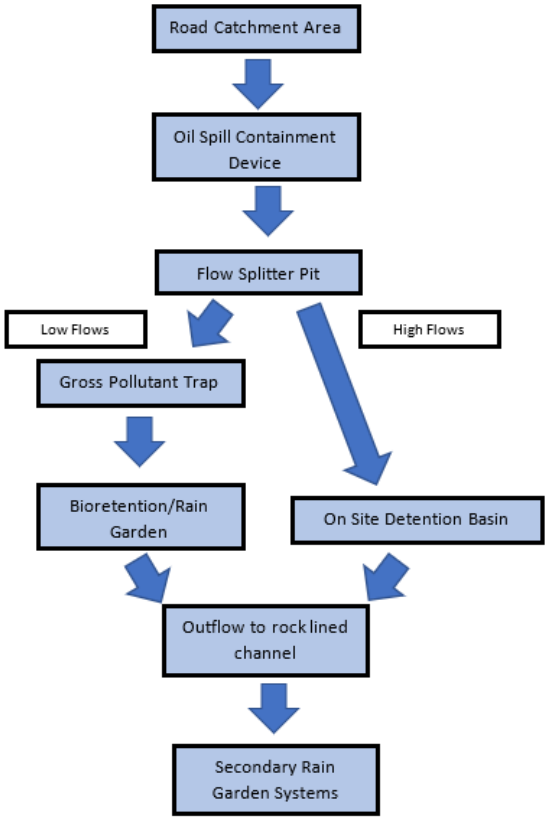

Figure 6-7: Water quality management process for the proposal

6.3.4 Safeguards and management measures

Table 6-11: Safeguards and management measures – Surface water and groundwater impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil degradation and water pollution	A Soil and Water Management Plan will be prepared and implemented as part of the CEMP. The plan will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The Soil and Water Management Plan will be reviewed by a soil conservationist on the TfNSW list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The Plan will then be revised to address the outcomes of the review.	Contractor	Detailed design / Pre-construction	Section 2.1 of *QA G38 Soil and Water Management*
Soil degradation and water pollution	Site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. The Plan/s will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather. The site specific Erosion and Sediment Control Plan/s will be developed in accordance with the principles and requirements in *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom, 2004) and *Volume 2D* (DECCW, 2008), commonly referred to as the 'Blue Book'.	Contractor	Detailed design / Pre-construction	Section 2.2 of *QA G38 Soil and Water Management*
Run-off velocity (scour protection)	Level spreaders will be installed at all discharge locations to the natural surface used to reduce velocity and depth of the flows reaching the natural watercourses /s. New discharge outlets will be designed with appropriate energy dissipation and scour protection measures as required to minimise the potential for sediment disturbance and resuspension in the receiving waters. Outlet design and energy	Contractor	Detailed design / Pre-construction	Best practice

Impact	Environmental safeguards	Responsibility	Timing	Reference
	dissipation/scour protection measures will be informed by drainage modelling. Check dams or velocity managing devices are installed into flow paths particularly in areas with steep gradients.			
Water quality	Maintenance requirements for all stormwater treatment systems and devices installed as part of the proposal will be identified and included in relevant operational maintenance schedules/systems.	TfNSW	Post construction	Best practice
Spill containment	Dedicated diversion equipment will be implemented for the storage of spills to avoid direct discharge to receiving watercourses.	Contractor	Detailed design / Pre-construction	Best practice
Sediment run-off from construction site	Sediment basins will be designed and constructed for the collection of sediment runoffs through reduction of flow velocity.	Contractor	Construction	Section 2.2 of *QA G38 Soil and Water Management*
Sediment run-off from construction site	The extent of ground disturbance and exposed soil will be minimised to the greatest extent practicable to minimise the potential for erosion.	Contractor	Construction	Section 2.2 of *QA G38 Soil and Water Management*
Sediment run-off from construction site	Disturbed ground and exposed soils will be permanently stabilised and proposed landscaped areas will be suitably profiled and vegetated as soon as possible following disturbance to minimise the potential erosion.	Contractor	Construction	Section 2.2 of *QA G38 Soil and Water Management*

6.4 Soils and contamination

This section summarises the results of a desktop investigation of the soils and geology underlying the proposal area and the *Great Western Highway Upgrade Medlow Bath Phase 1 Preliminary Site Investigation and Report* (Mott MacDonald, 2020), provided in Appendix G.

6.4.1 Existing environment

Geology

The geology of the proposed area is identified by the NSW Department of Planning, Industry and Environment's data as comprising:

- **Narrabeen Group**: Quartz-lithic to quartzose sandstone, conglomerate, mudstone, siltstone, rare coal
- **Early Triassic to Middle Triassic**: predominately sedimentary rocks; including sedimentary rocks of low metamorphic grade and diapiric breccias.

Soil landscape

The *1:100,000 Geology of Penrith Map* (Geological Survey of NSW, 1991), identifies the regional geology of the proposal area as a combination of the following landscape, as shown in Figure 6-8.

- **Medlow Bath (residual):** predominately a combination of Leptic Rudosols and Orthic Tenosols which are rapid to well-draining, achieving an approximate depth of 100 centimetres before bedrock.

Adjacent soil landscapes include:

- **Warragamba (erosional):** compromised of a combination between rapidly and well-drained soils to a maximum depth of 150 centimetres before bedrock appears
- **Wollangambe (erosional):** compromised of a variety of rapidly draining soils to a maximum depth of 150 centimetres before bedrock appears.

Acid sulphate soils

Acid sulphate soils include those where the sulfides in the soils have been exposed to air and acid is being generated (actual acid sulphate soil) and those which may form actual acid sulphate soil when drained or exposed to oxidisation processes (ie the exposure of iron sulphate minerals such as pyrite to oxygen).

A search of the NSW Department of Planning, Industry and Environment's database on Eastern Australian Acid Sulphate Soils on 26 November 2020 indicates that there are no known or risk of acid sulphate soils occurring within or in the vicinity of the proposal.

Salinity

Salinity is the accumulation of salts in soil and water to levels that impact on human and natural assets. Salinity occurs where salt in the landscape is mobilised and redistributed closer to the soil surface and / or into waterways by rising groundwater.

A search of the NSW Department of Planning, Industry and Environment's database on Eastern Australian Soil Salinity on 3 March 2021 did not include salinity data for the proposal area. However, records for the adjacent area states "no salting evident".

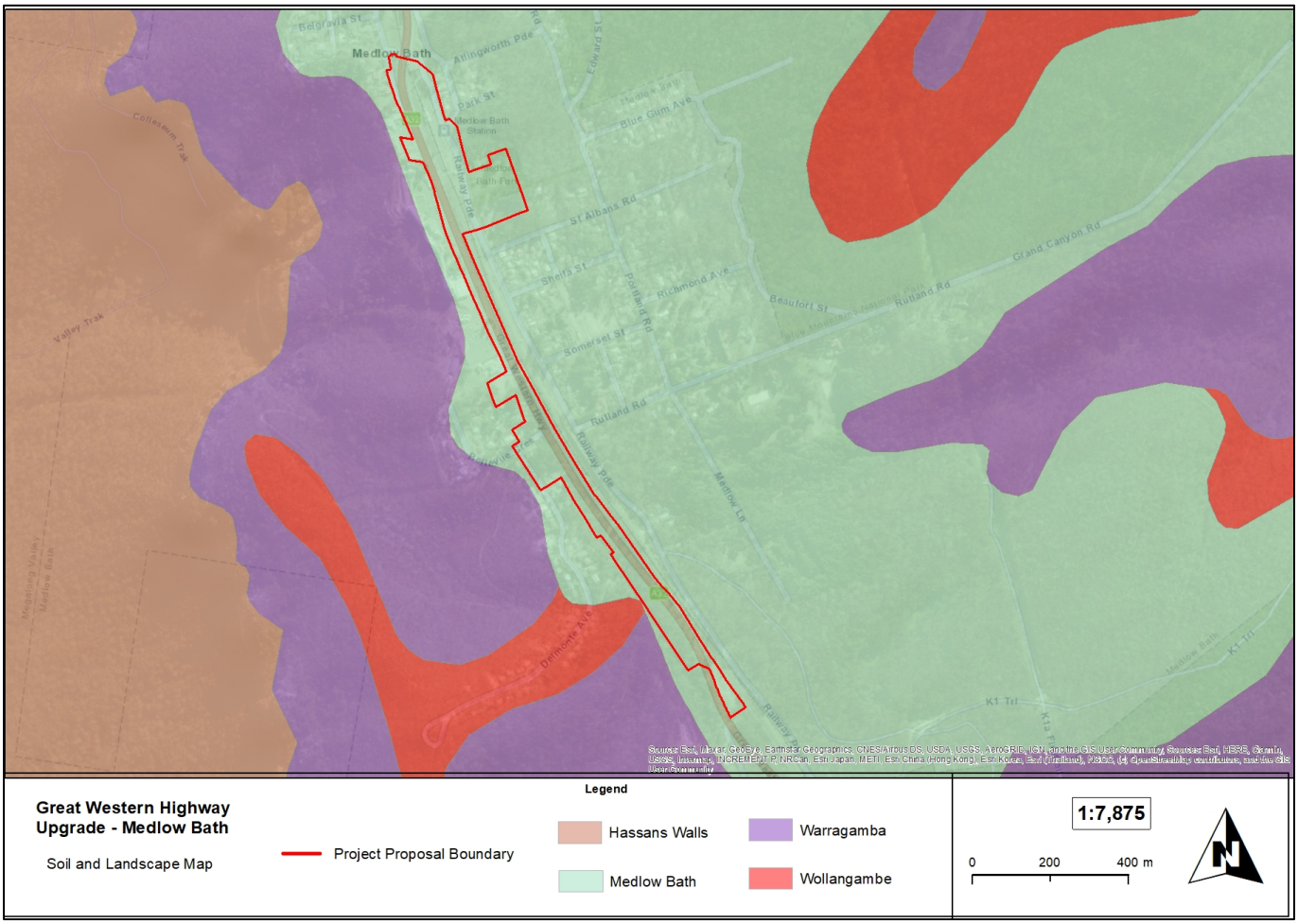

Figure 6-8: Soil landscape map for the proposal area (Source: Department of Planning, Industry and Environment)

Topography

The topography of the landscapes associated with the proposal have the following characteristics:

- **Medlow Bath:** rolling rises to rolling low hills on Hawkesbury Sandstone and Narrabeen Group Sandstone in the south west of the Hunter Region. Slopes 10 per cent to 20 per cent, local relief 20 metres to 50 metres, elevation 464 metres to 1,184 metres. Partially cleared open forest and open woodland
- **Warragamba:** steep, narrow, gorges on Narrabeen Group sandstone in the Hawkesbury Nepean and Hunter Central Rivers catchments. Slopes greater than 35 per cent, local relief 90 metres to greater than 300 metres, elevation 30 metres to 1,179 metres. Partially cleared tall open-forest and rainforest in sheltered gullies
- **Wollongambe:** rolling low hills to steep hills on Narrabeen Group Sandstone mainly in the north-west of the Hawkesbury Nepean Catchment but also the rugged south-west of the Hunter Region. Slopes 20 per cent to 40 per cent, local relief less than 220 metres, elevation 200 metres to 600 metres.

Contamination

The information presented in this section is based on a review of readily available government information sources and information, a site inspection carried out 19 November 2020, and the findings of the *Phase 1 Preliminary Site Investigation and Report* (Mott MacDonald, 2020) provided in Appendix G.

Historical aerial photographs and land use changes

- **1958:** the Great Western Highway and railway line are present, having previously been developed. The proposal area also comprises a combination of cleared/grazed paddocks with sparse residential occupation. Of the disturbed land, the United Petrol Station located opposite Somerset Avenue appears to have had its petrol tanks directly in-line with the Proposal area.
- **1966:** relatively unchanged land use from that of 1958.
- **1994:** parcels of residential land have now had property developed on most lots. With a majority of these houses constructed between 1970s-1980s, it is likely that they contain asbestos. The vegetation that lines the Great Western Highway remains the same, however the canopy cover is larger. The Hydro Majestic Hotel has been significantly upgraded.
- **2006:** vegetation lining the Great Western Highway has not increased in number but has increased in canopy cover. The Hydro Majestic Hotel has undergone further restoration/upgrade.

Desktop review

An online search of the NSW EPA contaminated land record of notices database and the POEO Act public register database was carried out on 25 November 2020 and displayed no records to suggest the presence of contamination within the proposal area.

Site inspection

The site inspection noted the following potential areas of environmental concern within and adjacent to the proposal area:

- a petrol station at 90-92 Great Western Highway has existed in excess of 20 years and as such there is the potential of hydrocarbon contamination from uncontrolled spills, surface water run-off and leakage from underground petroleum storage systems (previous and existing). Groundwater monitoring wells were noted onsite during the site inspection
- evidence of unknown fill material and unregulated waste dumping, particularly between the Great Western Highway and the rail corridor
- an operational car dealership that includes a maintenance workshop is located at 42 Great Western Highway which presents a potential historic risk of soil and groundwater contamination due to the likelihood of hydrocarbon spills, chemical storage and battery storage
- utility conduits presumed to contain asbestos were found between the Great Western Highway and Medlow Bath Station and could occur in additional locations.
- fill material from an unknown source associated with historical road construction was identified within several locations (notably between the Great Western Highway and rail corridor)
- stockpiled ballast was observed at the proposed compound site located at 181-183 Great Western Highway.

6.4.2 Potential impacts

Surface and groundwater quality impacts which are linked to soils and contamination are discussed in Section 6.3.

Construction

Erosion and sedimentation

Ground disturbing activities such as vegetation clearance, earthworks, stockpiling etc increase erosion potential which can lead to sedimentation from increased soil exposure, and which in turn can affect local surface water quality. The risks are increased where there are uncompacted or unconsolidated materials (such as excavated and stockpiled soils) or works being undertaken in steep or unstable soil areas.

During construction, soil erosion risks would be managed in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction Volume 2* (Department of Environment and Climate Change, 2008), commonly referred to as the 'Blue Book'.

Contamination

Potential contaminants of concern relating to the activities observed during the site inspection (or identified during the desk top review of aerial maps or recorded on the EPA and POEO Act public register) included material suspected of containing asbestos (including fill and conduits), total coverable hydrocarbons, benzene, toluene, ethylbenzene and xylene, polycyclic aromatic hydrocarbons, organochlorine pesticides, organophosphate pesticides, polychlorinated biphenyls, phenols, volatile organic compounds and asbestos containing materials. During construction there is a risk of disturbance to soil layers that potentially contain these contaminants.

Operation

Erosion and sedimentation

There is potential for recently disturbed soils to be susceptible to erosion, which could occur during initial periods of landscaping and re-establishment of vegetation. This may occur in areas where soft landscaping is proposed for the proposal, including open space areas at Medlow Bath Station, adjacent to disturbed areas, along embankments and in the reinstatement of temporary ancillary facilities where topsoil is settling and vegetation is establishing. Landscaping at Medlow Bath Station also presents the greatest risk of sediment loads entering waterways through the stormwater system, due to the extent of landscaping proposed and the proximity to waterways. In terms of soil stability, retaining walls are proposed along the highway alignment to provide support and ensure long term erosion or collapse risks are eliminated.

Contamination

During operation, the likely sources of contamination would be from exhaust particles and discharges from vehicle engines, litter and other waste, materials from vehicle incidents and wear from vehicle parts such as tyres. This would be managed through the installation of dedicated diversion equipment for the storage of spills to avoid direct discharge to receiving watercourses.

6.4.3 Safeguards and management measures

Table 6-12: Safeguards and management measures – Soils and contamination

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	A targeted Phase 2 investigation providing general coverage of the proposed alignment and areas of potential contamination sources (including areas where fill would be encountered during construction and hydrocarbon migration from the United Petrol Station) will be undertaken. The investigation will address the potential risk that fill material may pose to construction workers and future users of the site. Assessments will be carried out in accordance with guidance made or endorsed by the NSW EPA. The contaminated land investigations will be carried out and the report verified by a suitably qualified and experienced environmental consultant.	TfNSW	Detailed design / Pre-construction	Appendix G
Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (TfNSW, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to: • capture and management of any surface runoff contaminated by exposure to the contaminated land • any further investigations required to determine the extent, concentration and type of contamination. • management of the remediation and subsequent validation of the contaminated land, including any certification required • measures to ensure the safety of site personnel and local communities during construction. If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any	Contractor	Detailed design / Pre-construction	Section 4.2 of *QA G36 Environment Protection* Appendix G

Impact	Environmental safeguards	Responsibility	Timing	Reference
	necessary site-specific controls or further actions identified in consultation with the TfNSW Environment Manager and/or EPA.			
Pollution from run-off	The following measures will be included to limit sediment and other contaminations entering receiving waterways: • chemicals will be stored within a sealed or bunded area • appropriate controls will be in place where plant is stored • run-off from ancillary facilities will be controlled and treated before discharging into downstream waterways • vehicle movements will be restricted to designated pathways where feasible. Areas that will be exposed for extended periods, such as car parks will be stabilised where feasible.	Contractor	Construction	Additional safeguard
Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the TfNSW *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including TfNSW and EPA officers).	Contractor	Detailed design / Pre-construction	Section 4.3 of *QA G36 Environment Protection*

6.5 Traffic and transport

This section describes the traffic and transport impacts associated with the proposal and is based on the supporting *Traffic and Transport Report – Great Western Highway Upgrade Program Medlow Bath* (Mott MacDonald, 2021c) included at Appendix H.

6.5.1 Methodology

Construction assessment

The traffic and transport assessment considers how the proposed activities, work methods, program, expected vehicle movements and required management controls would temporarily impact the following within the study area:

- traffic network performance on the Great Western Highway between the intersections Bellevue Crescent and Station Street
- all modes of public, private and active transport
- public road and private property access.

Operation assessment

Potential traffic impacts of the proposal were assessed by comparing the performance of the road network with and without the proposal. Future traffic on the Great Western Highway was derived from the Strategic Traffic Forecast Model. Future traffic volumes were then put into the intersection modelling software 'SIDRA' (Signalised Intersection Design Research Aid) to evaluate the performance of the road network.

The key intersection performance indicators extracted from the SIDRA Network analysis for this study include:

- Level of Service (LOS) – this is the standard measure used to assess the operational performance of an intersection. It is a measure of the delay at an intersection. There are six levels of service from 'A' (excellent with delays of less than 15 seconds) to 'F' (unacceptable with delays of more than 70 seconds)
- Degree of Saturation (DOS) – this is the ratio of traffic using an intersection to its capacity. A DOS value greater than 1.0 indicates that the intersection is over capacity.

6.5.2 Existing environment

Road corridor

The Medlow Bath road corridor for the proposal extends 1.2 kilometres east-west between the existing rail overbridge at Railway Parade and a location around 330 metres south of the intersection with Bellevue Crescent. It is a state highway managed by TfNSW and is situated in the Blue Mountains LGA.

This section of the Great Western Highway is currently a two-lane single carriageway with a posted speed limit of 60 kilometres per hour for most of its length. The posted speed limit on the eastbound carriageway changes from 60 to 70 kilometres per hour around 75 metres south of the intersection with Bellevue Crescent. The corridor is accessed via an intersection at Bellevue Crescent and another at Railway Parade. Westbound, the Great Western Highway splits into Railway Parade and Station Street. The corridor provides access to a service station, Hydro Majestic Hotel, a Mazda dealership and Medlow Bath Station.

Freight and heavy vehicles

The Medlow Bath corridor forms part of the freight and heavy vehicles network connecting adjacent suburbs along the Great Western Highway. It accommodates freight and heavy vehicles up to 19 metre B-Doubles over 50 tonnes.

Observed traffic volumes

Traffic volumes were identified in December 2020 through a combination of link counts (seven day count and a 10 day count) and video turning movement surveys during AM and PM peak periods at various locations along the Great Western Highway. It is noted that these traffic volumes may have been affected by COVID-19, yielding lower volumes than expected in a normal year.

Below is a summary of observations from daily traffic volumes travelling westbound and eastbound on the Great Western Highway at a location just south of the intersection at Bellevue Crescent.

- Average weekday traffic volumes are around 20,000 vehicles in total with daily westbound flows slightly higher than daily eastbound flows.
- Average weekend traffic volumes are around 21,000 vehicles in total with daily eastbound flows slightly higher than daily westbound flows.
- Heavy vehicles make up around 20 per cent of total traffic on an average weekday. On a weekend, they make up around 10 per cent of total traffic.

Further, observed average weekday and weekend traffic volumes showed that:

- on an average weekday, eastbound flows are higher than westbound flows during the AM period (6-9am) while westbound flows are higher than eastbound flows during the PM period (4-7pm)
- on an average weekday, two-way traffic volumes are highest in the afternoon between 3-4pm. During this time, 793 vehicles were observed travelling westbound and 789 vehicles eastbound
- on an average weekend, westbound flows are higher than eastbound flows during the AM (6-9am) while eastbound flows are higher than westbound flows during the PM period (4-7pm)
- on an average weekend, two-way traffic volumes are highest in the afternoon between 12-1pm. During this time, 878 vehicles were observed travelling westbound and 942 vehicles eastbound.

Existing road network performance

Existing intersection performances were assessed following the calibration and verification of SIDRA models. Analysis results are summarised in Table 6-13 and indicates a LOS A for the Railway Parade intersection, and LOS B/C at Bellevue Crescent.

Table 6-13: Existing 2020 intersection performance (SIDRA 2020)

Intersection	Existing control	Peak hour	Traffic volume (veh/h)	Average vehicle delay (seconds)	Level of Service (LoS)	Degree of Saturation (DoS)	95 percentile queue lengths (m)
Great Western Highway and Railway Parade	Signalised	AM	1441	6	A	0.3	54 (west approach)
		PM	1482	6	A	0.3	54 (west approach)
Great Western Highway and Bellevue Crescent	Stop (unsignalised)	AM	1434	26	B	0.49	2 (north approach)
		PM	1476	31	C	0.48	2 (north approach)

Crash data

The results of crash data analysis associated with the Medlow Bath section of the highway over a five-year period ending in 2019 revealed nine crashes recorded along the Medlow Bath corridor, comprising:

- nil fatality crashes
- one serious injury crash at the dividing road westbound
- five moderate injury crashes
- three non-casualty towaway crashes.

The spatial grouping of crashes suggests that there exists a safety concern at the Bellevue Crescent intersection as 44 per cent of the total crashes occurred at this location. Despite the lack of formal footpaths and cycling routes, no pedestrian or cyclist crashes occurred during the five-year survey period. However, one pedestrian crash was recorded near the Hydro Majestic Hotel entrance at Medlow Bath Station during the 2009-13 period. The pedestrian refuge is highly susceptible to near miss incidents involving pedestrians and highway traffic due to its geometry and placement.

Parking provisions

Various parking arrangements are available within the proposal area as shown in Figure 6-9. Perpendicular parking for around 40 vehicles is available along the western side of the highway for around 300 metres adjacent to the Hydro Majestic Hotel. Parking bays in this area are unmarked and untimed. This on-road parking area has been identified for relocation into the 90-space car park to the south as part of the separate Hydro Majestic Hotel redevelopment approval.

There are currently no kiss and ride spaces available within the proposal area. There are four accessible parking spaces within the proposal area. Two accessible parking spaces are available within the Hydro Majestic Hotel car park.

Public and hotel guest car parks are located within the Hydro Majestic Hotel complex at the northern and southern ends with capacities of around 35 and 90 car spaces respectively. An informal rail customer car park exists on Railway Parade with a capacity for around eight parking spaces, identified to service railway customers.

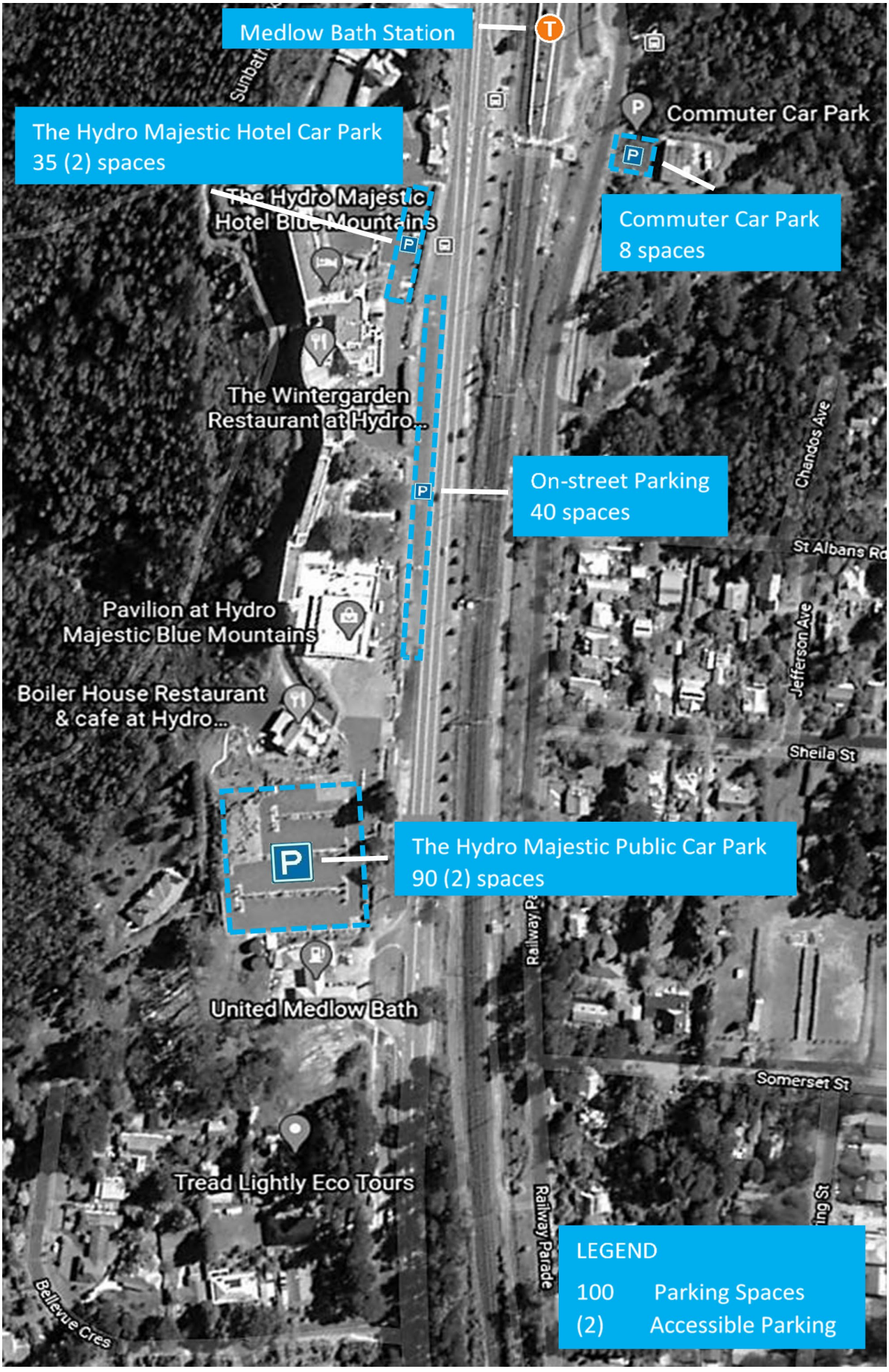

Figure 6-9: Medlow Bath existing corridor parking provisions (Mott MacDonald, 2021c)

Walking and cycling

Walking and cycling facilities on and around the Great Western Highway are shown in Figure 6-10. There is a lack of an accessible path of travel to the station from surrounds. Relevant details for these facilities are as follows.

- There are no dedicated cycling facilities within the proposal area. However, the Great Western Highway, Railway Parade and Rutland Road are marked as on-road cycling routes. This forms a regional on-road cycle route along the Medlow Bath alignment in which little protection for cyclists is provided along the narrow road shoulders. Shared pedestrian and bicycle paths begin along Bellevue Crescent and Station Street.
- No bicycle parking exists within the proposal area.
- A push button activated pedestrian crossing on the westbound approach of the Great Western Highway and Railway Parade intersection.
- A zebra crossing across the left turn slip lane from Railway Parade to the highway. This zebra crossing connects to a footpath that provides access to a pedestrian overbridge.
- A pedestrian overbridge north of the station platform. Pedestrian access to this overbridge is possible from:
    - west of the railway line via a footpath that runs along the eastern side of the Great Western Highway
    - east of the railway line via footpath that connects to Railway Parade.
- Pedestrians can access Medlow Bath Station and bus stops through two access points:
    - access from the north is via the rail overbridge and pedestrian crossing connecting the Great Western Highway and Railway Parade
    - a pedestrian/railway level crossing south of the station platform. This crossing is accessed from the western side of the highway via a refuge crossing. This refuge island can accommodate around three people at a time. Access to the level crossing from east of the railway line is via a footpath that connects to Railway Parade.
- A paved pedestrian footpath around 560 metres exists along the west side of the Great Western Highway while no formal footpath exists along the eastern side.
- A paved pedestrian footpath along the eastern side of the highway extending for around 195 metres between the level crossing and the overbridge. There are also various sealed and unsealed bush walking tracks in the area.

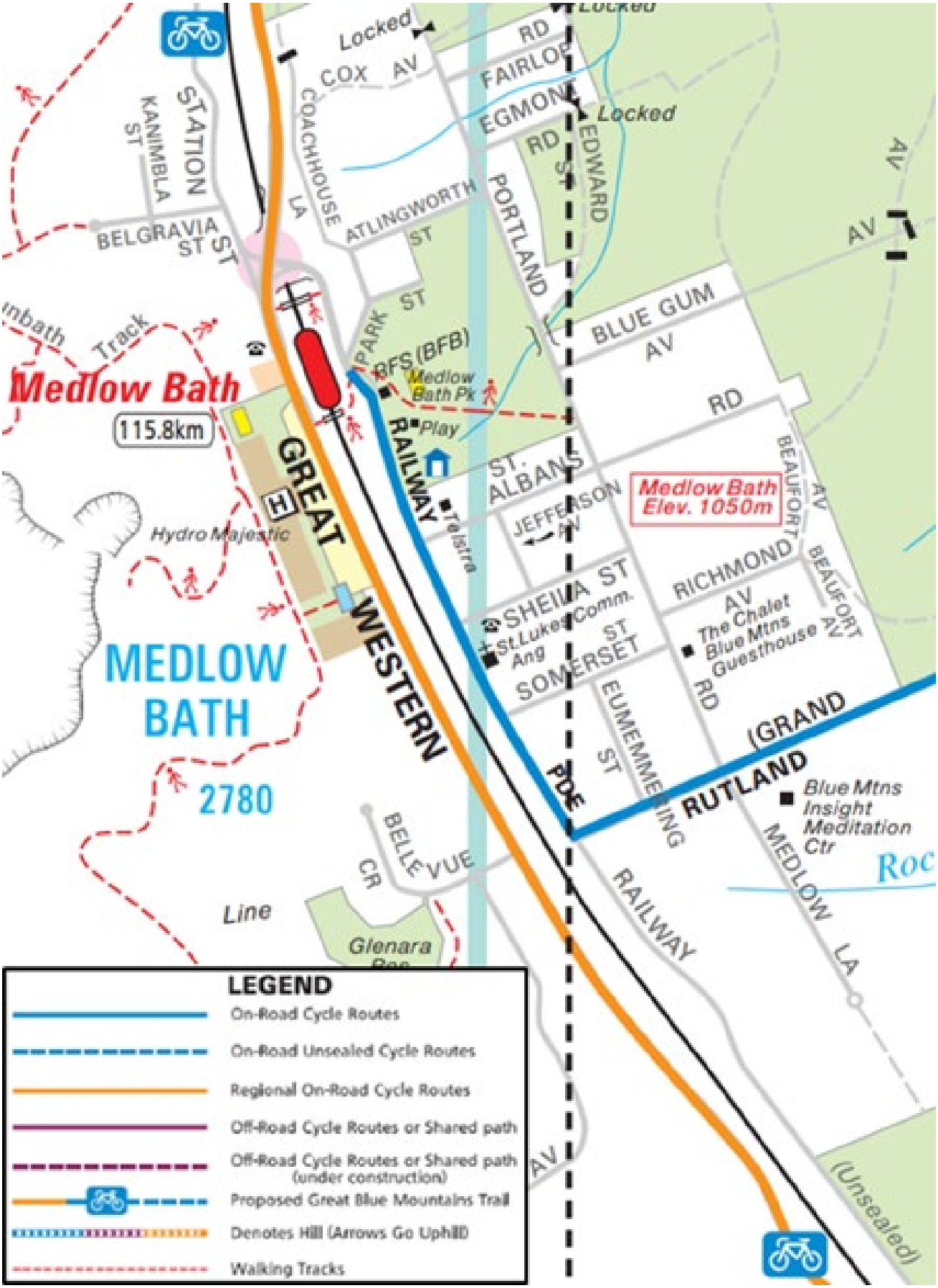

Figure 6-10: Cycle routes along the Medlow Bath corridor (Source: Blue Mountains City Council)

Public transport

Train services

Medlow Bath Station is serviced by the Blue Mountains Line, providing services between Central and Bathurst. Train frequencies are on average one service per hour.

Bus services

Bus stops within the proposal area are located on both sides of the highway at the Medlow Bath Station pedestrian level crossing. The Proposal area is serviced by the following bus routes:

- 698 – Katoomba to Blackheath (loop service) which extends across the entire length of the Proposal with four bus stops
- 698V – Katoomba to Mt Victoria (loop service) which extends across the entire length of the Proposal with three bus stops
- 8718 – Blue Mountains Christian School to Hazelbrook Station. This is a school bus that runs eastbound and stops at the eastern-side bus stop only.

The 698 service has an average of one service per hour between 7.30am to 6.30pm for both the eastbound and westbound directions. The 698V service has two services running westbound at 11.25am and 2.31pm and four services running eastbound at 8.16am, 8.44am, 12.19pm and 4.50pm. The Railway Parade Bus Stop is provided for 3.30pm exchange of students between bus routes on the local street to prevent the need to cross the highway.

Figure 6-11 illustrates the bus stops and their routes.

Figure 6-11: Medlow Bath Corridor Bus Stops and Bus Routes (Source: TfNSW)

Taxi

There are no existing taxi ranks located within Medlow Bath. Taxi services are located within the neighbouring Blue Mountains villages including Wentworth Falls, Lawson, Springwood, Winmalee, Harrington Park, Wetherill Park, Hinchinbrook and Prospect. Members of the community are able to book a taxi by phone call, online booking on agency's webpage or by hailing down a taxi.

6.5.3 Potential impacts

Construction

During construction, traffic and transport impacts and risks include:

- potential increases in vehicle movements and changes to traffic flows which may lead to short traffic delays, for example:
    - a temporary road closure of one hour would be required to allow for the operation of a crane to lift in and install the new pedestrian bridge
    - other temporary partial road or lane closures would be required at times to allow for road works (such as new pavement, kerb and gutter works) however it is proposed that alternating one-way traffic flow would be able to be maintained
- changes for pedestrians and cyclists accessing the station and surrounding footpath/road network which could mean detours and longer walking/cycling distances. There may also be an increased risk to safety as a result of changed conditions
- delays to buses on the Great Western Highway and temporary reduction in accessibility to bus stops as some bus stops would need to be relocated particularly where work activities being undertaken within the highway corridor
- removal of 40 perpendicular parking spaces to allow for construction works to establish the widened highway along the western side but which have already been compensated for by the Hydro Majestic Hotel southern car park works.

Theses impacts would be temporary and would only occur during construction work. The duration of construction is expected to be about 20 months, weather depending (refer to Section 3.2.4) for construction staging and timing of activities).

The number of truck movements to the work sites is unknown at this stage, however based on similar projects is likely to be less than 200 per day. Trucks movements would be distributed throughout the day equating to less than 30 movements per hour based on an eight-hour workday, which is estimated to be around a ten per cent increase in the hourly heavy vehicle movements. This additional traffic is unlikely to have a significant impact on the road network. However, if required, the movements of trucks would be scheduled to avoid peaks such as during local school zone hours.

Access to the construction site for trucks would be via the Great Western Highway, Bellevue Crescent and Railway Parade. Light vehicles to the site would be permitted to use all existing roads. Staff parking is likely to be provided within each construction site.

Light vehicle traffic to the site would be associated with the movements of construction personnel. The peak construction workforce is currently unknown but is likely to be a maximum of 200 at any one time based on similar projects. Assuming that five per cent of personnel travel to the site by public transport and 95 per cent travel by private car and an average car occupancy factor of 1.05, this equates to 362 light vehicle movements per day (181 in the morning and 181 in the afternoon). Assuming that 80 per cent of these light vehicles arrive and depart in the same peak hour, an additional 145 vehicles would be generated during each of the AM and PM peak hours. Given that two-way peak hours flow on the Great Western Highway are about 1500 vehicles per hour, there is sufficient capacity to accommodate this additional traffic.

There are a number of properties with direct access to the road network within the proposal area. Access to affected properties would be maintained throughout, and temporary property access would be provided where required.

Operation

Traffic and network impacts

A comparison of future (2036) intersection performance with and without the proposal for the AM and PM peak hours is presented in Table 6-14.

The SIDRA modelling indicates that the Great Western Highway/Railway Parade intersection would perform at an excellent LOS both with and without the proposal. Queue lengths and the DOS in the 'with proposal' scenario are slightly higher, but this is due to the overall increase in traffic volumes resulting from an assumption in the model that all Great Western Highway Upgrade Program improvements are operational by 2036 (ie improved travel speeds would attract traffic from alternative routes). It is noted that the intersection still performs with an excellent LOS and the impact of the slightly longer queues on intersection performance would be negligible.

The SIDRA modelling comparison of the 2036 intersection performance at the Great Western Highway/Bellevue Crescent intersection without and with the proposal (assumed to be a signalised intersection from the existing (stop) intersection) revealed that:

- there would be a reduction in average delays and DOS upon signalisation of the intersection
- the conversion of this intersection from a stop sign control system to signalisation would result in increased queuing on the highway. However, the proposed turning bay lengths of 100 metres for westbound left turning vehicles and 80 metres eastbound right turning vehicles would be sufficient to accommodate the modelled queueing.

Overall, the proposal would improve the existing performance of the highway including accommodating future increases to traffic volumes in 2036. Alterations to the existing alignment, particularly the signalised control system and U-turn bay at Bellevue Crescent and the addition of right turn bays eastbound into key amenities would improve the safety of vehicles and the community. The 5-year crash data reveal a 44 per cent of total crashes within Medlow Bath at Bellevue Crescent and so the modification to provide dedicated turning movement provisions at this location would improve vehicle safety.

Table 6-14: 2036 Scenario SIDRA outputs

Intersection	With proposal					Without proposal				
	Intersection type	Peak Hour	Average delay per vehicle (seconds)	LOS	Degree of Saturation	Intersection type	Peak Hour	Average delay per vehicle (seconds)	LOS	Degree of Saturation
Great Western Highway and Railway Parade	Signalised	AM	12	A	0.38	Signalised	AM	12	A	0.35
		PM	13	A	0.45		PM	12	A	0.39
Great Western Highway and Bellevue Crescent	Signalised	AM	6	A	0.35	Stop (unsignalised)	AM	38	C	0.56
		PM	5	A	0.35		PM	39	C	0.55

Modelling of the alternate Bellevue Crescent option (shown in Table 6-15) indicated an excellent LOS and that:

- turning lanes on both the west and east approaches of the highway would not block through movements
- queues at the new Bellevue Crescent at the approach to the highway would not block the new entry/exits of the United Petrol Station or Hydro Majestic Hotel.

Table 6-15: 2036 Scenario SIDRA outputs for alternative Bellevue Crescent option (with proposal)

Intersection	Intersection type	Peak hour	Average delay per vehicle (seconds)	LOS	Degree of Saturation
Great Western Highway and Railway Parade	Signalised	AM	12	A	0.36
		PM	12	A	0.43
Great Western Highway and Alternate Bellevue Option	Signalised	AM	6	A	0.33
		PM	6	A	0.34

When compared to the concept design. the alternate Bellevue Crescent option would lead to fewer vehicles making a U-turn at the Station Street/Railway Parade intersection. This is because the alternative design allows for traffic exiting the United Petrol Station and Hydro Majestic Hotel to turn right at the proposed new Bellevue Crescent intersection and travel eastbound (towards Sydney). The preferred design does not provide an opportunity for traffic exiting the United Petrol Station and Hydro Majestic Hotel to make this right turn movement requiring vehicles intending to travel eastbound to make a U-turn at the Station Street/Railway parade intersection.

Road and station user impacts

The proposal would result in the following positive impacts or changes to road and station users.

- The highway would be able to support longer, heavier vehicles that are able to transport more freight per vehicle. This would provide improvements to safety and sustainability as well as improvements in productivity. This is expected to increase the volume of freight, but reduce the number of vehicles required to transport the freight along the highway.
- The existing pedestrian refuge and level pedestrian/railway crossing would be removed and replaced with a new raised pedestrian crossing on Railway Parade and pedestrian bridge with stairs/lifts at Railway Parade, Medlow Bath Station and on both sides of the highway. The incorporation of lifts and stairs would significantly improve connectivity of the area for customers and tourists and provide an accessible path of travel to the station and across the highway/rail corridor. It would also improve safety by removing pedestrian/vehicle interactions.
- Enhanced pedestrian safety and connectivity through the provision of dedicated cycling and pedestrian facilities along the length of the Great Western Highway in respect to the proposal, where currently there are limited facilities.
- The relocation of existing bus stops and shelters on both sides of the highway is proposed to provide a safe interchange area that is close to the station. The relocated bus stop on the western side would be relocated as close as possible to the proposed lift at the pedestrian bridge and would allow for one bus. The relocated bus stop with bus shelter on the eastern side would also be located as close as possible to the proposed lift.

- Two new kiss and ride bays would be provided at Railway Parade providing a safe environment for customers to drop off and pick up.
- Parking changes, including:
    - the rail customer car park at Railway Parade would be formalised and expanded to include nine parking bays and include one accessible parking space
    - the loss of around 40 perpendicular car parking spaces along the western side of the highway but which have already been compensated for by the Hydro Majestic Hotel southern car park works.

6.5.4 Safeguards and management measures

Table 6-16: Safeguards and management measures – Traffic and transport

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	A Traffic Management Plan will be prepared and implemented as part of the CEMP. The plan will be prepared in accordance with the *Traffic Control at Work Sites Manual* (TfNSW, 2020c) and *QA Specification G10 Control of Traffic.* The plan will include: • confirmation of haulage routes • measures to maintain access to local roads and properties • site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • requirements and methods to consult and inform the local community of impacts on the local road network • access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • a response plan for any construction traffic incident • consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • monitoring, review and amendment mechanisms.	Contractor	Detailed design / Pre-construction	*QA Specification G10*
Traffic and transport	• The local bus operators will be consulted to confirm alternative temporary bus stop and operations during construction. • The local community will be notified about the agreed local temporary bus stop location, as coordinated and managed under the consultation strategy.	Contractor	Construction	
Property access	• Property access will be maintained where feasible and reasonable and property owners will be consulted	Contractor	Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	before starting any work that may temporarily restrict or control access. • (Side) road and lane closures will be minimised where feasible and reasonable.			

6.6 Noise and vibration

Potential noise and vibration impacts have been assessed in *Noise and Vibration Technical Paper Great Western Highway Upgrade Medlow Bath* (Mott MacDonald, 2021d) (refer Appendix I). A summary of the potential construction and operational noise and vibration impacts is presented in this section, together with management measures to mitigate any negative impacts.

6.6.1 Methodology

Construction noise

The *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change, 2009) details a process for the assessment and management of construction noise. The primary purpose of the construction noise assessment is to identify the potential for construction noise levels to exceed the acceptable noise management levels (NML) or highly affected level for sensitive receivers. NML are elevated from existing noise levels (and the levels vary, depending on if it is daytime, evening or night-time) but represent an increase in the noise level that is likely to be acceptable during construction.

In order to inform the NML for the proposal, long term noise monitoring was completed at four locations throughout Medlow Bath from Thursday 3 December to Monday 14 December 2020. The purpose of the monitoring was to measure the existing levels of traffic noise to assist in establishing criteria (refer Section 6.6.3), validating the noise model and to identify the rating background levels (RBLs) in support of the construction noise assessment.

Typical construction scenarios which assumed the number and type of equipment to be used were then modelled using SoundPLAN v8 software to compare the predicted noise levels during construction against the NML and highly affected noise level. It is noted that construction noise levels at sensitive receivers will depend upon the distance of the receiver to the works, the amount of shielding, if any, by topography or nearby structures, and the amount of noise generated by the construction activities. Construction traffic noise was also assessed.

Operational noise

Noise generated by road traffic operating on the proposed road upgrade has been modelled and assessed in accordance with the *NSW Road Noise Policy* (RNP) (Department of Environment, Climate Change and Water, 2011), the *Noise Mitigation Guideline* (Roads and Maritime Services, 2015c) and the *Noise Criteria Guideline* (Roads and Maritime Services, 2015a). To assess the potential impacts of the operational phase of the proposal on noise-sensitive receivers, the following steps were completed for both daytime and night-time scenarios:

- modelling of the existing environment as part of the validation process
- modelling of a ‘do minimum (the year of opening 2026)’ and a ‘do something (the design operational year 2036)’ scenarios for the purpose of establishing criteria
- modelling of road traffic noise levels for 10 years after opening (2036). These predictions were undertaken prior to optimisation of any noise barriers and aim to determine all receivers that qualify for consideration of noise mitigation.

The following factors were considered in assessing traffic noise impacts:

- traffic volume and proportions of heavy vehicles: measured traffic counts were used to validate the existing noise model and future traffic counts were sourced from modelling scenarios (refer Section 6.5)
- vehicle speed: the existing posted speed limit throughout the proposal area is 60 kilometres per hour and would remain at this speed in the future

- topographical information along and surrounding the proposal area
- road pavement surface types
- road gradient
- noise emission levels and source heights for different vehicle types
- building structures
- location of potentially affected receivers.

Road noise was modelled using UK Department of Transport, Calculation of Road Traffic Noise (CORTN) algorithm with noise source heights of 0.5 metres, 1.5 metres, and 3.6 metres above ground level. These heights represent the noise from light vehicles, combined engine/tyre noise from heavy vehicle and the exhaust noise from heavy vehicle.

6.6.2 Existing environment

Medlow Bath predominantly comprises residential properties, with the local noise environment controlled by traffic on the existing Great Western Highway and the Blue Mountains Line rail services. Both the road and rail line are freight routes, resulting in an appreciable noise contribution from trucks and diesel locomotives. Adjacent to Medlow Bath Station there is a pedestrian crossing. Trains are required to sound their horn at this location to warn pedestrians of their approach, which contributes to the local noise environment. The proposal would remove this pedestrian crossing and provide an alternate means of access (a pedestrian bridge elevated above the railway and highway), also removing the crossing noise events.

Existing background levels

Table 6-17 presents the rating background levels (RBLs) which are a measure of the existing noise level for each monitoring location, and which have been calculated in accordance with the *Noise Policy for Industry* (EPA, 2017).

Table 6-17: Rating background level

Noise logging location (NL)	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night-time (10pm – 7am)
NL1 25 Delmonte Avenue, Medlow Bath	40	37	27
NL2 104 Great Western Highway, Medlow Bath	50	42	29
NL3 40 Railway Parade, Medlow Bath	49	41	29
NL4 5 Railway Parade, Medlow Bath	46	41	24

Noise sensitive receivers

Noise sensitive receivers were identified through aerial photography and visual inspection. Locations and occupancy of all receivers have been identified to classify each building as either residential, commercial, industrial, educational, and other non-sensitive uses. Noise catchment areas (NCA) are used to group receivers within a similar noise environment and define appropriate construction NML.

The assessment identified 320 buildings around the proposal area as receivers and these receivers and which were divided into two NCA (refer Table 6-18).

Table 6-18: Noise Catchment Areas (NCAs)

NCA	Location	Description
NCA01	East of Great Western Highway	To the east of the Great Western Highway, the receivers are generally residential, with a small number of guest houses dotted throughout the area. There is a single commercial building (a café) towards the northern end of Railway Parade. The remainder of the receivers are residential.
NCA02	West of Great Western Highway	On the western side, the Hydro Majestic Hotel is a prominent feature of Medlow Bath with other commercial premises to the south including a restaurant and store. There is also a car dealership to the north of the Hydro Majestic Hotel. The remainder of the receivers are residential.

Vibration sensitive receivers

The following vibration sensitive receivers (heritage items) have been identified in and around the proposal area:

- Medlow Bath Station
- Hydro Majestic Hotel
- Former Post and Telegraph Store, 1 Railway Parade
- Urunga, 1 Park Street
- Melbourne House, 2 Station Street
- Cosy Cot, 4 Station Street
- Shelaugh Cottage, 6 Station Street.

6.6.3 Potential impacts

Construction

Assessment criteria

Table 6-19 presents information from the ICNG on NML for residential receivers, including how to calculate and apply for construction noise assessments.

Construction noise

Table 6-19: Noise Management Levels (NML) for residential receivers

Time of day	Noise Management Level $L_{Aeq,15min}$	How to apply
Recommended standard hours: **Monday to Friday: 7am to 6pm** **Saturday: 8am to 1pm**	Noise affected RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq,15min is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
No work on Sundays or Public Holidays	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Based on the RBLs for the proposal and the ICNG recommendations, NMLs for residential and non-residential receivers is established in Table 6-20 and Table 6-21, respectively.

Table 6-20: Construction noise management levels –residential land uses

Site	Noise management level, $L_{Aeq,15min}$ dBA		
NCA	Daytime	Evening	Night-time
01	50	42	35
02	51	46	35

Table 6-21: Construction noise management levels –non-residential land uses

Receiver type	External NML $L_{Aeq,15min}$
Industrial premises	75 dBA
Offices and retail offices	70 dBA

Sleep disturbance

Sleep disturbance noise goals have also been established for residential receivers. Sleep disturbance criteria for both NCAs are a screening level RBL + 15dBA. Where construction works are planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts should be completed. The sleep disturbance criteria for the NCAs are presented in Table 6-22.

Table 6-22: Sleep disturbance criteria – screening

NCA	External screening criteria Night ($L_{A1,1min}$) [$L_{A90,15min}$ + 15dBA]
01	45 dBA
02	45 dBA

Construction vibration

Perceptible vibration can be an annoyance to building occupants, particularly if the duration or frequency of events is significant. Vibration criteria for human comfort is provided by *Assessing Vibration – A Technical Guideline* (Department of Environment and Conservation, 2006) and provides guidance in terms of continuous and impulsive vibration, and intermittent vibration. The vibration dose value criterion adopted for the proposal for human comfort is 0.2 mm/s$^{1.75}$ (between 7am and 10pm) and 0.13 mm/s$^{1.75}$ (between 10pm and 7am).

Impacts from vibration may also result in impacts to building structure (cosmetic damage). Of these considerations, the human comfort criteria are the more stringent and if compliance with human comfort criteria is achieved, it will follow that compliance is achieved for the building damage objectives.

The German Standard *Structural Vibration, Part 3: Effects of Vibration on Structures (DIN 4150-3)* identifies more stringent vibration levels for building damage and includes a category specifically for heritage buildings which would be applied for the proposal (refer Table 6-23). Further consideration would be given to heritage structures throughout the detailed design stage to ensure adequate mitigation and management measures are included in the construction strategy.

Table 6-23: Structural damage safe limits for building vibration DIN 4150-3

Structure type	Vibration frequency at foundation 1-10 Hz	Vibration frequency at foundation 1-10 Hz	Vibration frequency at foundation 1-10 Hz	Vibration at the horizontal plane of highest floor at all frequencies
Heritage building	3	3-8	8-10	8

Construction noise

The predicted noise impacts for the proposal are provided in Table 6-24. The table provides the highest noise level in each NCA, and the number of receivers which are predicted to exceed the NML in three bands. The number of highly affected receivers (ie noise levels above 75 dbA) is also presented. These impacts are also presented graphically in the form of noise contours in Appendix I.

Due to the small offset distance between the proposal and sensitive receivers, there would be exceedances of the NML during construction works. A small number of receivers would be highly affected at some point during the works. The noisiest stage is predicted to be vegetation clearing due to the operation of equipment like chainsaws, but which would last only two weeks.

Table 6-24: Summary of construction noise impacts per NCA

NCA	Maximum L_{Aeq} noise level dBA	No. of receivers exceeding NML 1-10 dBA	No. of receivers exceeding NML 11-20 dBA	No. of receivers exceeding NML >20 dBA	No. of highly affected receivers
Site preparation (six weeks)					
NCA01	72	136	59	7	0
NCA02	90	49	31	16	12
Site establishment (six weeks)					
NCA01	71	127	56	2	0
NCA02	89	48	29	13	12
Vegetation clearing (two weeks)					
NCA01	79	81	115	47	23
NCA02	97	23	46	38	24
Roadworks (70 weeks)					
NCA01	76	132	82	32	2
NCA02	94	41	37	28	16
Finishing works (ten weeks)					
NCA01	66	76	32	0	0
NCA02	97	37	16	17	11

Out of hours works and sleep disturbance

Two out of hours work scenarios were assessed as part of this proposal. These scenarios include road works, which is often required to be undertaken with traffic management measures outside peak periods, and the pedestrian bridge installation which also requires traffic management. Predicted noise impacts for out of hours works and sleep disturbance are presented in Table 6-25 and Table 6-26.

Road works taking place at night may cause major disturbances to the community, on this basis such activities should take place during daytime hours unless necessary. Where they must take place out of hours, the duration of works should be minimised.

Table 6-25: Out of hours construction noise impacts – night road works

NCA	L_{Aeq} NML dBA	Maximum L_{Aeq} noise level dBA	NML exceedance <5 dBA	NML exceedance 5-15 dBA	NML exceedance 15-25 dBA	NML exceedance >25 dBA	Highly noise affected
1	35	94	0	2	34	100	17
2	35	77	0	3	91	133	6

Table 6-26: Out of hours construction noise impacts – night pedestrian bridge installation

NCA	L_{Aeq} NML dBA	Maximum L_{Aeq} noise level dBA	NML exceedance < 5 dBA	NML exceedance 5-15 dBA	NML exceedance 15-25 dBA	NML exceedance >25 dBA	Highly noise affected
1	35	54	4	3	3	0	0
2	35	51	9	7	2	0	0

Construction traffic noise

The proposal is expected to have a maximum of 20 heavy vehicle deliveries and a workforce of 75 personnel. This has been assessed as an additional 40 heavy vehicle movements and 150 light vehicle movements during the daytime period. Existing traffic volumes are considered in Section 6.5 with more than 17,800 vehicles from combined light and heavy vehicles per day. Based on these additional traffic movements, the increase in noise from construction traffic is predicted to be less than 0.1 dB, and the additional movements would have a negligible impact on the local noise environment.

Construction vibration

Construction of the proposal has the potential for vibration impacts as a result of the use of vibration generating equipment such as jackhammers and vibratory rollers. Table 6-27 recommends the minimum working distances for various plant and equipment to meet human comfort and cosmetic building damage criteria. At the start of any vibration intensive works these distances would be checked and maintained on site to avoid any negative impacts.

Table 6-27: Minimum working distances

Plant item	Rating/description	Min working distance cosmetic damage (m)	Min working distance human comfort (m)
Vibratory roller	< 50 kN (typically 1 – 2 tonnes)	5	15 to 20
	< 100 kN (typically 2 – 4 tonnes)	6	20
	< 200 kN (typically 4 – 6 tonnes)	12	40
	< 300 kN (typically 7 – 13 tonnes)	15	100
	> 300 kN (typically 13 – 18 tonnes)	20	100
	> 300 kN (> 18 tonnes)	25	100
Small hydraulic hammer	300 kg (5 to 12 tonnes excavator)	2	7
Medium hydraulic hammer	900 kg (12 to 18 tonnes excavator)	7	23
Large hydraulic hammer	1,600 kg (18 to 34 tonnes excavator)	22	73
Vibratory pile driver	Sheet piles	2 to 20	20
Pile boring	≤ 800 millimetres	2	4
Jackhammer	Hand held	1	2

Construction work also has the potential to impact heritage structures from vibration. Table 6-28 provides a review of heritage structures and whether they may be impacted by vibration.

Table 6-28: Heritage structures and potential vibration impacts

Heritage structure	Distance to works (m)	Potentially vibration impacted
Medlow Bath Railway Station	18	Yes
Hydro Majestic Hotel	16	Yes
Hydro Majestic Hotel Heritage Wall	<5	Yes
Former Post and Telegraph Store, 1 Railway Parade	60	No
Urunga, 1 Park Street	60	No
Melbourne House, 2 Station Street	16	Yes
Cosy Cot, 4 Station Street	32	No
Shelaugh Cottage, 6 Station Street.	53	No

A range of heritage receivers have been identified which would require careful consideration with respect to vibration impact when planning works. Vibration monitoring and consideration of appropriate vibration generating equipment (such as vibratory rollers) would be required throughout the construction of the project.

Operation

Assessment criteria

The *Road Noise Policy* (RNP) (EPA, 2011) sets out criteria for assessment of noise from vehicles on public roads. The RNP sets out noise criteria for 'freeways', 'arterial', 'sub-arterial' and 'local' roads and provided in Table 6-29 and Table 6-30. The RNP considers the overall noise levels in the future, in addition to the change in noise due to the proposal. To achieve this, two scenarios were assessed: a 'do minimum' scenario; and 'do something' scenario. The difference between these two scenarios would be the impact of the proposal. For this, the year 2026 has been assessed as the year of opening and the year 2036 has been assessed as the design operational year.

Table 6-29: RNP criteria for existing residences (freeway/arterial/sub-arterial roads)

Type of project/land use	Day (7am-10pm)	Night (10pm-7am)
Existing residences affected by noise from redevelopment of existing freeway/ arterial/ sub-arterial roads	$L_{Aeq,15hr}$ 60 dBA (external)	$L_{Aeq,9hr}$ 55 dBA (external)
Existing residences affected by increases in traffic noise of 12 dB(A) or more from a freeway/ arterial/ sub-arterial road	Between $L_{Aeq,15hr}$ 42-60 dBA (external)	$L_{Aeq,9hr}$ 42-55 dBA (external)

Table 6-30: RNP criteria for non-residential residences

Receiver type	Existing sensitive land use	Day (7am-10pm)	Night (10pm-7am)
Non-residential	School classrooms	$L_{Aeq,1hr}$ 40 (internal) when in use	
Non-residential	Hospital wards	$L_{Aeq,1hr}$ 35 (internal)	$L_{Aeq,1hr}$ 35 (internal)
Non-residential	Place of worship	$L_{Aeq,\ (15\ hour)}$ 40 (internal)	$L_{Aeq,\ (15\ hour)}$ 40 (internal)
Non-residential	Open space (active use)	$L_{Aeq,\ (15\ hour)}$ 60 (internal)	
Non-residential	Open space (passive use)	$L_{Aeq,\ (15\ hour)}$ 55 (internal)	
Non-residential	Childcare facilities	Sleeping rooms $L_{Aeq,\ (1\ hour)}$ 35 (internal) Indoor play areas $L_{Aeq,\ (1\ hour)}$ 40 (internal) Outdoor play areas $L_{Aeq,\ (1\ hour)}$ 55 (external)	Existing traffic $L_{Aeq,9hr}$ + 12 dBA (external)

Operational noise – Great Western Highway

Noise level predictions for the year 2036 were calculated at the sensitive receivers identified within the proposal area and are presented in Appendix I. Almost all sensitive receivers are predicted to exceed the noise criteria by 5dBA or more, both with or without the proposal.

Prior to the consideration of noise mitigation, a total of 13 residential receivers would experience noise levels above the relevant criteria and have been identified as qualifying for consideration for noise mitigation in accordance with guidelines set out in the *Noise Mitigation Guideline* (Roads and Maritime Services, 2015c). The exceedances identified above the relevant criteria are predominantly a result of the existing and future road traffic flows on the Great Western Highway and are not a direct result of the proposal.

At the Hydro Majestic Hotel (non-residential receiver), a noise level of 71 dBA during the daytime and 66 dBA during the night-time period has been predicted for the 'do something scenario'. These noise levels are predicted to reduce by less than 2 dBA from the 'do minimum scenario'. The RNP does not have noise criteria for hotels and in this situation operational road traffic noise levels are predicted to decrease as a result of the proposal.

Options for noise mitigation in the order of preference given in the RNP are:

- pavement design
- noise barriers
- at-property treatments.

The typical low noise pavement is stone-mastic asphalt and TfNSW recommends a correction factor of 0.0 dB for stone-mastic asphalt with a standard aggregate size of 10 millimetres. Given there is no acknowledged noise benefits, the standard low noise pavement is not recommended for the proposal. Options for noise barriers are not considered appropriate for the local environment given the village feel, several locally and state listed heritage items and views and high visual amenity along with existing space

constraints, and so at-property treatment would be investigated as part of detailed design to ensure operational noise levels are appropriately mitigated.

Operational noise – Bellevue Crescent U-turn bay

A U-turn bay is included in the design at Bellevue Crescent. The road has been assessed as a new local road, in accordance with the RNP. Vehicle movements would be generally slow speed throughout this area, with movements no greater than 10 kilometres per hour on average while using the bay itself. During the busiest one-hour period the traffic and transport assessment predicts 13 light vehicles and two heavy vehicles would use the U-turn bay in 2036. Traffic movements during 2026 and the night-time period are not available.

At the façade of the most affected receiver, 108 Great Western Highway, noise levels are predicted to be 54 dBA. Noise levels at the closest sensitive receiver, 3 Bellevue Crescent, are predicted to be 47 dBA during the busiest one-hour period. These predicted noise levels would comply with the daytime local road noise criteria of $L_{Aeq(1hour)}$ 55 dBA. While traffic volumes are not available for the night-time period, hourly night-time traffic volumes for 2036 are about 14 per cent of the daytime figures, which would yield noise levels about nine dB lower. Based on these volumes it is likely that night-time noise levels also comply with the night-time criteria of $L_{Aeq(1hour)}$ 50 dBA. Consideration of noise mitigation is not required for the operation of the U-turn bay.

Alternate Bellevue Crescent Option

At this stage of the design, only traffic volumes for the 2036 morning and afternoon peak periods are available for the alternate arrangement for Bellevue Crescent. The results of noise modelling indicate that three residential locations are predicted to exceed the applicable daytime noise criteria. Further analysis would be required during the detailed design stage to confirm the predicted noise levels during the night-time period. However, if this option was to proceed these three sensitive receivers would likely require consideration of additional noise mitigation measures. Low noise pavement and noise barriers would not be practicable in this location, and so at-property treatment would be investigated.

6.6.4 Safeguards and management measures

Table 6-31: Safeguards and management measures – Noise and vibration

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction noise and vibration	A Noise and Vibration Management Plan will be prepared and implemented as part of the CEMP. The plan will generally follow the approach in the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) and include the following: • the plan will consider potential vibration impacts associated with construction activities and would identify feasible and reasonable measures to mitigate these impacts, including safe working distances • all potential significant noise and vibration generating activities associated with the activity • feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement 2020: Urban design approach and procedures for road and maritime infrastructure planning, design and construction* (TfNSW Centre for Urban Design, 2020) • a monitoring program to assess performance against relevant noise and vibration criteria • arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • contingency measures to be implemented in the event of non-compliance with noise and vibration criteria • stakeholder engagement will be a key feature of these measures, particular with key stakeholders such as the Hydro Majestic Hotel • vibration sensitive receivers identified will require careful consideration when planning works and, dependent on the nature of the works, may require vibration monitoring throughout the proposal.	Contactor	Detailed design / Pre-construction	Section 4.6 of *QA G36 Environment Protection*
Out of hours works	As part of the Noise and Vibration Management Plan, an out-of-hours work protocol will be developed, including any requirements set under the EPL which defines: • all scheduled and planned out-of-hours activities • any oversized and other deliveries needing to take place out-of-hours as required by the police or other authorities for safety reasons ·	Contractor	Pre-construction/ Construction	Appendix I

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• other tie-in, utility connection and intersection work that may need to take place out-of-hours for road user safety issues • out-of-hours emergency work needed to prevent the loss of life, property, to prevent harm or as agreed under negotiation with EPA and affected sensitive receivers • the record-keeping process for capturing agreed and emergency out-of-hours work. • very noisy activities should, as much as practicable, be programmed for normal working hours. If the work cannot be undertaken during the day, it should be completed before 12:00am. In particular, there should be no jackhammering or saw cutting after midnight.			
Construction noise and vibration	All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least seven days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • the proposal • construction period and construction hours • contact information for project management staff • complaint and incident reporting • how to obtain further information.	Contactor	Detailed design / Pre-construction	
Construction noise and vibration	The following general mitigation measures will be applied as practicable: • limit work to daylight hours and only night works during notified road closures. • perform noisy work during less sensitive time periods • select low-noise plant and equipment • ensure equipment has quality mufflers installed • where practicable use smaller/lower capacity plant in reference to the safe working distances • where possible, concentrate noisy activities at one location and move to another as quickly as possible • vehicle movements outside construction hours, including loading and unloading operations, should be minimised and avoided where possible	Contractor	Pre-construction / Construction	Section 6 of Appendix I

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• ensure equipment is well maintained and fitted with adequately maintained silencers • use only necessary sized equipment • implement worksite induction training, educating staff on noise sensitive issues and the need to make as little noise as possible • consider alternatives, such as manually adjustable or ambient noise sensitive types ("smart" reversing alarms) and closed-circuit TV systems • consider installing temporary construction noise barriers • install noise-control kits for noisy mobile equipment and shrouds around stationary plant, as necessary.			
Construction noise	Noise management controls will be implemented early in the work program to benefit receivers while the proposal is being built.	Contractor	Detailed design / Pre-construction	Appendix I
Construction noise and vibration	Where possible, plant will be located as far from residences as possible and behind site structures, barriers, screens and/or noise walls. Plan for the use of less noise/vibration equipment where reasonable and feasible.	Contractor	Pre-construction /Construction	Appendix I
Construction vibration	Any proposed works within the minimum safe working distances will be undertaken with concurrent vibration measurements to ensure the cosmetic damage criteria are not exceeded at sensitive receiver locations.	Contractor	Construction	Table 6-27 Appendix I
Construction vibration – heritage structures	Vibration resulting from construction and received at any heritage structure will be managed in accordance with *German Standard DIN 4150: Part 3 – 1999 Structural Vibration in Buildings: Effects on Structures.* Where required, monitoring will be undertaken to ensure guideline values are achieved, or additional vibration mitigation measures developed to manage risks.	Contractor	Construction	Table 6-23 *Structural Vibration, Part 3: Effects of Vibration on Structures (DIN 4150-3)* Appendix I
Operational noise	Architectural treatment will be investigated for properties where there are exceedances of the noise criteria. Based on the concept design, this will likely include fourteen residential properties:	Contractor	Detailed design	Appendix I

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• 2 Station Street • 4 Station Street • 40 Great Western Highway • 50 Great Western Highway • 100 Great Western Highway • 102 Great Western Highway • 104 Great Western Highway • 106 Great Western Highway (proposed acquisition) • 108 Great Western Highway • 110-114 Great Western Highway • 116-118 Great Western Highway • 14 Delmonte Avenue • 122 Great Western Highway • 126 Great Western Highway.			

6.7 Aboriginal cultural heritage

This section describes Aboriginal cultural heritage impacts associated with the proposal with research and findings sourced from the *Great Western Highway Duplication – Katoomba to Lithgow Archaeological Survey Report* (Jacobs, 2020).

6.7.1 Methodology

Potential impacts on Aboriginal heritage during construction and operation of the proposal have previousy been considered as part of the *Great Western Highway Duplication – Katoomba to Lithgow Archaeological Survey Report* (Jacobs, 2020). This report assessed a 37 kilometre proposed highway alignment between Katoomba and Lithgow (including the Medlow Bath proposal area) and included a 50 metre buffer either side (referred to as the project area in this report, which was prepared as part of the Stage 2 PACHCI process as discussed in Section 5.3).

Jacobs carried out surveys of public lands and accessible properties within the project area through 2019 and 2020. Representatives from the Local Aboriginal Land Councils (LALCs) relevant to the project area were present during each survey, apart from the March 2020 survey due to availability. As no recorded items were identified within the searches and the area generally disturbed, no additional field survey was undertaken for this REF.

A summary of the assessment is provided below, together with safeguards and management measures to mitigate any negative impacts associated with the proposal.

6.7.2 Existing environment

Aboriginal context

The project area spans three distinct Aboriginal language groups, these are the Darug, the Gundungurra, and the Wiradjuri peoples. During European contact it was recorded that the Darug occupied the main east-west ridge of the Blue Mountains, the northern Blue Mountains and the Cumberland Plain. The Gundungurra were to the south, and the Wiradjuri were to the west (Attenbrow 1993; Attenbrow 2010; Breckell 1993).

A variety of resources were exploited by Aboriginal groups within the upper Blue Mountains. The Macquarie River was considered to be a valuable source of food and fishing skills were considered expert as Aboriginal people showed ‘patience and ingenuity’ in making and using snares to catch prey (Meredith 1973: 104).

Stone artefactual material within the project area is part of the eastern regional sequence. The sequence consists of artefact types changing their appearance, frequencies of production, and use of different materials through time. Meredith (1973) provides descriptions of stone tools in the area including hafted stone axes and stone knives (Towle n.d: 87). Boswell (1890: 7) also provides descriptions of men carrying spears and nulla nullas ‘a sort of rude club’, as well as boomerangs which were carried in their belt (Boswell 1890: 7).

The first European thought to have entered the Blue Mountains, specifically into Gundungurra territory, was ex-convict John Wilson in 1792. He is supposed to have lived with the Gundungurra for several years in the Bargo – Picton area (Comber Consultants 2009: 9).

Aboriginal and European interaction and contact significantly increased the opening of Coxs Road across the Victoria Pass. The road was built in 1814 – 1815 and is the earliest built road in the Blue Mountains. Though this aided in the settlement of Europeans it came at the detriment of Aboriginal groups. Conflict and violence began to become more frequent. Disposition of Aboriginal groups and their culture continued in

the late nineteenth century and in the twentieth centuries. Aboriginal people were moved into missions and reserves where they had their existence monitored and controlled.

Landscape context

The proposal area follows a relatively narrow ridgeline which runs overall on a north-south alignment and crosses the Medlow Bath soil landscape which has a local relief of 20-50 metres, and a slope of 10-20 per cent. The underlying geology comprises Narrabeen Sandstone forming abrupt scarp edges and sandstone outcrops exposed within the dissected sandstone plateau landform pattern.

During site surveys undertaken by Jacobs, the project area was generally found to be highly disturbed with little to no areas of the natural land surface visible. Major landform modifications associated with previous expansion and realignment of the highway include cutting into the natural rock and clearance of vegetation on either side of the road corridor. Other types of disturbance are associated with the maintenance of the highway occur in the form of drainage channels and culverts that have disturbed any deposits that may have existed within the road corridor.

Hydrology

The main tributaries in the Upper Blue Mountains are the Grose River and Coxs River with the general drainage flowing west to east. The Grose River catchment and Coxs River catchment are both located in the Hawkesbury–Nepean catchment and covers approximately 2.2 million hectares and is the main source of drinking water for the Sydney, Blue Mountains, and Illawarra region.

Search of heritage registers and databases

A search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted on 29 October 2019 of the Great Western Highway corridor. This search identified 58 previously registered Aboriginal sites or areas of Potential Archaeological Deposit within the searched area however none of these were within the Medlow Bath proposal area. The search identified six Aboriginal sites within 500 metres of the project area (refer to Figure 6-12).

Additional AHIMS searches were conducted by MRB on 17 May 2021 of the proposal area (including a 200 metre buffer). This confirmed that no new Aboriginal sites or places had been identified on the database since the previous search was completed in 2019.

Searches of the Australian Heritage Places Inventory, the Register of the National Estate, the National Heritage List and the NSW Heritage Council's SHR websites identified no recorded Aboriginal sites within the proposal area.

Native title and land use agreements

A search of the National Native Title Register on 7 November 2019 by Jacobs shows there is one active native title claim (NC2018/002 – Warrabinga-Wiradjuri #7) and one Land Use Agreement (NI2014/001 – Gundungurra Area Agreement) over the project area (refer to Figure 6-13).

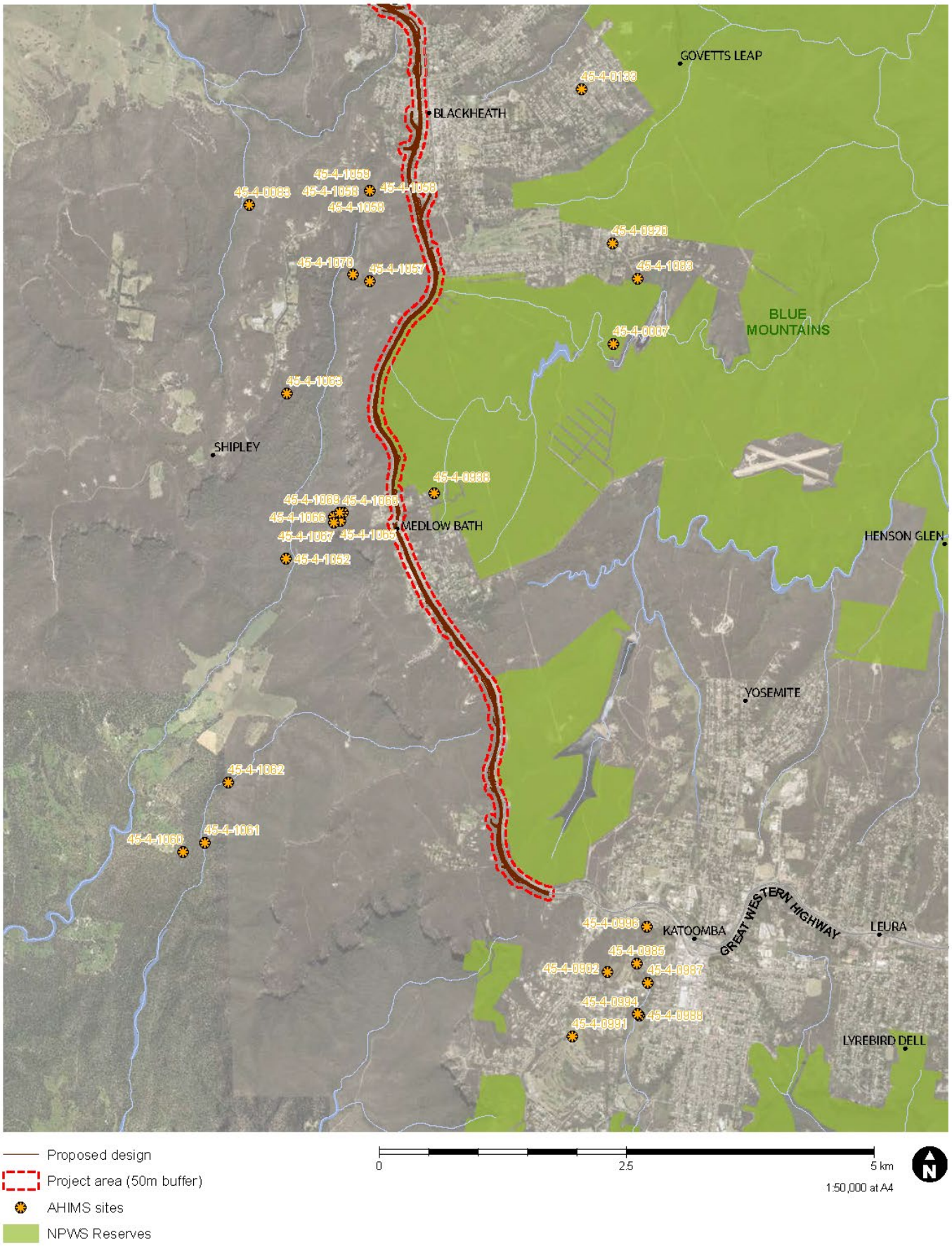

Figure 6-12: AHIMS sites around Medlow Bath (Jacobs, 2020)

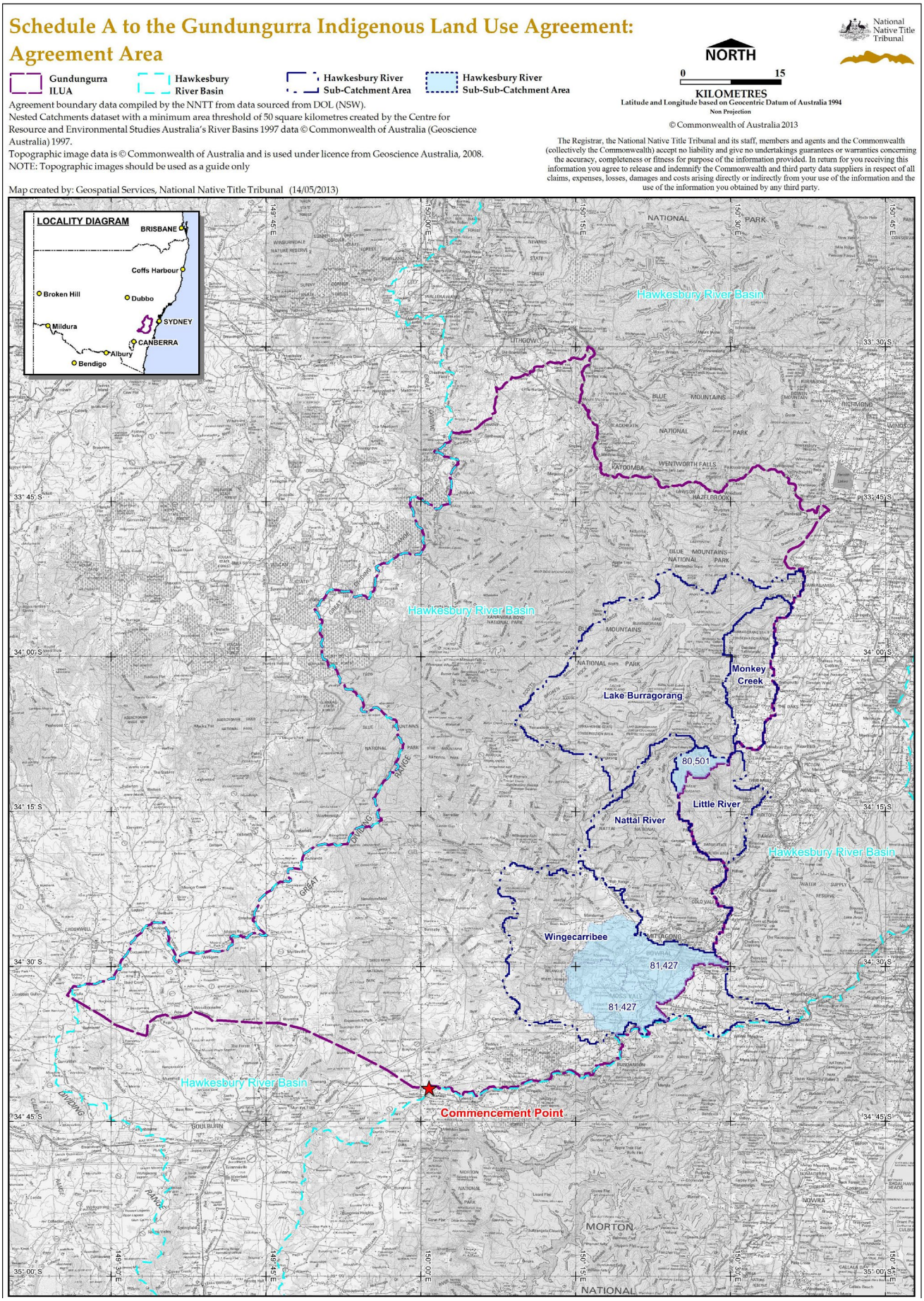

Figure 6-13: Gundungurra Indigenous Land Use Agreement area (National Native Title Tribunal, 2013)

6.7.3 Potential impacts

Construction

Construction would include excavation and other ground disturbing activities which can potentially impact Aboriginal archaeology, if present. There are no known Aboriginal sites identified within the proposal area. In addition, the proposal area has undergone extensive landscape modification and high level of disturbance from previous transport development which has been documented as part of previous Aboriginal heritage investigations (Jacobs, 2020). Therefore, there is a low likelihood that the proposal would impact any previously unidentified culturally sensitive items.

Operation

The proposal is not expected to impact on any items of Aboriginal heritage or cultural values once operational.

6.7.4 Safeguards and management measures

Table 6-32: Safeguards and management measures – Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	The *Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime Services, 2015d) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where TfNSW does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the procedure) is not in place. Work will only re-commence once the requirements of that procedure have been satisfied.	Contactor	Construction	Section 4.9 of *QA G36 Environment Protection*

6.8 Non-Aboriginal heritage

A Statement of Heritage Impact (SoHI) has been prepared by RPS (2021b) to assess the impact of the proposal on the significance of potential and registered non-Aboriginal heritage items located within, and adjacent to, the proposal area (refer to Appendix J). The SoHI recommends measures to avoid or minimise impact, and any approvals required under the NSW *Heritage Act 1977.* An additional SOHI specific to the State heritage-listed curtilage of the Medlow Bath Railway station will be written an accompany the Section 60 application.

6.8.1 Methodology

The non-Aboriginal heritage assessment consisted of a desktop assessment of the proposal area:

- including searches of the relevant heritage registers such as:
    - UNESCO World Heritage List
    - Commonwealth Heritage List
    - Australian heritage database
    - NSW State Heritage Register (SHR)
    - NSW State Heritage Inventory (SHI)
    - National Trust Register
    - former Roads and Maritime and RailCorp Section 170 Heritage and Conservation Registers
    - heritage schedule of the Blue Mountains LEP
- background research to inform the statement of significance
- an analysis of primary and secondary historical resources including original subdivision plans and parish maps for the proposal area
- review of conservation management plans relevant to the proposal including *Hydro Majestic Hotel, 52-88 Great Western Highway, Medlow Bath Conservation Management Plan* (Graham Brooks & Associates, 2010).

A visual inspection of the proposal area was undertaken on 23 December 2020 and 17 May 2021 to understand the site context and condition of the heritage items.

A SoHI was then prepared in accordance with the relevant heritage guidelines, and the level of impact assessed is in accordance with the definitions in Table 6-33, as sourced from the *Material Threshold Policy* (Heritage NSW, 2020).

Table 6-33: Definitions for the levels of impact to State heritage significance

Impact	Definition
Total loss of significance	Major adverse impacts to the extent where the place would no longer meet the criteria for listing on the SHR.
Adverse impact	Major (that is, more than minor or moderate) adverse impacts to State heritage significance. Moderate adverse impacts to State heritage significance. Minor adverse impacts to State heritage significance.
Little to no impact*	An alteration to State heritage significance that is so minor that it is considered negligible. *Little to no impact (as opposed to no impact) acknowledges that any change will result in some level of impact/alteration to State heritage significance.
Positive impact	Alterations that enhance the ability to demonstrate the State heritage significance of an SHR listed place.

6.8.2 Existing environment

Historical context

An overview of the historical context for the Proposal area is summarised in Table 6-34.

Table 6-34: Historical context

Historical aspect	Details
European crossing of the Blue Mountains (1815 onwards)	Cox's Road (the foundation for the Great Western Highway) was constructed over a period of about six months in 1815-1816, following the exploration of Blaxland Lawson, and Wentworth, and survey of William Evans. The alignment of the highway today largely follows the original alignment because it traverses ridges as much as possible and avoids gullies, which kept the road dry for horses, carts and carriages. A number of upgrades have taken place over the recent decades, including a new four lane railway bridge and improved alignment at Medlow Bath in December 2003.
Development of the Main West Line (1850-1870)	The railway line from Katoomba to Blackheath, through Medlow Bath, opened in 1868. A halt stop was established at Medlow Bath in 1881 undergoing some name changes until it was formally known as Medlow bath in 1903.
Township of Medlow Bath (1881 onwards)	The 1890 maps of the Blackheath, Kanimbla and Megalong Parishes indicate that at this time, land had been opened up to Crown land sales. The subdivision and sale of land continued in Medlow Bath through the early twentieth century, particularly with land to the east of the railway station in 1914 through to 1922.
Mark Foy and the Hydro Majestic (1900 onwards)	The Hydro Majestic Hotel (Blue Mountains LEP Item No. MB002) and Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic) (Blue Mountains LEP Item No. MB026) were developed by Mark Foy through bringing together three existing buildings into a complex from 1904 onwards. To emphasise the Hydro and provide a distinct point of reference for all travellers by both road and rail, Foy planted Avenue of Trees (Blue Mountains LEP Item No. MB015) around 1904.
Residential development (1900 onwards)	Following the subdivision and sale of land for the township of Medlow in the early 1900s, construction of houses and holiday retreats commenced. A group of four houses (Melbourne House, Cosy Cot, Sheleagh Cottage) is listed on the heritage schedule of the Blue Mountains LEP (Item No. MB019).
Medlow Post and Telegraph Store (1903 onwards)	The Post and Telegraph Store, Former (Blue Mountains LEP Item No. MB008) is to the north east of the proposal area and was first purchased by Isabella Jane Smith in 1903 and has since been utilised for a number of uses including as a post office, a dance hall for Hydro guests and a church hall. Today, the building is now an antique shop, book-shop and tearoom.
St Luke's Anglican Church (1908 onwards)	After initially holding services in a cave and private residence, St Luke's Anglican Church (Blue Mountains LEP Item No. MB010) was then built in 1913. It comprised a nave, chancel and transept, however the chancel was partly destroyed through storm damage in 1920. The building has since undergone various repairs and modifications, and was later deconsecrated and converted into a one bedroom home.
Annis and George Bills horse-trough (1930-1940)	Annis and George Bills were animal lovers who gave considerable sums to animal societies. When George died in 1927 and after various personal bequests, the remainder of his estate was to be used to construct and pay for horse troughs to prevent cruelty and alleviate the suffering of animals. The Medlow Bath example, Horse Trough (Blue Mountains LEP Item No. MB0013), was one of 700 troughs erected and located east of the proposal area at the corner of Somerset Street and Railway Parade, is a characteristic Bills' trough, with a small trough for small animals such as dogs to the right (Heritage NSW 2020f).

Heritage listings

The proposal traverses a number of heritage items listed on the SHR and Blue Mountains LEP, while the Greater Blue Mountains Area is listed a National and World Heritage site (refer to Table 6-35). Figure 6-14 and Figure 6-15 show the heritage listings in relation to the proposal area.

Table 6-35: Heritage listings within and in the vicinity of the proposal area

Item	Register	ID	Significance	Location
Medlow Bath Railway Station Group	SHR TfNSW RailCorp s170 Register Blue Mountains LEP 2015	01190 MB003 4801011	State	Proposal area
Avenue of Trees (formerly Avenue of Radiata Pines)	Blue Mountains LEP 2015	MB015	Local	Proposal area
Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic)	Blue Mountains LEP 2015	MB026	Local	Proposal area
Hydro Majestic	Blue Mountains LEP 2015	MB002	Local	Adjacent to proposal area
Former Post and Telegraph Store	Blue Mountains LEP 2015	MB008	Local	Adjacent to proposal area
Melbourne House, Cosy Cot, Sheleagh Cottage	Blue Mountains LEP 2015	MB019	Local	Adjacent to proposal area
Urunga	Blue Mountains LEP 2015	MB017	Local	Adjacent to proposal area
St Luke's Anglican Church	Blue Mountains LEP 2015	MB010	Local	Vicinity of proposal area
Greater Blue Mountains Area	World Heritage List National Heritage List	917 105999	World / National	Vicinity of proposal area
Horse Trough	Blue Mountains LEP 2015	MB013	Local	Vicinity of proposal area

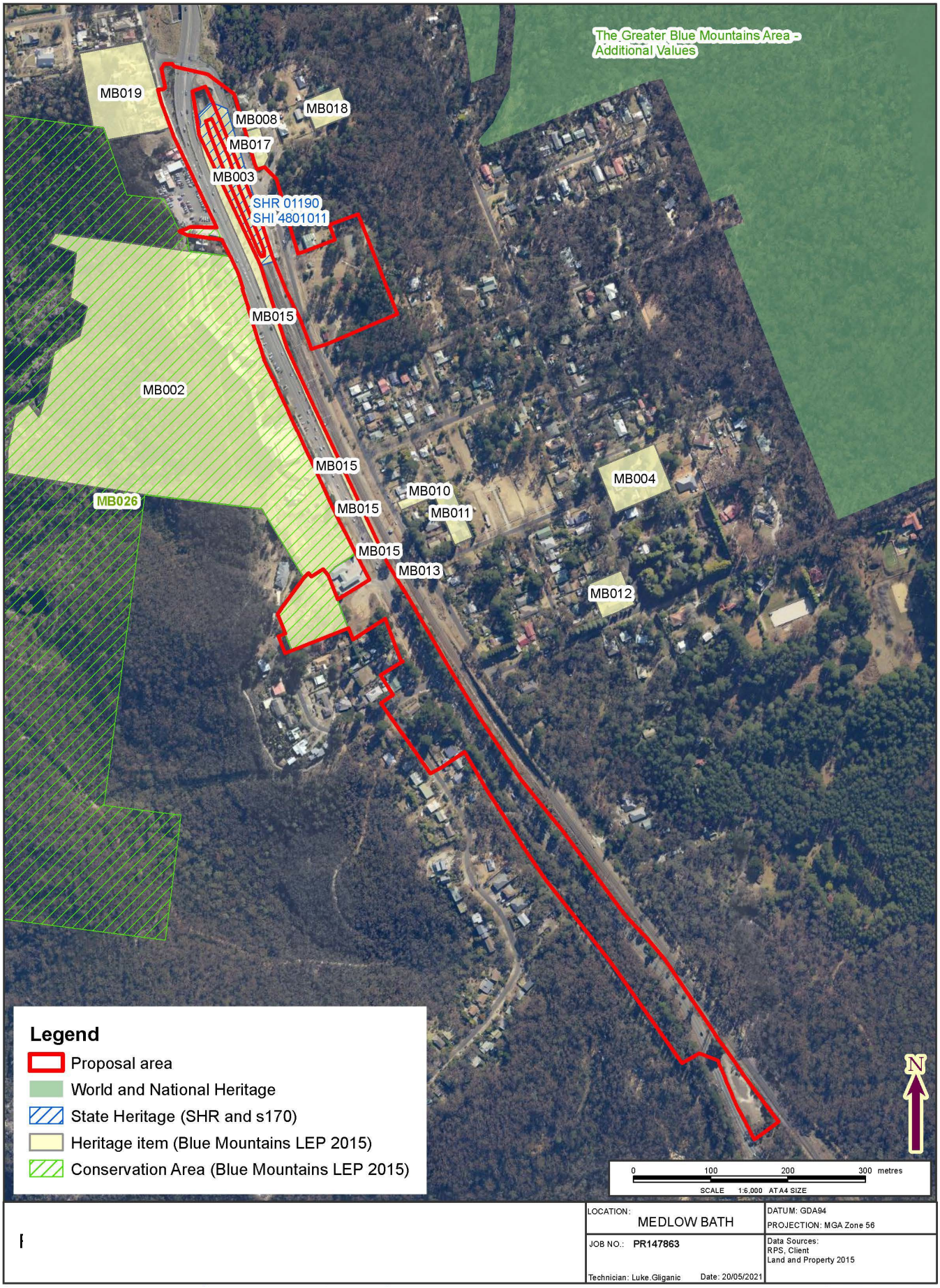

Figure 6-14: Heritage listings in relation to the proposal area (RPS, 2021b)

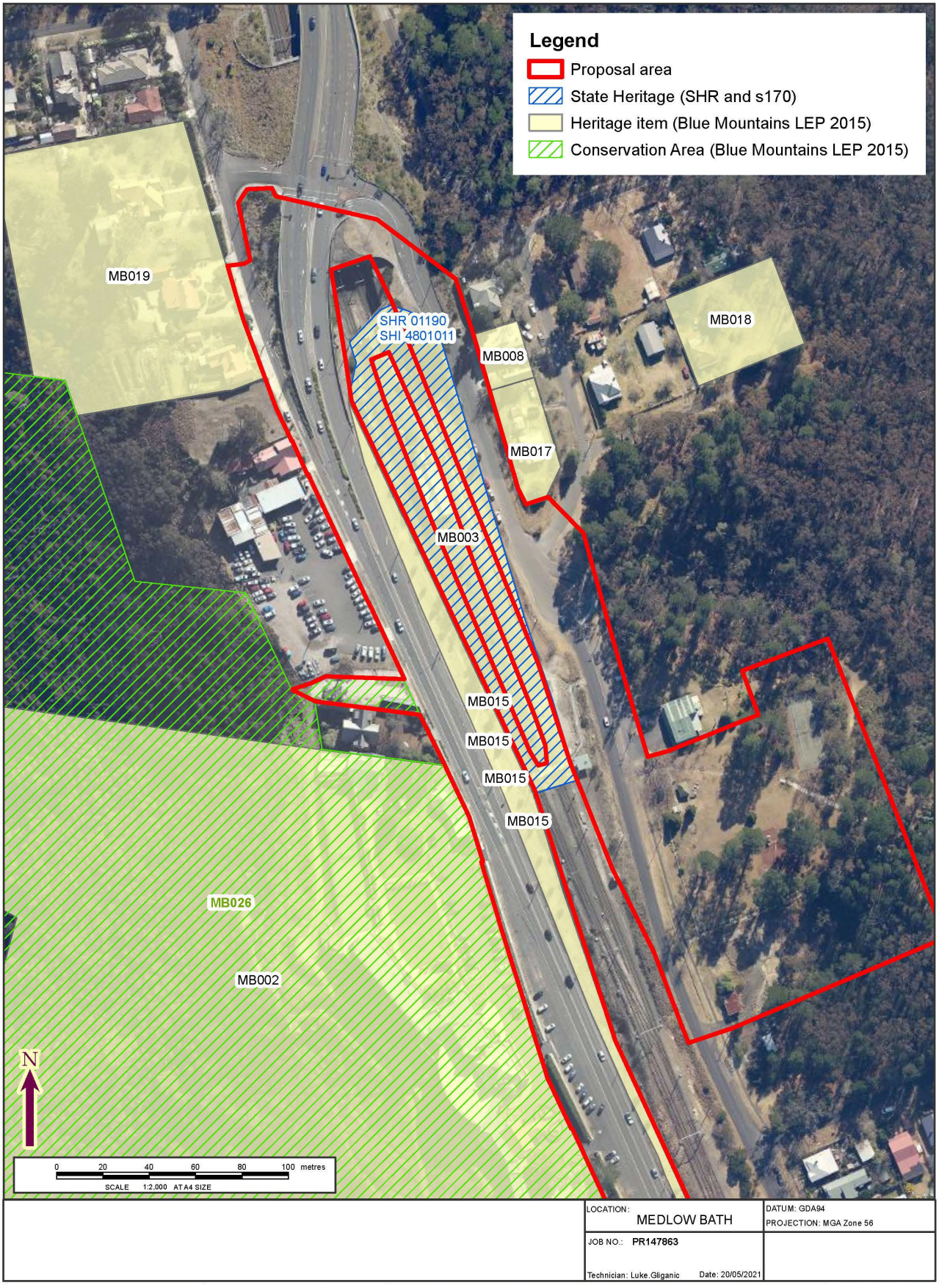

Figure 6-15: Heritage listings in relation to the proposal area near Medlow Bath Station (RPS, 2021b)

Railway Station Group

The statement of significance for the SHR item *Medlow Bath Railway Station Group* as presented on the SHR is:

Medlow Bath Railway Station is significant as part of the early construction phase of railway line duplication on the upper Blue Mountains demonstrating the technological and engineering achievements in railway construction at the beginning of the 1900s. Constructed in anticipation of a boom period in the mountains particularly in connection with large holiday resorts such as the Hydro-Majestic Hotel, Medlow Bath station building is a good example of a Federation free classical railway station. The station building demonstrates typical architectural elements of the standard Federation style island platform buildings that were built between Penrith and Lithgow when the line was duplicated.

The statement of significance for the Blue Mountains LEP 2015 item *Medlow Bath Railway Station Group* as presented on the SHI is: *The Medlow Bath Railway Station is one of a group of stations which are associated with the construction and duplication of the railway line across the Blue Mountains.*

The station is a representative example of a Federation free classical railway station.

Avenue of Trees

The statement of significance for the Blue Mountains LEP 2015 item Avenue of Trees as presented on the SHI is:

The avenue is an integral part of the significance of the Hydro Majestic, telling testimony to the public image of the resort projected by Mark Foy and continuing today. Viewed as part of the whole, aesthetically and historically, the avenue, like the hotel, has state significance.

After a review of site conditions, it is noted that the original radiata pine plantings have all been replaced.

Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic)

The statement of significance for the Blue Mountains LEP 2015 item *Medlow Bath Hydro Majestic original walking track complex* as presented on the SHI is:

The Hydro Majestic Hotel walking track complex has State Significance as the most extensive privately constructed walking track complex in Australia and for its association with Australia's only hydropathical resort developed on the European model.

The Hydro Majestic walking track complex has State Significance for its association with entrepreneur Mark Foy junior who made a fortune in retailing and invested most of it in developing the Hydro Majestic hydropathic resort. The track complex has local significance for its association with William Hargraves, Chief Clerk in Equity of NSW and Blackheath pioneer.

The Hydro Majestic walking track complex has aesthetic significance at the State level for the design values in its construction which demonstrate superb integration of natural and constructed features.

As nearly all of the track complex is intact, it offers an opportunity to research late 19th and early 20th century walking track design and construction techniques, significant at the local level.

The Hydro Majestic walking track network is a rare example of a very extensive privately constructed walking track complex, mostly over 100 years old, which as survived virtually fully intact to the present time.

Historical research and review of site conditions confirms this is an accurate assessment of the heritage significance of this item.

Hydro Majestic

The statement of significance for the Blue Mountains LEP 2015 item *Hydro Majestic* as presented on the SHI is:

The grandest of the grand hotels in the mountains, the Hydro has state significance as a pioneering spa resort with advanced facilities for the health and pleasure of guests. The century and more of use as a hotel, capitalising on one of the finest situations in the mountains, is also of state significance. The Hydro Majestic Hotel is a unique overlay of hotel building styles including the pre-fabricated Casino and Federation free-style Reception buildings and the art deco Hargravia, Belgravia and main wings and the federation free classical south wing. The hotel also includes a number of freestanding buildings with a unity of styling and detailing such as the north bunkhouse, toilet block and rear of the Road Bar.

The arrangement of buildings along the ridge parallel to the Great Western Highway with the distinctive street fencing and row of mature radiata pinus trees quickly became, and remains, a significant landmark on the road through the Blue Mountains.

Some individual elements including the Casino and Reception buildings are fine examples of Federation free style architecture.

The tennis courts have a rare quality with their rustic stone walling and location on the edge of the ridge.

The unusual feature of a prefabricated imported casino which became a showpiece for some of the greatest singers of the Edwardian period, the art collection and the cuisine further enhance the social significance of the Hydro.

Technical interest attaches to the remains of the flying fox into the Megalong and the symbiosis between the hotel and valley below has remained a significant element in the Hydro's success.

Historical research and review of site conditions confirms this is an accurate assessment of the heritage significance of this item.

Former Post and Telegraph Store

The statement of significance for the Blue Mountains LEP 2015 item *Former Post and Telegraph Store* as presented on the SHI is:

The hall and store have high local significance because of their association with the Hydro Majestic and Mark Foy's touristic entrepreneurship, particularly in catering for the interest in Jenolan Caves. The long-standing association with motor-cars is a particularly significant feature.

It is an unusual example of a Federation gothic shopfront. An unusual form for a post office, the building features 155renelated parapet, twisted columns and a decorative shield in the centre of the façade.

The hall had a high local profile as a centre for dances, films and, after World War II, a wide variety of Catholic and community functions, while the store and post-office played their usual key role for the residents and visitors alike

Historical research and review of site conditions confirms this is an accurate assessment of the heritage significance of this item.

Melbourne House, Cosy Cot, Sheleagh Cottage

No statement of significance for the Blue Mountains LEP 2015 item *Melbourne House, Cosy Cot, Sheleagh Cottage* is presented on the SHI. After historical research and review of site conditions, the following statement of significance is proposed:

The four houses, Lot 1 Great Western Highway, Melbourne House, Cosy Cot and Sheleagh Cottage, are significant as they represent a unique group constructed independently of each other in the early boom years of Medlow Bath. Cosy Cot and Sheleagh Cottage are significant for their association with renowned

historical figures. Melbourne House and Sheleagh Cottage are aesthetically significant for their use of particular materials.

Urunga

The statement of significance for the Blue Mountains LEP 2015 item Urunga as presented on the SHI is:

The association of the house with the railway and the growth of rail traffic at Medlow Bath associated with the Hydro gives the cottage local historical significance.

Historical research and review of site conditions confirms this is an accurate assessment of the heritage significance of this item.

St Luke's Anglican Church

The statement of significance for the Blue Mountains LEP 2015 item St Luke's Anglican Church as presented on the SHI is:

The church has had social significance for the Anglican community around Medlow Bath for over eighty years. It is a representative example of a Federation carpenter gothic church built for a small rural village, although it took its present simpler shape only after storm damage in 1920.

Historical research and review of site conditions confirms this is an accurate assessment of the heritage significance of this item.

Greater Blue Mountains Area

The *Greater Blue Mountains Area* is listed the World Heritage List (WHL) (Reference No. 917) and is located within the vicinity of the proposal area.

Horse Trough

The statement of significance for the Blue Mountains LEP 2015 item *Horse Trough* as presented on the SHI is:

All the Annis and George Bills horse-troughs have some local significance as evidence of philanthropy towards animals, even though they were erected when the days of the horse on the roads were almost over.

Historical research and review of site conditions confirms this is an accurate assessment of the heritage significance of this item.

Potential heritage items

Three potential heritage items were identified during the site inspection. The location of each potential heritage item in relation to the proposal area is shown in Figure 6-16.

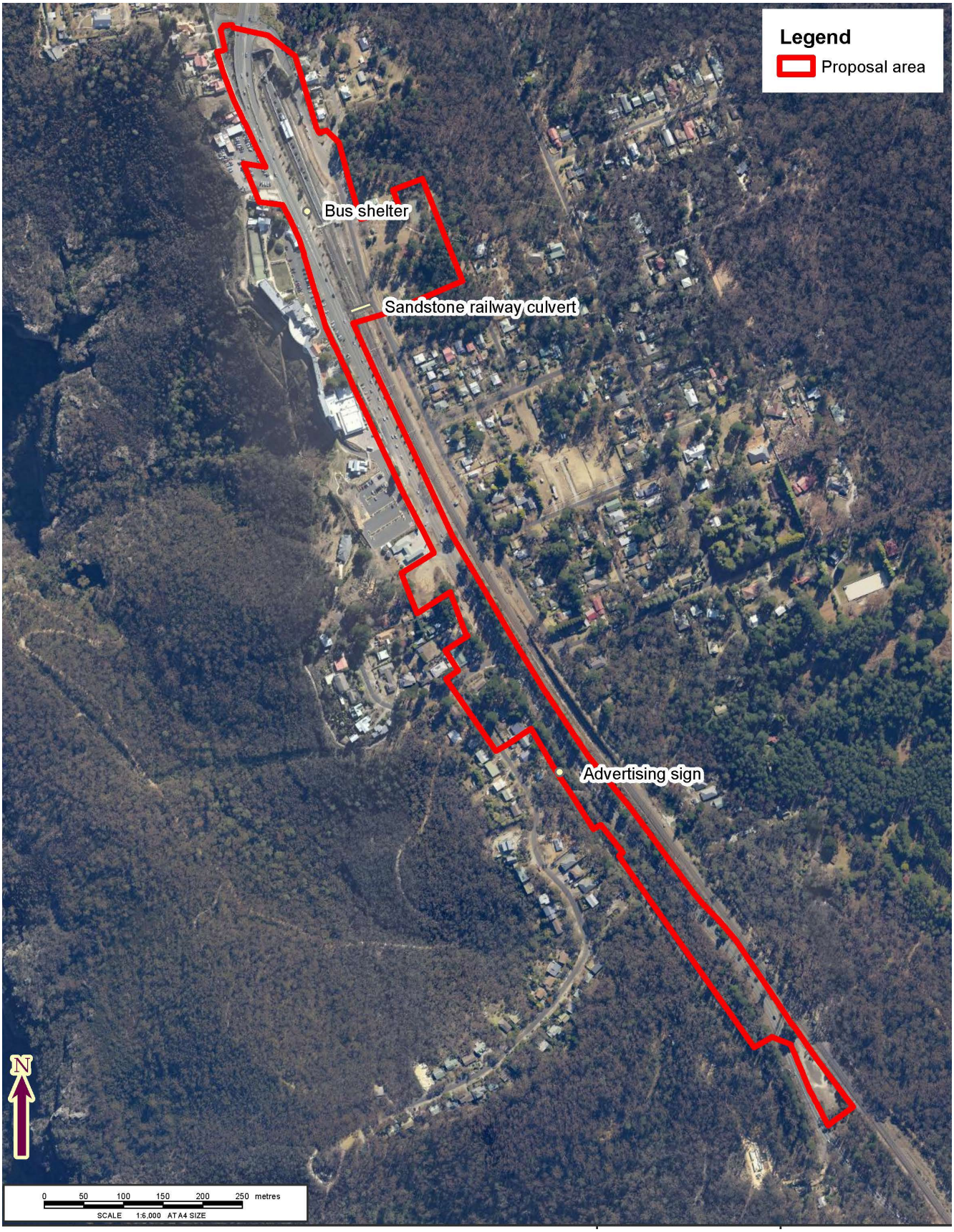

Figure 6-16: Location of potential heritage items in relation to the proposal area (RPS, 2021b)

Bus shelter

The concrete bus shelter is located at the bus stop near the southern entrance to Medlow Bath Railway Station. The bus shelter has been painted inside and out with murals. The interior boasts a mural of an historic view of the Hydro Majestic Hotel and Great Western Road, while the exterior is decorated with foliage motifs and naturalistic scenes. The bus shelter is shown in Figure 6-17.

After research and review of site conditions, the following statement of significance is proposed:

The bus shelter is considered to be of aesthetic significance for its historic mural and of social significance as it forms part of an extended mural campaign throughout the Blue Mountains.

Figure 6-17: Bus shelter looking north, showing interior mural (RPS, 2021b)

In addition to the findings of the SoHI prepared by RPS (2021b), a REF for the Great Western Highway – Katoomba to Mount Victoria Road Safety Upgrades was completed in 2016. The SoHI conducted by Artefact (2015b) to support the REF also identified the Medlow Bath Bus Shelter as a potential heritage item.

The bus shelter is proposed to be relocated to a location to be determined in consultation with the heritage interpretation strategy.

Sandstone railway culvert

The sandstone culvert runs beneath the railway embankment south of Medlow Bath Railway Station, within the proposal area. Visible on both sides of the embankment, the culvert has been recently modified through the addition of a plastic pipe. The sandstone culvert is shown in Figure 6-18.

After historical research and review of site conditions, the following statement of significance is proposed:

The culvert is considered to be of local significance for its association with railway engineering through the Blue Mountains. The culvert provides physical evidence of the construction of the railway in the 1860s. It provides physical evidence of the original rail alignment and of the workmanship of the period. It is of historical and archaeological significance.

Figure 6-18: Sandstone culvert on western side of railway embankment, looking east (RPS, 2021b)

Hydro Majestic sign

The timber sign advertising the “Majestic Lounge and Public Bar” is located on the western road embankment of the Great Western Highway in the southern section of the proposal area. Overgrown with roadside vegetation, the sign is in a dilapidated condition. The Advertising sign is shown in Figure 6-19 and Figure 6-20.

After historical research and review of site conditions, the following statement of significance is proposed:

The Advertising sign is considered to be significant for its association with the Hydro Majestic.

Figure 6-19: Rear of advertising sign, looking east (RPS, 2021b)

Figure 6-20: Front of advertising sign, looking north (RPS, 2021b)

Potential archaeological features

The archaeological potential of the proposal area is assessed to be low, with an area of moderate to high archaeological sensitivity identified south of the Hydro Majestic Hotel. The archaeological potential of the proposal area is associated with the potential for the following archaeological resources:

- low potential evidence of former road surfaces along the Great Western Highway from Foy Avenue to the rail overpass
- low potential evidence of former road surfaces along Railway Parade
- low potential evidence of former waiting shed beneath Medlow Bath Railway Station platform
- low to moderate potential evidence of former goods shed and platform to the west of Medlow Bath Railway Station
- moderate to high potential evidence of former house 'Glenara Cottage' on vacant land at south (eastbound) end of proposal area immediately south of Hydro Majestic.

6.8.3 Potential impacts

The summary of the SoHI for each heritage or potential heritage item impacted by the proposal are summarised below and in Table 6-36.

Table 6-36: Summary of the SoHI for each heritage or potential heritage item impacted by the proposal

Item	Listing	ID	Significance	Potential impact	Potential impact on significance by proposal
Medlow Bath Railway Station Group	SHR Transport for NSW RailCorp s170 Register Blue Mountains LEP 2015	01190 MB003 4801011	State	While the proposal would not physically impact significant fabric, the partial removal of elements such as the garden beds and the alteration of its heritage setting would impact the overall significance of the station. The addition of a pedestrian bridge would add an additional built form to the station complex which would visually dominate the heritage item.	The proposal would have a minor adverse physical impact and a major adverse visual impact on this heritage item.
Avenue of Trees	Blue Mountains LEP 2015	MB015	Local	The proposal would impact and greatly reduce the heritage curtilage and likely impact critical root zones of trees, or require the removal of trees altogether. Installation of the pedestrian bridge would introduce a new built form to the views and vistas both to and from the heritage item.	The proposal would have a major adverse impact and visual impact on this heritage item.
Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic)	Blue Mountains LEP 2015	MB026	Local	No physical impact is proposed within the heritage curtilage of this item for the preferred design option. No walking tracks associated with this heritage item appear to be within the alternate design proposal area, therefore the alternate design proposal would have no physical impact on significant fabric of this heritage item.	The proposal 'preferred option' would have little to no physical impact and a moderate adverse visual impact on this heritage item. However, the proposed 'alternate design' for Bellevue Crescent would have an additional minor adverse impact on this

Item	Listing	ID	Significance	Potential impact	Potential impact on significance by proposal
					heritage item through the reduction of its heritage curtilage
Hydro Majestic	Blue Mountains LEP 2015	MB002	Local	No physical impact is proposed within the heritage curtilage, however vibration from construction may have a minor to moderate adverse impact to the significant fabric of the stone fence by causing destabilisation. Additionally, excavation works associated with the proposal may have a minor to moderate adverse impact on significant trees *radiata pinus* located within the Hydro Majestic's heritage curtilage through impact to critical root zones. Installation of the pedestrian bridge would introduce a new built form to the views and vistas both to and from the heritage item. The proposed alternate design for Bellevue Crescent would have an additional minor adverse impact on this heritage item through the reduction of its heritage curtilage and impact on potentially significant pine plantings and archaeological resources.	The proposal may have a minor to moderate adverse physical impact and would have a moderate to major adverse visual impact on this heritage item.
Former Post and Telegraph Store	Blue Mountains LEP 2015	MB008	Local	No physical impact is proposed within the heritage curtilage or to significant fabric of this heritage item. Installation of the pedestrian bridge would introduce a new built form to the views and vistas both to and from the heritage item.	The proposal would have little to no physical impact and a moderate visual impact on this heritage item.
Melbourne House, Cosy Cot, Sheleagh Cottage	Blue Mountains LEP 2015	MB019	Local	No physical impact is proposed within the heritage curtilage or to significant fabric of this heritage item. However, vibration from adjacent construction may have a minor adverse impact on significant fabric, particularly the house and shop located at Lot 1 Great Western Highway which abuts the proposal area. Installation of the pedestrian bridge would introduce a new built form to the views and vistas both to and from the heritage item.	The proposal would have little to no physical impact and a moderate to major adverse visual impact on this heritage item.
Urunga	Blue Mountains LEP 2015	MB017	Local	No physical impact is proposed within the heritage curtilage or to significant fabric of this heritage item. Installation of the pedestrian bridge would introduce a new built form to the views and vistas both to and from the heritage item.	The proposal would have little to no physical impact and a moderate to major visual impact on this heritage item.

Item	Listing	ID	Significance	Potential impact	Potential impact on significance by proposal
St Luke's Anglican Church	Blue Mountains LEP 2015	MB010	Local	No physical impact is proposed within the heritage curtilage or to significant fabric of this heritage item. The proposed new pedestrian bridge would not visually impact views to this heritage item, however it would alter views from the heritage item.	The proposal would have little to no physical impact and a minor to moderate visual impact on this heritage item.
Greater Blue Mountains Area	World Heritage List	917	World	No physical impact is proposed within the heritage curtilage of this heritage item and the proposed new pedestrian bridge would not visually impact views and vistas to or from this heritage item.	The proposal would have little to no impact on this heritage item.
Horse Trough	Blue Mountains LEP 2015	MB013	Local	No physical impact is proposed within the heritage curtilage or to significant fabric of this heritage item and the proposed new pedestrian bridge would not visually impact views and vistas to or from this heritage item.	The proposal would have little to no impact on this heritage item.
Medlow Bath Bus Shelter	NA – potential heritage item	NA	Local	While removal of the bus shelter is required for the proposal, this would be mitigated by relocating the bus shelter elsewhere within the township, enabling it to retain its mural and setting within Medlow Bath and the Blue Mountains LGA	The proposal would have a minor to moderate physical impact and a moderate adverse visual impact on this potential heritage item.
Sandstone railway culvert (potential heritage item)	NA-potential heritage item	NA	Local	While new stormwater drains may connect to the same drainage network, no physical impact is proposed to any potentially significant fabric.	The proposal would have little to no impact on this potential heritage item.
Advertising sign (potential heritage item)	NA-potential heritage item	NA	Local	The potential heritage item may require removal and subsequent demolition to accommodate the proposed turning bay into Bellevue Crescent.	The proposal may have a major adverse impact on this potential heritage item.

Construction

The following aspects of the Proposal respect or enhance the heritage significance of the item or conservation area for the following reasons:

The proposal respects the heritage significance of a number of heritage items by, where possible, keeping within the designated road reserve alignment and avoiding impact to abutting heritage curtilages and significant heritage fabric.

The proposal requires the removal of the bus shelter, a potential heritage item. The proposal respects the identified potential heritage significance of this bus shelter by proposing to relocate the shelter elsewhere within the township, enabling it to retain its mural and setting within Medlow Bath township and the Blue Mountains LGA.

The following aspects of the Proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures taken to minimise impacts:

The new pedestrian bridge would introduce a new visual element to Medlow Bath Railway Station that would visually dominate the heritage setting as well as block views to and from the station complex. The pedestrian bridge would also impact views and vistas across Medlow Bath, impacting views to and from surrounding heritage items.

Construction of the highway and installation of pedestrian bridge would physically impact Avenue of Trees through the reduction of its heritage curtilage. Critical root zones of the trees would also be impacted, while some trees would require removal.

Construction of the alternate intersection design for Bellevue Crescent:

- could potentially impact archaeological resources associated with the former Glenara Cottage
- would impact the remaining stands of pine trees seemingly associated with the former Glenara Cottage. Some trees would require removal, while others may have their critical root zones impacted
- would have a minor adverse impact on Hydro Majestic (Blue Mountains LEP 2015 Item No. MB002) and Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic) (Blue Mountains LEP 2015 Item No. MB026) through the reduction of their respective heritage curtilages.

Archaeological impact

The proposal area has been assessed to be of low archaeological potential. Potential impacts due to excavation is considered to be unlikely. However, the proposal may have a moderate to major adverse impact on the archaeological potential of the proposal area, if archaeological resources survive.

If surviving, archaeological resources associated with former road surfaces are most likely to occur in the form of compacted earth, bitumen or ballast. Historical sources do not make reference to the proposal area being macadamised or paved with stone however, these should still be considered a possibility. If identified, it is likely that any archaeological resources associated with former road surfaces would have been impacted by twentieth century road resurfacing and would provide little research potential.

If surviving, archaeological resources associated with the former waiting shed or goods shed and associated platform would likely be in the form of post holes or brick foundations dependant on the original structural material. If identified, these resources would likely provide limited information and have little to no research potential.

If surviving, archaeological resources associated with the former house would likely comprise building foundations, cess pit or well structures and associated potential occupation deposits. If identified, these resources could provide information about the structure and use of Glenara Cottage, which is relatively unknown. Potential research material would likely be limited to the local historical context.

Operation

The new pedestrian bridge would introduce a new visual element to Medlow Bath Railway Station that would visually dominate the heritage setting as well as block views to and from the station complex. The pedestrian bridge and also the removal of some trees along the Avenue of Trees would also impact views and vistas across Medlow Bath, impacting views to and from surrounding heritage items.

6.8.4 Safeguards and management measures

Table 6-37: Safeguards and management measures – non-Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage. The plan will be prepared in consultation with Heritage NSW.	Contractor	Detailed design, pre-construction	Section 4.10 of *QA G36 Environment Protection*
Non-Aboriginal heritage	The detailed design will be developed and refined in consultation with either a heritage architect or a built heritage consultant. The detailed design would aim to further minimise the impact of the proposal, with particular reference to the pedestrian bridge through the use of appropriate form, proportion and materials. Bulk should be minimised, and new built forms should be clearly separate from existing heritage fabric. Where appropriate, the detailed design should also respond to existing and significant architectural detail, such as the architectural detailing of the station building, or the footbridge. Detailed design should be undertaken in accordance with appropriate Sydney Trains and TfNSW guidelines, including: • *Railway Footbridges Heritage Conservation Strategy* (NSW Government Architect's Office Heritage Group for Sydney Trains, 2016) • *Heritage Platforms Conservation Management Strategy* (Australian Museum Consulting for Sydney Trains, 2015) • *Heritage Technical Note: Installation of New Electrical and Data Services at Heritage Sites* (Sydney Trains, 2017a) • *Station Components Guide* (Sydney Trains 2017b).	Contractor	Detailed design	Appendix J SoHI recommendation 1

Impact	Environmental safeguards	Responsibility	Timing	Reference
State heritage	A Section 60 Application would be required for proposed works within the SHR curtilage of Medlow Bath Railway Station. The Application must be granted prior to works commencing.	TfNSW	Pre-construction	Appendix J SoHI recommendation 2
Archaeology	An Historic (non-Aboriginal) Archaeological Assessment will be prepared for the Hydro Majestic land proposed for use for the alternate design arrangement for Bellevue Crescent known as Lots 3, 4, 5 and 20 of DP25570. The assessment will be undertaken by a suitably qualified archaeologist in accordance with the *Heritage Act 1977* and the Heritage NSW publication *Assessing Significance of Historical Archaeological Sites and Relics* (2009). The purpose of the assessment is to determine the nature, extent and significance of any archaeological or historical resources associated with the former Glenara Cottage in this area and provide appropriate management recommendations in relation to the proposal.	TfNSW	Pre-construction	Appendix J SoHI recommendation 3
Non-Aboriginal heritage awareness training	• Works within the proposal area are being undertaken in an area of heritage significance. Prior to works commencing, contractors will be briefed as to the sensitive nature of the proposal area and informed of any recommended mitigation measures or controls required. • Non-Aboriginal heritage awareness training will be provided for all contractors and personnel prior to commencement of works to outline the identification of potential heritage items and associated procedures to be implemented in the event of the discovery of non-Aboriginal heritage materials, features or deposits (that is, unexpected finds), or the discovery of human remains.	Contractor	Pre-construction	Appendix J SoHI recommendation 4
Non-Aboriginal heritage protection of significant fabric	Works will be undertaken with care. To avoid impact to significant fabric during the construction of the proposal the following is recommended:	Contractor	Pre-construction	Appendix J SoHI recommendation 5

Impact	Environmental safeguards	Responsibility	Timing	Reference

	• machinery should be placed with sufficient clearance to significant heritage structures to avoid any inadvertent harm to significant fabric or incidental damage from vibration as per the TfNSW recommended minimum working distances for vibration intensive plant (refer Table 6-27 of the REF). In particular, care should be taken when working near:
	  ○ Hydro Majestic's stone fence
	  ○ Medlow Bath Railway Station platform structures, platform edges and footbridge
	  ○ Former Post and Telegraph Store
	  ○ Urunga
	  ○ Melbourne House, Cosy Cot and Sheleagh Cottage, in particular Lot 1 Great Western Highway
	  ○ Sandstone Railway culvert
	  ○ archaeologically sensitive vacant land north of the United Petrol Station
	• Protection of significant fabric – Hydro Majestic stone fence
	  ○ protective barriers or fencing should be erected between the works corridor boundary and the Hydro Majestic's stone fence for the duration of works within the vicinity of this significant fabric to ensure no inadvertent harm occurs
	  ○ machinery and works should be placed with sufficient clearance to significant fabric and associated protective barriers to avoid inadvertent harm from machinery or incidental damage from vibration
	  ○ vibration monitoring of the stone fence should be put in place for the duration of works			

Impact	Environmental safeguards	Responsibility	Timing	Reference

	• Protection of significant fabric – Sandstone Railway culvert
	  ○ redundancy of the Sandstone Railway culvert should not include work to significant fabric
	  ○ if closure or blocking of the culvert is required, these works should be undertaken in a manner that would not impact significant fabric
	  ○ if work to significant fabric is required, this should be undertaken in consultation with either a heritage architect or heritage consultant, and be conducted in a manner that minimises harm as much as practicable
	• Protection of significant fabric – bus shelter
	  ○ measures should be put place to protect significant fabric of the bus shelter during its proposed removal and relocation
	  ○ relocation position, and details of where and how it will be removed, stored and relocated, should be determined in consultation with Blue Mountains City Council
	  ○ after relocation, conservation of the mural should be undertaken to prevent further loss, or to sympathetically reinstate missing portions
	• Protection of significant fabric – advertising sign
	  ○ if removal of the advertising sign is required for the proposal, it should be salvaged and relocated
	  ○ relocation position, and details of where and how it will be removed, stored and relocated, should be determined in consultation with Blue Mountains City Council			

Impact	Environmental safeguards	Responsibility	Timing	Reference
	○ if removal of the advertising sign is not required for the proposal, appropriate measures should be put in place to protect it during proposed works, such as the installation of protective barriers or fencing • Protection of significant fabric – potential archaeological site of former Glenara Cottage ○ prior to use as an ancillary facility / stockpile area, the vacant land north of the petrol station should be covered with geotextile, or other suitable protective material, to ensure no inadvertent harm to potential archaeological resources occurs ○ no ground scraping, levelling or landscaping of this area should occur before, during or after the use of the area as an ancillary facility / stockpile area ○ this protection measure may not be required if a Historic (non- Aboriginal) Archaeological Assessment does not identify any significant archaeological potential.			
Protection and management of trees	A qualified arborist will be engaged to undertake an Arboricultural Impact Assessment of the proposal area, with a particular focus on trees associated with heritage items, Hydro Majestic (Blue Mountains LETP Item No.MB002), Avenue of trees (formerly Avenue of Radiata Pines) (Item No.MB015) and Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic) (Blue Mountains LEP 2015 Item No.MB026) . Management and protection measures recommended in the Arboricultural Impact Assessment should be implemented accordingly to ensure the protection and management of significant trees throughout the implementation of the proposal.	Contractor	Pre-construction	Appendix J SoHI recommendation 6

Impact	Environmental safeguards	Responsibility	Timing	Reference
Tree replacement	Trees removed as part of the proposal within the heritage curtilage of Hydro Majestic (Item No.MB002), Avenue of trees (formerly Avenue of Radiata Pines) (Item No.MB015) or Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic) (Blue Mountains LEP 2015 Item No.MB026) will be replaced in a manner that is consistent with, and accurately reflect, the extent, nature and significance of the respective heritage item. The location, species and number of trees to be planted will be determined in consultation with the land owner, Blue Mountains City Council and a qualified arborist with reference to the identified heritage significance of the respective heritage item.	Contractor	Construction	Appendix J SoHI recommendation 7
Movable heritage	All moveable heritage identified as part of this assessment will be managed in accordance with a moveable heritage procedure. Moveable heritage identified on Hydro Majestic (Blue Mountains LEP Item No. MB002) land will be managed in accordance with Section 6.5, *Conserving Moveable Heritage, in the Hydro Majestic Hotel, Medlow Bath, Conservation Management Plan* (Graham Brooks and Associates, 2010).	Contractor	Construction	Appendix J SoHI recommendation 8
Before and after photographic record	Prior to construction, an archival photographic recording of the heritage items impacted by the proposed works is to be prepared in accordance with the NSW Heritage Division of the Department of Environment and Heritage guidelines titled *"Photographic Recording of Heritage Items using Film or Digital Capture".* The photographic should be prepared by a heritage consultant and must document significant heritage elements and items that will be impacted by the proposed works. The record should also document significant views and vistas as selected by the heritage consultant. This archival recording should include the following items as a minimum: • Medlow Bath Railway Station Group (SHR No.01190, TfNSW Section 170 SHI No. 4801011, Blue Mountains LEP 2015 Item No. MB003) • Hydro Majestic (Item No. MB002)	Contractor	Pre-construction, Operation	Appendix J SoHI recommendation 9

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Former Post and Telegraph Store (Item No. MB008) • Avenue of Trees (Item No. MB015) • Urunga (Item No. MB017) • Melbourne House, Cosy Cot, Sheleagh Cottage (Item No. MB019) • Medlow Bath Hydro Majestic original walking track complex (only the parts within the grounds of the Hydro Majestic) (Blue Mountains LEP 2015 Item No. MB026) • Bus Shelter (potential heritage item) • Sandstone Railway culvert (potential heritage item) • Advertising sign (potential heritage item).			
Heritage interpretation	A heritage interpretation plan will be formulated and implemented in accordance with the Heritage NSW, *Interpreting Heritage Places and Items* (Heritage Office (former) 2005) as part of the proposed upgrade of the Great Western Highway. This is to be undertaken with the consent and co-operation of authorised owners or land managers and Blue Mountains City Council. Heritage interpretation should communicate the history of Medlow Bath, with reference to its identified heritage items, and enable audiences to engage with the significance of these places and the wider Blue Mountains area. It should be integrated into the broader cultural heritage design and heritage interpretation strategy for the overall Great Western Highway Katoomba to Lithgow Upgrade Program, and pick up themes relevant to the overall Great Western Highway route as well as Medlow Bath.	Contractor	Construction	Appendix J SoHI recommendation 10
Non-Aboriginal heritage	In the event that unexpected archaeological resources are identified in the course of the proposal, all work in the affected area should cease, the area should be cordoned off, and Heritage NSW should be notified, in accordance with Section	Contractor	Construction	Appendix J SoHI recommendation 11

Impact	Environmental safeguards	Responsibility	Timing	Reference
	146 of the *Heritage Act 1977*. The TfNSW (2016) *Unexpected Heritage Finds Guideline* should be adhered to.			
Non-Aboriginal heritage	If the proposed works, or proposal area, are modified to those discussed in this report, additional heritage advice may be required to appropriately manage and mitigate any potential impacts caused by these changes.	Contractor, TfNSW	Pre-construction, Construction	Appendix J SoHI recommendation 12

6.9 Landscape character and visual impacts

Potential impacts of the proposal on landscape character and visual amenity have been assessed in the *Great Western Highway Upgrade Medlow Bath – Urban Design, Landscape Character and Visual Impact Assessment* prepared by Spackman Mossop Michaels (2021) which is provided in Appendix K. A summary of the assessment is presented in this section, together with safeguards and management measures to mitigate any negative impacts.

6.9.1 Methodology

The assessment was prepared in accordance with the Roads and Maritime *Environmental Impact Assessment Practice Note: Guideline for Landscape Character and Visual Impact Assessment (EIA-N04)* (Roads and Maritime Services, 2018b). The sensitivity and magnitude of the landscape and visual impact was assessed to produce a combined impact rating of negligible, low, moderate and high (refer to Figure 6-21).

SENSITIVITY \ MAGNITUDE	HIGH	MODERATE	LOW	NEGLIGIBLE
HIGH	HIGH	HIGH-MODERATE	MODERATE	NEGLIGIBLE
MODERATE	HIGH-MODERATE	MODERATE	MODERATE-LOW	NEGLIGIBLE
LOW	MODERATE	MODERATE-LOW	LOW	NEGLIGIBLE
NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

Figure 6-21: Landscape character and visual impact rating matrix (NSW Roads and Maritime, 2018)

Below is a summary of the key activities undertaken for the landscape character and visual impact assessment.

- Undertaking an initial site visit and field investigation, reviewing relevant literature, analysing aerial photographs and topographic maps to understand the study area.
- Reviewing the preferred engineering concept design on a regular basis, and other supporting material to gain an appreciation of the project.
- Developing an Urban Design Strategy comprising objectives and principles to guide the development of the concept design.
- Defining landscape character through a study area analysis, including a detailed site investigation.
- Identifying and describing landscape character zones and evaluating the proposal's impact on them.
- Evaluating the impact of the project on these landscape character zones by combining the sensitivity of the zone and the magnitude of the works to provide an overall impact rating as indicated by the Impact Assessment Grading Matrix.
- Identifying the visual catchment of the proposed works for the visual impact assessment.
- Selecting viewpoints within the visual catchment representing a range of different land uses.

- Evaluating the visual impact of the project by comparing the sensitivity of viewpoints and the magnitude of the impact of the project upon them to provide an overall impact rating as indicated by the Impact Assessment Grading Matrix.
- Developing the Urban and Landscape Concept Design, described in plans, sections/ elevations, precedent photographs and other drawings as appropriate.
- Identifying urban design and landscape opportunities and methods of mitigating adverse visual impacts, both within and outside of the project scope to assist the ongoing development of the concept design and for consideration in the detail design phase of the proposal.

6.9.2 Existing environment

The proposal area is surrounded by land zoned for residential, recreational and conservation purposes.

The Great Western Highway along with the Main West Line, forms the primary transport corridors through the Blue Mountains, connecting Penrith to Lithgow. The villages along the Great Western Highway have vast and undisturbed views over the Greater Blue Mountains World Heritage Area.

The journey along the Great Western Highway through the Blue Mountains, crosses landscapes that have rich natural, cultural, scenic and historical values that enhance its attractive and picturesque setting. Generally, urban developments along the highway are located along the ridgeline above and are discrete in nature and separated by natural bushland creating a repeating sequence of urban areas and natural bushland, sometimes referred to as a “string of pearls”.

The village of Medlow Bath is located between Blackheath, to the north, and Katoomba, to the south and mostly consists of single story dwellings, guest-houses and retreats. The western edge of the Great Western Highway is physically and visually dominated by the Hydro Majestic Hotel, which is positioned atop the Megalong Valley escarpment. The escarpment is locally protected due to its high scenic values. To the east of the Great Western Highway, vegetation creates a buffer between Medlow Bath residential tree-lined streets and the existing highway and rail corridor. Further east, low density housing backs onto the national park.

Within the Medlow Bath village and to the east of the railway line, there is one public open space facility at Medlow Bath Park, adjacent to the Rural Fire Brigade station which provides public amenity in the form of a playground, picnic tables and landscaped gardens. Surrounding the village, there are several popular bushwalking tracks that provide recreational facilities for locals and tourists, as well as regional and local cycle routes that link to the Blue Mountains Trail and Mountain Bike Trails to Point Pilcher.

Landscape character

The proposal area comprises three distinct landscape character zones (LCZ). A LCZ is defined as the collective qualities including the built form, natural elements, and the cultural and social facets that combine to provide a locale with a unique sense of place. Each LCZ reflects broadly homogenous visual characteristics particularly in terms of vegetation, land use and landform.

Table 6-38 provides a summary description and attributes associated with each LCZ and Figure 6-22 provides the approximate extent of these landscape zones.

Table 6-38: Landscape Character Zones Categories (Spackman Mossop Michaels, 2021)

LCZ	Description
LCZ 1 – Enclosed Bushland	High quality plant communities, heavily vegetated enclosed bushland with prominent rock cuttings, edged by roadside vegetation.
LCZ 2 – Medlow Bath Western Plateau	Plateau adjacent to the Megalong Valley escarpment, Rich in high visual and scenic qualities.
LCZ 3 – Medlow Bath East Village	Flat to gently undulating topography, predominantly low-density housing surrounded by remnant stands of woodland vegetation and mature planted exotics.

Visual receivers/viewpoints

The extent from which the proposal would be visible from adjoining areas varies along the length of Medlow Bath. It is influenced by topography, vegetation, and associated buildings. Detailed field and desktop assessments were undertaken in conjunction with a viewshed analysis on the site digital elevation model to determine the area from where the proposal would be visible, defined as the Visual Envelope Map as illustrated in Figure 6-23.

The visual receivers of the proposal include residents, tourists, recreational and park users, pedestrians, cyclists and motorists; with views of proposal elements generally constrained by existing rail corridor infrastructure. Elements including the proposed pedestrian bridge and associated works are more likely to be seen from a greater distance given the approximate height of nine metres. The seven viewpoints selected for the visual impact assessment are identified in Figure 6-23, and photomontages to show the existing view and potential future view with the proposal are illustrated in Figure 6-24 to Figure 6-35.

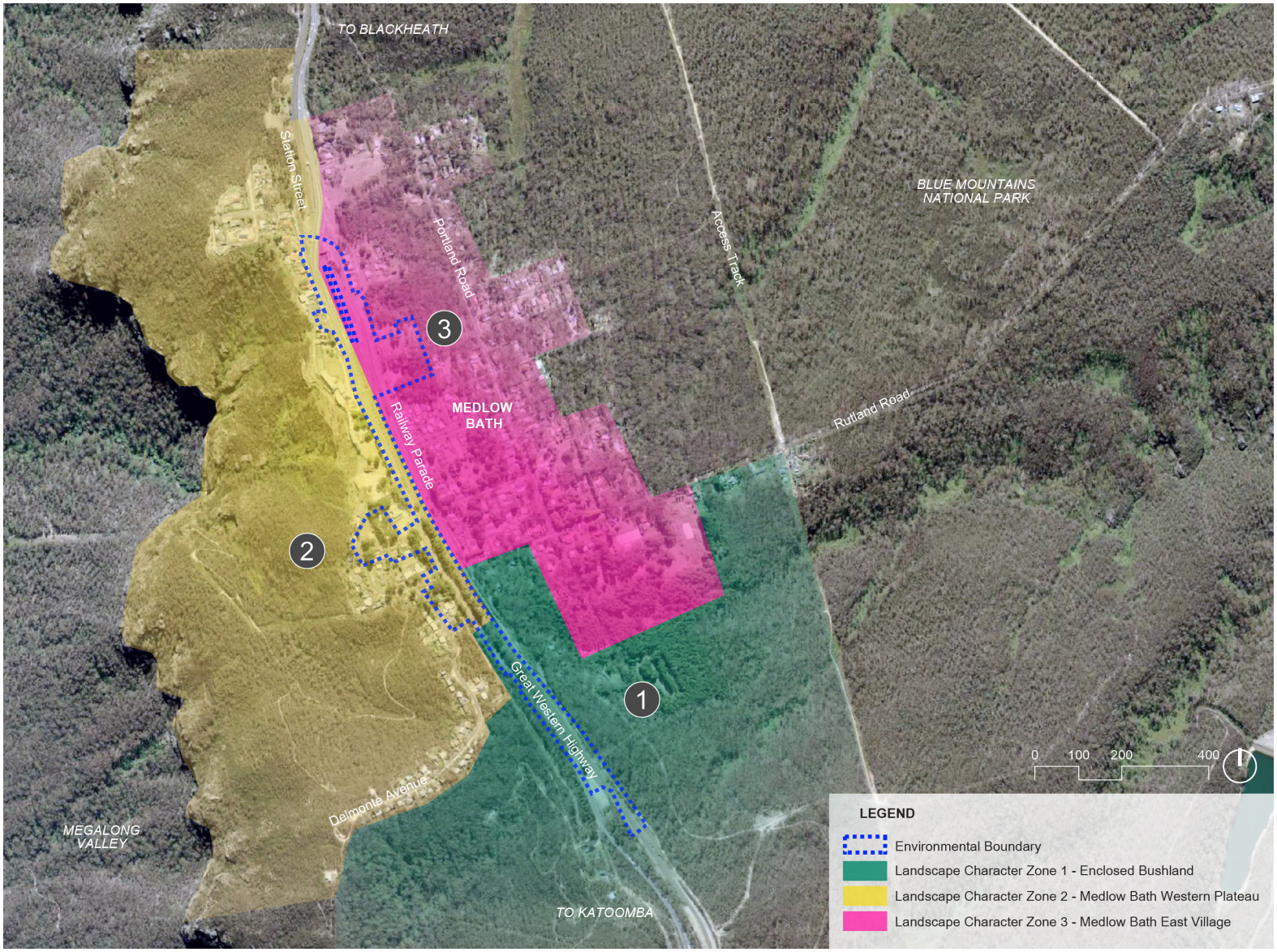

Figure 6-22: Map of identified Landscape Character Zones (SMM, 2021)

Figure 6-23: Visual impact assessment viewpoint locations (SMM, 2021)

6.9.3 Potential impacts

Construction

Construction of the proposal would result in a combination of temporary and permanent impacts to the existing landscape. Temporary visual impacts would be from construction work and materials, including:

- ancillary facilities such as site compounds
- traffic control vehicles and personnel
- construction vehicles
- various machinery and equipment
- construction fencing
- signage material
- stockpiling
- storage areas
- night-work lighting
- vegetation removal.

The ancillary facilities described in Section 3.3, would require the storage of construction materials, a site office, construction vehicles, plant and stockpiled materials. These impacts would occur throughout construction, but construction staging would result in the impact not being spread across the entire proposal area at the one time.

Operation

The *Urban Design, Landscape Character and Visual Impact Assessment* (Spackman Mossop and Michaels, 2021) outlines how key design initiatives have sought to minimise visual impacts.

- Develop an integrated design that fits with the existing visual qualities, ecology and character of Medlow Bath and the Blue Mountains setting through:
    - integrating the road into existing vegetation communities to maintain a sense of place
    - minimising the removal of vegetation to maximise opportunities to mitigate visual impacts through the refinement of retaining walls and assessment of new landscape treatment opportunities at cuttings and embankments
    - consolidating the road and rail corridor as much as possible in areas where there are limited landscape buffer zones along critical verges, such as the Hydro Majestic Hotel
    - maximising the area for verges to allow for a buffer between the shared path and highway and where space permits, the incorporation of street trees and endemic shrub planting to strengthen village character and user amenity.
- Minimise impacts to the integrity of heritage sites, significant trees and cultural values of the community within the proposal through:
    - enhancing heritage identity by using suitable materials within the landscape that enhance the character of Medlow Bath and the Blue Mountains. For example, the pedestrian bridge materials would be selected for their robustness and durability, considering tendencies to develop a patina (ie the green film formed over copper/bronze structures) as they age. The natural colours and materials of weathered steel is proposed for the pedestrian bridge, which is considered visually lightweight. Further the glass lifts proposed to be installed on the pedestrian bridge would help to reduce bulky forms given the pedestrian bridge is the most dominant feature of the proposal
    - maintaining views to heritage and cultural elements where possible to enhance Medlow Bath's cultural identity.

- ensuring materials used in public gathering spaces are complementary to Medlow Bath conditions and character, are robust and easily maintained and deter graffiti or at least allow for easy graffiti removal.

- Contribute to the functionality of public spaces and enhance local and regional connectivity through:
  - maintaining appropriate safety criteria and sightlines to strengthen village character and protecting users of the proposed shared path along the Great Western Highway
  - providing safe, direct and obvious connections between the pedestrian bridge and existing/proposed pedestrian and cycling circulation and access networks within Medlow Bath and its surrounds.

Artist's impressions have been prepared for Viewpoints 1-7, to provide an illustration of how the proposal may appear during operation and are included in the following figures.

Figure 6-24: Viewpoint 1 (existing): looking north from the western side of the highway at Bellevue Crescent

Figure 6-25: Viewpoint 1 (visualisation of proposal): looking north from the western side of the highway at Bellevue Crescent

Figure 6-26: Viewpoint 2 (existing): looking north along the existing highway shared user path towards the pedestrian bridge

Figure 6-27: Viewpoint 2 (visualisation of proposal): looking north along the existing highway shared user path towards the pedestrian bridge

Figure 6-28: Viewpoint 3 (existing): looking south along the existing shared user path toward the proposed pedestrian bridge from adjacent to the Blue Mountains Mazda

Figure 6-29: Viewpoint 3 (visualisation of proposal): looking south along the existing shared user path toward the proposed pedestrian bridge from adjacent to the Blue Mountains Mazda

Figure 6-30: Viewpoint 4 (existing) looking north toward the pedestrian bridge and Railway Parade

Figure 6-31: Viewpoint 4 (visualisation of proposal) looking north toward the pedestrian bridge and Railway Parade

Figure 6-32: Viewpoint 5 (existing) looking north from the Medlow Bath Station platform toward the pedestrian bridge and Railway Parade

Figure 6-33: Viewpoint 5 (visualisation of proposal) looking north from the Medlow Bath Station platform toward the pedestrian bridge and Railway Parade

Figure 6-34: Viewpoint 6 (existing) from Railway Parade looking south toward the proposal

Figure 6-35: Viewpoint 6 (visualisation of proposal) from Railway Parade looking south toward the proposal

Table 6-39 provides a summary of the visual impact assessment undertaken for seven viewpoints located across the LCZs (refer to Figure 6-22 for viewpoint locations). In summary the proposal would result in Moderate-Low to High impacts for several viewpoints. One viewpoint (Viewpoint 7) would have a High visual impact, three viewpoints would have a High-Moderate visual impact (Viewpoint 1, 4, and 6), two viewpoints would have a Moderate visual impact (Viewpoint 2 and Viewpoint 5), and one viewpoint would have a Moderate to Low visual impact (Viewpoint 3).

Table 6-39: Visual impact assessment for key viewpoints

Viewpoint	Location	LCZ	Sensitivity	Magnitude	Overall impact
1	Northern corner of Bellevue Crescent and the Great Western Highway, looking north towards the proposal. The viewpoint is representative of a number of views from residencies along this portion of the Great Western Highway.	1	The existing road infrastructure consists of a large portion of the existing view composition, especially from the motorists' perspective when travelling along the road. However, although the sensitivity of the existing road corridor to change would be low, the removal of existing vegetation along the fringes of the corridor which screens the existing highway from residencies along the Great Western Highway and Bellevue Crescent would be sensitive to change.	The proposal would introduce the widening of hardstand resulting in clearing between the existing road and rail corridors. Although there would be vegetation within private property would contribute to a green backdrop, the new bridge structure, widening of the roadway and subsequent shared property access, traffic signals and turning area would result in visual changes. Landscape works would reduce the visual effect over time, introducing formalised streetscape plantings and a succinct village character.	Sensitivity: High Magnitude: Moderate Impact: **High-Moderate**
2	Along the existing shared user path, adjacent to the Great Western Highway and Hydro Majestic Hotel, looking north towards the new pedestrian bridge.	2 and 3	The existing road infrastructure and associated perpendicular parking makes up a predominant proportion of the existing view. In particular, pedestrian views which are screened by existing vegetation and buildings to the west. Due to the combination of existing infrastructure and the transient nature of pedestrians, the sensitivity is considered to be low.	The clearing of trees and the proposed widening of the road corridor to the east of this viewpoint would partially remove vegetative screening of the rail corridor. Additionally, within the mid-ground, the new pedestrian bridge would provide a dominant visual feature. The proposal design and landscaping would contribute to a better visual outcome however the pedestrian bridge would contribute to the overall magnitude of change. Tree and shrub plantings along the median would introduce a succinct village character.	Sensitivity: Moderate Magnitude: Moderate Impact: **Moderate**
3	Along the existing shared user path, adjacent to Blue Mountains Mazda dealership, looking south toward sthe new pedestrian bridge.	2 and 3	Although the existing view is dominated road corridor and existing shared user path, it is exposed and does not offer much opportunity for the view to absorb changes.	The scale and material of the proposed pedestrian bridge result in a significant change to the existing view. The existing vegetation which frames the view and partially screens the rail corridor would be only partially reinstated. Soft	Sensitivity: Low Magnitude: Moderate Impact: **Moderate-Low**

				edges in the form of planted verges will only provide minimal reduction in impact.	
4	Station Street looking south toward the proposal. The viewpoint is representative of a number of views from residencies along this portion of the Great Western Highway/Station Street.	2 and 3	The view is comprised of built elements associated with the road infrastructure including an existing retaining wall, light posts, hardstand and gravel trail, with grasses and small trees providing a buffer between the highway and Station Street. The view would have a moderate sensitivity given the existing conditions and composition of the view.	The combination of hardstand widening, the proposed shared path and pedestrian bridge would result in the magnitude being assessed as moderate. Over time, the Proposal landscape design would contribute to a reduction in magnitude.	Sensitivity: High Magnitude: Moderate Impact: **High-Moderate**
5	Medlow Bath Station platform looking north toward the pedestrian bridge and Railway Parade.	2 and 3	Existing rail and road infrastructure comprise a large portion of the existing view composition, especially from patrons of the rail station. Although the scale of the new pedestrian bridge would impact this view, given the existing infrastructure, the sensitivity of the viewpoint to change would be moderate.	The view would be characterised by the pedestrian bridge, background landscape and rail corridor. Proposal landscape design would contribute to a reduction in magnitude of the scale and materiality of the bridge, adding to the improvement of character.	Sensitivity: Moderate Magnitude: Moderate Impact: **Moderate**
6	Railway Parade looking south toward the proposal. The viewpoint is representative of a number of views from businesses and residencies along Railway Parade.	2 and 3	The view is predominantly made up of road and rail infrastructure with fringe tree and larger shrub plantings along the fence-line. The sensitivity of this view to change is moderate given the existing infrastructure and character within this viewpoint would remain largely unchanged with the exception of localised vegetation clearing and formalisation of the roadway.	The bridge provides a dominant built element, given its scale and materiality when compared to surrounding elements. Changes to lighting, around the proposed forecourt, will also contribute to increased magnitude of change at night. Landscaped vegetation would reduce the visual effect of change over time.	Sensitivity: Moderate Magnitude: High Impact: **High-Moderate**
7	Bellevue Crescent, looking east toward the optional road realignment of Bellevue Crescent. The viewpoint is representative of a number of views from residences along Bellevue Crescent.	1 and 2	The view is predominantly made up a vegetated landform with a strong presence of larger tree plantings. The sensitivity of this view to change is high given the majority of the existing view is made up of vegetation with only a small portion of built form resulting in a significant change to the character and land use of this view for residents along Bellevue Crescent.	The proposed realignment of Bellevue Crescent sits in the foreground of this viewpoint and provides a dominant built element in place of significant existing vegetation which acts as a buffer between the Great Western Highway and residents. The removal of trees in this location Would be significant and given the increase of hardstand and significant increase in traffic in this location the overall magnitude of change in this location would be high.	Sensitivity: High Magnitude: High Impact: **High**

The proposal includes an alternate option for Bellevue Crescent with a new road through vacant lots to connect to the existing Bellevue Crescent and approximately 25 metres south of the United Petrol Station.

As a result, the proposed turning circle located at 106 Great Western Highway, Medlow Bath would not be required, ultimately reducing the impact on residents, as well as reducing the removal of existing mature trees within this location. The proposed option would also provide a stronger entry gateway into Medlow Bath, through the use of mature trees planted at the entry to the previous entrance into Bellevue Crescent.

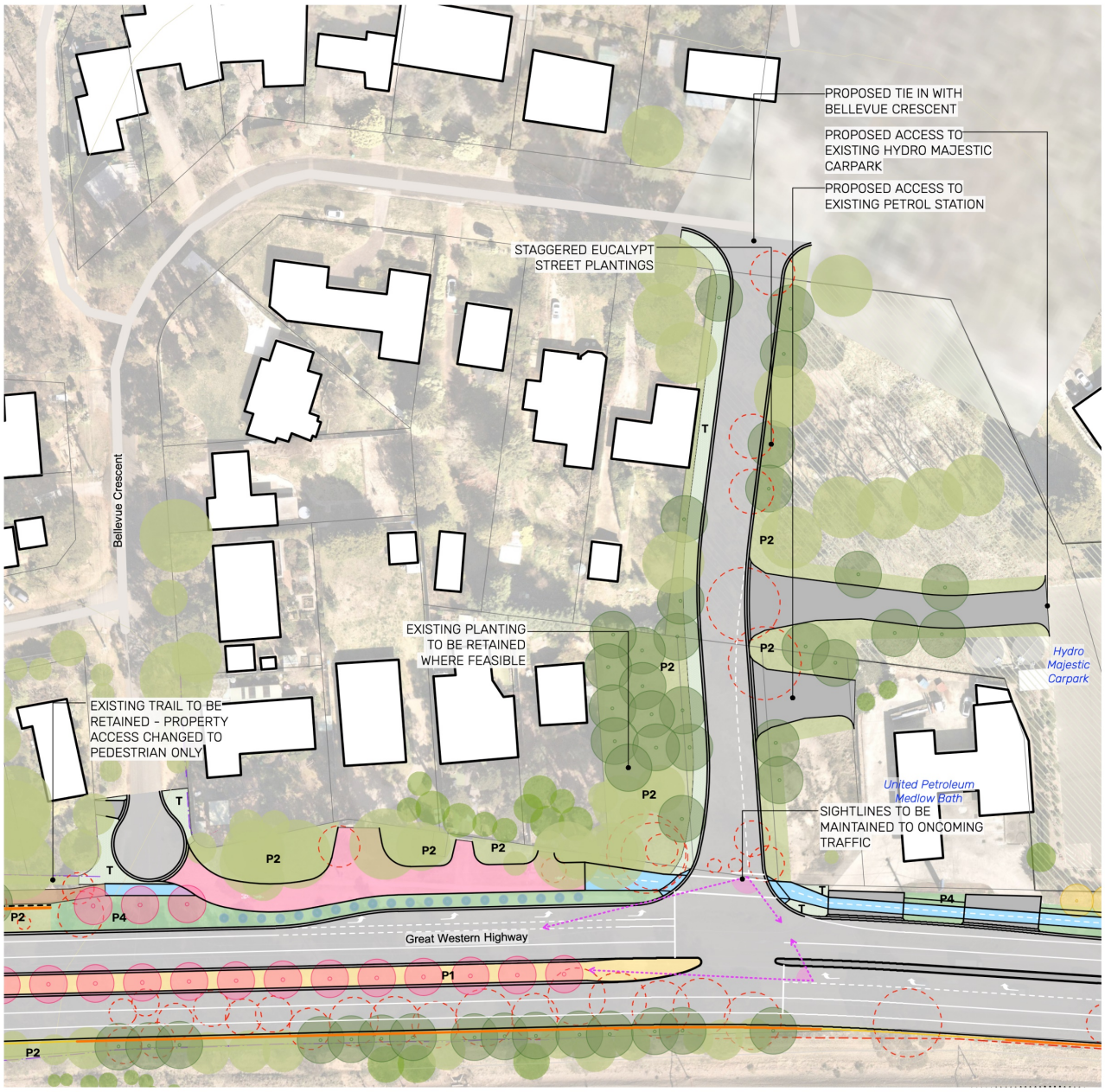

Figure 6-36: Proposed alternative option for Bellevue Crescent (including landscape treatments) (SMM, 2021)

The existing views of the location of the alternative Bellevue Crescent is as per Figure 6-37. As can be seen in Figure 6-36, there would be additional tree plantings in this area.

Figure 6-37: Viewpoint 7 (existing) from Bellevue Crescent looking east toward the option road realignment of Bellevue Crescent

6.9.4 Safeguards and management measures

Table 6-40: Safeguards and management measures – Visual and urban design

Impact	Environmental safeguards	Responsibility	Timing	Reference
Proposal Design	The following principles are to continue to be incorporated into the overall design of the proposal: • the motorists experience and attract people to town centre through the feature planting characteristic of the Blue Mountains area • screening of rail infrastructure where possible, using shrubs and trees, both native and exotic depending on the location • rounding of cut and fill batters to help integrate into the existing landform and create a more naturalised appearance • exploration of opportunities to reduce the Proposal footprint and need for temporary and ancillary sites to reduce impacts on surrounding landscape areas • Consolidating barriers and fences to increase visual access and pedestrian permeability in civic spaces • selection of lighting, signage and bus stops to compliment the Great Western Highway character • retention of views to existing non-aboriginal heritage items identified in the contextual analysis	TfNSW	Detailed design	Appendix K, UD, LC and VIA mitigation measures (Chapter 12)
Bridge Design	The following principles are to continue to be incorporated into the design of the bridge: • The simplification of the bridge forecourts to enhance sightlines and access and enable equitable access for all users, • The refinement of the pedestrian bridge design to reduce its visual impact, by increasing the visual permeability, the positioning of the bridge to reduce the required height and the visual elongation of the bridge through the design of the bridge truss bays that extend beyond the lift structures, • Maximising of opportunities to increase public amenity within the bridge forecourt and between proposed bus shelter/bus stops to enhance the public domain.	TfNSW	Detailed design	Appendix K, UD, LC and VIA mitigation measures (Chapter 12)
Accessibility	The design is to continue to provide improvements to cyclist and pedestrian access through new and upgraded, footpaths and shared paths to create a complete network around Medlow Bath	TfNSW	Detailed design	Appendix K, UD, LC and VIA mitigation measures (Chapter 12)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Station, connecting into the existing network along the Great Western Highway between Katoomba and Leura.			
Finishes of Structures	The design of new retaining walls to have finishes of a high standard and quality, that is in keeping with the Great Western Highway character	TfNSW	Detailed design	Appendix K, UD, LC and VIA mitigation measures (Chapter 12)
Landscaping	The following principles are to continue to be incorporated into the design of landscaping: • Planting strategies that respond to the existing historical and local context of Medlow Bath, • The planting of feature trees at the entry into Medlow Bath village, and to highlight access into Medlow Bath Station and proposed bus shelters, • The introduction of buffer planting in front of the retaining wall at the southern entry into Medlow Bath to minimise visual impacts, • Maximising of new tree planting where possible; within medians turning facilities, and verges to reduce the scale of the proposal over time as the tree plantings mature. Consideration has been given to sight lines for motorists when identifying possible locations, • Utilisation of native and endemic plantings along the highway outside of the village to consider pedestrians and cyclists using the existing trails as links to regional routes, • Maximisation of revegetation with appropriate species along the highway to reduce perceived corridor width.	TfNSW	Detailed design	Appendix K, UD, LC and VIA mitigation measures (Chapter 12)
Design Integration	The following measures are to be adopted during the Detailed Design stage: • All reasonable measures taken to minimise the loss of existing vegetation along the proposal corridor. Those measures will include minimise clearing of trees for construction access, rationalisation of maintenance access, • Investigate the borrowed landscape and opportunities for additional tree plantings along the proposal corridor, • Investigate opportunities to incorporate heritage qualities within the bridge design, • Further opportunities investigated to increase landscape zones within the road corridor,	TfNSW / Contractor	Detailed design / Construction	Appendix K, UD, LC and VIA mitigation measures (Chapter 12)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Lighting and signage to be well-considered in its placement and should not detrimentally add to the visual impact, • At locations where greater visual impacts have been identified, the specification and planting of more mature sized shrubs and trees would be adopted to help reduce the visual impact upon opening of the road since the proposed planting would take a number of years (approximately between 3 to 10 years) to establish at adequate height, • Where site compounds are needed rehabilitate to previous state.			

6.10 Socio-economic, property and land use

A socio-economic impact assessment (SEIA) has been prepared by RPS (2021c) for the proposal. The assessment is provided in Appendix L and is summarised in the following sections.

6.10.1 Methodology

The SEIA was prepared in accordance with the *SEIA Practice Note Guidelines* (January 2020) and *Assessing significance: socio-economic impacts* (Roads and Maritime Services, 2019). This included the incorporation of the following methodology:

- determining the study area based on the likely geographical extent of the impacts during both construction and operation
- reviewing the existing conditions including demographics, socio-economic status, income, employment, land use, business activity and social infrastructure using publicly available sources such as data from the Australian Bureau of Statistics, and relevant planning and policy documents
- assessing the likely social and economic impacts during construction, which may include but not be limited to, property acquisition, amenity impacts and disruption to trade
- assessing the level of significance of potential impacts by considering the sensitivity of the receptor and the magnitude of the proposed work
- consideration of cumulative social or economic impacts by considering other existing or planned proposals likely to interact with the proposal. For example, cumulative impacts related to nearby projects/proposals such as the Richmond Road Upgrade, Bandon Road Upgrade, etc
- identifying recommended mitigation measures to manage the extent of impacts.

The SEIA is also informed by the outcomes of various other technical reports prepared for the proposal, including the assessment of impacts to heritage, traffic and transport, noise and vibration, urban design, landscape character and visual amenity.

The study area for the assessment is shown in Figure 6-38. It comprises the Katoomba – Leura Statistical Area Level 2 (SA2 #124011452, 2016). The study area was chosen because it comprises areas that are most likely to be directly impacted during both construction and operation of the proposal.

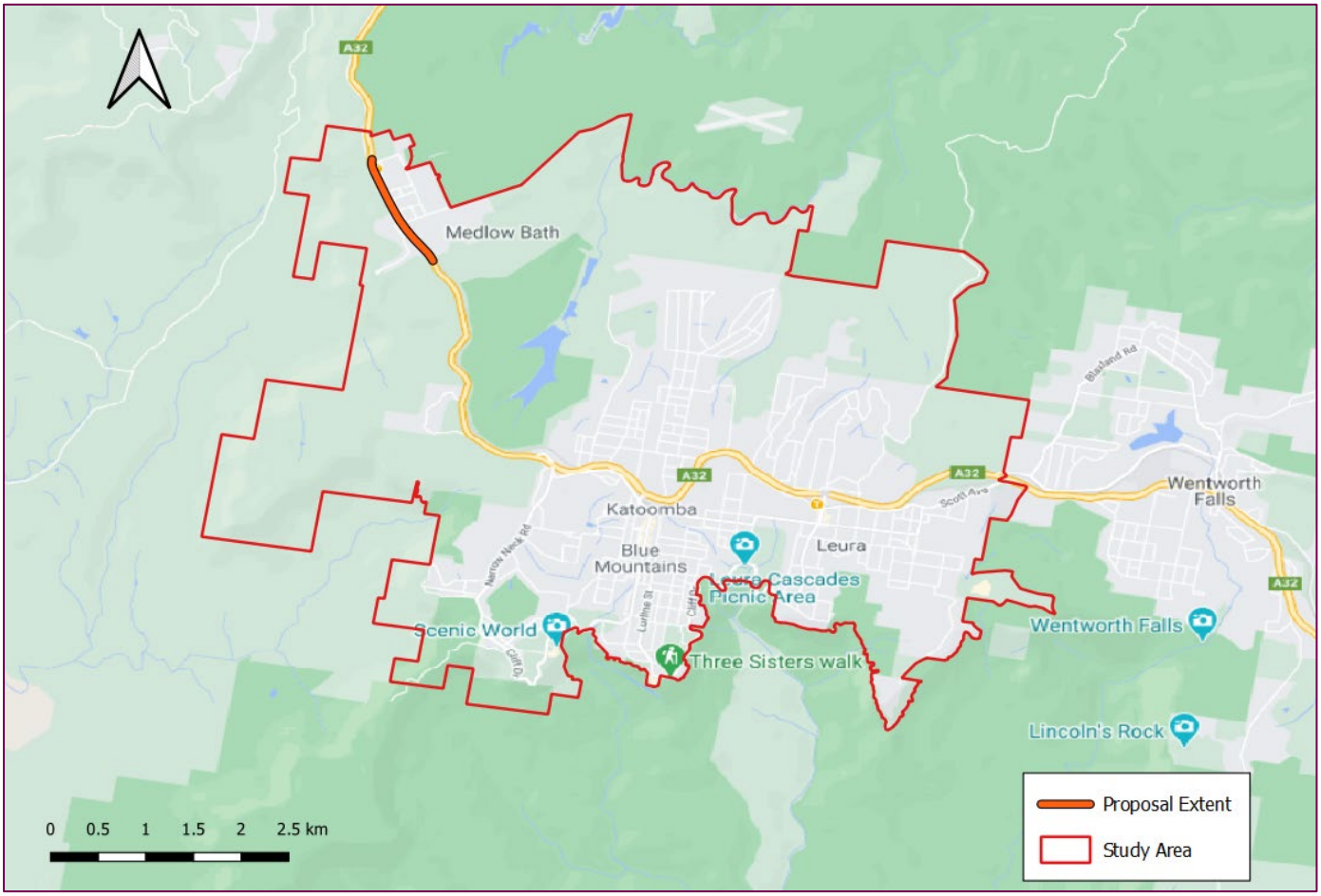

Figure 6-38: Study area and proposal corridor extent (RPS, 2021c)

6.10.2 Existing environment

Population and demographics

The proposal area is located in the Blue Mountains LGA. The population of the study area, Blue Mountains LGA, and the Western City District region in 2016 was 1,024,444 of which 13,222 lived in the study area. The study area and Blue Mountains LGA has a greater number of Australian born and English-speaking households than in the Western City District. The study area has a greater proportion of separate detached dwellings than in the Blue Mountains LGA or Western City District, reflecting an older established community. The study area had a labour force of 10,551 persons as of the 2016 census. Labour force participation and unemployment rates are broadly consistent across the study area, Blue Mountains LGA, and Western Sydney District, with the study area demonstrating marginally higher workforce participation and employment.

Local business and industry

The largest sector in the Blue Mountains LGA is Health Care and Social Assistance accounting for 3,442 jobs and 17.6 per cent of total employment. Tourism is the second largest sector in the Blue Mountains LGA, accounting for 2,430 jobs and 12.5 per cent of total employment in the region. Comparatively, approximately 4.2 per cent of jobs in Greater Western Sydney, 6.1 per cent in NSW and 6.3 per cent in Australia more broadly are supported by tourism, demonstrating the importance of this sector for the Blue Mountains LGA in supporting jobs.

Key attractions for the Blue Mountains LGA include the Three Sisters, Jenolan Caves, Blackheath Gardens, Blue Mountains Explorer Bus, Blue Mountains Cultural Centre, Scenic World and various restaurants, waterfalls, scenic bushwalking tracks, museums, and wineries.

The Hydro Majestic Hotel is a key landmark and destination for visitors to the Medlow Bath area. It also houses a range of other accommodation options such as bed and breakfasts with close access to walking trails and picturesque views. Other businesses include retail, a service station, and a car dealership. Some of these businesses cater for the needs of the local community. The Katoomba Airport is located nearby, outside the proposal area, but within the village of Medlow Bath.

Social infrastructure and community facilities

Near the study area, there are parks, reserves, trails, and creeks that provide key recreation, cultural and other public services to support the local community and tourism. Social infrastructure, nature and recreational facilities near the study area includes:

- recreation and leisure facilities such as:
    - Medlow Bath Park on Railway Parade
    - Blackheath Glen Reserve on Megalong Road
    - Coachwood Glen Nature Trail on Megalong Road
    - Pulpit Hill Creek on Megalong Road
    - Lake Medlow Dam / Adams Creek on Portland Road
- public services, such as:
    - Medlow Bath Station at the intersection of Station Street and Railway Parade
    - bus stops at Medlow Bath Station
    - rail customer car park on Railway Parade.

There are relatively few shops and services within the project corridor. As a result, residents must travel elsewhere in the Blue Mountains LGA for many of the shops, services, and facilities that support the day-to-day needs of the wider communities, in particular the Katoomba-Leura and Blackheath and Wentworth Falls townships, which are closest to the study area. These include education facilities, health and medical services, sports, recreation and leisure facilities, and community and cultural facilities.

Community values

Medlow Bath and the surrounding area predominantly has a land use that reflects its links to the environment. Much of Medlow Bath is currently zoned as Environmental Living (E4) and made up of low-density residential development that has a prominent rural character. Many heritage items are located within and adjacent to the proposal area and contribute to the village character of Medlow Bath.

In addition to the Environmental living zones, Medlow Bath Park, along Railway Parade provides public amenity in the form of local outdoor space, with consideration required to ensure pedestrian linkages to the railway station and proposed pedestrian bridge across the Great Western Highway.

Roadways, public and active transport

Roadways

The Great Western Highway and the Main West Line are two important transport infrastructure assets that pass-through Medlow Bath. This road and rail corridor not only links the local and regional centres but provides access to Sydney and the Orana regions. As a result, it plays a critical role in supporting the livelihood of the community.

The proposal is accessible via two intersections: one at Bellevue Crescent and another at Railway Parade westbound. The corridor provides access to a service station, Hydro Majestic Hotel, a Mazda dealership, and Medlow Bath Station. The Blue Mountains and the Medlow Bath area attracts significant weekend traffic and is a popular tourism destination for weekend travellers.

Public transport

Medlow Bath is served by a rail station located at the northern extent of the study area at the intersection of Station Street, Railway Avenue, and the Great Western Highway. The station is serviced by the Blue Mountains Line providing services between Central Station and Bathurst. Additionally, the proposal area is served by bus routes that connect the Blue Mountains villages along the highway. Currently there is one westbound and eastbound bus stop location in Medlow Bath in proximity to the school bus facilities located on Railway Parade.

Active transport

The existing pedestrian connections within the proposal area are minimal. Footpaths along the Great Western Highway are visually exposed with little to no shade or protection from noise and high levels of traffic along the highway.

Pedestrian access to the existing rail customer car park and bus stop is via Railway Parade, however, there are non-compliant footpaths onto the station platform and no footpaths between the northern access and the accessible entry in the south along Railway Parade.

Existing cycling and pedestrian links are located along the corridor in the form of the Great Blue Mountains Trail, which provides recreational links to the Greater Blue Mountains Area. Although pedestrian access is well patronised in the form of bushwalkers and recreational walkers, safe pedestrian amenity is lacking around Railway Parade and local roads to the east; with accessible links to the existing Medlow Bath Station platform only exist via a level crossing at the southern end of the platform.

6.10.3 Potential impacts

To support an assessment of the potential socio-economic impacts during the construction and operation phases, detailed layouts of the proposal are provided in Figure 6-39 (southern section), Figure 6-40 (middle section) and Figure 6-41 (northern section).

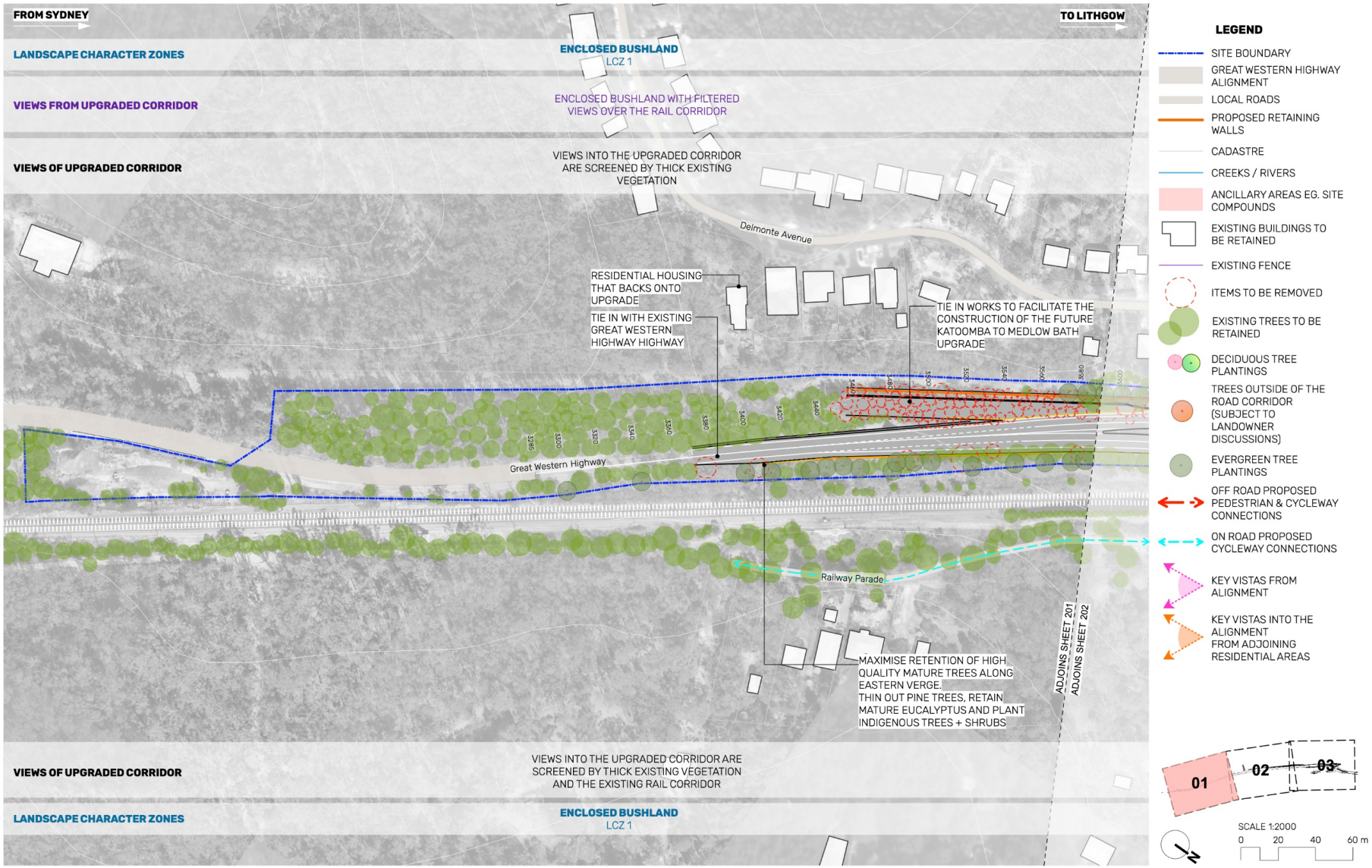

Figure 6-39: The proposal (southern section)

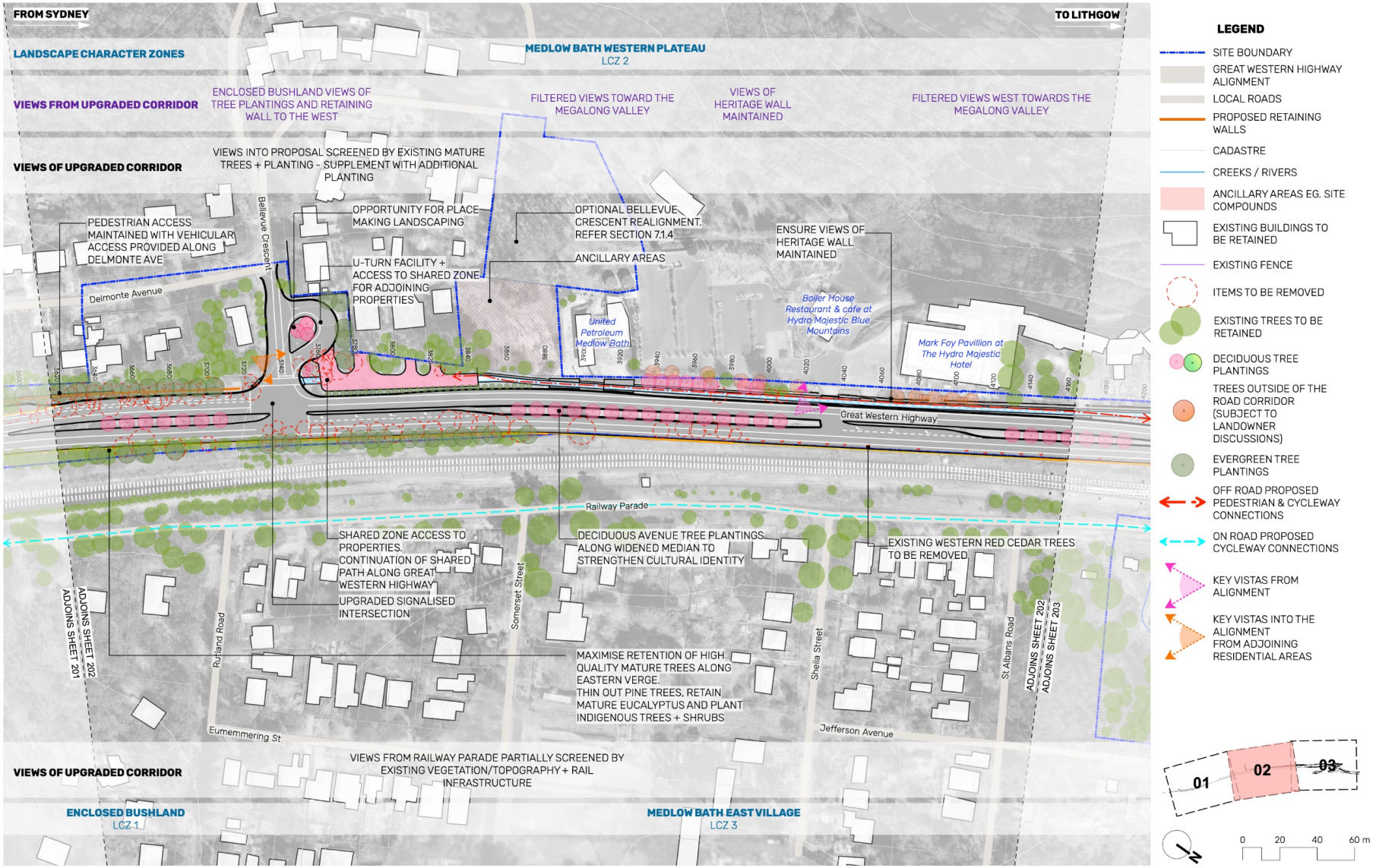

Figure 6-40: The proposal (middle section)

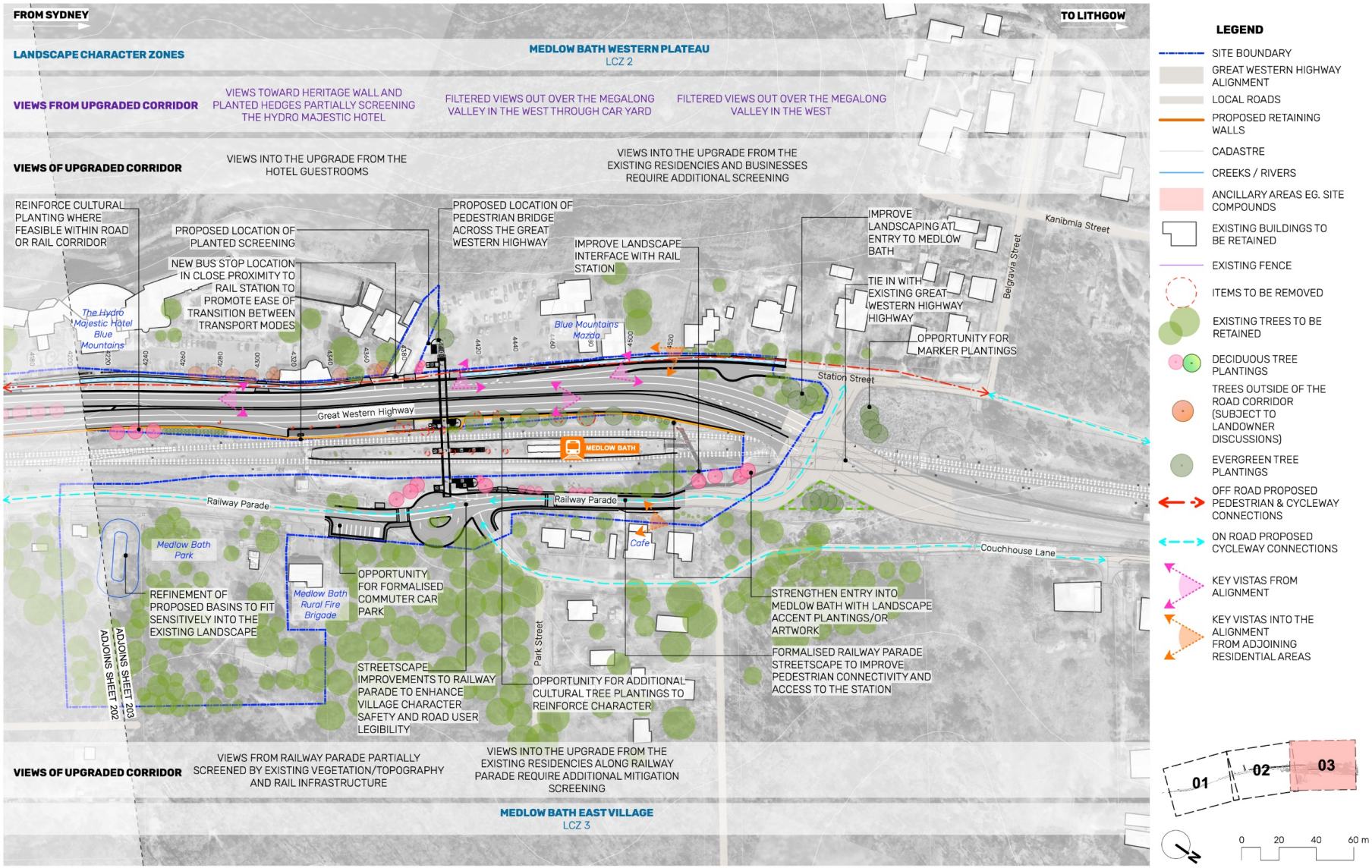

Figure 6-41: The proposal (northern section)

Construction

Access and connectivity

The main impact to residents and businesses would likely result from traffic movements of light and heavy construction vehicles. Construction would occasionally require altered traffic operations at times (one hour road shut down to allow for crane operations to install the new pedestrian bridge, temporary realignment of traffic etc). However, high traffic activities would be encouraged to be held during off peak hours to minimise delays and congestion.

The removal of 40 perpendicular parking spaces is required during construction to facilitate works to widen the highway. While the removal also reflects a permanent impact, the parking has already been compensated for through additional parking for the Hydro Majestic Hotel southern car park works. The rail customer car park would not be impacted during the construction phase.

Several properties with direct access to the road network within the proposal area would experience some impacts with respect to ease of access. Access to affected properties would be maintained throughout, and temporary changes to property access would be provided where required. TfNSW would work with Blue Mountains City Council to ensure local road connectivity is maintained for users during construction.

Given the relatively rural and low-density character of the area, negative impacts are expected to be temporary and relatively minor provided effective construction staging is implemented.

Social infrastructure

During construction, there would be temporary disruptions to some footpaths and cycling infrastructure, which would obstruct access to some of the rural recreational and historic assets and public transport facilities and may result in increased walking distances and safety risks as conditions change.

Community values and amenity

Noise and vibration from construction activities have the potential to disrupt amenity for occupants of some residencies and businesses in proximity to the proposal area. Due to the small offset distance between the proposal and sensitive receivers, there would be exceedances of the noise management levels during construction works. A small number of receivers would be highly affected at some point during the works with levels likely to exceed 75 dBA. The noisiest stage is predicted to be vegetation clearing due to the operation of equipment like chainsaws, but which would last only two weeks.

It is unlikely that vibration generating equipment would be in use within 10 metres of buildings and as such it is unlikely that there would be vibration with potential to cause damage to buildings or disturb human comfort.

Further community values and amenity impacts during construction are likely to be:

- removal of some established trees during construction. Areas impacted by construction would be rehabilitated, including planting of new trees and vegetation alongside the road and on the median
- visual impacts during construction would be minimal, and over time, the planting of new trees and vegetation would provide visual and amenity benefits.

Business impacts

Access to businesses on affected roads would be maintained during construction. There would be some disruption to parking access to parking spaces located at the Hydro Majestic Hotel and along Railway Avenue. Additionally, the presence of construction vehicles and workers is expected to increase demand for parking along Railway Parade, although where possible contractors would park in compound areas. The overall impact to businesses is expected to be minimal given the low-density nature of the area and potential for alterative parking spots.

A number of noise sensitive receivers within the community, including the Hydro Majestic Hotel have been identified as being potentially adversely impacted by noise levels. Predicted noise levels are considered to be typical of road infrastructure projects and the implementation of suitable noise mitigation measures would help manage and mitigate the impacts of noise on the community.

Given the relatively few businesses within the proposal area, the anticipated negative impacts from construction are expected to be minimal. There may be some positive impacts for some small businesses in the retail/hospitality sector as contractors purchase local goods and services.

Impacts to property

It may be necessary for some properties to be to be partially or fully acquired by TfNSW to facilitate the proposal (refer Section 3.5). The details for property acquisition would be determined during detailed design and any property acquisition would be undertaken in accordance with the provisions of the NSW *Property Acquisition (Just Terms Compensation) Act 1991*. Consultation would be conducted with property owners prior to the relocation of this infrastructure. TfNSW has commenced consultation with potentially affected property owners and would continue to engage with them through the detailed design phase about specific property impacts, including the acquisition process.

Operation

Access and connectivity impacts

At present traffic flows are generally good at the intersection of Station Street, Railway Parade, and the Great Western Highway. However, the level of service at Bellevue Crescent is currently moderate and would benefit from the proposed enhancements. Over the long term, residents and businesses in the proposal area would benefit from improved access and connectivity, especially with respect to pedestrian safety and amenity (for example the new pedestrian bridge would allow pedestrians/cyclists to safely cross the highway and access public transport facilities).

In addition to benefiting local traffic, the proposal would improve safety and travel times for tourists, freight and other regionally-based traffic. The highway would be able to support longer, heavier vehicles that are able to transport more freight per vehicle. This would provide improvements to safety and sustainability as well as improvements in productivity. This is expected to increase the volume of freight, but reduce the number of vehicles required to transport the freight along the highway.

Impacts to social infrastructure

Over the long term the proposal would have a positive impact and provide improved footpaths and pavement within the proposal area, including the formalisation of a shared path which would promote cycling and walking which are known to promote better health. The shared path would provide an important link to nearby walking trails which are popular with tourists.

It would also enhance connections to public transport assets by providing a safe and accessible path of travel including for those with a disability, carers with prams or customers with luggage both across the corridor and to the station and bus stops. The addition of canopies at lift waiting areas would provide weather protection while indented bus bays, kiss and ride and the new pedestrian bridge would help to reduce potential interactions with moving vehicles.

In addition, following completion of the proposal, a positive visual and amenity impact is expected due to replanting of trees and vegetation.

Community values and amenity

The proposal would increase the amount of the road-related infrastructure within the zone and would require some additional clearing of mature bushland vegetation. This would result in changes to the natural landform to accommodate the necessary road design requirements.

However, the proposal is located within an existing corridor meaning that it would result in minimal new negative impacts. Further, the proposal would have beneficial outcomes in terms of the reduction of congestion and improvements to connectivity, which help moderate the proposal's overall impact.

The SEIA concluded that over the long term the proposal would result in improved safety, access, and connectivity within the area once complete. Replanting of trees and vegetation would have positive visual and amenity impact on the area.

Business impacts

Over the long term, the operation of the proposal is not expected to negatively impact business operations within the proposal area. Where property might be negatively impacted, mitigation measures have been outlined in the next section. Additionally, businesses would likely benefit indirectly as travel through the corridor becomes easier, making it a more attractive destination.

Impacts to property

Key operational impacts of the proposal to local properties are related to noise and water.

Based on modelling of operational noise levels, owners of properties adjacent to the new U-turn bay proposed for Bellevue Crescent should not be significantly adversely affected by vehicle movements. In other areas, modelling has identified a number of receivers where the design noise criteria may be exceeded and would be eligible for consideration of additional noise mitigation during detailed design.

Changes to the proposal area by the increase in hardstand area needs to consider potential issues associated with the management of water. Upstream flooding impacts from increased impervious surfaces would be mitigated by additional stormwater systems to mitigate localised flooding. To alleviate pressure in the downstream areas, flooding impacts are to be mitigated through the use of flow control structures including the addition of detention basins. These impacts are generally considered minor, given the minimal vertical alignment changes, maintenance of flow discharge splits to downstream receivers, and general increase in available stormwater storage will also mitigate localised flooding.

Over the long term, the operation of the proposal is not expected to marginally increase noise for businesses and residents significantly beyond what is currently experienced within the proposal area. Where property might be negatively impacted, mitigation measures have been outlined in the next section.

Alternative Bellevue Crescent option

The alternative design for Bellevue Crescent would require some property acquisition to facilitate construction of the left turning lane from the Great Western Highway to the new corridor connecting to Bellevue Crescent. Potentially affected properties are not residential properties but vacant land, and the impact to property owners whose land would be fully or partially acquired would be minimal. Construction would also result in the removal of some trees on these vacant lots, the impact of which would be minimal.

Operation of the new corridor connecting the Great Western Highway to Bellevue Crescent would result in noise impacts to three residential receivers on Bellevue Crescent (17, 18 & 22 Bellevue Crescent). These residents would be impacted by an increase in vehicle movements along their property as a result of the alternative design. It is noted that these vehicle movements would mainly be by other residents in that part of Medlow Bath, which has a very small population, and the overall impact will be minimal when operational. If the alternative design proposal were to proceed, these residents would need to be considered for additional noise mitigation measures, such as architectural treatment.

6.10.4 Safeguards and management measures

Traffic, noise and vibration, visual and biodiversity management measures are addressed in the relevant sections of this REF. Additional management measures to address socio-economic impacts are included in Table 6-41.

Table 6-41: Safeguards and management measures – Socio-economic

Impact	Environmental safeguards	Responsibility	Timing	Reference
Property	A Property Acquisition Plan will be prepared and implemented in accordance with the requirements of the *Property Acquisition (Just Terms Compensation) Act 1991.*	TfNSW	Pre-construction	Standard safeguard
Community	A Communications Plan will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The plan will include (as a minimum): • identification of key stakeholders such as the Hydro Majestic Hotel, private residences and business, Blue Mountains City Council • mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • contact name and number for complaints • the plan will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (RTA, 2008).	Contractor	Detailed design / Pre-construction	Standard safeguard
Construction	Access to private residential properties, businesses and the Hydro Majestic Hotel would be maintained throughout the construction period.	Contractor	Construction	Appendix L

6.11 Cumulative impacts

This section discusses the potential cumulative impacts that may arise as a result of the construction and operation of the proposal, and the interaction of these impacts with other identified major developments within the local area. The cumulative impacts relate to both the individual environmental impacts of the proposal as well as the combined effects of this and other proposals in the vicinity of the proposal that form part of the wider program to upgrade the Great Western Highway.

6.11.1 Proposal area

The proposal area is defined in Section 1.1 and Figure 1-2. The cumulative impact assessment has considered the wider Blue Mountains region.

6.11.2 Broader program of work

The proposal is part of the Great Western Highway Upgrade Program between Katoomba and Lithgow. The program will ultimately deliver around 34 kilometres of four lane divided highway, building on the already upgraded section between Emu Plains and Katoomba. Subject to funding, the target is to open the full 34 kilometres to traffic by 2028. The Great Western Highway Upgrade Program includes:

- upgrade of the Great Western Highway between Katoomba and Mount Victoria
    - upgrade a 1.2 kilometre section of the Great Western Highway at Medlow Bath between Railway Parade and around 330 metres south of Bellevue Crescent
- upgrade of the Great Western Highway between Mount Victoria and Lithgow.

The program would provide a safer and more efficient link between Central West NSW and the Sydney Motorway network for freight, tourist and general traffic.

6.11.3 Other projects and developments

A search of the following registers was completed in April 2021:

- Department of Planning, Industry and Environment's Major Projects Register
- Sydney and Regional Planning Panel Development and Planning Register
- Blue Mountains City Council Development Application Register.

The search identified one major development application listed within Medlow Bath, for additions and alterations to the Hydro Majestic Hotel, and two projects under assessment by Blue Mountains City Council. Details of the search results are provided in Table 6-42.

Table 6-42: Past, present and future projects

Project	Construction impacts	Operational impacts
Additions and alterations to the existing Hydro Majestic Hotel Status: Determined DA number: X/773/2009, Address: 52 – 88 Great Western Highway, Medlow Bath Planning panel reference number: PPS-2009SYW011 Capital investment value: $22,700,000	Construction impacts of this project include: • increased traffic • increased dust during earthwork • increased noise • potential offsite water pollution due to poor erosion and sediment control • contribution to greenhouse gas emissions due to embodied carbon and energy consumption	Operational impacts of this project, including benefits: • better tourist/accommodation facilities • contribution to greenhouse gas emissions due to energy consumption.
Subdivision of one lot into two for residential housing which includes changes to the existing access driveway Status: Under Assessment DA number: S/29/2020 Address: 26 – 28 Rutland Road, Medlow Bath	Construction impacts of this project include: • increased dust during earthwork • increased noise • potential offsite water pollution due to poor erosion and sediment control • contribution to greenhouse gas emissions due to embodied carbon and energy consumption.	Operational impacts of this project, including benefits: • contribution to greenhouse gas emissions due to energy consumption.
A single storey manufactured home with detached garage- as modified – PAN # 70922 Status: Under Assessment DA number: XM/213/2018/A Address: 90 Railway Parade, Medlow Bath	Construction impacts of this project include: • increased dust during earthwork • increased noise • potential offsite water pollution due to poor erosion and sediment control • contribution to greenhouse gas emissions due to embodied carbon and energy consumption.	Operational impacts of this project, including benefits: • contribution to greenhouse gas emissions due to energy consumption.

6.11.4 Potential impacts

An assessment of the potential cumulative impacts is included in Table 6-43.

Table 6-43: Cumulative impact assessment

Environmental factor	Construction	Operation
Noise	It is likely that some overlap would occur during construction of the proposal, additions to the Hydro Majestic Hotel and the residential projects listed in Section 6.11.3. Considering the limited scale of the residential projects and temporary duration of the overlap, the cumulative noise impacts from the construction of these projects would be minimal. Construction of the road upgrade projects listed in Section 6.11.2 and the proposal would likely occur with some overlap and together construction would be for around five years. Over the five years some residences may regularly experience noise levels exceeding the relevant noise criteria.	The road upgrade projects listed in Section 6.11.2 would provide a safer and more efficient link between Central West NSW and the Sydney Motorway Network for freight, tourist and general traffic. The existing and future road traffic flows on the Great Western Highway could potentially result in receivers exceeding the cumulative noise limit which protects the community from impacts where noise levels are predicted to be 5 dBA or more above the RNP noise criteria. Measures recommended in accordance with the *Noise Mitigation Guideline* (Roads and Maritime Services, 2015c) would be required to mitigate the cumulative noise impacts from the road upgrade projects.
Air quality and greenhouse gas emissions	The construction of all projects, including the road projects would contribute to air quality impacts in the area due to dust and exhaust emissions. All projects, including the road projects would contribute to greenhouse gas emissions due to energy and fuel consumption and embodied carbon during construction.	All projects, including the road projects would contribute to greenhouse gas emissions due to energy and fuel consumption.
Traffic	There would be an increase in construction related traffic on the road network due to traffic restrictions during road work, construction worker movement and spoil transfer. The cumulative traffic impacts from the residential projects listed in Section 6.11.3 projects would be minimal due to the location and limited scale of the projects. Alterations and additions to the Hydro Majestic Hotel, the road upgrade projects listed in Section 6.11.2 and the Proposal would likely occur with some overlap and together there would be some cumulative traffic delays on certain routes.	The upgrades to the Great Western Highway upgrade projects listed in Section 6.11.2 and the Proposal would provide a safer and more efficient link between Central West NSW and the Sydney Motorway Network for freight, tourist and general traffic. Traffic impacts from the residential and Hydro Majestic Hotel projects would be minimal.
Flooding	Construction of the road upgrade projects listed in Section 6.11.2 and the proposal could potentially obstruct and divert flood waters and overland flow if not managed correctly. Cumulative flooding impacts are considered temporary, are expected to be minor and would be managed through the implementation of standard construction techniques.	The Great Western Highway upgrade projects, and the proposal would result in a cumulative increase to existing impervious areas or change in horizontal/vertical alignments which would impact upstream flood levels or downstream peak flow rates thereby affecting properties. Such impacts are to be limited through the use of flow control structures and detailed design to TfNSW standards.
Biodiversity	The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the	The accumulating impacts of historic vegetation clearing for agriculture and urban development have contributed to the loss of biodiversity. The road upgrade projects listed in Section 6.11.2

Environmental factor	Construction	Operation
	Biodiversity Conservation Act 2016 or *Fisheries Management Act 1994*. The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.	and the proposal would result in long-term effects such as habitat fragmentation and some loss of wildlife connectivity corridors in the area. Invasion and further spread of weeds, pests and pathogens, and changes to surface hydrology may occur as a result of the proposal and associated vegetation removal.
Impact fatigue	Impact fatigue is where people and environmental receivers are affected for a longer period of time than it would take to build the proposal. This can often happen in areas of high development where the building of several projects overlaps. In the case of the proposal, it would be reasonable to assume that any of the above projects would be built around the same time as the proposal; however, they may start or finish before or after the proposal. As such, any of the above impacts could be experienced for a longer period than assessed in the REF. This would lead to impact fatigue. It would be managed through consultation with the developers before work starts and by ensuring the safeguards and management measures committed to in this REF are implemented, effective, managed, audited and maintained throughout to minimise impacts.	

6.11.5 Safeguards and management measures

Table 6-44: Safeguards and management measures – Cumulative impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative construction impacts	Other developers will be consulted: • to obtain information about project timeframes and impacts. Identify and implement appropriate safeguards and management measures to minimise cumulative impacts • to manage the interfaces of the proposal's staging and programming in combination with the other projects occurring in the area.	TfNSW / Contractor	Pre-construction	Section 5.2
Cumulative construction impacts	All environmental management plans (including but not limited to the Traffic Management Plan and Noise and Vibration Management Plan) will be prepared to consider other developments in the area.	Contractor	Pre-construction	Section 6.1.4, Section 6.5.4, Section 6.6.4,